NSW GOVERNMENT
Department of Primary Industries

Winter crop variety sowing guide 2015

NSW DPI MANAGEMENT GUIDE

Peter Matthews, Don McCaffery and Leigh Jenkins

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SMARTER GROWING

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DISCOVER OUR NEW APH VARIETIES FOR NSW

LongReach Viking

KEY FEATURES

- A high yielding variety that delivers increased yield in upside situations making it well suited to medium to higher rainfall areas of NSW and Qld.
- Australian Prime Hard classification in the Northern and South Eastern Zones
- Mid-late maturity similar to EGA Gregory that suits early May to late May planting
- Excellent Stripe rust resistance package and good resistance to other rusts

LongReach Lancer

KEY FEATURES

- A mid to late maturing line which is responsive to temperature
- APH classification in Northern and South Eastern Zones (All NSW and QLD)
- Excellent grain package with good protein delivery, good grain size and low screenings
- Solid Stripe rust resistance package based on Adult Plant Resistance
- Shorter canopy height with good resistance to lodging
- Performs well under crown rot pressure (MS) and leading tolerance to RLN (T-MT)

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Introduction

The complexities of modern technology, fluctuating markets and the vagaries of weather all contribute to the winter crop producer's need for careful planning and management to optimise production and profitability.

Profitable winter crop growing demands higher production per unit area at lower cost per unit of production. This can only be achieved by increasing grain yields through economic adoption of new or improved technology. The aim is not higher total production, but greater productivity from the resources invested in crop production, along with total sustainability of the farm business.

Profit depends on choosing the most suitable variety for each paddock and sowing time and matching this to available markets. This guide helps to select the most suitable variety and contains updated technical information from the latest research, extension and industry programs. It aims to assist growers to make better cropping decisions and higher profits. Consult your local agronomist or farm adviser for more specific advice.

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Disclaimer

The information contained in this publication is based on knowledge and understanding at the time of writing (March 2015). However, because of advances in knowledge, users are reminded of the need to ensure that the information upon which they rely is up to date and to check the currency of the information with the appropriate officer of the Department of Trade and Investment, Regional Infrastructure and Services or the user's independent adviser.

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Wheat Quality Australia, GrainCorp, Grain Trade Australia and Barley Australia provide valuable assistance on the subjects of grain quality assessment, recieval standards and marketing.

This publication is a companion to *Weed control in winter crops* and *Insect and mite control in field crops*, both publications are available on the NSW DPI website at **www.dpi.nsw.gov.au**

Front cover main photo: barley crop, Oodnadatta, Guy McMullen, NSW DPI. Smaller photos, left to right: barley seed, Nick Moody, NSW DPI; National variety trial, barley, Gilgandra and barley products both Peter Matthews, NSW DPI.

Plant Breeder's Rights

Throughout this guide, varieties protected under Plant Breeder's Rights (PBR) legislation are signified by the symbol ⒫

Plant Breeder's Rights are exclusive commercial rights to a registered variety. In relation to propagating material of the registered variety, the breeder has exclusive rights to:

(a) produce or reproduce the material;

(b) condition the material for the purpose of propagation (conditioning includes cleaning, coating, sorting, packaging and grading);

(c) offer the material for sale;

(d) sell the material;

(e) import the material;

(f) export the material; and

(g) stock the material for any of the purposes described in (a) to (f).

In most instances the breeder will licence these rights to a selected seed company (the licensee).

Exceptions to breeder's rights are the rights of farmers to save seed for sowing future commercial crops. However harvested material derived from farm saved seed will be subject to the End Point Royalty (EPR) applying to that variety.

Where EPRs apply, growers will be required to enter into arrangements with the breeder or licensee whereby royalties are paid on delivery of the grain. Some varieties may have a Seed Royalty (SR) paid on purchase of seed rather than an EPR.

Royalties collected are used to support ongoing research and the breeding of new and improved varieties.

Contents

Highlights/changes 2015

Cereal diseases

***Barley yellow dwarf virus* (BYDV):** BYDV was present in most regions last season, with plant symptoms being observed and confirmed in a large number of early sown crops. Consider using a insecticidal seed dressing on all early sown cereals. There is a high risk of the disease recurring this year after a mild wet summer, which has been ideal for over-summering of aphids, growth of volunteer cereals and other host plants. Management of the disease relies on growing a tolerant variety or preventing the spread of the disease in crops by controlling aphids.

Wheat stripe rust: Stripe rust was again present across NSW last year, with seasonal conditions dictating the level of disease in each region. Growers need to remain proactive with stripe rust management plans for 2015, as many varieties can suffer yield loss from this disease without adequate fungicide protection.

Wheat stem rust: Stem rust was detected in all regions of NSW in 2014. Only select varieties that have the best available stem rust resistance and adapted to your area. Avoid relying on fungicides for the management of this disease.

Wheat leaf rust: With the presence of the new leaf rust pathotype in NSW, growers should check the new variety ratings as many have been downgraded and now may be susceptible to leaf rust. Be vigilant and if you see any unexpected development of leaf rust in a variety, speak to your local agronomist, collect and have a sample sent for identification.

Crown rot: Crown rot was widespread through NSW in 2014, with a higher incidence in the central and northern regions. Be aware of the presence of crown rot in your farming systems and adjust farm rotations to lower the risk of yield losses. With the high inoculum loads being carried by infected wheat stubbles from 2014, consider this when making both crop type and variety decisions for 2015.

Yellow leaf spot: Yellow leaf spot was again an issue early in the season for many of the more susceptible varieties in NSW. With the increased practice of sowing wheat into wheat stubbles, selecting a more tolerant variety where possible or budgeting for fungicides through the season is advisable.

***Wheat streak mosaic virus* (WSMV):** There were only isolated reports of WSMV in 2014. If you are considering sowing wheat for grazing, where perennial pastures or roadsides are adjoining the paddock consider replacing early grazing wheat with oats, triticale or barley.

Barley powdery mildew: A new pathotype of powdery mildew was detected in Queensland and NSW in 2014. This new pathotype overcomes the *MlLa* resistance gene that many barley varieties carry. Be vigilant and if you see any unexpected development of powdery mildew in a variety, speak to your local agronomist, collect and have a sample sent for identification.

Smuts in cereals: Despite conditions through late spring bring drier than average, smut was still detected through NSW. Review your seed fungicide programs for 2015 and ensure at least seed blocks for the 2016 season have a protective fungicide applied. Both feed and malt barley have a 'Nil' tolerance for smut contaminated grain.

New varieties with limited data available

Consult either the owners or commercial partners of these varieties for further information.

Wheat classification

The classification zones for NSW were changed in 2013. The former central delivery zone has now been amalgamated with the northern zone. The variety characteristics and reactions to diseases table for wheat lists the maximum quality classification of varieties for the northern and south eastern zones at the time of publishing. Some newer varieties may not have a final classification for all NSW regions pending further testing of quality samples. Durum varieties may not have a quality classification for all regions. In these regions they have a default classification of 'Feed'.

Varietal changes

Wheat. New milling wheat varieties for the 2014 season include Condo, Kiora, LongReach Viking, Mitch and Sunmate. A number of new feed wheat varieties are also available, B53 a main season wheat and SF Adagio, SF Ovalo and SF Scenario which are long season winter wheats.

When considering a new variety compare the yield, grain quality and disease resistances of the new variety with the currently grown varieties.

Barley. Three new potential malting barley varieties were released last season. Compass is from the University of Adelaide's barley breeding program and is currently undergoing malt accreditation, with a decision expected in early 2016. Compass has performed consistently across NSW NVT trials and is one of the highest yielding lines currently available. Compass seed is available for planting this year. Two barley lines were released by Elders cereal breeding program, Alestar and Maltstar. They are in the early stages of accreditation for malt with limited quantities of seed available in NSW for the 2015 sowing.

Oats. No new grain only oat varieties have been released for sowing this year. If growing milling oats consider applying a fungicide to reduce the impact of rust on grain yield and grain quality. There are no changes to dual-purpose oat varieties.

Triticale. No new grain only triticale varieties have been released for sowing this year. The new variety Fusion has been a consistent performer in the NSW NVT trials and should be considered if seeking a new variety.

Canola. There are 12 new releases for 2015. One new conventional hybrid has been released, Nuseed® Diamond. Seed production problems prevented Nuseed® Diamond from being released in 2014. Hyola® 433 has been withdrawn.

One new triazine tolerant (TT) specialty hybrid has been released; MONOLA® 515TT. The following have been withdrawn; Crusher TT, MONOLA® 413TT and Thumper TT.

Two new CLEARFIELD® hybrids have been released; Pioneer® 44Y89 (CL) and the long season winter type SF Edimax CL.

Six new Roundup Ready® hybrids have been released; DG 550RR, Hyola® 600RR, IH51RR, IH52RR, Pioneer® 44Y26(RR) and Pioneer® 45Y25(RR). One new specialty RR hybrid, MONOLA® G11, has also been released. The following have been withdrawn; GT Cobra, GT Viper, IH50RR, Pioneer® 45Y22(RR) and Victory® V5002.

One new dual herbicide tolerant (triazine tolerant plus Roundup Ready) has been released, Hyola® 725RT.

Chickpea. There are no new chickpea varieties released for the 2015 season.

Growers are reminded to follow the disease management strategies in this guide.

Ascochyta blight occurred in more chickpea crops (62 of 332 crop inspections) in 2014 than in 2012 and 2013 combined. Most infected crops were PBA HatTrick$^{\phi}$ mainly bcause it is the most widely grown variety.

Inoculum for the 2014 Ascochyta infections resulted from dry summer (2012/2013 and 2013/14) conditions contributing to slow stubble breakdown and infection of volunteers.

Work is underway to determine if the unexpected number of 2014 infections, especially on PBA HatTrick$^{\phi}$, is related to changes in the Ascochyta fungus. Initial results show that the fungus varies both in ability to cause disease (pathogenicity) and time to develop fruiting bodies (latent period). However, there was no evidence it has changed in response to the widespread cultivation of PBA HatTrick$^{\phi}$.

Localities where Ascochyta was found on any variety in 2014 are considered high risk for 2015 crops and growers are advised to apply a preventative fungicide before the first post-emergent rain event to all varieties including PBA HatTrick$^{\phi}$.

Varietal purity remains an issue and is likely to get worse unless the industry implements a plan to reduce contamination and accidental mix ups in planting seed. Make sure you know the varietal purity of your 2015 planting seed, as this could have implications for disease management, particularly if the seed lot is contaminated with less disease resistant varieties.

Faba bean. There is one new faba bean variety for 2015. PBA Samira$^{\phi}$ was released from the southern node of the PBA faba bean breeding program. It has improved Ascochyta resistance over Farah$^{\phi}$ with slightly larger seed size and is suited to human consumption markets.

The main feature of the 2014 growing season were the highly variable and generally dry seasonal conditions, especially from July onwards, which lowered yields but meant disease pressure was low. Heavy aphid pressure early in the season and severe frosts in early-mid August were other notable features. Plantings were reduced in the northern region as only some areas received sufficient summer fallow rainfall and moisture seeking technology was required to establish the crop. Early sown crops performed creditably in southern NSW. Commercial yields of up to 2 t/ha were achieved in some areas. Dryland National Variety Trials yields were generally 0.75-1.4 t/ha in the north west, and up to 2.10 t/ha in the north east. In the better rainfall areas of the south east trial yields averaged 2.5-3.5 t/ha, showing the potential faba beans continue to have in that region.

Field pea. There are no new field pea varieties released for the 2015 season. However three varieties were released by Pulse Breeding Australia in spring 2013 – PBA Wharton$^{\phi}$, PBA Hayman$^{\phi}$ and PBA Coogee$^{\phi}$. PBA Wharton$^{\phi}$ is the most suited to production across all regions of NSW. It has wide adaptability, high yield potential, early to mid-maturity, and resistance to both powdery mildew and viruses. PBA Wharton$^{\phi}$ is a Kaspa-type with semi-leafless erect growth, distinctive pink flowers, shatter resistant 'sugar' pods and tan coloured seed.

The 2014 season was not overly favourable for field peas, with growing season rainfall well below average from July to October. However, this also meant that crops were largely free of disease. There were isolated outbreaks of bacterial blight in southern NSW due to frost events in August and September which triggered disease outbreaks in commercial crops. Dry seasons over the past three years have favoured pulse crops largely through containing disease and assisting harvest of high quality seed.

Lupin. PBA Barlock$^{\phi}$ is a new release for NSW. Seed production was undertaken in 2014 after it was released in Western Australia in 2013. PBA Barlock$^{\phi}$ is slightly later flowering and maturing than Mandelup, but has shorter harvest height than Mandelup. It is more resistant to pod shattering than Mandelup. Its yield is equal to Mandelup in the south but lower than Mandelup in the north.

Apart from dry seasonal conditions virus infection and sowing time as it related to frost risk were two of the more important management factors in 2014, especially for narrow-leaf lupin. The very high aphid activity early in the season resulted in some crops being infected with *Bean yellow mosaic virus* (BYMV) and *Cucumber mosaic virus* (CMV). CMV is specific to narrow leafed lupin whereas BYMV can infect both albus and narrow-leaf varieties. A seed dressing to control aphids should be considered for 2015 sowings. The incidence of BYMV was higher in 2014 than in previous years. Mandelup in particular was seriously damaged by frosts in early-mid August last season. The unusually very warm temperatures throughout May and early June brought forward the flowering time of varieties like Mandelup. Being one of the earliest flowering varieties available, sowing Mandelup before the last week in April increases the risk of frost damage.

Wheat

Crop management

Profitable yields result from good management, of which variety choice is only a minor part. To reach their full potential, varieties must be grown in a rotation that minimises the risks from diseases and weeds, and maximises soil fertility and soil moisture storage.

Variety choice

Varieties are tested across NSW prior to inclusion in the *Winter crop variety sowing guide*. However, varietal performance varies from year-to-year due to seasonal conditions and many other factors. Use varieties yielding consistently well over several years that offer the best combination of yield potential, grain quality and disease resistance.

Sow at least two different varieties each year. This spreads the risk of frost and disease damage. To ensure high yields select varieties by considering:

- grain quality to attract premium payments
- good disease resistance
- maturity suited to sowing time
- strong seedling vigour
- resistance to lodging and shattering
- tolerance to herbicides
- tolerance to soil acidity
- tolerance to pre-harvest sprouting
- good threshing ability
- tolerance to frost.

Varieties for each receival zone

Varieties are considered according to their suitability for the two recieval zones in NSW – Northern and South eastern. The major purpose of this division is for the environmental growing season differences, transport and marketing arrangements. This facilitates deliveries by quality grade, maximising grower returns.

To be included in the *Winter crop variety sowing guide* varieties must have a quality classification and ideally two or more years of regional yield evaluation. With the recent changes, there are now only two quality classification zones in NSW, with the central zone being amalgamated with the northern zone. Growers should check carefully the maximum quality classification of each variety in their delivery zone.

Growers are encouraged to try new varieties for which there is limited yield and agronomic data available. Information on these varieties should be obtained from either the owner or commercial partner.

Farmers can grow the varieties of their choice and deliver them to selected clients. If a variety is to be accepted into its classification grade, it must be taken to a receival site where that grade is segregated. Certain quality standards must be met before the variety will be accepted.

Segregation is a separate issue from variety approvals. Varieties are commonly suited to a range of end uses like pan bread, steam bread or noodles, whereas others have specific uses like biscuits or pasta, depending on their quality.

Sow on time

Varieties differ in the time they take from sowing to flowering. Late sown (quicker maturing) varieties take fewer days to flower than early sown (late maturing) varieties. This difference is more marked from early sowings (April) than from late sowings (July).

Avoid sowings that result in crops flowering in late winter. Frosts can cause damage resulting in reduced yield and can also affect grain quality. Some varieties sown too early will flower in late winter. Varieties sown too late have little chance of reaching their yield potential because flowering and grain filling occur under hot, dry, stressful conditions.

Sowing time is a management compromise between having the crop flowering soon after the last heavy frost, but early enough to allow adequate grain fill before the onset of moisture stress and heat in spring.

Yield drops 4–7% with each week of delay in sowing after the optimum time for a specific variety.

If varieties are sown within the optimum sowing period, they can produce their highest yields but the best sowing date varies with topography and variety. Locally, sowing dates may need to be extended (earlier or later) depending upon local climatic conditions and soil types.

Sowing towards the earliest part of the recommended sowing window usually results in higher yields.

Conservation tillage techniques (no-till, minimum till) as well as the use of moisture seeking sowing tynes can enable varieties to be sown on time.

Frost damage is a major consideration and the risk cannot be eliminated entirely; therefore the potential for higher yields from earlier sowings needs to be balanced against the risk of frost damage at flowering. There are two ways of doing this:

1. In areas where the risk of frost is high, sow later than the suggested optimum sowing period. As a rule of thumb, three days difference at planting makes one day difference at heading.
2. Change varieties. Use maturity differences to have the crop flowering at a time when frost risk is acceptable.

Since rain for sowing is often erratic, varieties must be chosen carefully to achieve this balance.

Seeding rates and plant populations

High yields are possible from a wide range of seeding rates because wheat compensates by changing the number of tillers and the size of the head – the number of grains per head in response to the prevailing environment, including weather, fertility and plant competition.

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New varieties in 2015

- Mitch
- Sunmate
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- Compass

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Aim to establish a target number of plants. To achieve this target population for the environment and the seasonal conditions, adjust sowing rates to compensate for:

- sowing date – higher with later sowings
- seed germination
- seed size
- seedling vigour differences
- seedbed conditions
- conservation tillage techniques (no-till, minimum till)
- double cropping
- soil fertility
- soil type
- field losses – see the following explanation.

Field losses. Under normal conditions, expect to lose up to 20% of seed sown in addition to germination losses. Adjust seeding rates to suit sowing conditions.

Press wheels improve establishment under dry or marginal moisture conditions.

Where herbicide resistance is suspected higher seeding rates may assist with competition against weeds.

Calculating sowing rates

The following formula can be used to calculate sowing rates, taking into account:

- target plant density
- germination percentage (90% = 90 in the formula)
- seed size
- establishment – usually 80%, unless sowing into adverse conditions (80% = 80 in the formula).

Tip – 1000 seed weight:

- count out 200 seeds
- weigh to at least one decimal point of a gram
- multiply weight in grams by five.

Example

100 seed weight (grams) [35] × target plant population [140] × 100
÷ establishment percentage [80] × germination percentage [90]
= your seeding rate [68] kg/ha

Your calculation

100 seed weight (grams) [ ] × target plant population [ ] × 100
÷ establishment percentage [ ] × germination percentage [ ]
= your seeding rate [ ] kg/ha

Nutrition

A balance of nutrients is essential for profitable yields. Fertiliser is commonly needed to add the essential nutrients phosphorus and nitrogen. The lack of other essential plant nutrients may also limit production in some situations.

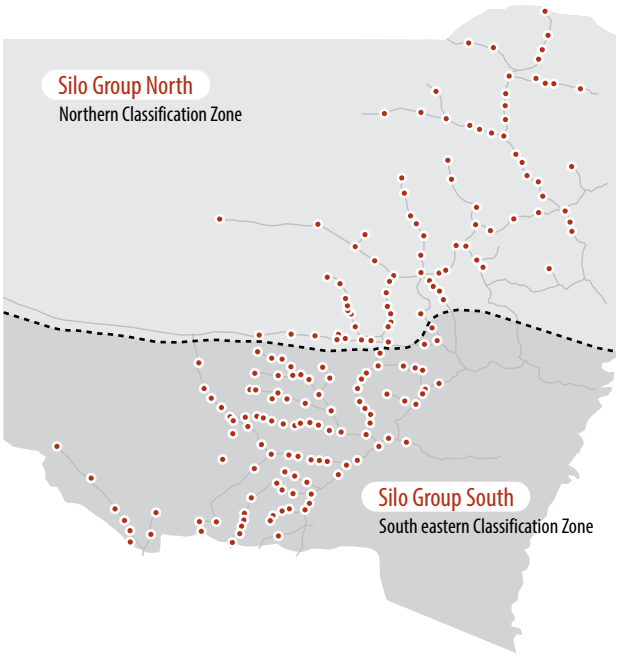
Knowing the nutrient demand of crops is essential in determining nutrient requirements. Soil testing and nutrient audits assist in matching nutrient supply to crop demand.

Weed management in winter crops

Herbicide resistance in weeds is a problem that continues to become more widespread through NSW, and that growers should be alert to. It is the biggest threat to the sustainability of cropping systems. However, this problem can be managed by having good crop and pasture rotations, by rotating herbicide groups and by combining both chemical and non-chemical methods of weed control.

Variety selection

Locate your farm on the map for either of the delivery regions – Northern or South eastern – and check the classification of varieties for each classification zone.



Region		Sowing rate kg/ha	Plant establishment targets				
			Plants/m row				Plants/m²
			18 cm row spacing	25 cm row spacing	30 cm row spacing	36 cm row spacing	
North-West Plains		15–35	–	8–18	10–22	12–26	30–70
North-West Slopes		35–55	–	18–28	22–34	26–40	70–110
Central	(higher rainfall)	40–60	14–21	20–30	24–36	28–42	80–120
	(lower rainfall)	25–45	9–17	12–22	14–26	18–34	50–90
Southern	(higher rainfall)	45–65	16–23	23–32	27–38	32–48	90–130
	(lower rainfall)	25–45	9–17	12–22	14–26	18–34	50–90
Irrigation		80–110	29–45	40–60	48–72	58–90	150–200
Cover crop – pasture, dryland		15–20	5–7	7–10	8–12	10–14	30–40

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Northern NSW – Varieties

Yield performance experiments from 2010 to 2014.

Yield results are combined across sites analysis of NVT yield trials. The number of trial results are listed. The more trials, the greater the reliability.

Long season varieties

Compared with EGA_Wedgetail = 100%

Variety	East EGA_Wedgetail = 3.45 t/ha	Trial Number
EGA_Wedgetail■	100	10
Frelon■	107	2
Mackellar■	98	10
Manning■	87	4
Mansfield	92	8
Naparoo■	99	10
Rudd■	97	10
SF Adagio■	106	3
SQP Revenue■	105	9
Tennant■	101	9
Wylah■	98	10

■Winter wheat

Early sown – before 15 May

Compared with EGA_Gregory = 100%

Variety	East EGA_Gregory = 4.12 t/ha	Trial Number	West EGA_Gregory = 3.33 t/ha	Trial Number
Bolac	100	8	96	11
EGA_Bounty	96	22	96	25
EGA_Eaglehawk	–	–	87	3
EGA_Gregory	100	22	100	25
EGA_Wedgetail■	85	22	87	25
EGA_Wylie	94	3	90	4
Forrest	89	9	–	–
Gascoigne	99	19	98	14
Gauntlet	104	19	98	21
Gazelle*	92	22	95	25
Kiora	108	14	103	11
Lancer	100	19	93	21
Mitch	102	19	100	21
Sentinel3R	103	13	100	18
Strzelecki	81	22	88	25
Sunbri	86	22	85	25
Sunvale	97	22	92	25
Sunvex	95	8	89	13
Sunzell	91	22	88	25
Viking	105	14	103	14
Feed wheats				
Naparoo■	70	3	–	–

■Winter wheat. *Soft/biscuit wheat variety.

Main season sown – after 14 May

Compared with EGA_Gregory = 100%

Variety	East EGA_Gregory = 3.84 t/ha	Trial Number	West EGA_Gregory = 3.42 t/ha	Trial Number
Baxter	86	21	87	27
CLF Janz	93	10	92	15
Condo	102	11	99	20
Crusader	94	25	90	34
Dart	100	25	93	34
EGA_Gregory	100	25	100	34
EGA_Wills	103	4	101	5
EGA Wylie	89	25	88	34
Ellison	88	20	85	28
Elmore CL PLUS	100	21	98	27
Gascoigne	97	21	96	20
Gauntlet	98	25	96	34
Gazelle*	91	5	92	8
Giles	–	–	95	5
Impala*	105	25	102	34
Janz	92	20	90	20
Livingston	102	25	96	34
Merinda	97	14	92	22
Merlin	101	14	95	22
Mitch	106	6	105	6
Orion*	93	19	94	28
QAL2000 *	86	9	86	9
Spitfire	99	25	95	34
Sunco	90	14	90	22
Sunguard	99	19	97	26
Sunlin	89	4	84	7
Sunmate	107	17	101	20
Suntop	109	25	104	34
Sunvale	94	25	91	34
Sunvex	93	8	89	14
Sunzell	84	4	79	7
Ventura	99	25	98	34
Viking	103	5	101	6
Wallup	104	25	98	34
Feed wheats				
B53	105	13	102	20
EGA_Stampede	101	8	98	12

*Soft/biscuit wheat variety.

Suggested sowing times

Aim to sow grain-only crops in the earlier part of the optimum period. The actual date is influenced by location, soil fertility and the likelihood of frost at flowering in a particular paddock.

Variety / Weeks	March				April				May				June				July		
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
SLOPES																			
Brennan ■, Mackellar ■, SF Adagio■, SF Ovalo■, SF Scenario■, Tennant ■	>	★	★	★	★	★	★	★	<	<									
EGA_Wedgetail ■, Manning■, Naparoo■, Rudd ■, SQP Revenue ■		>	>	★	★	★	★	★	★	★	<								
EGA_Eaglehawk, Sunbrook						>	★	★	★	<	<								
Kiora, Lancer, Sunbri, Sunzell							>	★	★	★	★	<							
EGA_Gregory, Gazelle, Giles, Mitch, SentinelR, Strzelecki, Sunlin, Viking								>	★	★	★	★	<						
EGA_Bounty, EGA_Burke, EGA_Wills, EGA_Wylie, Ellison, Elmore CL PLUS, Espada, Gauntlet, Impala, Janz, Lincoln, Merinda, Orion, Sunco, Sunguard, Suntop, Sunvale, Sunvex, Wallup									>	★	★	★	★	★	<				
Baxter, Petrel										>	★	★	★	★	<	<			
B53, Crusader, Derrimut, EGA_Stampede, Kennedy, Livingston, Merlin, Peake, Spitfire, Sunmate, Ventura											>	★	★	★	★	<	<		
Axe, Condo, Dart												>	★	★	★	★	<	<	
PLAINS																			
EGA_Wedgetail ■, Naparoo ■					>	★	★	★	★	★	<								
EGA_Eaglehawk, Sunbrook						>	★	★	★	<	<								
Kiora, Sunbri, Sunzell,						>	>	★	★	★	★	<	<						
EGA_Gregory, Gazelle, Giles, Lancer, Mitch, SentinelR, Strzelecki, Sunlin, Viking								>	★	★	★	★	<						
EGA_Bounty, EGA_Burke, EGA_Wills, EGA_Wylie, Ellison, Elmore CL PLUS, Espada, Impala, Janz, Lincoln, Merinda, Orion, Sunco, Sunguard, Suntop, Sunvale, Sunvex, Wallup									>	★	★	★	★	★	<				
Baxter, Petrel										>	★	★	★	★	<	<			
B53, Crusader, Derrimut, EGA_Stampede, Emu Rock, Kennedy, Livingston, Merlin, Peake, Spitfire, Sunmate, Ventura											>	★	★	★	★	<			
Axe, Condo, Dart												>	★	★	★	★	<		

> Earlier than ideal, but acceptable. ★Optimum sowing time. < Later than ideal, but acceptable. ■Winter wheat.
Petrel sown in late May for hay/chaff production. Can be sown earlier if grazed. **Note: For durum suggested sowing times see Durum section, page 36.**

NVT

National Variety Trials

A GRDC INITIATIVE

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ARIAH PARK 2665 BOOROWA 2586 BROCKLESBY 2642 CANOWINDRA 2804 COOTAMUNDRA 2590 COWRA 2794 CUDAL 2864 CUMNOCK 2867 GALONG 2585 GEROGERY 2642
GRENFELL 2810 HARDEN 2587 HENTY 2658 QUANDIALLA 2721 TEMORA 2666 WAGGA WAGGA 2650 BALRANALD 2715 BECKOM 2665 BOREE CREEK 2652 COLEAMBALLY 2707
CONDOBOLIN 2877 LOCKHART 2656 MAYRUNG 2710 MERRIWAGGA 2652 OAKLANDS 2646 WILLBRIGGIE 2680 BILOELA 4715 CAPELLA 4723 DUARINGA 4712 KILCUMMIN 4721
SPRINGSURE 4722 BROOKSTEAD 4364 JONDARYAN 4401 KINGSTHORPE 4400 MACALISTER 4406 BUNGUNYA 4494 DULACCA 4425 LUNDAVRA 4390 MEANDARRA 4422
MUNGINDI 2406 NINDIGULLY 4497 WESTMAR 4422 COCKALEECHIE 5631 CUMMINS 5631 GREENPATCH 5607 MT HOPE 5607 RUDALL 5642 UNGARRA 5607 WANILLA 5607
WHARMINDA 5603 YEELANNA 5632 CRYSTAL BROOK 5523 LAURA 5480 MINTARO 5415 RIVERTON 5412 SALTERS SPRINGS 5401 SPALDING 5454 TARLEE 5411 TURRETFIELD 5411
COOKE PLAINS 5261 GERANIUM 5301 LAMEROO 5302 NANGARI 5333 PALMER 5237 PARUNA 5311 PINNAROO 5304 WAIKERIE 5330 WANBI 5310 WUNKAR 5311
BORDERTOWN 5268 CONMURRA 5272 FRANCES 5262 KEITH 5267 MOYHALL 5271 MUNDULLA 5270 SHERWOOD 5267 WOLSELEY 5269 DARKE PEAK 5642 ELLISTON 5670
KIMBA 5641 LOCK 5633 MINNIPA 5654 MITCHELLVILLE 5602 NUNJIKOMPITA 5680 PENONG 5690 PIEDNIPPIE 5680 STREAKY BAY 5680 TOOLIGIE 5607 WARRAMBOO 5650
ARTHURTON 5572 BRENTWOOD 5575 BUTE 5560 MAITLAND 5573 MINLATON 5575 PASKEVILLE 5552 PORT CLINTON 5570 URANIA 5573 WAROOKA 5577 WILLAMULKA 5554
WOKURNA 5520 CRESSY 7302 BIRCHIP 3483 HOPETOUN 3396 MANANGATANG 3546 MERRINEE 3496 MURRAYVILLE 3512 QUAMBATOOK 3540 RAINBOW 3424 ULTIMA 3544
WALPEUP 3507 BALLIANG 3340 CHARLTON 3525 COLBINABBIN 3559 DIGGORA 3561 EASTVILLE 3463 MITIAMO 3573 DOOKIE 3646 RUTHERGLEN 3685 WUNGHNU 3635
YARRAWONGA 3730 HAMILTON 3300 STREATHAM 3351 TEESDALE 3328 BRIM 3391 CORACK 3480 HORSHAM 3400 KANIVA 3419 MINYIP 3392 TARRANYURK 3414
WONWONDAH 3401 BADGINGARRA 6521 CARNAMAH 6517 ERADU 6532 MINGENEW 6522 MORAWA 6623 NABAWA 6532 OGILVIE 6535 WALKAWAY 6528 BADGINGARRA 6521
BEVERLEY 6304 BINNU 6532 BUNTINE 6613 CALINGIRI 6569 COOROW 6515 CORRIGIN 6375 CUNDERDIN 6407 ENEABBA 6518 ERADU 6532 GOOMALLING 6460
KATANNING 6317 KULIN 6365 MILING 6575 MINGENEW 6522 NAREMBEEN 6369 PINGELLY 6308 WAGIN 6315 WICKEPIN 6370 WONGAN HILLS 6603 WONGAN HILLS R.S. 6603
ARTHUR RIVER 6315 COOROW 6515 FRANKLAND 6396 GNOWANGERUP 6335 KENDENUP 6323 KOJONUP 6395 MT. BARKER 6324 MULLEWA 6630 NARROGIN 6312
NYABING 6341 PINGRUP 6343 TOODYAY 6566 WILLIAMS 6391 YORK 6302 ARTHUR RIVER 6315 BENCUBBIN 6477 CADOUX 6466 DALWALLINU 6609 KATANNING 6317
KELLERBERRIN 6410 MERREDIN 6415 MOORINE ROCK 6425 MUKINBUDIN 6479 MULLEWA 6630 PINGELLY 6308 PITHARA 6608 WYALKATCHEM 6485 YUNA 6532
GRASS PATCH 6446 HOLT ROCK 6355 HYDEN 6359 JERRAMUNGUP 6337 LAKE GRACE 6353 MT. MADDEN 6356 SALMON GUMS 6445 SCADDAN 6447 WITTENOOM HILLS 6447
WONGAN HILLS 6603 ESPERANCE 6450 GIBSON 6448 MUNGLINUP 6450 NEWDEGATE 6355 HYDEN 6359 MERREDIN 6415 ESPERANCE 6450

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Southern PULSE Agronomy

Variety Specific AGRONOMY Packages

Southern Barley Agronomy

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Southern NSW – Varieties

Yield performance experiments from 2010 to 2014.

Yield results are combined across sites analysis of NVT yield trials. The number of trial results are listed. The more trials, the greater the reliability.

Long season varieties

Compared with EGA_Wedgetail = 100%

Variety	East EGA_Wedgetail = 3.99 t/ha	Trial Number
Amarok■	102	3
EGA_Wedgetail■	100	16
Frelon■	105	3
Mackellar■	105	16
Manning■	113	10
Mansfield	99	11
Naparoo■	96	16
Rudd■	101	16
SF Adagio■	111	7
SF Scenario■	110	7
SQP Revenu■	107	16
Tennant■	102	16
Wylah■	94	16

■Winter wheat

Early sown – before 15 May

Compared with EGA_Gregory = 100%

Variety	East EGA_Gregory = 4.54 t/ha	Trial Number	West EGA_Gregory = 4.16 t/ha	Trial Number
Bolac	98	27	99	30
EGA_Bounty	97	27	97	30
EGA_Eaglehawk	90	12	91	12
EGA_Gregory	100	27	100	30
EGA_Wedgetail■	92	27	93	30
Estoc	96	27	95	30
Forrest	98	15	100	11
Gascoigne	98	15	97	18
Gauntlet	98	21	99	24
Gazelle*	99	27	99	30
Kiora	105	15	108	18
Lancer	91	21	90	24
Mitch	99	21	99	24
Phantom	102	13	102	12
Sentinel3R	101	18	103	19
Strzelecki	92	27	90	30
Sunvale	92	27	92	30
Sunvex	90	18	89	19
Sunzell	89	27	89	30
Trojan	102	9	103	11
Viking	103	15	103	18
Yenda*	84	6	84	6
Feed wheats				
Naparoo■	90	6	–	–
Preston	103	26	–	–

■Winter wheat. *Soft/biscuit wheat variety.

Main season sown – after 14 May

Compared with EGA_Gregory = 100%

Variety	East EGA_Gregory = 4.21 t/ha	Trial Number	West EGA_Gregory = 3.60 t/ha	Trial Number
Axe	95	24	96	26
Barham*	88	30	88	30
Bolac	96	18	98	13
Chara	94	24	93	26
CLF Janz	89	12	89	14
Cobra	105	12	102	20
Condo	107	12	109	19
Corack	100	19	99	33
Correll	–	–	99	9
Crusader	87	30	87	30
Dart	93	30	95	32
EGA_Bounty	98	15	99	13
EGA_Gregory	100	30	100	30
Ellison	87	30	86	23
Elmore CL PLUS	98	24	98	26
Emu Rock	96	30	96	33
Espada	102	24	102	24
Estoc	96	12	97	16
Forrest	93	12	–	–
Gascoigne	99	24	98	17
Gauntlet	94	30	95	31
Gazelle*	96	12	96	9
Gladius	95	24	96	26
Grenade CL PLUS	90	24	93	27
Impala*	102	30	103	30
Janz	90	21	91	23
Justica CL PLUS	95	30	96	33
Kord CL PLUS	96	24	97	26
Lincoln	99	30	99	31
Livingston	96	30	98	30
Mace	100	12	99	20
Merinda	93	18	96	19
Merlin	95	30	97	31
Orion*	95	24	94	23
Peake	92	12	92	13
Phantom	101	24	101	26
QAL2000*	89	18	86	11
Scout	103	18	103	20
Shield	91	6	92	10
Spitfire	94	30	96	31
Sunguard	94	24	96	25
Sunmate	98	18	99	17
Suntop	103	30	103	30
Sunvale	91	30	93	30
Sunvex	89	15	91	13
Trojan	103	12	100	14
Ventura	94	30	92	30
Viking	104	6	102	7
Waagan	100	12	102	13
Wallup	97	30	97	31
Yenda*	83	18	80	11
Yitpi	94	24	95	26
Feed wheats				
B53	99	18	99	20

*Soft/biscuit wheat variety.

Suggested sowing times

Aim to sow grain-only crops in the earlier part of the optimum period. The actual date is influenced by location, soil fertility and the likelihood of frost at flowering in a particular paddock.

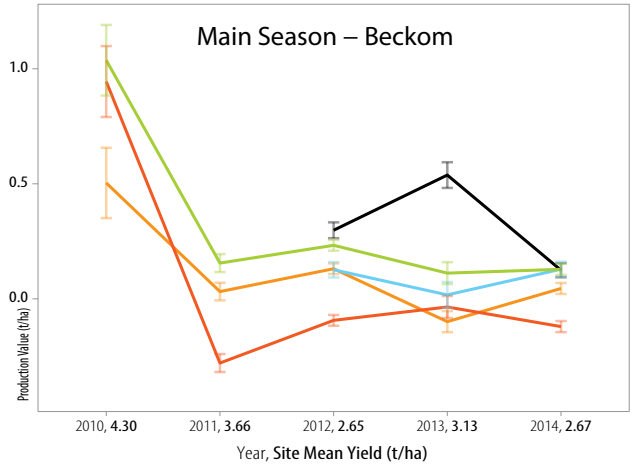
Variety / Weeks	March				April				May				June				July		
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
SLOPES																			
Brennan■, Mackellar■, SF Adagio■, SF Ovalo■, SF Scenario■, Tennant■	>	★	★	★	★	★	★	★	<	<									
EGA_Wedgetail■, Manning■, Naparoo■, Rosella■, Rudd■, SQP Revenue■		>	>	★	★	★	★	★	★	★	<								
Bolac, EGA_Eaglehawk, Forrest, Kiora, Yenda						>	★	★	★	★	★	<	<						
Correll, EGA_Gregory, EGA_ Wills, Gazelle, Gladius, Lancer, Preston, Sentinel3R, Strzelecki, Sunzell, Trojan, Viking							>	★	★	★	★	<							
Barham, Corack, EGA_Bounty, Ellison, Elmore CL PLUS, Espada, Estoc, Gauntlet, Grenade CL PLUS, Impala, Janz, Justica CL PLUS, Kord CL PLUS, Lincoln, Livingston, Merinda, Orion, Petrel, Phantom, QALBis, QAL2000, Scout, Shield, Sunguard, Suntop, Sunvale, Sunvex, Wallup									>	★	★	★	★	<					
B53, Crusader, Derrimut, EGA_Stampede, Emu Rock, Merlin, Peake, Spitfire, Sunmate, Ventura										>	★	★	★	★	<				
Axe, Condo, Dart, Waagan											>	★	★	★	★	<			
PLAINS																			
EGA_Wedgetail■, Rosella■				>	★	★	★	★	<	<									
Bolac, EGA_Eaglehawk, Kiora, Yenda						>	★	★	★	★	<	<							
Correll, EGA_Gregory, EGA_Wills, Gazelle, Gladius, Lancer, Preston, Sentinel3R, Strzelecki, Sunzell, Trojan, Viking								>	★	★	★	<							
Barham, Corack, Gauntlet, EGA_Bounty, Ellison, Elmore CL PLUS, Espada, Estoc, Grenade CL PLUS, Impala, Janz, Justica CL PLUS, Kord CL PLUS, Lincoln, Livingston, Merinda, Orion, Petrel, QALBis, QAL2000, Scout, Shield, Sunguard, Suntop, Sunvale, Sunvex, Wallup								>	>	★	★	★	<	<					
B53, Crusader, Derrimut, EGA_ Stampede, Emu Rock, Merlin, Peake, Spitfire, Sunmate, Ventura									>	>	★	★	★	★	<				
Axe, Condo, Dart, Waagan										>	>	★	★	★	★	<			

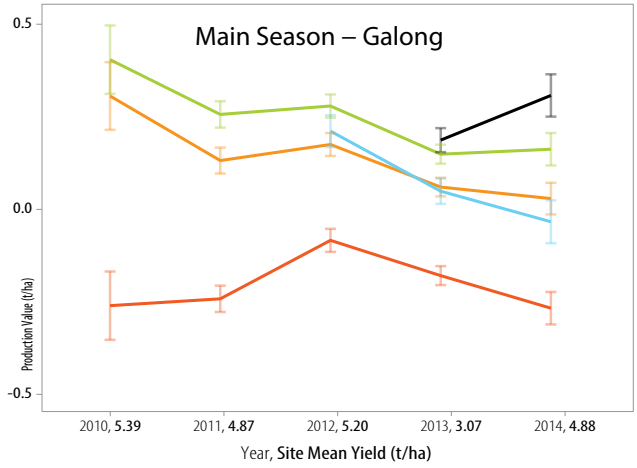
> Earlier than ideal, but acceptable. ★Optimum sowing time. < Later than ideal, but acceptable. ■Winter wheat.
Petrel sown in late May for hay/chaff production. Can be sown earlier if grazed. **Note: For durum suggested sowing times see Durum section, page 36.**

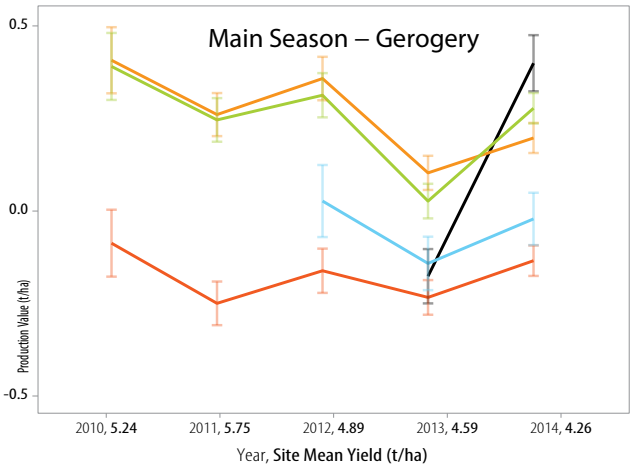
New way to look at NVT trial results

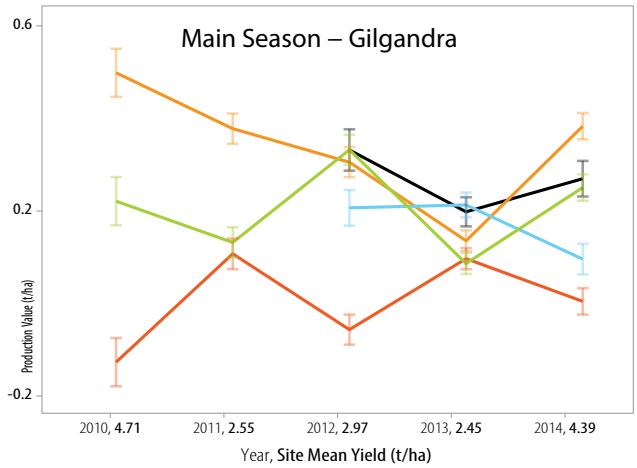
The regional mean yields shown in the tables on the previous pages average varietal performance across trial locations within each region. This averaging can mask the variety by environment interaction, that is, the ability of a variety to yield differently at each location across seasons (years). The production value reporting shown in the graphs below unlocks the variability in grain yield performance observed over different sites and seasons in the NVT trials. The production value (PV) is the varietal yield advantage (t/ha) for each variety at each environment. The PVs are shown as positive or negative differences relative to a baseline, which reflects the expected average yield of all the varieties in the current northern region wheat NVT data, for main and early season trial sets. Varieties may be viewed as having expected yields that are equal to the baseline (PV=0) or above (PV>0) or below (PV<0) average for each particular environment.

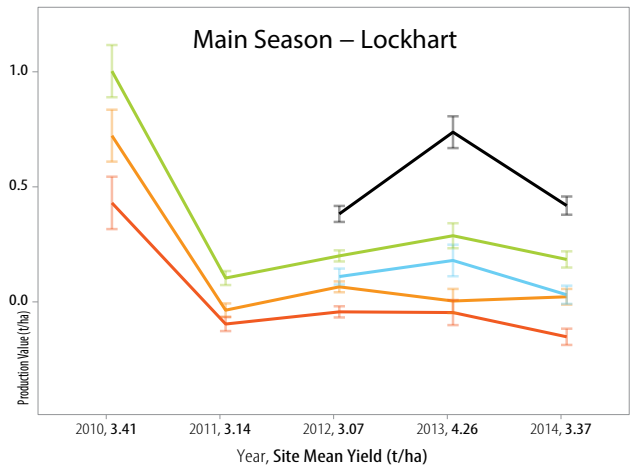
Below are example graphs for a number of main season wheat sites in NSW if you wish to explore this type of comparison across a number of different sites, crops and varieties, you need to go to the NVT website **www.nvtonline.com.au**. On the site you will be able to choose the crop you wish to look at, the preferred site and then choose up to six varieties to look at how they compare across the years tested. The production value graph's provide an indication of the stability of the variety over a number of locations and years.

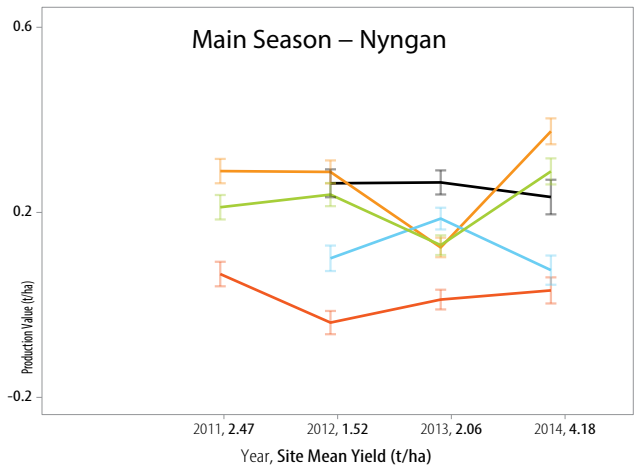












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Varietal characteristics and reaction to diseases

Variety	Maximum quality classification		Resistances and tolerances																	Origin	Year release
	Northern zone	South eastern zone	Crown rot	Common root rot	Flag smut	Leaf rust	Stem rust	Stripe Rust WA Yr 17–27 pathotype	Septoria tritici blotch	Yellow leaf spot	RLN *P. thornei* resistance	RLN *P. thornei* tolerance	RLN *P. neglectus* resistance	RLN *P. neglectus* tolerance	CCN resistance	Black point	Sprouting	Lodging	Acid soils tolerance		
Bread wheat																					
Axe	APW	APW	S	MS–S[$]	S[$]	S[P]	MS	R–MR	S–VS	S	MS	MT–MI[P]	MS	MI[P]	S	S	S–VS	MR	I	AGT	2007
Baxter	APH	APH	MS	MS[N]	–	S[P]	MR–MS	MS–S	S	S	MS	MT	MS–S	MI–I	–	MS[N]	S	MS–S	MT	DAFF Qld	1998
Bolac	APW	APH	S	MS[$]	R–MR[$]	S	MR–MS	R–MR	MS	S	MR–MS	MT–MI[P]	MS–S	MI[P]	S	MS–S	S	MR	MI	Viterra	2006
Chara	APH	APH	S[P]	S[$]	MS[$]	S[P]	MR–MS	MS–S	MS–S	MS–S	MR–MS	MT–MI	S–VS	–	R	MS	S	MR	I	DELWP Victoria	1998
CLF Janz	APH	AH	S[P]	MS–S	R	S[P]	MR	MS–S	S	MS–S	S	I–VI[P]	S	MI[P]	S	S	S	MS	–	BASF/Ag WA	2001
Cobra	APW	AH	S	MS	S[P]	MR	R–MR	MS–S	MS–S	MR–MS	MS–S	MI–I	MS	MI–I	MS	MS–S	S	MR	MT	LongReach	2011
Condo	AH	AH	–	–	–	MR–MS[P]	R–MR	MS–S	S	MS–S	MR–MS	T–MT[P]	S	MT[P]	R	–	–	–	MT	AGT	2014
Corack	APW	APW	S	MS[$]	S[$]	S–VS[P]	MR	MS	S–VS	MR	S	MI	MS–S	MT[P]	R–MR	MS–S	–	MR	T–MT	AGT	2011
Correll	APW	AH	S	MS[$]	R[$]	S[P]	MR–MS	MR–MS	MS–S	S–VS	S	MI–I	MS–S	MT–MI[P]	MR	MS	S–VS	MS	–	AGT	2007
Crusader	APH	APH	S	MR–MS	MR[$]	S[P]	R–MR	MS	S	MS	MS–S	MI	S–VS	MI[P]	MS	R–MR[N]	S	R–MR	MT	LongReach	2007
Cunningham	APH	APH	MS	MS	R	–	R–MR	MS	S	MS	S–VS	MI–I	S	MT–MI	–	MS	MS–S	MS–S	I	DAFF Qld	1991
Dart	APH	APH	MS–S	MS–S	MS[$]	S–VS[P]	MR	MR	S–VS	MS	MS	MI	MS–S	MI[P]	S	MR–MS[P]	S	R–MR	MT	LongReach	2012
Derrimut	APW	APW	MS	S[$]	R–MR[$]	MS[P]	MR	MS–S	S	S	S	MI–I	MS–S	MI[P]	R	S	S	MR–MS	–	Nugrain	2007
Diamondbird	AH	AH	–	–	R	–	MS	MS	MS	MS–S	MS	MI–I[P]	MS–S	MI–I[P]	–	MR–MS	S	MS	T–MT	NSW DPI Wagga	1997
Drysdale	AH	AH	–	–	R	–	MR	MS	MS	MS	MS	MT	S	T–MT[P]	–	–	S	MS	T–MT	Graingene/NSW DPI	2001
EGA_Bounty	AH	AH	S	S[N]	–	MS[P]	MR	MR	MS–S	MS	MS	MT	MS–S	MT–MI[P]	–	MS–S[N]	S	MR–MS	–	EGA	2008
EGA_Burke	APH	AH	S	MS–S[N]	MR[$]	MR–MS[P]	MR	MS	MS	MS–S	MS	MT	MS–S	MT–MI[P]	–	R–MR[N]	MS–S	S–VS	–	EGA	2006
EGA_Eaglehawk	AH	APH	–	–	MS	–	R–MR	MR–MS	MS	MS–S	MS	MT	MS	MI[P]	–	MR–MS[NP]	S	MS	T	EGA	2008
EGA_Gregory	APH	AH	S	MR–MS[N]	R & MS–S[$]	MR	MR	MR†	MS	S	MS	MT	MS–S	MT	S	MS[N]	S	MS	T	EGA	2004
EGA_Wedgetail	AH	APH	MS–S	–	MR	MS	MR–MS	MS	MS–S	MS–S	S	MI[P]	S	MI–I[P]	S	–	S	MR	T–MT	EGA	2002
EGA_Wentworth	AH	AH	MS–S	MR–MS	–	–	R–MR	MS	–	MS–S	MS–S	MI–I	S	MT[P]	–	R–MR	S	MS	–	EGA	2004
EGA_Wills	AH	APW	S	MR–MS[N]	–	–	R–MR	MR–MS†	–	MS	MS	MT	MS–S	MT[P]	–	MS[N]	S	MS	–	EGA	2007
EGA_Wylie	AH	AH	MR–MS	MS[N]	MS–S[$]	MS[P]	R	MS	MS–S	MS–S	MS–S	T–MT	MS–S	MI	–	MR[N]	S	MS	–	EGA	2004
Ellison	APH	APH	S–VS[N]	S[N]	R–MR	–	MR	MS	MS–S	MR–MS	MS–S	I–VI	MS–S	MI	–	MS[N]	MR	MR	I	Uni Sydney	2003
Elmore CL PLUS	AH	AH	MS–S[P]	MS[$]	S[$]	R–MR	MR	MR–MS	MS–S	S	S	MI–I[P]	S	MT[P]	S	MS[N]	–	MR–MS	I	AGT	2011
Emu Rock	APW	AH	MS–S	MS–S[$]	MS[$]	S	MR–MS	MR–MS	S–VS	MR–MS	S	I–VI	MS–S	MI[P]	S	MS	–	–	–	InterGrain	2011
Espada	ASW	AH	S	MS–S[$]	MR–MS[$]	R	MR	MR–MS	S	MS	S	I–VI[P]	S	MT–MI[P]	MS	S	S–VS	MR–MS	MT	AGT	2007
Estoc	ASW	ASW	MS–S	MR–MS[$]	MR–MS[$]	MR–MS	MR	MS	S–VS	MS–S	S	I–VI[P]	S	MT[P]	MR	MS	MS	MR	–	AGT	2010
Forrest	ASW	APW	S–VS	MS[$]	MR[$]	MS–S[P]	R–MR	R–MR	MS–S	MR–MS	S–VS	I–VI[P]	S	MI[P]	S	MR	S	MR–MS	–	Advantage Wheat	2011
Gauntlet	APH	AH	MS–S	MS–S	MS[$]	MS	R–MR	MR–MS	MS–S	MS	MR	MT	S	MT–MI[P]	MR–MS	MR–MS[N]	MS–S	MR–MS	MT	LongReach	2011
Giles	APH	AH	S	MS–S[N]	–	R	R–MR	MS	MR–MS	MS–S	MS–S	MI	S	MT	–	MR–MS[N]	MS–S	MR–MS	MT	DAFF Qld	1999
Gladius	APW	AH	S	MS[$]	R–MR[$]	MS	MR	MR–MS	MS–S	MS	S	I–VI[P]	MS	MT–MI[P]	MS	MS	S–VS	MR–MS	MT	AGT	2007
Grenade CL PLUS	APW	APW	S	MR–MS[$]	R–MR[$]	S[P]	MR	MR–MS	MS–S	S	S	I–VI[P]	MS–S	–	MR	MS	MS	–	–	AGT	2012

Varietal characteristics and reaction to diseases (continued)

Variety	Maximum quality classification		Resistances and tolerances																Origin	Year release
	Northern zone	South eastern zone	Crown rot	Common root rot	Flag smut	Leaf rust	Stem rust	Stripe Rust WA Yr 17–27 pathotype	Septoria tritici blotch	Yellow leaf spot	RLN *P. thornei* resistance	RLN *P. thornei* tolerance	RLN *P. neglectus* resistance	RLN *P. neglectus* tolerance	CCN resistance	Black point	Sprouting	Lodging	Acid soils tolerance		
H45	AH	AH	–	–	R	–	MS	VS	S	MR	MS–S	MT–MI[P]	S	–	–	–	S	MS	I–MI	Hyb Wheat Aust	1999
H46	APW	APW	S	MS–S	R–MR	–	MR–MS	VS	VS	MR–MS	S	I	S[P]	I[P]	S	MR–MS	S	MS	I	Hyb Wheat Aust	2004
Janz	APH	APH	S	MR–MS	MR	MR–MS	R–MR	MS	MS–S	S	S	I	S	MT–MI	S	S	S	MS	I	DAFF Qld	1989
Justica CL PLUS	ASW	APW	S	MS[$]	R[$]	S[P]	MR	MR–MS	S	S	S	I–VI[P]	S	MI[P]	MS	S	S	–	–	AGT	2011
Kennedy	APH	FEED	S	MS[N]	R	–	MR	MS	–	MS–S	S	MT–MI	S	MT–MI	–	R[N]	S	MR–MS	MT	DAFF Qld	1998
Kiora	APH	AH	S	MS	MR–MS[$]	MR–MS[P]	R–MR	R–MR	MS–S	MS–S	MR–MS	MT[P]	MS	MT–MI[P]	MS	–	–	–	–	AGT	2014
Kord CL PLUS	APW	APW	S	MR–MS[$]	MR[$]	MS	MR	MR–MS	MS–S	MS–S	MS	I[P]	MS–S	MT–MI[P]	MR	MR	S	–	–	AGT	2011
Lancer	APH	APH	MS–S	S	R–MR[$]	R–MR	R	MR	MS	MS	MS	T–MT[P]	S	MT–MI[P]	S	–	–	MR	–	LongReach	2013
Lang	APH	APH	MS–S	MR–MS[N]	–	MS[P]	R	MS	MS–S	MS–S	MS–S	MI–I	S	MI	–	R–MR[N]	MS–S	S	I	DAFF Qld	2000
Lincoln	AH	AH	S–VS	MS[$]	R–MR[$]	MS–S[P]	MR	R–MR	S	MS–S	S	I–VI[P]	MS–S	MI[P]	S	MR–MS	S–VS	MS	MT–MI	LongReach	2007
Livingston	AH	AH	S	S[N]	–	MS[P]	MR–MS	MR–MS	S–VS	MS	MS	MT	S	MI[P]	MS	MR–MS[N]	–	MR–MS	I	AGT	2007
Mace	AH	AH	S	MS[$]	S[$]	MS–S[P]	MR	S–VS	S	MR–MS	MS	MT[P]	MS	VI[P]	MR–MS	MS		MR–MS	–	AGT	2007
Marombi	ASW	ASW	MS–S	–	R	–	MS	MS	MS	MS	MS	–	MS–S[P]	–	–	R–MR	–	–	–	Uni Sydney	2001
Merinda	AH	AH	S–VS	S[N]	–	R	R–MR	MR–MS	MS–S	MS–S	MS	MT	S	MT–MI[P]	S	MR	–	MR	–	AGT	2007
Merlin	AH	AH	MS	S	MR–MS[$]	MS	MR	MR	S	S	MS–S	MT–MI	MS	MT–MI[P]	MS	S	MS	MS	MT–MI	LongReach	2012
Mitch	AH	APW	MS	–	S[$]	S–VS[P]	MR–MS	MR–MS	S	MS	MS	MT–MI[P]	MS	T[P]	S	MR	–	MR–MS[P]	MT–MI	AGT	2014
Peake	APW	AH	S	S[$]	MR–MS[$]	MS–S[P]	MR	MS	S–VS	S	MS–S	MI[P]	MS–S	MI–I[P]	R–MR	MS–S	MS–S	MS	MT	Nugrain	2008
Phantom	APW	APW	MS–S	MS–S[$]	MR–MS[$]	MS–S[P]	MS	MR	MS	S–VS	S	MI	S	MT[P]	MS	MR–MS[P]	MS–S	MS–S	MT–MI	LongReach	2012
Scout	ASW	APW	S	S[$]	MR[$]	MR–MS[P]	MR	MS	MS–S	S–VS	MS	MT[P]	S	MI[P]	R	S	MS–S	MS	MT–MI	LongReach	2009
Sentinel3R	ASW	ASW	MS–S	S[$]	MS–S[$]	R	R–MR	R–MR	MR–MS	MS	MS–S	MI–I[P]	S	MT[P]	S	MS–S	S	MR	T–MT	LongReach	2005
Shield	APW	APW	S	MR–MS[$]	S[$]	R	R–MR	R–MR	MS–S	MS–S	MS	–	MS	–	MR–MS	MS	S	MR	MT	AGT	2012
Spitfire	APH	APH	MS	MS[N]	MS–S[$]	S[P]	MR	MR	MS–S	MS–S	MR–MS	MT–MI	MS–S	MT–MI[P]	MS	S	MS	MS	MT–MI	LongReach	2010
Strzelecki	APH	AH	S	MR[N]	–	R	MR–MS	MR	MS	MS	S–VS	I	S	MT[P]	–	MS[N]	MS–S	MS	–	DAFF Qld	2000
Sunbri	APH	APH	MS	MR–MS	R–MR	–	R	MR	MS	MS	MS–S	MI	MS–S	MT–MI	–	R–MR	MS–S	MS–S	I	Uni Sydney	1990
Sunbrook	APH	AH	MR–MS	R	MS–MS	–	MR–MS	MR–MS	MR–MS	S	MS	MT–MI	MS–S	MT–MI[P]	–	–	S	MS–S	T–MT	Uni Sydney	1995
Sunco	APH	APH	MS	MR–MS[N]	MR–MS	MR	R	MR–MS	MS	MS–S	MS–S	I	S	MI	–	R–MR[N]	MS–S	S	I	Uni Sydney	1986
Sunguard	AH	AH	MS	MR–MS	S–VS[$]	MR	R	MR	MS	MS–S	MS–S	MT	S	MT–MI[P]	–	MR[N]	MS–S	MS	I	AGT	2011
Sunlin	APH	APH	MS–S	R–MR[N]	–	–	MR–MS	MR	MR–MS	MS	S	I	S–VS	MI	–	S[N]	R	R–MR	I	Uni Sydney	1996
Sunmate	APH	AH	MS–S	–	R–MR[P]	MS[P]	MR–MS	MR–MS	MS–S	MS–S	MR	T–MT[P]	MS–S	MT–MI[P]	MR–MS	MR	S	MR[P]	MT–MI	AGT	2014
Sunstate	APH	APH	S	MR–MS[N]	–	–	MR	MS	–	MS–S	MS–S	MT–MI	MS–S	MT–MI	–	MR–MS[N]	S	MS–S	T–MT	Uni Sydney	1992
Suntop	APH	APH	MS–S	MS	R[$]	MR–MS[P]	MR	MR–MS	S	MS–S	MR	T–MT	MS–S	MT[P]	S	MR	S	MR–MS	MT	AGT	2012
Sunvale	APH	APH	MS–S	MS[N]	–	S[P]	R	MR[†]	MS	MS–S	MS	MT	MS–S	MI	–	R–MR[N]	S	S–VS	I	Uni Sydney	1995
Sunvex	APH	AH	S	VS[N]	MS–S[$]	MR	R	MR	MR–MS	MR–MS	MS–S	I	MS–S	MT–MI	–	MS[NP]	S	MS–S	I	AGT	2008
Sunzell	AH	APH	MS–S	MS–S	MS–S[$]	MR–MS[P]	MR	MS	MS–S	MS–S	MS	MT	MS	MI[P]	–	S[N]	–	MR–MS	T–MT	AGT	2006

Varietal characteristics and reaction to diseases (continued)

Variety	Maximum quality classification		Resistances and tolerances																	Origin	Year release
	Northern zone	South eastern zone	Crown rot	Common root rot	Flag smut	Leaf rust	Stem rust	Stripe Rust WA Yr 17–27 pathotype	Septoria tritici blotch	Yellow leaf spot	RLN *P. thornei* resistance	RLN *P. thornei* tolerance	RLN *P. neglectus* resistance	RLN *P. neglectus* tolerance	CCN resistance	Black point	Sprouting	Lodging	Acid soils tolerance		
Trojan	ASW	APW	MS	MS[$]	S–VS[$]	MR–MS[P]	MR–MS	MR	MS	MS–S	MS	MI[P]	MS–S	MT[P]	MS	MR–MS	–	MR–MS[P]	–	LongReach	2013
Ventura	AH	AH	MS–S	MR–MS[N]	R	MS–S[P]	R–MR	MS–S	MS–S	S	MR–MS	MT	MS–S	MT–MI	–	MR–MS[P]	S	MS–S	T	Uni Sydney	2004
Viking	APH	APH	MS–S	MR–MS[P]	MS–S[P]	S–VS[P]	MR	R–MR	S	MS–S	MR–MS	T[P]	S	I–VI[P]	R	MR–MS[N]	S	MS	–	LongReach	2014
Waagan	AGP	ASW	S	–	MS[$]	MS	MS–S	S	S	MS–S	MS–S	MT–MI	S	MT–MI[P]	–	MS[NP]	–	MS	MI	AGT	2009
Wallup	APH	APH	S	MS[$]	S–VS[$]	S–VS[P]	MR–MS	MR–MS	S–VS	MS–S	MR–MS	MT	MR–MS	T–MT[P]	MR	MR	–	MR	I	AGT	2011
Whistler	ASW	ASW	–	–	MR	–	MR	MS–S	MR–MS	–	MS–S	–	MS–S	–	–	–	S	R	T–MT	NSW DPI Temora	1998
Wylah	AH	AH	–	–	R	–	MR	MS	MR–MS	MS	S	I[P]	S	–	–	–	S	MS–S	MI–I	NSW DPI Temora	1999
Feed Wheat																					
Amarok	FEED	FEED	–	–	–	–	S	MR–MS	–	–	MR–MS[P]	–	S[P]	–	–	–	–	–	–	–	2003
B53	FEED	FEED	MS	–	–	MS–S	MS	MR	S	MS–S	–	–	–	–	–	–	–	–	–	Elders	2015
Brennan	FEED	FEED	S	–	–	–	MS	R–MR	MR	MS	S–VS	–	S	–	–	–	–	MR	–	CSIRO	1998
EGA_Stampede	FEED	FEED	S[N]	MS[N]	–	–	R–MR	MR	S	MS–S	S	I–VI	MS–S	MT[P]	–	MR–MS[N]	MS–S	MS	–	EGA	2008
Mackellar	FEED	FEED	–	–	–	S–VS[P]	MR	R–MR	R–MR	MR–MS	MS	–	MS–S	MT[P]	–	S	–	–	–	CSIRO	2001
Manning	FEED	FEED	VS	S–VS	R[$]	R–MR	MR–MS	R–MR	R	MR–MS	S	–	MS–S	–	MS	–	–	–	–	CSIRO	2013
Mansfield	FEED	FEED	MS	–	R[$]	MS	S–VS	R–MR	R–MR	MS	S	–	MS	–	S	–	–	R–MR	–	Advantage Wheat	2010
Naparoo	FEED	FEED	MS–S	–	VS[$]	R & S	R–MR	MR	MR	MS	S–VS	MT[P]	S–VS	–	–	–	–	–	–	AGT	2007
Preston	FEED	FEED	S	MS[$]	S[$]	S–VS[P]	S–VS	R–MR	MS–S	MS–S	MS–S	MI–I[P]	MS–S	–	S	MR–MS	–	MR	–	Advantage Wheat	2009
Rudd	FEED	FEED	–	–	–	–	S	R	MR–MS	MR–MS	S–VS	–	S	–	–	–	–	–	–	CSIRO	2001
SF Adagio	FEED	FEED	S–VS	MS	MS	MS[P]	S–VS	R–MR	R–MR	MR–MS	MS	–	MS	–	S	–	–	R–MR	–	Seedforce	2014
SF Ovalo	FEED	FEED	S–VS	–	–	MS[P]	S	R	R	MR	MS	–	MS–S	–	–	–	–	R–MR	–	Seedforce	2014
SF Scenario	FEED	FEED	S–VS	–	–	S[P]	–	MR	R–MR	MS	MS–S	VI[P]	MS	–	–	–	–	R–MR	–	Seedforce/RAGT	2014
SQP Revenue	FEED	FEED	S	S–VS[$]	S[$]	R	R–MR	R	MR	MS	MS–S	–	MS–S	–	S	MS–S	–	–	–	Ausgrainz	2009
Tennant	FEED	FEED	–	–	–	–	R & S	R–MR	MR	MR	S	–	MR–MS	–	–	–	–	–	–	CSIRO	1998
Durum																					
Caparoi	ADR	ADR	VS	MS[$]	R[$]	MR–MS	MR	MR	MR	MR–MS	MR	T–MT	MS–S	MI[P]	MR	MR	MR	MR–MS	VI	NSW DPI Tamworth	2008
EGA_Bellaroi	ADR	ADR	VS	MR[N]	R	MR–MS	MR	MR	MR–MS	MR–MS	MR	MT	MS	MI–I	–	R–MR[N]	MS–S	MR	VI	NSW DPI Tamworth	2002
Hyperno	ADR	FEED	S–VS	MS[$]	R[$]	R–MR	R	MR	MR–MS	MS	R–MR	T–MT	MS	MT[P]	MS	MR–MS[NP]	R	S–VS	VI	AGT	2008
Jandaroi	ADR	FEED	VS	MR[N]	R	MR	R–MR	MR[†]	R–MR	MS	MR–MS	MI[P]	MS	MI[P]	MS	R–MR[N]	MR	MS–S	VI	NSW DPI Tamworth	2007
Wollaroi	ADR	ADR	VS	R–MR[N]	R	–	MR	MR	R	MS	MR–MS	MT–MI	MS–S	I	–	R–MR[N]	MR–MS	R	VI	NSW DPI Tamworth	1993
Yallaroi	ADR	ADR	VS	R–MR[N]	R	–	R–MR	MR	R	MR–MS	MR	MT	MR–MS	MT–MI	–	MR[N]	MS	R	VI	NSW DPI Tamworth	1987
ASW Soft/Noodle																					
Lorikeet	ANW	ANW	–	–	VS	MS	MS	MS–S	R–MR	S	S[P]	–	MS–S[P]	–	–	–	S	–	I	NSW DPI Temora	2001
Rosella	ANW	ANW	MS–S	–	VS	–	MR–MS	MR–MS	MR–MS	S	S	–	S	–	–	S	MS–S	MR–MS	I	NSW DPI Temora	1985
Sunsoft 98	ANW	ANW	S–VS	S–VS[N]	VS	–	R–MR	MS–S	MR–MS	MS	S	I	MS	MI–I	–	–	S	–	I	Uni Sydney	1998

Varietal characteristics and reaction to diseases (continued)

Variety	Maximum quality classification		Resistances and tolerances																Origin	Year release
	Northern zone	South eastern zone	Crown rot	Common root rot	Flag smut	Leaf rust	Stem rust	Stripe Rust WA Yr 17–27 pathotype	Septoria tritici blotch	Yellow leaf spot	RLN *P. thornei* resistance	RLN *P. thornei* tolerance	RLN *P. neglectus* resistance	RLN *P. neglectus* tolerance	CCN resistance	Black point	Sprouting	Lodging	Acid soils tolerance		
Soft Domestic																				
Barham	AGP	ASF1	S [P]	MS–S [$]	MR–MS [$]	MR–MS	MR–MS	S	S	MS–S	MS–S	MI [P]	MR	T–MT [P]	MS	MS	–	MS	I	AGT	2006
Bowie	ASF1	ASF1	S	S	–	–	S	S	MS	S	MS–S	MT–MI [P]	MS	–	MR–MS	MR–MS	–	MS–S	I	Roseworthy	1996
Gazelle	ASF1	ASF1	S	MS–S	S [$]	MR	MR	MR	MR–MS	MS–S	S	I [P]	MS–S	MT [P]	S	MS–S	S	MR	–	LongReach	2012
Impala	ASF1	ASF1	MS–S	MS–S [$]	S–VS [$]	S–VS [$]	MR	MR	S–VS	MS–S	S	MI–I	S	MT–MI [P]	MS–S	MR–MS [N]	MS–S	MR–MS	MT–MI	LongReach	2011
Orion	ASF1	ASF1	MS–S	MS [NP]	S [$]	R	MR	MS–S	MS–S	MS–S	MS–S	MT–MI [P]	MS	MT–MI [P]	S	S [N]	–	S	–	LongReach	2009
QAL2000	ASF1	ASF1	S–VS	MR [N]	–	R	R–MR	VS	MR–MS	MS–S	MR–MS	MT–MI	S	MI [P]	–	–	–	–	–	VAWCRC	2000
QALBis	ASF1	ASF1	S	R–MR	MR–MS	–	R–MR	S–VS	–	MS–S	MS–S	I–VI	S	MI	–	S [NP]	–	–	–	VAWCRC	2002
Yenda	AGP	ASF1	S	MS–S	MR	–	R	S	MS	MR–MS	MS–S	MI–I	MR	MT–MI [P]	MS	MR	–	R–MR	I	AGT	2006

Scoring: – = Insufficient data. † Varieties expected to respond to control measures if stripe rust begins early. ‡ Mix, may have some more susceptible plants in population. Where ratings are separated by '&' the first is correct for the majority of situations, but different pathotypes are known to exist and the latter rating reflects the response to these pathotypes, [P] Provisional rating. [N] = North. [$] = South. Crown rot and common root rot ratings come from screening in SARDI, SA([$]) and DAFF Qld ([N]). DAFWA = Department of Agriculture and Food Western Australia; NSW DPI = NSW Department of Primary Industries; DAFF Qld = Department of Agriculture, Fisheries and Forestry, DELWP Victoria = Department of Environment, Land, Water & Planning Victoria.
Resistance ratings – The root-lesion nematode (*P. thornei* & *P. neglectus*) rating systems were revised during 2014 and some cultivars may have different ratings to previous years. Resistance ratings that appear in this planting guide are national consensus ratings based on glasshouse and field data collected in the northern and southern grain regions.
Tolerance ratings – The root-lesion nematode (*P. thornei* & *P. neglectus*) rating systems were revised during 2014 and some cultivars may have different ratings to previous years. Tolerance ratings that appear in this planting guide are based on field data collected in the northern grain region rather than national consensus ratings

Resistances

R (Resistant) indicates a high level of resistance and grain yield is unlikely to be reduced.
R–MR (Resistant–Moderately Resistant) indicates a high level of resistance and grain yield is unlikely to be reduced.
MR (Moderately Resistant) indicates disease may develop in favourable conditions, some yield loss may occur. Early disease control may be important in some varieties.
MR–MS (Moderately Resistant–Moderately Susceptible) indicates disease may develop in favourable conditions, some yield loss may occur. Early disease control may be important in some varieties.
MS (Moderately Susceptible) indicates disease may be conspicuous in favourable situations with moderate yield losses. Early disease control is important.
MS–S (Moderately Susceptible–Susceptible) indicates disease may be conspicuous in favourable situations with moderate yield losses. Early disease control is important.
S (Susceptible) indicates high levels of disease may occur with substantial yield losses. Early disease control is essential.
S–VS (Susceptible–Very Susceptible) indicates high levels of disease may occur with substantial yield losses. Early disease control is essential.
VS (Very Susceptible) indicates high levels of disease may occur with substantial yield losses.

Tolerances

T (Tolerant) indicates a high level of tolerance and grain yield is unlikely to be reduced.
T–MT (Tolerant–Moderately Tolerant) high level of tolerance and grain yield is unlikely to be reduced.
MT (Moderately Tolerant) indicates disease may develop in favourable conditions, some yield loss may occur.
MT–MI (Moderately Tolerant–Moderately Intolerant) indicates disease may develop in favourable conditions, some yield loss may occur.
MI (Moderately Intolerant) indicates disease may be conspicuous in favourable situations with moderate yield losses.
MI–I (Moderately Intolerant–Intolerant) indicates disease may be conspicuous in favourable situations with moderate yield losses.
I (Intolerant) indicates high levels of disease may occur with substantial yield losses.
I–VI (Intolerant–very intolerant) indicates high levels of disease may occur with substantial yield losses.
VI (Very Intolerant) indicates high levels of disease may occur with substantial yield losses.

Acknowledgments for Variety characteristics and reaction to diseases

CCN ratings are largely from the southern region screening coordinated by Hugh Wallwork, SARDI. RLN ratings are from the Queensland screening program coordinated by Jason Sheedy, Toowoomba, DAFF Qld.
Note: RLN or CCN tolerance indicates the ability of the variety to grow and yield in the presence of nematodes. Resistance refers to the ability of the variety to reduce nematode carryover.
Disease scores courtesy of the various NVT screening projects through out Australia. Lodging scores are combined ratings from the southern irrigated wheat project and Allan Peake's, CSIRO (northern irrigated wheat project).
Contributing authors: Robert Park, Harbans Bariana, Colin Wellings, The University of Sydney, Cobbitty; John Thompson, Graeme Wildermuth (formerly DAFF Qld); Peter Williamson, Phillip Banks, John Sheppard, DAFF Qld; Andrew Milgate, NSW DPI, Steven Simpfendorfer, NSW DPI, Peter Martin and Ray Hare (formerly NSW DPI); Daryl Mares, University of Adelaide; Hugh Wallwork, SARDI; Grant Holloway, DELWP Victoria.

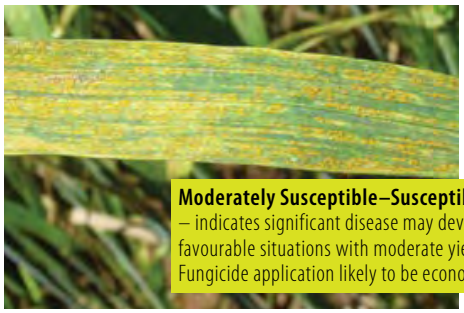
Stripe rust ratings – what do they mean?

The pictures below show the varying levels of adult plant reaction to stripe rust.

Resistant (R) – indicates a high level of resistance; disease should not be normally seen and grain yield should not be affected.

Moderately Susceptible (MS) – indicates moderate levels of disease may develop in favourable situations with moderate yield losses. Fungicide application likely to be economic.

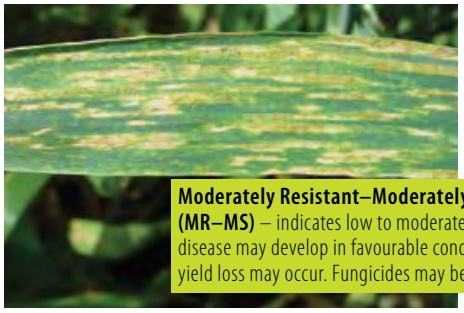
Resistant–Moderately Resistant (R–MR) – indicates a high level of resistance; very low levels of disease may be seen and grain yield should not be reduced.



Moderately Susceptible–Susceptible (MS–S) – indicates significant disease may develop in favourable situations with moderate yield losses. Fungicide application likely to be economic.

Moderately Resistant (MR) – indicates low levels of disease may develop in favourable conditions, some yield loss may occur but fungicide control unlikely to be economic.

Susceptible (S) – indicates high levels of disease may occur with substantial yield losses. Fungicide applications should be budgeted and most likely economic to apply.



Moderately Resistant–Moderately Susceptible (MR–MS) – indicates low to moderate levels of disease may develop in favourable conditions, some yield loss may occur. Fungicides may be economic.

Susceptible–Very Susceptible (S–VS) – indicates high levels of disease may occur with substantial yield losses. Disease may require close monitoring and proactive fungicide control.

Adult plant resistance – what does it mean?

Response to stripe rust is determined by the interaction of genes for resistance in a variety and genes for virulence in the pathogen population. The reaction of a wheat variety to stripe rust depends on two forms of resistance.

Seedling genes, effective from seedling emergence through to maturity, provided the matching virulence gene in the pathogen population is absent.

Adult plant resistance (APR) genes which become effective at various growth stages, ranging from the fourth leaf stage through to full head emergence. APR will also be effective provided that matching virulence is not present in the pathogen. Both seedling and APR genes, and combinations of both, provide varying levels of crop protection which may be influenced by environment (temperature, crop nutrition, management) and disease pressure. **Growers need to be aware that varieties which predominantly rely on APR for stripe rust protection may be more susceptible to stripe rust infection earlier in the season until the APR provides protection. Wheat varieties with APR may benefit from early stripe rust control by fertiliser, seed or foliar fungicides. If unsure speak to your local agronomist.**

AGT varieties for 2015

Conventional Wheat

Condoⓑ — *Fast maturing, AH quality, with excellent grain size, test weight and black point resistance.*

Corackⓑ — *Suitable for wheat on wheat rotations, with excellent CCN and yellow leaf spot resistance. Exceptional relative yield performance in areas suffering terminal drought stress.*

Kioraⓑ — *An alternative to Bolac*ⓑ*, best performance in medium-high yield potential environments, with AH quality.*

Mitchⓑ — *Suits late April-early May plantings in northern NSW, excellent yield performance with a strong disease resistance package. AH quality.*

Sunmateⓑ — *Maturity similar to Spitfire*ⓑ*, with very high yield and APH quality classification in Northern Zone.*

Suntopⓑ — *A very high yielding APH quality variety with an outstanding disease resistance package and wide adaptation.*

Wallupⓑ — *Excellent grain quality with APH quality and good disease resistance package*

Clearfield® Wheat

Clearfield® Plus
Production System for Wheat

Elmore CL Plusⓑ — *Imidazolinone tolerant, suited to the medium yield potential environments of NSW.*

Kord CL Plusⓑ — *A CCN resistant, Imidazolinone tolerant variety suited to tougher environments.*

Coleoptile length of wheat varieties

Coleoptile length of wheat varieties is an important characteristic when selecting a variety to sow into difficult seedbed conditions. Coleoptile length will affect how deep you can sow a variety before plant emergence is reduced. Coleoptile length has been found to be influenced by several factors including variety, seed size, temperature, low soil moisture and certain seed fungicide dressings. Following are the results of wheat variety screening for coleoptile length from samples collected from the National Variety Testing program which is funded by GRDC.

Predicted mean coleoptile length for durum wheat varieties at 15 NVT sites across Australia from 2010 to 2013

Variety	Predicted mean coleoptile length (cm)
Caparoi	7.75
DBA-Aurora	7.65
EGA Bellaroi	8.03
Hyperno	7.95
Jandaroi	7.15
Kalka	7.58
Saintly	7.51
Tamaroi	8.25
Tjilkuri	7.78
WID802	7.90
Wollaroi	7.30
Yawa	7.78
Check varieties	
Federation (long)	9.40
Whistler (short)	5.99

Predicted mean coleoptile length for early and long season wheat varieties at 14 NVT sites across Australia from 2008 to 2013

Variety	Predicted mean coleoptile length (cm)
Amarok	6.38
Beaufort	8.22
Bolac	5.67
Currawong	6.58
EGA Bounty	6.33
EGA Burke	6.13
EGA Eaglehawk	6.47
EGA Gregory	6.29
EGA Wedgetail	5.87
Estoc	7.05
Forrest	6.02
Frelon	7.28
Gascoigne	6.25
Gauntlet	6.70
Gazelle	5.77
Kiora	6.46
Lancer	6.71
Mackellar	6.07
Manning	5.66
Mansfield	6.21
Mitch	6.92

Variety	Predicted mean coleoptile length (cm)
Naparoo	6.33
Preston	6.94
QAL2000	7.02
Rosella	6.92
Rudd	5.77
Sentinel	6.33
SF Adagio	6.19
SF Ovalo	9.19
SF Scenario	6.56
SQP Revenue	6.40
Strzelecki	6.48
Sunbri	6.84
Sunsoft 98	5.90
Sunzell	6.42
Tennant	7.18
Thornbill	5.86
Trojan	6.98
Viking	6.37
Wylah	6.13
Yenda	6.98
Check varieties	
Federation (long)	9.45
Whistler (short)	5.66

Predicted mean coleoptile length for main season wheat varieties at 38 NVT sites from 2008 to 2013

Variety	Predicted mean coleoptile length (cm)
Axe	6.05
Barham	6.91
Baxter	7.11
Chara	6.36
Clearfield Janz	6.43
Cobra	6.61
Condo	6.64
Corack	6.84
Correll	7.78
Crusader	6.65
Cunningham	6.80
Dart	7.18
Diamondbird	6.63
Drysdale	6.43
EGA_Bounty	6.54
EGA_Gregory	6.40
EGA Hume	6.58
EGA Kidman	6.47
EGA_Stampede	6.38
EGA_Wentworth	6.66
EGA_Wills	6.87

Variety	Predicted mean coleoptile length (cm)
EGA_Wylie	6.88
B53	6.40
Ellison	7.06
Elmore CL PLus	7.21
Emu Rock	6.47
Espada	6.79
Giles	7.01
Gladius	6.60
Grenade CL Plus	6.69
Hartog	6.54
Impala	5.69
Janz	7.14
Justica CL Plus	6.78
Kennedy	5.94
Kord CL Plus	6.79
Lang	7.16
Lincoln	6.09
Livingston	6.66
Mace	6.91
Merinda	6.52
Merlin	7.28

Variety	Predicted mean coleoptile length (cm)
Orion	7.50
Phantom	6.61
Scout	7.41
Shield	6.69
Spitfire	7.21
Sunco	7.06
Sunguard	6.98
Sunlin	6.77
Sunstate	6.89
Suntop	7.11
Sunvale	7.06
Sunvex	7.52
Sunzell	6.50
Trojan	7.03
Ventura	6.60
Waagan	6.75
Wallup	6.33
Yitpi	7.94
Check varieties	
Federation (long)	9.37
Whistler (short)	5.79

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AGRIPHAR CROP SOLUTIONS

Varietal characteristics

* NB: Quality classifications are preliminary and subject to final review.

Aim to spread the overall risk by planning to sow at least one variety at each sowing opportunity. This depends upon suitable sowing rains. See the tables *Variety characteristics and reaction to diseases* for further details.

Refer to the chapter on *Durum* (page 36) for notes on durum varieties.

Axe.[Φ] Australian Premium White classification in NSW. Very early maturity, similar to slightly earlier than H45. Moderately susceptible to stem rust and resistant–moderately resistant to stripe rust. Susceptible to leaf rust, yellow leaf spot and cereal cyst nematode. Axe is not boron tolerant. Susceptible to black point. Produces very large grain with low screenings. AGT.

Barham.[Φ] Awnless. Biscuit wheat. Australian soft quality in southern NSW. Improved rust resistance, grain yield and quality over Bowie. Mid season maturity, similar to Bowie. Moderately resistant–moderately susceptible to stem and leaf rust. Susceptible to stripe rust and Septoria tritici blotch. Moderately susceptible–susceptible to yellow leaf spot. Moderately resistant to root lesion nematode (*P. neglectus*). Moderately susceptible to cereal cyst nematode and black point. Seednet.

Baxter.[Φ] Australian Prime Hard quality. Combines high tolerance to root lesion nematode (*P. thornei*) and moderate susceptibity to crown rot. Maturity similar to Cunningham. Moderately susceptible–susceptible to stripe rust, susceptible to yellow leaf spot. High protein achiever. Heritage Seeds.

Bolac.[Φ] Australian Prime Hard quality in southern NSW and Australian Premium White northern NSW. Later maturing than Chara. Adapted to mildy acidic, neutral and alkaline soils. Moderately resistant–moderately susceptible to stem rust, resistant–moderately resistant to stripe rust and susceptible to leaf rust. Susceptible to yellow leaf spot. Small grain size. Seednet.

Bowie. Awnless. Biscuit wheat. Australian Soft quality. Moderately resistant–moderately susceptible to cereal cyst nematode. Susceptible to stripe and stem rust. Moderately susceptible to Septoria tritici blotch.

Corack.[Φ] Australian Premium White quality in NSW. An early maturing Wyalkatchem derivative that has yielded well in low and medium rainfall environments and/or tight finishes to the growing season. It has high straw strength, good resistance to cereal cyst nematode and yellow leaf spot. May be suitable for a wheat on wheat situation, low rainfall environments or late sowings. Corack is rated moderately resistant to stem rust, moderately susceptible to stripe and susceptible–very susceptible to leaf rust. Susceptible to powdery mildew to moderately susceptible–susceptible black point. Corack has a high level of tolerance to acid soils. AGT.

Correll.[Φ] Australian Hard quality in southern NSW. A Yitpi derivative with improved stem rust resistance, black point tolerance and Septoria tritici blotch resistance. Mid season, similar maturity and adaptation to Yitpi with high levels of boron tolerance. Produces lower test weights than Yitpi. AGT.

Derrimut.[Φ] Australian Premium White quality. Medium to early maturity, medium to short in height. Moderately susceptible to leaf rust, moderately resistant to stem rust, moderately susceptible–susceptible to stripe rust. Susceptible to yellow leaf spot, Septoria tritici blotch and black point. Cereal cyst nematode resistant. Area of adaptation southern NSW. Nuseed.

EGA_Bounty.[Φ] Australian Hard quality. Suitable for early to mid season sowings. Moderately resistant to stem and stripe rust, moderately susceptible to leaf rust. Moderately susceptible to yellow leaf spot. Susceptible to crown rot and common root rot. Moderately tolerant to root lesion nematode (*P. thornei*). Moderately susceptible–susceptible to black point. Nuseed.

EGA_Burke.[Φ] Australian Prime Hard quality in northern NSW and Australian Hard in southern NSW. Suitable for early to mid season sowings. Medium to medium–slow maturity, similar to Giles. Moderately resistant to stem rust, moderately resistant–moderately susceptible to leaf rust and moderately susceptible to stripe rust. Susceptible to crown rot, moderately susceptible–susceptible to common root rot and yellow leaf spot. Moderately tolerant and moderately susceptible to root lesion nematode (*P. thornei*). Resistant–moderately resistant to black point. Pacific Seeds.

EGA_Eaglehawk.[Φ] Australian Prime Hard quality in southern NSW and Australian Hard in northern NSW. Late maturing spring type, similar to Sunbrook. Resistant–moderately resistant to stem rust and moderately resistant–moderately susceptible to stripe rust. Moderately susceptible to Septoria tritici blotch and flag smut. Tolerant to acid soils. Moderately tolerant to root lesion nematode (*P. thornei*). Heritage Seeds.

EGA_Gregory.[Φ] Australian Prime Hard quality in northern NSW and Australian Hard in southern NSW. Similar maturity, straw strength and height to Batavia and Strzelecki. Moderately resistant to leaf, stem and stripe rust. Good tolerance to root lesion nematode (*P. thornei*). Susceptible to yellow leaf spot and crown rot and moderately resistant–moderately susceptible to common root rot. Pacific Seeds.

EGA_Wedgetail.[Φ] Winter wheat– see note page 32. Australian Prime Hard quality in southern NSW and Australian Hard quality in northern NSW. Acid soils-tolerant, early sowing variety. Large grain size. Similar maturity and height to Rosella. Adapted to higher rainfall regions in southern and central NSW and the eastern part of the northern wheat belt. Moderately resistant–moderately susceptible to stem rust and moderately susceptible to stripe and leaf rust. Moderately susceptible–susceptible to Septoria tritici blotch, crown rot and yellow leaf spot. Seednet.

EGA_Wills.[Φ] Australian Hard quality in northern NSW and Australian Premium White classification for southern NSW. Early to mid season variety. Resistant–moderately resistant to stem rust and moderately resistant–moderately susceptible to stripe rust and common root rot. Susceptible to crown rot, moderately susceptible to yellow leaf spot. Moderately tolerant to root lesion nematode (*P. thornei*). Moderately susceptible to black point. Good resistance to shattering, good straw strength. Pacific Seeds.

EGA_Wylie.(ф) Australian Hard quality. Suited to northern NSW. A sister line to Baxter with improved disease and lodging resistance. Medium maturity, slightly longer maturity than Baxter. Resistant to stem rust, moderately susceptible to leaf and stripe rust. Tolerant–moderately tolerant to root lesion nematode (*P. thornei*). Moderately resistant–moderately susceptible to crown rot, moderately susceptible to common root rot. Moderately susceptible–susceptible to yellow leaf spot. Good black point resistance. Pacific Seeds.

Ellison.(ф) Australian Prime Hard quality. Mid season maturity. Moderately resistant to stem rust and moderately susceptible to stripe rust. Moderately resistant–moderately susceptible to yellow leaf spot. Susceptible–very susceptible to crown rot and moderately susceptible–susceptible to root lesion nematode (*P. thornei*). Moderately resistant to sprouting. AGT.

Elmore CL PLUS.(ф) Australian Hard quality classification in NSW. A mid-maturing variety with Clearfield® Plus technology, which provides tolerance to label rates of Intervix® herbicide. The line has an adaptation pattern similar to Janz and is expected to perform well in moderate to high yield potential areas in NSW, providing an alternative strategy for in-crop weed control. Elmore CL PLUS is rated as moderately resistant–moderately susceptible to stripe rust, resistant–moderately resistant to leaf rust and moderately resistant to stem rust. Susceptible to yellow leaf spot and cereal cyst nematode. AGT.

Emu Rock.(ф) Australian Hard quality classification for southern NSW. Early season variety with broad adaptation. Produces large grain with good test weight and has a low susceptibility to screenings. Moderately resistant–moderately susceptible to yellow leaf spot, stripe and stem rust, and susceptible to leaf rust. Susceptible to cereal cyst nematode. Bred by InterGrain and marketed by Nuseed.

Espada.(ф) Australian Hard quality in southern NSW. Mid season variety with wide adaptation. Good seedling vigour. Produces large grain with low screenings. Moderately resistant–moderately susceptible to stripe rust. Susceptible to Septoria tritici blotch. Moderately susceptible to cereal cyst nematode and susceptible to root lesion nematode (*P. neglectus*). Tolerant of boron. AGT.

Estoc.(ф) Australian Standard White quality in southern NSW. Mid to late season variety, 1–3 days earlier than Yitpi. Cereal cyst nematode resistance and boron tolerance. Moderately resistant to stem rust, moderately resistant–moderately susceptible to leaf rust and moderately susceptible to stripe rust. AGT.

Forrest.(ф) Australian Premium White quality southern NSW and Australian Standard White quality in northern NSW. Forrest is a long season spring wheat best suited to mid to high rainfall areas of southern NSW. Forrest is rated as moderately susceptible–susceptible to leaf rust, resistant–moderately resistant to stem and stripe rust, moderately resistant–moderately susceptible to yellow leaf spot and is currently the only released

wheat variety with tolerance to *Wheat streak mosaic virus*. Moderately resistant to black point. Released by Advantage Wheats and marketed by Seednet.

Giles.[Φ] Australian Prime Hard quality in northern NSW and Australian Hard quality in southern NSW. Strong straw. Similar maturity to Sunvale. Moderately susceptible to stripe rust, moderately intolerant to root lesion nematode (*P. thornei*). Moderately susceptible–susceptible to yellow leaf spot and common root rot and susceptible to crown rot. Heritage Seeds.

Gladius.[Φ] Australian Hard quality in southern NSW and Australian Premium White in northern NSW. Mid–quick season maturity, similar to Diamondbird and Drysdale. Maintains high relative grain yields under drought stress. Moderately resistant–moderately susceptible to stripe rust, moderately resistant to stem rust, moderately susceptible to leaf rust and yellow leaf spot, moderately susceptible–susceptible to Septoria tritici blotch. Boron tolerant. Moderately susceptible to cereal cyst nematode and root lesion nematode (*P. neglectus*). AGT.

Grenade CL PLUS.[Φ] Australian Premium White quality in NSW. An early to mid maturing line, carrying Clearfield Plus® technology which provides tolerance to label rates of Intervix herbicide. Grenade CL PLUS combines the flexibility of improved weed management options through the use of Intervix® with high yield and cereal cyst nematode resistance. Grenade CL PLUS is rated moderately resistant–moderately susceptible to stripe rust, susceptible to leaf rust and moderately resistant to stem rust. Susceptible to yellow leaf spot. AGT.

Janz.[Φ] Australian Prime Hard quality. Widely adapted main season variety. Moderate seedling vigour. Medium to strong straw with good lodging and shattering resistance. Good milling quality. Susceptible to yellow leaf spot and crown rot, moderately susceptible to stripe rust, moderately resistant–moderately susceptible to leaf rust.

Justica CL PLUS.[Φ] Australian Premium White classification in southern NSW. A mid maturing variety, possessing Clearfield® Plus technology which provides tolerance to label rates of Intervix® herbicide. Justica CL PLUS is most suited to the mid to high yielding environments of southern NSW. Rated susceptible to leaf rust, moderately resistant to stem rust, moderately resistant–moderately susceptible to stripe rust, susceptible to yellow leaf spot and moderately susceptible to cereal cyst nematode. AGT.

Kord CL PLUS.[Φ] Australian Premium White classification in southern NSW. An early to mid maturing variety with CCN resistance and Clearfield® Plus technology which provides tolerance to label rates of Intervix® herbicide. Kord CL Plus performance has been better at sites and in years that have experienced terminal drought stress. Rated moderately susceptible to leaf rust, moderately resistant to stem rust, moderately resistant–moderately susceptible to stripe rust, moderately susceptible–susceptible to yellow leaf spot and moderately resistant to CCN. AGT.

Livingston.[Φ] Australian Hard quality. Early maturing variety, later than H45 but earlier than Ventura and Sunstate. Moderately resistant–moderately susceptible to stripe and stem rust. Moderately susceptible to leaf rust and yellow leaf spot, and susceptible to crown rot. Moderately tolerant to root leasion nematode (*P. thornei*), moderately resistant–moderately susceptible to black point. Intolerant of acid soils. AGT.

LongReach Cobra.[Φ] Australian Hard quality in southern NSW. High yielding early-mid season variety suited to both acid soils and alkaline soil types. Compact plant height, moderately resistant to lodging and has performed particularly well on irrigation and in high production areas. Resistant–moderately resistant to stem rust, moderately susceptible–susceptible to stripe rust and moderately resistant to leaf rust. Moderately susceptible to cereal cyst nematodes and moderately resistant–moderately susceptible to yellow leaf spot. Pacific Seeds.

LongReach Crusader.[Φ] Australian Prime Hard quality. Quick maturity, similar to Ventura and H45. Strong straw with good lodging resistance. Moderately resistant–moderately susceptible to leaf rust, resistant–moderately resistant to stem rust, moderately susceptible to stripe rust. Susceptible to crown rot. Moderately susceptible to yellow leaf spot. Pacific Seeds.

LongReach Dart.[Φ] Australian Prime Hard quality in NSW. Quick maturity suited to later plantings, slightly quicker than Ventura, LongReach Crusader and H45. Suited to Queensland, NSW and NE Victoria. Late plantings may be a useful tool in herbicide resistance management. Good physical grain, milling and baking quality. Moderately resistant to stripe rust, (resistance to stripe rust based on adult plant resistance (APR)) and stem rust. Susceptible–very susceptible to leaf rust. Rated moderately susceptible to yellow leaf spot. Lower tillering variety, with a long coleoptile and good early seedling vigour. Pacific Seeds.

LongReach Gauntlet.[Φ] Australian Prime Hard in northern NSW and Australian Hard quality in southern NSW. Main season maturity, similar to Janz and Lang. Fully awned. Medium length coleoptile with good early seedling vigour, short–medium plant height at maturity. Resistant–moderately resistant to stem rust, moderately resistant–moderately susceptible to stripe rust and moderately susceptible to leaf rust. Moderately susceptible to yellow leaf spot and moderately susceptible–susceptible to crown rot. Moderately resistant to root lesion nematode (*P. thornei*). Performs well in acid soils. Seednet.

LongReach Gazelle.[Φ] Biscuit wheat. Australian Soft quality in NSW. Mid to late season maturity, similar to QAL2000 and slightly quicker than Yenda. Fully awned. Medium length coleoptile with good early seedling vigour, medium plant height at maturity and suited to high rainfall production areas and irrigation. Moderately resistant to stem rust, stripe rust and leaf rust. Very susceptible to powdery mildew. Good soft wheat grain package with low screenings, low protein accumulation and good test weight. Pacific Seeds.

LongReach Impala.[Φ] Biscuit wheat. Australian Soft quality in NSW. Quick to main season maturity, similar to Lincoln and Ventura. Fully awned. Medium length coleoptile with good early seedling vigour, medium plant height at maturity. Moderately resistant to stem and stripe rust, and susceptible–very susceptible to leaf rust. Good soft wheat grain package with low screenings, low protein accumulation and good test weight. Pacific Seeds.

LongReach Lancer.[Φ] Australian Prime Hard milling quality in NSW. Slower maturing spring wheat for earlier planting opportunities. Medium coleoptile length and has a medium plant height at maturity, improved lodging resistance over EGA_Gregory. Stripe rust resistance based on adult plant resistance, rated moderately resistant, resistant to stem rust and resistant–moderately resistant to leaf rust. Moderately susceptible to yellow leaf spot. Tolerant–moderately tolerant to root lesion nematode (*P. thornei)*. Moderately susceptible–susceptible to crown rot. Pacific Seeds.

LongReach Lincoln.[Φ] Australian Hard quality. Medium maturity, slightly earlier than Janz. Erect, strong and upright canopy. Well suited to southern NSW. Moderately resistant to stem rust and resistant–moderately resistant to stripe rust. Moderately susceptible–susceptible to yellow leaf spot and moderately resistant–moderately susceptible to black point. Very susceptible to crown rot and pre-harvest sprouting. Pacific Seeds.

LongReach Merlin.[Φ] Australian Hard milling wheat, with early to mid season maturity similar to Ventura, Baxter and Drysdale. Suited to NSW and NE Vic. A Drysdale type with similar growth habit. A sister line to LongReach Spitfire, with a similar grain quality package. Stripe rust resistance package based on adult plant resistance (APR), rated moderately resistant. Moderately susceptible to crown rot and moderately tolerant–moderately intolerant to root lesion nematode (*P. thornei*). Pacific Seeds.

LongReach Orion.[Φ] Awnless. Biscuit wheat. Australian Soft quality. Mid season maturity, similar to Bowie and QALBis. Long coleoptile with good seedling vigour. Resistant to leaf rust and moderately resistant to stem rust, moderately susceptible–susceptible to stripe rust and yellow leaf spot. Performs well in acid soils. Pacific Seeds.

LongReach Phantom.[Φ] Australian Premium White in NSW. A mid to late season variety with similar area of adaptation as Yipti. Tolerance to boron and acid soils. Sprouting tolerance similar to Yitpi with good black point tolerance. Moderately susceptible for stem rust, moderately susceptible–susceptible leaf rust, moderately resistant for stripe rust. Moderately resistant–moderately susceptible to cereal cyst nematode but susceptible–very susceptible to yellow leaf spot. Pacific Seeds.

LongReach Scout.[Φ] Australian Premium White in southern NSW. Mid season maturity, similar to Gladius. Rated as resistant to cereal cyst nematode. Good grain package with low screenings and high test weight. Moderately resistant to stem rust moderately resistant–moderately susceptible to leaf rust and moderately susceptible to stripe rust. Very susceptible–susceptible to yellow leaf spot. Medium to long coleoptile with good early vigour. Performs well in both alkaline and acid soils. Pacific Seeds.

LongReach Spitfire.[Φ] Australian Prime Hard quality in NSW. Early to mid season maturity, similar to Ventura and Livingston. Good soil disease control against crown rot and root lesion nematode (*P. thornei*). Good grain package with low screenings and high test weights. Moderately resistant to stem and stripe rust, susceptible to leaf rust. Moderately susceptible–susceptible for yellow leaf spot. Long coleoptile and medium plant height. Performs well in acid soils. Pacific Seeds.

LongReach Trojan.[Φ] Australian Premium White in southern NSW. Mid to long season maturity suited to the medium-high rain zone of southern Australia. Short

to medium plant height at maturity. Moderately tolerant to boron. Moderately resistant–moderately susceptible to stem and leaf rust, and moderately resistant to stripe rust. Useful levels of resistance to cereal cyst nematodes, rated moderately susceptible. Pacific Seeds.

Mace.[Φ] Australian Hard quality in NSW. Has good tolerance to stem rust, however is susceptible–very susceptible to stripe rust and should only be grown where a full fungicide management program can be implemented. Has shown good adaptation in South Australia and Victoria wheat producing regions. AGT.

Merinda.[Φ] Australian Hard quality. Mid season maturity, similar to Janz. Resistant–moderately resistant to stem rust and resistant to leaf rust. Moderately resistant–moderately susceptible to stripe rust. Susceptible–very susceptible to crown rot and moderately susceptible–susceptible to yellow leaf spot. Moderately tolerant to root lesion nematode (*P. thornei*). Moderately resistant to black point. AGT.

Peake.[Φ] Australian Hard quality for southern NSW and Australian Premium White in northern NSW. Area of adaptation southern NSW. Medium to early maturity, medium to short in height. Moderately susceptible–susceptible to leaf rust, moderately resistant to stem rust and moderately susceptible to stripe rust. Cereal cyst nematode resistance. Nuseed.

Petrel. Awnless. For hay/white chaff production. Aim to sow late May to early June, but adjust so the crop can be cut for hay in optimum weather. Can be grazed if sown early.

QALBis.[Φ] Biscuit wheat. Australian Soft quality for NSW. Similar maturity to Sunstate. Resistant–moderately resistant to stem rust and susceptible–very susceptible to stripe rust and susceptible to crown rot. Austgrains International.

QAL2000.[Φ] Biscuit wheat. Australian Soft quality. Similar maturity to Sunstate. Resistant–moderately resistant to stem rust and resistant to leaf rust, very susceptible to stripe rust. Susceptible–very susceptible to crown rot. Austgrains International.

Rosella. Winter wheat – see note page 32. Australian Standard White/Noodle quality. Widely adapted with good seedling vigour. A useful dual-purpose grazing wheat. Strong straw but with early sowing and higher soil fertility it may lodge when not grazed. Mid season maturity once cold requirement is met.

Sentinel3R.[Φ] Australian Standard White quality in NSW. Later maturing than Janz. Resistant–moderately resistant to stem and stripe rust. Resistant to leaf rust. Moderately susceptible–susceptible to crown rot. Moderately susceptible to yellow leaf spot. Moderately susceptible–susceptible to black point, susceptible to pre-harvest sprouting and resistant to shattering. Short coleoptile. Seednet.

Shield.[Φ] Australian Premium White quality in southern NSW. An early to mid-maturing, high quality line with good disease resistance and competitive grain yield. Shield has achieved grain yield levels a little lower than Wyalkatchem across southern Australia. Resistant–moderately resistant to stripe rust and moderately resistant–moderately susceptible to cereal cyst nematodes and moderately susceptible–susceptible to yellow leaf spot. AGT.

Strzelecki.[Φ] Australian Prime Hard quality for northern NSW and Australian Hard quality in southern NSW. Resistant to leaf rust, moderately resistant–moderately susceptible to stem rust, moderately resistant to stripe rust. Moderately susceptible to yellow leaf spot. Susceptible to crown rot, moderately resistant to common root rot. Susceptible–very susceptible and intolerant to root lesion nematode (*P. thornei*). Heritage Seeds.

Sunbri. Australian Prime Hard quality. Resistant to stem rust and moderately resistant to stripe rust. Moderately susceptible to yellow leaf spot and crown rot. Does not have the seedling vigour of many other varieties. Avoid sowing deeper than 10 cm.

Sunbrook.[Φ] Australian Prime Hard quality for northern NSW and Australian Hard quality in southern NSW. A long season spring wheat, not suited to very early sowing. Good seedling vigour. Strong straw. Prone to shattering. AGT.

Sunco. Australian Prime Hard quality. Moderate straw strength. Moderately susceptible to crown rot. In crown rot-free paddocks, lower yielding than other varieties with similar maturity. Resistant to stem rust, moderately resistant to leaf rust, moderately resistant–moderately susceptible to stripe rust.

Sunguard.[Φ] Australian Hard quality classification in NSW. Sunguard is moderately tolerant to root lesion nematode (*P. thornei*), and exhibits a similar level of crown rot tolerance to EGA_Wylie with higher yield potential. A main season Janz derivative, is rated resistant to stem rust, moderately resistant to stripe rust and leaf rust and moderately susceptible–susceptible to yellow leaf spot. AGT.

Sunlin. Awnless. Australian Prime Hard quality. Excellent sprouting tolerance and grain retention in the head at harvest. Moderately resistant to stripe rust and moderately resistant–moderately susceptible to stem rust. Moderately susceptible–susceptible to crown rot. Resistant–moderately resistant to common root rot, moderately susceptible to yellow leaf spot and moderately resistant–moderately susceptible to Septoria tritici blotch. Susceptible to root lesion nematode (*P. thornei*). Susceptible to black point. Some frost tolerance. AGT.

Suntop.[Φ] Australian Prime Hard quality in NSW. A main season line that is well adapted to NSW, showing high and stable yields from low to high yield potential areas. Suntop is quicker maturing than EGA_Gregory, similar in maturity to Janz. Moderately resistant to stem rust and moderately resistant–moderately susceptible to stripe and leaf rust. It has moderate tolerance to acid soils and root lesion nematode (*P. thornei*). It is also moderately resistant to root lesion nematode (*P. thornei*). Suntop is rated moderately susceptible–susceptible to yellow leaf spot and moderately susceptible–susceptible to crown rot. AGT.

Sunvale.[Φ] Australian Prime Hard quality. Main season maturity. Medium straw strength. Resistant to stem rust, susceptible to leaf rust and moderately resistant to stripe rust. Moderately susceptible–susceptible to crown rot. Moderately susceptible to common root rot. AGT.

Sunvex.[Φ] Australian Prime Hard quality for northern NSW and Australian Hard in southern NSW. A Sunvale derivative. Mid to late maturing line with similar maturity

to Sunvale. Resistant to stem rust, moderately resistant to stripe and leaf rust. Moderately resistant–moderately susceptible to yellow leaf spot, susceptible to crown rot. Moderately susceptible to black point. AGT.

Sunzell.Φ Australian Prime Hard quality for southern NSW and Australian Hard in northern NSW. Acid soils tolerant early sowing variety. Slightly longer season than Strzelecki. Moderately resistant–moderately susceptible to leaf rust, moderately susceptible to stripe rust, moderately resistant to stem rust. Moderately susceptible–susceptible to yellow leaf spot. Moderately susceptible–susceptible to crown rot. Moderately tolerant to root lesion nematode (*P. thornei*). AGT.

Ventura.Φ Australian Hard quality. Main season semi-dwarf spring wheat. Sunstate maturity. Good straw strength. Resistant–moderately resistant to stem rust, and moderately susceptible–susceptible to leaf and stripe rust. Moderately resistant–moderately susceptible to root lesion nematode (*P. thornei*). Moderately susceptible–susceptible to crown rot. Susceptible to yellow leaf spot and moderately susceptible–susceptible to Septoria tritici blotch. Tolerant of black point and acid soils. AGT.

Waagan.Φ Australian Standard White quality for southern NSW. A widely adapted, very early maturing spring wheat, similar to H45. High yield potential in medium to low rainfall environments. Moderately intolerant of acid soils. Susceptible to stripe rust, moderately susceptible to leaf rust and black point, and moderately susceptible–susceptible stem rust. Susceptible to Septoria tritici blotch. AGT.

Wallup.Φ Australian Prime Hard quality classification in NSW. A wheat which has very good grain processing quality characteristics and high straw strength. Moderate coleoptile length. Best suited to medium yield potential environments, but has not performed as well in Mallee environments. It is intolerant of toxic levels of soil boron and acid soils. Moderately resistant to cereal cyst nematode, moderately resistant–moderately susceptible to stem and stripe rust, and susceptible–very susceptible to leaf rust. Moderately susceptible–susceptible to yellow leaf spot. Intermediate level of resistance to pre-harvest sprouting and black point and expresses low levels of screenings. AGT.

Yenda.Φ Biscuit wheat. Australian Soft quality in southern NSW. Short stiff strawed variety suitable for irrigation and high rainfall areas. Resistant to stem rust and susceptible to stripe rust. Moderately resistant–moderately susceptible to yellow leaf spot, moderately susceptible to Septoria tritici blotch and cereal cyst nematode. Seednet.

The following are more recently released varieties with limited data available in NSW.

Condo.Φ Australian Hard quality in NSW. Tested as VX1634. Early maturity, adapted to low to medium rainfall areas of NSW. Similar in maturity to Livingston. Condo has a tall plant type with medium straw strength. Resistant–moderately resistant to stem rust, moderately resistant–moderately susceptible to leaf rust and moderately susceptible–susceptible to stripe rust. Moderately susceptible–susceptible to yellow leaf spot and tolerant–moderately tolerant of root lesion nematode (*P. thornei*). Moderately susceptible–susceptible to crown rot. Moderately tolerant of acid soils. Released in 2014. AGT.

Kiora.Φ Australian Hard quality in southern NSW and Australian Prime Hard in northern NSW. Tested as VX2485. Medium to late maturity suited to early to mid season sowings in medium to high rainfall areas. A possible replacement for Bolac in medium to high rainfall environments. Resistant–moderately resistant to stem and stripe rust. Moderately resistant–moderately susceptible to leaf rust. Moderately susceptible–susceptible to yellow leaf spot and moderately tolerant to root lesion nematode (*P. thornei*). Susceptible to crown rot and black point. Released in 2014. AGT.

LongReach Viking.Φ Australian Prime Hard quality in NSW. Tested as LPB08-0079. Mid-late maturity, similar to EGA_Gregory that suits early May plantings. Viking has a similar plant type and early growth habit to Chara, but is taller, being comparable in height to EGA_Gregory at maturity. Moderately resistant to stem rust and susceptible–very susceptible to leaf rust. Resistant–moderately resistant to stripe rust. Moderately susceptible–susceptible to yellow leaf spot and crown rot. Tolerance to root lesion nematode (*P. thornei*). Susceptible to Septoria tritici blotch. Release in 2014. Pacific Seeds.

Mitch.Φ Australian Hard quality in northern NSW and Australian Premium White in southern NSW. Tested as QT14381. Mid to late maturing variety, suited to late April early May sowing in northern NSW. Similar height to EGA_Gregory, but has improved straw strength. It is moderately resistant–moderately susceptible to stem and stripe rust. Susceptible–very susceptible to leaf rust . Moderately susceptible to yellow leaf spot, moderately tolerant–moderately intolerant to root lesion nematodes (*P. thornei*) and moderately susceptible to crown rot. It is moderately resistant to black point. Released in 2014. AGT.

Sunmate.Φ Australian Prime Hard quality in northern NSW and Australian Hard quality in southern NSW. Tested as SUN595I. An early maturing variety similar to Spitfire. Moderately resistant–moderately susceptible to stem and stripe rust, and moderately susceptible to leaf rust. Moderately susceptible–susceptible to yellow leaf spot and tolerant–moderately tolerant and moderately resistant to root lesion nematode (*P. thornei*). Moderately susceptible–susceptible to crown rot. Moderately tolerant–moderately intolerant of acid soils. Released in 2014. AGT.

Feed wheats

Amarok.Φ Winter wheat – see note page 32. Red grained feed wheat. Maturity between Brennan and Chara. Short straw with excellent standability. Moderately resistant–moderately susceptible to stripe rust. GrainSearch.

Brennan.Φ Winter wheat – see note page 32. Awnless. White grain feed wheat. Suitable for sowing after second week of February for grazing. Resistant–moderately resistant to stripe rust and moderately susceptible to stem rust. Seednet.

EGA_Stampede.Φ Early to mid-maturing, similar to Hartog. Resistant–moderately resistant to stem rust and moderately resistant to stripe rust. Intolerant–very intolerant of root lesion nematode (*P. thornei*). Moderately susceptible–susceptible to pre-harvest sprouting. Nuseed.

Mackellar.[ф] Awnless. Winter wheat – see note page 32. Red grained, dual-purpose feed wheat. Moderately resistant to stem and stripe rust, susceptible–very susceptible to leaf rust. Resistant–moderately resistant to Septoria tritici blotch. Tolerant to pre-harvest sprouting. Average coleoptile length. Resistant to *Barley yellow dwarf virus*. Seednet.

Manning.[ф] Winter wheat – see note page 32. White grained feed wheat. Long season dual purpose grazing and grain variety with a maturity similar to SQP Revenue. Resistance to *Barley yellow dwarf virus*. Resistant–moderately resistant to stripe and leaf rust, moderately resistant to moderately susceptible to stem rust. Bred by CSIRO and commercialised by GrainSearch.

Mansfield.[ф] White grained feed wheat, bred by Advantage Wheat. Tennant maturity, potential dual-purpose variety. GrainSearch.

Naparoo.[ф] Awnless. Winter wheat – see note page 32. Feed quality. Maturity similar to Marombi, slower than Whistler and EGA_Wedgetail. Medium height with good straw strength. Consistently produces higher levels of dry matter than Marombi, but lower grain recovery. Resistant–moderately resistant to stem rust and moderately resistant to stripe rust and susceptible to leaf rust. AGT.

Preston.[ф] Broadly adapted mid to long season variety. Has Australian Standard White quality grain but is only classified as feed because of late maturity alpha-amylase (LMA) expression. Susceptible–very susceptible to stem and leaf rust, susceptible to crown rot and moderately susceptible to common root rot. Resistant–moderately resistant to stripe rust. Moderately susceptible–susceptible to yellow leaf spot and Septoria tritici blotch. Exhibits some physiological flecking that does not affect yield. Seednet.

Rudd.[ф] Awnless. Winter wheat – see note page 32. Red grained feed wheat. Resistant to stripe rust and susceptible to stem rust. Suitable for sowing after the second week of February for early grazing opportunities. Seednet.

SQP Revenue.[ф] Awnless. Winter wheat – see note page 32. Red grained feed wheat. Resistant to the three rusts. Suitable for sowing late February–early March for early grazing opportunities. GrainSearch.

Tennant.[ф] Awnless. Winter wheat – see note page 32. Red grained, dual-purpose feed wheat. Tall with good straw strength. Resistant or susceptible to stem rust depending on pathotype present and resistant–moderately resistant to stripe rust. Moderately resistant to yellow leaf spot. Sown February to March for grazing. Seednet.

The following are more recently released varieties with limited data available in NSW.

B53. White grained early maturing feed wheat variety with a high yield performance and very wide adaptation. Plant height is 2 cm less than EGA_Gregory with strong straw. Does not fit conventional classification profiles but has high dough strength and excellent sponge & dough baking performance. It is being marketed as "Feed" class but with "Specialty End Use" potential under contract. Moderately resistant to stripe rust, moderately susceptible-susceptible to leaf rust and moderately susceptible to stem rust and crown rot. Moderately susceptible to Septoria tritici blotch. Intolerant to boron. Application for PBR on B53 is pending, and the variety will be commercialised in 2015 via the Elders network and other partners.

SF Adagio.[ф] Red feed grain quality awned winter wheat with potential for high yields. Medium to long season maturity suited high rainfall zones. Suitable for sowing late February to early March for early grazing. Commercialised by Seedforce.

SF Ovalo.[ф] An awnless, long growing season winter wheat with potential for high yields in the high rainfall zone. Commercialised by Seedforce

SF Scenario.[ф] Awnless Red winter wheat, feed grain quality, suited to the high rainfall zone. Suitable for sowing late February to early March for early grazing. Maturity similar to Frelon. Moderately resistant to stripe rust. Bred by RAGT, commercialised by Seedforce.

Note – Winter wheats

Winter wheats have the major advantage of adaptability to a wide range of sowing times. Winter habit delays maturity in early sowings, thus reducing the risk of frost damage. Maturity varies once cold requirement has been met. Winter wheats can be sown from February to early April for grazing depending on vernalisation (cold) requirement. See *Managing grazing cereals*, page 68.

Disease and crop injury guide – wheat

Disease/Cause	Symptoms	Occurrence	Survival/Spread	Control
Foliar Diseases				
Yellow leaf spot *Pyrenophora tritici-repentis*	Tan coloured leaf lesions with a yellow border. Lesions eventually join resulting in leaf death.	More severe in north and centre, associated with retained wheat stubble. Can develop in all crops late in season after above average rainfall. Common in the south early in the crop growth.	Spores from stubble, which are air-borne for a short distance. Other spores from infected leaves during season, which are air-borne for longer distances.	Stubble removal, crop rotation. Resistant varieties. Foliar fungicides.
Septoria tritici blotch *Mycosphaerella graminicola*	Leaf lesions with minute black spots, leaf death.	Once common in south, in early sown crops in wet springs; now rare. May occur in high rainfall regions.	Initially air-borne spores, then rain-splashed spores within crop.	Resistant varieties. Seed and foliar fungicides. Fungicide resistance has developed in Victoria and Tasmania with some fungicide less effective now.
Septoria nodorum blotch *Phaeosphaeria nodorum*	Leaf blotches with minute grey-brown spots, leaf death. Brown to grey darkening of glumes.	Uncommon. Develops late in season with above average mid–late spring rainfall and warm temperatures.	Initially air-borne spores, rain-splashed spores within crop.	None required at present.
Ring spot *Drechslera campanulata*	Small (1–4 mm) spots with light centres and dark brown rims.	Southern and central areas; favoured by prolonged wet periods in late winter–early spring.	Spores spread from previously infected grass seed.	Reduce grass weeds in previous season. Minor disease.
Physiological black chaff genetic disorder	Brown-purple-black discolouration of glumes, and sometimes stem, below the head.	Throughout the state. Develops in wet, humid springs.	This is a genetic disorder associated with the stem rust resistance gene Sr2 in some wheat varieties.	None. Is not a disease.
Stripe (yellow) rust *Puccinia striiformis* f.sp. *tritici*	Yellow powdery pustules, often in stripes on leaves.	Can develop from mid-autumn onwards; favoured by cool (8–15°C) moist weather.	Air-borne spores from living plants.	Resistant varieties; seed applied and foliar fungicides; control volunteer wheat over summer–autumn period.
Leaf rust *Puccinia triticina*	Small, orange-brown powdery pustules on leaf.	Can develop from early spring; favoured by mild (15– 22°C) moist weather.	Air-borne spores from living plants.	Resistant varieties, foliar fungicides; control volunteer wheat over summer–autumn period.
Stem rust *Puccinia graminis* f.sp. *tritici*	Red-brown, powdery, oblong pustules with tattered edges on leaf (both sides) and stem.	Can develop from mid-spring to end of season, more severe in north; favoured by warm (15–30°C) humid weather.	Air-borne spores from living plants.	Resistant varieties; foliar fungicides; control volunteer wheat and barley over summer–autumn period.
Powdery mildew *Blumeria graminis* f.sp. *tritici*	White to grey cottony fungal growth on leaf and leaf sheath; black resting bodies developing during the season.	More in irrigated crops, more in winter and early spring.	Spores blown from infected trash and infected plants.	Resistant varieties, fungicides. Note: fungicide resistance in barley powdery mildew has been recorded in Western Australia.
Virus Diseases				
Barley yellow dwarf *Barley yellow dwarf virus* (BYDV)	Yellowing, dwarfing of infected plants, reduced seed set.	Most common near perennial grass pastures and in early sown crops.	Transmitted by aphids from infected grasses and cereals.	Resistant/tolerant varieties. Seed treatments to control early aphids in crop. In-crop aphid control.
Wheat streak mosaic *Wheat streak mosaic virus* (WSMV)	Light green leaf streaks and blotches, stunting of plants, reduced seed set.	Has occurred in wheat in southern irrigation areas, and in early sown grazing wheat on the tablelands and slopes.	Transmitted by the wheat curl mite.	Generally no control required. In irrigation areas, spray out grasses in adjoining paddock 4 weeks before sowing wheat.
Root and Crown Rots				
Take-all *Gaeumannomyces graminis* var. *tritici*	Blackening of roots, stem bases and crown, stunting, 'whiteheads' and pinched grain.	More common in the centre and south, favoured by a wet winter and early spring, followed by dry weather.	Soil-borne on grass and cereal residues, mostly roots and crowns.	Crop rotation for one year free of hosts; seed and in-furrow fungicides.
Crown rot *Fusarium pseudograminearum*	Browning of stem bases, crown and sometimes roots, 'whiteheads', pinched grain.	More common in northern and western areas, favoured by moist early season and dry finish. Becoming common in the south.	Stubble-borne on grass and cereal residues.	Crop rotation, preferably for 18 months– 2 years; avoid highly-susceptible varieties; grass weed control; balance inputs to available soil water.
Common root rot *Bipolaris sorokiniana*	The root between the crown and seed (sub-crown internode) is always dark; roots and sometimes the stem base are brown; white heads, pinched grain.	Widespread through grain belt, often found in association with crown rot; scattered through the crop.	As spores in soil and on grass and cereal residues in soil.	Resistant varieties; crop rotation; optimise nutrition.

Disease and crop injury guide – wheat (continued)

Disease/Cause	Symptoms	Occurrence	Survival/Spread	Control
Root and Crown Rots (continued)				
Rhizoctonia bare patch *Rhizoctonia solani*	Patches of spindly stunted plants with yellow to red erect leaves; 'spear point' root rot; plant death. Later infection of crown roots just seen as wavy appearance across crop.	Associated with minimum or reduced tillage; often aggravated by Group B herbicides.	As fungal threads in soil; soil-borne on residues of many grass, cereal and broadleaf plants.	Crop rotation, soil disturbance to 5–10 cm below sowing depth at or within 2–4 weeks before sowing; avoid the build-up of Group B herbicides which may cause root pruning. Some seed treatments provide suppression only.
Eyespot *Tapesia yallundae*	Lodging, distinctive 'eyespot' with sharp bend in stem 3–5 cm above ground.	South and Central West Slopes, eastern Riverina; favoured by prolonged wet periods in late winter to mid spring.	Rain-splashed spores from crop or grass residue during winter.	Crop rotation (two-year break from cereals); fungicide at first node stage (Zadoks GS 31).
Root lesion nematode *Pratylenchus thornei* *Pratylenchus neglectus*	Lower leaves yellow, reduced tillering, general ill thrift, restricted root system.	*P. thornei* more common in north. Crops differentially host each species, e.g. canola hosts *P. neglectus* but not *P. thornei*. Lower soil fertility and delayed sowing can exacerbate impacts.	Survive within old roots or as dormant nematodes in the soil. Nematodes can be spread between paddocks and regions through the movement of soil on machinery or in flood water.	Crop rotation but note different crops, differentially host the two nematode species, tolerant or resistant varieties which again can differ for the two nematode species.
Smuts				
Flag smut *Urocystis agropyri*	Stunted plants with black, powdery streaks in leaves.	Most likely in early sown crops (sown in warm soil).	Soil and seed-borne spores.	Resistant varieties, seed-applied fungicide.
Loose smut *Ustilago tritici*	Black powdery heads on diseased plants.	Statewide.	Air-borne spores infect developing seeds at flowering.	Seed-applied fungicide.
Bunt *Tilletia laevis, T. tritici*	Seed contains a black, foul smelling mass of spores – affected grain is not accepted by buyers.	Now very rare, but present at low levels in many crops.	Spores on seed coat infect seedling before it emerges.	Seed-applied fungicide.
Grain Conditions				
Head blight *Fusarium graminearum*; other fungi	Dying portions of head; white or pink, pinched grain; orange spore masses on head.	In wet springs; more common in north. Durum wheat very susceptible. Overhead irrigation during flowering can provide conditions favourable for infection	Stubble-borne on wheat, maize, sorghum, other grasses; wind-borne and rain-splashed spores.	Crop rotation; avoid highly susceptible varieties especially durum; fungicides at flowering.
Black point genetic disorder	Dark coloured areas on grain, particularly at embryo end, reducing appearance of grain products.	Favoured by moist weather during late stages of grain filling and ripening.	This is a physiological condition affecting some varieties of bread wheat and durum.	Resistant varieties.
Frost Injury				
	1. Dark or split nodes, kinking of stem. 2. Whole or partial death of head. 3. Absence of seeds.	After severe frost at stem elongation. After frost during booting. After frost from heading to flowering.		Avoid early sowing of short season varieties. Avoid short sowing windows to spread risk.

'Herbicide injury' – Crops under climatic or disease stress can show symptoms of injury after they are sprayed with herbicide. Refer to NSW DPIs *Weed control in winter crops*.

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Handy hints

Grain	Typical values for key grain characteristics				
	Seeds/kg	Volumetric grain weight (kg/hL)	Bulk densities		Angle of repose°
			kg/m³	t/m³	
Barley	53,200	62	620	0.62	28
Canary seed	143,000	70	700	0.70	–
Canola	250,000	70	700	0.70	22
Cereal rye	40,000	71	710	0.71	26
Chickpea – desi	4,500	75	750	0.75	–
Chickpea – kabuli	2,100	75	750	0.75	–
Cowpea	5,000	76	760	0.76	–
Faba bean	2,000	75	750	0.75	–
Field pea	5,000	75	750	0.75	–
Grain sorghum	45,000	72	720	0.72	28
Linseed	150,000	73	730	0.73	20
Lupin – narrow-leaf	6,000	75	750	0.75	–
Lupin – albus	3,000	75	750	0.75	–
Maize	3,000	72	720	0.72	28
Millet	250,000	62	620	0.62	–
Mungbean	15,000	75	750	0.75	–
Navy bean	5,000	75	750	0.75	–
Oats	34,400	45	450	0.45	28
Pigeon pea	6,600	75	750	0.75	–
Rice – medium grain	35,700	56	560	0.56	31
Rice – long grain	40,000	56	560	0.56	31
Safflower	24,000	53	530	0.53	28
Soybean	5,500	75	750	0.75	27
Sunflower	17,300	40	400	0.40	30
Triticale	23,000	65	650	0.65	–
Vetch	14,000	75	750	0.75	–
Wheat	34,800	75	750	0.75	27

Note: Number of seeds/kg will vary according to variety and growing conditions. The bulk density and angle of repose varies according to variety, moisture content, quality and trash content of the grain.
To check grain bulk density weigh 1 L of grain. This weight in kilograms is its density in tonnes per cubic metre.
Acknowledgment: The information above was adapted from Agfact E3.9, *Storage capacity of circular silos and field bins*.

Durum

Durum wheat makes semolina upon milling which is used to make pasta, spaghetti and similar products.

Durum wheat produces high yields and often attracts a price premium, giving growers in Prime Hard wheat or similar areas a useful alternative to bread wheat production. Durum varieties should only be grown in high fertility soils where grain of 13% protein or above is consistently produced and preferably following a weed-free fallow, broadleaf or sorghum crop to minimise the risk of crown rot.

Varieties

See the *Variety characteristics and reaction to diseases* table on page 20 for additional information.

Caparoi.[Φ] ADR quality. A mid season maturity durum, with a maturity between EGA_Bellaroi and Jandaroi. Semi-dwarf durum variety with excellent yield potential. Grain quality better than Wollaroi, similar to Jandaroi and EGA_Bellaroi. Caparoi has improved dough strength compared to EGA_Bellaroi but is inferior to Jandaroi for this trait. Caparoi is superior to both Jandaroi and EGA_Bellaroi for semolina yellowness. Moderately resistant to stem rust, moderately resistant–moderately susceptible to leaf rust and moderately resistant to stripe rust. Moderately resistant–moderately susceptible to yellow leaf spot and moderately susceptible to root lesion nematode (*P. thornei*). Very susceptible to crown rot. Adequate resistance to common root rot. Good shedding resistance. Seednet.

EGA_Bellaroi.[Φ] ADR quality. A mid season maturity durum variety. Grain yield typically better than Yallaroi and Wollaroi, but inferior to the newer released varieties. Grain protein is consistently higher than other current commercial varieties. EGA_Bellaroi makes good quality pasta. Moderately resistant to stem and stripe rust. Moderately resistant–moderately susceptible to leaf rust and yellow leaf spot, moderately resistant to common root rot. Very susceptible to crown rot. May lodge under high yielding conditions, but is still the best variety for irrigated production in southern NSW. Seednet/Heritage Seeds.

Hyperno.[Φ] ADR quality for northern NSW. A mid season maturity durum with excellent yield potential. Maturity similar to EGA_Bellaroi. Resistant to stem rust and resistant–moderately resistant to leaf rust. Moderately resistant to stripe rust. Moderately susceptible to yellow leaf spot and susceptible–very susceptible to crown rot. Good level of sprouting and black point tolerance. Can produce higher screenings than other durum varieties in some circumstances. May lodge under irrigation or high yielding conditions. AGT.

Suggested sowing times – Aim to sow crops in the earlier part of the optimum period.
The actual date is influenced by location, soil fertility and the likelihood of frost at flowering in a particular paddock.

Variety / Weeks	March				April				May				June				July		
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
Northern Slopes																			
Caparoi, EGA_Bellaroi, Hyperno, Wollaroi										>	★	★	★	★	★	<			
Jandaroi											>	★	★	★	★	★	<		
Northern Plains (Moree, Narrabri)																			
Caparoi, EGA_Bellaroi, Hyperno, Wollaroi											>	★	★	★	★	★	<		
Jandaroi												>	★	★	★	★	<		
Northern Plains (Liverpool Plains)																			
Caparoi, EGA_Bellaroi, Hyperno, Wollaroi												>	★	★	★	★	★	<	
Jandaroi													>	★	★	★	★	<	
South Western Plains (Griffith, Hillston)																			
Caparoi, EGA_Bellaroi, Hyperno										>	★	★	<						
Jandaroi											>	★	★	<					

> Earlier than ideal, but acceptable. ★ Optimum sowing time. < Later than ideal, but acceptable.

Durum – Northern region – compared with Caparoi = 100%

Variety	East % Caparoi = 3.51 t/ha	Trial Number	West % Caparoi = 2.84 t/ha	Trial Number
Caparoi	100	15	100	16
EGA_Bellaroi	92	15	88	16
Hyperno	107	15	111	16
Jandaroi	95	15	93	16
Wollaroi	99	5	95	7

Durum: Consider Caparoi, EGA_Bellaroi, Hyperno and Jandaroi. Yield results are a combined across sites analysis of NVT yield trials from 2010–2014.

Durum – Southern region – compared with Caparoi = 100%

Variety	West[#] % Caparoi = 4.43 t/ha	TrialNumber
Caparoi	100	9
EGA_Bellaroi	94	9
Hyperno	104	9
Jandaroi	91	9
Wollaroi	97	3

[#] Includes irrigated and dryland variety trials.
Durum: Consider EGA_Bellaroi and Caparoi.

Jandaroi.[Φ] ADR quality for northern NSW. Quick maturity durum adapted to most durum producing regions and is suited to sowing later in the season. Grain quality is similar to EGA_Bellaroi and superior to Wollaroi but with much stronger dough properties. Erect, semi-dwarf plant type. Very prone to lodging under high yield conditions in southern NSW. Rated moderately resistant to leaf rust, resistant to moderately resistant to stem rust, moderately resistant to stripe rust, moderately susceptible to yellow leaf spot, moderately susceptible–susceptible to root lesion nematode and moderately resistant to black point, very susceptible to crown rot. Seednet.

Crop management

Seed. Use sound, true to type seed which is free of weed seeds, cracked grain, bread wheat and barley. Durum seed is significantly larger than bread wheat seed. Thousand grain weight should be determined and used to calculate a sowing rate, based on target plant population. Target plant populations are similar to bread wheats (see page 8). Germination percentage should exceed 90%.

Sowing time. Best yields are obtained from mid May to end of June sowings, depending on variety. Frost may damage earlier sowings. Later sowings into July usually yield less.

Sowing. Adjustments may be necessary for the larger seed size. A higher or lower sowing rate may be beneficial in some situations. Increase the sowing rate if using seed with a reduced germination percentage, or sowing later into cold conditions or higher yield potential situations. Short coleoptile length should be considered when moisture seeking.

Nutrition. A balance of nutrients is essential for profitable yields. Fertiliser is commonly needed to add the essential nutrients nitrogen and phosphorus. Other essential plant nutrients (e.g. sulfur and zinc) may also limit production in some situations. Soil test and consider paddock history to determine nutritional requirements. Complete a nitrogen budget to ensure protein levels above 13% are achieved.

Zinc sensitivity. Crops usually tolerate low zinc (Zn) levels when grown on heavy self-mulching black earths (pH_{Ca} 8–8.5). When grown in very wet, high phosphate soils for several weeks, zinc deficiency symptoms may appear.

If the soil is known to be low in zinc (soil and plant tissue tests are available), a 1% aqueous solution of zinc sulfate heptahydrate applied as a foliar spray 2–4 weeks after sowing ameliorates the deficiency. A range of zinc fortified starter fertilisers are also available.

Diseases. Durums generally have useful levels of resistance to all pathotypes (including the new virulent strains) of the three rusts but are very susceptible to crown rot. Durums are also susceptible to Fusarium head blight which is common in very wet seasons and in areas where durum is grown in close proximity to maize stubble. This disease is not commonly observed under irrigation in southern NSW when grown in rotation with maize, however growers must be aware of the risks. Rotations and paddock selection are therefore important. Avoid wheat on wheat/barley situations, due to the high crown rot risk and low nutrition. Nutrient management also needs to be considered if following cotton, as incorporated cotton trash ties up and immobilises a large amount of nutrient. Ensure good grass weed control as many grass species may also host crown rot. Current varieties have useful tolerance to yellow leaf spot.

Weed control. Crops with good even plant stands usually compete well with weeds, but strong weed competition reduces yield.

Herbicide sensitivity trials suggest durum varieties can be sensitive to various Group B herbicides. Growers are advised to read product labels and refer to the *Weed control in winter crops* for the latest information on variety tolerances. Consider plant-back periods for rotations when using residual products. For additional information, check the reaction of varieties to herbicides on the relevant herbicide labels.

Harvesting. Concave adjustments may be necessary as durum may be slightly more difficult to thresh than most bread wheats. Take care when adjusting headers, because durum grain has a greater tendency to fracture than bread wheat grain.

Crops should be harvested as soon as the grain is ripe, to avoid wether damage and black point development. Buyers consider grain appearance important and pay premiums for large, well-filled vitreous grain with a low percentage of mottled and bleached grains. Header cleaning is also critical to prevent contamination with barley or other cereals.

Grain storage and disposal. Durum must be strictly segregated so clean on-farm storage is necessary if immediate delivery to buyer storage cannot be arranged. Check with end users or consult insecticide labels before applying any insecticide for grain insect management to durum in storage.

Durum Wheat Growers Association. Growers are advised to join this association as the group provides a forum for growers and industry to exchange information such as variety performance, prevailing prices, market supply and demand. Refer to *Industry information*, page 59.

Further reading

Durum wheat production, John Kneipp, NSW DPI can be found on the NSW DPI website **www.dpi.nsw.gov.au**

Agronomy of the durum wheats Kamilaroi, Yallaroi, Wollaroi and EGA_Bellaroi can be found on the NSW DPI website www.dpi.nsw.gov.au

Durum wheat chemistry and technology, 2nd edition. M. Sissons, J. Abecassis, B. Marchylo and M. Carcea Eds. AACC International Press. 2012.

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Barley

Paddock selection and nitrogen management are often the keys to producing malting quality.

Sowing time

Sowing time determines the time a crop matures, and ideally flowering and grain fill should be in the cooler part of spring.

Sowing on time maximises the chances of achieving high yields and malting grade. Sowing after mid June usually limits yield potential and results in smaller grain and higher protein, rendering the grain less likely to be accepted as malting.

Nutrition

Soil fertility and fertiliser management, with attention to nitrogen and phosphorus, is essential to optimise yield.

Grain protein below 10.5% in combination with low yields usually indicates nitrogen deficiency. Where the level of protein is consistently less than 10%, at least 50 kg/ha of nitrogen can normally be applied at sowing or up to the 5-leaf stage to increase yields whilst maintaining malting quality. High fertility paddocks usually produce grain protein too high for malting grade. High rates of nitrogen can optimise feed grain yields.

Sowing depth

Pay close attention to sowing depth, particularly where direct-drilling is practised and for varieties with a short coleoptile. The ideal depth is 3–6 cm, but seed should always be sown into moist soil. If dry sowing is being considered target a sowing depth of 3–4 cm, particularly on a hardsetting or slumping soil to avoid problems with crop emergence.

Irrigation

Barley does not tolerate waterlogging, so good paddock drainage and management are essential for high grain yields.

Seeding rates

Select seed carefully for large size and high germination percentage. A germination test can be conducted if in doubt. The formula for calculating cereal seeding rate is located on page 8.

A suggested guide per hectare is:

- plains: 35–50 kg
- slopes: 45–60 kg
- tablelands and partial irrigation: 60–90 kg
- full irrigation: 70–110 kg
- grazing and grain: increase the above rates by 10–20 kg
- cover crops for pastures: 10–20 kg.

The lower rates should be used when there is limited subsoil moisture at sowing, and in drier areas. High seeding rates tend to decrease grain size and increase screenings.

Acid soils tolerance

Yambla and Tulla are tolerant of high soil aluminium and can tolerate levels up to 10–15%. Most varieties are very tolerant of high manganese levels.

Variety choice

When selecting a variety consider:

- Crop use. For grazing and grain recovery, feed grain, or malt grain production?
- Grazing value. When is feed most important? Dual-purpose varieties are most suitable.
- Grain.
  - For retention on farm?
  - For sale as feed grain?
  - For sale as human food?
  - For sale as a malting or food grade – for general delivery to malt segregations or under contract? Use only accredited malting or food grade varieties.
- Disease prevalence. Check variety response to common diseases in the area, see *Variety characteristics and reaction to diseases* table page 44.
- Herbicide tolerance.

See variety details under *Varietal Characteristics* (page 39).

Management to achieve malting barley

Paddock selection

- nitrogen status appropriate for expected yield
- soil pH_{Ca} not less than 5.0 or soil aluminium not more than 5%
- avoid soils prone to waterlogging
- rotation: ideally sow after a root disease break crop
- avoid barley on barley. Barley may be sown after wheat if disease or seed contamination is not a problem.
- avoid varietal contamination

Variety choice

- appropriate for the environment
- to suit the sowing time
- availability of segregation

Sowing time

- too early increases the risk of frost damage
- too late will increase protein and screenings

Seeding rate

- too high may reduce grain size and increase lodging especially under irrigation
- too low will reduce yield potential

Seed treatment

- use appropriate seed dressings to control smuts and foliar diseases
- note the effect of seed treatments on short to medium coleoptile length varieties, particularly in deep sown situations.

Phosphorus

- too low will limit yield and increase protein

Nitrogen

- too low will reduce yield and quality
- excessive nitrogen fertiliser can increase screenings and protein levels

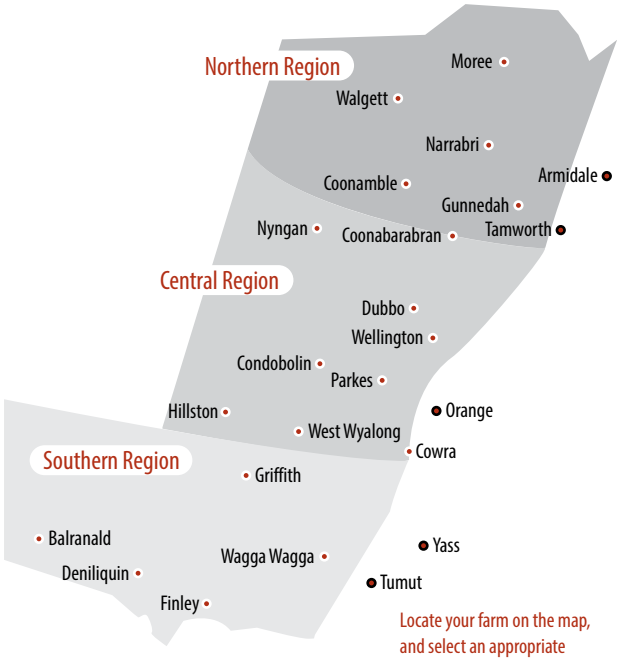
Timely weed control

- weeds compete for nutrients and moisture
- reduce contamination

Care with harvest

- avoid 'skinning'
- try to minimise weather damage effects
- avoid varietal contamination
- only use grain protectants registered for malting barley.

Variety selection



Locate your farm on the map, and select an appropriate variety from the following tables after consulting the Varietal characteristics section.

Varietal characteristics

The following is a list of barley varieties, including new releases for 2015.

Information has been collated from breeding companies. Refer to tables for suggested sowing times.

BARLEYmax. Specialty barley for the human food market. Early-mid season maturity. Dark coloured, semi hulless seed with a shrunken endosperm. Susceptible to powdery mildew and spot form of net blotch. Marketed by Austgrains Pty Ltd.

Baudin.(ф) Malt. Excellent malting quality. A Gairdner replacement with earlier maturity (rated mid season) and lower screenings. Adapted to medium rainfall areas. Short with excellent straw strength and head retention. Very susceptible to powdery mildew and susceptible–very susceptible to leaf rust. Released by the Department of Agriculture and Food WA (DAFWA) in 2002. Seednet.

Binalong. Feed. Good straw strength and high yield potential in the north. Medium–slow maturity. Moderate grain size. Variable response to powdery mildew. Very susceptible to net form of net blotch and susceptible–very susceptible to leaf scald. Moderately susceptible to the spot form of net blotch and susceptible–very susceptible to leaf rust. Bred by NSW DPI. Heritage Seeds.

Buloke.(ф) Malt. Excellent malting quality for the export market. Tall, early to mid season variety, with a flowering time similar to Schooner. Good levels of resistance to net form of net blotch and powdery mildew, susceptible to cereal cyst nematode, susceptible–very susceptible to leaf scald and susceptible to leaf rust. Buloke has a better grain size than Gairdner but smaller than the benchmark variety Schooner. Buloke exhibits sprouting tolerance, similar to Gairdner. May lodge under conditions favouring high yield and is susceptible to head loss. Bred by VIC DEPI. Seednet.

Capstan.(ф) Feed. Very short, cereal cyst nematode resistant variety with outstanding straw strength and head retention. Best suited to high input farming systems targeting very high yield. Offers advantages in stubble management. Modest early vigour and potential for low test weights under drought stress should preclude it from drier districts. Bred by the University of Adelaide. Seednet.

Yield performance experiments from 2005–2014

Yield results are combined across sites analysis of NVT yield trials from 2005–2014. The number of experiment results is listed. The more trials, the greater the reliability.

Main season sown: Compared with Hindmarsh = 100%

Variety	North-east Hindmarsh = 3.78 t/ha	Trial Number	North-west Hindmarsh = 3.59 t/ha	Trial Number
Alestar	96	12	100	8
Bass ◆	91	27	94	30
Baudin ◆	85	14	90	20
Buloke ◆	93	21	96	30
Capstan	95	22	99	10
Charger	99	9	–	–
Commander ◆	103	31	105	43
Compass	104	9	106	10
Fairview ◆	99	6	–	–
Fathom	106	15	109	20
Finniss	85	22	90	6
Fitzroy ◆	94	31	97	43
Flagship ◆	92	19	94	28
Fleet	100	22	105	33
Flinders	92	15	95	20
Gairdner ◆	84	30	88	43
GrangeR ◆	100	15	101	15
Grimmett ◆	87	31	87	43
Grout	99	31	98	43
Hindmarsh	100	28	100	38
LaTrobe	100	12	101	15
Mackay	95	27	95	43
Maltstar	93	12	97	13
Navigator ◆	91	20	–	–
Oxford	97	19	100	25
Schooner ◆	87	23	89	38
Scope CL ◆	90	19	93	25
Shepherd	98	26	100	34
Skipper	101	16	103	20
SY Rattler	95	15	93	5
Urambie	91	27	95	34
Westminster ◆	91	22	95	3
Wimmera ◆	97	18	96	20

Note: ◆Accredited malt varieties.
For grazing consider Yambla and Urambie.
For grazing and grain recovery consider Urambie.
For malting production, consider Buloke, Commander, Gairdner and Scope CL.
In more reliable rainfall regions also consider GrangeR and Navigator.
For food grade production, consider Hindmarsh.
For feed grain production, consider Compass, Grout, LaTrobe, Mackay, Oxford and Shepherd.

Variety	South-east Hindmarsh = 4.15 t/ha	Trial Number	South-west Hindmarsh = 3.70 t/ha	Trial Number
Alestar	99	8	92	12
Bass ◆	94	14	91	27
Baudin ◆	90	13	84	26
Buloke ◆	96	16	91	31
Capstan	98	7	–	–
Charger	104	10	–	–
Commander ◆	100	16	92	31
Compass	107	6	101	12
Fairview ◆	96	8	90	4
Fathom	101	10	97	20
Finniss	80	10	79	4
Fitzroy ◆	99	3	93	8
Flagship ◆	88	10	85	19
Fleet	101	16	93	31
Flinders	93	10	90	20
Gairdner ◆	91	16	84	31
GrangeR ◆	98	10	92	16
Hindmarsh	100	15	100	27
LaTrobe	102	8	100	16
Maltstar	99	8	91	12
Oxford	98	13	89	22
Schooner ◆	84	16	83	31
Scope CL ◆	95	12	90	22
Shepherd	96	11	90	22
Skipper	98	10	95	18
SY Rattler	96	12	–	–
Tulla	90	7	85	15
Urambie	96	16	90	27
Westminster ◆	92	12	–	–
Wimmera ◆	95	13	–	–

Note: ◆Accredited malt varieties.
Yambla and Urambie can be sown from mid–late March if grazed.
For grazing and grain recovery consider Urambie.
For malting production, consider Buloke, Commander, Gairdner and Scope CL.
In more reliable rainfall regions also consider GrangeR.
For food grade production, consider Hindmarsh.
For feed grain production, consider Compass, LaTrobe, Oxford and Urambie. In western areas, consider Fathom and Tilga.

Suggested sowing times

Aim to sow in the earlier part of the indicated optimum time to achieve maximum potential yield, particularly in western parts of the region.
Selection of the actual date should allow for soil fertility and the risk of frost damage in particular paddocks.

Variety / Weeks	March				April				May				June				July		
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
Northern Region																			
Urambie ■, Yambla ■		>	★	★	★	★	★	★	★	★	<								
Binalong, Capstan, Fairview ▲, Gairdner, GrangeR , Navigator , Oxford, Westminster ▲, Wimmera ▲							>	★	★	★	★	<							
Bass ▲, Baudin, Yarra								>	★	★	★	★	★	<					
Buloke, Commander, Compass ▲, Fitzroy, Flagship, Fleet, Grimmett, Hindmarsh, LaTrobe ▲, Mackay, Scope CL									>	★	★	★	★	★	<				
Fathom ▲, Grout, Shepherd,									>	>	★	★	★	★	★	<	<		
Central Region																			
Urambie ■, Yambla ■		>	★	★	★	★	★	★	★	★	★	<							
Bass ▲, Capstan, Fairview ▲, Gairdner, Oxford, Westminster ▲, Wimmera ▲							>	★	★	★	★	<							
Baudin, GrangeR , SY Rattler ▲								>	★	★	★	★	<	<					
Buloke, Commander, Compass ▲, Fitzroy, Flagship, Fleet, Mackay, Schooner, Scope CL, Tilga, Tulla									>	★	★	★	★	<	<				
Fathom ▲, Grout, LaTobe ▲, Hindmarsh, Shepherd, Skipper										>	★	★	★	★	<	<			
Southern Region																			
Urambie ■, Yambla ■		>	★	★	★	★	★	★	★	★	<								
Admiral ▲, Bass ▲, Baudin, Capstan, Charger ▲, Fairview ▲, Flinders ▲, Gairdner, GrangeR , Oxford, SY Rattler ▲, Westminster ▲, Wimmera ▲							>	>	★	★	★	★	★	★	<	<			
Fitzroy, Tilga, Tulla									>	>	★	★	★	★	★	★	<	<	
Buloke, Commander, Compass ▲, Fathom ▲, Flagship, Fleet, Hindmarsh, LaTrobe ▲, Schooner, Scope CL, Shepherd, Skipper, SouthernStar ▲										>	★	★	★	★	★	★	★	<	<

> Earlier than ideal, but acceptable. ★ Optimum sowing time. < Later than ideal, but acceptable.
■ Dual purpose varieties that can be grazed. Yambla and Urambie can be sown from mid–late March, if grazed. ▲ Limited information available on performance in NSW.

Commander.[Φ] Malt. Malting quality variety suitable for the domestic and Asian export markets. Mid season variety, with a maturity between Schooner and Gairdner. Plump grain size compared to other malting varieties. High yield potential and lower grain protein than Schooner and Gairdner when grown under the same conditions. Cereal cyst nematode resistant but very susceptible to leaf scald and moderately susceptible–susceptible to leaf rust. Moderately susceptible–susceptible to net blotches. May lodge when sown early. Developed by the University of Adelaide. Seednet.

Fairview.[Φ] Malt. A mid to late season variety available only under contract to Malteurop. Better straw strength and grain size than Gairdner. Has performed particularly well under irrigation. Fairview has an export malt quality profile and must be marketed through Malteurop.

Fathom.[Φ] Feed. Fathom is a feed quality variety developed using wild barley to improve stress tolerance and water use efficiency. It has a long coleoptile and good early vigour. Early maturity, similar to Hindmarsh, best suited to lower and medium rainfall environments. Fathom is a moderately tall variety but shows good straw strength and has excellent grain plumpness with screenings levels lower than both Fleet and Hindmarsh. Developed by the University of Adelaide. Seednet.

Finniss.[Φ] A hulless barley targeted for use in the intensive livestock and niche human food markets. Semi-dwarf type with a mid-maturity similar to Schooner. Good straw strength and head retention. Improved yield and agronomic traits over older hulless barley varieties. Released by the University of Adelaide. Seednet.

Fitzroy.[Φ] Malt. Medium to medium–late maturing variety with improved disease resistance over Gairdner and acceptable grain size. Fitzroy is a semi-dwarf plant with good seedling vigour and good straw strength. Best suited to northern NSW and Queensland barley growing areas. Best results will be achieved in more favourable environments. Can exhibit low test weights under stressed conditions. Seednet.

Flagship.[Φ] Malt. Good malting qualities, particularly for SE Asian markets. Tall, early–mid season maturity variety, similar in plant type to Schooner. Excellent early vigour and weed competitiveness, but modest straw strength with lodging resistance similar to Schooner. Resistance to cereal cyst nematode. Prone to pre-harvest weather damage. Heritage Seeds.

Gairdner.[Φ] Malt. Adapted to medium to higher rainfall areas (>400 mm). Mid to late season maturity and strong straw. Best sown early. Gairdner has a thin grain, producing significantly greater screenings losses relative to Schooner and is also around 1% lower in grain protein. Resistant to BYDV. Susceptible to the spot form of net blotch and susceptible to cereal cyst nematode. Developed by DAFWA. Heritage Seeds.

GrangeR. Malt. Medium-late, high-yielding, broadly adapted barley with excellent malt extract, good diastatic power, and targeted for the domestic malting industry as a potential Gairdner replacement. Performs better than Oxford under late planting conditions. GrangeR is on average 10 cm taller than Baudin and 3–4 cm taller than Gairdner, but with better lodging resistance; higher test weight; a potentially larger kernel size (2–4 grams/1000 grains); and lower screenings. Resistant to powdery mildew and moderately resistant to leaf rust. Variable reaction to net form of net blotch depending on pathotype present and susceptible–very susceptible to spot form of net blotch and barley scald depending on region. Licensed to Heritage Seeds by Nickerson–Limagrain, UK.

Grimmett. Malt. Reliable malting variety for the northern region. Suitable for mid season and late plantings, particularly in western areas. Very good grain size. Consider seed treatment for net blotch and powdery mildew.

Grout.[Φ] Feed. Quick maturing variety with good grain size, suited to northern NSW and Qld. Matures up to two weeks earlier than Grimmett from a mid-May to mid-June plant. Vigorous seedling with a high tillering ability and erect growth habit. Medium height with moderate standability, better than Grimmett and similar to Mackay. Grout has variable resistance to powdery mildew depending on pathotype. Leaf rust needs to be managed, rated as susceptible–very susceptible. Seednet.

Hindmarsh.[Φ] Food. Erect, semi-dwarf variety, which flowers earlier than Schooner, and is widely adapted to low and medium rainfall areas. Excellent yield potential, grain plumpness close to Schooner, and high test weight. It has resistance to cereal cyst nematode, moderately resistant to moderately susceptible to net form of net blotch but is susceptible–very susceptible to the spot form of net blotch and susceptible to leaf rust. Very susceptible to the main pathotype of leaf scald in NSW. Short coleoptile, so deep sowing should be avoided. It has been given a new classification of 'food', and may be segregated for human food and possibly used for Shochu (Japanese distilled spirit) and for malt production in some markets. Developed by Vic DEPI. Seednet.

LaTrobe.[Φ] LaTrobe is an early maturing semi-dwarf variety with good yield potential in low to medium production environments. It has very similar growth habit and plant architecture to Hindmarsh. It has excellent head retention, lodging resistance and good physical grain characteristics. Similar disease profile to Hindmarsh but depending on rust strain may be more susceptible to leaf rust. LaTrobe also possesses good pre-harvest sprouting tolerance. Currently undergoing malt accreditation, with accreditation expected in March 2015. InterGrain.

Mackay.[Φ] Feed. Mid season variety with good resistance to lodging. Large grain size. Adequate resistance to leaf rust and powdery mildew. Variable response to net form of net blotch, dependent on the pathotype present. Susceptible to spot form of net blotch. Partial resistance to common root rot. Bred by DAFF Qld. Heritage Seeds.

Navigator.[Φ] Malt. Navigator is a semi-dwarf variety suited to the domestic malt market. Navigator is similar in maturity to Gairdner but offers shorter straw, better physical grain quality and higher yield. Navigator barley is recommended for medium to high rainfall areas. Good resistance to lodging but is very susceptible to leaf rust. Bred by the University of Adelaide. Seednet.

Oxford. Feed. A medium to late maturing variety similar to Gairdner. High yield potential, with wide adaptation. Excellent head retention with above average test weight and excellent grain colour. Good straw strength and resistance to lodging. Resistant to powdery mildew

and moderately resistant to leaf rust. Moderately susceptible–susceptible to net form of net blotch and susceptible to spot form of net blotch. Heritage Seeds.

Schooner. Malt. Formerly a major central and southern malting variety, favoured for its reliability in maintaining grain size, although lower yielding than later releases. Can be prone to pre-harvest headloss. Susceptible–very susceptible to leaf rust and powdery mildew. Showing increasing susceptibility to scald.

Scope CL.(Φ) Malt. Imidazolinone tolerant barley, which provides tolerance to label rates of Intervix® herbicide. Check current herbicide registrations for registered product rates. Tall, early–mid season variety, with a flowering time and headloss susceptibility similar to Buloke. Resistant to powdery mildew and moderately resistant to net form of net blotch but susceptible to cereal cyst nematode. Developed by Agriculture Victoria Services and Seednet.

Shepherd.(Φ) Feed. Slightly later maturing than Grout, but similar in growth habit with erect vigorous early growth. Suited to medium rainfall areas of northern NSW and Qld. Moderately resistant–moderately susceptible to leaf rust and moderately susceptible–susceptible to powdery mildew. Has a variable response to net form of net blotch, dependent on the pathotype present. Susceptible–very susceptible to spot form of net blotch. Seednet.

SY Rattler.(Φ) SY Rattler is a high yielding mid maturity potential malting barley with medium height and stiff straw. It exhibits good resistance to powdery mildew and leaf rust. SY Rattler has all the necessary quality for the domestic brewing markets coupled with excellent grain quality. Undergoing malt evaluation by Barley Australia. SY Rattler was bred by Syngenta and seed is available through GrainSearch.

Tilga. Feed variety suited to western areas. Tall with moderate straw strength in high yielding situations. Good grain size. Tilga has some light blue aleurone (skin) grain. Suscept. ible to loose smut – use a seed dressing.

Tulla.(Φ) Feed. Main season variety. Acid soil tolerant. Similar yields to Tantangara on non-acid soils. Bred by NSW DPI. Waratah Seeds.

Urambie.(Φ) Feed. Best suited to grain and grazing situations. Two row barley, adapted to early sowing, having early maturity combined with a cold requirement for initiation of heading. Sowing window is early May to mid-June, earlier if grazed. Consistent yields across seasons, but low grain quality. Waratah Seeds.

Westminster.(Φ) Malt. A medium to late maturity variety similar to Gairdner, Westminster has a high yield potential and performs well under high rainfall or irrigation. Medium–tall variety with good straw strength and improved head retention compared to Gairdner. Moderately resistant to leaf rust, resistant to powdery mildew. Variable reaction to net form of net blotch and susceptible to spot form of net blotch. Introduced malt barley from Nickerson International Research, licensed to GrainSearch in Australia.

The following are more recently named or released varieties. Only limited seed may be available of some lines in 2015.

Admiral.(Φ) Malt. Limited information on the performance of Admiral in NSW. A new malting barley developed by Joe White Maltings and the University of Adelaide. Admiral is a semi-dwarf variety with good straw strength and maturity similar to Gairdner, so is best suited to high yield potential environments and early sowing. Admiral can be grown under contract production to Joe White Maltings, Barrett Burston Maltings or Malteurop.

Alestar. (SMBA11-2341) A high yielding line which is six days earlier in maturity than Oxford. The NVT long term yield performance in NSW is similar to GrangeR, with excellent lodging resistance and high grain retention. Alestar carries the mlo-11 gene and is resistant to powdery mildew. Resistant to leaf rust, moderately resistant–moderately susceptible to the spot form of net blotch and moderately resistant to scald. At similar grain nitrogen levels Alestar has a higher malt extract and higher fermentability than Gairdner. It is currently under commercial seed increase, and is being marketed initially as a feed variety prior to malt accreditation. Alastar was licensed and developed by Elders from a Nickerson-Limagrain line, released 2014. Elders.

Bass.(Φ) Malt. Baudin replacement with excellent grain plumpness and high test weight, suited to medium to higher rainfall districts. Similar maturity to Baudin. Moderately short variety with good straw strength and head retention. Improved disease resistance compared to Baudin. Undergoing market development. InterGrain.

Charger.(Φ) A new malting barley developed by Carlsberg and Heineken Breweries in collaboration with the University of Adelaide. Mid maturing with good straw strength and resistance to leaf rust and powdery mildew but is susceptible to very susceptible to net form and spot form of net blotch and very susceptible leaf scald. Charger has shown consistently high grain yield, particularly in favourable environments. Contract production is being managed by Australian Grain Growers Cooperative.

Compass.(Φ) Potential new malt barley, currently undergoing malt accreditation. High yield potential in all regions of NSW with benchmark grain plumpness. Mid to early maturity, earlier than Commander but later than Hindmarsh. Similar in plant architecture to Commander, but with improved straw strength and lodging resistance. More susceptible to leaf scald than Commander, but improved net blotch resistance. Powdery mildew resistance is variable depending on pathotype present. Leaf rust resistance is variable, rated susceptible in northern NSW. Bred by the University of Adelaide, marketed by Seednet.

Flinders.(Φ) Flinders is a medium to late maturing high yielding barley variety, potentially offering yields greater than Baudin and Gairdner. It offers a useful disease resistance package, in particular resistance to powdery mildew. Susceptible to leaf rust, susceptible–very susceptible to scald, moderately resistant–moderately susceptible to spot form of net blotch and susceptible to net form of net blotch. Flinders is currently undergoing malt accreditation. InterGrain.

Maltstar. (SMBA11-1771) A high yielding, medium–late barley (3 days earlier than Oxford). It is resistant to powdery mildew (carries the mlo11 gene) and resistant to moderately resistant for leaf rust (carries the Rph3 and RphDash genes). It is susceptible to the spot form of net blotch, moderately susceptible to the net form of net blotch and moderately resistant–moderately susceptible to scald. Maltstar has shown excellent test

Variety characteristics and reaction to diseases

Variety	Straw strength	Leaf scald	Net Blotch Net form	Net Blotch Spot form	Powdery mildew	Leaf rust	BGYR (Stripe) rust	Crown rot	Common root rot	Cereal cyst nematode Resistance	RLN *P. thornei* Resistance	RLN *P. thornei* Tolerance	RLN *P. neglectus* Resistance	*RLN P. neglectus* Tolerance	Issued by	Year registered
Admiral	very good	S–VS	MS–S	S	MR & S–VS	MS	R	–	–	R	–	–	–	–	Joe White Malting/ University of Adelaide	2014
Bass◆	good	S–VS	S	S	S–VS	MS–S	MR	S	MS	S	MR	MT[p]	MR–MS	MI–I[p]	InterGrain	2012
Baudin◆	good	S–VS	MS	MS–S	VS	S–VS	MR	–	S	S	–	–	MR	–	DAFWA	2002
Binalong	good	S–VS	VS	MS	R & S	S–VS	–	MS	MR	S	–	I[p]	MR–MS[p]	–	NSW DPI/DAFF Qld	2002
Buloke◆	medium	S–VS	MR–MS	S	MR	S	MR	S–VS[p]	MS	S	MR–MS	–	MR–MS[p]	–	DELWP Victoria	2004
Capstan	very good	S–VS	MS–S	MR–MS	S	S	MR–MS	–	S–VS	R	–	–	–	–	University of Adelaide	2002
Charger	good	VS	S–VS	S–VS	R	MR	R	S[p]	MS	R	MR–MS	MT[p]	MR	MT–MI[p]	Carlsberg & University of Adelaide	2013
Commander◆	medium	VS	MS–S	MS–S	MR & S[p]	MS–S	R–MR	MS–S	MS	R	MR–MS	MT	MR–MS	T–MT[p]	University of Adelaide	2008
Compass	medium	S–VS	MR–MS	MS–S	MR & S[p]	MR–MS	R–MR	S	MS	R	MR	T[p]	MR	T[p]	University of Adelaide	2013
Fairview◆	very good	VS	S	S	R	MR & S	R–MR	–	–	–	–	–	–	–	Malteurop	2008
Fathom	good	MR	MS	MR	MS	MS–S	MR	MS–S	S	R	MR–MS	–	MR–MS	–	University of Adelaide	2012
Fitzroy◆	good	S–VS	MR–MS	MS–S	S–VS	MS	MR–MS	S[p]	–	S	MS–S	MT–MI	MS–S	I[p]	DELWP Victoria	2004
Flagship◆	medium	S–VS	MR–MS	MR–MS	S	MS–S	MR	–	S	R	MR–MS	MT[p]	MR–MS	–	University of Adelaide	2006
Fleet	medium	S–VS	MR–MS & S	MR	MR	MS–S	MR	MS–S	MS–S	R	MR–MS	MT–MI[p]	MR–MS	MT[p]	University of Adelaide	2006
Flinders	good	S–VS	MR–MS	S	R	S	MR	S–VS	MS	MR–MS	MR	–	MR–MS	–	InterGrain	2014
Gairdner◆	medium–good	S–VS	MR–MS	S	S	S	MR	S	MS–S	S	MS	I–VI	MR–MS	MI[p]	DAFWA	1998
GrangeR◆	good	S–VS	MR–MS & S–VS	S–VS	R	MR	R–MR	S	S	R	MR	MT–MI[p]	MR	MI–I[p]	Heritage Seeds	2013
Grimmett◆	medium	VS	S–VS	S	S	MS	MR	S[p]	MR	–	MS	MI	MS	MI[p]	DAFF Qld	1982
Grout	good	VS	MR–MS & S	S	R & S	S–VS	MR	S[p]	MS	–	MS	MT	MS	MT–MI[p]	DAFF Qld	2005
Hindmarsh●	good	VS	MR–MS	S–VS	S–VS[p]	S	MR–MS	S	S	R	MR–MS	T–MT[p]	MR–MS	MT–MI[p]	DELWP Victoria	2006
La Trobe	good	VS	MR–MS	S	S–VS[p]	S	MR	MS–S	S	R	MR	T–MT[p]	MR	MT[p]	InterGrain	2013
Mackay	medium–good	S–VS	MS & S	S	MR	MR–MS	MR	S–VS[p]	MR–MS	–	MS	MI	MR–MS	MI–I[p]	DAFF Qld/NSW DPI	2002
Navigator◆	medium	S–VS	MR–MS & S	MR–MS	MR & S–VS	VS	MR	S	MS	R	MR–MS	MI–I[p]	MR–MS	MI–I[p]	University of Adelaide	2012
Oxford	good	S–VS	MS–S	S	R	MR	R & S	S	MS–S	S	MR–MS	I[p]	MR	I[p]	Nickerson/ Heritage Seeds	2009
Schooner◆	medium	S	MR–MS	MS–S	S–VS	S–VS	MR	MS–S	S	VS	MR–MS	MT[p]	MS	–	University of Adelaide	1983
Scope CL◆	medium	S–VS	MR	MS–S	R	MS–S	MR	S	MS	S	MR–MS	MI[p]	MR–MS	MI[p]	DELWP Victoria	2010
Shepherd	good	S–VS	MR–MS & VS	S–VS	MS	MR–MS	MR	MS–S	–	–	MS–S	MT–MI	MR–MS	MI[p]	DAFF Qld/DAFWA	2008
Skipper	medium–poor	VS	MR	MR–MS	MR & MS–S	S	R–MR	MS–S	MS–S	R	MR–MS	MT[p]	MR–MS	T[p]	University of Adelaide	2012
SouthernStar	medium	S	MR–MS	MS	S	MS	MR	–	–	R	–	–	–	–	Sapporo Breweries/ University of Adelaide	2014
SY Rattler	good	S–VS	MS	S–VS	R	MR	MR	S	MS–S	–	MR–MS	MI–I[p]	R–MR	MI–I[p]	Syngenta Seeds/ GrainSearch	2011
Tilga	medium	S	MR–MS & S	MR	S	S–VS	MR	VS	VS	VS	–	–	–	–	NSW DPI/DELWP Vic.	1997
Tulla	good	S	MS	S	S–VS	S	MR	–	–	VS	–	–	–	–	NSW DPI	2003
Urambie■	very good	MR	MR–MS	S	MR–MS	MS–S	R	–	–	–	–	–	–	–	NSW DPI	2005
Westminster◆	good	S	MR–MS & S	S	R	MR	R	MS–S	MR–MS	–	MR–MS[p]	I[p]	MR–MS	I–VI[p]	Nickerson/GrainSearch	2010

Variety	Straw strength	Leaf scald	Net Blotch Net form	Net Blotch Spot form	Powdery mildew	Leaf rust	BGYR (Stripe) rust	Crown rot	Common root rot	Cereal cyst nematode Resistance	RLN *P. thornei* Resistance	RLN *P. thornei* Tolerance	RLN *P. neglectus* Resistance	*RLN P. neglectus* Tolerance	Issued by	Year registered
Wimmera◆	medium–good	S–VS	MR–MS & S	S	S–VS	MS	R–MR	MS–S	MS	S	MR–MS	–	MR–MS	–	DPI Victoria/University of Adelaide	2012
Yambla■	good	S	S	S	MS–S	S	R–MR	–	–	S	–	–	–	–	NSW DPI	1998

Where ratings are separated by '&' the first is correct for the majority of situations, but different pathotypes are known to exist and the latter rating reflects the response to these pathotypes, ■ = suitable for grazing and grain recovery, P = provisional rating, – = Insufficient data. ◆ May be accepted as malting. Accredited by Barley Australia. • Food grade.
Resistance ratings – The root-lesion nematode (*P. thornei* & *P. neglectus*) rating systems were revised during 2014 and some cultivars may have different ratings to previous years. Resistance ratings that appear in this planting guide are national consensus ratings based on glasshouse and field data collected in the northern and southern grain regions.
Tolerance ratings – The root-lesion nematode (*P. thornei* & *P. neglectus*) rating systems were revised during 2014 and some cultivars may have different ratings to previous years. Tolerance ratings that appear in this planting guide are based on field data collected in the northern grain region rather than national consensus ratings.
DAFWA = Department of Agriculture and Food Western Australia; NSW DPI = NSW Department of Primary Industries, DAFF Qld = Department of Agriculture Fisheries and Forestry, Queensland; DELWP Victoria = Department of Environment, Land, Water and Planning Victoria.

Resistances
R (Resistant) indicates a high level of resistance; disease should not be seen and grain yield should not be affected.
R–MR (Resistant–Moderately Resistant) indicates a high level of resistance; very low levels of disease may be seen and grain yield should not be reduced.
MR (Moderately Resistant) indicates low levels of disease may develop in favourable conditions, some yield loss may occur but fungicide control unlikely to be economic.
MR–MS (Moderately Resistant–Moderately Susceptible) indicates low to moderate levels of disease may develop in favourable conditions, some yield loss may occur. Fungicides may be economic.
MS (Moderately Susceptible) indicates moderate levels of disease may develop in favourable situations with moderate yield losses. Fungicide applications likely to be economic.
MS–S (Moderately Susceptible–Susceptible) indicates significant disease may develop in favourable situations with moderate yield losses. Fungicide application likely to be economic.
S (Susceptible) indicates high levels of disease may occur with substantial yield losses. Fungicide applications should be budgeted.
S–VS (Susceptible–Very Susceptible) indicates high levels of disease may occur with substantial yield losses. Disease may require close monitoring and proactive fungicide control.
VS (Very Susceptible) indicates very high levels of disease may occur in favourable seasons with serious yield losses. Will require close monitoring and proactive fungicide control. Likely to develop some disease even when conditions less favourable.

Tolerances
VT (Very Tolerant) indicates a high level of tolerance and grain yield is unlikely to be reduced.
T (Tolerant) indicates a high level of tolerance and grain yield is unlikely to be reduced.
T–MT (Tolerant–Moderately Tolerant) indicates disease may develop in favourable conditions, some yield loss may occur.
MT (Moderately Tolerant) indicates disease may develop in favourable conditions, some yield loss may occur.
MT–MI (Moderately Tolerant–Moderately Intolerant) indicates disease may be conspicuous in favourable situations with moderate yield losses.
MI (Moderately Intolerant) indicates disease may be conspicuous in favourable situations with moderate yield losses.
MI–I (Moderately Intolerant– Intolerant) indicates high levels of disease may occur with substantial yield losses.
I (Intolerant) indicates high levels of disease may occur with substantial yield losses.
VI (Very Intolerant) indicates high levels of disease may occur with substantial yield losses.

weight and compared to Gairdner lower grain protein achievement. Grain retention is similar to Hindmarsh with lower screenings. The variety was licensed and developed by Elders from a Nickerson-Limagrain, UK line, and was released in 2014. It is currently under commercial seed increase, and is being sold initially as a feed variety prior to malt accreditation. Elders.

Skipper.(D) Skipper is a potential malting quality line, similar in plant type to Buloke but with early maturity similar to Hindmarsh. Under high yielding or good growing conditions Skipper may lodge. Grain yield potential is similar to Commander but Skipper is better suited to lower rainfall environments. Currently undergoing malt accreditation. Bred by the University of Adelaide but not yet commercially available in NSW.

SouthernStar.(D) Limited information on the performance of SouthernStar in NSW. A potential new malting barley developed by Sapporo Breweries and the University of Adelaide. SouthernStar is a derivative of Flagship, which includes a patented novel gene for improved beer quality. SouthernStar can be grown under contract to Barrett Burston Maltings and Joe White Maltings.

Wimmera.(D) Malt. Wimmera is a mid to late maturing variety with similar plant architecture to Gairdner however it has significantly higher yield potential, and better physical grain quality. Developed by Vic DPI and the University of Adelaide but not yet commercially available.

Diseases

Sound management is the key to minimising losses from disease. Avoid sowing barley into barley stubble and consider carefully barley into wheat stubble. Improved levels of resistance to some leaf diseases is available in some varieties, and these are preferred if suitable for your region.

Paddock management and crop rotation are preferred controls for the root and crown rots. Seed dressings control smuts and delay the build-up of leaf scald and powdery mildew early in the season.

Varying pathotypes of the main diseases, leaf rust, leaf scald and net blotches occur in different regions across NSW and other barley growing regions.

Growers should be aware that depending on what pathotype of a pathogen is present in their region will affect the variety's disease resistance rating.

For a number of varieties you will see two distinct ratings, growers are advised to show caution and monitor their crops carefully and be prepared where feasible to apply foliar fungicides to manage the leaf disease should the variety begin to show susceptibility.

Leaf diseases

Rusts

Four rusts; stem rust, leaf rust, barley grass stripe rust and wheat stripe rust, can affect barley in NSW with leaf rust the major concern. Varieties such as Baudin, Grout and Navigator are very susceptible to leaf rust. Varieties that are rated very susceptible to leaf rust should be monitored carefully as they may build up leaf rust to damaging levels on other varieties, since many widely grown varieties are rated

as susceptible. Care should be taken to destroy any susceptible or very susceptible barley variety volunteers over summer to prevent build up of leaf rust.

Stem rust is not usually a problem on main season sowings of barley. It develops at higher temperatures and can develop on very late sown crops.

Barley stripe rust is a major disease of barley in some overseas countries but is not present in Australia. However, barley grass stripe rust and wheat stripe rust can develop to a small extent on some barley varieties, particularly if the diseases are severe on nearby barley grass or wheat. Report any unusually severe infections of stripe rust on barley to your agronomist or NSW DPI plant pathologists and collect samples to be sent to the national cereal rust survey, contact details can be found in *Industry Information* section on page 59.

Net blotch

There are two forms, the spot form and the net form. Both forms survive in infected barley stubble and the net form can also be seed-borne. It can be difficult to distinguish between the forms and mixed infections are possible.

The spot form produces small dark brown spots or blotches up to 10 mm long. Blotches are round to oval when small, becoming more straight-sided as they enlarge. Larger blotches are often surrounded by a yellow margin, particularly towards the leaf tip.

The net form also produces small round to oval dark brown spots at first, but these elongate into dark brown streaks along the leaf, often giving a netted appearance. Severely affected leaves wither. The net form only can also infect grain.

Spot form of net blotch is widespread as most varieties are susceptible. The net form has been less common in the southern region because most of the major varieties have good levels of resistance, however it can be a major disease in northern NSW if susceptible varieties are grown.

Use of a seed treatment that will control the seed-borne stage of net form of net blotch is advisable. Growers should be aware that the fungicide flutriafol commonly applied as a fertiliser treatment is not effective in controlling net or spot forms of net blotch. Planting seed retained from crops infected with the net form of net blotch should be treated with an appropriate dressing. See *Cereal seed dressings* section (page 122) for details. Note, this only disinfects the seed and will not provide protection against infection from spores coming off infected stubble.

Scald

This is the major leaf disease in the higher rainfall areas of central and southern NSW. It can reduce grain yield of susceptible varieties by more than 30%.

Fungicides applied to fertiliser and seed treatment gives useful early control. One fungicide spray at late stem elongation gives economic responses in crops with high yield potential.

PLS (Physiological leaf spotting)

Under some circumstances barley plants may develop various forms of leaf spots that are not caused by a pathogen. Spots may vary from tiny white/yellow flecks to dark-brown or black blotches. These can easily be mistaken for diseases. Some varieties (e.g Gairdner and GrangeR) are more prone to Physiological leaf spotting than others and growers are advised to consult their agronomist or adviser if uncertain of the causes of leaf spotting.

Powdery mildew

Powdery mildew can occasionally be severe on seedlings and tillering barley in northern and central NSW and is favoured by high humidity but reduced by rain. High nitrogen levels in crops can also favour development. Foliar fungicides are often applied, but in many cases after powdery mildew has damaged the crop. Growing resistant varieties is the best management strategy as the powdery mildew pathogen of barley has been found to develop resistance to some triazole fungicides in other regions. Some seed treatments provide effective and economic control of powdery mildew at the seedling stage in areas where the disease frequently develops. See *Cereal seed dressings* section (page 122) for details.

Management of diseases with foliar fungicides

The use of foliar fungicides in disease management is increasing and can give economic returns when applied correctly. Application of foliar fungicides should be an economic decision based on the following factors:

- Accurate disease diagnosis
- Yield potential
- Potential loss (varietal susceptibility, growth stage, effect on yield and quality)
- Time of spraying
- Cost of fungicide and application
- Duration of control
- Amount of disease present
- Future disease development (weather) and
- Stock/harvest withholding periods.

With most diseases, application should aim to protect the flag-1 leaf in barley. Losses from diseases in the vegetative stage are relatively small in comparison to infection of the adult plant. Consequently, in most cases, spraying at this stage is not worthwhile. In areas where severe powdery mildew infection frequently occurs on seedlings, an appropriate seed dressing generally provides better and more economic control than in-crop spraying.

Duration of control varies with fungicide and rate of application; therefore, early sprays may require repeat applications.

Fungicide resistance has been documented in a number of foliar pathogens in Australia such as barley powdery mildew and Septoria tritici blotch in wheat. This means that repeated applications of the same fungicide active ingredient should be avoided and label instructions need to be followed.

Root and crown diseases

Barley is susceptible to the same root diseases as wheat. Yield losses are usually not as severe as for wheat with crown rot because of barley's earlier maturity. However, barley is very susceptible to crown rot infection and builds up inoculum levels within the rotation. Barley can still suffer significant yield loss from crown rot if moisture stress occurs during crop development. As with wheat, control relies on effective rotations.

Disease and crop injury guide – barley

Disease/Cause	Symptoms	Occurrence	Survival/Spread	Control
Foliar Diseases				
Scald *Rhynchosporium secalis*	'Scalded' patches with dark brown margins on leaf.	More common and severe in south, favoured by wet weather.	Rain-splashed spores from barley and grass residues and infected leaves.	Resistant varieties; rotation with non-host crops. Fertiliser, seed and foliar fungicides; avoid sowing into barley and barley grass residues.
Net blotch – net form *Pyrenophora teres* f. *teres*	First, as small elliptical dark brown spots which elongate into fine, dark brown streaks on the leaf blades giving a netted appearance. Severely affected leaves wither. It also infects heads.	Favoured by wet weather and early sowing.	Air-borne spores from infected plants and stubble. Carried on seed.	Resistant varieties; rotation with non-host crops. Stubble removal. Clean seed. Fungicide seed treatments. Appropriate foliar fungicides.
Net blotch – spot form *Pyrenophora teres* f. *maculata*	Small, dark brown, round to oval spots or blotches up to 10 mm long becoming more straight-sided as they enlarge. Larger blotches are often surrounded by a yellow margin, particularly towards the leaf tip.	Favoured by wet weather and early sowing.	Air-borne spores from infected plants and stubble.	Resistant varieties; rotation with non-host crops. Stubble removal. Foliar fungicides.
Powdery mildew *Blumeria graminis* f.-sp. *hordei*	White to grey cottony fungal growth on leaf and leaf sheath.	More common in north and south-west crops, more prevalent in winter and early spring.	Air-borne spores from infected trash and infected plants.	Resistant varieties; Seed and foliar fungicides.
Leaf rust *Puccinia hordei*	Very small pustules of orange-brown powdery spores on leaves and leaf sheaths.	Favoured by moist conditions and temperatures around 15–22°C.	Air-borne spores from living plants.	Resistant varieties; clean fallows; foliar fungicides to protect flag-1 to flag-2 leaves. Monitor very susceptible varieties regularly.
Stripe rust *Puccinia striiformis*	Pustules and stripes of yellow powdery spores on leaves.	Barley stripe rust is not present in Australia. However some varieties may develop small amounts of barley grass stripe rust and wheat stripe rust. Promoted by cool nights (10–15°C) with heavy dews.	Air-borne spores from living plants.	Rarely required. Varieties such as Skiff and Tantangara may show some infection. Resistant varieties, foliar fungicides not likely to be required.
Stem rust *Puccinia graminis* spp.	Elongated pustules of dark brown spores on stems, leaves and awns.	Favoured by warm (15–30°C) moist conditions. Only likely to be a problem in very late crops or where crops are in close proximity to other infected cereal crops.	Air-borne spores from living plants.	Clean fallows. Resistant cereals (wheat, rye, triticale); avoid sowing very susceptible varieties; foliar fungicides.
PLS (Physiological leaf spotting)	Range from tiny white or yellow flecks to conspicuous dark brown to black spots and blotches on leaves.	Most prevalent under mild, moist growing conditions. Some genotypes are more susceptible. Grimmett often develops white flecking; Gairdner and GrangeR prone to brown blotching.	Not a pathogen. (Note that some brown flecking may be a resistant reaction to other diseases and in some regions a reaction to adverse soil nutrient levels.)	Avoid susceptible varieties. Confirm cause before considering application of fungicide as they will provide no control of PLS as they are not diseases .
Sunblotch (Physiological reaction to nutrient stress and sunlight)	Orange to dark brown spots more common on upper surface of leaf, leaf death.	Sporadic in occurrence. Conditions causing it yet to be defined.	Not a pathogen.	No control.
Virus Diseases				
Barley yellow dwarf *Barley yellow dwarf virus* (BYDV)	Yellowing, dwarfing of infected plants, reduced seed set.	Most common near perennial grass pastures and in early sown crops.	Transmitted by aphids from infected grasses and cereals.	Most varieties have some tolerance.
Wheat streak mosaic *Wheat streak mosaic virus* (WSMV)	Light green leaf streaks and blotches, stunting of plants, reduced seed set.	Not yet observed in barley. Has occurred in wheat in southern irrigation areas and early sown grazing wheat crops on the tablelands and slopes.	Transmitted by the wheat curl mite.	No control required.
Root and Crown Rots				
Take-all *Gaeumannomyces graminis* var. *tritici*	Blackening of roots and crown, stunting, 'white heads', pinched grain.	More common in south, favoured by wet winter and early spring, then dry. Less severe on barley than on wheat.	Soil-borne on grass and cereal residues.	Crop rotation to provide one year free of grass hosts. Some seed treatments provide some level of suppression.
Crown rot *Fusarium pseudograminearum*	Browning of stem bases, stunting or plant death if severe early infection, 'white heads' not common in barley, pinched grain.	More common in north and western areas becoming common in south, favoured by moisture/heat stress during season.	Stubble-borne on grass and cereal residues.	Crop rotation. Grass weed control. Balance inputs to available soil water.
Common root rot *Bipolaris sorokiniana*	The root between the crown and seed (sub-crown internode) is always dark; roots and sometimes the stem base are brown; white heads, pinched grain	Scattered through the crop. Plants can have reduced tillering and appear to have ill-thrift.	Stubble-borne on grass and cereal residues; also survives as spores in the soil.	Resistant varieties; crop rotation; optimise nutrition.
Eyespot *Tapesia yallundae*	Lodging, 'eyespot' with sharp bend in stem 3–5 cm above ground.	South and Central West Slopes, eastern Riverina. Less severe on barley than on wheat.	Rain-splashed spores from crop or grass residue during winter.	Crop rotation.
Smuts				
Loose smut *Ustilago tritici*	Black powdery heads on diseased plants, black lumps in harvested grain.	Statewide, presence may make grain unacceptable to maltsters.	Air-borne spores infect developing seeds at flowering.	Seed-applied fungicides.
Covered smut *Ustilago segetum* var. *hordei*	Ball of black powder replaces the seed.	Statewide, presence may make grain unacceptable to maltsters.	Spores on seed coat infect seedling before emergence.	Seed-applied fungicides, resistant varieties.

Smuts

There is a nil tolerance for smuts for both malting and feed barley receivals. Grain appearance is damaged by smuts, making it less attractive for human and animal consumption. Control is readily achieved with the use of seed dressings at sowing. Treat all seed for sowing each year and ensure good coverage during the application process.

Use of a seed dressing that will also control scald and powdery mildew is advisable.

Do not sow untreated seed from a crop with any visible head smut. See *Cereal seed dressings* section (page 118) for details.

Black point

This darkening of the grain coat at the embryo (shoot) end can occur during wet periods from flowering to harvest. All varieties can be affected, depending on seasonal conditions. There are no known control measures as this is a physiological condition and not a disease.

Badly discoloured grain is unacceptable for malting, although affected seed is usually satisfactory for sowing. For further information on diseases, refer to listed publications.

Marketing

Barley may be freely traded on both the domestic and export market. Prior to adopting a new barley variety look at what marketing options are available in your region. Not all new varieties will be accepted by the bigger grain recieval sites, so alternative arrangements may need to be sought or grain stored on farm prior to delivery to a end user.

Take care not to over-thresh barley at harvest, which results in damage to the grain. Ideally, markets seek malting barley with 10.5% protein.

Feed barley is traded through major traders and private merchants, or direct to domestic end-users like stockfeed manufacturers, feedlotters and other farmers. Prices tend to be lower around harvest time, and are usually higher during winter.

Barley is more difficult than most other cereals to store for more than three months, because of its susceptibility to grain insect attack.

Grain insect treatment WARNING: Malting barley may only be treated with a limited number of grain protectants for insect control. Check with the end user prior to treatment to ensure a particular pesticide is acceptable. Refer to *Grain insects – options for control* section (page 114) for more details.

Current barley delivery standards are available from your local grain trader or from Grain Trade Australia (GTA), **www.graintrade.org.au/commodity_standards**.

Malting varieties

Malting barley varieties in Australia are accredited by Barley Australia and undergo rigorous testing to ensure they meet malting standards both for domestic and international markets. The Barley Australia website has a list of currently accredited varieties, **www.barleyaustralia.com.au.** Delivery of malting varieties will depend on segregations in your region and must meet the GTA quality standards/specifications for malt barley.

Food grade varieties

This is a new classification, introduced in 2010 by Barley Australia. Barley varieties will need to meet all of the physical quality parameters which apply to accredited malting barleys, such as protein, test weight, screenings and retention, before they can be accepted into Food Barley segregations.

Feed varieties

NSW Feed Barley No. 1: 2-row varieties with white aleurone layer only.

Further reading

Barley Australia: **www.barleyaustralia.com.au**

DAFF Qld – *Barley Planting Guide*

GTA – *Barley Receival Standards*

GRDC – *Wheat and Barley Leaf Symptoms: The Back Pocket Guide*

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Oats

Crop management

This widely adapted and reliable cereal is the major winter cereal grazing crop. It also offers major rotational benefits where conditions are not suitable for broadleaf break crops. Oats can tolerate some cereal diseases such as take-all, crown rot and common root rot. The ease of establishment and its comparatively low cost compared to other grazing crops, are both major benefits.

Its adaptability to acid soils, use for hay and silage, for pasture renovation, suitability for broadleaf weed control by in-crop herbicides, and usefulness for grazing-out make oats a versatile crop in farming systems.

Sowing

Except for very high tablelands areas, January and February sowings should be avoided. Hot conditions, soil temperatures consistently above 25°C, and rapidly drying soils can cause patchy establishment.

Optimum sowing times are shown for each variety in the respective zones. Sowing later than recommended increases the risk of lower yields. In wet, acid soil conditions sow grain-only varieties at the earliest recommended time.

Direct-drilling of early sown varieties is easier in paddocks cropped the previous year. New paddocks can be direct-drilled early with machinery that gives adequate penetration and minimum soil disturbance following chemical fallow. Early forage production from direct-drilled crops is less than from crops sown into cultivated seedbeds.

A sowing depth of 5 cm is ideal, but oats can be sown as deep as 7 cm if moisture seeking.

Nutrition

Apply fertiliser at above the normally recommended rates to crops used for grazing and grain, as they have a longer productive period than grain-only crops.

To achieve grain protein of 10% and above in high yielding varieties like Mitika and Possum, avoid sowing into low fertility paddocks.

Seeding rates

High seeding rates give rapid growth rates and high forage yields. Use high rates where dense weed populations are expected, when conditions are likely to be wet during winter, in low pH soils, and/or in paddocks with low soil fertility, or if seed quality is substandard.

Seed size varies significantly between oat varieties and season, so it is important to know the 1000 grain weight of the selected variety to calculate the required seeding rate. The seeding rates shown should be used as a guide only and growers should calculate their own seeding rates based on 1000 seed weight, target plant population and seed establishment percentage. See page 8 for an example of seed rate calculation.

Higher Tablelands/Tablelands/Slopes

- 80–120 kg/ha, grazing and grain
- 60–80 kg/ha, grain-only

Slopes/Plains

- 60–80 kg/ha, grazing and grain
- 40–60 kg/ha, grain-only

Early sown – grazing only

- 100–130 kg/ha

Irrigation

- 100–150 kg/ha, grazing and grain
- 80–120 kg/ha, grain-only

Hay production (Seeding rates are 30–50% higher than grain crops in the same region.)

- 60–100 kg/ha dryland
- 80–140 kg/ha irrigated

Grazing

The ideal stage to start grazing is when plants are well anchored and the canopy has closed. Continuous grazing may be better for fattening stock than rotational grazing. Maintain adequate plant material to give continuous and quick regrowth, e.g. a minimum of 1000–1500 kg/ha of dry matter.

For the best recovery after grazing, do not graze below 5 cm for prostrate varieties, and below 10 cm for more erect types. The higher grazing height is particularly important with erect growing varieties. Over-grazing greatly reduces the plant's ability to recover.

(See *Managing grazing cereals*, page 68).

Grazing value

Financial returns from grazing can be based on:

- Changes in body weight throughout the grazing period. Weight gains of 1.2 kilograms per head per day for steers, and 200 grams per head per day for lambs are common
- Stock value before and after grazing
- Current agistment rates for stock, and
- Hand feeding costs for the same period.

On the tablelands and slopes, grazing oats significantly reduces the grazing pressure on pastures and can often reduce the necessity for hand feeding during winter.

On the slopes and plains, grazing oats enables autumn spelling of lucerne pastures.

Grain recovery

An accurate method for assessing the correct time for stock removal is to find where the immature head is in the stem (slice it open and look above the highest node); if stock graze the immature head, yields are drastically reduced as plants have to grow new tillers. August is traditionally the month when livestock are removed from grazed crops to allow

optimum grain recovery for harvest. In drier areas and on lower fertility paddocks, earlier stock removal should improve grain recovery. With later maturing varieties on the tablelands, stock removal can be delayed with little overall reduction in grain recovery.

Weeds

Planning in the previous season to prevent annual weeds, especially grass weeds from setting seed by pasture cleaning, spray topping or early fallow, helps to reduce in-crop weeds and improves crop production.

Some post-sowing pre-emergent herbicides and early post-emergent herbicides will control annual ryegrass, but timing is critical. Broadleaf weeds can be effectively controlled with either early or late post-emergent herbicides, but again, timing is most important.

Higher seeding rates and narrow row spacings improve competition against weeds. Maintain crop canopy (bulk) to discourage weed recovery.

Diseases

Barley yellow dwarf virus (BYDV) is transmitted by aphids. Early sown crops are more at risk. Sow tolerant varieties or be prepared to control aphids to prevent disease transmission. Imidacloprid is registered for use on cereal crops as a seed dressing for the management of aphids and BYDV spread in cereal crops, see page 123 for available products.

Significant production losses can result from either stem or leaf rust. With the development of new pathotypes in some regions for stem rust, there are no remaining genetic resistances available in commercially grown varieties to fully protect crops from stem rust. Leaf rust resistance levels in some varieties provide useful field tolerance to the disease. Monitor crops in season for the presence of these rusts. Rusts can be managed by selecting appropriate varieties for sowing, avoiding sowing later maturing varieties and applying late irrigations, and adjusting grazing management (see *Managing grazing cereals*, page 68) or controlled by the use of foliar fungicides in crop.

Insects

Earth mites and armyworm commonly affect crops. Earth mites can affect young crops, so monitor and control as necessary. They should be suppressed in the previous spring by applying an insect spray with the fallow weed control program.

Armyworms can cause severe damage to the ripening crop and should be monitored. Chewing of leaf margins and/or oat spikelets on the ground are sure signs of armyworm presence. Always inspect the more dense areas of the crop.

Producing quality grain

There are strong domestic and export markets with premium payments for oats with a high test weight (kg/hL) – see varietal tables. Producers aiming at milling markets should consider Bannister, Mitika, Possum, Mortlock, Williams, Wombat or Yallara.

For high-quality feed oats for livestock consider low husk lignin varieties Mannus, Mitika, Yarran or Yiddah and avoid over-grazing crops or grazing too late into early spring. Crops maturing under hot, dry conditions result in low grain quality.

Choose paddocks with good soil moisture retention characteristics. Use moderate seeding rates and sow at the suggested time. Pay attention to weeds and provide adequate nutrition, but be careful not to apply excessive fertiliser rates (especially nitrogen) which can result in delayed maturity.

Marketing

Before harvest, careful weed and insect control ensure the best quality product to market. In crops used for hay, ensure even curing after cutting.

Prevent grain contamination by weed seeds and insects. If the grain is to be stored for longer than three months, protect against insects. Store in the best possible facility to ensure a quality product.

Grain size, plumpness, variety, husk lignin content, protein and hectolitre weight are some of the buyers' criteria for feed grain sales. To aid marketing, samples should be protein and energy tested and premiums sought. Varieties and samples vary considerably.

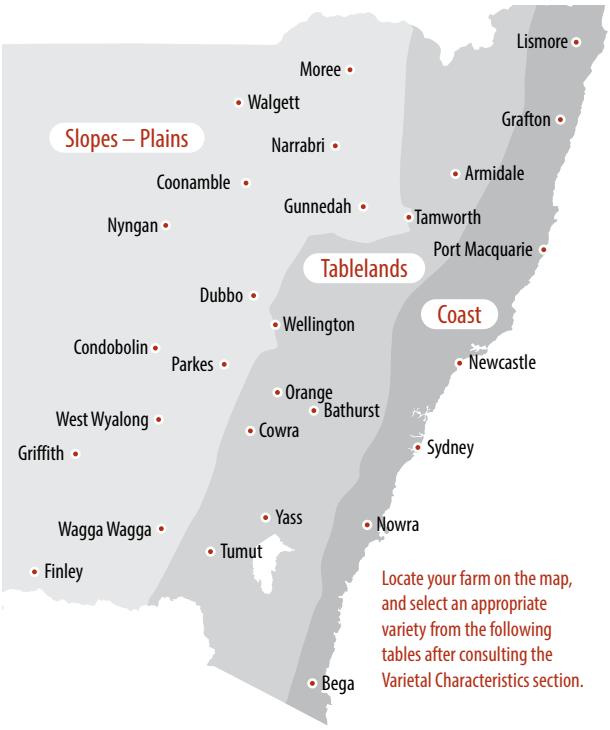
Collect a representative running sample at harvest by sampling each truckload as a marketing aid.

Bannister, Mitika, Possum, Mortlock, Williams, Wombat or Yallara are accepted milling varieties. The newer varieties Bannister, Williams and Wombat whilst acceptable as milling oats, may have limited opportunities for segregation in NSW storage systems. Growers should contact prospective buyers before growing these varieties. Echidna and Yarran may also be accepted.

Variety selection

When selecting a variety consider:

- **Region.** (see map)



- **Crop use.** For grazing only, or for dual-purpose grazing and grain, for hay, for silage, or for grain-only?
- **Grazing value.** When is feed most important – in early or late winter?

Varieties

Variety	Grazing		Straw strength after grazing	Grain maturity	Test weight (kg/hL)	Husk lignin content*	Diseases				Acid soils – sensitivity to aluminium
	Early dry matter production	Grazing recovery					Stem rust ✦	Leaf (crown) rust ✦	BYDV	Red leather leaf	
Dual-purpose varieties											
Bass	medium	excellent	good	late	medium	low	S	S	T	–	Tol
Bimbil	medium	excellent	good	early–mid	high	low	S	MS	MS	–	–
Blackbutt	slow	excellent	good	late	low–medium	medium ●	S	S	MT	–	Tol
Cooba ▲	medium	excellent	fair	early–mid	high	low	MS–S	MS–S	MT	–	Int
Coolabah ▲	quick	moderate	fair	early	medium	high	MS–S	S	MT	–	Sen
Eurabbie	quick	excellent	very good	late	low–medium	low	S	MS–S	VS	–	Tol
Mannus	medium	excellent	good	mid	high	low	S	MS	MS	–	–
Nile	quick	excellent	good	very late	medium	low	S	S	T	–	Tol
Yarran ▲	medium	moderate	good	early	high	low	S	MS	VS	–	Int
Yiddah	slow	excellent	good	early	high	low	MS	S	MT	–	–
Grain only varieties#											
Bannister	quick	poor	–	early–mid	med–high	high	MR & S	R	MS	MS	–
Mitika	quick	poor	very good	early	high	low	MR & S	MS & S	MS & S	S	–
Mortlock ▲	quick	poor	good	early–mid	high	high	S	S	MS	–	Tol
Possum	quick	poor	very good	early–mid	med–high	high	MS & S	MS	S	MS & S	–
Williams	quick	poor	–	mid	med-high	high	MR & S	R	MR & MS	MS	–
Wombat	quick	poor	–	early–mid	high	high	MS & S	MS	MR	MS	–
Yallara	quick	poor	good	early–mid	high	high	S	MS	MS	MS	–

– = Insufficient data, R = Resistant, R-MR = Resistant to Moderately Resistant, MR = Moderately Resistant, MR-MS = Moderately Resistant to Moderately Susceptible, MS = Moderately Susceptible, MS-S = Moderately Susceptible to Susceptible, S = Susceptible, VS = Very Susceptible. Where ratings are separated by '&' the first is correct for the majority of situations, but pathotypes are known to exist in some regions and the later rating reflects the response to these pathotypes. ✦ Field resistance to the rusts on crops differ depending on season, maturity and strains present. Sen = Sensitive, Int = Intermediate, MT = Moderately Tolerant, Tol = Tolerant. # Ratings for the grain only varieties are from the SARDI Oat Breeding and Pathology Programs, they are from SA screening, and may not represent the reaction to stem and leaf rust in NSW where more virulent pathotypes are present. ▲ Outclassed, Yarran (BYDV), Cooba, Coolabah & Mortlock (grain yield). * Refer to Feeding value of oats grain, page 57. ● Lignin content of Blackbutt can be variable.

Sowing times

Variety / Weeks	January		February				March				April				May				June		
	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
Higher Tablelands/Tablelands: Dual-purpose – grazing and/or grain recovery																					
Bass, Blackbutt, Nile	>	★	★	★	★	★	★	★	★	★	<	<									
Eurabbie			>	>	★	★	★	★	★	★	★	★	★	★	<	<					
Bimbil, Mannus					>	>	★	★	★	★	★	★	★	★	<	<					
Tablelands/Slopes: Dual-purpose – grazing and/or grain recovery																					
Blackbutt					>	★	★	★	★	<	<	<	<								
Eurabbie					>	★	★	★	★	★	★	<	<								
Cooba ▲						>	★	★	★	★	<	<	<	<	<						
Bimbil, Mannus, Yiddah								>	★	★	★	★	<	<	<						
Coolabah ▲, Yarran ▲									>	★	★	★	★	<	<						
Slopes/Plains: Dual-purpose – grazing and/or grain recovery																					
Cooba ▲, Eurabbie						>	★	★	★	★	★	<	<	<	<						
Bimbil, Mannus, Yiddah								>	★	★	★	★	★	★	<	<	<				
Coolabah ▲, Yarran ▲									>	★	★	★	★	★	<	<	<				
Tablelands/Slopes grain only																					
Bannister, Mitika, Mortlock ▲, Possum, Williams, Wombat, Yarran ▲															>	★	★	★	<	<	<
Slopes/Plains grain only																					
Bannister, Mitika, Possum, Williams, Wombat, Yallara															>	★	★	★	★	<	<
Mortlock ▲, Yarran ▲															>	★	★	★	★	★	<

> Earlier than ideal, but acceptable. ★ Optimum sowing time. < Later than ideal, but acceptable. ▲ Outclassed varieties
Warning: High soil temperatures (> 25°C) with early sowings may reduce germination and establishment.

Yield performance experiments from 2004 to 2009 – the more trials, the greater the reliability.

Higher Tablelands dual-purpose compared with Eurabbie = 100%

Variety	1st Grazing DM Eurabbie = 2.37 t/ha	2nd Grazing DM Eurabbie = 2.51 t/ha	Grain Recovery Eurabbie = 2.94 t/ha	Ungrazed Eurabbie = 4.57 t/ha
Bass	94	95	85	92
Bimbil	88	93	87	84
Blackbutt	89	91	84	89
Eurabbie	**100**	**100**	**100**	**100**
Mannus	87	91	87	72
Nile	99	97	85	93

Consider Nile, Bass and Blackbutt for very early sowing. Eurabbie is outstanding for grain recovery after grazing. Mannus is outstanding for grain quality.

Tablelands/Slopes dual-purpose compared with Bimbil = 100%

Variety	1st Grazing DM Bimbil = 2.90 t/ha	2nd Grazing DM Bimbil = 2.34 t/ha	Grain Recovery Bimbil = 2.07 t/ha	Ungrazed Bimbil = 2.50 t/ha
Bimbil	**100**	**100**	**100**	**100**
Blackbutt	102	97	86	86
Cooba ▲	106	106	87	87
Eurabbie	114	107	119	118
Mannus	99	97	98	101
Yarran ▲	103	95	105	105
Yiddah	109	111	86	85

Consider Eurabbie or Blackbutt for the Tablelands, or areas with later maturity. Eurabbie is outstanding for grain recovery after grazing. Preferred varieties for feeding grain to livestock are Mannus, Yiddah and Yarran.

Slopes/Plains dual-purpose compared with Bimbil = 100%

Variety	1st Grazing Bimbil = 2.09 t/ha	2nd Grazing Bimbil = 2.34 t/ha	Grain Recovery Bimbil = 2.26 t/ha	Ungrazed Bimbil = 2.59 t/ha
Bimbil	**100**	**100**	**100**	**100**
Cooba ▲	106	106	97	86
Eurabbie	107	107	112	120
Mannus	99	97	101	94
Yarran ▲	106	95	120	103
Yiddah	111	111	103	87

For the Slopes, consider Eurabbie, Mannus, Bimbil and Yiddah for grazing and especially Eurabbie and Mannus for grain recovery. For the Plains consider Yarran, Yiddah and Coolabah for grazing and especially Yiddah for grain recovery. Preferred varieties for feeding grain to livestock are Mannus, Yiddah and Yarran.

Grain only varieties compared with Mitika (2010–2014) – the more trials, the greater the reliability.

Variety	North-east	No. of trials	South-east	No. of trials	South-west	No. of trials
	Mitika = 3.28 t/ha		Mitika = 4.10 t/ha		Mitika = 3.22 t/ha	
Bannister	113	4	105	17	106	10
Mitika	100	4	100	17	100	12
Mortlock ▲	–	–	90	3	–	–
Possum	104	4	98	17	100	12
Williams	115	4	105	17	101	10
Wombat	108	4	98	17	98	12
Yallara	108	4	94	17	94	12

Yield results are a combined across sites analysis of the NVT yield trials from 2010–2014 Preferred milling varieties are Mitika and Yallara. Preferred variety for feeding grain to livestock is Mitika. ▲ Outclassed.

Hay varieties

Variety	Grazing		Straw strength after grazing	Maturity	Diseases					Acid soils – sensitivity to aluminium
	Early dry matter production	Grazing recovery			Bacterial blight	Stem rust ✦	Leaf (crown) rust ✦	BYDV	Red leather leaf	
Bass	medium	excellent	good	late	–	S	S	T	–	Tol
Bimbil	medium	excellent	good	early–mid	R	S	MS	MS	–	–
Blackbutt	slow	excellent	good	late	R	S	S	MT	–	Tol
Cooba ▲	medium	excellent	fair	early–mid	R	MS–S	MS–S	MT	–	Int
Coolabah ▲	quick	moderate	fair	early	R	MS–S	S	MT	–	Sen
Nile	quick	excellent	good	very late	R	S	S	T	–	Tol
Yarran ▲	medium	moderate	fair	early	R	S	MS	VS	–	Int
Yiddah	medium	excellent	good	early	–	MS	S	MT	–	–
Specialist hay varieties#										
Brusher	medium	–	good	early–mid	MR & MS	MS & S	MS & S	MS	MR & MS	–
Forester	medium	–	–	very late	MS & S	R & S	MR & MS	MR & S	R & MR	–
Kangaroo	medium	–	–	mid–late	MR & MS	MS & S	MS & S	MR & S	MS	–
Mulgara	medium	–	–	early–mid	MR	MS & S	MR & MS	MS	MS	–
Tammar	medium	–	–	late–mid	MR	MR & S	MR & MS	MS	R & MS	–
Tungoo	medium	–	–	mid–late	MR	MS & S	MS	MR & MS	R	–
Wintaroo	medium	–	fair–good	mid	MR & MS	S	S	MR	MS	–

– = Insufficient data, R = Resistant, R-MR = Resistant to Moderately Resistant, MR = Moderately Resistant, MR-MS = Moderately Resistant to Moderately Susceptible, MS = Moderately Susceptible, MS-S = Moderately Susceptible to Susceptible, S = Susceptible, VS = Very Susceptible. Where ratings are separated by '&' the first is correct for the majority of situations, but pathotypes are known to exist in some regions and the later rating reflects the response to these pathotypes. ✦ Field resistance to the rusts on crops differ depending on season, maturity and strains present.
Sen = Sensitive, Int = Intermediate, MT = Moderately Tolerant, Tol = Tolerant. Select more than one variety, with at least one from the early maturing group and another from mid or late maturing group. # Ratings for the specialist hay varieties are from the SARDI Oat Breeding and Pathology Programs, they are from SA screening, and may not represent the reaction to stem and leaf rust in NSW where more virulent pathotypes are present. ▲ Outclassed, Yarran (BYDV), Cooba & Coolabah (grain yield).

Forage, silage or hay varieties

Variety	Growth habit	Speed to grazing	Flowering time#	Diseases	
				BYDV	Leaf (crown) rust
Aladdin	semi-erect	medium–quick	late	–	R*
Barcoo	semi-prostrate	medium	mid	–	R*
Bass	semi-prostrate	medium	mid	T	S
Blackbutt	prostrate	slow	mid	MT	S
Comet	semi-erect	medium–quick	mid–late	–	R
Cooee	erect	very quick	mid	–	S
Culgoa II	semi-prostrate	slow	mid–late	–	S
Dawson	erect	very quick	mid–late	–	S
Drover	semi-prostrate	medium	mid–late	–	R*
Enterprise	erect	medium	late	–	S
Eurabbie	semi-prostrate	medium	mid	S	S
Galileo	semi-erect	quick	late	MT	S
Genie	erect	very quick	late	–	S
Graza 50	erect	quick	late	–	S
Graza 51	erect	quick	med–late	–	S
Graza 68	semi-erect	medium	late	MT	S
Graza 80	erect	quick	late	–	S
Gwydir	semi-prostrate	medium	late	–	S
Lordship	semi-erect	very quick	late	T	S
Mannus	prostrate	medium	mid	MS	MS & S
Moola	semi-erect	quick	late	–	S
Nile	semi-prostrate	medium	mid–late	T	S
Nugene	semi-erect	quick	late	–	S
Outback	erect	quick	med–late	–	S
Quamby	erect	medium	mid–late	–	S
Saia	erect	medium	early	T	S
SF Colossus	–	–	mid–late	–	–
SF Tucana	–	–	late	–	–
Taipan	erect	quick	late	–	S
Volta	semi-erect	medium	mid–late	I	S
Warrego	semi-prostrate	medium	mid–late	–	S

– = Insufficient data, I = Intolerant, R = Resistant, MR = Moderately Resistant, MS = Moderately Susceptible, MT = Moderately Tolerant, S = Susceptible, Sen = Sensitive, Tol = Tolerant.
* Virulent pathotypes have been detected for these varieties, however, they are not common. Crops should therefore be inspected regularly for the presence of leaf rust.
# These varieties are rated according to flowering time and not grain maturity, the relative flowering times may change depending on which region in NSW they are grown, particularly in southern NSW.

- **Hay.** Freedom from leaf and stem diseases, resistance to lodging, and maturity to cutting time?
- **Grain.**
  - For retention on-farm or for sale?
  - For retention – high yield and low husk lignin content?
  - For sale – market requirements? White or cream in colour, 'attractive'?
  - For feed – high test weight, protein and low husk lignin content?
  - For milling? As specified by milling companies.
- **Forage only varieties.**

The suggested sowing time for forage-only varieties is mid February to early April. As Saia has a much smaller seed than other varieties, use lower seeding rates, for instance, 60–80 kg/ha.

As many of these varieties are late/very late for grain maturity, they may not be suitable for grain production in many regions.

Grazing management of the more erect types needs to be different to the usual heavy grazing of dual-purpose grazing and grain varieties. Avoid heavy grazing to below 10 cm if plant recovery is expected. More upright varieties are best suited to grazing with cattle. **For coastal and northern regions, consider varieties with the best rust resistance ratings.**

- **Herbicide Tolerance.** Refer to NSW DPI guide *Weed control in winter crops.*

Varietal characteristics

Most varieties are suitable for grazing. Variety selection depends on the crop use, sowing date, likely diseases, and tolerance to acid soil, grain quality and possible market outlet.

Growers are warned that there are now no commercial varieties with resistance to all the current field pathotypes of stem rust. Growers should also be aware that there are a number of leaf (crown) rust pathotypes present in NSW, with pathotypes present in central and northern NSW that have overcome many of the resistance genes in oat varieties bred for southern Australia.

Milling varieties

Bannister.[Φ] Released in Western Australia in 2012 as a milling oat variety for the western region. It has high grain yield potential and has performed well in trials in southern NSW. It is taller than Mitika and heads about 3 to 4 days later than Mitika. It is susceptible to and intolerant to cereal cyst nematodes. Bannister is resistant to leaf rust and moderately resistant to bacterial blight. Bannister has slightly lower hectolitre weight and slightly higher screenings compared to Mitika. Seednet.

Mitika.[Φ] Mitika is a dwarf milling oat released in 2005. It is earlier maturing than Possum and Echidna and this trait favours Mitika in a dry finish. Mitika was resistant to stem rust until 2010 when a new pathotype of stem rust was identified, rendering it susceptible. Moderately susceptible to leaf rust. Mitika has improved resistance to bacterial blight and is superior to Echidna for septoria resistance. Mitika is susceptible to BYDV, septoria and red leather leaf disease. It is very susceptible and intolerant of cereal cyst nematode and moderately intolerant of stem nematode and is not recommended in areas where either of these nematodes are a problem. Mitika has high hectolitre weight, low screenings and high groat percent compared to Echidna. Mitika also has improved feed quality with low husk lignin and high grain digestibility. Heritage Seeds.

Mortlock. Medium height, strong strawed grain oat. Can be leniently grazed. It has a consistently high test weight, protein content and lower screening losses with light coloured grain, but discolours easily. Low yielding compared to Mitika and Possum. Released by Agriculture Western Australia in 1983.

Possum.[Φ] Possum is a dwarf milling grain variety. It is a replacement for Echidna in medium and high rainfall areas. Possum has a similar yield to Echidna in high rainfall zones and slightly lower yield in medium rainfall zones. Possum also has a high husk lignin content like Echidna. It has better milling quality than Echidna and has similar hectolitre weight and fewer screenings than Euro. It is an improvement compared to Echidna for stem rust, leaf rust and Septoria resistance. Like Echidna, Possum is susceptible to bacterial blight and *Barley yellow dwarf virus* (BYDV) and very susceptible and intolerant to cereal cyst nematode. Possum is not recommended for areas where cereal cyst or stem nematode is a problem. Possum is susceptible to red leather leaf and intolerant of stem nematode. Developed by SARDI, released in 2003. Seednet.

Williams.[Φ] Released in Western Australia in 2013, Williams has a high grain yield potential and has performed well in trials throughout NSW. Williams is an early to mid season variety similar to Yallara, but three to seven days later than Mitika. Taller than Mitika by 15 cm, 5 cm taller than Bannister, and 15 cm shorter than Yallara. Williams is resistant to leaf rust and depending on the stem rust pathotype present can range from moderately resistant to susceptible. It is susceptible and intolerant to cereal cyst nematodes. Williams is resistant to bacterial blight and moderately resistant to moderately susceptible to BYDV. Williams has lower hectolitre weight and higher screenings compared to Mitika. Williams is not recommended for low rainfall areas due to higher screenings. Heritage Seeds.

Wombat.[Φ] A dwarf milling variety, which is similar in height to Possum and slightly taller than Mitika. It is a mid season variety flowering about six days later than Mitika. Wombat was the first dwarf milling variety with cereal cyst nematode resistance and tolerance. It is also moderately tolerant to stem nematode. Wombat has high hectolitre weight and low screenings compared to the feed variety Potoroo, which was the first dwarf variety with cereal cyst nematode resistance and tolerance. It also has a high groat percent, slightly higher than Mitika. Developed by SARDI. Seednet.

Yallara.[Φ] A medium–tall, early to midseason variety similar to Euro for flowering and maturity. Yallara was released in 2009. Yallara is a Euro look-alike milling line with slightly better grain quality, but not as susceptible to stem rust. It is resistant but

intolerant to cereal cyst nematode. It is moderately susceptible to BYDV and septoria. Yallara is susceptible and intolerant to stem nematode and moderately susceptible to red leather leaf disease.

Yallara has excellent grain quality. It has a high hectolitre weight, low screenings and a high groat percent. Yallara has bright, plump grain suitable for the milling industry and specialised feed end-uses like the horse racing industry as well as human consumption. Yallara was evaluated for hay production and although the hay yield is lower than popular hay varieties it has excellent hay quality. Seednet.

Feed grain, hay and grazing varieties

Aladdin.[Φ] New late maturity grazing variety with good semi-erect early growth and quick recovery from grazing. Completely resistant to leaf rust. Selected for Queensland and northern NSW. Released by DAFF Qld and Heritage Seeds in 2012, and available through Heritage Seeds.

Bimbil. Dual-purpose type suitable for early to mid season sowing, grazing and grain recovery. Early and total dry matter production are similar to Cooba. Grain yield and grain recovery after grazing are better than Cooba. Straw is shorter and stronger than Cooba but it may still lodge. High groat percentage. Bred by NSW DPI at Temora. Released in 1993.

Blackbutt. Popular on the higher tablelands and tablelands/slopes, especially for early sowing. Late maturing provides extended grazing with excellent grain recovery. Straw is strong and of medium height. Good resistance to frost damage after grazing. Tends to have small grain and a low test weight. Bred by NSW DPI at Glen Innes. Released in 1975.

Brusher.[Φ] A tall, early-mid season hay variety with improved hay digestibility. Resistant and moderately intolerant to cereal cyst nematode. Intolerant of stem nematode. Low husk lignin. Released by SARDI in 2003. AEXCO.

Comet.[Φ] New medium-late maturity grazing variety released by Pacific Seeds, semi-erect early growth, with early growth similar to Aladdin. High level of resistance to leaf rust. Available through Pacific Seeds.

Cooba. Suitable for early sowing, extended grazing and good grain recovery in most areas. Early growth is slow. It is mid season maturing. Medium straw height and strength, average grain size, low husk percentage, high test weight and high groat percentage. Bred by NSW DPI at Glen Innes, selected at Temora. Released in 1961.

Cooee. Forage oat that has good early growth and dry matter production for multiple grazings. Erect habit with good regrowth, with fine stems. Late maturing. Released by Wrightson Seeds in 2010.

Coolabah. Suitable for lenient grazing and good recovery for grain in most areas. Quick early growth. Early maturing. Straw of medium height and strength. Fairly long grain, satisfactory test weight, high husk percentage. Bred by NSW DPI at Temora. Released in 1967.

Drover.[Φ] Intermediate growth habit. Now susceptible to leaf rust due to a new race that appeared in southern Qld in 2013 (in the absence of this race it will appear resistant). Suitable for grazing and hay. Released by Pacific Seeds in 2006.

Eurabbie. Winter habit. Semi-dwarf with similar maturity to Blackbutt and later than Cooba by about 10 days. Can be very short after heavy late grazing, possibly resulting in harvesting difficulties. Grazing management is crucial for high grain recovery yields at sufficient height. Excellent grain recovery yields, despite its susceptibility to BYDV. Grain quality is generally inferior and very similar to Blackbutt in tablelands/slopes situations. Generally lower quality than Cooba from slopes/plains samples. Bred by NSW DPI at Temora. Released in 1998.

Forester.[Φ] Very late hay variety adapted to high rainfall and irrigated cropping regions. It is three days later than Riel and three weeks later than Wintaroo. Forester has excellent early vigour, lodging and shattering resistance. Good foliar disease resistance spectrum. It is moderately susceptible to cereal cyst nematode. Good hay colour, but like all late hay varieties may not resist hot dry winds as well as earlier varieties. Forester has excellent hay quality. Released by SARDI in 2012. Seed of Forester is available from AGF Seeds, Smeaton, Victoria.

Galileo.[Φ] Forage oat that has good emergence, vigour and early growth. Good dry matter production for early grazing. Late maturing, similar to Enterprise. Moderately tolerant to BYDV. Moderately resistant to crown rust. Released by Heritage Seeds in 2006.

Genie.[Φ] Late maturity erect grazing variety with quick early growth and very high dry matter yields. Susceptible to leaf and stem rust in the northern region. Selected for Queensland and northern NSW. Released by DAFF Qld and Heritage Seeds in 2008 and available through Heritage Seeds.

Graza 51.[Φ] Erect, quick growing, medium to late grazing variety developed by Agriculture Canada. Susceptible to leaf and stem rust in the northern region. Released by Pioneer Hi-Bred in 2007. Seed available through Elders.

Graza 80.[Φ] Erect, quick growing, late maturing grazing variety developed by Agriculture Canada. Susceptible to leaf and stem rust in the northern region. Released by Pioneer Hi-Bred in 2005. Seed available through Elders.

Graza 85.[Φ] New grazing forage oat released by Elders. Medium to medium-quick maturity, with good early vigour, quicker to first grazing than Graza 80. A high tillering oat with soft, broad leaves, with a low growing point. Improved tolerance to rust over both Graza 80 and Graza 51. Very limited information available on its performance in NSW. Seed available through Elders.

Kangaroo.[Φ] Tall, mid–late season hay variety. Cereal cyst nematode resistant and moderately tolerant. High husk lignin. Released by SARDI in 2005. AEXCO.

Mannus.[Φ] Tall, strong strawed, mid maturing variety for feed grain. Grain yield after grazing is similar to Eurabbie on the tablelands/slopes but lower on the slopes/plains. Physical grain quality is better than Eurabbie. Large uniform grain size with high test weight, high groat percentage, medium protein and fat content. Low lignin husk. Moderately susceptible to BYDV, better than Eurabbie and Yarran. May exhibit physiological yellowing in winter. Bred by NSW DPI at Temora. Released in 2006. Waratah Seeds.

Disease guide – oats

Disease/Cause	Symptoms	Occurrence	Spread	Control
Foliar Diseases				
Bacterial stripe blight *Pseudomonas striafaciens* pv. *striafaciens*	Water soaked stripes on leaves, drying to tan/red stripes, leaf death.	More severe in early maturing crops in wetter seasons.	Rain splash, insects, seed-borne.	Nil
Barley yellow dwarf *Barley yellow dwarf virus* (BYDV)	Yellowing, dwarfing of infected plants, floret blasting, leaf reddening in some varieties.	Most common near perennial grass pastures and in early sown crops.	Transmitted by aphids from infected grasses and cereals.	Resistant and tolerant varieties; controlling aphids, insecticidal seed treatments.
Leaf (Crown) rust *Puccinia coronata* f.sp. *avenae*	Orange powdery pustules on upper leaf surface.	In wet seasons; more important on the coast.	Air-borne spores from living plants.	Graze infected crops in autumn, Varieties with the best possible field resistance. Foliar fungicides.
Leaf spots Several fungi	Leaf spots, leaf death.	Usually minor.	Depends on disease.	None.
Red leather leaf *Spermospora avenae*	Long lesions with reddish borders and light centres. Leaves may look and feel leathery.	Higher rainfall, cool wet weather.	Oat stubble. Stubble and rain splash.	Avoid susceptible oat varieties and rotate crops.
Stem rust *Puccinia graminis* f.sp. *avenae*	Reddish-brown, powdery, oblong pustules with tattered edges on leaf and stem; progressive death of plant.	More important inland, from spring to summer in warm, wet weather.	Air-borne spores from living plants.	Early maturing varieties to avoid rust. Foliar fungicides.
Smuts				
Smuts *Ustilago avenae, U. segetum* var. *hordei*	Replacement of florets by black sooty mass.	Statewide.	Spores on or in the seed infect the seedling after sowing.	Thorough treatment of seed with appropriate fungicide.

Moola.(Φ) Grazing variety with rapid early growth developed by Agriculture Canada and released in 1998 by DAFF Qld. Susceptible to leaf and stem rust in the northern region.

Mulgara.(Φ) Tall mid season hay oat similar in heading time and height to Wintaroo with cereal cyst nematode and stem nematode resistance and tolerance. Mulgara is an improvement compared to Wintaroo for resistance to stem rust and bacterial blight, lodging and shattering resistance and early vigour. Hay yield is an improvement compared to Brusher but slightly lower than Wintaroo. Hay quality is similar to Wintaroo. Mulgara has excellent hay colour and resists brown leaf at hay cutting. Grain yield and quality is similar to Wintaroo with lower screenings, higher protein and groat percent. Mulgara has high husk lignin. Released by SARDI in 2009. AEXCO.

Nile. A medium height, late maturing variety, producing good winter grazing in tableland districts. Grain recovery yields depend heavily on good late-spring finishing conditions. It has good BYDV tolerance. Released by Tasmanian Department of Agriculture in 1982.

Outback. A forage oat that has quick early growth and dry matter production. Susceptible to leaf rust. Erect habit and mid to late maturity. Released in 2005, marketed by Seed Distributors.

Quoll.(Φ) High yielding semi-dwarf grain oat. Resistant to crown rust and some resistance to stem rust. Released by SARDI in 1999. Heritage Seeds.

Saia. Grazing only type. Has a much smaller seed than most other varieties, so use lower seeding rates. Produces early feed and extended grazing. Recovery from grazing is sometimes poor. Tall, fine, weak straw. Highly tolerant to aluminium and manganese toxicity. Its blackish grain can be regarded as a contaminant if mixed with white grained varieties. Introduced from Brazil.

SF Colossus. A late flowering forage oat suitable for grazing and producing hay. Medium seed size compared to mainline oat varieties reducing overall seed rates(kg/ha). Marketed by Seed Force.

SF Tucana. A late flowering forage oat suitable for grazing and hay production. Seven days later in flowering then SF Colossus. Marketed by Seed Force.

Taipan.(Φ) Erect plant with quick early growth and high dry matter yields. Ideally suited to cattle, particularly in a continuous grazing situation. Susceptible to leaf and stem rust in the northern region. Released by Pacific Seeds in 2001.

Tammar.(Φ) A new tall, late season hay variety, later in cutting time than Kangaroo and Tungoo. Tammar has a good foliar disease resistance profile and is an improvement compared to Tungoo for stem rust resistance. Has good lodging resistance, comparable to Kangaroo. Tammar has excellent hay colour and resists brown leaf at cutting and has similar hay yields to Kangaroo and Tungoo, but lower than Wintaroo. Released by SARDI in 2012. AEXCO.

Tungoo.(Φ) A medium–tall, mid to late season hay variety. Tungoo combines resistance and moderate tolerance to cereal cyst nematode and stem nematode. Resistant red leather leaf. Moderately susceptible to susceptible to stem rust. Moderately resistant to leaf rust. Hay yield is similar to Kangaroo but grain yield and grain quality is poor. Hay quality is similar to Wintaroo (better than Kangaroo), although it tends to be higher in neutral detergent fibre (NDF) than Wintaroo but not as high as Kangaroo. Early vigour is not as good as Kangaroo. Low husk lignin. Released by SARDI in 2010. AEXCO.

Wintaroo.(Φ) A tall, mid season hay variety. Resistant and moderately tolerant to cereal cyst nematode and tolerant to stem nematode. Low husk lignin. Released by SARDI in 2002. AEXCO.

Yarran. A medium height, early–mid season maturing variety for feed grain. Performs better than Coolabah for grain recovery, or grain-only on the slopes/plains, but is slightly inferior to Coolabah for grazing production. In very dry years it outyields Echidna in grain-only trials. Large grain with a high test weight, protein percentage and medium to low husk content. Very susceptible to BYDV. Bred by NSW DPI at Temora. Released in 1988.

Yiddah.(ф) A tall, strong strawed, early maturing variety for feed grain. It can be sown earlier than Yarran and has quicker early feed production. Grain yield after grazing is similar to Yarran. Physical grain quality is better than Yarran. Very large grain with high test weight and protein percentage and low husk content. Low lignin husk. Moderate tolerance to BYDV, effective stem and some crown rust resistance. Bred by NSW DPI at Temora. Released in 2001. Waratah Seeds.

Oat varieties that are no longer in commercial seed production by the respective marketing or seed company but may still be available on a limited basis.

Barcoo. Semi-prostrate grazing variety with medium maturity, suitable for early-mid season sowing, grazing and grain recovery. Released by Pacific Seeds in 1996.

Bass.(ф) Suitable for early sowings on the higher tablelands. Provides extended grazing with good grain recovery. Strong straw. Good BYDV tolerance. Released by the Tasmanian Institute of Agricultural Research and the Department of Primary Industries, Water and the Environment in 1998.

Culgoa II. A semi-prostrate variety mainly for grazing. Slow initial growth. Released by DAFF Qld in 1991.

Dawson.(ф) Medium-late maturity grazing variety with erect early growth and high dry matter yields. Susceptible to leaf rust. Ideally suited to cattle, particularly in a continuous grazing situation. Released by Pacific Seeds in 2008.

Enterprise. Erect grazing forage oat. Provides good early grazing. Poor recovery after hard grazing and/or frosting. After grazing, grain maturity is much later than Blackbutt. Released by Heritage Seeds in 1993.

Graza 50. Erect, quick growing grazing variety developed by Agriculture Canada. Released by Pioneer Hi-Bred in 1994. Austgrains International.

Graza 68. Semi-erect, medium growing grazing variety developed by Agriculture Canada. Released by Pioneer Hi-Bred in 1998. Austgrains International.

Gwydir. Semi-prostrate grazing variety developed jointly by University of Queensland/DAFF Qld/Pacific Seeds. Released by Pacific Seeds in 1999.

Lordship. Long season, late maturing variety. Maturity similar to Enterprise and Graza 50. Excellent early vigour and forage production. Will grow tall if ungrazed but is moderately resistant to lodging. Good BYDV resistance. Released by Heritage Seeds in 2000.

Nugene.(ф) A semi-erect grazing oat with quick early growth. Late maturing after grazing. Susceptible to leaf and stem rust in the northern region. Released by DAFF Qld and Heritage Seeds in 2000. Heritage Seeds.

Quamby. Very erect, similar to Enterprise. Very late maturing. If grazed when tall, does not recover well. Released by Tasmanian Department of Agriculture in 1988.

Volta.(ф) A semi-erect grazing variety. Medium–late maturity. Susceptible to leaf and stem rust in the northern region. Selected for Queensland and northern NSW. Released by DAFF Qld and Heritage Seeds in 2003 and available through Heritage Seeds.

Warrego. A semi-prostrate grazing oat with quick early growth. Developed by North Dakota State University and released by Pacific Seeds in 1999.

Feeding value of oats grain

The GRDC-supported *Premium Grains for Livestock Production* project demonstrated large differences between varieties in whole grain digestibility. Cattle feeding trials have subsequently demonstrated these differences translate into large differences in grain digestibility.

Most of the difference in whole grain digestibility is caused by varietal differences in the lignin content of the oat husk. Where varieties have a high husk lignin content, digestion of both the husk and the underlying grain is poor. Husk lignin content is assessed using a simple staining test (phloroglucinol stain test). A list of lignin ratings of a range of oat varieties is presented in the following table.

While other seasonal factors affect whole grain digestibility, varieties with a high husk lignin rating will inherently have low whole grain digestibility. NIR tests have been developed to measure the feeding value of grains.

Hull lignin rating of a range of oat varieties – low is better for ruminant feed value

Low	Medium	Medium–High	High
Bass, Bimbil, Brusher, Carbeen, Cooba, Eurabbie, Graza 68, Mannus, Mitika, Mulgara, Nile, Tungoo, Wintaroo, Yarran, Yiddah	Blackbutt (variable), Graza 80, Quoll	Euro, Potoroo, Wandering	Bannister, Carrolup, Coolabah, Dawson, Drover, Dunnart, Echidna, Forester, Genie, Graza 50, Kangaroo, Mortlock, Nugene, Possum, Taipan, Williams, Wombat, Yallara

Feed quality tests can accurately measure whole grain digestibility, protein levels and metabolisable energy. For livestock feeding grain protein is an important attribute. Oats can vary widely in protein levels due to varietal factors, paddock variability, fertiliser inputs and yield levels. Oats with low protein levels (<12%) may limit growth rates of young animals.

Oaten hay

For information on quality and marketing of oaten hay, including export options, contact the Australian Fodder Industry Association (AFIA) (see page 59 for details).

Further reading

SARDI website www.sardi.sa.gov.au for new variety brochures and further information on hay only varieties.

Contributing authors

Glenn Roberts, former Oat Breeder, NSW DPI, Temora; Pamela Zwer and Sue Hoppo, Oat Breeders, SARDI, Adelaide; Frank McRae, former Technical Specialist Cereals, NSW DPI, Orange; Bruce Winter, Plant Breeder (Oats), DAFF Qld, Toowoomba.

Industry information

Seed testing laboratories

The key to getting a reliable seed testing result is using an accredited laboratory and making sure you collect a representative sample of your seed lot. There are a number of commercial seed testing services available to growers. The following list is not an exhaustive list and others are available.

SGS Australia Pty Ltd
59 Bancroft Road PINKENBA Queensland 4008
t: 07 3622 4700 f: 07 3622 4770
e: **au.food.agriculture@sgs.com**

Seed Services Australia
Primary Industries and Regions South Australia
GPO Box 1671 ADELAIDE South Australia 5001
t: 1300 928 170 or 08 8303 9549 f: 08 8303 9508
e: **seeds@ruralsolutions.sa.gov.au**

Futari Grain Technology Services
34 Francis Street [PO Box 95] NARRABRI NSW 2390
t: 02 6792 4588 f: 02 6792 4221
e: **info@futari.com.au**

EM Pascoe Seed Testing services
12 Ridge Road GREENSBOROUGH Victoria 3088
t: 03 9434 5072 f: 03 9434 5072
e: **elizabethpascoe@gmail.com**

GrainCorp Technical Services
30 Barwon Street NARRABRI NSW 2390
t: 1800 809 482 or 02 6792 8605 m: 0408 860 995
f: 02 6792 3825
e: **jlowien@graincorp.com.au**

Industry organisations

Australian Fodder Industry Association Inc.
www.afia.org.au
Suite 3.01, 620 St Kilda Road MELBOURNE
Victoria 3004
t: 03 9530 2199 f: 03 9510 7558
e: **info@afia.org.au**

Australian Oilseeds Federation
www.australianoilseeds.com
PO Box H236 AUSTRALIA SQUARE NSW 1215
t: 02 8007 7553 f: 02 8007 7549
e: **aof@australianoilseeds.com**

Grain Growers Association
www.graingrowers.com.au
1 Rivett Rd, Riverside Corporate Park
NORTH RYDE NSW 2113
PO Box 7 NORTH RYDE NSW 1670
t: 1800 620 519 or 02 9888 9600 f: 02 9888 5821
e: **enquiry@graingrowers.com.au**

Grain Trade Australia (GTA)
Formerly National Agricultural Commodities Marketing Association (NACMA)
www.graintrade.org.au
Level 7, 12 O'Connell Street SYDNEY NSW 2000
PO Box R1829 Royal Exchange NSW 1225
t: 02 9235 2155 f: 02 9247 0194
e: **admin@graintrade.org.au**

NSW Durum Wheat Growers Association
Chairman: Ross Durham
Nombi MULLALEY NSW 2379
t: 02 6743 7841 f: 02 6743 7932
m: 0427 437 841

Pulse Australia Ltd
www.pulseaus.com.au
Level 10 Farrer House
24–28 Collins Street MELBOURNE Victoria 3000
t: 03 9004 4081 m: 0425 717 133
e: **tim@pulseaus.com.au**

The University of Sydney
Plant Breeding Unit – Cereal Rust
107 Cobbitty Road COBBITTY NSW 2570
t: 02 9351 8800 f: 02 9351 8875

Variety Central
http://varietycentral.com.au
Contact: Denis McGrath
m: 0408 688 478 f: 03 4206 7015
e: **denis@seedvise.com.au**

National Cereal Rust Survey

Cereal rust samples can be collected and mailed to the address below. Rusted plant samples can be mailed in paper envelopes; do not use plastic wrapping or plastic lined packages.

Send to:
Australian Cereal Rust Survey
Plant Breeding Institute
Private Bag 4011 NARELLAN NSW 2567

Triticale

Crop management

This high yielding feed grain crop is suited to all soil types, but has yield advantages on light, acid soils high in exchangeable aluminium. In these soils, it significantly out-yields wheat, barley and sometimes oats, in all seasonal conditions, wet or dry.

In low soil fertility situations, triticale is very responsive to high inputs of seed and fertiliser. Adequate fertiliser needs to be applied to achieve optimum yields.

On the better wheat soils, and in better seasons, triticale yields are equal to or exceed those of wheat. However, in dry springs triticale yields may be 10–15% below wheat, due to triticale's longer grain filling period.

Triticale often suffers more from frost damage than wheat, hence it should generally be sown later. It flowers earlier than most wheats, but matures at about the same time.

Triticale usually commands a lower price per tonne at the farm gate. An exception to this can be where there is strong local demand for feed grain, where a better cash return with low transport costs could be expected.

Phosphorus. Consider using 15–25 kg P/ha, depending on expected yield, paddock history, soil test results and soil type.

Nitrogen. Give particular attention to nitrogen supply. Triticale used for grazing and grain could use up to 100 kg/ha of N. Consider applying 60–100 kg/ha of N as a topdressing if soil nitrogen levels are low.

Long fallow paddocks following good legume pastures generally have satisfactory nitrogen levels. Long fallow paddocks have the highest yield potential because of stored moisture and have the greatest potential to respond to soil nitrogen. Yield increases are likely when nitrogen is applied to paddocks with low nitrogen status.

The contribution of pulse crops and pastures to soil nitrogen depends on the amount of plant material produced and/or the subsequent grain yield. The actual amount of soil nitrogen accumulated is highly variable.

Cover crop. The low tillering growth of some varieties and good shattering tolerance of triticale has proven useful as a cover crop for undersowing pastures on the slopes and tablelands.

Seeding rates

Aim to achieve the same plant populations as for wheat by setting the seeder 25–40% above the setting recommended for district wheat sowings. The higher setting is needed because:

- the grain is larger than wheat, and flows more slowly.
- the plants tiller less than wheat.

See page 8 for calculating sowing rates.

Purpose/growing conditions	Sowing rate (kg/ha)
Grain only	60–100
Grazing and grain	100–120
Irrigation and favourable environments	100–120
Undersowing pasture	15–30

Check germination and seed size to calculate sowing rate.

Grazing

The ideal stage to start grazing dual-purpose varieties is when plants are well anchored and the canopy has closed. Continuous grazing is better than rotational grazing for fattening stock. Maintain adequate plant material to give continuous and quick regrowth of the crop (1000–1500 kg DM/ha).

For the best recovery after grazing, do not graze below 5 cm for prostrate varieties, and below 10 cm for more erect types.

The higher grazing height is particularly important with the erect growing varieties. Over-grazing greatly reduces the plant's ability to recover. (See *Managing grazing cereals* page 68).

Disease

Triticale is susceptible to loose smut. It is slightly less susceptible to take-all than wheat; early sowing increases the risk. It has vastly superior tolerance over wheat to Septoria tritici blotch. Although it does not usually exhibit severe symptoms of yellow leaf spot, it will harbour this disease.

Growers should check to ensure their current variety has adequate field resistance to both the Jackie and Tobruk pathotypes of stripe rust or consider using foliar fungicides to control the disease.

Seed treatment should be considered for controlling seedling stripe rust in susceptible varieties, especially those sown early for grazing.

Variety selection

Grazing and grain recovery: Endeavour and Tuckerbox.

Outclassed: Breakwell, Crackerjack and Tobruk (all stripe rust).

Grain only: Fusion, Hawkeye, Jaywick, and Yukuri – for main season sowings (mid May–June).

Outclassed: Berkshire, Bogong, Canobolas, Chopper, Rufus, Tahara and Tobruk (for earlier sowings in higher rainfall areas) (all stripe rust).

Marketing

Triticale is predominantly used as a stockfeed, often processed. As with other cereal grains, care is needed when introducing stock to triticale grain.

The market is small compared to other grains like barley. Grain is traded domestically through merchants or direct to end users in the dairy, feedlot, pig and poultry industries.

Dual-purpose yield performance experiments from 2004 to 2009.

Compared with Endeavour = 100%

Variety North	1st Grazing DM Endeavour = 2.63 t/ha	2nd Grazing DM Endeavour = 2.39 t/ha	Grain Recovery Endeavour = 2.41 t/ha
Breakwell▲	99	97	85
Crackerjack▲	103	87	100
Endeavour	**100**	**100**	**100**
Tobruk▲	76	111	111
South	**Endeavour = 2.19 t/ha**	**Endeavour = 2.23 t/ha**	**Endeavour = 2.98 t/ha**
Breakwell▲	93	102	83
Crackerjack▲	101	85	90
Endeavour	**100**	**100**	**100**
Tobruk▲	76	108	110

▲Outclassed – Breakwell, Crackerjack and Tobruk (stripe rust).

Grain only yield performance experiments from 2009 to 2014

Compared with Tahara = 100%

Variety	North-east Hawkeye = 4.05 t/ha	Number of Trials	South-east Hawkeye = 4.39 t/ha	Number of Trials	South-west Hawkeye* = 5.98 t/ha	Number of Trials
Berkshire▲	100	13	97	26	98	5
Bison	107	4	106	7	–	–
Bogong▲	103	13	100	26	101	5
Canobolas▲	101	13	98	26	102	5
Chopper▲	93	13	90	26	83	5
Fusion	107	9	107	19	99	4
Goanna	92	8	91	15	89	3
Hawkeye	100	13	100	26	100	5
Jaywick	97	13	98	26	101	5
KM10	–	–	90	4	–	–
Rufus▲	91	13	90	26	87	5
Tahara▲	90	13	88	26	86	5
Tobruk▲	93	5	84	11	–	–
Tuckerbox	82	11	81	22	84	4
Yowie	91	9	90	19	94	4
Yukuri	79	13	79	26	93	5

▲Outclassed – Berkshire, Bogong, Canobolas, Chopper, Rufus, Tahara and Tobruk (all stripe rust). * Includes some irrigation trials.
No data is available for the NSW north-west region as only a limited number of trials have been conducted in the period of 2009-2014, insufficient for across years and site analysis.
Yield results are a combined across sites analysis of the NVT yield trials from 2009–2014.

Suggested sowing times

Aim to sow in the earlier part of the optimum time indicated to achieve maximum potential yield, particularly in western areas. The actual date selected is influenced by soil moisture, soil fertility and the likelihood of frost in a particular paddock at flowering.

	February		March				April				May				June				July	
Variety Weeks	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2
Endeavour	>	★	★	★	★	★	★	★	<	<										
Tobruk▲		>	★	★	★	★	★	★	★	★	★	★	★	★	<					
Breakwell▲			>	★	★	★	★	★	<	<										
Crackerjack▲, Tuckerbox									>	★	★	★	★	★	★	<				
Berkshire▲, Bison, Bogong▲, Canobolas▲, Credit▲, Fusion, Goanna, Hawkeye, Jaywick, Kosciuszko▲, Rufus▲, Tahara▲, Tickit▲, Yowie, Yukuri											>	★	★	★	★	★	<			
Chopper▲, KM10, Speedee▲												>	>	★	★	★	★	★	<	<

> Earlier than ideal, but acceptable. ★Optimum sowing time. < Later than ideal, but acceptable. ▲Outclassed. Limited data available on Bison, Goanna, KM10 and Yowie in NSW.

Prices offered are often relative to Australian Standard White wheat and are influenced by:

- supply and price of other grains like barley, wheat, sorghum and possibly oats
- quality and quantity of grain
- location of grain and transport costs
- seasonal effects on the grazing industries.

Prices tend to be lowest at, or soon after harvest and rise during winter.

Aim for a maximum 12% moisture, with a test weight of 65 kg/hL with a minimum of admixture. Grain protein and metabolisable energy levels (ME) should be known before negotiating sales. ME levels are similar to wheat.

Since triticale is often grown in acid soils and later in the rotation, low protein grain can result, affecting marketability and price. Adequate nitrogen fertiliser should be applied to alleviate this problem.

Storage

Triticale grain is very prone to weevil attack, more than barley. Be careful of high grain moisture contents (see page 118, *Grain insects – options for control*).

Varietal characteristics

Dual-purpose grazing varieties

Breakwell. Semi-awnless dual-purpose variety. Good straw strength. Better dry matter production than Jackie and superior grain recovery. Later maturing than Jackie (9 days). Cereal cyst nematode resistant. Susceptible–very susceptible to stripe rust. Seed royalty only. Released by University of Sydney in 2004. Waratah Seeds.

Crackerjack.[Φ] Medium season dual-purpose variety. Optimum sowing time mid April onwards. Excellent establishment and early vigour. Excellent grain recovery after grazing and produces grain with a high test weight. Tall when mature and may be prone to lodging if not grazed. Susceptible to stripe rust head infection, rated moderately susceptible to the Tobruk pathotype of stripe rust. Released by Heritage Seeds in 2003.

Endeavour.[Φ] Semi-awnless dual-purpose variety. Excellent dry matter production and grain recovery after grazing. Resistant–moderately resistant to stripe rust. Released by the University of Sydney in 2007. Waratah Seeds.

Tobruk.[Φ] A fully awned, dual-purpose and long season grain-only variety. Strong winter habit. Excellent grain yield after grazing. Moderately susceptible–susceptible to stripe rust. Also susceptible to stripe rust head infection. Consider seed treatment for stripe rust when sown early for grazing. Released by the University of Sydney in 2007. Waratah Seeds.

Tuckerbox. A reduced awn, medium season, tall, dual-purpose triticale. Moderately resistant to stripe rust, resistant to cereal cyst nematode. A variety suitable for hay or silage. Tuckerbox is most suited to production areas of 450 mm annual rainfall or greater, but will grow to maturity in lower rainfall areas or in tough seasons. Approximately one week later than Rufus to heading, slightly earlier than Yukuri. Selected at Sherlock, SA, by Kath Cooper. Non-PBR. Cooper & Elleway and Yankalilla Seeds.

Variety characteristics and reaction to diseases

Variety	Grazing production	Straw strength	Maturity	Resistances						Acid soils–sensitivity to aluminium
				Stem rust	Leaf rust	Stripe rust		Cereal cyst nematode	RLN *P. neglectus*	
						Tobruk Pathotype	Yr 17–27 Pathotype			
Dual-purpose										
Breakwell▲	quick–early	very good	mid–late	R	R	S–VS	MR	R	–	V. Tol
Crackerjack▲	quick–early	moderate	mid	R	MR–MS	MS[a]	R–MR	–	–	–
Endeavour	quick–early	very good	late	R	R	R–MR	R–MR	R	–	V. Tol
Tobruk▲	quick–early	very good	mid–late	R	R	MS–S	MR	–	–	–
Tuckerbox	quick–early	–	mid	MR	R	MR–MS	MR	R	–	V. Tol
Grain only										
Berkshire▲	NR	good	early–mid	R	R–MR	MS	MR–MS	–	–	–
Bison#	NR	good	early–mid	R–MR	R–MR	–	R	R	R	V. Tol
Bogong▲	NR	very good	early–mid	R–MR	R–MR	MS	MR–MS	–	–	V. Tol
Canobolas▲	NR	good	early–mid	R–MR	R–MR	MS–S	MR–MS	–	–	V. Tol
Chopper▲	NR	very good–good	very early	MR–MS	R	MS–S	MR–MS	R	MR	–
Fusion	NR	medium-good	mid	R	R	MR[b]	R–MR	R	R	V.Tol
Goanna#	NR	good	early–mid	R	R–MR	MR–MS	MR	R	–	–
Hawkeye	NR	good	mid	R–MR	R	MR, MS–S[b]	MR, MS[b]	R	R	V. Tol
Jaywick	NR	good	early–mid	MR–MS	R	MR, MR–MS[b]	R–MR, MS[b]	R	R	V. Tol
KM10#	NR	good	very early	R–MR	MR–MS	–	R	S	–	–
Rufus▲	NR	good	early–mid	R–MR	R	MS	MR–MS	R	R – MR	V. Tol
Tahara▲	NR	moderate	early–mid	R–MR	R	MS	MR–MS	R	R	V. Tol
Yowie#	NR	good	mid	R	R	MR–MS, MS[b]	MR	R	–	–
Yukuri	NR	good	mid–late	R	R	R–MR	R–MR	S	–	V. Tol

NR = Not Recommended, R = Resistant, R-MR= Resistant to Moderately Resistant, MR = Moderately Resistant, MR–MS= Moderately Resistant to Moderately Susceptible, MS = Moderately Susceptible, MS–S= Moderately Susceptible to Susceptible, S = Susceptible, S–VS=Susceptible to Very Susceptible, VS=Very Susceptible. V. Tol = Very Tolerant,
[Φ]Outclassed. [a] Susceptible to head infection. [b] mixed population, some plants are more susceptible to stripe rust.
Where ratings are separated by '&' the first is correct for the majority of situations, but different pathotypes are known to exist at a low level and the latter rating reflects the response to these pathotypes. – Unknown or no data. #Limited data available on Bison, Goanna, KM10 and Yowie in NSW.

The following are more recently released varieties with limited data available:

SF Bolt. A new forage triticale bred in New Zealand for lower ADF and higher ME to make it suitable for grazing, green chop or whole crop silage. It can be autumn or spring sown. Very limited data on performance in NSW. Marketed by Seed Force.

Monstress. A new forage triticale specifically targeting grazing and whole crop silage. PGG Wrightson Seeds

Grain only varieties

Berkshire.(Φ) Main season variety, especially suited to the pig industry. Suitable for central and southern NSW, and eastern Victoria. Good straw strength. Moderately susceptible to stripe rust, resistant–moderately resistant to leaf rust and resistant to stem rust. Released by University of Sydney in 2009. Waratah Seeds.

Bogong.(Φ) Early–mid season maturing variety. Maturity is 1–2 days faster than Everest and Treat. Widely adapted spring variety that performs best in medium to high rainfall areas or late maturing environments. Strong straw. Released by the University of New England in 2008. Seednet.

Canobolas.(Φ) Early–mid season maturing variety. Maturity is 1–2 days faster than Everest. Spring variety, suited to the NSW slopes and tablelands. Strong straw. Moderately susceptible–susceptible to the Tobruk pathotype of stripe rust. Released by the University of New England in 2008. Seednet.

Chopper.(Φ) Very early maturing variety, 3–4 days earlier than Speedee and 7–15 days earlier than Tahara. Fully awned spring triticale, a possible replacement for Speedee, offering improved yield and reduced lodging. Suited to short growing seasons or late sowing. Moderately susceptible–susceptible to stripe rust, resistant to leaf rust and moderately resistant to stem rust. Semi-dwarf variety, shorter than many of the current varieties, reducing the risk of lodging. Released by AGT in 2010. Available from AGT Affiliates.

Fusion.(Φ) A mid maturity grain triticale resistant to cereal cyst nematode. Tested as TSA0291, Fusion is a unique line bred from a cross between triticale parents and a bread wheat parent called Stylet. Fusion has a high level of resistance to all three rusts. Fusion maintains exceptionally high yields under tough conditions, such as drought or tight finishes. Fusion is best suited to medium yield potential environments and has performed well across all regions of NSW. Fusion is available through AGT Affiliates. AGT.

Goanna. An early–main season, spring type, grain triticale. Moderately resistant–moderately susceptible to stripe rust, resistant to cereal cyst nematode. Fully-awned, tall, white-chaffed variety. Good physical grain quality. Goanna was bred at Sherlock, South Australia by Kath Cooper. Marketed by Cooper & Elleway.

Hawkeye.(Φ) Broadly adapted mid season variety. Good early vigour and highly stable across environments. Moderately resistant to stripe rust. Some plants may have a higher susceptibility to stripe rust. Resistant to cereal cyst nematode. High yield potential. Excellent physical grain quality. Released by AGT in 2007. Available from AGT Affiliates.

Jaywick.(Φ) Broadly adapted mid season variety. Stable grain yield even in a tough finish. Moderately resistant to stripe rust. Some plants may have a higher susceptibility to stripe rust. Resistant to cereal cyst nematode. Good physical grain quality. Selected from University of Adelaide germplasm. Released by AGT in 2007. Available from AGT Affiliates.

Rufus. Widely adapted main season variety maturing a few days earlier than Tahara. Reduced awn, tall, large grain, suitable for fodder conservation and grain production. Moderately susceptible to stripe rust, resistant to cereal cyst nematode, resistant–moderately resistant to root lesion nematode. Released by University of New England in 2004.

Tahara. A main season variety with wide adaptability. Its straw can be weaker in high yielding conditions, and it has lower grain protein. Moderately susceptible to stripe rust. Cereal cyst nematode resistant. Released by DEPI Victoria in 1987.

Yowie. A later maturing main season variety (slightly later heading than Tahara), spring type, grain triticale. Moderately resistant–moderately susceptible to stripe rust, low level of plants in the variety have lower rating of moderately susceptible. Resistant to cereal cyst nematode. Fully-awned, medium–tall, white-chaffed variety. Selected at Sherlock, South Australia by Kath Cooper. Non-PBR and marketed by Cooper & Elleway.

Yukuri. A later maturing main season variety. Medium height with wheat-like, high test weight grain. It matures 7–10 days later than Tahara. Reduced awns make it suitable for fodder conservation. Resistant–moderately resistant to the Tobruk pathotype of stripe rust. Resistant to stem and leaf rust, although moderately susceptible to Mackellar leaf rust. Released by UNE in 2004. Non-PBR.

New varieties with potential for the 2016 season

Bison.(Φ) Early to mid maturity variety, suited to low to medium yield potential environments. Tested as TSA 0451. Reduced awned variety, possible replacement for Rufus. Resistant to stem rust, moderately resistant to stripe rust and resistant to moderately resistant to leaf rust. Seed expected to be available for the 2016 planting season through AGT Affiliates. AGT.

KM10. Quick maturing line, suited to late sowing or short season environments. Reduced awned variety with quick early growth. May be suitable for fodder production systems as it has good early growth. It could be used as part of an annual ryegrass management program, where sowing is delayed and/or the option for cutting as silage is used. Non PBR variety. Selected at Sherlock, SA, by Kath Cooper. Marketed by Cooper & Elleway.

Further reading

Triticale – a Guide to the Use of Triticale in Livestock Feeds 2002. Grains Research and Development Corporation.

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Cereal rye

Crop management

Cereal rye is a winter growing cereal that tolerates high aluminium levels in acid soils, and performs well on lighter soils. Cereal rye is even more tolerant of high aluminium levels than triticale, also regarded as an acid soil tolerant crop choice. It is used for early sowings as a dual-purpose cereal providing abundant, quick, early stock feed and as a grain-only crop.

Rotations

Paddocks with higher fertility are preferred as most crops are sown for the dual-purposes of grazing and grain. It is often used as a grazed cover crop undersown with sub clover pasture. Tolerance to take-all disease makes cereal rye suitable for sowing after grassy pastures.

Self-sown cereal rye can be a problem in following cereal crops because of a high level of seed dormancy, so it should be sown following wheat. When sown the year before a broadleaf crop such as lupins, volunteer cereal rye can be controlled with herbicides.

Role of cereal rye

Cereal rye is very distinct from wheat for bread-making, the dough lacks elasticity and gas retention properties. Used alone, it produces a distinctive black bread. Lighter rye loaves are produced from rye and wheat mixtures. Rye flour, rye meal and kibbled rye are all end products. Rye flour and meal are used in rye bread and biscuits. Plump grain is highly sought after for kibbled rye manufacture.

Cereal rye should be mixed with other grains when fed to monogastrics, especially chickens. It has a high soluble pentosan content which can cause a decrease in weight gain and sticky droppings in chickens.

Cereal rye is the preferred cereal option for erosion control, as it withstands adverse conditions better than other cereals, such as cold, waterlogging, low soil pH and drought. Cereal rye has a more extensive root system in the top 30 cm than both wheat and oats. This more developed root system increases soil stabilisation and allows the plant to explore more of the topsoil profile, increasing the plants tolerance to dry conditions.

Vineyards sow cereal rye early as a 'between row' green manure crop which is mulched into the soil before vine budburst.

Sowing

Grain only

Cereal rye is adapted to all soils however its major fit is on the lighter acid soils, where yields are usually 70–100% of wheat and triticale, when sown between May and June.

On the more traditional wheat soils, cereal rye yields about 50–70% of wheat. When sown late (in July) and in dry springs cereal rye yields are often less than 50% of comparable wheat yields. Whilst it heads early, its longer grain filling period and later maturity limits its performance in the western areas of the grain belt. Lodging is common.

Grazing and grain recovery

Growth is rapid, with grazing possible four weeks after emergence if tillering and the secondary root system development has occurred to anchor the plant. When sown early, it compares very favourably with other cereals for quick feed, total dry matter production, and grain recovery. Ungrazed crops should be sown from late May until the end of June. Where sown for grain, it should be grazed only if excessive early growth or premature heading is evident. Grazing should be completed by early July.

Seeding rates

Seeding rates vary with seed size, target plant populations and establishment percentage. Growers should target 120–150 plants /m^2 for grazing and grain crops. Higher populations are needed for green manure crops.

Comparative seed rates for grazing and grain crops are 60–70 kg/ha and green manure 80–100 kg/ha.

Harvesting

Grain is harvested at about the same time as wheat. Cereal rye is tall and the bulky straw makes harvest slow due to the large volume of straw going through the harvester.

Harvest as soon as the grain dries and hardens. Ripe crops left to stand are likely to shed grain. Maturity is often uneven, so inspect the whole paddock before harvest.

A standard wheat header is suitable for harvesting cereal rye. Adjustments need to be made to the harvester settings to avoid grain losses and damage because the grain is lighter and longer than wheat. Tall crops are likely to lean or lodge, so crop lifters may be necessary.

Clean out all machinery after harvest to prevent contamination of other cereal grains with cereal rye.

Varieties

Growers should be aware that cereal rye is a cross pollinating species and will outcross. To maintain pure seed and varietal type growers should source new seed on a regular basis from the various seed companies. The availability of seed of the older cereal rye varieties is limited and some may no longer be under commercial seed production.

Ryesun. A main season variety with adequate stem rust resistance. Likely to lodge under good conditions.

Southern Green. Forage rye that was developed for very rapid growth to first grazing. High tiller density and leaf development, and strong tiller survival after initial grazing. Spring habit, likely to lodge under good conditions. Released by Wrightson Seeds.

Vampire.[Φ] A main season cereal rye, with better lodging resistance and higher yield than Ryesun. Rapid early growth, suitable for grazing and grain recovery. Released by the University of Sydney and marketed by Waratah Seeds.

Westwood.[Φ] A main season variety, similar maturity to Ryesun. Adequate stem and leaf rust resistance. Higher yielding and better lodging resistance than Ryesun. Seed Royalties apply. Released by George Weston Technologies in 2003.

Diseases

Cereal rye has tolerance to take all, making it a useful break crop following grassy pastures. All commercial cereal rye varieties have resistance to the current pathotypes of stripe rust. However the out-crossing nature of the species will mean that under high disease pressure, a proportion of the crop (approaching 15–20% of the plant population) may show evidence of the disease. Other diseases are usually insignificant.

Marketing

Grain is generally traded direct to merchants, with prices fluctuating according to supply and demand. Some merchants may offer sowing contracts usually with a guaranteed price based on a fixed area and estimated yield. Seek out all the available market opportunities before embarking on growing for grain production only.

Grain receival standards will be dependent on contractual arrangements with your buyer, growers should confirm these prior to entering into any contracts. The current GTA standard for cereal rye grain CSG-60 is a minimum test weight of 70 kg/hL with maximum screenings of 5% through a 1.6 mm screen.

Contributing authors

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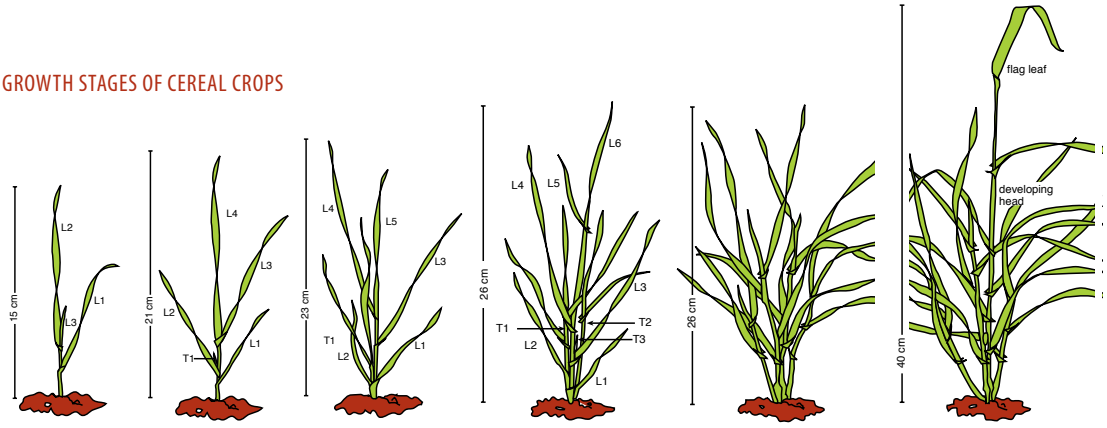
GROWTH STAGES OF CEREAL CROPS



Crop growth stage					
2-leaf stage Two leaves (L) have unfolded; third leaf present, yet to fully expand.	**Start of tillering** First tiller (T1) appears from between a lower leaf and the main shoot. Usually 3 or 4 leaves are on the main tiller.	**Tillering stage** Tillers come from the base where leaves join the stem and continue forming, usually until there are 5 leaves on the main shoot. Secondary roots developing.	**Fully tillered stage** Usually no more tillers form after the very young head starts forming in the main tiller. Tillering completed when first node detected at base of main stem.	**Start of jointing** Jointing or node formation starts at the end of tillering. Small swellings – joints – form at the bottom of the main tiller. Heads continue developing and can be seen by dissecting a stem.	**Early boot stage** The last leaf to form – the flag leaf – appears on top of the extended stem. The developing head can be felt as a swelling in the stem.
Zadoks decimal code					
2 leaves unfolded (Z12).	4 leaves unfolded (Z14). Main shoot and 1 tiller (Z21).	5 leaves on main shoot or stem (Z15). Main shoot and 1 tiller (Z21).	6 leaves on the main shoot or stem (Z16). Main shoot and three tillers (Z23).	First node formed at base of main tiller (Z31).	Z35–Z45.

There is no difference between spring wheat varieties sown on the same day in the rate of appearance of new leaves.
At the early boot stage, the last flowering part – the pollen – is being formed. This occurs earlier in barley than in wheat or triticale.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Pyrinex Super

Managing grazing cereals

Choosing a cereal

Forage and dual-purpose cereals are normally grown to help overcome winter feed shortages.

Oats and other grazing cereals have higher winter growth rates than most pastures. Saved autumn growth from early sown crops can also be used to carry feed through into winter. Selection of the type of crop, variety and sowing time will influence the total amount of feed available. Dual-purpose varieties should be chosen where a grain harvest is required after grazing. For hay production, cereal types with large awns such as barley, some triticales, cereal rye and some wheats should be avoided. The same applies with grazing when head emergence cannot be controlled.

Ideally there should only be one type of cereal sown in a paddock as stock can preferentially graze one cereal over another.

Oats will generally produce more overall forage than wheat, barley, cereal rye or triticale. Grain recovery, however is not so clear cut, with winter wheats and triticale often having similar, or better yields than oats.

Average dry matter yield performance for cereals in NSW

Crop type	Dry matter 1# (kg/ha)	Dry matter 2# (kg/ha)
Oats	2593	2324
Barley	2183	2570
Wheat	1922	2222
Triticale	2303	2525

Dry matter results are an average of combined across sites analysis for each crop type from the NSW DPI mixed cereal trials in NSW from 2004–2010.

Quality tests on the forage value of oats, wheat, barley, cereal rye and triticale grown under similar conditions, show no significant differences in protein, energy and digestibility. The decision to sow an alternative cereal to oats is therefore mostly made with regard to paddock suitability, grain recovery and expected higher grain returns. Soil acidity also influences cereal choice, as species and/or varieties vary in their tolerance to soil aluminium. Even when highly acid soils are limed, acid tolerant types should be grown where the subsoil is acidic.

Consideration should also be given to the diseases that affect the various grazing cereals. Diseases such as *Barley yellow dwarf virus* (BYDV) or *Wheat streak mosaic virus* may limit what is grown in a particular area. The availability of seed insecticide dressings may reduce the impact of diseases such as BYDV on the crop by reducing the levels of early aphid feeding activity which spreads the virus. See page 123 for a list of currently available seed dressings for aphid control.

Growth habit

Knowledge of the winter habit and maturity of varieties will influence the choice of variety, sowing time and expected grazing performance.

Winter habit

Varieties with a strong winter habit, such as Mackellar wheat and Blackbutt oats, are suitable for early sowing as head initiation does not occur until there has been exposure to periods of cold temperature – vernalisation (this exposure can be cumulative). Once these requirements have been met, head initiation begins as warmer temperatures and increasing daylength occurs. The degree of winter habit will depend on the genetics of each variety. Varieties described as semi-winter types require a shorter cold temperature exposure to initiate heading.

Maturity

Cereals described as late maturing do not necessarily have a strong winter habit. Without this requirement for vernalisation, these types, when sown early in warm/long day conditions, will quickly initiate heads. Removal of the immature heads with grazing will kill tillers with subsequent loss in forage production from delayed regrowth. Late maturing types without a winter habit, when sown early, often require quick early grazing to retard early growth and head initiation. This earlier-than-normal grazing will assist subsequent regrowth.

Sowing

Cereals used for either grazing or grain production, will only attain maximum production if seed rates are kept high and crop nutrition is adequate. Optimum seed rates will vary with climate and region. Nutritional requirements will likewise vary according to climate, soil type and paddock history. Where nitrogen fertiliser is required, split applications are suitable for dual-purpose cereals. For example, applying some nitrogen at sowing and follow-up with topdressing/s after grazing for subsequent hay/silage or grain production.

Early sowings, particularly on the higher tablelands, will allow more growth before the onset of cold winter temperatures. However, sowing too early in other areas can cause germination and establishment problems if soil temperatures are high.

Early crop vigour may be reduced with stubble retention and reduced tillage practices.

Wide row sowings can also affect forage yields. At Gulgong, for instance, on a light granite soil, a 25 cm row spacing compared to a 17.5 cm row spacing resulted in a reduction of nearly 12% in early dry matter production of Coolabah oats. Wide rows and low seeding rates may however help to reduce leaf diseases.

Grazing management

The earliest time to start grazing is when the plants are well anchored and reach the tillering stage (Zadoks 21–29). For most grazing types under good growing conditions this will occur 6–8 weeks after plant emergence, depending on variety. Should you need to graze earlier than this, check how well the young plants are anchored by doing a 'twist and pull test' by holding the plant between the thumb and forefinger and pulling as you twist the plant. If the plant remains anchored, it should not be pulled out by grazing livestock. At this early stage, choosing livestock with sound teeth will help reduce any plant damage.

Grazing withholding periods must be observed on crops sown with treated seed. Withholding periods vary from a few days up to 12 weeks depending on the product and rate used. For the current withholding periods for the main seed fungicide and insecticide dressings, see pages 122 and 123. Always check the pesticide label before grazing cereal crops sown with treated seed.

Delaying early grazing of winter types allows more feed to be accumulated and saved for winter. For erect types, crops should be 20–25 cm high and for prostrate types, 10–15 cm high. Varieties without a strong winter habit but sown in early autumn should be grazed pre-tillering to retard growth and prevent premature stem elongation/head initiation. When stem elongation occurs, immature heads are located just above the highest node (joint). If these are removed by grazing, tiller death occurs and while the plant is usually able to produce more tillers, forage production (and grain production) is severely reduced.

The latest time and severity of grazing of crops intended for grain recovery or hay production should be governed by the position of the immature head in the stem. Stock should be removed at the latest by growth stage Z31, this can be determined by examining the plant for the first sign of stem elongation and the presence of the developing head (see *Growth stages of cereal crops*, page 65). The beginning of stem elongation can be seen by slicing the main tiller with a sharp blade to expose the developing head as shown by the figure above.

Z31 is determined when the first node is 1 cm or more above the base of the shoot and the gap between the first node and the second is less than 2 cm.

Some growers choose to graze later and remove these heads, particularly if they need the feed for livestock or if the crop or variety is prone to lodging. These growers accept lower grain or hay yields as a 'trade-off'. Late grazing of semi-dwarf types can also greatly reduce crop height possibly causing harvesting problems in rocky or uneven paddocks.

All cereals in the vegetative stage under good growing conditions are highly digestible and often contain 80–85% moisture (15–20% dry matter). The resultant loose faeces of stock is regarded as normal on highly digestible, high moisture, green feed. Adding hay or roughage to the diet will reduce animal performance as the animal substitutes the hay/roughage for the higher quality forage. In some cases, this may be of benefit by extending the grazing life of the crop. Veterinary advice should be sought if abnormal scouring occurs, as there are many non-nutritional causes of scours including internal parasites.

Relative to the mineral requirements of grazing livestock, the forage of dual-purpose wheat (*Triticum aestivum*) has a very high potassium (K) content and is deficient in sodium (Na), due to the effects of the KNa1 gene. Wheat forage is also often marginal for magnesium (Mg) and the very high K:Na ratio of consumed forage also impedes gut Mg absorption. Livestock grazing wheat will therefore benefit from supplementation with Na and Mg. Supplements of Na:Mg in the form of 1:1 granular salt:Causmag (grade AL4) have consistently shown 25–30% increases in growth rates of sheep and cattle grazing wheat. Trough feeding rates should be sufficient to allow intakes of 20 g supplement/day in growing sheep or 150–180 g/day in growing cattle. At this feeding rate, supplementation is economically worthwhile; the value of the improved liveweight gain can be 15–20 times the cost of the supplement costs. Oat and barley forage have much higher Na contents and higher Mg content than wheat forage and as a result, livestock grazing oats or barley have not responded to Na:Mg supplements.

Leaf diseases such as rust (oats) or powdery mildew (barley) may also influence the timing and severity of grazing. By removing the canopy and 'opening-up' the crop, the incidence and severity of leaf diseases can be greatly reduced.

Stocking rates

Stocking densities will depend on specific animal production targets. Research has shown that continuous grazing of winter forage cereals gives better animal performance as the best feed on offer will always be selected. This will only be achieved if stocking rates are balanced with crop growth rates and the feed on offer is not being significantly depleted (see table).

Growers should consider developing a feed budget to work out how much feed will be required by a set livestock mob and how many grazing days may be available from a particular paddock. This will maximise overall feed production on the whole farm, particularly in high stocking density situations.

High stocking densities are used under rotational grazing but lower animal performance can be expected than from continuous grazing. With continuous grazing, stock densities should be set so as to leave plants with enough residual leaf material to enable both good regrowth and animal performance. Benchmarks exist for both purposes. Residual plant heights of around 5–10 cm for prostrate types and 10–20 cm for erect types will correspond fairly closely to benchmarks of around 1000–1500 kg/ha of dry matter, suitable for lactating ewes, fattening steers and all other classes of livestock.

Feed on offer to stock can be estimated by using crop height as an indicator or by taking physical crop dry matter cuts. The table below shows an estimated relationship between crop height and available DM (kg/ha) for crops 25 cm or shorter. This table should be used as a guide only with dry matter cuts needing to be taken for a more precise estimate.

Crop	Relationship to crop height DM per each 1 cm crop height#
Wheat	60 kg DM/ha
Barley	75 kg DM/ha
Oats	65 kg DM/ha

These relationships are based on a 20 cm row spacing for crops sown at 100 kg/ha. Subtract or add 10% to the estimate for every 2.5 cm increase or decrease in row spacing.
Source: Mingenew–Irwin group – Grazing cereals fact sheet.

Rotational grazing can be used to maximise the grazing value of a crop, by reducing wastage from trampling and/or frost damage or by the restriction of intake per head. Techniques such as strip grazing or limiting access times to the crop can also be used for rationing feed.

Sustainable continuous stocking rate for oats

Stock Class	Kg of forage dry matter removed per head*	Sustained Stocking Rate/ha**
Ewes and lambs (6 weeks)	3.2	9.3
Weaned lambs (30 kg)	2.0	15.0
350 kg steers	12.4	2.4
450 kg steers	13.9	2.1
Cow and calf (3 months)	19.1	1.5

* Calculated using GrazFeed™ for green oats at 2000 kg DM/ha, 20 cm tall, 73% DDM assuming 25% spoilage rate.
** Assuming 30 kg DM / ha / day crop growth.
DM – Dry matter. DDM – Digestible dry matter.

Livestock health

Enterotoxaemia (pulpy kidney), hypomagnesaemia (grass tetany), hypocalcaemia (milk fever), bone growth disorders in lambs (rickets), photosensitisation in sheep and nitrate poisoning are some of the possible livestock health disorders that might occur under certain growing and management conditions. Seek advice and plan to minimise the possibility of animal health disorders, for example, ensure stock are vaccinated, graze classes of stock that are less likely to suffer from grass tetany and be careful when introducing stock to grazing crops. Never put hungry stock straight onto a young crop and be careful re-grazing a crop that has recently been topdressed with nitrogen.

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Canola

Crop management

Canola is an excellent 'break' crop as it provides the opportunity to control a range of weeds, especially grasses that can host the cereal root diseases take-all and crown rot. It can be an important tool in the management of herbicide resistance. Canola is best grown as the first crop following legume pasture or after a cereal in a cropping rotation. Cereal stubble paddocks are generally suitable provided there are no herbicide residues and crop nutrition, particularly nitrogen and sulfur, are properly managed.

Canola will grow in a range of soils but is best suited to high fertility paddocks free of hard pans, crusting, waterlogging and subsoil constraints. Avoid acid soils, especially those with high aluminium levels. Do a soil test to determine pH and nutrient status for both the 0–10 cm and the 10–20 cm depths if there is a risk of a deeper acid layer. This can occur after a paddock has been limed to correct a surface pH problem. Avoid paddocks with major weed problems or choose an appropriate herbicide tolerant variety.

Maintain an adequate break between canola crops to minimise the risk of yield losses from blackleg and sclerotinia stem rot. Select a paddock as far from last year's canola stubble as possible to minimise the blackleg spore load reaching the new crop. A minimum distance of 500 m is recommended.

Canola is very sensitive to some herbicides and soil residual herbicides. Spray equipment previously used to apply sulfonylurea herbicides such as Glean®, Ally®, Logran®, Monza® and Hussar® or other Group B herbicides should be thoroughly decontaminated with fresh chlorine bleach before using on canola. This will minimise the risk of herbicide residues damaging the canola crop.

Sowing

Canola can be sown using no-till techniques or sown into a well-prepared, cultivated seedbed. When sowing into cereal stubble ensure that straw and header trash is pushed away from the sowing row. Stubble covering the row can reduce canola emergence and early plant growth to significantly reduce yield. Where conditions allow, aim to drill seed through the main seed box to 1.5–3 cm deep and up to 5 cm in self-mulching clays. Where there is moisture below 1.5–3 cm, a reduced but viable establishment may still be achieved by sowing deeper, provided large seed is sown. This strategy can be used to sow some crop on time in seasons of good summer rainfall that are followed by drying surface seedbeds in autumn. Success with this strategy is very dependent on soil type, soil structure and the amount and timing of follow-up rainfall. Use rollers, cultipackers or press wheels to improve seed-soil contact where appropriate, ensuring the pressure applied by these devices is low.

Aim for 40–60 plants/m² (20–40 plants/m² in northern and western NSW) which can normally be achieved with 2–4 kg/ha of seed. Plant densities as low as 15 plants/m², if consistent across a paddock, can still result in profitable crops when sown early and plants have time to compensate. Seed size varies between and within varieties and hybrids. Check seed size to calculate the correct number of seeds per square metre to be sown.

Establishment can be significantly reduced by sowing too deep, sowing late into cold, wet soils and no-till sowing into dense stubble. Use the higher seed rate, consider sowing the seed at a shallower depth or select a variety/hybrid with high vigour in these situations. Hybrids are generally more vigorous than open-pollinated varieties, primarily because of larger seed size. Where seed is retained on-farm, grade seed and keep the largest seed for sowing.

High plant densities, combined with suitable environmental conditions can increase the risk of sclerotinia stem rot infection during flowering.

High plant densities can also increase the risk of moisture deficit during grain fill in dry spring conditions, potentially reducing yields.

Suggested sowing times

Region		April				May				June			
Week		1	2	3	4	1	2	3	4	1	2	3	4
Northern	West												
	East												
Central	West												
	East												
Southern	West												
	East												
	Irrigation												

Best sowing time

Earlier or later than desirable, possible yield reduction
Earlier – too vegetative, lodging, disease and/or frost risk
Later – spring moisture and heat stress

Too late for good yields, unless favourable spring

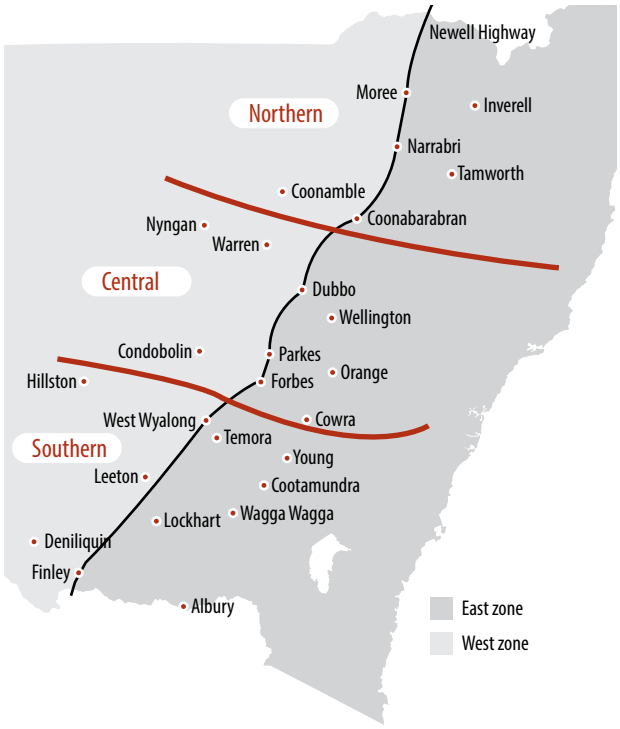
Northern region. In the western zone commence sowing mid maturing varieties in late April. Sow early maturing varieties about 2 weeks later than mid maturing varieties to minimise the risk of frost damage. In the eastern zone commence from the first week of May and finish by the end of May. Delay sowing further in frost prone areas.

Central and southern regions. Have paddocks ready to sow by mid to late April. An early break, allowing sowing to occur from mid to late April maximises yield potential and oil content. Sowing before mid April may lead to crops becoming too vegetative, increasing their susceptibility to lodging, disease and moisture stress during pod fill. They can also be at greater

risk of frost damage. For these reasons longer season varieties should be chosen for early sowings so that flowering and pod-filling occurs in a period of lower frost risk and lower risk of spring moisture and heat stress. Where there is a low risk of frost damage at early pod-fill, early maturing varieties can be planted from the second week of April in the western zone.

In the eastern zone of central and southern NSW sow mid–late maturing varieties at the start of the sowing window and early maturing varieties towards the end of the sowing window. Aim to finish sowing by mid May in the better rainfall areas. Yields can fall by 10% per week after this period.

Southern irrigation areas. Sowing time is often determined by the close to the irrigation season. The risk of winter waterlogging, spring water availability and the risk of high spring temperatures are other considerations. These factors need to be taken into account when choosing a variety with suitable maturity. For most situations mid to early-mid maturing varieties are preferred.



For all regions the suggested sowing times are provided as a guide.

Nutrition

Nitrogen (N). High yielding crops need high nitrogen levels, which can be provided by 2–4 years of legume dominant pasture or by applying adequate N before, at or after sowing. Split applying N at, or just prior to sowing, followed by topdressing in the vegetative stage is a very effective strategy, allowing N requirements to be adjusted as seasonal conditions dictate. Crops can be topdressed until the stem elongation stage. Topdressing at early flowering may still be economic in some situations and seasons. However, the total amount of nitrogen is more important than the timing. Deep soil testing for N before sowing or during the seedling stage will help determine appropriate N rates and timing. Where canola follows cereal crops of 3 t/ha or more, consider applying 75–125 kg N/ha if 2–3 t/ha canola yields are anticipated. The continuous cropping systems of the past 20 years are depleting soil fertility. Growing a pulse crop such as field peas and spraying it out (brown manuring) the year before sowing canola can be useful for fixing and conserving more organic N, controlling weeds and storing more soil water as the fallow period is extended.

Canola is sensitive to fertiliser toxicity. No more than 10 kg/ha of N should be sown in direct contact with the seed in eastern zones of central and southern NSW. In the northern region, and for early sowings in western zones of the centre and south, limit rates to a maximum 5 kg N/ha with the seed, especially on row spacings of 30 cm and wider.

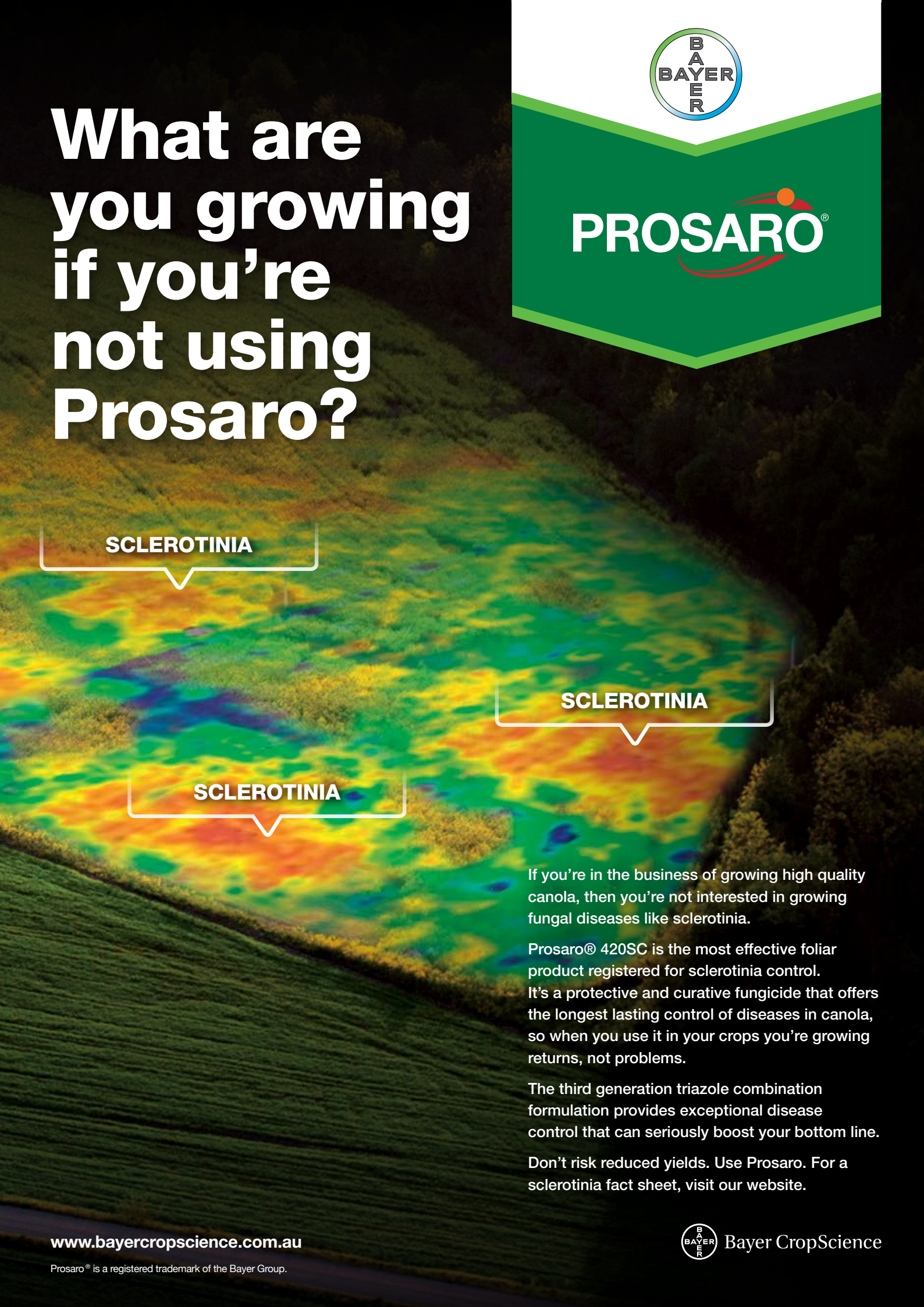
Sulfur (S). Canola has a high sulfur requirement – more than double that of wheat. Apply 25 kg/ha of sulfate S (not elemental S), unless local experience clearly indicates that your soil is not deficient or that a lower rate is adequate. Recent research has not been able to demonstrate consistent responses to applied sulfur. Apply sulfur fertiliser test strips at sowing to confirm that sulfur is not lacking. Sulfur deficiency can be quickly corrected in-crop by applying sulfate of ammonia.

The main sources of sulfur are sulfate of ammonia, gypsum and single super.

Phosphorus (P). Ensure that adequate P is applied at sowing. Unless you are planting into a soil high in P, apply at least 8 kg/ha of P for every tonne of canola you expect to harvest. For example apply 20 kg/ha of P if your target yield is 2.5 t/ha. Low or deficient P levels may limit the potential of the crop to respond to nitrogen. Research has shown that canola may respond to higher rates of up to 12 kg P/ha for every tonne of grain yield in responsive soils. As with nitrogen, canola seed is sensitive to phosphate fertilisers. Avoid drilling high rates of phosphorus in direct contact with canola seed.

Micronutrients. Several micronutrients including boron, molybdenum and zinc are known to be essential for healthy, high yielding canola crops. In soils with a long cropping history or where deficiencies are suspected, the use of a supplemented fertiliser at sowing should be considered. Some micronutrients can be applied with pre-emergent herbicides. Check to ensure compatibility.

What are you growing if you're not using Prosaro?



PROSARO®

If you're in the business of growing high quality canola, then you're not interested in growing fungal diseases like sclerotinia.

Prosaro® 420SC is the most effective foliar product registered for sclerotinia control. It's a protective and curative fungicide that offers the longest lasting control of diseases in canola, so when you use it in your crops you're growing returns, not problems.

The third generation triazole combination formulation provides exceptional disease control that can seriously boost your bottom line.

Don't risk reduced yields. Use Prosaro. For a sclerotinia fact sheet, visit our website.

www.bayercropscience.com.au

Bayer CropScience

Pests

There are a number of pests that can impact on canola crops, particularly during emergence, early seedling and flowering growth stages. Pests are best managed using an Integrated Pest Management (IPM) approach. Careful planning prior to sowing, followed by regular monitoring of crops after sowing will ensure potential problems are identified and, if necessary, treated early.

Earth mite

Earth mites are the major pests of seedling canola, especially in central and southern NSW. Damage can be caused by redlegged earth mites (RLEM) and blue oat mites (BOM), which often occur in mixed populations. Bryobia mites are an increasing problem in some areas. A good mite control program starts with a population reduction treatment the previous spring. Learn to identify these three species of mites to ensure that the correct insecticide and rate is applied to the correct species.

Bare earth treatments. Germinating and establishing crops can be protected by:

- Boom spraying the soil surface of previous pasture or high-risk paddocks with a residual insecticide immediately after sowing.
- Perimeter spraying bare ground in low-risk paddocks, not forgetting to spray around trees, rocky outcrops and dams, and along water flow lines. If you are unsure of the level of risk from mites, spray the whole paddock.

There are three registered bare earth sprays that will give several weeks residual protection. Bifenthrin is registered for RLEM, BOM and bryobia mites but the application rate varies according to the mite species being targeted. Alpha-cypermethrin will control RLEM whilst methidathion is registered for both RLEM and BOM.

Seed dressings. Imidacloprid (refer page 124) and Poncho® Plus (clothianidin + imidacloprid) are registered for use on canola seed for protection against RLEM, BOM and aphids. Poncho® Plus is also registered to control Lucerne flea, wireworm and cutworm. A third seed dressing, Cruiser® Opti (thiamethoxam +lambda-cyhalothrin) is registered for suppression of RLEM and Lucerne flea. These seed dressings will protect emerging seedlings for 3–5 weeks after sowing. Use treated seed following a pasture phase if a well-timed spring spray of insecticide has been applied. Apply a bare earth border spray where untreated pastures border the canola crop. Seed companies can supply seed pre-treated with imidacloprid, Poncho® Plus and Cruiser® Opti.

Cosmos® Insecticidal Seed Treatment (a.i. fipronil) is also registered for control of RLEM in canola.

Even where a seed dressing or bare earth treatment has been used it is advisable to regularly check seedling canola for mite damage.

Lucerne flea

Lucerne flea is an occasional pest of establishing canola crops. The pest is identified by its action of jumping and hopping between plants rather than flying. It is present across a range of soil types in southern NSW. Early sown crops are more at risk of attack. Frequent crop inspection from the time of emergence and early control measures are important because of the impact of seedling vigour on crop performance. Ensure that monitoring is sufficient to detect localised patches or 'hot spots'. Seek advice on management and spray strategies.

Slugs

Slugs are a potential problem along the northern, central and southern slopes, and occasionally adjacent to rivers on the western plains. Slugs kill plants at the seedling and rosette stages and can leave large bare soil areas.

Slugs are favoured by wet springs and summers, where abundant growth and damp conditions provide an ideal habitat. This allows slugs to breed and survive into autumn and winter, when they attack newly sown crops.

Canola sown into dense stubble or adjacent to grassy fence lines, creek banks or damp areas is at greatest risk as these areas provide an ideal habitat for slugs to survive over summer. Heavy, cracking soils provide additional hiding places for slugs.

Closely monitor crops at risk for 6–8 weeks after sowing so that any infestation can be treated with slug pellets containing metaldehyde.

Diamondback moth

Diamondback moth (DBM) has been observed in canola crops for many years in NSW. The summer of 2001/02 favoured their build-up and they became a serious pest in the drought of 2002. Few if any crops have required spraying since, despite major drought in 2006 and 2009. Caterpillars of DBM do most damage when large numbers are present in seedling crops or when they move from leaves to graze developing pods during crop ripening. DBM has developed resistance to a range of insecticides. Future management will involve regular monitoring and careful selection of control methods.

Aphids

Aphid flights can occur in autumn and winter in some years and can infest young canola crops. Crops may need to be treated with insecticide to prevent transmission of virus diseases, but also to reduce seedling damage and the risk of spring infestations. The Green peach aphid is the major vector of *Beet western yellows virus* which caused some crop damage in southern and central NSW in 2014. Imidacloprid, Poncho® Plus and Cruiser® Opti. treated seed will protect seedling canola for up to 5 weeks. This is especially important in seasons and at sites where early infestation with aphids occurs. A new GRDC Grownotes publication *Reducing aphid and virus risk* is available at **www.grdc.com.au/Resources/Factsheets/2015/02/Reducing-aphid-and-virus-risk**. Green peach aphid has developed resistance to the synthetic pyrethroid, carbamate and organophosphate groups of insecticides. Transform™ (sulfoxaflor) is a new selective insecticide for control of early season infestations of Green peach aphid.

Aphids can also infest crops in the spring, especially in years of moisture stress. High aphid populations are more evident and potentially damaging in dry seasons. Monitoring for beneficial insects is very important as control may not be justified in some cases. If control is warranted, careful selection of an insecticide is essential to ensure that damage is not caused to nearby bee hives or to beneficial insects within the crop. Ensure the harvest withholding period (WHP) of the insecticide is adhered to. Seek advice on thresholds and product registrations or permits before spraying.

Helicoverpa (heliothis) caterpillars

Helicoverpa caterpillars are an occasional pest of canola in southern NSW and may require control measures if they are present in high numbers. In central and northern NSW they are a more frequent pest. Because of the seasonal variation in incidence and timing of infestation relative to crop growth stage, growers should seek advice and check the harvest WHP of the chosen insecticide before deciding to spray.

Other soil pests

As with slugs, there are increasing reports of **European earwigs** causing significant damage to emerging crops, particularly in the South West Slopes region. Stubble retention in combination with wet springs and summers and an early autumn break appear to favour the build-up of these insects. The damage caused by earwigs can be difficult to identify and as control can also be difficult growers should seek advice if they either suspect or see earwigs.

A number of soil dwelling insect pests such as **cutworms, wireworms, bronzed field beetle, cockchafers** and **false wireworms** have caused damage to emerging canola seedlings in recent years. In severe cases plant stands can be thinned to such an extent that the paddock requires re-sowing. Occurrence of these pests is difficult to predict so advice on their control should be sought prior to sowing if any problems are foreseen. The most severe damage tends to occur in crops following pasture or where stubble has been retained.

Disease

Blackleg

Blackleg is the most important disease of canola, but management of the disease does not have to be complex. The most effective strategies to reduce the severity of blackleg include growing varieties with an adequate level of resistance for your district, separating this year's crop from last year's canola stubble by at least 500 m and using a fungicide seed dressing or fungicide amended fertiliser.

Typically around 90% of spores that infect new season crops originate from the previous year's stubble. However, significant numbers of spores from two year old stubble may be produced if seasonal conditions have been dry or the stubble is still largely intact. Spores can travel 1–2 km on the wind but most of them originate more locally. A buffer distance of at least 500 m and up to 1 km is recommended. Use of the fungicide seed dressings containing fluquinconazole or fertiliser treated with flutriafol will also assist in minimising the effects of blackleg and protect seedlings from early infection which later cause stem canker development. Whilst raking and burning can reduce canola stubble by up to 60%, it is the least effective strategy in managing blackleg and is therefore not generally recommended.

Blackleg resistance groups. All current canola varieties are now assessed for the presence of resistance genes and classified into resistance groups. If the same variety has been grown for two or more seasons, consider changing varieties this season. Consult the *Blackleg management guide* on the GRDC website **www.grdc.com.au/GRDC-FS-BlacklegManagementGuide**, to determine the resistance group for your current canola varieties and select future varieties that belong to a different group.

Blackleg rating. All varieties are rated according to the independent Australian National Blackleg Resistance rating system to which all canola breeding companies are participants. The relative differences between varieties are as follows:

- Resistant: R
- Resistant to Moderately Resistant: R–MR
- Moderately Resistant: MR
- Moderately Resistant to Moderately Susceptible: MR–MS
- Moderately Susceptible: MS
- Moderately Susceptible to Susceptible: MS–S
- Susceptible: S
- Susceptible to Very Susceptible: S–VS
- Very Susceptible: VS

Varieties with a rating of 'Resistant' (R) in high blackleg risk areas and at least 'Moderately Resistant' (MR) in lower blackleg risk areas will normally give sufficient disease protection.

The blackleg resistance rating for each variety is listed in the Varietal characteristics section on the following page. **Please note they are the ratings released in spring 2014**. Blackleg resistance ratings can change from year to year. New ratings for 2015 will be available from the GRDC website.

Sclerotinia

Sclerotinia stem rot is a fungal disease that can infect a wide range of broadleaf plants including canola. Disease development is favoured by prolonged wet conditions in late winter followed by periods of prolonged leaf wetness during flowering. Yield losses range from 0–20% in some years, but losses have been as high as 35% in the past. Districts with reliable spring rainfall and long flowering periods for canola appear to develop the disease more frequently. Continual wheat/canola rotations are also very effective at building up levels of soil-borne sclerotia. Burning canola stubble will not effectively control Sclerotinia as sclerotia survive mainly on or in the soil. Crop rotation with cereals, following recommended sowing times and ensuring crops do not develop heavy vegetative growth, which are likely to reduce air circulation, are the best means of reducing the impact of the disease. The inconsistent

relationship between the level of stem infection and yield loss make it difficult to reliably predict an economic response from using foliar fungicides in any one year. The environmental conditions for Sclerotinia to develop are very specific and will not occur every year, so even when the fungus is present the disease may fail to develop in dry conditions. Consult your farm adviser and refer to the Fact Sheet *Sclerotinia stem rot in canola* on the GRDC website **www.grdc.com.au/GRDC-FS-Sclerotinia**. The fungicide Prosaro®, along with iprodione and some procymidone products are registered for the management of Sclerotinia.

Viral diseases

Three virus species have been recorded in canola in Australia: B*eet western yellows virus* (BWYV), *Turnip mosaic virus* (TuMV) and *Cauliflower mosaic virus* (CaMV). Of these, BWYV is the more common and has potential to cause yield losses in canola. Commercial canola varieties appear resistant to TuMV. However, some lines of condiment mustard and juncea canola (both *Brassica juncea*) have been severely affected by TuMV in trials in northern NSW. The importance of CaMV in canola and *B. juncea* is not known. All three viruses are spread by aphids from weeds which act as hosts. BWYV can come from a range of weed, pasture and crop species. Turnip weed, wild radish and other *Brassica* weeds are important hosts of TuMV.

Substantial yield losses from viruses, particularly BWYV, can occur even when there are no obvious symptoms. Seed treated with either imidacloprid or Poncho® Plus is recommended to protect crops from early infestation with aphids. Further information on viruses and control options is available in Agnote DPI 495 *Virus diseases in canola and mustard* on the NSW DPI website **www.dpi.nsw.gov.au/agriculture/broadacre/pests-diseases/13-winter-crops-wheat-barley-and-cereals/virus-canola-mustard**

A new GRDC Grownotes publication *Reducing aphid and virus risk* is also available at **www.grdc.com.au/GRDC-TnT-ReducingAphidVirus**

Windrowing and harvesting

Although all varieties have improved shattering tolerance, windrowing is still desirable in most areas as it greatly reduces the risk of seed losses caused by heavy winds. It also allows harvest to start 7–10 days earlier as there is no waiting for green plants to dry down. Cutting the crop higher than 30 cm reduces the risk of windrows being blown across the paddock in windy/stormy conditions. When windrowing, ensure the crop is cut at the recommended stage of maturity i.e. when 40–60% of the ripening seeds on the main stem have started to change to a bronze colour and most seeds are firm when rolled between the forefinger and thumb. Windrowing too early increases the risk of immature green seed in the sample and reduces yield and oil content. As the crop is at the correct stage for windrowing for only 3–4 days, careful and regular monitoring of the ripening crop is essential to ensure it is done on time. Uniform windrows improve harvest efficiency. The delivery standard for grain moisture is a maximum 8%.

Direct harvesting is increasingly seen as a viable option in the absence of shattering. While not having the flexibility of logistics and time management as windrowing it can be an alternative or inclusive operation i.e. windrow and direct harvest portions of the overall canola crop (may vary with crop maturity and crop biomass and time pressures). Direct harvesting is a cost-effective option on crops that have a yield potential of around 1 t/ha or lower, have a short plant height or the plant stand is low and stems cannot hold the windrow above the ground.

Both overall canola and cereal/winter crop areas and number of harvesters in operation are key aspects of overall harvest risk management.

New varieties

There are expected to be 52 canola varieties and one *Brassica juncea* variety on the market in NSW for 2015.

New releases — there are 12 for NSW

- MONOLA® 515TT, MONOLA® G11 and Nuseed® Diamond from Nuseed
- Hyola® 600RR and Hyola® 725RT from Pacific Seeds
- Pioneer® 44Y26(RR), Pioneer® 45Y25(RR) and Pioneer® 44Y89(CL) from DuPont Pioneer
- IH51RR and IH52RR from Bayer
- DG 550RR from Seednet
- SF Edimax CL from AGFSeeds

Outclassed, but still available

- Hyola® 555TT, Hyola® 505RR, Hyola® 971CL, Monola 605TT

Withdrawn

- Pioneer®45Y22(RR), Crusher TT, GT Cobra, GT Viper Hyola® 433, IH50RR, Monola 413TT Tawriffic TT, Thumper TT, Victory® V5002RR

Varietal characteristics

The amount of information on the following varieties varies, as some of them are new and have very limited 'independent' data. Some statements about the newer varieties are based on seed company information. Blackleg resistance ratings and resistance groups published for each variety are for 2014 (released spring 2014), which are based on blackleg nursery data from 2011–2013. **Resistance ratings and resistance groups are updated each year**. Check 2015 ratings and groups for all varieties. Ratings can be found on the Australian Oilseeds Federation website **www.australianoilseeds.com.** Some varieties may have a provisional rating, denoted as (P).

Note: Varieties are grouped according to their physiological maturity in the variety maturity table (page 82). A variety's maturity rating is describing its windrow/harvest time. Varieties grow and respond to temperature, vernalisation and daylength (photoperiod). Some varieties may flower early when sown very early (early April) where they only respond to temperature. It is important to understand that the relative maturity of some varieties changes in different environments, particularly from north to south but also from east to west. Confirm the relative maturity of an unfamiliar variety with your local adviser.

Oil content. Statements for oil content are based on 2014 NVT data only. Oil data presented on page 79 is the average oil content across a group of sites for that maturity grouping (early or mid) in 2014. The more sites the more reliable the data is for comparison purposes. Some of the newer varieties have oil data from a limited number of sites. This data should be viewed with caution. Descriptions for oil content (e.g. Moderate – High) are based on mid-maturing sites only. In drier western and northern zones, oil contents are nearly always lower due to higher spring temperatures and moisture stress in most seasons. Oil content is influenced by seasonal conditions and crop nutrition. For example oil tends to be lower in years with a hot dry finish and higher in years with a mild, moist finish. Variety rankings for oil usually remain the same in these contrasting seasonal finishes.

Conventional varieties

AV-Garnet. ◊ Mid to mid–early maturing variety. Medium height. Moderate-high oil content. Widely adapted. Blackleg resistance rating 2014 MR and resistance group A. Tested in NVT trials 2006–2014. Bred by DEPI Victoria. Marketed by Nuseed Pty Ltd.

AV-Zircon. ◊ Mid maturing variety. Medium height. Moderate oil content. Blackleg resistance rating 2014 MR and resistance group currently unknown. Tested in NVT trials 2011–2014. Bred by DEPI Victoria and Nuseed Pty Ltd. Marketed by Nuseed Pty Ltd.

Hyola® 50. Mid to mid–early maturing hybrid. High oil content. Widely adapted. Blackleg resistance rating 2014 R and resistance group AD. Tested in NVT trials 2005–2014. Bred by Canola Breeders International. Marketed by Pacific Seeds.

Nuseed® Diamond. New release (coded NCH1203C). Early maturing hybrid. Medium height. High oil content. Suited to low to medium rainfall zones. Blackleg resistance rating 2014 R-MR and resistance group ABF. Tested in NVT trials 2012–2014. Bred and marketed by Nuseed Pty Ltd.

SF Brazzil™. Late maturing, winter dual-purpose open-pollinated variety. Suited to early sowing and winter grazing in very high rainfall zones. Blackleg resistance rating 2014 R-MR and resistance group BC. Not tested in NVT trials. Marketed by Seed Force.

SF Sensation™. Very late maturing, winter dual-purpose hybrid. Suited to early sowing and winter grazing in very high rainfall zones. Blackleg resistance rating 2014 R–MR and resistance group currently unknown. Not tested in NVT trials. Marketed by Seed Force.

Victory® V3002. Early–mid maturing conventional specialty (high stability oil) hybrid, slightly later than Victory V3001. Moderate-high oil content. Blackleg resistance rating 2014 R–MR and resistance group ABF. Tested in NVT trials 2011–2014. Bred by Cargill and DEPI Victoria. Marketed by AWB in a closed loop program.

Triazine tolerant (TT) varieties

Triazine tolerant (TT) varieties can have lower yield and oil content than some Roundup Ready varieties. However, they can give good yields in weedy paddocks, when sprayed with atrazine and/or simazine herbicides.

ATR-Bonito. ◊ Early to early-mid maturing variety. High-very high oil content. Plant height slightly shorter than ATR-Gem. Blackleg resistance rating 2014 MR and resistance group A. Tested in NVT trials 2012–2014. Bred by Nuseed Pty Ltd and DEPI Victoria. Marketed by Nuseed Pty Ltd. An EPR applies.

ATR-Gem. ◊ Mid-early maturing variety. High-very high oil content. Slightly shorter plant height than Tawriffic TT. Blackleg resistance rating 2014 MR and resistance group A. Tested in NVT trials 2011–2014. Bred by Nuseed Pty Ltd and DEPI Victoria. Marketed by Nuseed Pty Ltd.

ATR-Stingray. ◊ Early maturing variety. High oil content. Short plant height. Blackleg resistance rating 2014 MR and resistance group C. Tested in NVT trials 2010–2014. Bred by Nuseed Pty Ltd and DEPI Victoria. Marketed by Nuseed Pty Ltd.

ATR-Wahoo. ◊ Mid maturing variety, similar to ATR-Marlin. High-very high oil content. Plant height similar to ATR-Gem. Blackleg resistance rating 2014 MR and resistance group A. Tested in NVT trials 2012-2014. Bred by Nuseed Pty Ltd and DEPI Victoria. Marketed by Nuseed Pty Ltd. An EPR applies.

Hyola® 450TT. Early to mid–early maturing hybrid. High-very high oil content. Medium plant height. Suited to low to medium–high rainfall areas. Blackleg resistance rating 2014 R and resistance group ABD. Tested in NVT trials 2013 and 2014. Bred and marketed by Pacific Seeds.

Hyola® 559TT. Mid to mid-early maturing hybrid. High oil content. Medium plant height. Suited to medium to very high rainfall areas. Blackleg resistance rating 2014 R and resistance group ABD. Tested in NVT trials 2012-2014. Bred and marketed by Pacific Seeds.

Hyola® 650TT. Mid to mid–late maturing hybrid. High oil content. Medium–tall plant height. Suited to medium–high rainfall areas. Blackleg resistance rating 2014 R and resistance group ABE. Tested in NVT trials in 2013 and 2014. Bred and marketed by Pacific Seeds

MONOLA® 314 TT. Early–mid maturing open-pollinated specialty oil variety. Moderate oil content. Medium plant height. Blackleg resistance rating 2014 and resistance group. Tested in NVT trials in 2013 and 2014. Bred and marketed by Nuseed Pty Ltd.

MONOLA® 515 TT. New release (coded NL805). Mid maturing open-pollinated specialty oil variety. Moderate-high oil content. No published GRDC blackleg resistance rating or resistance group 2014. Tested in NVT trials for the first time in 2014. Bred and marketed by Nuseed Pty Ltd.

Pioneer® Sturt TT. Early to early–mid maturing open-pollinated variety. Moderate oil content. Short–medium plant height. Adapted to low to medium rainfall zones. Blackleg resistance rating 2014 MS. Tested in NVT trials 2011–2014. Bred by NPZ Australia Pty Ltd. Marketed by DuPont Pioneer. An EPR applies.

Pioneer® Atomic TT. Mid-maturing hybrid. Medium height. Moderate oil content. Suited to medium rainfall zones. Blackleg resistance rating 2014 MS and resistance group AB. Tested in NVT trials 2012–2014. Bred by NPZ Australia Pty Ltd. Marketed by DuPont Pioneer.

CLEARFIELD® (imidazolinone tolerant) varieties

These varieties are tolerant to Intervix® imidazolinone herbicide and are part of the CLEARFIELD® Production System.

Archer. Mid–late maturing hybrid. High oil content. Medium-tall plant height. Blackleg resistance rating 2014 MR–MS. Tested in NVT trials 2011–2014. Marketed by Heritage Seeds.

Carbine. Early–mid maturing hybrid. Moderate-high oil content. Medium plant height. Blackleg resistance rating 2014 MR–MS. Tested in NVT trials 2011–2013. Marketed by Heritage Seeds.

Hyola® 474CL. Mid to mid–early maturing hybrid. High oil content. Medium–tall plant height. Suited to medium–low to high rainfall areas. Blackleg resistance rating 2014 R and resistance group BF. Tested in NVT trials 2011–2014. Bred and marketed by Pacific Seeds.

Hyola® 575CL. Mid maturing hybrid. High–very high oil content. Medium plant height. Suited to medium–very high rainfall areas. Blackleg resistance rating 2013 R and resistance group BF. Tested in NVT trials 2010–2014. Bred and marketed by Pacific Seeds.

Hyola® 577CL. Mid maturing hybrid. High–very high oil content. Medium–tall plant height. Suited to medium to high rainfall areas. Blackleg resistance rating 2014 R. Tested in NVT trials in 2013 and 2014. Bred and marketed by Pacific Seeds.

Hyola® 970CL. Late maturing, winter graze and grain hybrid. Pacific Seeds indicate high–very high biomass, good grain yield and oil content. Early–mid autumn and spring sowing graze and grain option for very high rainfall zones. No published GRDC blackleg resistance rating or resistance group 2014. Released in 2014. Not tested in NVT trials. Bred and marketed by Pacific Seeds.

Hyola® 971CL. Late maturing, winter graze and grain hybrid. Pacific Seeds indicate high–very high biomass, good grain yield and oil content. Early–mid autumn and spring sowing graze and grain option for very high rainfall zones. Blackleg resistance rating 2014 R–MR and resistance group A. Released in 2012. Not tested in NVT trials. Bred and marketed by Pacific Seeds.

Pioneer® 43C80(CL). ϕ Early maturing variety. Adapted to low rainfall areas. Medium plant height. Blackleg resistance rating in 2013 was MR–MS. Tested in NVT trials in 2008–2009 and 2011–2012. Bred and marketed by DuPont Pioneer.

Pioneer® 43Y85(CL). Early maturing hybrid. Short-medium plant height. Moderate oil content. Suited to medium–low rainfall areas. Blackleg resistance rating 2014 MR and resistance group A. Tested in NVT trials in 2011–2014. Bred and marketed by DuPont Pioneer.

Pioneer® 44C79(CL). ϕ Early to early–mid maturing variety. Medium plant height. Blackleg resistance rating in 2013 MS. Tested in NVT trials in 2008, 2009 and 2011. Bred and marketed by DuPont Pioneer.

Pioneer® 44Y84(CL). Early to early–mid maturing hybrid. High-very high oil content in 2013 trials. Medium–tall plant height. Blackleg resistance rating 2014 MS and resistance group A. Tested in NVT trials 2009–2013. Bred and marketed by DuPont Pioneer.

Pioneer® 44Y87(CL). Early–mid maturing hybrid. Moderate-high oil content. Medium plant height. Suited to medium rainfall areas. Blackleg resistance rating 2014 MR and resistance group A. Tested in NVT trials 2012-2014. Bred and marketed by DuPont Pioneer.

Pioneer® 44Y89(CL). New release (coded PHI-1305). Early–mid maturing hybrid. High oil content. Short-medium plant height. Suited to low to medium rainfall areas. Blackleg resistance rating 2014 R–MR and resistance group BC. Tested in NVT trials 2013 and 2014. Bred and marketed by DuPont Pioneer.

Pioneer® 45Y86(CL). Mid maturing hybrid. High–very high oil content. Medium–tall plant height. Suited for dual-purpose (graze and grain) option in full season environments. Blackleg resistance rating 2014 MR–MS. And resistance group AB. Tested in NVT trials 2010–2014. Bred and marketed by DuPont Pioneer.

Pioneer® 45Y88(CL). Mid maturing hybrid. Moderate-high oil content. Medium plant height. Suited to high rainfall areas. Blackleg resistance rating 2014 R–MR and resistance group A. Tested in NVT trials in 2012–2014. Bred and marketed by DuPont Pioneer.

SF Edimax CL. New release. Late maturing dual-purpose winter hybrid. Undergoing BASF Clearfield registration. Suited to early sowing and spring sowing in high rainfall areas. Blackleg resistance rating 2014 R–MR and resistance group C. Not tested in NVT trials. Marketed by AGFSeeds.

Roundup Ready® varieties

DG 550RR. New release (coded VT-WZ-11-2685). Mid maturing hybrid. High oil content. Blackleg resistance rating 2014 R–MR and resistance group AB. Tested in NVT trials 2013 and 2014. Bred and marketed by Seednet.

Hyola® 400RR. Early to mid–early maturing hybrid. Very high oil content. Medium plant height. Suited to low to medium rainfall areas. Blackleg resistance rating 2014 R and resistance group ABD. Tested in NVT trials in 2013 and 2014. Bred and marketed by Pacific Seeds.

Hyola® 404RR. Early to mid–early maturing hybrid. Very high oil content. Medium plant height. Suited to low to high rainfall areas. Blackleg resistance rating 2014 R–MR and resistance group ABD. Tested in NVT trials 2010–2014. Bred and marketed by Pacific Seeds.

Comparative performance in NVT trials[1] – early maturing

Variety	North West	North East	South West	South East	Oil % #	Blackleg rating ##
	2010–2014	2010–2014	2010–2014	2010–2014	2014	2014
Early maturing conventional trials– mean seed yield expressed as a % of Hyola® 50						
AV-Garnet	88 (9)	94 (2)	94 (5)	n.d.	37.8 (3)	MR
Hyola® 50	100 (9)	100 (2)	100 (5)	n.d.	39.5 (3)	R
Nuseed® Diamond	91 (3)	n.d.	101 (2)	n.d.	38.8 (3)	R–MR
Victory V3002	90 (5)	97 (2)	94 (2)	n.d.	38.6 (1)	R–MR
Hyola® 50 t/ha	1.82	1.23	1.34			
Early maturing Triazine tolerant (TT) trials – mean seed yield expressed as a % of ATR-Stingray						
ATR-Bonito	108 (3)	105 (2)	106(3)	n.d.	39.8 (3)	MR
ATR-Gem	107 (3)	n.d.	104 (3)	n.d.	40.1 (2)	MR
ATR-Stingray	100 (8)	100 (2)	100 (4)	n.d.	40.2 (3)	MR
Hyola® 450TT	n.d.	n.d.	106 (2)	n.d.	40.7 (3)	R
Hyola® 559TT	122 (5)	112 (2)	116 (2)	n.d.	39.6 (3)	R
MONOLA® 314TT	n.d.	n.d.	89 (2)	n.d.	39.1 (2)	MR
Pioneer® Atomic TT	123 (2)	n.d.	n.d.	n.d.	39.0 (2)	MS
Pioneer® Sturt TT	106 (5)	n.d.	106 (3)	n.d.	38.0 (3)	MS
ATR-Stingray t/ha	1.74	0.91	1.37			
Early maturing Clearfield trials – mean seed yield expressed as a % of Hyola® 474CL						
Hyola® 474CL	100 (7)	100 (2)	100 (4)	n.d.	39.4 (3)	R
Hyola® 575CL	102 (7)	102 (2)	101 (4)	n.d.	39.2 (3)	R
Pioneer® 43Y85(CL)	91 (7)	92 (2)	98 (4)	n.d.	37.6 (3)	MR
Pioneer® 44Y87(CL)	99 (4)	100 (2)	105 (3)	n.d.	37.2 (3)	MR
Pioneer® 44Y89(CL)	n.d.	n.d.	n.d.	n.d.	38.7 (3)	R–MR
Hyola® 474CL t/ha	1.75	1.12	1.19			
Early maturing Roundup Ready trials – mean seed yield expressed as a % of Hyola® 404RR						
Hyola® 400RR	97 (2)	n.d.	96 (3)	n.d.	41.5 (2)	R
Hyola® 404RR	100 (4)	n.d.	100 (4)	n.d.	42.0 (2)	R–MR
Hyola® 500RR	94 (2)	n.d.	n.d.	n.d.	40.0 (2)	R
IH30 RR	97 (3)	n.d.	100 (3)	n.d.	39.6 (2)	R–MR
Nuseed GT-41	99 (3)	n.d.	96 (3)	n.d.	40.0 (2)	R–MR
Pioneer® 43Y23(RR)	100 (4)	n.d.	100 (4)	n.d.	38.5 (2)	R–MR
Pioneer® 44Y24(RR)	100 (3)	n.d.	98 (3)	n.d.	38.5 (2)	R–MR
Pioneer® 44Y26(RR)	97 (2)	n.d.	n.d.	n.d.	38.9 (2)	R–MR
Hyola® 404RR t/ha	1.72		1.35			

Number of trials in brackets ( ). The more trials, the greater the reliability. n.d. No data.

1 Based on predicted yields from an analysis across all sites (2010–2014 NVT trials).
New varieties have less trial data supporting the 5 year dataset and hence should be viewed with some caution, especially where there are only 2 trial results.

Oil content, adjusted to 6.0% moisture content, is expressed as a region-wide average for the maturity trial grouping and is for 2014 only. Number of trials in brackets ( ).

Blackleg ratings are the published ratings for spring 2014. Ratings will be updated in 2015 and may be available before sowing.

Blackleg Rating Disclaimer

NSW DPI publishes this rating system on the basis of the best information available at the time of publication. However, nursery and grower experience has shown that disease severity may vary between locations and years depending on seasonal conditions and possible changes in the fungus for reasons which are not currently understood. Therefore growers may sometimes experience significant variation from the averages shown in these ratings.

Comparative performance in NVT trials[1] – mid maturing

Variety	North West	North East	South West	South East	Oil % #	Blackleg rating ##
	2010–2014	2010–2014	2010–2014	2010–2014	2014	2014
Mid-maturing conventional trials– mean seed yield expressed as a % of AV-Garnet						
AV-Garnet	100 (3)	100 (4)	100 (3)	100 (6)	41.9 (4)	MR
AV-Zircon	101 (3)	102 (3)	100 (3)	96 (4)	41.4 (4)	MR
Hyola® 50	111 (3)	111 (4)	113 (3)	105 (6)	42.7 (4)	R
Nuseed® Diamond	115 (2)	n.d.	119 (2)	115 (3)	42.7 (4)	R–MR
Victory® V3002	105 (3)	103 (2)	106 (3)	104 (2)	42.1 (4)	R–MR
AV-Garnet t/ha	2.13	2.01	2.33	2.63		
Mid-maturing Triazine Tolerant (TT) trials – mean seed yield expressed as a % of ATR-Gem						
ATR-Bonito	103 (4)	104 (5)	104 (3)	104 (16)	44.3 (12)	MR
ATR-Gem	100 (5)	100 (5)	100 (4)	100 (20)	43.5 (12)	MR
ATR-Stingray	96 (7)	96 (7)	99 (4)	98 (22)	43.2 (12)	MR
ATR-Wahoo	101 (4)	100 (4)	n.d.	102 (15)	43.8 (10)	MR
Hyola® 450TT	103 (3)	106 (4)	106 (3)	102 (8)	43.7 (8)	R
Hyola® 559TT	108 (4)	111 (5)	111 (3)	108 (17)	43.4 (12)	R
Hyola® 650TT	107 (2)	109 (4)	110 (2)	111 (9)	42.9 (12)	R
Hyola® 525RT	101 (2)	n.d.	103 (3)	103 (7)	44.5 (8)	R–MR
Hyola® 725RT	n.d.	n.d.	n.d.	101 (3)	44.4 (4)	n.d.
MONOLA® 314TT	92 (2)	93 (2)	89 (3)	84 (7)	41.5 (9)	MR
MONOLA® 515TT	92 (2)	n.d.	90 (2)	87 (4)	42.4 (9)	n.d.
Pioneer® Atomic TT	106 (4)	109 (5)	106 (3)	101 (13)	41.1 (8)	MS
ATR-Gem t/ha	2.03	2.06	1.95	2.28		
Mid-maturing CLEARFIELD® trials– mean seed yield expressed as a % of Hyola® 575CL						
Archer	104 (4)	105 (5)	101 (3)	100 (18)	42.4 (12)	MR–MS
Hyola® 474CL	100 (6)	100 (7)	100 (6)	98 (18)	42.8 (8)	R
Hyola® 575CL	100 (7)	100 (8)	100 (6)	100 (29)	43.5 (12)	R
Hyola® 577CL	100 (3)	99 (4)	100 (2)	100 (11)	43.6 (12)	R
Pioneer® 44Y87(CL)	103 (3)	104 (3)	101 (3)	100 (10)	41.6 (12)	MR
Pioneer® 44Y89(CL)	103 (2)	104 (2)	103 (3)	100 (5)	42.8 (12)	R–MR
Pioneer® 45Y86(CL)	105 (6)	107 (7)	102 (6)	100 (29)	43.7 (12)	MR–MS
Pioneer® 45Y88(CL)	104 (4)	105 (5)	103 (4)	103 (16)	41.7 (12)	R–MR
Hyola® 575CL t/ha	2.18	2.16	2.02	2.50		
Mid-maturing Roundup Ready trials – mean seed yield expressed as a % of Hyola® 500RR						
DG550 RR	96 (6)	n.d.	96 (2)	96 (6)	43.4 (7)	R–MR
Hyola® 400RR	100 (3)	n.d.	98 (3)	100 (3)	45.2 (4)	R
Hyola® 404RR	102 (19)	n.d.	99 (5)	102 (19)	45.9 (7)	R–MR
Hyola® 500RR	100 (8)	n.d.	100 (3)	100 (8)	45.0 (7)	R
Hyola® 600RR	103 (3)	n.d.	n.d.	103 (3)	46.9 (4)	n.d.
IH51 RR	93 (3)	n.d.	91 (2)	93 (6)	42.5 (7)	n.d.
IH52 RR	99 (6)	n.d.	96 (2)	99 (6)	42.6 (7)	R–MR
MONOLA® 513GT	92 (8)	n.d.	88 (3)	92 (8)	45.5 (4)	MR
MONOLA® G11	96 (5)	n.d.	95 (2)	96 (5)	45.3 (6)	R–MR
Nuseed GT-41	99 (7)	n.d.	95 (4)	99 (7)	43.2 (4)	R–MR
Nuseed GT-50	106 (14)	n.d.	101 (5)	106 (14)	44.2 (7)	R–MR
Pioneer® 43Y23(RR)	105 (10)	n.d.	103 (4)	105 (10)	42.2 (5)	R–MR
Pioneer® 44Y24(RR)	106 (15)	n.d.	101 (5)	106 (15)	42.9 (7)	R–MR
Pioneer® 44Y26(RR)	n.d.	n.d.	95 (2)	99 (3)	44.1 (7)	R–MR
Pioneer® 45Y25(RR)	109 (6)	n.d.	105 (2)	103 (16)	44.1 (7)	R–MR
Hyola® 500RR t/ha	2.40		1.84	2.63		

Number of trials in brackets ( ). The more trials, the greater the reliability. n.d. No data.

1 Based on predicted yields from an analysis across all sites (2010–2014 NVT trials).
New varieties have less trial data supporting the 5 year dataset and hence should be viewed with some caution, especially where there are only 2 trial results.

Oil content, adjusted to 6.0% moisture content, is expressed as a region-wide average for the maturity trial grouping and is for 2014 only. Number of trials in brackets ( ).

Blackleg ratings are the published ratings for spring 2014. Ratings will be updated for 2015 and may be available before sowing.

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Hyola® 500RR. Mid maturing hybrid. Medium–tall plant height. High oil content. Suited to medium to high rainfall areas. Blackleg resistance rating 2014 R and resistance group ABD. Tested in NVT trials in 2013 and 2014. Bred and marketed by Pacific Seeds.

Hyola® 600RR. New release. Mid to mid–late maturing hybrid. Very high oil content. Medium-tall plant height. Suited to medium–high to very high rainfall areas. No published GRDC blackleg resistance rating or resistance group 2014. Tested in NVT trials for the first time in 2014. Bred and marketed by Pacific Seeds

IH30 RR. Early maturing hybrid. High oil content. Suited to low–medium rainfall areas. Blackleg resistance rating R–MR and resistance group AB. Tested in NVT trials 2012–2014. Bred and marketed by Bayer.

IH51 RR. New release (coded AN13R9003). Mid maturing hybrid with Bayer's new Pod Shatter Reduced Trait. High oil content. Suited to later windrow timings or direct harvesting in medium-high rainfall areas. No published GRDC blackleg resistance rating or resistance group 2014. Tested in NVT trials for the first time in 2014. Bred and marketed by Bayer.

IH52 RR. New release (coded AN11R5201). Mid maturing hybrid. High oil content. Suited to medium-high rainfall areas. Blackleg resistance rating 2014 R–MR and resistance group AB. Tested in NVT trials 2013 and 2014. Bred and marketed by Bayer.

MONOLA® 513GT. Early–mid maturing open-pollinated specialty oil variety. Very high oil content. Medium plant height. Blackleg resistance rating 2014 MR. Tested in NVT trials 2012–2014. Bred and marketed by Nuseed Pty Ltd.

MONOLA® G11. New release (coded NMH13G011). Early–mid maturing specialty oil hybrid. Very high oil content. Medium plant height. Blackleg resistance rating 2014 R–MR and resistance group ABS. Tested in NVT trials in 2013 and 2014. Bred and marketed by Nuseed Pty Ltd.

Nuseed® GT-41. Early maturing hybrid. High oil content. Medium plant height. Blackleg resistance rating 2012 R–MR and resistance group ABF. Tested in NVT trials 2012–2014. Bred and marketed by Nuseed Pty Ltd.

Nuseed® GT-50. Mid maturing hybrid. High-very high oil content. Medium–tall plant height. Blackleg resistance rating 2014 R–MR and resistance group ABF. Tested in NVT trials 2012–2014. Bred and marketed by Nuseed Pty Ltd.

Pioneer® 43Y23 (RR). Early maturing hybrid. Moderate-high oil content. Blackleg resistance rating 2014 R–MR and resistance group B. Tested in NVT trials 2011–2014. Bred and marketed by DuPont Pioneer.

Pioneer® 44Y24 (RR). Early–mid maturing hybrid. High oil content. Medium plant height. Suited to medium–high rainfall areas. Blackleg resistance rating 2014 MR and resistance group C. Tested in NVT trials 2011–2014. Bred and marketed by DuPont Pioneer.

Pioneer® 44Y26 (RR). New release (coded PHI-1311). Early–mid maturing hybrid. High-very high oil content. Medium-tall plant height. Suited to medium–high rainfall areas. Blackleg resistance rating 2014 R–MR and resistance group ABS. Tested in NVT trials in 2013 and 2014. Bred and marketed by DuPont Pioneer.

Variety maturities

	Lower rainfall north < 550 mm, centre/south < 500 mm		Higher rainfall north > 500 mm, centre/south > 450 mm	
	Early-maturing	Early–mid maturing	Mid-maturing	Mid–late maturing
Conventional	Nuseed® Diamond	Victory® V3002	AV-Garnet AV-Zircon Hyola® 50	
Triazine tolerant (TT)	ATR-Stingray MONOLA® 314TT Pioneer® SturtTT	ATR-Bonito ATR-Gem Hyola® 450TT	ATR-Wahoo Hyola® 559TT Pioneer® Atomic TT MONOLA® 515TT	Hyola® 650 TT
CLEARFIELD®	Pioneer® 43C80(CL) Pioneer® 43Y85(CL) Pioneer® 44C79(CL) Pioneer® 44Y84(CL)	Carbine Hyola® 474CL Pioneer® 44Y87(CL) Pioneer® 44Y89(CL) XCEED® VT Oasis CL	Hyola® 575CL Hyola® 577CL Pioneer® 45Y86(CL) Pioneer® 45Y88(CL)	Archer
Roundup Ready®	Hyola® 400RR IH30 RR Nuseed® GT-41 Pioneer® 43Y23(RR)	Hyola® 404RR MONOLA® 513GT Pioneer® 44Y24(RR) Pioneer® 44Y26(RR)	DG 550RR Hyola® 500RR MONOLA® G11 Nuseed® GT-50 Pioneer® 45Y25(RR) IH51RR IH52RR	Hyola® 600RR®
Roundup Ready® plus Triazine tolerant (Dual tolerance)			Hyola® 525RT®	Hyola® 725RT®

The relative maturity of varieties may vary depending on location and sowing time. The groupings are made as a guide only and relates to physiological maturity. The winter canola types for grazing and grain recovery are not included in this table. Maturity of these types is generally considered late–very late.

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Pioneer® 45Y25 (RR). New release (coded PHI-1306). Mid maturing hybrid. High–very high oil content. Medium plant height. Suited to medium–high rainfall areas. Blackleg resistance rating 2014 R–MR and resistance group BC. Tested in NVT trials 2012–2014. Bred and marketed by DuPont Pioneer.

Roundup Ready – Triazine tolerant varieties

New varieties are being developed that combine two herbicide tolerance traits, allowing improved weed control in paddocks where weeds have developed resistance to other herbicide chemistries.

Hyola® 525RT®. Mid maturing RT® dual herbicide tolerant hybrid. High-very high oil content. Medium plant height. Suited to medium to high rainfall areas. No Blackleg resistance rating 2014 R–MR and resistance group ABD. Tested in NVT trials in 2013 and 2014. Bred and marketed by Pacific Seeds.

Hyola® 725RT®. New release. Mid-late maturing RT® dual herbicide tolerant hybrid. High-very high oil content. Medium-tall plant height. Suited to medium-high to very high rainfall areas. No published GRDC blackleg resistance rating or resistance group 2014. Tested in NVT trials for the first time in 2014. Bred and marketed by Pacific Seeds.

Juncea canola (*Brassica juncea*)

Juncea canola is adapted to low rainfall areas (300 – 400 mm) and dry conditions. It has similar oil quality to canola, but still requires segregation and has designated delivery sites.

XCEED™ VT Oasis CL. ◊ First herbicide tolerant Clearfield juncea canola in Australia. Early–mid maturing open-pollinated variety. High oil content. Suitable for direct harvesting. Blackleg resistance rating R and resistance group G. Tested in NVT trials 2008–2013. Bred by DEPI Victoria/Viterra. Marketed by Seednet. An EPR applies.

Further information

Weed control in winter crops (NSW DPI, 2014)

NSW DPI website: **www.dpi.nsw.gov.au/agriculture/broadacre/winter-crops/oilseeds** for:

- *Insect and mite control in field crops* (NSW DPI, 2013)
- *Virus diseases in canola and mustard* – Agnote DPI 495
- *Clubroot of canola and mustard* – Primefact 115
- *Canola: northern NSW planting guide*
- *Juncea canola in the low rainfall zone of south-western NSW* – Primefact 783
- *Brassica juncea in north-western NSW* – Primefact 786

GRDC website: **www.grdc.com.au/Resources/Publications/2009/08/Canola-best-practice-management-guide-for-southeastern-Australia** for:

- *Canola best practice management guide for south-eastern Australia* (GRDC, 2009) **www.grdc.com.au/GRDC-TnT-ReducingAphidVirus** for:
- *Reducing aphid and virus risk* (GRDC Grownotes)

Australian Oilseeds Federation website: **www.australianoilseeds.com** for:

- *Sclerotinia stem rot in canola*
- *Burning canola stubble may not control blackleg*
- *Blackleg management guide*

Contributing authors

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Chickpea

Chickpea are a winter pulse crop which are profitable in their own right. In addition, they contribute to crop rotations through their ability to fix nitrogen, and by providing a disease and weed break for cereal crops. However, chickpea crops require systematic monitoring for foliar diseases and insect pests.

Chickpeas are well adapted to warm environments because they tolerate higher temperatures during and after flowering better than other winter pulses like faba beans, lupins and field peas.

Chickpeas are best suited to loams and self-mulching clay soils that are neutral–alkaline in pH. Acidic (pH_{Ca}<5.2), sodic, saline and/or sandy soils are generally unsuitable. Soils which have high chloride levels (> 600 mg/kg) in the subsoil (30–90 cm depth) are best avoided. Chickpeas do not tolerate waterlogging, so avoid poorly drained paddocks or those prone to flooding.

Sowing

Seed

Profitable crops start with quality planting seed (i.e. high germination and vigour). Obtain seed from a commercial supplier or from a source known to have negligible levels of seed-borne pathogens. If using grower-retained seed from previous crops, be aware that such seed may be infected with Botrytis or Ascochyta even if the disease did not cause economic damage or was not obvious in the crop. Irrespective of year of harvest and source, all planting seed must be thoroughly treated with a thiram-based fungicide. Information on seed treatment and establishing a profitable crop can be found on the Pulse Australia website at **www.pulseaus.com.au** (see *2011 Chickpea Disease Management Considerations for Northern Growers and Agronomists).* Refer to the Further information section at the end of this chapter.

Paddock selection

Maintain a distance of at least 500 m (further is better) from 2014 chickpea paddocks and a break of at least three years between chickpeas in the same paddock. These practices work by reducing the amount of disease inoculum available to initiate new season infection. Do not plant chickpeas in paddocks with a history of lucerne, medics, Phytophthora root rot, Sclerotinia in other broadleaf crops, or waterlogging. Flooding can also carry disease inoculum long distances.

Stubble

In the north, no-till crops sown into cereal stubble consistently yield 10% higher than those planted into conventionally prepared or reduced tillage seedbeds. Standing cereal stubble will also help deter aphids (which can transmit viruses) during the early vegetative stage.

Seeding depth

Sow 5–7 cm deep into moisture. If moisture is not present at the desired planting time chickpeas can be moisture-seeked by placing the seed 10–17.5 cm below the paddock soil surface, depending on moisture depth, and levelling the seedbed before the crop emerges. Use high quality seed if intending to moisture-seek. Levelling the seedbed will increase ease of harvesting, especially for later sown crops which grow shorter, and may reduce the risk of herbicide damage to establishing seedlings. Ensure that seed is well covered with at least 7 cm of soil if using Balance® (a.i. isoxaflutole) or simazine herbicides.

Seeding rate

Aim to establish 20–30 plants/m^2 under most conditions in northern and central NSW. In southern NSW the target density is 35–45 plants/m^2. Aim for the lower end of the range when yield potential is low (e.g. lower starting soil moisture); target the higher end of the range when yield potential is high such as when good subsoil moisture is available or under irrigation. Adjust sowing rates to take account of seed size, germination, vigour and establishment conditions. Avoid skimping on seed which could lead to gappy plant stands, as a uniform plant establishment has been found to be highly effective in reducing aphid infestation.

Row spacing

In northern NSW, there is generally no yield difference for row spacing from 25–75 cm.

Wide row spacing (up to 100 cm) offers a number of advantages, including:

- planting into heavy stubble in zero-till situations
- in-crop pesticide application by ground rig
- ability to band spray, reducing costs and chemical usage
- the option of inter-row cultivation or shielded spraying
- better airflow to reduce foliar diseases
- more moisture to finish the crop in low moisture situations.

Seeding rate (kg/ha) based on 100% germination and 80% establishment

Variety	100 seed weight (g)	Target plant density/m^2			
		Northern & Central NSW		Southern NSW	
		20	30	35	45
Almaz	41	103	154	179	231
Flipper	18	45	68	79	101
Genesis 090	30	75	113	131	169
Genesis 425	33	83	124	144	186
Genesis Kalkee	45	113	169	197	253
Howzat	21	53	79	92	118
Jimbour	20	50	75	88	113
Kyabra	26	65	98	114	146
PBA Boundary	19	48	71	83	107
PBA HatTrick	20	50	75	88	113
PBA Maiden	24	60	90	105	135
PBA Monarch	42	105	158	184	236
PBA Slasher	18	45	68	79	101
PBA Striker	21	53	79	92	118
Yorker	21	53	79	92	118

Your calculation

100 seed weight # (grams) ____ × target plant population ____ × 1000

÷ establishment percentage* ____ × germination percentage ____

= your seeding rate ____ kg/ha

To determine your seed weight, weigh 100 seeds in grams.

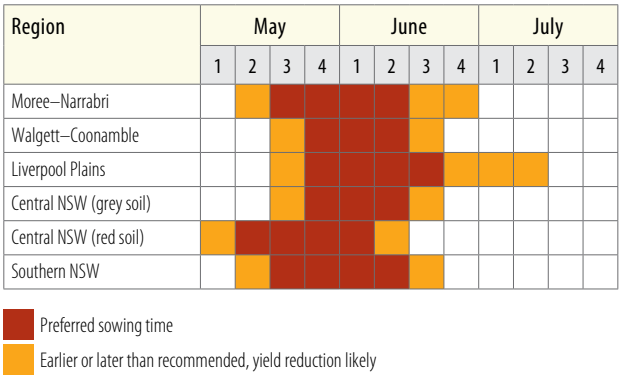
*Establishment percentage – 80% is a reasonable estimate, unless sowing into adverse conditions.

Disadvantages of wide row spacing can include reduced crop competition with weeds and increased crop lodging making harvesting more difficult (particularly with older less erect varieties such as Howzat and Yorker). Yield penalties may be observed in above average seasons.

Sowing time

Aim to sow in the early-mid period of the sowing window to maximise yield potential and minimise disease levels. Sowing early exposes the crop to more rain events which can increase the risk of Ascochyta and Phytophthora root rot. It can also result in greater crop biomass, which can increase the risk of Botrytis grey mould (BGM) later in the season and increase the risk of lodging. Early sowing can also lead to a possible moisture shortage during the grain fill period, which can reduce seed size and hence yield. Later sown crops can attract greater heliothis pressure (as a result of being later maturity than surrounding crops) and are often shorter plants which can lead to harvesting difficulties. However, later sowing may reduce the risk of Ascochyta and Phytophthora infection events and lessen the risk of Botrytis grey mould.

Suggested sowing times



Inoculation

Inoculation is essential for every chickpea crop planted, regardless of soil type or previous history. Use the commercially available Group N chickpea inoculant. Take care with seed inoculation. Treat seed with fungicide first, then apply inoculant separately just before sowing. Avoid inoculating directly into airseeder bins as the seed will need to dry for a short period prior to being sown. Newly inoculated seed is often sticky and does not flow properly. This can cause uneven seed flow, resulting in patchy establishment across the paddock.

A number of new inoculant products are available for chickpeas, such as freeze-dried and dry granular products. Read and follow the instructions to avoid inoculation problems.

Nutrition

Most growers in northern NSW use starter fertiliser (MAP, DAP) or other phosphorus-based fertilisers such as Granulock with added zinc (1–2% zinc). A common rate is 50–75 kg/ha. Responses to zinc are most likely in alkaline soils. These products should be drilled with the seed. If using greater than 100 kg/ha of starter fertiliser, band it slightly away from the seed to avoid fertiliser

toxicity, especially on wider (60–100 cm) row spacing. Extra care should also be taken if sowing into marginal moisture seedbed conditions.

A good way to determine the response from starter fertilisers is to put down test strips, leaving a control (nil) strip for comparison.

Variety selection

When choosing a variety many factors should be considered including disease susceptibility, paddock suitability, seed availability, seed size and sowing rate (with reference to sowing machinery), seed cost, harvesting ease and marketing options. A Pulse Breeding Australia (PBA) variety brochure or Variety Management Package (VMP) is available from Pulse Australia, NSW DPI or the relevant seed supply company for each variety. Refer to the tables on page 88 for yield, varietal characteristics and disease reactions of the different varieties.

There are no new variety releases for the 2015 season.

Desi types

Ambar.Φ Resistant (R) to Ascochyta, similar to Genesis™ 509 and Genesis™ 090, superior to PBA HatTrick and PBA Boundary. Susceptible (S) to Phytophthora root rot, so not recommended for northern NSW. Limited evaluation in southern NSW. Developed by DAFWA and UWA from germplasm bred by NSW DPI. Marketed by Heritage Seeds. An EPR of $4.40/tonne applies.

Flipper.Φ Moderately resistant-moderately susceptible (MR-MS) to Ascochyta, less resistant than PBA HatTrick and PBA Boundary. Moderately susceptible (MS) to Phytophthora, less resistant than PBA HatTrick. Susceptible (S) to viruses. Tall erect variety with very good lodging resistance and medium sized seed. Bred by NSW DPI; commercial partner is Seednet with seed available through Seednet agents. An EPR of $3.30/tonne applies.

Jimbour. Susceptible (S) to Ascochyta. Suited to areas where Ascochyta is not considered a major threat and experience shows that the disease can be managed in susceptible varieties. Moderately susceptible–moderately resistant (MS–MR) to Phytophthora. Bred by DAFF Qld, commercialised by Mt Tyson seeds. No EPR applies.

Kyabra.Φ Susceptible (S) to Ascochyta. Suited to areas where Ascochyta is not considered a major threat and experience shows that the disease can be managed in susceptible varieties. Moderately susceptible (MS) to Phytophthora. Susceptible (S) to BGM. Larger seed size and superior grain quality for the whole seed market to other current varieties. Bred by DAFF Qld and NSW DPI; commercial partner is Heritage Seeds. A seed royalty applies to all sales of Kyabra; no EPR applies.

Neelam.Φ Resistant (R) to Ascochyta, similar to Genesis™ 509 and Genesis™ 090, superior to PBA HatTrick and PBA Boundary. Susceptible (S) to Phytophthora root rot, so not recommended for northern NSW. Limited evaluation in southern NSW. Developed by DAFWA and UWA from germplasm bred by DEPI Victoria. Marketed by Heritage Seeds. An EPR of $4.40/tonne applies.

PBA Boundary.Φ Moderately resistant (MR) to Ascochyta, superior to PBA HatTrick. Susceptible (S) to Phytophthora, less resistant than PBA HatTrick and only suitable for paddocks with a low Phytophthora risk. Highest yielding variety across chickpea growing regions of northern NSW and southern QLD. Lower yielding than PBA Slasher in southern NSW but suitable option if a tall erect plant type is required. Mid season maturity, equivalent to PBA HatTrick. Medium sized desi seed suited to the human consumption market. Developed by Pulse Breeding Australia (PBA). Marketed by Seednet with seed available through Seednet agents. An EPR of $4.40/tonne applies.

PBA HatTrick.Φ Moderately resistant (MR) to Ascochyta, superior to Flipper. Moderately resistant (MR) to Phytophthora, more resistant than Jimbour but less than Yorker. High yielding variety across chickpea growing regions of northern NSW and southern Qld, recommended and suited to areas north of Parkes. Tall, erect plant type with mid season maturity, equivalent to Jimbour. Medium sized desi seed suited to the human consumption market. Developed by Pulse Breeding Australia (PBA). Marketed by Seednet with seed available through Seednet agents. An EPR of $4.40/tonne applies.

Chickpea variety characteristics

Variety	Plant height	Lodging resistance	100 seed weight (g)	Maturity	North		South	
					Yield as a % of PBA HatTrick 2010–2014		Yield as a % of PBA Slasher 2010–2014	
					East 2.03 t/ha	West 1.64 t/ha	East 1.79 t/ha	West 1.82 t/ha
Desi Types								
Flipper	T	VG	18	M–L	97 (4)	98 (9)	n.d	n.d
Howzat	M	M	21	M	n.d.	n.d.	89 (4)	82 (3)
Jimbour	T	VG	20	M	94 (13)	96 (31)	n.d.	n.d
Kyabra	T	VG	26	M	97 (10)	102 (24)	n.d.	n.d.
PBA Boundary	T	G	19	M	103 (13)	102 (31)	99 (4)	88 (3)
PBA HatTrick	T	G	20	M	**100 (13)**	**100 (31)**	96 (4)	87 (3)
PBA Maiden	MS	M	24	M	n.d.	n.d.	93 (4)	93 (3)
PBA Slasher	MS	M	18	M	n.d.	n.d.	**100 (4)**	**100 (3)**
PBA Striker	MS	M	21	E	n.d	n.d	94 (4)	104 (3)
Yorker	M	G	21	M–L	98 (4)	97 (9)	n.d.	n.d
Variety	**Plant height**	**Lodging resistance**	**100 seed weight (g)**	**Maturity**	**Yield as a % of Almaz 2010–2014**		**Yield as a % of Genesis™ 090 2010–2014**	
					East 2.04 t/ha	**West 1.65 t/ha**	**East 1.20 t/ha**	**West n.d.**
Kabuli Types								
Almaz	MT	G	41	L	**100 (3)**	**100 (15)**	93 (3)	n.d.
Genesis™ 090	M	G	30	M–L	107 (3)	107 (15)	**100 (3)**	**n.d.**
Genesis™ 114	T	VG	39	M–L	96 (3)	97 (12)	92 (3)	n.d.
Genesis™ 425	M	G	33	M–L	97 (3)	96 (12)	98 (3)	n.d.
Genesis™ Kalkee	T	VG	45	L	96 (3)	98 (15)	95 (3)	n.d.
PBA Monarch	M	F	42	E	100 (3)	99 (15)	101 (3)	n.d.

Yield results are a combined across sites analysis using NVT and PBA data from 2010-2014. Number of trials in brackets ( ). n.d. = No data.
Plant height: T – tall; MT – medium tall; M – medium; MS – medium short. **Lodging resistance**: VG – very good; G – good; M – moderate; F – fair; P – poor.
Maturity: E – early; M – medium; L – late.

Chickpea variety ratings for common chickpea diseases in Australia

Variety	Ascochyta blight	Phytophthora root rot[1]	Botrytis grey mould[2]	Virus[3]	Root-lesion nematode (*Pratylenchus thornei*)		Root-lesion nematode (*P. neglectus*)	
					Resistance[4]	Tolerance[4]	Resistance[4]	Tolerance[4]
Desi								
Ambar	R	S	S	–	–	–	–	–
Flipper	MR–MS	MS	S	S	MS	T	MS	–
Howzat	S	MS	MS	S	S	MT	S	MI
Jimbour	S	MS–MR	S	S	S	T	MS	T
Kyabra	S	MS	S	S	VS	–	R	–
Neelam	R	S	S	–	–	–	–	–
PBA Boundary	MR	S	S	S	–	–	–	–
PBA HatTrick	MR	MR	S	S	–	–	–	–
PBA Maiden	MR	S	S	S	–	–	–	–
PBA Slasher	R	S	S	S	–	–	–	–
PBA Striker	MR	S	S	S	–	–	–	–
Yorker	S	MR	S	S	MS	MT	MR	–
Kabuli								
Almaz	MS	VS	S	S	VS	T	MR	–
Genesis™ 090	R	VS	S	S	VS	T	MR	–
Genesis™ 114	MS	VS	S	S	–	–	–	–
Genesis™ 425	R	S	S	S	MS	MI	MR	–
Genesis™ Kalkee	MS	VS	S	S	–	–	–	–
PBA Monarch	MS	VS	S	S	–	–	–	–

Source: Pulse Breeding Australia. R = resistant, MR = moderately resistant, MS = moderately susceptible, S = susceptible, VS = very susceptible, T = tolerant, MI = moderately intolerant, I = intolerant, – = No data.
[1] Ratings a compilation of NSW (Tamworth) and Qld (Warwick) data. [2] The risk of Botrytis grey mould damage may be affected by the management of Ascochyta blight; fungicides used to control Ascochyta can also control Botrytis. Note that if BGM risk is high, then a fungicide with greater efficacy for BGM than used for AB may also be needed. BGM screening is conducted in a controlled environment, and rating is independent of plant architecture. [3] Virus ratings could change with different virus species predominating in different areas. [4] Resistance measures the plant's ability to resist disease. Tolerance measures the plant's ability to yield at a given disease level. Tolerant varieties, while potentially yielding well, are unlikely to reduce nematode numbers for following crops. Data supplied by John Thompson, DAFF Qld, Toowoomba.

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PBA Maiden.[ф] **Released 2013 (tested as CICA0717).** Moderately resistant (MR) to Ascochyta, less than PBA Slasher. Susceptible (S) to Phytophthora root rot, so not recommended for northern NSW. Semi-spreading plant type with mid season maturity, similar to PBA Slasher. Large sized desi for southern environments with a yellow-tan seed coat suitable to whole seed markets. Developed by Pulse Breeding Australia (PBA). Marketed by Seednet with seed available through Seednet agents. An EPR of $4.40/tonne applies.

PBA Slasher.[ф] Resistant (R) to Ascochyta, similar to Genesis™ 509 and Genesis™ 090, superior to PBA HatTrick and PBA Boundary. Susceptible (S) to Phytophthora root rot, so not recommended for northern NSW. High yielding variety across all southern and western Australian chickpea growing regions, recommended and suited to areas south of Parkes. Semi-spreading plant type with mid season maturity, similar to Howzat. Medium sized desi with tan-brown seed coat suitable for the whole and split seed markets. Developed by Pulse Breeding Australia (PBA). Marketed by Seednet with seed available through Seednet agents. An EPR of $4.40/tonne applies.

PBA Striker.[ф] Moderately resistant (MR) to Ascochyta, less than PBA Slasher. Susceptible (S) to Phytophthora root rot, so not recommended for northern NSW. High yielding variety in short season environments in southern and western Australian chickpea growing regions. Semi-spreading plant type with earlier flowering and maturity than PBA Slasher. Medium sized desi with tan-brown seed coat suitable for the whole and split seed markets. Developed by Pulse Breeding Australia (PBA). Marketed by Seednet with seed available through Seednet agents. An EPR of $4.40/tonne applies.

Yorker.[ф] Moderately susceptible (MS) to Ascochyta, inferior to PBA HatTrick and PBA Boundary. Moderately resistant (MR) to Phytophthora, better than PBA HatTrick. Suited to drier areas where Phytophthora rather than Ascochyta is the greater risk. Yorker is sensitive to Balance® herbicide (see Weed control section). Bred by NSW DPI; commercial partner is Seednet with seed available through Seednet agents. An EPR of $3.30/tonne applies.

Kabuli types

Almaz.[ф] Moderately susceptible (MS) to Ascochyta, inferior to Genesis™ 090 and Genesis™ 425. Susceptible (S) to Phytophthora. Medium seed size, 8–9 mm. Introduced from ICARDA, Syria and selected by Department of Agriculture & Food Western Australia (DAFWA). Commercial partner is COGGO Group. Contact Seednet in eastern Australia for seed orders. An EPR of $7.15/tonne applies.

Genesis™ 090. Resistant (R) to Ascochyta, equal to Genesis™ 509. Broadly adapted. Very susceptible (VS) to Phytophthora, suited only to areas with a low Phytophthora risk. Seed size is smaller than Almaz, predominantly 7–8 mm. Introduced from ICARDA, Syria and selected by DEPI Victoria. Marketed by Australian Agricultural Crop Technologies. An EPR of $5.00/tonne applies.

Genesis™ 114. Moderately susceptible (MS) to Ascochyta, inferior to Genesis™ 090 and Genesis™ 425. Susceptible (S) to Phytophthora. Medium seed size similar to Almaz, predominantly 8–9 mm. Introduced from ICARDA, Syria and selected by DEPI Victoria. Excellent harvestability with an erect plant habit and good lodging resistance. Marketed by Australian Agricultural Crop Technologies. An EPR of $5.50/tonne applies.

Genesis™ 425. Resistant (R) to Ascochyta, superior to Almaz, and equal to Genesis™ 090. The least susceptible kabuli variety to Phytophthora but its susceptible (S) rating means it will sustain economic yield loss in high risk Phytophthora situations. Higher yielding than Almaz but lower yielding than Genesis™ 090. Seed size is smaller than Almaz, but slightly larger than Genesis™ 090 (predominantly 8 mm). Genesis™ 425 has shown some sensitivity to Balance® in northern NSW trials and herbicide screening trials in SA. Introduced from ICARDA, Syria and selected by DEPI Victoria and NSW DPI. Marketed by Australian Agricultural Crop Technologies. An EPR of $5.50/tonne applies.

Genesis™ Kalkee. Moderately susceptible (MS) to Ascochyta, inferior to Genesis™ 090 and Genesis™ 425. Susceptible (S) to Phytophthora. Larger seed size than Almaz and Genesis™ 114, predominantly 9 mm. It is a selection from an introduction from ICARDA, Syria, selected by DEPI Victoria. Yield is similar to Genesis™ 114 and Almaz in northern and southern NSW. Excellent harvestability with an erect plant habit and good lodging resistance. Marketed by Australian Agricultural Crop Technologies. An EPR of $5.50/tonne applies.

PBA Monarch.[ф] **Released 2013 (tested as CICA0857).** Moderately susceptible (MS) to Ascochyta, inferior to Genesis™ 090 and Genesis™ 425. Susceptible (S) to Phytophthora. Early flowering and early maturing. Medium seed size, 8–9 mm, similar to Almaz. Highest yielding medium sized kabuli chickpea. Semi-spreading plant type which can be prone to lodging. Developed by Pulse Breeding Australia (PBA). Marketed by Seednet with seed available through Seednet agents. An EPR of $7.15/tonne applies.

Weed control

Chickpeas do not compete well with weeds, and there are few options for broadleaf weed control. However, isoxaflutole (Balance®) and more recently terbuthylazine (Terbyne®) have made weed control more effective. Plant chickpeas in paddocks with relatively low broadleaf weed seed banks. Chickpeas can be sensitive to herbicide wash in planting furrows and care needs to be taken, particularly when moisture-seeking, that seed is well covered with at least 7 cm of soil. Consult your farm adviser.

Plants weakened by herbicide injury are more susceptible to diseases. The most common problems come from residual herbicides applied to prior cereal crops.

1. *Sulfonylurea herbicides* (e.g. Logran®, Glean®, Ally®, Eclipse®) applied to preceding cereal crops. Take special note of label instructions concerning crop rotation, rainfall required for breakdown and plant-back periods, particularly on high pH and/or compacted soils.

2. *Triazine herbicides* (simazine, cyanazine, atrazine, terbuthylazine). Seek advice as to potential crop damage when using triazine herbicides in winter cereals, sorghum and maize as application rates on different soil types influence the extent of residual herbicide breakdown. Follow label recommendations and avoid spray overlaps.
3. *Clopyralid* (e.g. Lontrel®) *2,4-D amine and some other hormone herbicides*. Under dry conditions, breakdown of these herbicides is slower and residues can also carry over in stubble and affect subsequent crops. Read labels carefully and observe plant-back periods, including rainfall requirements.

Isoxaflutole can damage Yorker and is not recommended for this variety. Under certain conditions, other varieties may be damaged causing delayed growth and flowering, and nitrogen benefits in rotations may not be maximised. Damage can occur where rain follows soon after spray application and the full rate is used. However the full rate will provide longer residual activity through the season. Ensure there is no open trench left above the seed at planting. Consult your farm adviser if unsure.

To minimise the risk of spray rig herbicide residues damaging the crop, decontaminate the main tank, hopper and all spray lines including pressure relief lines. Herbicide injury from carryover of fallow spray mixtures occurred in several crops in 2010 despite decontamination via the main tank. If this cannot be done satisfactorily, fit end taps to booms so that they can be thoroughly flushed.

Be aware of plant-back periods for herbicides such as Broadstrike® if used later in the season, especially when considering double cropping.

Consult herbicide labels and the NSW DPI guide *Weed control in winter crops* for further information on current weed control and plant-back recommendations.

Insect control

Helicoverpa spp. (heliothis caterpillars) are the major insect pest of chickpeas. They can reduce yield and cause grain quality problems. Careful monitoring of crops is required from flowering until seed maturity.

Research by DAFF Qld has suggested changes to control decisions for *Helicoverpa*. The change is from a fixed threshold of 1–2 larvae/m^2, to one based on the relationship between damage potential (determined by size and number of larvae, and crop growth stage), chickpea grain price and cost of control. Full details of the monitoring protocol to determine the cost/benefit ratio of control are outlined in *Helicoverpa management in chickpea*, available from the Pulse Australia website **www.pulseaus.com.au**

Management of *Helicoverpa* must be considered in terms of area-wide management and regional Insecticide Resistance Management Strategies. Where possible, growers should consider using products which do not increase the risk of *Helicoverpa* developing resistance to chemicals used in summer crops. This means growers are advised not to use certain chemicals such as synthetic pyrethroids and thiodicarb (Larvin®) without actively considering the benefits and disadvantages this will have to both their own crop and those of summer crop growers. Possible options are the 'softer' more selective products such as Vivus® or Gemstar®, Steward®, and Dipel®. There are many factors to consider when deciding which product to use, such as *Helicoverpa* species and risk of resistance, compatibility with fungicides, cost and harvest withholding period (WHP).

Read pesticide labels carefully before use. See *Insect and mite control in field crops* and *Helicoverpa management in chickpeas* for more information on pest control measures and thresholds.

Diseases

Disease monitoring and management is an important aspect of chickpea production. Growers are urged to seek advice on which diseases occur in their area. Control measures include crop rotation, paddock selection, and seed and variety selection, so it is best to start planning at least one season ahead of sowing.

Disease can occur at any time but economic losses are more likely late in the season, making pre-harvest contracts risky. The major chickpea diseases in NSW are Ascochyta blight, Phytophthora root rot, Botrytis grey mould, virus diseases, seedling disease caused by seed-borne Botrytis and ill-thrift caused by root-lesion nematodes. Sclerotinia can also cause problems in dense canopy crops. Physiological disorders with disease-like symptoms are also significant, in particular injury by low temperature, frost, herbicides, waterlogging, sodicity and salinity. See GRDC *Chickpea Disease Management Fact Sheet* (Northern and Southern Regions) at **www.grdc.com.au/Resources/Factsheets/2013/05/Chickpea-disease-management**

Ascochyta foliar disease (Ascochyta blight)

Ascochyta first caused widespread damage in NSW in 1998. A management strategy has been successfully adopted by the chickpea industry and is updated as new information becomes available and new varieties are released. It includes paddock selection and rotation, hygiene, growing less susceptible varieties (e.g. PBA Boundary, PBA HatTrick, PBA Slasher and most Genesis™ varieties), planting low risk seed, treating seed with a thiram-based fungicide, applying an early protectant fungicide spray, routine crop inspections and a willingness to apply additional fungicide sprays. All fungicide sprays must be applied before rain and wherever possible by ground rig with a minimum of 80 L/ha water (see *2011 Chickpea Disease Management Considerations for Northern Growers and Agronomists*, available from the Pulse Australia website **www.pulseaus.com.au**).

Foliar disease management strategy

In the 2014 season Ascochyta infection of chickpea crops was common in some localities. Although the extent of infection was not severe and the disease was well managed there will be carry-over of inoculum for the 2015 season. Implications for Ascochyta management in the 2015 season are that:

- Where Ascochyta WAS found on any variety on your or a neighbouring farm there will be inoculum present and a high Ascochyta risk. Apply a registered fungicide prior to the first rain event after crop emergence to all varieties with less resistance than PBA HatTrick. PBA HatTrick will also need to be sprayed. Monitor the crop 2 weeks after rain and if Ascochyta is detected, consider a second fungicide spray.

Disease and crop injury guide – chickpea

Disease/Cause	Symptoms	Occurrence	Survival/Spread	Control
Fungal and oomycete diseases				
Pre-emergence diseases Many fungi	Seedlings fail to emerge.	Mainly kabuli cultivars.	Wet soils. Survives in soil.	Treat seed with a thiram based fungicide.
Botrytis seedling disease *Botrytis cinerea* (fungus)	Seedlings wilt and die. Random distribution (not patches of plants).	Related to infected seed source.	Survives in seed after pods become infected.	Treat seed with a thiram based fungicide (first grading out small or mouldy seed, if present).
Damping off *Pythium* (oomycete) and several fungi	Seedlings wilt and die. Patchy distribution.	Wet soils.	Survives in soil.	Treat seed with a thiram based fungicide (may not give adequate control of Pythium).
Phytophthora root rot *Phytophthora medicaginis* (oomycete)	Rotted roots, plants easily pulled up. Patches of plants wilting; yellowing and defoliation starting from bottom leaves.	In patches with poor soil drainage, after heavy rainfall. Paddock history of medic, lucerne, or root rot in chickpea.	Survives in soil. Can persist for years. Spreads by water and soil movement.	Use the variety Yorker or PBA HatTrick which combine useful resistances to Phytophthora and Ascochyta. Avoid paddocks with a history of root rot in chickpea. Rotate with cereals. In high risk situations treat seed with metalaxyl (effective against early but not late infection).
Ascochyta leaf, stem and pod blight *Phoma rabiei (syn. Ascochyta rabiei)* (fungus)	Lesions with concentric rings of tiny black specks, death of leaves, stems, pods and, when severe, whole plants and patches of plants. Can kill entire crops of susceptible varieties if not managed properly.	Endemic in NSW. Favoured by wet humid weather.	Seed, chickpea trash. Volunteer chickpeas.	Use NSW DPI/DAFF Qld/Pulse Australia management strategy. Prevent introduction of chickpea trash, especially on equipment. Maintain machinery hygiene. Control volunteers early in the fallow. Use varieties with improved resistance.
Botrytis grey mould *Botrytis cinerea* (fungus)	Grey or dead patches on stem, collar, flowers or pods. Spore clusters evident as 'bunches of grapes' on dark brown stalks, best seen with hand lens	Warm (>15°C), humid, overcast conditions, dense canopies.	Many sources including any crop trash, sclerotes in soil, neighbouring crops, in-crop weeds, and infected seed. Inoculum usually not limiting.	Prevention is the same as for Ascochyta blight. Current recommendations for Ascochyta have reduced the impact of Botrytis grey mould. Pre-emptive spraying may be possible; check current recommendations and permits.
Sclerotinia wilt *Sclerotinia sclerotiorum, S. minor* (fungi)	Beige to tan lesions on stems at ground level or higher. White to grey mould in wet or humid weather. Sclerotes (1–5 mm black bodies) usually form on or inside stems or on tap roots.	Basal stem rot usually occurs in late winter/early spring. Canopy stem rot favoured by dense luxuriant growth.	Sclerotes survive in soil for at least 8 years, germinate directly and infect roots and stem bases or indirectly to release wind blown spores. Very wide host range in broadleaf weeds and crops.	Rotate with cereals, 4 year break between broadleaf crops. Avoid planting next to canola paddocks; control broadleaf weeds.
Virus diseases				
Beet western yellows virus (BWYV), *Alfalfa mosaic virus* (AMV), *Subterranean clover redleaf virus* (SCRLV), *Cucumber mosaic virus* (CMV), *Mastrevirus* pp., *Bean leafroll virus* (BLRV), *Tomato spotted wilt virus* (TSWV), and at least three other species	First symptoms are bunching, reddening, yellowing, or death of shoot tips. Later symptoms are reddening or yellowing and early death of whole plants. Diseased plants are scattered, i.e. solitary or in small groups of 2–4 plants.	Seasons or districts with major aphid flights. Most common in crops that have a low plant density, weed infestation.	Survives in weeds and pasture legumes, especially lucerne. Spread by aphids, and to a minor extent thrips and leafhoppers. AMV and CMV are transmitted through seed to seedlings at incidences up to 1% and 2% respectively.	Aim for optimal establishment, standing stubble, and no weeds by following best agronomic practices.
Nematodes				
Ill-thrift *Pratylenchus thornei, P. neglectus*	Poor plant growth in situations where nodulation and other factors are favourable. Microscope shows nematodes with stylets.	Widespread in soils with high clay content.	Survives and spreads in soil.	Crop rotation with a nematode-resistant cereal cultivar may be beneficial. Some chickpea varieties are less susceptible than others (seek advice).
Herbicide Injury				
Injury from soil residues of Group C herbicides (e.g. triazines) and sulfonylurea herbicides, and isoxaflutole (Balance®)	Discolouration, stunting, death, or leaf necrosis, especially in seedlings.	Related to pre-emergence herbicide use in current and previous seasons. Damage greatest in boom overlaps and compacted areas.	Most persistent in alkaline soils.	Observe label recommendations and avoid spray overlaps. Thoroughly decontaminate spray gear, especially auto rigs. Be aware of Group C herbicide risk when following sorghum (double crop) and triazine tolerant (TT) canola.
Waterlogging				
Injury from saturated soil or standing water	Similar to Phytophthora root rot, but roots remain intact. Initially plants do not pull easily out of ground. Onset is more rapid (1–2 days after rain) than for Phytophthora. Leaflets show bleaching, yellowing or reddening and may not fall.	Soil saturation for one day or longer, plants most sensitive when stressed and/or podding.	Poor drainage due to compacted soils or subsoil constraints.	Ensure good paddock drainage. Avoid irrigation after podding (see Pulse Australia publication Irrigated Chickpea Management).

- Localities where Ascochyta was NOT found in 2014 are considered low Ascochyta risk and the usual management practices (described below) apply.

Apart from considering the risk from 2014 inoculum, the following strategy should reduce losses from Ascochyta in 2015:

- In north-central and northern NSW, spray all varieties with less Ascochyta resistance than PBA HatTrick (MR) with a registered Ascochyta fungicide prior to the first rain event after crop emergence, three weeks after emergence, or at the 3 branch stage of crop development, whichever occurs first.
- In north-central and northern NSW, in paddocks that have not had chickpeas for at least 2 years, PBA Boundary, PBA HatTrick and most Genesis™ lines will not require their first Ascochyta spray until the disease is detected. Monitor these crops 2–3 weeks after each rain event from emergence onwards and spray if Ascochyta is detected in the crop or is found in the district on any variety.
- For all varieties with less Ascochyta resistance than PBA HatTrick and for varieties with Ascochyta resistance as good as or better than PBA HatTrick but where Ascochyta has been detected, apply a second fungicide spray before the second post-emergence rain event. In 2011, crops that were sprayed on this schedule had the least Ascochyta and subsequent management was successful.
- Ground application of fungicides is preferred. Select a nozzle such as a DG TwinJet or Turbo TwinJet that will produce no smaller than medium droplets (ASAE) and deliver the equivalent of 80–100 litres water/hectare at the desired speed.
- Where aerial application is the only option (e.g. wet weather delays) ensure the aircraft is set up properly and that contractors have had their spray patterns tested to ensure full canopy coverage.

Further information on chickpea Ascochyta can be found at the website **www.pulseaus.com.au**

Botrytis grey mould foliar disease (BGM)

This disease can be very damaging in seasons with frequent rainfall and prolonged high humidity, such as 2010. There were four reasons BGM was particularly severe in 2010 which could also apply if the same conditions occur in 2015:

1. Early planting (April–mid/late May) and narrow rows caused early canopy closure, resulting in high in-crop humidity and poor penetration of fungicides. Many crops lodged, exacerbating the situation.
2. Frequent overcast, showery weather – rainfall totals between June and December in 2010 were well above the long term averages across the northern region and in many cases the number of rainy days during this period was double the long term average. Wet paddocks limited spraying by ground rigs.
3. Lack of supply of effective fungicides – the large area of chickpeas planted in the northern region in 2010, combined with the sequence of rainfall events early in the season, resulted in a widespread and significant Ascochyta epidemic. This resulted in a severe shortage of registered fungicides when BGM started to develop. Even after Emergency Use permits were issued, supplies of BGM fungicides were limited.
4. Lack of BGM tolerant/resistant varieties – there is no useful resistance in current Australian chickpea varieties to BGM.

Fungicide sprays can reduce losses if applied early and repeatedly. The principles for fungicide application and management are the same as for Ascochyta (but the product selection differs). Check labels and permits or registration for fungicides on chickpea.

Botrytis seedling disease

The fungus that causes BGM (*Botrytis cinerea*) also causes pre- and post-emergence seedling death. In 2011, Botrytis seedling disease was common in most northern NSW crops sown with grower retained seed. The disease came from seed infected during the 2010 BGM epidemic. In every case, this seedling disease in 2011 crops could be traced to inadequate treatment of the 2010 crop seed, due to poor coverage and/or insufficient rate. Together with poor germination and vigour, the result was a patchy crop with a low plant population and secondary infection of healthy seedlings by Botrytis via root contact. Botrytis basal collar rot appeared from September onwards. Patchy stands made weed management challenging and led to a higher risk of viruses.

Field trials in 2011 at Moree, Bellata, Breeza and Tamworth, using seed from 2010 crops affected by BGM, showed that Botrytis seedling disease is readily controlled with registered seed treatments, as long as they are applied correctly. However, it is recommended to not use Botrytis infected grain as planting seed even if treated. The seed will have lower vigour and this will increase the risk of other seedling diseases. Also, sowing rates will need to be increased to account for the reduced vigour, which may make using grower retained seed uneconomical.

Phytophthora root rot

Phytophthora root rot is a soil and water-borne disease that can become established permanently in some paddocks. Damage is greatest in seasons with above average rainfall but only a single saturating rain event is needed for infection. Avoid high-risk paddocks such as those with a history of Phytophthora in chickpea, waterlogging, or pasture legumes, particularly medics and lucerne. If considerations other than Phytophthora warrant sowing in a high-risk paddock, choose PBA HatTrick or Yorker and consider treating seed with metalaxyl. Metalaxyl can be applied in the same operation as other seed dressings providing all conditions of permits and labels are met. Metalaxyl only provides protection for about 8 weeks; crops can still become infected and die later in the season. Do not plant PBA Boundary in any paddock that has had a history of pasture legumes or chickpea Phytophthora root rot.

Root lesion nematode, RLN

(Pratylenchus thornei, P. neglectus)

Root lesion nematode cause poor plant growth in situations that otherwise appear favourable. They attack cereals and pulses and are thus a threat to the whole farming system. Nematodes feed and multiply on and in the roots of chickpea plants and in sufficient numbers will reduce growth and yield. Chickpea varieties differ in their resistance and tolerance to RLN but are generally considered more susceptible (allowing nematodes to multiply) than field peas, faba beans and lupins. Reduce

the risk of losses from RLN by not planting chickpeas in paddocks that had susceptible or intolerant cereal varieties in 2014 and by following the recommendations on the following website link: **www.daff.qld.gov.au/documents/Biosecurity_GeneralPlantHealthPestsDiseaseAndWeeds/Root-Lesion-Nematode-Brochure.pdf**

Sclerotinia base rot (*S. sclerotiorum, S. minor*) and Sclerotinia aerial blight (*S. sclerotiorum*)

In 2010, Sclerotinia was more common than in previous years and in some paddocks caused serious damage. There are two species that attack chickpeas and they can be distinguished by the size of their sclerotes (survival structures). *Sclerotinia sclerotiorum* produces large, irregular shaped sclerotes 5–10 mm in diameter and up to 20–30 mm long in chickpea stems, whereas *S. minor* sclerotes are angular and much smaller, rarely larger than 2–3 mm in diameter.

Both species of Sclerotinia have a wide host range including many broadleaf weeds and crop plants such as canola, faba beans and sunflowers. Reduce the risk of losses from Sclerotinia by planting seed free of sclerotia and by not planting chickpeas in paddocks that have recently had alternative host crops. The resting structures (sclerotes) can survive for up to 10 years but it is impracticable to maintain a host-free break for that period. No fungicides are registered for control of Sclerotinia in chickpea.

Virus diseases

Viruses spread by flying aphids can cause major losses in some years, often later in the season as was the case in 2012. The Liverpool Plains, and Gilgandra and Narrabri districts have a history of virus disease. Prevention is the only technique to limit losses because there is no cure. However, prevention measures are not adequate due to limited effectiveness and practicality, and there are no immune varieties. Follow best agronomic practices including retention of standing stubble, optimising seeding rate and sowing time, and controlling in-crop and fallow weeds. Other measures that may be beneficial in some cases include use of virus-free seed, controlling 'host' weeds, distancing from lucerne, and use of narrow row spacing and higher seeding rate. Monitoring and spraying aphids is not recommended. Virus control is different for chickpea than for other pulses because spread is almost entirely by non-colonising aphids that visit crops only briefly. The prevention options are detailed and evaluated in *Virus control in chickpea – special considerations*, available from the Pulse Australia website **www.pulseaus.com.au**

Fungicide seed dressings

Chickpea seed should always be treated to control seed-borne Ascochyta and Botrytis and some soil-borne diseases. Research has shown P-Pickel T® (thiram plus thiabendazole), and products containing thiram only (e.g. Thiram® 600) are equally effective against Ascochyta and Botrytis. Additionally, application of metalaxyl may be warranted if there is a risk of Phytophthora in a paddock.

Chickpea seed treatments

Active ingredient	Example product	Rate	Target disease
thiram 360 g/L + thiabendazole 200 g/L	P-Pickel T®	200 mL/100 kg seed	Seed-borne Ascochyta and Botrytis, Damping off, Fusarium
thiram 600 g/L	Thiram® 600	200 mL/100 kg seed	Damping off, seed-borne Botrytis and Ascochyta
thiram 800 g/kg	Thiragranz®	150 g/100 kg seed	Seed-borne Botrytis and Ascochyta, Damping off
metalaxyl 350 g/L	Apron® XL 350 ES	75 mL/100 kg seed	Phytophthora root rot

Injury by herbicide residues in soil

Herbicide residues can cause disease-like symptoms. Damage is greatest on alkaline soils above pH_{Ca} 7.6 and may be aggravated by soil compaction. Group B sulfonylurea herbicides (e.g. Ally®, Associate®, Glean®, Logran®, Lynx®, Nugran® and Tackle®) on preceding cereal crops are especially risky, requiring special attention to crop rotation recommendations on labels. The trend in northern NSW to double crop sorghum and include triazine tolerant (TT) canola varieties in the rotation also increases the risk of Group C herbicide damage.

Consult herbicide labels and the NSW DPI guide *Weed control in winter crops* for further information on plant back periods and rainfall requirements.

Harvesting

Chickpea plants often contain pods with various stages of maturity (i.e. first set pods may be mature whilst young green pods are still forming). Chickpea seeds are physiologically mature when yellowing from the beak of the seed begins to extend through the remainder of the seed.

Chickpeas can be desiccated using glyphosate (540 g/L) +/– metsulfuron-methyl (600 g/kg), or diquat (200 g/L), to aid harvest efficiency once the majority (90–95%) of seeds have reached physiological maturity. Note that harvest WHP varies depending on product used. Desiccation allows earlier harvest, maximising both yield and grain quality. However, a crop ripening evenly under very hot conditions or with no weed problems may not require desiccation (see *Chickpea Harvest and Seed Storage*, available from Pulse Australia). Crops desiccated with glyphosate should not be kept for planting seed.

The receival standard for chickpea is 14% seed moisture content. Harvesting should start as soon as the seeds have dried down sufficiently to thresh. Harvesting chickpeas at 14–15% moisture then drying or aerating will normally result in higher yield, better quality, fewer harvest difficulties and less problems with late Ascochyta infection. Harvest losses and downgrading in quality (cracking) can be substantial if chickpea harvest is delayed until moisture is below 11–12%.

Significant harvest losses can occur if harvest operators are inexperienced. Make sure contractors are experienced in chickpea harvesting and that headers travel at appropriate speeds.

Marketing

The bulk of the Australian chickpea crop is exported. Most desi chickpeas go to the Indian subcontinent for human consumption as whole seed, *dhal* (split seed) or *besan* (flour). A small proportion is split in Australia and consumed locally or sold to expatriate Indian communities in the UK, Canada and Fiji.

Prices in the Indian subcontinent are low in their post-harvest period from April to June and Turkish imports fill the period from August to December. The Australian crop meets the off season demand from December to March, although prices for chickpeas in Australia in October/November are often higher than in December/January.

Small seeded kabulis (up to 7 mm diameter) meet separate market requirements to large kabulis and are therefore priced accordingly. They are mainly exported to the Indian subcontinent and Middle East. Larger kabulis command a higher price, with significant premiums applying to each 1 mm increment in seed diameter. The size of these premiums varies from year to year, depending on supply from key competitors. The larger kabuli chickpeas are exported to the Indian subcontinent, Middle East and Europe.

Further information

Agfact P4.2.2 *Chickpea – best practice management for sustainable production* (NSW DPI, 2000)

Weed control in winter crops (NSW DPI, 2015)

Insect and mite control in field crops (NSW DPI, 2013)

NSW DPI website: **www.dpi.nsw.gov.au/agriculture/broadacre/winter-crops/pulses** for:

Pulse Point 7, *Reducing disease risk* (NSW DPI, 1999)

Pulse Point 20, *Germination testing and seed rate calculation* (NSW DPI, 2005)

Pulse Australia (PA) website **www.pulseaus.com.au** for:
2011 Chickpea Disease Management Considerations for Northern Growers and Agronomists (PA Bulletin 2011 #05)

Chickpea: Sourcing High Quality Seed (PA Bulletin 2011 #06)

Chickpea: Effective Crop Establishment (PA Bulletin 2011 #07)

Chickpea: Integrated Disease Management (PA Bulletin 2011 #08)

Chickpea: Ascochyta Blight Management (PA Bulletin 2011 #09)

Chickpea: Botrytis Grey Mould Management (PA Bulletin 2011 #10)

Chickpea: Phytophthora Root Rot Management (PA Bulletin 2011 #11)

Chickpea Disease Management Strategy – Southern Region (PA Bulletin 2012 #08)

Virus control in chickpea – special considerations (PA Bulletin 2009 #10)

Growers Guide to Deep Planting Chickpeas (PA Bulletin 2009 #01)

Helicoverpa Management in Chickpea (PA, 2007)

Chickpea Harvest and Seed Storage (PA, 2007)

Irrigated Chickpea Management (PA Bulletin 2010 #17)

Chickpea Checklist for Southern Growers (PA Bulletin 2010 #05)

Chickpea Checklist for Northern Growers (PA Bulletin 2010 #06)

Variety Management Packages (VMP) for all new varieties

List of Accredited Chickpea Agronomists

List of major grain traders/exporters

Pesticide permits for pulses

Other publications include:
2013 GRDC Chickpea Disease Management Fact Sheet (Northern and Southern Regions, May 2013) available at: **www.grdc.com.au/Resources/Factsheets/2013/05/Chickpea-disease-management**

Chickpea Disorders: The Ute Guide, TOPCROP Australia, DAFF Qld

Field Crop Herbicide Injury: The Ute Guide, TOPCROP Australia

Winter Pulse Disorders: The Ute Guide, TOPCROP Australia

Root-lesion nematodes: Management of root-lesion nematodes in the northern grain region (DAFF Qld, 2009)

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Faba bean

Crop management

Many dryland and irrigation grain-growing areas are well suited to faba bean. All varieties are suitable for stockfeed or human consumption. However, in some environments seed size and colour may limit the potential to achieve human consumption market specifications. Faba bean are best suited to deep, neutral–alkaline, well-structured soils. Avoid shallow, acidic (less than pH_{Ca} 5.2) or very light to sandy-textured soils. In southern areas, test pH to ensure the soil is suitable. Good drainage is preferable, however faba bean can withstand short periods of waterlogging much better than chickpea, field pea and lupin. If possible locate crops at least 500 m from faba bean stubble. In northern NSW, faba beans should be planted on a minimum of 100 mm plant available water at sowing.

Faba beans enhance soil nitrogen levels and break weed and disease cycles in cereal crop rotations. Under conditions of adequate moisture, they may be sown immediately following maize, sorghum or cotton provided no residual herbicides damaging to faba bean have been applied in the previous crop.

Optimum temperature for growth is in the range of 15–25°C, with flowering ideally occurring from July to late September. Flowering may start as soon as June if sown early in northern NSW and may extend to mid-October in southern NSW. High temperatures and hot, dry winds during flowering will reduce yield. Severe frosts following mild weather often causes elongating stems to develop a bent stick (hockey stick) appearance, blackening of leaf margins and abortion of flowers and pods in some varieties. Faba bean is an open-pollinated crop, so out-crossing from one variety to another can occur. If retaining faba bean for seed, crops of different varieties should be separated by the maximum distance possible to reduce any out-crossing and varietal contamination from another variety.

The introduction of bee hives to paddocks at flowering has been shown to benefit pod set and increase yields in areas where low naturalised honey bee or native bee populations exist.

Grain yield potential and nitrogen benefit are closely related to growth – the more dry matter produced, the higher the potential yield and the more nitrogen added to the soil. To achieve high yields, early sowing is essential.

Plant residues, particularly lost grain left after harvest, can provide valuable grazing with no stock health risks. Adhere to harvest withholding periods (WHP) for all herbicides, insecticides and fungicides applied to the crop.

Sowing

Seeds are relatively large and flat compared to cereal seed. Some equipment is incapable of successfully sowing seed of this size and shape. It is important to test equipment before sowing using inoculated seed, as the peat increases seed bridging in planter boxes. Ideally sow faba bean into cereal stubble for maximum nitrogen fixation, rotational benefits, and to minimise aphid infestation. Wider row spacing can assist in trash flow.

Faba beans are generally sown 4–6 cm deep, depending on soil moisture, but they can be sown up to 12–13 cm if needed. Deep furrow or moisture seeking techniques can be used to ensure planting on time. The large seed size makes them very suitable for this type of planting system. Deep sowing may also reduce potential effects on crop establishment from post sowing, pre-emergent herbicides. Under furrow irrigated conditions, it is best to sow shallow (2–3 cm) and water the crop up.

Suggested sowing times

Region / week	April				May				June			
	1	2	3	4	1	2	3	4	1	2	3	4
Northern												
Narrabri–Boggabilla												
Walgett–Coonamble												
Liverpool Plains												
Central West												
Dubbo–Warren												
Cowra–Forbes												
Central and Southern												
Temora–Wagga–Lockhart												
Griffth–Hillston (irrigated)												

too early, high disease pressure likely and increased risk of aphid flights and virus infection

best sowing time

later than desirable, yield reduction likely

too late for good results, large yield reduction likely

Plant population target	Plants/m²
North dryland	15–25
North irrigated	15–20
South dryland	20–35
South irrigated	20–30

Seeding rates	Average 100 seed weight (g)	Seed rate (kg/ha) 20 plants/m²	Seed rate (kg/ha) 30 plants/m²
Establishment %		90	90
Doza	50 (40–60)	111	166
Cairo, Fiesta VF, Farah, Nura, PBA Samira	68 (60–75)	151	227
PBA Warda	64 (58–70)	142	212

[#] Calculations based on 100% seed germination.

Your calculation

100 seed weight # (grams) [ ] × target plant population [ ] × 1000

÷ establishment percentage* [ ] × germination percentage [ ]

= your seeding rate [ ] kg/ha

To determine your seed weight, weigh 100 seeds in grams.

* Establishment percentage – 90% is a reasonable estimate, unless sowing into adverse conditions.

Sowing time

Aim to sow in the earlier part of the sowing window to maximise yield potential. Avoid sowing earlier than the suggested sowing times, particularly under irrigation, as this can promote excessive vegetative growth and consequently increase crop lodging and foliar diseases. Sow irrigated crops in southern NSW in early to mid-May.

Seeding rate

Seeding rates for faba bean vary according to seed size, sowing time and region. Faba beans can yield well over a wide range of plant populations under favourable conditions as they have the ability to compensate and fill in plant rows. Trials conducted in northern and southern NSW under dryland conditions show that plant densities below the recommended populations reduce yield in most years. Later sown crops require a higher plant population to minimise potential yield loss. A plant population of 20 plants/m^2 has been acceptable on a row spacing of 50–100 cm in northern NSW dryland crops and southern NSW irrigated crops. Plant populations of 25–35 plants/m^2 are required for southern NSW dryland crops.

Inoculation

Inoculation is essential on all soil types. Use the commercially available faba bean inoculant (rhizobium strain WSM 1455). Faba bean rhizobia are very sensitive to soil acidity. Some products are more sensitive to drying out than others, so ensure seed is sown into good soil moisture, especially when moisture-seeking. **Calibrate the planter using inoculated seed.**

Nutrition

Phosphorus (P) is the main nutrient required by faba beans. Apply phosphorus fertiliser on deficient soils at equivalent rates to that used on cereals. Phosphorus is best banded close to the seed at planting, especially in soils that have grown rice within the last two years. Responses to zinc have been recorded on alkaline clay soils. Consider molybdenum on acid soils.

Variety selection

When selecting a variety consider season length, seed size with reference to sowing machinery, disease tolerance, seed availability and suitability to markets. A number of varieties are available, differing in a range of characteristics with most suited to specific growing regions of NSW. Carefully select varieties based on local data. For characteristics of the different varieties, refer to the variety characteristics and reaction to diseases table below.

Variety characteristics and reaction to diseases

Variety	PBR	Maturity	Seed colour	Seed size (g/100 seeds)	Disease			Yield							
								North East		North West		South East		South West irrigated	
								Yield as % of Cairo		Yield as % of Cairo		Yield as % of Farah		Yield as % of Farah	
					Ascochyta	Chocolate spot	Rust	%	No. Trials	%	No. Trials	%	No. Trials	%	No. Trials
								Cairo = 2.67 t/ha		Cairo = 2.02 t/ha		Farah = 2.59 t/ha		Farah = 4.07 t/ha	
Cairo	yes	mid–late	buff	50–75	VS	VS	MS	100	22	100	45	100	7	–	–
Doza	yes	early	light buff	40–60	VS	MS	MR-R	105	22	105	45	97	16	94	3
Farah	yes	mid	light buff	60–75	R–MR	S	S	101	4	100	7	105	28	100	7
Fiesta VF	no	mid	buff	60–75	MR–MS	S	S	102	17	101	33	106	28	100	7
Fiord	no	early–mid	buff	33–55	MS	VS	S	98	17	98	33	94	13	–	–
Nura	yes	mid	light buff	50–65	R–MR	MS	MS	87	12	85	18	100	28	93	7
PBA Rana	yes	mid–late	light buff	75–90	R	MS	MS–MR	–	–	–	–	100	24	93	6
PBA Samira	yes	mid	light buff	60-80	R	MS	MS	–	–	–	–	107	11	96	3
PBA Warda	yes	early	beige to brown	58–70	S	MS	MR–R	110	110	110	45	103	9	–	–

Yield results are a combined across sites analysis using PBA and NVT yield trials from 2007–2014.

– = Insufficient data; VS = Very Susceptible; S = Susceptible; MS = Moderately Susceptible; MR = Moderately Resistant; R = Resistant.

Faba bean

Cairo.[Φ] Released in 2003 for the northern grains region, superior to Fiord and Barkool for yield, seed size and quality, rust resistance and tolerance to stem collapse from frost. Now outclassed for yield and rust resistance by Doza. It is not generally recommended for southern NSW where Ascochyta and chocolate spot are major constraints. An End Point Royalty (EPR) of $3.00/tonne (GST excl.) applies. Commercialised under licence to Seednet and available through local seed suppliers.

Doza.[Φ] Released in 2008 for the northern grains region from central NSW to southern Queensland by Pulse Breeding Australia's (PBA) northern faba bean breeding node at Narrabri. Doza is significantly better adapted to warmer spring temperatures than Barkool, Cairo and Fiord. Doza is higher yielding than Cairo, with improved rust resistance. Seed is smaller than Cairo, but more uniform with a light buff seed colour. It is not generally recommended for southern NSW where Ascochyta is a major constraint. An EPR of $3.30/tonne (GST excl.) applies. Commercialised under licence to Seednet and available through local seed suppliers.

Farah.[Φ] Farah is a selection from Fiesta VF with improved resistance to Ascochyta. It has similar agronomic characteristics and yield to Fiesta VF. The improved Ascochyta resistance will result in a lower level of Ascochyta staining of seed compared to Fiesta VF. Selection was also undertaken for reduced environmental staining of seed and improved uniformity of seed size. An EPR of $3.00/tonne (GST excl.) applies. Commercialised under licence to Heritage Seeds and available through local seed suppliers.

Nura.[Φ] Released in 2005 from the southern node of the National Faba Bean Breeding Program, Nura was produced from a cross between Icarus and Ascot and selected for improved resistance over Fiesta VF to both chocolate spot and Ascochyta. It also has moderate resistance to rust. Nura is later flowering than Fiesta VF, however is of similar maturity. Suited to the medium to high rainfall areas of southern NSW and is not recommended for northern NSW. Shorter in height than Farah and Fiesta VF and is less likely to lodge. Seed is slightly smaller than Farah and light buff in colour. An EPR of $3.00/tonne (GST excl.) applies. Commercialised under licence to Seednet and available through local seed suppliers.

PBA Rana.[Φ] Released in 2011 from the southern node of the PBA faba bean breeding program. PBA Rana is suited to the higher rainfall, longer season growing areas. It is mid to late flowering, with improved resistance to chocolate spot compared to Farah and resistant to Ascochyta. It has large plump light brown seed that is bigger than current varieties. In NSW PBA Rana has performed well at longer season or high rainfall sites. Prior to considering growing PBA Rana growers should investigate marketing options as it needs to be segregated to achieve a premium for its larger seed size. An EPR of $3.50/tonne (GST excl.) applies. Licensed to Seednet.

PBA Samira.[Φ] New release (breeding code AF05069-2). Released in spring 2014 from the southern node of the PBA faba bean breeding program. PBA Samira is adapted to a wide range of environments in the southern region. It is mid to late flowering but matures at the same time as Farah and Fiesta VF. PBA Samira is resistant to Ascochyta, including the new strain that was recently identified in the mid-north of South Australia. Its seed is slightly larger than Farah and Fiesta VF, but of the same colour and should be suitable to be co-mingled with other varieties for the human consumption market. Licensed to Seednet. An EPR of $3.50/tonne (GST excl.) applies.

PBA Warda.[Φ] Released late 2012 from the northern node of the PBA faba bean breeding program. PBA Warda is higher yielding than Doza and best adapted to the higher rainfall zone of the northern region. It is similar to Doza for earliness, chocolate spot and rust resistance, but has better tolerance to frost and *Bean leafroll virus*. Its seed is more uniform and bigger than Doza making it suitable for the human consumption market. An EPR of $3.50 /tonne (GST excl.) applies. Licensed to Seednet.

Broadbean

PBA Kareema.[Φ] Released in 2010 from the southern node of the PBA faba bean breeding program. PBA Kareema is a broadbean that is adapted to the higher rainfall zones of south east South Australia and southern Victoria. PBA Kareema maintains the adaption of Aquadulce, but with more uniform larger seed, no evergreen seed and improved resistance to Ascochyta. Similar maturity to Aquadulce and requires a long pod filling period to achieve maximum yield and large seed. An EPR of $4.40 /tonne (GST incl.) applies. Licensed to PGG Wrightson Seeds.

Irrigation

Faba bean is grown in rotation with irrigated summer crops such as cotton, rice, maize or sorghum. Faba bean is a safe crop to dry sow and water up on either beds or hills. To increase rhizobium inoculum survival, dry sown beans should be watered immediately after sowing. Always ensure good seed-soil contact. Plant populations can be lowered to 15 plants/m^2 in the north and 20 plants/m^2 in the south without yield penalties, provided plant establishment is even.

In short season northern areas one irrigation at early pod-fill (early–mid August) may be all that is required. Avoid irrigating before flowering as often tall, vegetative, low yielding crops may result. In southern areas apply the first spring irrigation early to avoid stress during flowering and early pod filling as delays will reduce yield potential. Follow-up irrigations can be scheduled according to plant water use. Although the crop is tolerant of some waterlogging, a good layout is essential and irrigation times should be kept as short as possible for high yields.

In southern NSW furrow irrigation is preferred over spray irrigation as overhead watering encourages more foliar disease. Border check layouts increase the risk of waterlogging during and after irrigation. In these layouts irrigation and drainage should be complete within eight hours.

Weed control

To maximise rotational benefits effective weed control is essential. Herbicides can damage faba bean, so use only registered products according to label directions.

Plants weakened by herbicide injury are more susceptible to diseases, especially chocolate spot. The most common problems come from residual herbicides applied to prior cereal crops but non-residual herbicides have also been implicated.

1. *Sulfonylurea herbicides* (triasulfuron, chlorsulfuron, metsulfuron methyl, metosulam) applied to preceding cereal crops. Take special note of label instructions concerning crop rotation and plant-back periods, particularly on high pH and/or compacted soils where rainfall has been limited.
2. *Clopyralid* applied to preceding cereal crops and summer fallows. Clopyralid can carry over in straw and affect subsequent crops.
3. *Atrazine* applied at full rates to preceding maize and sorghum crops. Check the label for crop rotation guidelines.
4. *Picloram and aminopyralid* formulations e.g. Grazon Extra and Tordon 75-D, applied to previous summer fallows. Under dry conditions the breakdown of these fallow herbicides is reduced and following crops may suffer herbicide injury.

Triazine herbicides (simazine, cyanazine, terbuthylazine) applied in-crop can potentially cause crop damage in some circumstances – application rates influence herbicide action on different soil types. Follow label recommendations and avoid spray overlaps

Correct boomspray decontamination procedures must be followed to avoid the potential for herbicide injury.

Be aware of the plant-back periods for the post-sowing pre-emergent herbicides (e.g. imazethapyr – Spinnaker®) used in faba bean crops as these may affect following crops, especially other non-pulse broadleaf crops such as sunflowers and canola.

Read pesticide labels and the NSW DPI guide *Weed control in winter crops* for further information on current weed control recommendations, plant-back periods and correct spray unit decontamination procedures.

Insects

Early detection of insect damage and appropriate control measures are important in improving crop health and vigour, and in reducing the crops susceptibility to foliar disease. The two critical times that pests need to be monitored are establishment and from flowering to harvest.

Redlegged earth mite and blue oat mite – large populations can cause distorted early growth and may kill seedlings. The rasping of the leaf surface during feeding results in a distinctive silvering on the leaves. Areas may redden and can be confused with early disease infection.

Lucerne flea – damage is characterised by clear membranous windows chewed into leaf surfaces. It is a sporadic pest in the paddock, so not all the crop will be infested. Hot spots can occur along weedy fence lines and around trees and rocky outcrops in paddocks.

Early detection of mite and flea damage, and control improves crop health and vigour, reducing the crops susceptibility to foliar diseases.

Aphids – monitor from early establishment. Dense colonies of cowpea aphid (*Aphis craccivora*), consisting of shiny black adults and dull grey juveniles, often damage shoot tips early in the season and may ultimately reduce yield. Cowpea aphid is a vector of several virus diseases. Pea aphid (*Acyrthosiphon pisum)* and blue green aphid (*Acyrthosiphon kondoi*) are large green aphids that are less conspicuous on plants. They are not known to cause major feeding damage. However, out of all the colonising and visiting aphids, pea aphid is the most damaging as it is an important vector of virus diseases of faba bean.

Thrips – monitor from early establishment. Thrips feeding can damage seedlings and high populations can cause seedling death. Fields sown close to cotton often have high populations. Thrips can cause flower and early pod abortion and should be monitored regularly during this period. Thrips can also spread *Tomato spotted wilt virus* in faba bean.

Helicoverpa spp. (Heliothis) – base control decisions on regular monitoring. Crops should be monitored twice weekly from flowering onwards. Larvae feed on leaves, stems and pods. Once they are of sufficient size larvae burrow into pods and feed on the developing seed. Human consumption markets have strict limits on *Helicoverpa*-damaged seeds, so spray thresholds of one larva per m^2 warrants control. Early sown crops may mature prior to infestation by *Helicoverpa* moths, avoiding the need for control.

Helicoverpa spp. can develop resistance to certain insecticides, so find out the resistance status for your region. The recommended strategy for limiting resistance is:

- check crops regularly to detect eggs and small caterpillars
- correctly identify the species present
- spray caterpillars when they are less than 10 mm long
- rotate insecticides from different chemical groups according to the *Helicoverpa* strategy for each region.

See the NSW DPI guide *Insect and mite control in field crops* for more detailed information on pest control measures and thresholds.

Disease and crop injury guide – faba bean

Disease/Cause	Symptoms	Occurrence	Survival/Spread	Control
Foliar Diseases				
Ascochyta blight *Ascochyta fabae*	Small grey circular leaf spots, showing through both sides of the leaf, developing light brown centres with age. Under humid conditions lesions become dotted with black specks. The disease also causes stem breakage and pod lesions which result in seed discolouration.	Wet conditions in mid to late winter or when late rains occur prior to harvest and causes pod infection.	Spores spread by wind and rain splash. Infected seed, faba bean residues and volunteer plants are sources of initial infection.	Disease-free seed. Crop rotation. Destroy or incorporate infected stubble. Locate crops at least 500 m from last year's faba bean crop. Control volunteer plants. Resistant varieties. Foliar fungicides.
Chocolate spot *Botrytis fabae/B. cinerea*	Leaf spots are initially reddish-brown pin head sized and on one side of the leaf only. Under suitable conditions spots expand into large, irregular, black dead areas, expanding onto the stem. Flowers and pods can also be affected.	Extended (> 1 day) periods of leaf wetness. Favoured by mild temperatures between 15 and 20°C which can rapidly spread the disease.	Infected faba bean residues. Infected volunteer plants. Spores spread by wind and rain.	Resistant varieties. Foliar fungicides. Crop rotation, good crop hygiene. Locate crops at least 500 m from last years faba bean crop or from wind blown stubble residues. Control volunteer faba bean.
Rust *Uromyces viciae-fabae*	Several spore stages can appear on leaves, stems and sometimes pods at the same time. Early on, creamy-yellow pustules form on leaves. These are soon replaced by orange-brown pustules. Later, black spore masses develop on stems.	Only a short period of leaf wetness during the night (like a heavy morning dew) is needed for infection to occur. Infection can occur under a wide range of temperatures, but disease development is favoured by high (> 20°C) temperatures and therefore of more importance in northern NSW and towards the end of the season in southern NSW.	Infected volunteer plants very important. Infected faba bean residues.	Resitant varieties. Foliar fungicides. Locate crops at least 500 m from last year's faba bean crop. Control volunteers faba bean. Crop rotation
Viral Diseases				
Virus yellowing diseases: *Bean leafroll virus* (BLRV), *Subterranean clover stunt virus* (SCSV), *Subterranean clover redleaf virus* (SCRLV)	Yellowing, interveinal at first, and often prominent at shoot tips. Leaves are stiffer than normal and often rolled upwards at the edges, pointing upwards. Infected plants are usually stunted and often die prematurely.	Seasons or districts with major aphid flights.	These viruses survive in weeds and pastures, particularly in forage legumes. All are spread by aphids and are persistent (aphids remaining infective for four days or longer).	Follow best management recommendations including; retention of standing cereal stubble (deters aphids), using recommended seeding rates, sowing on time, and controlling weeds. Poorly established, weedy crops suffer most from viruses. If it is detected early and while infection is at a low incidence that a yellowing type virus is present, controlling aphids with a registered aphicide may be beneficial for limiting the spread of the virus. Seek advice from your agronomist.
Virus mosaic diseases: *Bean yellow mosaic virus* (BYMV), *Broad bean wilt virus* (BBWV)	Leaves show mosaic, dark green colour against a pale green or yellow background. Leaf texture is abnormal, ranging from uneven to crinkled.	Seasons or districts with major aphid flights.	These viruses survive in weeds and pastures, particularly in forage legumes. Both BYMV and BBWV are spread by aphids and are non-persistent, lasting no more than four hours in aphids and usually less.	Follow best management recommendations including; retention of standing cereal stubble (deters aphids), using recommended seeding rates, sow on time, and controlling weeds. Poorly established, weedy crops suffer most from viruses. Foliar aphicides are not reliable for controlling virus mosaic diseases.
Necrosis: *Tomato spotted wilt virus* (TSWV)	Large dark lesions are formed on the leaves and later dark brown streaks develop on the upper stem, often on one side. The growing point of the shoot is often killed, but sometimes the plant partially recovers. Seed production from affected plants is severely reduced.	Locally common in some years.	TSWV survives in weeds and is spread by thrips.	No proven control.
Herbicide Injury				
Group B such as sulfonylureas (SU's)	Seedlings become stunted, stem and leaf margins blackened, leaflets cupped and growth of lateral roots reduced. Plants often die.	Related to use of pre- and post-emergent herbicides. Alkaline soils increase risk of injury.		Follow label recommendations especially plant-back periods, soil pH and minimum rainfall requirements. Avoid spray overlaps and drift.
Group C such as triazines	Leaves blackened and die back from edges and tips.	Alkaline soils or sandy soils, low in organic matter. Shallow sowing. Wet conditions following application to dry soil.		Follow label recommendations especially plant-back periods. Avoid spray overlaps and drift.
Group I such as phenoxys	'Hormone-type' injury including abnormal leaves.	Related to the use of herbicides in previous crops and fallows, also drift from neighbouring crops.		Follow label recommendations and be aware of rainfall and soil pH requirements in plant-back periods.

Disease management

Proactive decisions will assist in managing the risks of disease. Monitoring from emergence for disease, especially during favourable conditions, is crucial. Effective disease control is dependent on strategic fungicide use, but careful attention to other management practices can reduce disease pressure, making the fungicide program more effective. These include:

- growing faba bean no more than once in four years in the same paddock
- separation of crops by 500 m from previous faba bean crops
- reduction of disease infected stubble load by grazing and/or incorporating
- control of volunteer faba bean
- use of clean Ascochyta blight lesion-free seed, and
- growing locally adapted varieties that are the most tolerant to the major regional diseases.

Fungicide control

Seven fungicides – mancozeb, carbendazim, chlorothalonil, copper, metiram, tebuconazole and procymidone are either registered or available under permit. Check pesticide permits and registrations for any changes in use patterns before using fungicides. Mancozeb, chlorothalonil, metiram and copper are protectants and have no curative action on existing infections. Newly grown, untreated foliage is not protected. Carbendazim, procymidone and tebuconazole have protectant and limited curative action and work best when applied before an infection event. These fungicides are not translocated from sprayed leaves so newly grown foliage after spraying is not protected.

Spray on time. Organise spraying ahead of schedule so that fungicides can be applied as soon as a decision is made. Frequent viewing of four day weather forecasts can assist decision making. Do not compromise a fungicide spray to wait for a herbicide application. Plan to spray one or two days before a significant rain period, but do not delay spraying because of the threat of rain. Light rain (less than 12 mm) can actually increase the efficacy of mancozeb. For ground application, aim for 100 L water/ha. If the label or permit specifies a minimum water rate, the fungicide must be applied at the specified water rate. Correct timing of fungicide application is essential for good disease control.

Ascochyta, chocolate spot and rust management (southern NSW)

Research and commercial evaluation have shown the effectiveness of disease management programs using strategic sprays of mancozeb, carbendazim, chlorothalonil and procymidone.

The recommended program includes an application of mancozeb four to six weeks after emergence to control Ascochyta and early chocolate spot. Mancozeb, carbendazim, chlorothalonil or procymidone is then applied for chocolate spot control throughout the growing season. Under registration restrictions carbendazim must not be applied for more than two consecutive sprays and should be rotated with other fungicides. The number of sprays depends on the number of infection periods (i.e. rainfall events). Monitor crops regularly in spring for development of chocolate spot, which can be rapid under favourable conditions (i.e. mild temperatures and frequent rainfall events).

Fungicides are effective for up to 14 days. Severe disease pressure will reduce the protection period, as will rapid growth which is unprotected. A final spray of mancozeb should be considered for rust and late control of Ascochyta which can cause blemishes on the seed. Use mancozeb or chlorothalonil earlier if rust becomes a problem, as carbendazim has no activity against this disease.

Mancozeb or chlorothalonil are broad spectrum fungicides and may need to be used through the season on varieties that are susceptible to Ascochyta. This is particularly important when producing grain for whole seed markets, as Ascochyta staining will cause downgrading.

Rust and chocolate spot management (northern NSW)

To manage rust and chocolate spot:

- Control volunteer faba bean over summer.
- Select paddocks as far from previous faba bean crops as possible (preferably at least 500 m).
- Apply a spray of mancozeb 4–6 weeks after crop emergence or prior to a significant rain event and before canopy closure. This may be combined with a grass herbicide spray if the timing is correct for both products. This early spray is critical and will assist in controlling an early infection of both chocolate spot and rust in the crop.
- Monitor crops for signs of rust and chocolate spot. It is very important to protect the crop during flowering and early pod set.

Spraying just before canopy closure is particularly effective as the fungicide can still reach the lower parts of the plant. Mancozeb is the preferred fungicide for disease control in northern NSW because of its proven effectiveness against rust.

At late crop stages, consult your agronomist, as the economics of spraying is determined by disease levels, seasonal conditions and outlook, stage of crop development, yield potential and grain prices. In Doza and PBA Warda crops it is likely that chocolate spot will be the main disease present in which case carbendazim or procymidone are the most effective fungicides when a second fungicide spray is necessary. In Cairo, rust is likely to be the main problem in which case mancozeb or tebuconazole will be more effective. Identify the disease correctly before choosing a product.

In wet seasons, chocolate spot may become a problem in its own right and additional sprays may be warranted. Consult your agronomist.

Virus disease management

Virus diseases in faba bean crops can be a problem throughout NSW, even though varieties released for the north have greatly improved resistance compared to older varieties. Disease management is still dependent on reducing the entry of aphids into the crop and spreading viruses that they have picked up from other host plants.

Crop management techniques to reduce the entry of aphids into faba bean crops include retention of cereal stubble to deter aphids, sowing at the recommended times for your district, but where

possible avoiding autumn flights of aphids, and sowing at recommended seeding rates for early canopy closure. Also, separate faba bean crops from lucerne pastures, as they act as reservoirs for aphid species that transmit viruses to faba bean.

Research on controlling aphids in crops and reducing the transmission of viruses by the use of insecticides is continuing; however, no clear thresholds have been determined for the different viruses and the type or number of aphids infesting faba bean crops. Imidacloprid (Gaucho® 350SD) is registered for use in faba bean crops for early protection from aphids. Growers should consult their advising agronomist if either a seed dressing and/or a foliar insecticide is being considered. Ensure that the viral disease is correctly identified prior to making the decision to apply any insecticides.

Harvesting

Faba bean should be harvested to give 14% moisture at delivery into storage. At this stage, the crop will be black, although some top growth may still be green. If the pod splits and the seeds become exposed, they can be discoloured by sunlight or stained by rainfall. It is preferable to harvest the crop before the seed changes colour, is stained, becomes brittle or splits, particularly for human consumption markets.

Faba bean can be windrowed, potentially allowing an earlier harvest and to reduce harvest problems from crop lodging and late maturing weeds.

Harvest efficiency surveys in northern NSW in 2008 and 2009 showed windrowed crops had less grain losses than direct heading, but were not always more profitable, due to the extra costs of windrowing. In both 2010 and 2011 windrowing faba bean crops in north western NSW was beneficial, as it quickened crop dry down and allowed crops to be harvested prior to rainfall. Consider windrowing for higher yielding crops.

Windrowed faba bean samples may contain more dirt, especially if rain falls on the windrow. Where possible avoid placing windrows onto deepened wheel tracks where controlled traffic farming systems are used. Swath width may need to be adjusted according to crop biomass. Large bulky windrows will result in slower dry down time, delaying harvest. In seasons with low crop biomass, windrowing should be avoided as small windrows may not pick up well and the extra cost will not be recouped. Crops can appear green at the correct windrow timing but determining windrow timing is relatively simple. See Pulse Point 9 *Windrowing Faba Bean* for more detailed information.

Faba bean pods thresh easily so drum speed should be reduced to 400–600 rpm and concave clearance set at 15–35 mm to reduce mechanical damage to the grain. Blanking plates and alternative wires should be removed from the concave so that the grain is not cracked as separation can occur at the concave.

Grain damaged during harvest and subsequent movement using augers can be down-graded and have lower germination percentage and lower seedling vigour. Rotary harvesters and belt conveyers are gentler on the grain and generally cause less grain damage than conventional augers.

Marketing

The majority of the Australian faba bean crop is exported for human consumption, mostly to Egypt, but also to Italy, Sudan and the United Arab Emirates. Around 10% is retained domestically for stockfeed and some is split for human consumption. There are developing markets in the aquaculture industry. It is difficult to achieve food quality standards where disease or insects have not been controlled, or after prolonged storage.

Australia cannot compete on a price basis with other exporters but has other advantages. We are reliable shippers, have low moisture content grain and harvest in the off-season to the northern hemisphere. Northern NSW and southern Queensland grown crops often have smaller seed than the main growing areas in southern Australia. This is a marketing disadvantage, however good quality grain marketed prior to the southern harvest can achieve human consumption export grade. After this window of opportunity northern beans will normally be traded domestically at reduced prices.

Domestically, faba bean are used in the aquaculture, pig, poultry and horse industries, being a source of protein and hence compete with field pea, fishmeal, lupin, soybean meal and other protein supplements.

Further information

Weed control in winter crops (NSW DPI, 2015)

Insect and mite control in field crops (NSW DPI, 2013)

W*inter pulse disorders: The ute guide* (GRDC)

NSW DPI website: **www.dpi.nsw.gov.au/agriculture/broadacre/winter-crops/pulses** for

Agfact P4.2.5 *Faba bean*

Pulse Point 7, *Reducing your disease risk*

Pulse Point 9, *Windrowing faba bean*

Pulse Point 20, *Germination testing and seed rate calculation*

Pulse Australia website **www.pulseaus.com.au** for:

Faba bean disease management strategy – Southern Region

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Field pea

Field pea is a valuable pulse crop rotation option in cereal farming systems. The crop fixes nitrogen from the atmosphere and conserves soil mineral nitrogen. It is less exploitive of soil water at depth, increases flexibility for weed control, and provides a break for cereal disease cycles. Wheat yields after field pea are well above those of wheat after wheat and increased wheat protein is common.

Field pea is suited to a wide range of soils from light to heavy textured and from pH_{Ca} 4.5–8.0. The crop is sensitive to high soil exchangeable aluminium levels and does not tolerate extended periods of waterlogging. Grain can be used for both stockfeed and human consumption. The critical management factors for producing high yields and good quality seed are optimising plant density, effective nodulation, post-sowing rolling to flatten clods and stones, weed control, insect control and timely harvest.

Sowing time

Field pea is one of the few crops preferring a late sowing window, giving it the edge in dry autumns plus an extended pre-sowing weed control period. Sowing too early increases the risk of disease and frost damage; delayed sowing increases the risk of moisture stress and high temperatures during the critical grain filling stage. Suggested sowing times shown in the accompanying table apply to average to wet years. Grower experience and research trials over the last decade clearly show yield responses from sowing up to two weeks earlier in dry seasons when disease in spring has not been a problem.

There is now a wider range of varieties available with differing maturities and some with shatter-resistant pods. Growers should consider their preferred sowing window and select a variety that has a maturity to match. Any variety intended as a brown or green manure crop, or for hay, should be sown as early as possible within the recommended sowing window, to maximise dry matter production.

Suggested sowing times [see map]

Region	May				June			
	1	2	3	4	1	2	3	4
Western Zone								
Central Zone								
Eastern Zone								

Only suggested for the lower rainfall areas of zones or for hay crops

Preferred sowing time

Later than recommended, yield reduction likely

Seeding rate

Optimum plant populations vary depending on the height and vigour of the specific variety and on the time of sowing. Populations for tall vigorous scrambling types such as Morgan, Parafield, PBA Percy, or Sturt can be as low as 30 plants/m^2 when sown early, or as high as 40 plants/m^2 when sown late. For hay/manure types PBA Coogee and PBA Hayman, establish at least 40–50 plants/m^2 to maximise biomass. For the shorter less vigorous group of varieties (see accompanying table on variety characteristics) such as Excell, Maki, PBA Pearl, PBA Oura, Yarrum, and SW Celine, target 40 plants/m^2 with early sowing, increasing up to 60 plants/m^2 when sowing late. Kaspa-type varieties with intermediate growth characteristics such as Kaspa, PBA Gunyah, PBA Twilight and PBA Wharton should be sown to establish 35–50 plants/m^2.

These establishment targets can only be achieved by accounting for seed size, germination and sowing conditions when calculating seeding rates. Also, consider the condition of the seedbed and adjust accordingly. Use the table below to calculate the desired seeding rate based on target density, seed size, germination and potential establishment percentage of your seed.

Airseeders can reduce germination and establishment, particularly with weather damaged seed or seed low in moisture. Larger round-seeded varieties such as Excell, PBA Pearl, Maki and SW Celine are particularly susceptible to damage from impact on distributor heads and other hard surfaces, as their seed coats are less tightly attached to the cotyledons. Lowering the air

speed of the seeder reduces the impact of seed on the seed distributor heads and other hard surfaces. Adjust ground speed to avoid problems of seed and fertiliser blockages. Lowering ground speed and air flow of the seeder at sowing also reduces seed bounce and improves seed placement in the furrow, aiding establishment.

Seeding rate (kg/ha) based on 100% germination and 80% establishment

Field pea type	Variety	Average 100 seed weight (g)	Target plant density/m²			
			30	40	50	60
Tall scrambling	PBA Hayman	13	–	65	81	–
	Morgan	18	68	90	–	–
	Sturt	19	71	95	–	–
	PBA Coogee	20	–	100	125	–
	Parafield, PBA Percy	23	86	115	–	–
Medium–tall semi-leafless	Excell, Maki, PBA Pearl, PBA Oura, SW Celine, Yarrum	22	–	110	138	165
Kaspa types	Kaspa, PBA Gunyah, PBA Twilight, PBA Wharton	22	–	110	138	–

Your calculation

100 seed weight # (grams) ☐ × target plant population ☐ × 1000

÷ establishment percentage* ☐ × germination percentage ☐

= your seeding rate ☐ kg/ha

To determine your seed weight, weigh 100 seeds in grams.

*Establishment percentage – 80% is a reasonable estimate, unless sowing into adverse conditions.

Seeding depth

Field pea should be sown under most conditions at a depth of 3 to 5 cm. They will emerge from deeper sowing (up to 7 cm) provided moisture is adequate for consistent germination. Do not dry sow or moisture seek field pea at depth if uneven moisture is present, as crops will germinate unevenly, causing management difficulties (such as herbicide timing) for the crop. Crops sown later in the sowing window (for example due to a delay in sowing rainfall) should be sown shallower to assist germination under cold conditions.

Inoculation

Inoculation each season is essential on all soil types. Check for effective nodulation 6–10 weeks after sowing to ensure nodulation has been effective. Use the commercially available Group E field pea inoculant. Take care with seed inoculation. If seed is to be treated with a fungicide, carry out this operation first and apply inoculant separately just before sowing. Avoid inoculating directly into airseeder bins as the seed will need to dry in the short period prior to being sown. Newly inoculated seed is often sticky and does not flow properly, leading to uneven seed flow and patchy establishment across the paddock.

A number of new inoculant products are available for field pea, such as freeze-dried and dry granular products. Read and follow the instructions carefully to avoid inoculation problems.

Nutrition

Apply phosphorus fertiliser at rates equivalent to those used with cereals (10–25 kg P/ha). Adjust P rate according to paddock cropping history and potential crop yield for your area. A long history of phosphorus use can build soil P levels and at high levels little or no additional P will be required. Consider applying molybdenum on acid soils.

Paddock rolling

Rolling paddocks after sowing levels the ground and presses loose stones and sticks into the soil, avoiding header damage and grain contamination at harvest. Rolling can be carried out either directly after sowing or at the 2–3 node stage. Rolling after crop emergence has the advantage of avoiding crusting on soils prone to this condition, but may increase the chance of bacterial blight disease infection.

Variety selection

When selecting a variety consider seed type (white, dun, blue), varietal maturity and sowing date, disease resistance, standing ability, seed shattering resistance, ease of harvest, yield in your region, market outlets and seed availability. A large number of varieties are available, differing in a wide range of characters; some are only suited to specific growing regions of NSW and growers should select varieties carefully based on local data. For characteristics and yield of the different varieties, refer to the 'Variety characteristics and reaction to diseases' table on page 106.

There are no new variety releases for the 2015 season.

CRC Walana.(ф) Released 2010 by the Pork Cooperative Research Centre field pea breeding program; licensed to Waratah Seeds. White seeded, semi-leafless field pea with yellow cotyledons and white flowers. Very erect growth habit, medium height and quick, early maturity. Selected for improved yield potential and quicker flowering in the warmer, short season environments of northern NSW and southern Queensland, combined with complete resistance to powdery mildew and good levels of resistance to *Bean leafroll virus* (BLRV) and *Pea seed-borne mosaic virus* (PSbMV). Suitable for human consumption or stockfeed. An EPR of $4.50/tonne applies.

Excell. Released 1998 from the Australian Coordinated Field Pea Improvement Program. Public variety with no marketing restrictions, now largely outclassed. A semi-leafless blue seeded type, medium height and excellent standing ability, up to 20% lower yielding than newer commercial varieties. Moderately resistant to downy mildew. Susceptible to black spot, bacterial blight, PSbMV and powdery mildew. Pods susceptible to shattering and blue seed prone to bleaching. No EPR applies.

Kaspa.(ф) Released 2002 from the Australian Coordinated Field Pea Improvement Program; licensed to Seednet. High yield potential in average to good seasons, but due to its late flowering, has performed poorly across southern Australia in harsh finishes. Dun seed type, but unlike other varieties in this category, seeds are round (no dimples) and light brown/red in colour (not green/brown). Distinctive pink flowers, semi-leafless, medium in height, erect vigorous growth.

Flowers 7 days later than Parafield, and 10–14 days later than Excell. Non-shattering pods (sugar pod) a distinct advantage at maturity, reducing or totally eliminating any seed losses. Susceptible to new Kaspa strain of downy mildew, very susceptible to bacterial blight, susceptible to powdery mildew, PSbMV and blackspot. An EPR of $2.20/tonne applies.

Maki.(Φ) Released 2008 by University of Sydney, Narrabri; licensed to Australian Grain Technologies (AGT Seeds). Blue pea with green cotyledons, white flowered, semi-leafless and short/medium plant height. Good resistance to seed bleaching and mid maturity. Resistant to powdery mildew and PSbMV, tolerant to downy mildew and moderately resistant to resistant to BLRV. Susceptible to black spot, bacterial blight and downy mildew in disease prone areas. Potential for niche human consumption blue pea market. An EPR of $4.40/tonne applies.

Morgan.(Φ) Released 1998 by NSW DPI; licensed to Hart Bros Seeds. Original cross made in Victoria, selected in NSW. Tall semi-leafless dun type with excellent vigour and bulky upright growth habit. Late flowering, purple flowered with dimpled, dun-coloured seed. Seed size approximately 25% smaller than PBA Percy. Moderately resistant to bacterial blight, susceptible to black spot, PSbMV, powdery mildew and downy mildew. Very competitive with weeds; best choice for hay, forage, silage and green/brown manure; lodges at maturity. Holds up well in dry seasons and tight finishes because of its height. No EPR applies.

Parafield. Released 1998 by SARDI. Public variety with no marketing restrictions. Now largely outclassed and very little if any grown. Conventional tall scrambling dun type, high yield potential with broad adaptation but has largely been replaced by Kaspa. Seed and plant appearance similar to Dundale but flowers later and seed size larger and more dimpled. Moderately susceptible to bacterial blight, susceptible to black spot, PSbMV, powdery mildew and downy mildew.

PBA Coogee.(Φ) Released 2013 by Pulse Breeding Australia; licensed to Seednet. Conventional trailing type dun pea similar to PBA Percy and Parafield. It has not performed any better than these varieties in NSW and unlikely to be widely grown. Long season variety that flowers mid to late season. Pod set is rapid and maturity time is significantly later than PBA Percy. Resistant to powdery mildew. Higher tolerance to soil boron and salinity compared to Kaspa and Parafield. Moderate resistance to bacterial blight. Moderately susceptible to blackspot and BLRV. Ratings for downy mildew (both strains) and PSbMV unknown at time of publication. Produces a medium size, dimpled dun type grain with a greenish brown seed coat. Grain is marketed as 'Australian dun type' which is suited to human consumption markets (e.g. dhal or snackfood). It can also be marketed for pea sprouting as tendrils have leaflets present, or as stockfeed. An EPR of $2.86/tonne applies.

PBA Gunyah.(Φ) Released 2010 by Pulse Breeding Australia; licensed to Seednet. Higher yielding Kaspa type adapted to low and medium rainfall zones of southern and central west NSW. Similar plant type to Kaspa with distinctive pink-white flowers, semi-dwarf and semi-leafless plant habit, medium height and early vigour. Commences flowering about five days earlier than Kaspa. Longer flowering duration than PBA Twilight and Kaspa, particularly in shorter growing seasons. Matures earlier than Kaspa. Sugar-pod trait, resistant to pod shattering at maturity. Disease resistance similar to Kaspa. Resistant to Parafield strain of downy mildew but susceptible to Kaspa strain of downy mildew, powdery mildew, bacterial blight, PSbMV and blackspot. Produces a dun seed with spherical (non-dimpled) grain, marketed as a 'Kaspa type' to suit Indian sub-continent human consumption requirements. An EPR of $2.75/tonne applies.

PBA Hayman.(Φ) Released 2013 by Pulse Breeding Australia; licensed to Seednet. Very late forage type of field pea for hay or silage production or for green or brown manuring. Adapted across all cropping zones but not recommended for grain production because of very low yields. High biomass production in spring similar to Morgan. Semi-erect growth habit with multi-branched long vines. Very late flowering and maturity, later than Morgan; as such it should be sown earlier than optimal times for other grain varieties. There may also be an increased risk of insect pests and disease due to later maturity. Resistant to powdery mildew, moderately resistant to bacterial blight and Parafield strain of downy mildew, moderately susceptible to blackspot. Produces small pods and very small white soft seeded grain. Grain is suitable for stockfeed if harvested but yields are likely to be 30 to 80% of a normal field pea crop. No EPR applies; a breeder royalty is included in the price of the seed.

PBA Oura.(Φ) Released 2011 by Pulse Breeding Australia; licensed to Seednet. Broadly adapted across all major field pea production regions; performs relatively well in short growing seasons and low-rainfall climates. Recommended for bacterial blight prone regions. Erect semi-dwarf, semi-leafless type with vigorous early growth, medium height and purple flowers. Early-mid flowering (earlier than Kaspa) and early maturing. Suitable for crop-topping in long seasons. Fair to good lodging resistance and moderate pod shatter resistance at maturity. Moderately resistant to bacterial blight (*P. syringae* pv *syringae*) and the Parafield strain of downy mildew but susceptible to Kaspa strain of downy mildew, powdery mildew, blackspot and PSbMV. Produces a medium size, dimpled dun type grain, light green in colour, similar in size to Kaspa. Grain is marketed as 'Australian dun type' which is exported to the Asian sub-continent for production of dhal and pea flour, and also sold for stockfeed. An EPR of $2.86/tonne applies.

PBA Pearl.(Φ) Released 2012 by Pulse Breeding Australia; licensed to Seednet. Broadly adapted across all major field pea production regions and is the highest yielding variety in the south east and south western production regions of NSW. Semi-leafless, semi-dwarf erect growing variety with white flowers. Early to mid season flowering (10 days earlier than Kaspa and similar to Sturt) and early maturing (earlier than Sturt). Ideally suited to crop-topping due to early maturity. Superior lodging resistance compared to other semi-dwarf varieties, moderate resistance to pod shattering. Resistant to the Parafield strain of downy mildew and BLRV, moderately susceptible to bacterial blight and blackspot, susceptible to powdery mildew and PSbMV. Produces medium to large spherical white pea seed

(larger than Sturt) suitable for human consumption or stockfeed markets. Recommended for regions where growers can deliver white pea seed for export or for domestic sale. An EPR of $2.97/tonne applies.

PBA Percy.[Φ] Released 2011 by Pulse Breeding Australia; licensed to Seednet. Broadly adapted across all major field pea production regions; performs relatively well in short growing seasons and low rainfall zones. Recommended for bacterial blight-prone regions. Conventional type with vigorous early growth, tall height and purple flowers. Very early flowering (about a week earlier than PBA Oura) and early maturing. Suitable for crop-topping in long seasons. Lodges at maturity but moderate pod shatter resistance at maturity. Excellent resistance (better than PBA Oura) to bacterial blight (*P. syringae* pv *syringae*) but susceptible to both Parafield and Kaspa strain of downy mildew, powdery mildew, blackspot and PSbMV. Produces a very large, dimpled dun type grain, tan-green in colour similar to Parafield. Grain is marketed as 'Australian dun type' which is exported to the Asian sub-continent for production of dhal and pea flour, and also sold for stockfeed. An EPR of $2.86/tonne applies.

PBA Twilight.[Φ] Released 2010 by Pulse Breeding Australia; licensed to Seednet. Higher yielding Kaspa type adapted to lower rainfall, short season climates of southern and central west NSW. Similar plant type to Kaspa with distinctive pink-white flowers, semi-dwarf and semi-leafless plant habit, medium height and early vigour. Commences flowering about a week earlier than Kaspa. Shorter flowering duration than PBA Gunyah but longer than Kaspa, particularly in shorter growing seasons. Matures earlier than Kaspa. Sugar-pod trait, resistant to pod shattering at maturity. Disease resistance similar to Kaspa. Resistant to Parafield strain of downy mildew but susceptible to Kaspa strain of downy mildew, powdery mildew, bacterial blight, PSbMV and blackspot. Produces a dun seed with spherical (non-dimpled) grain, marketed as a 'Kaspa type' to suit Indian sub-continent human consumption requirements. An EPR of $2.75/tonne applies.

PBA Wharton.[Φ] Released by Pulse Breeding Australia in 2013; licensed to Seednet. Kaspa-type pea well suited to all field pea production regions of NSW, including central and northern NSW, due to both powdery mildew and virus resistance. This variety is well positioned to replace Kaspa, PBA Gunyah and PBA Twilight across all production regions of NSW. Similar plant type to

Variety characteristics and reaction to diseases

Variety	PBR	Standing at maturity	Leaf type	Height	Maturity	Shatter resistance	Disease			Seed size (g/100 seeds)	Yield % Kaspa*				Yield % Yarrum*	
											South East		South West		North West	
							Bacterial blight# (*Pseudomonas syringae* pv *syringae*)	Downy mildew (Parafield strain)	Powdery mildew		%	No. Trials	%	No. Trials	%	No. Trials
Dun Field Peas											Kaspa = 2.48 t/ha		Kaspa = 1.76 t/ha		Yarrum = 2.14 t/ha	
Kaspa	Yes	4	SL	M	8	R	S	MR	S	22	**100**	**16**	**100**	**19**	80	12
Morgan	Yes	3	SL	T	9	MR	MR	R	S	18	98	13	102	15	80	9
Parafield	No	2	C	T	7	MR	MR–MS	S	S	23	93	9	99	13	78	3
PBA Coogee	Yes	2	C	T	8	MR	MS–MR	–	R	20	87	6	101	10	83	7
PBA Gunyah	Yes	4	SL	M	5	R	S	R	S	22	102	16	102	19	89	12
PBA Oura	Yes	4	SL	M	5	MR	MR	MR	S	22	110	16	112	19	95	12
PBA Percy	Yes	2	C	T	5	MR	R	S	S	23	107	16	113	19	89	12
PBA Twilight	Yes	4	SL	M	4	R	S	R	S	22	100	16	100	19	89	12
PBA Wharton	Yes	4	SL	M	5	R	S	R	R	23	104	16	107	19	99	12
Yarrum	Yes	4	SL	M–S	5	MR	MR–MS	S	R	22	115	11	107	13	**100**	**10**
Blue Field Peas																
Excell	No	6	SL	M	6	S	S	MR	S	22	94	4	89	8	n.d.	n.d.
Maki	Yes	4	SL	M	3	MS	S	MR–MS	R	22	101	6	99	9	96	6
White Field Peas																
CRC Walana	Yes	4	SL	M	3	MS	–	–	R	18	108	3	99	5	103	5
PBA Hayman	Yes	3	C	T	9	MR	MR	MR–R	R	13	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
PBA Pearl	Yes	5	SL	M	4	MR	MS	R	S	22	115	16	120	19	95	12
Sturt	Yes	2	C	T	5	MR	MR–MS	MS	S	19	105	14	119	17	86	7
SW Celine	Yes	5	SL	M	4	MR–MS	S	MR–MS	S	22	112	8	107	11	85	5

*** Yield results are a combined across sites analysis using NSW DPI, PBA and NVT yield trials from 2010–2014.**

[#] Resistance only demonstrated to the bacterial blight pathovar *Pseudomonas syringae* pv *syringae*.

Standing: 1–9 (1 = flat on ground, 9 = erect) **Leaf type**: C = Conventional; SL = Semi-leafless **Height**: T = Tall; M = Medium; S = Short. – = Unknown or no data available.
Shatter resistance and disease resistance ratings: R = Resistant; MR = Moderately resistant; MS = Moderately susceptible; S = Susceptible
Maturity: 1 to 9 (1 = early, 9 = late) less than 5 best for crop-topping.

Kaspa with a semi-leafless erect growth habit and distinctive pink-white flowers. Early to mid season flowering (similar to PBA Gunyah but five days earlier flowering than Kaspa) and early maturing. Sugar-pod trait, resistant to pod shattering at maturity. Has broader disease resistance than Kaspa, by combining disease resistance to powdery mildew and the viruses PSbMV and BLRV with higher soil boron toxicity tolerance. Resistant to Parafield strain of downy mildew but susceptible to Kaspa strain of downy mildew and blackspot. Like Kaspa, is very susceptible to bacterial blight. Produces a medium size, tan colour seed. Grain is marketed as a 'Kaspa type' to suit Asian sub-continent human consumption requirements (dhal, flour and roasted snackfoods). An EPR of $2.86/tonne applies.

Sturt.(ф) Released 2005 from the Australian Coordinated Field Pea Improvement Program. Conventional tall plant type, scrambling growth habit, early to mid season flowering, small smooth white seeds. Still one of the most adapted and highest yielding pea in the drier production areas of south western NSW. Moderately resistant–moderately susceptible to bacterial blight, susceptible to black spot, PSbMV, powdery mildew and downy mildew. No EPR applies.

SW Celine.(ф) Released 2007 by Access Genetics; commercialised under licence to Nuseed. Semi-leafless white pea with medium height, white flowers and a short to medium upright growth habit. Early flowering, similar to PBA Oura but two weeks earlier than Kaspa. It is the earliest maturing of the current commercial pea varieties making it ideally suited to quick finishing seasons and crop-topping. SW Celine does not carry the shatter resistant sugar-pod character of Kaspa-type varieties therefore care is needed at harvest. Medium/large white round seed. Susceptible to powdery mildew, moderately resistant–moderately susceptible to downy mildew. An EPR of $3.30/tonne applies.

Yarrum.(ф) Released 2003 by University of Sydney, Narrabri; licensed to AGT Seeds. Extensive testing has shown Yarrum to be a consistently high yielding commercial line across both northern and southern NSW. Dimpled dun pea, purple flowered, semi-leafless, medium height. Late flowering but fills pods and finishes quickly. Erect growth but tends to lodge at maturity. Resistant to powdery mildew, resistant to PSbMV, good level of resistance to BLRV, moderately resistant–moderately susceptible to bacterial blight. Susceptible to black spot and downy mildew. An EPR of $4.40/tonne applies.

Weed control

Field pea provides valuable management strategies for integrated weed management and unique features to assist weed control in the cropping rotation. These include a relatively late sowing window compared to other crops; the availability of competitive varieties such as Morgan; and the availability of earlier maturing varieties such as Maki, PBA Oura, PBA Twilight and SW Celine that enable 'crop-topping' to be synchronised with maturity. Field pea has the widest range of herbicides available for broadleaf weed control of any pulse crop. There are a number of soil applied residual herbicides registered which provide an excellent opportunity to use alternative herbicides as part of a herbicide resistance management program. They may also be more cost effective than post-emergent herbicide options for weed control.

As residual herbicides applied to the prior cereal crop can affect the establishment and growth of field pea, refer to current pesticide labels for further information on plant-back periods.

For detailed information on registered herbicides, refer to NSW DPI guide *Weed control in winter crops* and pesticide labels.

Insect control

Redlegged earth mite, blue oat mite and lucerne flea – Monitor these pests closely from emergence up to the 4-node stage. If crop damage becomes apparent, undertake appropriate control measures.

Aphids – Monitor for aphids from the early establishment stage. High numbers of aphids, particularly pea aphids (*Acyrthosiphon pisum*) can cause feeding damage and yield loss. Control of aphids may be more important for reducing the transmission of certain viruses that are transmitted in a persistent manner, than actual feeding damage.

Pea weevil – This pest is a continuing problem in most areas. Be careful not to introduce it onto the farm in purchased seed or any other seed containing field pea as an impurity. Monitor crops at least weekly from flowering through to early pod set for pea weevil adults. Apply a border spray of insecticide if pea weevils are found or if you know that you are in a pea weevil area. Fumigate all seed with phosphine in a sealed silo soon after harvest to destroy any pea weevil that may be present or developing in the grain.

On farm problems can be reduced by:

- harvesting promptly
- fumigating carry over seed soon after harvest
- controlling all self-sown field pea in following crops.

For further information, see Pulse Point 4 – *Managing Pea Weevil*.

Helicoverpa spp. (Heliothis) – Most crops require spraying during late flowering and pod filling and should be checked at least twice a week during this time. The spray threshold for human consumption grade is 1–2 larvae per 10 sweeps, and for stockfeed, 4 or more larvae per 10 sweeps. One well-timed early spray before larvae get too large (10 mm) is generally adequate. However control can be very difficult once larvae enter the pods if not detected early. Monitor crops after spraying to determine effectiveness.

For detailed information on insecticides, refer to the NSW DPI guide *Insect and mite control in field crops*.

Disease management

The impact of disease on field pea production can be minimised by sowing disease and virus-free seed, by planning sensible crop rotations (not growing field pea in the same paddock more than once every five years), eliminating volunteer field pea plants and not sowing near or immediately downwind of the previous season's field pea paddock. The following diseases have the potential to cause severe yield losses.

Bacterial blight – This disease is very sporadic and often unpredictable. It is caused by the bacterium *Pseudomonas syringae*. There are two pathovars (pv) of *P. syringae* found in NSW, *P. syringae* pv *pisi* and *P. syringae* pv *syringae*. Frost damage followed by wind and frequent rain encourages the development and spread of the disease. This highly infectious disease can be easily spread by movement of machinery, people and animals through the crop.

P. syringae bacterium can survive on both seed and infected plant material and these two sources are the main means of disease transmission to new crops. Therefore, seed harvested from infected crops should not be used for sowing. Likewise, movement of pea stubble from these crops should be closely monitored, particularly when baled for hay as this is a ready source of infective bacteria. Also note that crops having no obvious signs of disease may still carry the bacteria at low levels.

Bacterial blight will often develop in frost-prone, low lying areas first. Be aware that frost events can trigger development of this disease and check these areas first for symptoms. Avoid sowing field pea crops in paddocks prone to frequent frost events.

Operations favouring rapid breakdown of pea trash can greatly reduce the length of survival of the bacterium. Control of volunteer pea plants is equally important for control of this disease between seasons. Survival can be up to three years on seed in storage.

Field pea variety screening for bacterial blight is regularly undertaken at Wagga Wagga in NSW for the Pulse Breeding Australia – Field Pea Breeding Program. Field pea breeding lines showing good field tolerance to *Pseudomonas syringae* pv *syringae* have been identified as part of this screening program under conditions of high disease pressure. The varieties PBA Oura and PBA Percy were released in 2011 with significantly improved resistance to *Pseudomonas syringae* pv *syringae*. In the older varieties, Morgan, Parafield, Sturt and Yarrum display the best field tolerance.

Reports were received of isolated outbreaks of bacterial blight in southern NSW in 2014. Despite mild winter temperatures, frost events in August and September triggered disease outbreaks in some commercial crops. Crops sown into heavy cereal straw and/or low lying paddocks appeared to be the worst affected. Growers should be aware that field peas sown early for green or brown manuring are prone to develop bacterial blight. There are currently no post emergence control options available to manage bacterial blight outbreaks.

Traditionally, major outbreaks of bacterial blight in NSW result from early frosting coinciding with wet conditions. Management factors that favour a bacterial blight outbreak include early sowing of field pea crops, sowing infected seed and new season crops coming into contact with infected pea straw. More recently it appears that crops sown into a thick covering of cereal straw under the crop (not standing cereal stubble) and into heavy textured soils can develop bacterial blight more readily.

Kaspa, one of the most popular varieties, is also one of the most susceptible to bacterial blight. The safest strategy is to only grow the more resistant varieties and only use seed from crops inspected to be visibly free of symptoms. A seed test is available to detect for presence of the bacteria. Under conditions favouring disease development, even very low levels of seed-borne bacterial blight can lead to the development of an epidemic.

Blackspot and Septoria blotch – These two fungal diseases regularly infect pea crops in southern and central NSW. In wetter years and in high rainfall production zones, yield losses of 10–30% are common. Drier growing conditions may have reduced the impact of these diseases in recent years, but under ideal conditions these diseases can develop quickly, even from very low levels of disease in the previous year. Cool winter conditions, with frequent rainfall events aid in the build up and dispersal of blackspot. The impact of blackspot and septoria blotch can vary with proximity to old field pea stubble and paddock rotation history. Use of a fungicidal seed dressing, crop rotation and separation from last year's field pea stubble by at least 500 m will reduce disease potential. In recent years blackspot has been observed at high levels in some districts, mainly in field pea crops sown early for manuring. Dry summer conditions in combination with early sowing opportunities and wet winter conditions are favourable for disease epidemic development.

Downy mildew – This disease can develop quickly when conditions are cool (5–15°C) and wet for 4–5 days, often when field pea crops are emerging and in the early vegetative stage. Heavy dews will promote the production of spores and rain splash is the main means of disease dispersal within a crop. The disease is caused by the fungus *Peronospora viciae*, which can survive in soil, on old field pea trash and also on seed. The most notable symptom of downy mildew is the appearance of stunted, yellowish/pale green seedlings within a crop, which have fluffy grey spore masses on the underside of infected leaves. Heavy infection can stunt plants early and kill seedlings if favourable conditions continue. Warm, dry weather is unfavourable for disease development. Downy mildew can impair wax formation on leaves, rendering field pea plants more susceptible to post emergent herbicides. The most effective means of managing the disease is by growing resistant varieties. Varieties such as Morgan, Bundi, Excell and Kaspa have useful resistance. However, a new strain of downy mildew was identified in South Australia in 2008 that can overcome the resistance contained in many field pea varieties. This strain has not yet been detected in NSW. Other methods of managing downy mildew include use of a fungicide seed dressing containing metalaxyl, crop rotation (at least 4 years between field pea crops) and separating this year's field pea crop away from last year's field pea paddock.

Disease guide – field pea

Disease/Cause	Symptoms	Occurrence	Survival/Spread	Control
Seedling Disease				
Damping off *Pythium* spp., *Rhizoctonia* spp.	Seedlings collapse within a few days of emergence. Stem/taproot near ground-level sunken, water soaked.	Cool, wet, poorly drained soils. Late sowing leading to slow germination.	Spores survive in soil for extended periods. Wide host range among other broadleaf crops.	Sow on time into well-drained soils. Treat seed with fungicide seed dressing. Cultivate below seed sowing depth.
Root Diseases				
Foot rot *Phoma medicaginis* var. *pinodella* *Mycosphaerella pinodes*	Purplish-black rot of lower stem. Black rot of upper tap-root.	Cool damp weather. Paddocks with a recent field pea history or adjacent paddocks.	Survives on infected pea trash and as spores in soil for several years. Also seed-borne at low levels.	Crop rotation – 4 years between pea crops and avoid sowing into paddocks adjacent to last years field pea crop.
Root rots *Pythium*, *Rhizoctonia* and *Fusarium* spp.	Dark-brown, girdling lesions on taproot and lateral roots. Patches of stunted plants within crops.	Wet, poorly drained conditions. Variable moisture.	Survives in soil and on plant debris.	Crop rotation – 4 years between field pea crops. Aim to sow on time. Avoid poorly-drained paddocks.
Foliar Diseases				
Black spot complex *Mycosphaerella pinodes, Ascochyta pisi, Phoma medicaginis* var. *pinodella*	Dark brown to black spots on leaves, with reddish/purplish margin, often with an irregular outline. Girdling of lower stem and tendrils with a dark lesion. Bluish-black sunken spots on pods.	Cool, wet conditions. More severe on early-sown crops.	Spores survive in soil and plant debris. Spread by rain splash and wind-blown rain.	Avoid early sowing. Crop rotation – 4 years between field pea crops and avoid sowing into paddocks adjacent to last years field pea crop.
Septoria blotch *Septoria pisi*	Spreading light brown angular leaf lesions containing very small, dark brown to black spots. Tends to appear on moisture stressed crops in spring.	Cool, wet weather. More severe on early sown crops.	The fungus survives on infected plant debris and can be seed-borne at low levels.	Avoid early sowing. Crop rotation – at least four years between pea crops and avoid sowing into paddocks adjacent to last years field pea crop.
Sclerotinia wilt *Sclerotinia sclerotiorum*	White cottony fungal growth on aerial parts of plants. Plants wilt. Sclerotia of fungus form on plant surfaces and inside stems.	Cool–mild humid conditions following rain in spring. Worse in dense crops.	Survives as resting sclerotia in soil. Sclerotia germinate in spring and infect with airborne spores.	Difficult because of wide host range and long survival in soil – 10 years. Avoid sowing consecutive broadleaf crops.
Downy mildew *Peronospora viciae*	Thick grey-brown fungal growth on lower leaf surface. Upper leaf surface turns yellow above growth on lower surface. Leaf death.	Favoured by cool, moist conditions. Rarely causes economic damage.	Survival on plant debris and soil. Spores spread by wind.	Crop rotation. Grow resistant varieties.
Powdery mildew *Erysiphe polygoni*	White powdery growth on upper leaf surface. Leaf withering. Poor seed set in late pods.	Warm humid (but not wet) weather. More likely when sowing is late or on late-maturing varieties.	Over-summers on infected pea trash or volunteer plants. Spores blown by wind into new crops.	Crop rotation. Grow resistant varieties. Foliar fungicides in susceptible varieties. Burn or incorporate infected crop residue after harvest.
Bacterial Disease				
Bacterial blight *Pseudomonas syringae* pv *pisi* *Pseudomonas syringae* pv *syringae*	Fan-shaped water soaked lesion spreading into the leaf from the base. Dark-brown spreading stem lesions. Sometimes a sheen on the lesion when dry.	Frost events followed by cool, wet weather.	Infected seed. Infected crop debris. Easily spread in crop by machinery, people and animals.	Crop rotation. Seed testing. Do not keep seed from infected crops for sowing. Use newer resistant varieties.
Major Virus Diseases				
Bean leafroll virus (BLRV), *Soybean dwarf virus* (SbDV, syn *Subterranean clover redleaf virus).*	Yellowing or sometimes reddening, stunting, leaf stiffening, premature death.	Areas prone to aphid flights. Can be very damaging, occasionally causing complete crop loss.	Survive in legumes including lucerne, subterranean clover and medic. Spread by aphids.	Follow best management recommendations including retention of standing stubble to deter aphids from landing in the crop.
Pea seed-borne mosaic virus (PSbMV)	Commonly symptomless. May show leaf mosaic, stunting, pod abortion, seed markings.	Has potential to reach high incidence in all districts.	Source is usually infected seed. Spread within crops by aphids.	Use seed which has been tested and found to be free of PSbMV. Grow resistant varieties.
Cucumber mosaic virus (CMV), *Alfalfa mosaic virus* (AMV)	Mosaic, mottle or yellowing along veins of leaves. Early infection can results in stunting, stem nercrosis and premature death.	Uncommon in the major pea growing areas.	Range of weed and pasture spp. AMV also in lucerne. Spread by aphids.	Follow best management recommendations including retention of standing stubble to deter aphids from landing in the crop.

Powdery mildew – This disease can cause yield losses and occurs more frequently in the drier areas of the central and northern wheat belt, generally towards the end of the season. Mild day temperatures and cool nights with dew formation favour the disease. Varietal resistance is the best method of control. All three newer varieties PBA Coogee, PBA Hayman and PBA Wharton, as well as the older varieties CRC Walana, Maki and Yarrum, carry a powdery mildew resistance gene that provides complete protection against this disease. Other currently commercially available varieties are susceptible to varying degrees. Foliar fungicides can be used to manage the disease in more susceptible varieties.

Virus diseases – Several virus species cause disease in field pea and other pulses. As symptoms caused by virus infection can be easily confused with those caused by environmental stresses, expert advice should be sought to correctly identify the virus. All the important pulse viruses are aphid transmitted and most need to survive between cropping seasons in living plants. Control strategies for virus diseases can only be preventative, as infected plants can not be cured. Not enough is known about virus and vector epidemiology in NSW to recommend economic control of aphid vectors. Following the recommended crop management guidelines will reduce the risk of virus infections, as poorly growing crops and plants are more prone to infection. Aphid vectors are most active during the warmer periods of autumn and spring. Early sowing of crops in virus prone areas should be avoided so plants can escape autumn infections. Plant resistance is the best defence against virus infection and Pulse Breeding Australia's field pea breeding program is making rapid progress in developing varieties with adequate resistance to the most important field pea viruses.

Pea seed-borne mosaic virus **(PSbMV)** – PSbMV survives between seasons in infected seed. The virus is found wherever susceptible pea varieties are grown and infected seed has been sown. PSbMV reduces yields and can, depending on the growing environment of the plant, cause markings on the seed. Seed lots with high levels of seed infection have lower levels of plant emergence and seedling vigour. Evaluation of commercial seed lots harvested in 2005 and 2007 in southern NSW showed infection levels of up to 30% in some seed lots of the varieties Kaspa and Excell. A field survey in 2006 highlighted the importance of seed infection; crops sown with clean seed had low levels of PSbMV, while neighbouring paddocks sown with infected seed showed severe infection. Growers are advised to have their seed tested and not to use seedlots with infection levels greater than 1%. Among the currently available varieties, PBA Wharton, CRC Walana, Maki and Yarrum have resistance to PSbMV.

Bean leafroll virus **(BLRV)** – BLRV infection results in yellowing and stiffening of the leaves. BLRV can cause severe yield losses and, with early infection, stunting and plant death. The virus survives between seasons on pasture legumes and lucerne. Higher levels of infection are generally found in the higher rainfall cropping zones or in the vicinity of irrigated lucerne paddocks. The varieties Kaspa and Excell are highly susceptible to BLRV and should not be grown in virus prone areas. Of the current varieties, PBA Pearl, PBA Wharton and Yarrum have good resistance and CRC Walana and Maki have adequate BLRV resistance, whilst a number of other breeding lines with good BLRV resistance are in advanced testing.

Desiccation and harvest

Desiccation – This harvest-aid is the early chemical termination of plant growth strategically timed when field pea pod and seed development has physiologically finished so as not to compromise grain yield. Desiccation advances pea maturity and harvest by up to 10 days, thereby reducing problems caused by uneven ripening and/or late weed growth. Earlier harvest improves both yield and quality, particularly when commencing at higher seed moisture content. Soil and weed seed contamination in the grain sample can be reduced. Desiccation also doubles up as a spray-topping operation to prevent seed set in weeds, provided timing is targeted at the correct stage of the weed.

Chickpeas can be desiccated using glyphosate (540 g/L) or diquat (200 g/L). Note that harvest WHP varies depending on product used. Crops desiccated with glyphosate should not be kept for planting seed.

Timing of desiccation – Note and record the end of flowering date and from then on commence regular monitoring every few days for changes in foliage and pod colour, and particularly seed developmental and colour changes within the pod. From the end of flowering, days to desiccate vary enormously depending on the length of the spring and finishing conditions, but should occur within 2–3 weeks. Desiccate when the lower three quarters of pods along the stem are brown, seeds are firm, rubbery, and split rather than squash when squeezed and the shells are thin and leathery. Pea pods mature from the lowest flowering node upwards. Many plants at this stage may still have green tips.

Seed moisture changes can also be monitored. Desiccate when seed moisture drops to around 30%. To collect seed for this, randomly pick 10–20 stems or more across the paddock. Further information on timing of desiccation can be found in Pulse Point 5, *Desiccation and Harvest of Field Pea*.

Harvest – Normally occurs well before wheat is ready and should start as soon as seed moisture falls to 14% to maximise yield. Delayed harvest leads to seed quality loss, harvest clashes with other crops, greater soil contamination, increased pod shattering, emergence of pea weevil in the field, problems with late weed growth, more severe crop lodging and increased crop vulnerability to damage by late rain and hail. The important message – plan to commence harvest early.

Rolling after sowing reduces pick-up of rocks and clods at harvest. Crops sown into cereal straw have considerably less soil contamination in the grain sample. Use contour following crop lifters. Seed to be kept for sowing should be harvested first when moisture content is higher and damage caused by the header is least. Minimise subsequent handling to reduce cracking and splitting of the seed.

Marketing

The domestic stockfeed industry continues to be the main user of field pea produced in NSW, as supply and grain quality over the last few years has been erratic from drought conditions or wet weather at harvest reducing yields. Dun field pea continues to be the most robust of the pea types with both food and feed market opportunities. They still remain the preferred field pea type to be exported to the Asian and Indian subcontinent. The smooth, non-dimpled 'Kaspa-type' varieties PBA Gunyah, PBA Twilight and PBA Wharton may attract a small premium in human consumption export markets, but quality is an ongoing issue, particularly damage from pea weevil and heliothis, and the amount of dirt in samples.

The recent erratic supply of Australian white field pea has hampered the development of overseas markets, with the main competitor Canada producing large quantities of quality white field pea. The domestic stockfeed industry has been the major consumer of white field pea and this is expected to continue until more stable production occurs to allow export markets to be supplied on a continuing basis.

The Australian blue pea crop supplies a small niche domestic market and a few niche export markets. Quality is vital. Colour bleaching, pea weevil, helicoverpa damage and contamination from other pea types are major problems that need to be addressed by growers.

Further information

Weed control in winter crops (NSW DPI, 2015)

Insect and mite control in field crops (NSW DPI, 2013)

NSW DPI website: **www.dpi.nsw.gov.au/agriculture/broadacre/winter-crops/pulses** for:

Pulse Point 4,
Managing pea weevil (3rd edition)

Pulse Point 5,
Desiccation and harvest of field pea (2nd edition)

Pulse Point 7,
Reducing disease risk

Pulse Point 13,
Strategies to minimise bacterial blight in field pea

Pulse Point 14,
Powdery mildew in field pea – a growers' guide to management

Pulse Point 20,
Germination testing and seed rate calculation

Field Pea: Western NSW Planting Guide (NSW DPI, 2005)

Pulse Australia website **www.pulseaus.com.au** for:

Northern region field pea management guide (Pulse Australia, 2010)

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Lupin

Lupin is a profitable pulse crop well suited to lighter soil types in central and southern NSW. Lupin has many advantages in both cropping and mixed cropping-livestock farming systems. It can be used to extend cereal crop rotations by acting as a break crop (non-host) for cereal diseases. Other benefits include significant nitrogen contribution for subsequent crops, improved soil structure, and alternate weed control options to delay or reduce the incidence of herbicide resistance. Lupin also provides a high protein grain that can be valuable as part of a profitable livestock enterprise.

Two species of lupin, narrow-leaf (*Lupinus angustifolius*) and albus (*L. albus*), are widely grown. Narrow-leaf lupin is tolerant of moderately acid soils (pH_{Ca} 4.2–6.0) and high levels of exchangeable aluminium (up to 20%) and manganese. Albus lupin are less tolerant of acid soils than narrow-leaf lupin (but more so than canola or wheat) and may accumulate high manganese levels in the grain when grown in high manganese soils. Both species are sensitive to soils containing free lime (bicarbonate). High pH soils can be tolerated, provided free lime is not present. High pH soils can reduce nodulation as symbiosis with rhizobia is impaired. Albus lupin is more susceptible to waterlogging than narrow-leaf lupin.

Albus lupin average 10–15% higher yields than narrow-leaf lupin, especially under high rainfall conditions.

Be aware of seed import quarantine restrictions into NSW due to the foliar disease Anthracnose. This disease has not been identified in commercial crops in NSW.

Sowing

Direct drilling lupin into cereal stubble is a successful crop establishment method. Stubble conserves soil moisture, reduces brown leaf spot incidence and also reduces aphid infestations, minimising virus infection and transfer.

Dry sowing lupin is an option with grower experience showing it to be a successful method to establish crops on time (see Pulse Point 6, *Dry sowing*). Dry sowing can be difficult on virgin lupin paddocks where inoculation will be required and rhizobia survival may be poor. New granular inoculants may help in this regard.

Suggested sowing times for narrow-leaf and albus lupin

Week	April				May			
	1	2	3	4	1	2	3	4
Low rainfall								
High rainfall								

Preferred sowing time

Later than recommended, yield reduction likely depending on spring conditions

Aim to sow at a depth of up to 5 cm. Albus lupin have a much larger seed than narrow-leaf types – if soil moisture is marginal then albus seeds are at greater risk of not imbibing enough water, resulting in false germination. Deeper sowing into warmer soils (moisture seeking) can be a successful method to allow earlier sowing but is risky, especially with larger seeded albus. Low vigour seed and sowing late into soils with low temperatures results in poor establishment and often crop failure, especially in albus lupin.

Sowing time

All current lupin varieties are susceptible to frost damage. Lupins are most vulnerable to frost damage during the reproductive phase, which occurs once they initiate stem elongation. The risk of frost damage can be reduced by not sowing varieties earlier than the recommended sowing window. This is to avoid flowering in July to early August. For most lupin growing areas in southern NSW, sowing before late April with early flowering varieties such as Mandelup increases the risk of frost damage.

Seed quality

Always do a germination test on seed and adjust seeding rate accordingly. Good seed quality is critical to achieve adequate plant density and high yields. In trials, yields increased by 20% when using high germination seed (more than 80%) compared to low germination seed (50%), even when the seed rate was doubled to compensate.

Seed is easily damaged by the header and excessive handling during harvest, grading and sowing. Rotary headers cause less damage. Seed that is to be kept for sowing should be harvested as soon as seed moisture content reaches 14%. Use a low header drum speed and open the concave; and minimise subsequent handling of the seed.

Test germination in a laboratory or at home, counting only healthy seedlings – those with both cotyledons (seed leaves) present. Test narrow-leaf lupin seed for *Cucumber mosaic virus* (CMV) and obtain documentation of germination, seeds/kg and CMV status when purchasing seed. For further details see Pulse Point 20, *Germination testing and seed rate calculation.*

Bitterness in albus lupin seed

To maintain the seed quality standards for the sweet (low seed alkaloid) albus lupin industry, growers should test all sowing seed for possible bitter (high alkaloid) contamination. Bitterness seed testing for albus lupin is available through Futari Grain Technology Services, 34 Francis Street, Narrabri 2390 (phone 02 6792 4588).

The albus industry has set a zero bitter contamination level for seed to be used for sowing.

Avoid growing lupini bean (100% bitter, large seeded albus) in sweet albus production areas. These measures are to protect the most recently released 100% sweet albus varieties Luxor and Rosetta from bitter pollen contamination. Bitterness prevention in these new varieties is crucial to maintain the threshold standards set for albus for both human consumption and stockfeed use.

Only grow one albus lupin variety on the farm – discard old varieties – and keep a minimum one kilometre isolation from all other albus crops. Check with neighbours about their albus sowing intentions. If growing a small quantity of albus for seed increase, surround it by a narrow-leaf lupin crop – the agronomy is similar and the albus crop will be protected from pollen contamination. Pollen is transferred between albus crops by foraging honey bees. Test all sowing seed for bitterness every year – including new varieties. Do not buy any albus seed without a testing certificate showing the seed to be free of bitterness.

Seeding rate

Aim to establish 35 plants/m^2 for early sowing and up to 45 plants/m^2 for later sowings. Seeding rates will vary depending on seed size and germination percentage. Albus lupin seed rates are much higher than narrow-leaf varieties due to their large seed size. For further detail see Pulse Point 20, *Germination testing and seed rate calculation.*

Inoculation

Lupin requires specific rhizobium (Group G) to form active root nodules. Take care with seed inoculation techniques, especially into paddocks where lupin has not been previously grown. Adequate inoculum can persist for more than five years once established but survival is reduced with increasing soil acidity, or prolonged periods of low rainfall or drought. If sowing seed is to be treated with a fungicide, carry out this operation first and allow the seed to dry thoroughly. Apply inoculant immediately before sowing. A number of new inoculant products are available for lupin such as freeze-dried and dry granular products; read the instructions carefully and follow them to avoid inoculation failure.

Seeding rates (kg/ha) based on 80% establishment and 100% germination

Lupin type	100 seed weight (g)	Target plant density	
		35 plants/m^2	45 plants/m^2
Narrow-leaf lupin	13	56	73
Albus lupin	35	153	197

Your calculation

100 seed weight # (grams) ☐ × target plant population ☐ × 1000

÷ establishment percentage* ☐ × germination percentage ☐

= your seeding rate ☐ kg/ha

To determine your seed weight, weigh 100 seeds in grams.

*Establishment percentage – 80% is a reasonable estimate, unless sowing into adverse conditions.

Variety characteristics and reaction to diseases

Variety	Flowering time	Pod loss, shatter resistance	Lodging resistance	Seed size (g/100 seeds)	Disease						North		South	
					Brown leaf spot	Pleiochaeta root rot	Phomopsis stem infection	CMV # seed transmission	BYMV #	Anthracnose resistance	Yield as a % of Mandelup 2008–2014		Yield as a % of Mandelup 2008–2014	
											East 1.93 t/ha	West 1.93 t/ha	East 2.30 t/ha	West 1.67 t/ha
Narrow-leaf														
Jenabillup	early	G	MG	14	MR	R	MS	MR	MR	MS	99 (6)	97 (12)	97 (44)	102 (11)
Jindalee	mid–late	G	G	13	MR	MR	R	MS	S	MS	89 (6)	82 (11)	84 (44)	82 (11)
Mandelup	very early	G	MP	14	MS	R	R	MR	MS	MR	100 (6)	100 (12)	100 (44)	100 (11)
PBA Barlock	early	VG	G	13	MS	R	MR	MR–R	MS	R	99 (6)	97 (10)	100 (44)	100 (11)
PBA Gunyidi	very early	VG	G	13	MS	R	R	MR–R	MS-MR	MR–R	96 (6)	92 (12)	102 (44)	102 (11)
Quilinock	early	G	MP	16	MS	R	MR–MS	MR		VS	98 (6)	96 (12)	96 (44)	101 (11)
Wonga	early–mid	G	MG	13	MS	S	R	R	MS	R	95 (6)	92 (12)	88 (44)	87 (11)

Albus											Yield as a % of Luxor 2007–2014		Yield as a % of Luxor 2007–2014	
											East 1.90 t/ha	West 1.72 t/ha	East 2.14 t/ha	West 1.34 t/ha
Kiev Mutant	very early	G	G	35	R	VS	R	Immune	n.d.	VS	90 (8)	95 (14)	92 (48)	91 (12)
Luxor	early	G	G	35	R	R	R	Immune	n.d.	VS	100 (8)	100 (14)	100 (48)	100 (12)
Rosetta	mid	G	G	35	R	MR	R	Immune	n.d.	VS	102 (8)	98 (14)	99 (48)	98 (12)
Ultra	very early	G	G	35	R	S	R	Immune	n.d.	VS	91 (8)	94 (14)	94 (48)	93 (12)

* Yield results are a combined across sites analysis using NSW DPI, PBA and NVT yield trials from 2007–2014. Number of trials in brackets ( ). n.d. = No data.

Lodging, pod loss and shattering resistance: MP = Moderately Poor; MG = Moderately Good; G = Good; VG = Very Good.

Disease resistance: VS = Very Susceptible; S = Susceptible; MS = Moderately Susceptible; MR = Moderately Resistant; R = Resistant; n.d. No data.

Data from Pulse Breeding Australia

Nutrition

Phosphorus – Application rates on responsive soils should be similar to cereals to achieve optimum yields and maintain soil phosphorus levels, usually 15–25 kg/ha. Responses in albus lupins are often very low or negligible to these rates of applied P. Be careful when using higher rates of high analysis fertilisers as lupin seed is sensitive to fertiliser burn. The issue of high levels of fertiliser directly next to seed is exacerbated by the use of wider rows and narrow tynes that concentrate the seed and fertiliser together in a narrow band. Sowing into marginal moisture conditions can also increase the risk of fertiliser burn. Consider separating the seed and fertiliser by banding fertiliser below the seed where possible.

Sulfur – Fertilisers blended with a sulfur component are recommended.

Molybdenum – If soils are acid or likely to be deficient, an application every five years promotes rhizobial activity. Sodium molybdate is relatively cheap and is compatible in mixes with most herbicides.

Variety selection

Select lupin varieties depending on yield potential for your environment and resistance to diseases that cause regular problems in your area.

For characteristics and yield potential of different varieties, refer to the 'Variety characteristics and reaction to diseases' table in this chapter.

Narrow-leaf lupin

Jenabillup.[Φ] Released in 2007 by the Western Australian Department of Agriculture and Food (DAFWA). High yielding, medium-tall, early flowering variety. Resistant to 'Black Pod Syndrome' (BPS) which is a problem in cool, higher-rainfall areas of southern Western Australia. This resistance also appears to be beneficial in the eastern states when conditions favour high levels of *Bean yellow mosaic virus*. Commercialised under licence to Seednet, protected by PBR. An EPR of $2.53/tonne applies.

Jindalee.[Φ] Released in 2000 by NSW DPI. Mid flowering, later maturing lupin variety, well suited to the medium to high rainfall areas of NSW. Improved Phomopsis stem infection resistance. Jindalee is susceptible to *Cucumber mosaic virus* and can be severely affected when sown early in seasons with high aphid populations. Marketed by Seednet, protected by PBR. An EPR of $1.38/tonne applies.

Mandelup.[Φ] Released in 2004 by DAFWA. High yielding, early maturing variety with good early vigour. Suited to the low to medium rainfall zones of NSW. Has a tendency to lodge in very high productivity situations and not generally recommended for the higher rainfall zones. Mandelup is the earliest maturing variety currently available and therefore the most suitable for crop topping. Marketed by Heritage Seeds, protected by PBR. An EPR of $2.53/tonne applies.

PBA Barlock.[Φ] Released in 2013 by Pulse Breeding Australia in Western Australia only, as a replacement for Mandelup and Tanjil in all WA lupin growing zones. PBA Barlock is slightly later flowering and maturing than Mandelup, but has shorter harvest height than Mandelup. It is moderately resistant to lodging in high rainfall regions, and is more resistant to pod shattering than Mandelup. Resistant (R) to anthracnose. Tolerant to metribuzin (equal to Mandelup). Moderately resistant (MR) to phomopsis stem blight. Commercialised by Seednet, protected by PBR. An EPR of $2.75/tonne applies.

PBA Gunyidi.[Φ] Released in 2011 by Pulse Breeding Australia in Western Australia only, as a replacement for all varieties in the medium and low rainfall zones of WA. In NSW PBA Gunyidi yields have been marginally lower than Mandelup based on long term trial results. PBA Gunyidi has superior resistance to pod shatter and good lodging resistance, allowing later harvest without incurring significant shatter losses. Moderately resistant (MR) to anthracnose. Tolerance to metribuzin is equivalent to Mandelup but is more susceptible to damage from the herbicide Eclipse®. Commercialised by Seednet, protected by PBR. An EPR of $2.75/tonne applies.

Albus lupin

Luxor. [Φ] Released in 2005 by NSW DPI. Higher yielding than Kiev Mutant and Ultra. Resistant to Pleiochaeta root rot (the cause of many seedling deaths in older varieties). Luxor is 7 days later flowering than Ultra, but earlier flowering than its companion line Rosetta. Suited to the medium–low rainfall zones of NSW. Commercialised under licence to Seednet, protected by PBR. An EPR of $3.08/tonne applies.

Rosetta.[Φ] Released in 2005 by NSW DPI. Higher yielding than Kiev Mutant and Ultra in longer season environments. Moderately resistant to Pleiochaeta root rot. Later flowering and taller than Luxor, especially suited to higher rainfall areas. Commercialised under licence to Seednet, protected by PBR. An EPR of $3.08/tonne applies.

Weed control

There are a range of herbicides for control of both broadleaf and grass/cereal weeds in lupin. Sowing early with good crop establishment is essential to achieve more effective results from herbicides.

Herbicide damage causing yield losses in lupin crops have been observed from both residual herbicides applied to prior cereal crops and from in-crop herbicides. Plants weakened by herbicides are more susceptible to root and foliar diseases such as Phytophthora root rot, Pleiochaeta root rot and brown leaf spot.

1. *Sulfonylurea herbicides* (e.g. Glean® or Logran®) applied to preceding cereal crops. Take special note of label instructions concerning crop rotation and plant-back periods, particularly on high pH and/or compacted soils, and after prolonged periods of low rainfall or drought.
2. *Triazine herbicides* (e.g. simazine). Be aware that application rates vary significantly on different soil types. Follow label recommendations and avoid spray overlaps. Albus lupin is more sensitive to triazine damage.
3. *Clopyralid* (e.g. Lontrel®) applied to preceding cereal crops. Clopyralid can carry over in straw and affect subsequent crops.
4. *Metosulam* (e.g. Eclipse®). Damage can occur in-crop if applied beyond the recommended growth stage. Some varieties are sensitive and have narrow safety margins. Follow label recommendations.

Disease guide – lupin

Disease/Cause	Symptoms	Occurrence	Survival/Spread	Control
Root Diseases				
Damping off *Pythium* spp., *Rhizoctonia* spp.	Seedlings collapse within a few days of emergence. Stem/taproot near ground-level sunken, water soaked.	Cool, wet, poorly drained soils. Late sowing leading to slow germination and emergence.	Spores survive in soil for long periods. Wide host range among other broadleaf crops.	Sow on time into well drained soils.
Pleiochaeta root rot *Pleiochaeta setosa* (mainly in albus lupin, rare in narrow-leaf lupin)	Dark brown, girdling lesions on taproot and lateral root spots.	Winter/spring. More severe in older albus varieties. Paddocks with a recent lupin history.	Survives in soil and on infected plant debris.	Crop rotation, four years or more between crops. Avoid growing near last year's lupin stubble. Grow resistant albus varieties Luxor or Rosetta.
Rhizoctonia root rot *Rhizoctonia* spp.	Dark brown, girdling lesions on taproot, fine roots rotted with 'spear point' effect. Patches of stunted plants within crops.	Favoured by minimum tillage, marginal soil moisture, mild conditions and some herbicide residues. Survives as fungal fragments in soil.	Host range depends on strain, but can include cereals and other broadleaf crops.	Suppressed by frequent cultivation. Cultivate below seed sowing depth.
Phytophthora root rot *Phytophthora* spp.	Plants wilt, turn yellow and die suddenly between flowering and pod set. Roots are completely rotted with a blackish, sunken lesion extending up to 5 cm up the stem base.	Favoured by wet, late winters and early springs on poorly drained heavier soils, especially with hard pans.	Resting spores survive extended periods in soil.	Avoid hard pans and poorly drained sites.
Foliar Diseases				
Anthracnose *Colletotrichum lupini*	Twisting of stems and 'Shepherds Crook' syndrome. Dark lesions with pale pink centres on stems, leaves and pods.	Not found on narrow-leaf or albus lupin crops in NSW. Found on Russell ornamental lupin.	Seed-borne and on trash. Spread by rain splash, machinery and animal movement.	Varieties with improved resistance are available. Crop rotation, use of fungicide seed dressings and foliar fungicides.
Brown leaf spot *Pleiochaeta setosa* (mainly in narrow-leaf lupin, rare in albus lupin)	Initially dark brown spots on cotyledons, which die and drop off. Dark brown spots on leaves. Leaves distorted, may be shed. Lesions may girdle stems in extreme cases.	Cool, wet conditions. Worse on late sown crops, low pH soils and exacerbated by wetting agents used with herbicides. Only a problem in narrow-leaf lupin.	Spores survive in soil and on infected plant debris. Spread by rain splash and wind-blown rain.	Crop rotation, four years between crops. Early sowing. Retain cereal stubble. Minimum tillage and soil disturbance at sowing. Avoid growing near last year's lupin stubble. Use fungicide seed dressings.
Grey mould *Botrytis cinerea*	Dead areas on stem, covered with fluffy, greyish-brown fungal growth, usually near ground level. Stem girdling leads to wilting and death.	The disease is worse in dense crops. The fungus can survive in infected trash for extended periods as resting mycelium and is favoured by cool to mild, wet conditions in spring.	Survives on many alternative hosts. Aerial spores blown considerable distances.	Consider wider rows and/or lower plant populations to reduce dense canopies and increase air movement in the canopy. Use of foliar fungicides.
Phomopsis stem blight *Diaporthe toxica*	Generally few symptoms on living plants. Black fruiting bodies of the fungus form on the surface of dead stems after harvest. Infected seeds discoloured, especially visible in albus. Fungal toxin poisons stock causing lupinosis.	Plants can be infected at any time during growth. Infection usually during cool, moist conditions in autumn, winter or spring.	Survival on infected stubble. Spores spread by rain splash and in wind-blown rain. Infected seed can spread disease.	Resistant varieties. Safe grazing practices reduce lupinosis.
Sclerotinia stem rot *Sclerotinia sclerotiorum*	White cottony fungal growth on stem at ground level and sometimes in upper canopy. Plants wilt. Sclerotia of the fungus develop on plant surfaces and inside stems. Can sometimes cause a basal rot.	Cool to mild humid conditions following rain in spring. Worse in dense crops.	Survives as resting sclerotia in soil. Sclerotia germinate in late winter and early spring and infect with airborne spores.	Difficult because of wide host range and long survival in soil (10 years). Canola is a major host of sclerotinia and should not be sown too close to lupin in the crop rotation. Consider wider rows in high rainfall areas to increase air movement in the canopy.
Virus Diseases				
Bean yellow mosaic virus (BYMV)	Plants yellow with blackened flat pods. Plants wilt and die. The non-necrotic strain causes downturned leaflets.	Mainly in mild conditions during spring. Often seen at crop margins.	Survives in many legume and weed species. Spread by several aphid species.	Follow best management practices including retention of standing cereal stubble and weed control.
Cucumber mosaic virus (CMV) (narrow-leaf lupin only)	Plants stunted. Foliage distorted, bunchy leaves with upturned leaflets. Persistent green plants at harvest. Infected narrow-leaf lupin seeds smaller.	Occurs early in the season from infected seed, any other time from aphid transmission.	Survival in many legume and weed species. Infected seed of narrow-leaf lupin only. Spread by several aphid species.	Grow narrow-leaf lupin varieties resistant to seed transmission e.g. Wonga. Use virus tested narrow-leaf lupin seed. Follow best management practices including retention of standing cereal stubble and weed control. In high risk areas grow albus lupin.

For more detailed information on current weed control and plant-back recommendations, refer to pesticide labels and NSW DPI guide *Weed control in winter crops*.

Insect control

Redlegged earth mite and blue oat mite – Large mite populations are common and can cause distorted early growth and may kill seedlings. The rasping of the cotyledon and leaf surface during feeding results in a distinctive silvering on the leaves. Mite damage can be confused with brown leaf spot lesions, so correct identification is required before control measures are used. Early detection and control improves crop health and vigour.

Lucerne flea – Damage is common and is characterised by clear membranous windows chewed into cotyledons and leaf surfaces. Early detection and control improves crop health and vigour.

Cutworms, armyworms and pasture cockchafers – These caterpillar pests can cause sporadic damage to seedlings and young plants. Monitor crops regularly during the establishment phase and control if required.

Aphids – These insects rarely cause significant feeding damage on lupin in NSW, but may transmit viruses. Aphids are vectors of two potentially serious lupin viruses; *Cucumber mosaic virus* (CMV) and *Bean yellow mosaic virus* (BYMV). Yield losses are greatest when aphids arrive early in the season, usually following wet seasonal conditions that provide a 'green bridge' of weed hosts over the summer months. BYMV is not seed-borne whereas CMV can be. Lupin varieties differ in their susceptibility to viruses (see disease section on *Cucumber mosaic virus*). Wonga and Jenabillup appear to have more resistance to aphid attack than other varieties. Aphid visitation is reduced by having uniform plant density, early canopy closure, and retained cereal stubble.

Thrips – Monitor for thrips from early flowering. Thrips can cause reduced vigour, and flower and early pod abortion. Thrips can be particularly damaging to albus lupin. Critical control decisions should be made at early flowering. Control threshold is 1–2 thrips per open flower, not 1–2 per flowering spike.

Heliothis (*Helicoverpa* spp.) – Occurrence is common and control decisions should be based on regular monitoring. Crops should be monitored twice weekly once flowering has started. Larvae feed on leaves, stems and pods, and once of sufficient size, they burrow into pods and feed on the developing seed. Human consumption markets have strict limits on insect damaged seeds, so populations of 1–2 larvae per square metre warrant control. Aerial insecticide application is often required.

Refer to NSW DPI guide *Insect and mite control in field crops* for more detailed information on pest control measures and thresholds.

Diseases

Anthracnose – This destructive disease remains confined to naturalised ornamental lupin in alpine regions of south eastern Australia and commercial lupin crops in South Australia and Western Australia. Wonga and PBA Barlock are resistant (R) whilst PBA Gunyidi (MR–R) and Mandelup (MR) are slightly more susceptible. All other narrow-leaf and albus lupin varieties are susceptible. Fungicide seed dressing will provide some early protection. Be sure to report suspicious crop symptoms which include twisting of stems and 'Shepherds Crook' syndrome (see the Lupin Disease Guide in this chapter for further detail). If it is detected early in NSW, the disease could be eradicated. Restrictions apply on the movement of lupin material into NSW from South Australia and Western Australia.

Brown leaf spot (**BLS**) – This can potentially be a damaging disease affecting narrow-leaf lupin. It is more likely to occur in soils that are easily rain splashed and/or where the soil pH is low (which aids spore survival) and in paddocks with a recent lupin history. Albus lupin is less affected by this disease where it is not usually a significant problem – some lesions may develop on pods but do not cause any yield loss. The disease is favoured by cool, wet conditions during seedling emergence when soil-borne spores are splashed onto leaves and cause infection. Seedlings can rapidly become defoliated and die. Good crop management can prevent losses from BLS. Preventive measures are necessary to protect crops in high disease risk situations, particularly in areas with intensive lupin production. Crop rotation (at least 4 years between lupin crops), paddock separation from last year's lupin crop, cereal stubble cover and minimum tillage, and fungicide seed dressing all used together, provide the maximum protection.

Pleiochaeta root rot (**PRR**) – Albus lupin are reasonably tolerant to BLS, when grown on red-brown loamy soils. However, older varieties are susceptible to PRR caused by the same fungus, *Pleiochaeta setosa*. Soil-borne spores can infect the taproot of albus plants, causing stunting and premature death. The new variety Luxor is rated resistant and Rosetta rated moderately resistant to the disease. Management of the disease is the same as for BLS. Treat seed at sowing with a fungicide seed dressing, separate this year's crop from last year's lupin paddock and avoid growing lupin for at least four years in the same paddock.

Cucumber mosaic virus (**CMV**) – This disease tends to be more important in central and northern NSW but only in narrow-leaf lupin. Albus lupin are immune to the disease. It is spread through infected seed and by aphid movement. Narrow-leaf lupin seed should be tested for CMV infection. Wonga is the most resistant narrow-leaf lupin to CMV seed transmission. CMV can cause symptoms in all narrow-leaf lupin varieties but it is the seed transmission from infected plants that cause problems for growers. The infected seed then carries over the disease into next year's lupin crop. Infected plants are most commonly seen around crop margins and in areas of low plant density or in gaps. Best management practices including retention of standing cereal stubble and weed control (to deter aphids) will reduce incidence of the disease.

Bean yellow mosaic virus (**BYMV**) – This is a common virus infection in both narrow-leaf and albus lupin. The disease causes yellowing, wilting and plant death. It is most common on crop margins and near gaps in the crop where aphids land more often. BYMV infection in narrow-leafed lupin can cause three types of symptoms. When infection is before pod set, the most common symptom is the necrotic (BYMV-N) one that kills the infected plant. The less common non-necrotic

(BYMV-NN) symptom causes stunting without killing the plant. The third main symptom is when plants are infected after pod set where black pods develop (Black pod syndrome) There are no seed-borne BYMV strains in Australia. Best management practices including retention of standing cereal stubble and weed control (to deter aphids) will reduce incidence of the disease.

Phomopsis and lupinosis – Be aware of the potential danger to stock grazing stubble and seed infected with the phomopsis stem blight fungus. Fungal growth and toxin production on stubble is stimulated by summer rainfall. Strategies to avoid lupinosis in stock involve careful grazing management in the first few months after harvest and growing a narrow-leaf lupin variety with the best available phomopsis resistance. Current albus lupin varieties have a good level of resistance to stem infection by the phomopsis pathogen, but are susceptible to pod and seed infection especially after heavy rain, wind, or hail close to harvest. Look for pink, tan or brown discoloured or mouldy seed. Do not feed grain to stock or deliver for human consumption if phomopsis infected seed is suspected. Manage the disease through separation of this year's crop from last year's paddock and avoid growing lupin for at least four years in the same paddock. For further information see NSW DPI Primefact 1308, *Reducing the risk of lupinosis and the incidence of phomopsis.*

Phytophthora root rot 'Sudden death' – A serious disease in years with a wet late winter and early spring where plants suddenly wilt and die around pod set stage. The disease can occur as individual plants or patches within a crop. Occurrence is associated with soil hard pans or perched water tables, as the disease initiation requires a brief period of waterlogging for the infection of lupin roots. In narrow-leaf lupin the disease is caused by an undescribed species of Phytophthora. In albus lupin the disease is caused by *Phytophthora cryptogea*. The latter fungus is also highly pathogenic to lentil. Disease management is difficult because of the extended period of survival of the fungus in the soil. Methods of minimising the occurrence of the disease include crop rotation and avoidance of paddocks with a known water logging problem.

Sclerotinia stem rot – This disease is caused by the same fungus that infects canola. Disease development is favoured by prolonged wet conditions in late winter followed by periods of prolonged leaf wetness during flowering. Districts with reliable spring rainfall and long flowering periods for lupin appear to develop the disease more frequently. The environmental conditions for Sclerotinia to develop are very specific and will not occur every year, so even when the fungus is present the disease may fail to develop in dry conditions. Be aware of crop rotations that include lupin and canola in close rotation as this can increase soil-borne sclerotia. Burning canola or lupin stubble will not effectively control Sclerotinia as sclerotia survive mainly on or in the soil. Crop rotation with cereals, following recommended sowing times and ensuring crops do not develop heavy vegetative growth, which are likely to reduce air circulation, are the best means of managing the disease. There are currently no foliar fungicides registered to manage sclerotinia stem rot in lupin.

Harvest

Lupin seed can be harvested and delivered as soon as seed moisture content is below 14% (maximum receival standard). Timing is critical to maximise yields. Pods are prone to shattering if left too long after maturing, especially albus lupin. If harvest is delayed or dry conditions prevail, harvest at night or in the early morning with dew to minimise shattering and pod drop. Use extended fingers to help trap pods. Grower reports suggest pod loss is reduced if draper fronts are used. Windrowing and crop desiccation are viable options, particularly for crops with variable maturity or high weed burdens. For further details see Pulse Point 10, *Windrowing lupin*. Registered products for desiccation are listed in NSW DPI guide *Weed control in winter crops*. As desiccation timing is similar to windrowing, seek advice from your local agronomist if unsure.

Marketing

Narrow-leaf lupin is a readily marketable, high protein stockfeed and is sold domestically for use in pig, poultry, dairy and feedlot rations. A small quantity is exported but price is driven by competition with soymeal.

Albus varieties are suitable for export human consumption provided grain quality parameters are met. The principal export market for Australian Albus is Egypt. Albus lupin is also suitable for dairy and cattle feedlot rations but is not readily accepted into pig rations at high inclusion rates. Albus lupin is commonly dehulled, concentrating the protein content for use in feed mixes, while the hulls provide a fibre source.

Further information

Agfact P4.2.17 *Lupin – best practice management for sustainable production* (NSW DPI, 2000)

Primefact 1308 *Reducing the risk of lupinosis and the incidence of phomopsis* (NSW DPI, 2013)

Weed control in winter crops (NSW DPI, 2015)

Insect and mite control in field crops (NSW DPI, 2013)

NSW DPI website: **www.dpi.nsw.gov.au/agriculture/broadacre/winter-crops/pulses** for:

Pulse Point 6, *Dry sowing* (NSW DPI, 1999)

Pulse Point 10, *Windrowing lupin* (NSW DPI, 2000)

Pulse Point 17, *Phytophthora root rot of lupin* (NSW DPI, 2002)

Pulse Point 18, *Cucumber mosaic virus in lupin* (NSW DPI, 2003)

Pulse Point 20, *Germination testing and seed rate calculation* (NSW DPI, 2005)

Pulse Australia (PA) website **www.pulseaus.com.au** for:

Variety Management Packages (VMP) for all new varieties

Pulse Australia Trading Standards

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Grain insects – options for control

Most cereal grains in storage provide ideal conditions for infestation by a range of grain insects at harvest temperature. Some species multiply many times per generation, with the potential to seriously damage grain. Grain may be protected with either chemical or residue-free technologies as described below. Grain must also be dry to prevent moulds or fungus developing. Maximum delivery moisture contents are: 12.5% for wheat, barley, oats and 12% for triticale, 8% for canola, 9% for sunflower, 13% for feed soybeans, 13.5% for sorghum and 14% for maize. Grain below these moisture limits still needs protection from insect infestation.

Storage hygiene

Empty silos should be thoroughly cleaned on a regular basis. Mid-winter is ideal for a major storage facility clean up before the warmer weather of early spring leads to increased grain insect activity and movement. Silos for cereal grain may be treated with a number of products (Table 1). Desiccant dusts are the preferred option due to some grain insects developing resistance to some of these insecticides. Silos for organic grain, canola, pulses and other non-cereal grains can only be treated with a desiccant dust to avoid any possibility of transferring chemical residues to the grain. Avoid placing fresh grain on top of carry-over grain. If carry-over grain must be stored in the same silo, it should all be fumigated or chemically treated prior to the new grain being added to the silo.

Chemical protectants

These insecticides (Table 2) are sprayed directly onto the grain stream while augering into storage. They protect uninfested cereals from insects during storage periods ranging from 3–9 months but are not intended for control of infestations that have already developed. Some full rate treatments have withholding periods (WHP) of up to 3 months before the grain may be used. This is to ensure that residues meet domestic and export limits. **Always check with end-users prior to treatment with any contact insecticide as buyers have the right to specify low or nil residues on grain for particular markets despite the protectant having full registration**. Where possible, use alternate chemicals for repeated treatments. This will prevent the build-up of resistance through overuse of the same chemical. Some seed dressings will also protect grain against stored insect pests (refer to pesticide labels).

Protectants are not registered for use on canola, other oilseeds or pulses. These grains must be protected by residue-free methods such as fumigation or aeration. Some insecticide treatments on grain, including carbaryl and desiccant dusts, are not accepted by bulk handlers and many other grain buyers. Malting barley may only be treated with a limited range of protectants, see Table 2.

Sealed silo fumigation

Use of phosphine and sulfuryl fluoride (Profume®) is restricted to sealed, gas-tight storages. Sulfuryl fluoride is restricted to licensed fumigators that have undergone the Precision Fumigation program only.

For phosphine fumigations, cereals, pulses and oilseeds are best fumigated by hanging bag chains or blankets of aluminium phosphide in the headspace of a sealed silo. If tablets are used, they should not be placed in the grain, but spread out on a tray. A disposable aluminium tray is generally adequate. This tray can either be placed on the surface of the grain or suspended in the headspace. Do not add water to the tablets. Phosphine gas is generated in the headspace and gradually diffuses down through the grain. This method leaves no powdery residue in the grain, and minimises insect resistance.

Prior to fumigation, silos should be tested to confirm gas-tightness by pressurising the silo to an oil level difference of 25 mm at the silo relief valve. The oil level difference should hold above 12.5 mm for at least 5 minutes after the air supply is shut off. This is important as phosphine is unlikely to kill pupae and eggs in poorly sealed silos, resulting in re-infestation and resistance.

Aeration cooling

Grain aeration is a very effective way of cooling grain, thereby reducing the feeding activity and rate of reproduction of stored grain insects. It also helps maintain grain quality. A typical system consists of an externally-mounted fan and motor which directs air to perforated ducting on the inside cone or base of the silo. The fan must be matched to silo size; a small 0.37 kW motor (0.5 HP) is usually adequate to cool up to 80 tonnes of wheat. Multiple fans or larger capacity units are needed for larger tonnages or smaller, compact seed like canola.

An aeration controller will automatically turn on fans to select the most appropriate cooling air available at any time. Depending on the control unit, multiple silo fans can be managed by one controller. Begin aerating as soon as the ducting is covered. Manual systems using time switches and other means produce less reliable results. Manual operations should aim for the best 100 h or cool, dry air per month.

Monitoring grain temperatures in aerated storages is a worthwhile practice. In general, during summer we should be aiming for grain temperatures of 23°C or less. In winter we should achieve grain temperatures of less than 15°C. Achieving both of these cool grain temperatures will significantly slow or even stop insect breeding lifecycles. A grain temperature probe of 1.2 m should be pushed 1 m into grain and left for a minimum of 3 min before taking the grain temperature reading.

Do you know what is eating at your profits?
– common stored grain insect pests of NSW

Lesser grain borer – *Rhyzopertha dominica*

Key features: dark brown, pellet shaped, 3 mm long, eyes and mouth parts tucked underneath A

Rust-red flour beetle – *Tribolium castaneum*

Key features: red brown, 3–4 mm long, three larger segments at end of antennae A

Rice weevil – *Sitophilus oryzae*

Key features: dark brown to black, 2–4 mm long, long weevil snout A

Saw-toothed grain beetle – *Oryzaephilus surinamensis*

Key features: dark brown, 3 mm long, fast moving, saw tooth pattern on side of body behind head A

Flat grain beetle or rusty grain beetle – *Cryptolestes ferrugineus*

Key features: brown, small, 2 mm long, fast moving, keen to hide, long thin antennae A

India meal moth – *Plodia interpunctella*

Key features: distinctive bicoloured wings, 5–7mm long, larvae create webbing on grain surface B

A Images courtesy Department of Agriculture, Fisheries and Forestry, Queensland. B Image courtesy K Walker, PaDIL www.padil.gov.au

Monitoring

It is most important to check the condition of the stored grain regularly, at least every month, and be prepared to take remedial action if required. If possible, check the top surface as well as a sample from the base, as different species prefer different locations within the grain bulk. Check for insects by using an insect sieve and/or pitfall traps. Also look for damage caused by insects and moisture. Keep a monthly storage record of insects found, plus any grain treatments and fumigations applied.

Grower update – cancellation of products containing Dichlorvos and label approvals of products containing Dichlorvos

The APVMA has cancelled the following registrations and label approvals of agricultural chemical products containing dichlorvos identified in the table below.

Cancelled products

Product Name	Company
Divap 1140 Insecticide	United Phosphorus Ltd
Barmac Dichlorvos 500 Insecticide	Amgrow Pty Ltd
Barmac Dichlorvos 1140 Insecticide	Amgrow Pty Ltd

The product registrations and label approvals were cancelled on 20 January 2015.

The period for use of cancelled dichlorvos products for grain protection use, in line with the expiry of permit PER14075 version 5, ENDS on 2 March 2015.

Insectigas-D DDVP insecticide, which is registered for treatment of empty stored grain facilities, empty silos, farm machinery, green houses, factories and warehouses remains registered. Growers should ensure they have a copy of the new registration label and are aware of the changes in regard to its use.

Refer to the AMPVA website for the latest changes for dichlorvos use at **http://apvma.gov.au/sites/default/files/gazette_20150127.pdf**

Table 1: Insecticides for disinfesting empty grain storages and grain handling equipment

Purpose	Insecticide	Mixing rate per L	Summary notes: READ THE LABEL BEFORE USING
Desiccant dust treatments (activated amorphous silica or diatomaceous earth) **for treating grain storage surfaces and equipment such as headers, augers, mobile bins.**	Dryacide® Perma-Guard® D-10 Absorba-cide® Cut 'N Dry® Abrade®	120 g (1 L/20 m^2) 200 g (1 L/33 m^2) 120 g (1 L/20 m^2) 120 g (1 L/20 m^2) 240 mL (1 L/20 m^2)	Apply dust to empty silos and bins (2 g/m^2) using a hand or power operated duster (a venturi blower is effective). Avoid heavy deposits of dust that may dislodge. Wear a dust mask and goggles for safety. Alternatively, a slurry (10–20%) may be applied with a centrifugal pump or venturi-type sand blaster with continuous agitation. Header harvesters may be treated with 2.5 kg of dry dust. Refer to label for instructions. Please note: Some desiccant dust products are ineffective against rust red flour beetle (*Tribolium* spp.), studies have shown Dryacide® to be most efficacious.
Disinfesting empty silos, storage areas and equipment such as headers, augers, mobile bins.	Carbaryl 500	10 mL	Ensure silos are cleaned thoroughly prior to any treatment. Carbaryl is registered only for control of lesser grain borers. Mixtures of carbaryl with any of the other components listed here may be used for control of all species. Follow label precautions about mixing. Do not pre-mix. Agitate thoroughly and clean equipment after use. Refer to label for spraying rates.
	Actellic® 900 Reldan® 500 Fenitrothion 1000 Reldan® PluS IGR*	11 or 22 mL 20 mL 10 mL 20 mL	Actellic®, Reldan® and Fenitrothion are not effective against lesser grain borer. May be mixed with carbaryl (above), or methoprene (IGR). However, methoprene will not kill any live adult lesser grain borers that may be present. * A premixed formulation of Reldan® and methoprene. **NOTE: None of these chemicals are to be used in storages where canola and other oilseeds or pulses are to be stored.**

Table 2: Protectants for treating cereal grain in storage

Grain situation	Insecticide rate per 100 litres		Summary notes: READ THE LABEL BEFORE TREATING for limitations and full instructions.
Protect cereal grain except malting barley, rice and maize	Conserve™ On-Farm, Part A 1 L & Part B 400 ml per 50 L of water (Part A - 500g/L Chlorpyrifos-methyl, 30 g/L S-Methoprene, Part B 120 g/l Spinosad)		Ensure treatment is acceptable to buyer. K-Obiol® and Conserve™ may be used against all the major stored grain insect pests. However, they are both restricted to one application per parcel of grain. They are also only available through stewardship programs with Bayer (K-Obiol®) or Dow (Conserve ™) Make up ONE Group A insecticide to strength before adding the required amount of ONE Group B insecticide to the spray mix. Mixtures are needed to control the whole range of grain insects. Apply 1 L of diluted spray per tonne of grain entering storage. Ensure an even coverage of the grain. Treat only non-infested grain with protectants. Check labels for withholding periods (WHP) Different twin packs are available containing one Group A and one Group B insecticide. Twin pack premixed formulation may be available and can be used to control all stored grain insect pests. Please note: Resistance in lesser grain borer to IGR widespread. * A premixed formulation of Reldan® and methoprene.
Protect cereal grain except malt barley	K-Obiol® Combi (Deltamethrin) 2.0 L		
	GROUP A	Actellic® 0.45 L Reldan® 2.0 L Fenitrothion 1.2 L	
	GROUP B	Rizacon-S® 0.2 L IGR grain protectant (methoprene) various rates	
	TWIN PACK PRE-MIXED	Two-component packs Reldan® PluS IGR 2.0 L*	
Protect malting barley	K-Obiol® Combi 2.0 L Fenitrothion 1.2 L, PLUS ONE Group B insecticide at rates indicated above		
Protect cereal grain (for treatment of cereal grain to be retained and used on farm only)	Dryacide® 1 kg/1 t Perma-Guard® D-10 1 kg/1 t Absorba-cide® 1 kg/1 t Cut 'N Dry® 1 kg/1 t Carbaryl 500, 1.6 L PLUS ONE Group A insecticide at rates indicated above		Apply dusts evenly, and reduce auger rate to prevent choking. Follow label directions when mixing carbaryl with the Group A insecticide. Do not pre-mix concentrates. Agitate thoroughly and clean equipment after use. Vat mix may lose compatibility if left overnight. Withholding period 3 months. Not accepted off-farm by most traders.
Protect organic cereal grain	Dryacide® 1kg/1 t Perma-Guard® D-10 1 kg/1 t Absorba-cide® 1 kg/1 t Cut 'N Dry® 1 kg/1 t		Dusted grain may retain protection for more than 12 months if grain moisture is low. Higher rates may be used for dirty or infested grain, but not where grain is for human consumption. Apply dusts evenly, and reduce auger rate to prevent choking.

Table 3: Fumigants for treating cereal grain in storage

Grain situation	Fumigant	Summary notes: READ THE LABEL BEFORE TREATING for limitations and full instructions.
Disinfest cereals, pulses, oilseeds and malting barley by fumigation	Aluminium phosphide (150 tablets/100 m^3) producing phosphine gas	Ensure silo is gas-tight. Calculate fumigant as if the silo is full. Fumigate for 7–20 days, withholding period 2 days after ventilation. Do not place tablets in the grain bulk. Other phosphine formulations are available, including bag chains, belts, blankets and cylinder gas. Refer to labels for rates and methods of use.
Disinfest cereals only by fumigation	Sulfuryl fluoride (Profume®)	Requires a fumigator trained under the Dow AgroSciences Precision Fumigation training program and a gas-tight storage.

Registered insecticides as at January 2015

The product names are supplied on the understanding that no preference between equivalent products is intended, and that inclusion of a product does not imply endorsement by NSW DPI over any other equivalent product from another manufacturer.

ALWAYS READ THE LABEL. Users of agricultural chemical products must always read the label and any permit before using the product, and strictly comply with the directions on the label and the conditions of any permit. Users are not absolved from any compliance with the directions on the label or the conditions of the permit by reason of any statement made or omitted to be made in this publication.

Cereal grains include wheat, barley, oats, maize, sorghum, triticale, paddy rice and millet. Canola and other oilseeds may only be treated with phosphine. Withholding periods listed on some labels ensure that residues decay to acceptable levels before grain is sold. Any queries, please seek information from Dr Joanne Holloway, NSW DPI Grain Storage Unit WAGGA WAGGA t: 02 6938 1605.

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Cereal seed dressings – 2015, control of seed-borne disease

Cereal seed dressings control smuts and bunt, and some can suppress certain leaf and root diseases. Outbreaks of bunt and flag smut in wheat emphasise the need for annual seed treatment. If such grain is not treated the levels will quickly build up to unacceptable levels.

Recommendations for controlling smuts are:

- discard grain carrying the disease
- avoid sowing wheat for at least two seasons into land where flag smut or bunt have occurred
- treat all seed for sowing

Some fungicides only control one or two of the three smuts. Use a product controlling all three diseases. Some dressings can reduce the coleoptile length and emergence of some varieties. The risk of emergence failure is increased when some fungicides are used on varieties with short coleoptiles, or when seed is sown deeply or into a poor seedbed.

Active ingredient of fungicide or insecticide	Examples of seed treatment trade name and manufacturer	Rate to apply to each 100 kg	Approx. cost to treat 100 kg of seed ($)##	Smuts controlled B – bunt C – covered smut L – loose smut				F – wheat flag smut		Diseases suppressed								
				Wheat	Barley	Oats	Triticale	Wheat	Wheat	Wheat				Wheat/ Barley	Barley			Grazing withholding period (weeks)
								Seed-borne flag smut	Soil-borne flag smut	Septoria tritici	Stripe rust	Leaf rust	Take-All	Rhizoctonia	Scald	Powdery mildew	Seed-borne Net blotch	
Powders – various trade names sometimes available under these active ingredients, concentrations and formulations. See specific labels for details.																		
Carboxin 750 g/kg + cypermethrin 6.4 g/kg	Vitavax® 750 C ST – Agriphar	70 g	3.24	B	C	CL	–	F	–	–	–	–	–	–	–	–	–	7
	Crop Solutions *	125 g	5.79	BL	CL	–	L	F*	–	–	–	–	–	–	–	–	–	
Flutriafol 100 g/kg + cypermethrin 4 g/kg	Armour® C SD – Cheminova	100 g	2.64	BL	CL	CL	L	F	F	✓	✓	–	–	–	✓	✓	–	4
Flutriafol 25 g/kg + cypermethrin 4 g/kg	Veteran™ C SD – Crop Care	100 g	2.25	BL	CL	CL	L	F	F	–	–	–	–		–	–	–	4
Tebuconazole 25 g/kg + triflumuron 4 g/kg	Raxil® T SD – Bayer CropScience	100 g	2.33	BL	CL	CL	–	F	F	–	–	–	–	–	–	–	–	4
Triadimenol 150 g/kg + triflumuron 4 g/kg	Baytan® T SD – Bayer	100 g	3.15	BL	CL	CL	–	F	F	–	✓	–	–	–	✓	✓	–	5
	CropScience*****	150 g	4.72	BL	CL	CL	–	F	F	✓	✓✓	–	–	–	✓✓	✓✓	–	5
Triadimenol 150 g/kg + cypermethrin 4 g/kg	Triadimenol 150+® SD –	100 g	2.70	BL	CL	CL	–	F	F	–	✓	–	–	–	✓	✓	–	5
	4 Farmers	150 g	4.05	BL	CL	CL	–	F	F	–	✓✓	–	–	–	✓✓	✓✓	–	5
Flowable Liquids – water based – various trade names sometimes available under these active ingredients, concentrations and formulations. See specific labels for details.																		
Carboxin 400 g/L + cypermethrin 3.2 g/L	Vitaflo® C ST – Agriphar	125 mL	2.96	B	C	CL	–	F*	–	–	–	–	–	–	–	–	–	7
	Crop Solutions *	250 mL	5.91	BL	C	CL	L	F	–	–	–	–	–	–	–	–	–	7
Carboxin 200 g/L + thiram 200 g/L	Vitavax® 200 FF ST – Agriphar	250 mL	7.84	B	C	CL	–	F*	–	–	–	–	–	–	–	–	✓	7
	Crop Solutions*	375 mL	11.76	B	C	–	–	F	–	–	–	–	–	–	–	–	✓✓	7
		500 mL	15.68	BL	CL	–	L	F	F	–	–	–	–	–	–	–	✓✓✓✓	7
Difenoconazole 92 g/L + metalaxyl-M 23 g/L	Dividend® FSD – Syngenta****	100 mL	4.58	B	C	–	–	F	F	–	–	–	–	–	–	–	–	6
		30 mL	5.95	BL	CL(s)	–	–	F	F	–	–	–	–	–	–	–	✓	6
		60 mL	11.90	BL	CL	–	–	F	F	–	–	–	–	✓	–	–	✓✓	6
Difenoconazole 66.2 g/L + metalaxyl-M 16.5 g/L + 13.8 g/L Sedaxane	Vibrance ™– Syngenta	180 mL	5.93	BL	CL	L	BL	F	F	–	–	–	–	–	–	–	✓	6
		360 mL	11.86	BL	CL	L	BL	F	F	–	–	–	–	✓^^^	–	–	✓✓	6
Fluquinconazole 167 g/L	Jockey® Stayer® – Bayer	300 mL	18.83	BL	CL***	–	–	F	F	✓	✓✓✓	✓	–	–	✓✓✓***	✓✓***	–	6, 12^^
	CropScience###	450 mL	28.25	BL	–	–	–	F	F	✓✓	✓✓✓✓	✓✓	✓	–	–	–	–	6, 12^^
Flutriafol 6.25 g/L	Vincit® C Zinc FSD – Cheminova	400 mL	8.91	BL	CL	CL	L	F	F	–	–	–	–	–	–	–	–	4
Flutriafol 25 g/L + cypermethrin 4 g/L	Vincit® C FSD – Cheminova	100 mL	2.25	BL	CL	CL	L	F	F	–	–	–	–	–	–	–	–	4
	Veteran® C – Crop Care																	
Flutriafol 100 g/L + cypermethrin 4 g/L	Arrow® C FSD – Crop Care	100 mL	2.94	BL	CL	–	–	F	F	–	✓	–	–	–	✓	✓	–	4
Flutriafol 6.25 g/L + imidacloprid 180 g/L	Veteran® Plus – Crop Care	400 mL	7.64	BL	CL	CL	–	F	F	–	–	–	–	–	–	–	–	9
Ipconazole 20 g/L + cypermethrin 4 g/L	Rancona® C – Agriphar	100 mL	3.36	BL	CL	CL	–	F	F	–	–	–	–	–	–	–	–	6
	Crop Solutions																	
Ipconazole 25 g/L + metalaxyl 20 g/L	Rancona® Dimension –	80 mL	4.15	BL	CL	CL	–	F	F	–	–	–	–	–	–	–	–	10
	Agriphar Crop Solutions	320 mL	16.61	BL	CL	CL	–	F	F	–	–	–	–	✓	–	–	–	10
Penflufen 240 g/L	EverGol® Prime – Bayer	40 mL	6.38	BL	CL	–	–	F	F	–	–	–	–	✓	–	–	–	5
	CropScience	80 mL	12.76	BL	CL	–	–	F	F	–	–	–	–	✓✓	–	–	–	5
Tebuconazole 25 g/L + cypermethrin 4 g/L	Innova® Tebuconazole	100 mL	2.59	BL	CL	CL	–	F	F	–	–	–	–	–	–	–	–	0
	25 C FSD – Syngenta																	
Tebuconazole 6.25 g/L + imidacloprid 180 g/L	Hombre® – Bayer CropScience**	400 mL	8.36	BL	CL	CL	–	F	F	–	–	–	–	–	–	–	–	9
	ProGuard® Plus – Agriphar																	
	Crop Solutions																	
Tebuconazole 12.5 g/L + imidacloprid 360 g/L	Hombre® Ultra –	200 mL	8.03	BL	CL	CL	–	F	F	–	–	–	–	–	–	––	–	9
	Bayer CropScience**																	
Tebuconazole 150 g/L + prothioconazole 250 g/L	Raxil® Pro – Bayer CropScience	15 mL	1.88	BL	CL	CL	–	F	F	–	–	–	–	–	–	–	–	5

Tebuconazole 25 g/L + triflumuron 4 g/L	Raxil® T FSD – Bayer CropScience ProGuard® T ST – Agriphar Crop Solutions	100 mL	2.31	BL	CL	CL	–	F	F	–	–	–	–	–	–	–	–	4
Triadimenol 150 g/L + cypermethrin 4 g/L	Foliarflo® C ST – Agriphar Crop Solutions	100 mL	2.70	BL	CL	CL	–	F	F	–	✓	–	–	–	✓	✓	–	5
		150 mL	4.04	BL	CL	–	–	F	F	✓	✓✓	–	–	–	✓✓	✓✓	–	5
Triadimenol 56 g/L + imidacloprid 180 g/L	Zorro® – Bayer CropScience** ProLeaf Plus® – Agriphar Crop Solutions **	400 mL	8.83	BL	CL	CL	–	F	F	✓	✓✓	✓	–	–	✓✓	✓✓	–	9
Triadimenol 150 g/L + triflumuron 4 g/L	Baytan® T FSD – Bayer CropScience	100 mL	2.60	BL	CL	CL	–	F	F	–	✓	–	–	–	✓	✓	–	5
		150 mL	3.90	BL	CL	–	–	F	F	✓	✓✓	–	–	–	✓✓	✓✓	–	5
Triticonazole 25 g/L + cypermethrin 4 g/L	Premis® Pro C – BASF	100 mL	3.41	BL	CL	CL	–	F	F	–	–	–	–	–	–	–	–	Nil
In furrow treatments – various trade names sometimes available under these active ingredients, concentrations and formulations. See specific labels for details.																		
		Rate and approx cost /ha																
Azoxystrobin 322 g/L + metalaxyl-m 124 g/L	Uniform®– Syngenta*****	200 mL/ha	12.66	–	–	–	–	–	–	–	✓✓	–	–	✓	–	–	–	6
		300 mL/ha	18.99	–	–	–	–	–	–	–	–	–	–	✓✓	–	–	–	–
		400 mL/ha	25.32	–	–	–	–	–	–	–	✓✓✓✓	–	–	✓✓✓	–	–	–	–
Flutriafol 250 g/L	Innova® Flutriafol 250 – Syngenta	200 mL/ha	4.12	–	–	–	–	–	–	–	✓✓	–	–	–	✓	✓	–	4
		400 mL/ha	8.24	–	–	–	–	–	–	✓	✓✓✓✓	–	✓	–	✓✓	✓✓	–	4
Flutriafol 250 g/L	Intake® Combi – Crop Care ###	200 mL/ha	4.50	–	–	–	–	–	–	–	✓✓	–	–	–	✓	✓	–	4
		400 mL/ha	9.00	–	–	–	–	–	–	✓	✓✓✓	–	✓	–	✓✓	✓✓	–	4
		800 mL/ha	18.00	–	–	–	–	–	–	✓	✓✓✓✓	–	✓	–	✓✓	✓✓	–	4
Flutriafol 500 g/L	Intake® Hiload Gold – Crop Care ###	100 mL/ha	2.06	–	–	–	–	–	–	–	✓✓✓	–	–	–	✓	✓	–	4
		200 mL/ha	4.13	–	–	–	–	–	–	✓	✓✓✓✓	–	✓	–	✓	✓	–	4
		400 mL/ha	8.25	–	–	–	–	–	–	✓	✓✓✓✓	–	✓	–	✓✓	✓✓	–	4
Triadimefon 500 g/kg	Triad® 500 WP – Adama	200 g/ha	4.60	–	–	–	–	–	–	–	–	✓	–	–	–	–	–	Not stated$
Triadimefon 500 g/kg	Triadimefon 500 WG – Cheminova	200 g/ha	3.90	–	–	–	–	–	–	–	✓✓	✓	–	–	–	✓	–	Not stated@
Triadimefon 500 g/kg	Triadimefon 500 – 4 Farmers	200 g/ha	3.60	–	–	–	–	–	–	–	–	✓	–	–	–	–	–	Not stated@

Prices quoted are GST inclusive at February 2015 and approximate only. Prices will vary depending on pack size purchased and special marketing arrangements. ### Rate of product varies for disease controlled, check label.
✓ Affords useful suppression in early crop growth stages. ✓✓, ✓✓✓ and ✓✓✓✓ Affords extended suppression. * Also controls seed-borne flag smut in triticale. There are no registered seed treatments for cereal rye.

** Barley yellow dwarf virus. Hombre®, ProGuard® Plus, ProLeaf® Plus and Zorro® provide early season control of BYDV. *** Plus Raxil® T with Jockey® Stayer® at 100 mL/100 kg seed. ****Also provides control of pythium root rot. *****Also provides control of pythium root rot and suppression of Yellow spot. ^^^ Suppresses Rhizoctonia root rot in oats.

Caution: Observe stock withholding periods on crops produced from treated seed.
^^ Withholding period – Livestock producing milk for human consumption 12 weeks.
Treated seed must not be used for animal or human consumption.
Read Label before using pesticides. @ – Do not mix leaves treated with this product with feed intended for animal consumption. $ – Feed treated with this product must not be used for animal consumption, poultry feed or mixed with animal feed.

Cereal insecticide seed dressings for aphid and *barley yellow dwarf virus* (BYDV) control 2015

Active ingredient of insecticide and fungicide – various trade names sometimes available under these active ingredients, concentrations and formulations. See specific labels for details.	Examples of seed treatment trade name and manufacturer	Rate to apply to each 100 kg###	Approx. cost to treat 100 kg of seed ($)##	Aphid feeding damage suppression (wheat aphid and corn aphid)	Reduces spread of BYDV	Grazing withholding period (weeks)
Imidacloprid 180 g/L + tebuconazole 6.25 g/L	Hombre® – Bayer CropScience	400 mL	8.36	✓	✓	9
Imidacloprid 360 g/L + tebuconazole 12.5 g/L	Hombre® Ultra– Bayer CropScience	200 mL	8.03	✓	✓	9
Imidacloprid 180 g/L + triadimenol 56 g/L	Zorro® – Bayer CropScience	400 mL	8.62	✓	✓	9
Imidacloprid 180 g/L + flutriafol 6.25 g/L	Veteran® Plus – Crop Care	400 mL	8.42	✓	✓	9
Imidacloprid 180 g/L + flutriafol 25 g/L	Arrow® Plus – Crop Care (registered for barley only)	400 mL	8.69	✓	✓	9
Imidacloprid – 350 g/L	Gaucho® 350 – Bayer CropScience	200 mL – 400 mL	8.11–16.22	✓	✓	9
Imidacloprid – 600 g/L	Gaucho® 600 – Bayer CropScience Senator® 600 Red – Crop Care	120 mL – 240 mL	6.11–12.21	✓	✓	9

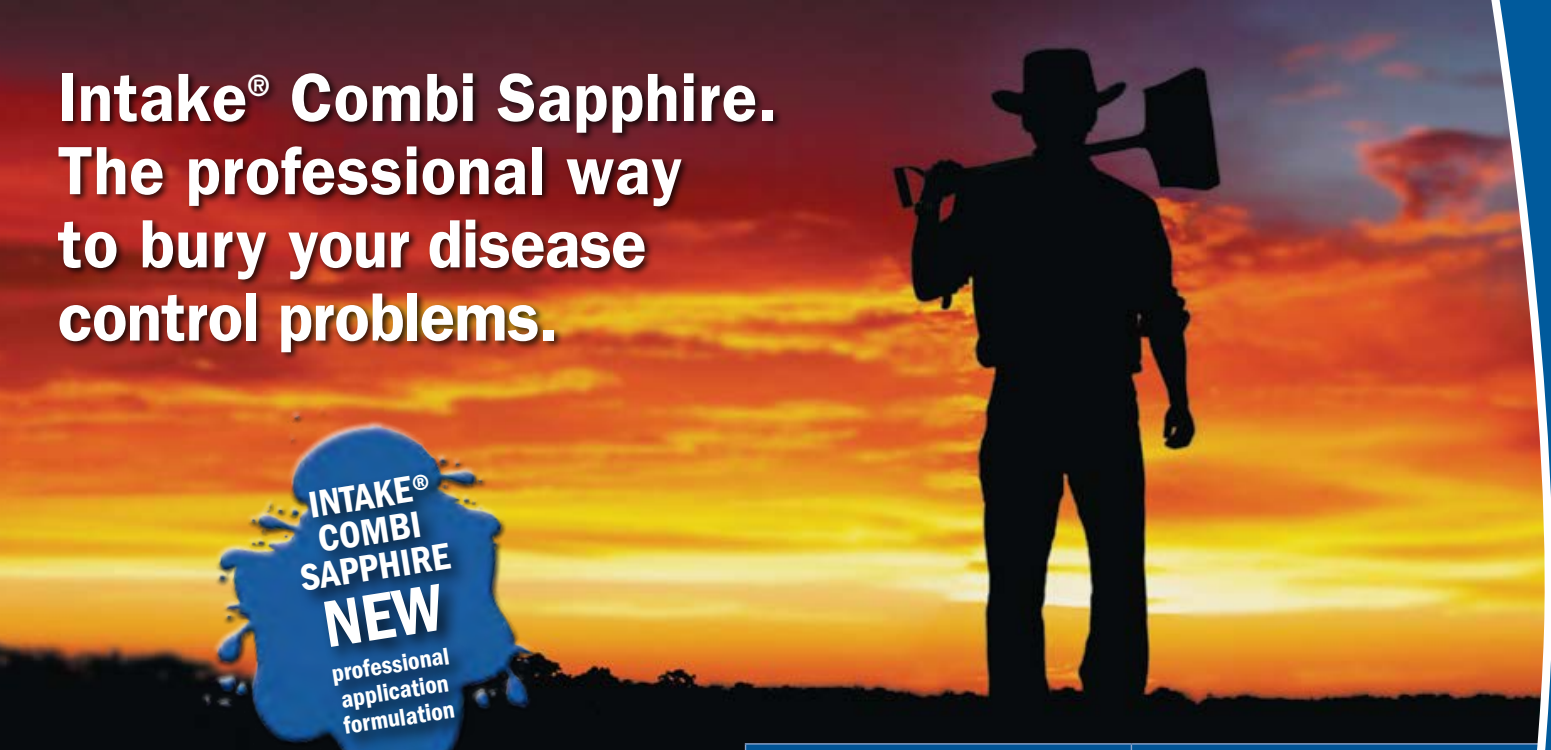
Prices quoted are GST inclusive at February 2015 and approximate only. Prices will vary depending on pack size purchased and special marketing arrangements.
Rate of product varies for length of disease control and risk level, check label. ✓ Affords useful suppression in early crop growth stages.

Canola and pulse seed dressings – 2015, Seed dressings for canola, chickpea, field pea, faba bean and lupin

Example seed treatment, trade name and manufacturer	Active ingredient of fungicide or insecticide	Rate to apply to each 100 kg of seed	Approx cost to treat 100 kg ($) ##	Range of pack sizes (kg or L)	Canola	Chickpea	Field pea	Faba bean	Lupin
Powders									
Thiragranz* – Crop Care	thiram (800 g/kg)	150 g	2.10	20 kg		Seed-borne Botrytis Ascochyta blight			Seed-borne Anthracnose
Flowable liquids									
Danadim® – Cheminova Dimethoate 400 - Adama	dimethoate (400 g/L)	150 mL (field pea) 150 mL (lupin) 330 mL (canola)	2.00 2.00 4.40	5–200 L	Redlegged earth mite, Lucerne flea		Redlegged earth mite Lucerne flea		Redlegged earth mite Lucerne flea
Gaucho® 600 – Bayer CropScience	imidacloprid (600 g/L)	300 mL (lupin) 400 mL (canola)	13.45 17.95	1–200 L	Redlegged earth mite, Blue oat mite, Aphids				Redlegged earth mite Blue oat mite
Gaucho® 350 – Bayer CropScience	imidacloprid (350 g/L)	100 mL (field pea) 200 mL (faba bean) 500 mL (lupin)	4.05 8.10 20.25	5–175 L			Aphids	Aphids	Redlegged earth mite Blue oat mite
Emerge ™ Flowable Seed Treatment – Syngenta	imidacloprid (600 g/L)	300 mL (lupin) 400 mL (canola)	13.45 17.95	1 & 10 L	Redlegged earth mite, Blue oat mite, Aphids				Redlegged earth mite Blue oat mite
Cosmos® – Agriphar Crop Solutions	fipronil (500 g/L)	400 mL	354.00	500 mL–200 L	Redlegged earth mite				
Cruiser® Opti - Syngenta	thiamethoxam (240 g/L) + lambda-cyhalothrin (37.5 g/L)	500–1000 mL	66.55–133.10		Green peach aphid				
		1000 mL	133.10		Suppression of: Redlegged earth mite, Lucerne flea				
Jockey® Stayer® – Bayer CropScience	fluquinconazole (167 g/L)	2 L	120.10	5–1000 L	Blackleg (suppression)				
Apron® XL 350 ES – Syngenta	metalaxyl-M (350 g/L)	75 mL	31.50	1 L–1000 L		Phytophthora root rot	Damping-off, Downy mildew		
Maxim® XL – Syngenta	fludioxonil (25 g/L) + metalaxyl-M (10 g/L)	200–400 mL	69.95–133.90	1 L–1000 L	Damping-off (*Pythium* spp.) Rhizoctonia solani Blackleg (suppression)				
P-Pickel T® – Crop Care	thiram (360 g/L) + thiabendazole (200 g/L)	200 mL	7.40	10 & 200 L		Ascochyta blight, Botrytis seed rot Seedling root rots (*Pythium* spp., *Fusarium* spp.)	Black spot, (Leaf and Pod Spot and Collar Rot), Seedling root rots (*Pythium* spp., *Fusarium* spp.) *Macrophomina phaseolina*	Seedling root rots (*Pythium* spp., *Fusarium* spp.)	
Poncho® Plus# – Bayer CropScience	clothianidin (360 g/L) + imidacloprid (240 g/L)	500 mL	NA	5–1000 L	Wireworm, Cutworm Lucerne flea, Redledgged earthmite, Blue oat mite				
Thiram 600 Flowable Fungicide – Crop Care	thiram (600 g/L)	200 mL (chickpea) 170–200 mL (lupin)	2.85 2.45-2.85	10–200 L		Damping-off (*Pythium* spp.) Seed-borne Botrytis and Ascochyta blight			Seed-borne Anthracnose
Rovral® Liquid Seed Dressing – Crop Care	iprodione (250 g/L)	100–500 mL	2.00–10.00	5–1000 L					Brown leaf spot
Sumisclex® Broadacre – Sumitomo	procymidone (500 g/L)	100 or 200 mL	4.70 or 9.40	5 –20 L					Brown leaf spot
In furrow treatments		**Rate per hectare**	**Cost per hectare ($)**						
Intake® Hiload Gold – Crop Care	flutriafol (500 g/L)	200 mL	5.50	5–1000 L	Blackleg				

* Wettable granule formulation. ##Prices quoted are GST Inclusive at 15 January 2015 and approximate only. Prices will vary depending on pack size purchased, seed treatment services i.e. imidacloprid + fluquinconazole or Poncho Plus + fluquinconazole, and special marketing arrangements. # Price of Poncho Plus is included in the cost of the seed. Poncho plus can only be applied by accredited applicators. NA = not available.

Intake® Combi Sapphire. The professional way to bury your disease control problems.



	Crop Care INTAKE® COMBI SAPPHIRE	Other formulations
Formulation	**500g/L flutriafol**	**500g/L flutriafol**
Colour	**Blue**	**Yellow**
Registered Disease protection in wheat, barley & canola	✓	✓
- Protection against Septoria tritici blotch in wheat	✓	✓
- Protection against Stripe rust in wheat	✓	✓
- Protection against Take - all in wheat	✓	✓
- Protection against Barley scald in barley	✓	✓
- Protection against Powdery mildew in barley	✓	✓
- Protection against Blackleg in canola	✓	✓
Registered Rate Range Extensions - superior length of protection	✓	×
- Stripe Rust in wheat - up to 130 days protection	✓	×
- Barley Scald in Barley - up to 120 days protection	✓	×
- Powdery Mildew in Barley - up to 120 days protection	✓	×
- Net Form Net Blotch suppression in barley - up to 110 days	✓	×
Stewardship program	✓	?
- Callibration of application equipment	✓	?
- Retained samples & sample analysis	✓	?
- Traceability	✓	×
Professional Application	✓	?
- Increased visibility - application & coverage	✓	×
- Reduced risk of contamination of transport equipment	✓	×
- Less transfer to handling equipment	✓	×
- Faster drying time	✓	×
- Reduced odour	✓	×
- Fertiliser integrity maintained	✓	?

The secret to disease control lies just beneath the surface.

Bury your disease problems by using Intake® Combi Sapphire In-Furrow Fungicide.

Crop Care has developed Intake® Combi Sapphire specifically for professional application to solid fertiliser, providing superior protection for diseases in wheat barley and canola. Professional application ensures superior fertiliser coverage and consequent distribution of the desired rate of flutriafol within the row, optimising disease control throughout the field whilst maintaining fertiliser integrity.

Ask your Crop Care sales representative or local fertiliser distributor about Intake® Combi Sapphire and the benefits of professional application to fertiliser, and take the first step in burying your disease problems.

INTAKE® COMBI Sapphire

Crop Care

Cereal foliar fungicides – 2015 currently registered products (NSW) – winter cereals

Various trade names sometimes available under these active ingredients and concentrations. See specific labels for details.

Active and Concentration	Examples of commercial trade names		WHP (weeks) W – wheat B – barley		Cost/L[1]	Adjuvant (as per Label)	Diseases controlled[2]										Registered for aerial application
	Product	Manu-facturer	Grazing	Harvest			Stripe Rust	Stem Rust	Leaf Rust	Crown (leaf) Rust	*Septoria tritici* blotch	*Septoria nodorum* blotch	Yellow Spot	Barley Scald	Net Blotch	Powdery Mildew	
Azoxystrobin 200 g/L + cyproconazole 80 g/L	Amistar® Xtra	Syngenta	3	6	$38.08	Barley – addition of Adigor® at 200 mL/100 L improves disease control at lower rates	400 mL–800 mL (wheat) $15.23–$30.46		200 mL–800 mL (wheat & barley[7]) $7.62–$30.46				400 mL–800 L (wheat) $15.23–$30.46		200 mL–800 mL (barley) $7.62–$30.46	400 mL–800 mL (wheat & barley) $15.23–$30.46	Yes
Azoxystrobin 75 g/L + Lepoxiconazole 75 g/L	Radial®	Adama Australia	6 + ESI	6	$38.52		420 mL–840 mL (wheat) $16.18–$32.36	420 L–840 mL (wheat) $16.18–$32.36	420 mL–840 mL (wheat & barley) $16.18–$32.36			420 mL–840 mL (wheat) $16.18–$32.36	420 mL–840 mL (wheat) $16.18–$32.36	420 mL–840 mL (barley) $16.18–$32.36	420 mL–840 mL (barley) $16.18–$32.36	420 mL–840 mL (wheat & barley) $16.18–$32.36	Yes
Azoxystrobin 120 g/L + tebuconazole 200 g/L	Custodia®	Adama Australia	3 +ESI	6	$52.00		315mL–630 mL (wheat) $16.38–$32.76	315mL–630 mL (wheat) $16.38–$32.76	315mL–630 mL (wheat & barley[7]) $16.38–$32.76		630 mL (wheat) $32.76	315mL–630 mL (wheat) $16.38–$32.76	315mL–630 mL (wheat) $16.38–$32.76	315 mL (barley) $16.38	315mL–630 mL (barley) $16.38–$32.76	315mL–630 mL (wheat & barley) $16.38–$32.76	Yes
Epoxiconazole 125 g/L	Opus® 125	Nufarm	6 + ESI	6	$24.02	200 mL/100 L Chemwet may assist in certain conditions	250 mL–500 mL (wheat) $6.01–$12.02		500 mL (wheat) 250 mL–500 mL (barley) $6.01–$12.02			250 mL–500 mL (wheat) $6.01–$12.02		250 mL (barley) $6.01	250 mL–500 mL (barley[6]) $6.01–$12.02	250 mL (wheat & barley) $6.01	Yes
Fenbuconazole 240 g/L	Indar®	Dow AgroSciences	2 + ESI	NR	$27.50	500 mL/100 L Uptake Spraying Oil	150–300 mL (wheat) $4.13–$8.25										No
Flutriafol 250 g/L	Intake® Combi	Crop Care	7-W 10-B	7-W 10-B	$22.50	200 mL/100 L BS1000®	250 mL–500 mL (wheat) $5.63–$11.25		250 mL–500 mL (wheat) $5.63–$11.25		250 mL–500 mL (wheat) $5.63–$11.25	250 mL–500 mL (wheat) $5.63–$11.25				250 mL–500 mL (barley) $5.63–$11.25	Yes
Flutriafol 500 g/L	Jubilee® Loaded	Adama Australia	7-W 10-B	7-W 10-B	$20.79	200 mL/100 L BS1000®	125 mL–250 mL (wheat) $2.60–$5.20		125 mL–250 mL (wheat) $2.60–$5.20		125 mL–250 mL (wheat) $2.60–$5.20	125 mL–250 mL (wheat) $2.60–$5.20				125 mL–250 mL (barley) $2.60–$5.20	Yes
Propiconazole 250 g/L[##]	Tilt®	Syngenta	1	4	$13.48	Not Required	250 mL–500 mL (wheat)^^^ $2.02–$6.74	500 mL (wheat & oats) $6.74	150 mL–500 mL (wheat) $2.02–$6.74	250 mL–500 mL (oats) $3.37–$6.74	250 mL–500 mL (wheat & oats[4]) $3.37–$6.74	150 mL–500 mL (wheat) $2.02–$6.74	250 mL–500 mL (wheat) $3.37–$6.74	500 mL (barley) $6.74	250 mL–500 mL (barley) $3.37–$6.74	150 mL–500 mL (wheat & barley) $2.02–$6.74	Yes
Propiconazole 435 g/L	PropiMax®	Dow AgroSciences	1	4	$27.23	Not Required	145 mL or 285 mL (wheat) $3.95–$7.76	285 mL (wheat & oats) $7.76	85 mL–285 mL (wheat) $2.31–$7.76	145 mL–285 mL (oats) $3.95–$7.76	145 mL–285 mL (wheat & oats[4]) $3.95–$7.76	145 mL–285 mL (wheat) $3.95–$7.76	145 mL–285 mL (wheat) $3.95–$7.76	285 mL (barley) $7.76	285 mL (barley[5]) $7.76	85 mL–285 mL (wheat & barley) $2.31–$7.76	Yes
Propiconazole 500 g/L	Throttle®500	Nufarm	1	4	$26.35	Not Required	125 mL or 250 mL (wheat) $3.29–$6.59	250 mL (wheat & oats) $6.59	75 mL–250 mL (wheat) 125 mL–250 mL (barley) $1.98–$6.59	125 mL–250 mL (oats) $3.29–$6.59	125 mL–250 mL (wheat & oats[4]) $3.29–$6.59	75 mL–250 mL (wheat) $1.98–$6.59	125 mL–250 mL (wheat) $3.29–$6.59	250 mL (barley) $6.59	125 mL–250 mL (barley) $3.29–$6.59	75 mL–250 mL (wheat & barley) $1.98–$6.59	Yes
Propiconazole 250 g/L + cyproconazole 80 g/L	Tilt® Xtra	Syngenta	3 + ESI	6	$32.42	Not Required	250 mL–500 mL (wheat) $8.11–$16.21	500 mL (wheat) $16.21	150 mL–500 mL (wheat & barley[3]) $4.86–$16.21		250 mL–500 mL (wheat) $8.11–$16.21	150 mL–500 mL (wheat) $4.86–$16.21	250 mL–500 mL (wheat) $8.11–$16.21	500 mL (barley) $16.21	250 mL–500 mL (barley) $8.11–$16.21	150 mL–500 mL (wheat & barley) $4.86–$16.21	Yes

Active and Concentration	Examples of commercial trade names		WHP (weeks) W – wheat B – barley		Cost/L[1]	Adjuvant (as per Label)	Diseases controlled[2]										Registered for aerial application
	Product	Manu-facturer	Grazing	Harvest			Stripe Rust	Stem Rust	Leaf Rust	Crown (leaf) Rust	*Septoria tritici* blotch	*Septoria nodorum* blotch	Yellow Spot	Barley Scald	Net Blotch	Powdery Mildew	
Propiconazole 250 g/L + Tebuconazole 250 g/L	Cogito™	Syngenta	2	5	$26.95		125 mL or 250 mL (wheat) $3.37–$6.74	125 mL–250 mL (wheat) 250 mL (oats) $3.37–$6.74	125 mL–250 mL (wheat & barley) $3.37–$6.74	125 mL–250 mL (oats) $3.37–$6.74	125 mL–250 mL (wheat & oats[4]) $3.37–$6.74	125 mL–250 mL (wheat) $3.37–$6.74	125 mL–250 mL (wheat) $3.37–$6.74	250 mL (barley) $6.74	125 mL–250 mL (barley) $3.37–$6.74	125 mL–250 mL (wheat & barley) $3.37–$6.74	Yes
Prothioconazole 210 g/L + tebuconazole 210 g/L	Prosaro® 420 [8]	Bayer CropScience	2	5	$75.91	Various(adjuvants required for some diseases) – As per Label directions	150 mL–300 mL (wheat & triticale) $11.39–$22.77	150 mL–300 mL (wheat) 300 mL (oats) $11.39–$22.77	150 mL–300 mL (wheat & barley) $11.39–$22.77	300 mL(oats) $22.77		150 mL–300 mL (wheat) $11.39–$22.77	150 mL–300 mL (wheat) $11.39–$22.77	150 mL–300 mL (barley) $11.39–$22.77	150 mL–300 mL (barley) $11.39–$22.77	150 mL–300 mL (wheat & barley) $11.39–$22.77	Yes
Pyraclostrobin 85 g/L + epoxiconazole 62.5 g/L	Opera®	BASF	3 + ESI	NR	$43.27	Non-ionic surfactant (not specified)	500 mL (wheat) $21.64	500 mL (wheat) $21.64	500–1000 mL (wheat) 500 mL (barley) $21.64–$43.27		500 mL (oats) $21.64	500 mL (wheat) $21.64		500 mL (barley) $21.64	500 mL – 1000 mL (barley) $21.64–$43.57	500 mL (wheat) 500 mL–1000 mL (barley) $21.64–$43.57	Yes
Tebuconazole 430 g/L##	Folicur®	Bayer CropScience	2	5	$16.76	1% D-C-Trate or equivalent may improve results	145 mL–290 mL (wheat)^^^ $2.43–$4.86	145 mL–290 mL (wheat & oats) $2.43–$4.86	145 mL–290 mL (wheat) $2.43–$4.86	145 mL–290 mL (oats) $2.43–$4.86	290 mL (wheat) $4.86	145 mL–290 mL (wheat) $2.43–$4.86	145 mL–290 mL (wheat) $2.43–$4.86	145 mL (barley) $4.86		145 mL–290 mL (barley) $2.43–$4.86	Yes
Tebuconazole 225 g/L + flutriafol 75 g/L	Impact Topguard®	Cheminova	2-W 10-B	7-W 10-B	$16.50	100 mL/100 L of Ospray 1000 or 1 L/100 L D-C-Trate	200 mL or 400 mL (wheat) $3.30–$6.60		200 mL or 400 mL (wheat) $3.30–$6.60		200 mL or 400 mL (wheat) $3.30–$6.60	200 mL or 400 mL (wheat) $3.30–$6.60				200 mL or 400 mL (barley) $3.30–$6.60	Yes
Tebuconazole 45 g/kg + sulfur 700 g/kg	Unicorn 745 WG	Sulphur Mills Aust. Limited	2	5	-		1.37 or 2.75 kg/ha	1.37 or 2.75 kg/ha	1.37 or 2.75 kg/ha	1.37 or 2.75 kg/ha		1.37 or 2.75 kg/ha	1.37 or 2.75 kg/ha	1.37 kg/ha		1.37 or 2.75 kg/ha	No
Triadimefon 125 g/L	Triadimefon 125 EC	Genfarm	Not stated, see footnote [$]	4	$6.22	Not required	500 mL or 1000 mL (wheat)^^^ $3.11–$6.22							1,000 mL (barley) $6.22		1,000 mL (barley) $6.22	Yes
Triadimefon 500 g/kg	Triadimefon 500WG	Cheminova	Not stated, see footnote@	4	$19.76	Not required	125 g– 250 g (wheat) $2.47–$4.82		125 g– 250 g (wheat) $2.47–$4.82		125 g– 250 g (wheat) $2.47–$4.82					250 g (barley) 125 g–250 g (wheat) $2.47–$4.82	Yes

Notes:

1 Indicative costs only: significantly Lower prices are often obtained for bulk purchases of commonly used products.
2 Body of table shows rate mL/ha, g/ha and associated cost $/ha for registered products.
3 Rate on barley is 250 mL–500 mL.
4 Propiconazole and propiconazole + tebuconazole is registered for suppression of Septoria leaf blotch in oats.
5 Spot form of net blotch.
6 Net form of net blotch only.
7 Rate on barley is 200 mL–800 mL.
8 Prosaro® 420 is registered for the control of Fusarium head blight.

Various formulations and active ingredient concentrations of propiconazole and tebuconazle are available.
@ Do not mix leaves treated with this product with feed intended for animal consumption.
$ Feed treated with this product must not be used for animal consumption, poultry feed or mixed with animal feed.
+ ESI Export slaughter interval applies. Do not slaughter animals destined for export within 7 days of consumption of treated cereal forage or straw.
NR Not required when used as directed.
^^^ i.e. Permit PER 12654, expiry 31/03/17 – Stripe rust control in triticale – use under permit, tebuconazole 430 g/L, tebuconazole 500 g/L, propiconazole 250 g/L, tridimefon 125 g/L based products, see permit for full use patterns. www.ampva.gov.au

Growers applying a foliar fungicide to control rust or other diseases need to observe the withholding period (WHP). Fungicides applied late, closer to harvest, may produce an excessive, illegal residue if applied within the WHP. For most of the fungicides registered to control diseases in winter cereals, the maximum residue Limit (MRL) is set very low, at the limit of detection. A residue above the MRL is illegal under the *Pesticides Act 1999* and renders the offender liable to prosecution and a fine. Excessive residues also put Australia's export trade at risk. If it is necessary to apply a fungicide late, select a product with a short WHP.

Canola and pulse foliar fungicides – 2015

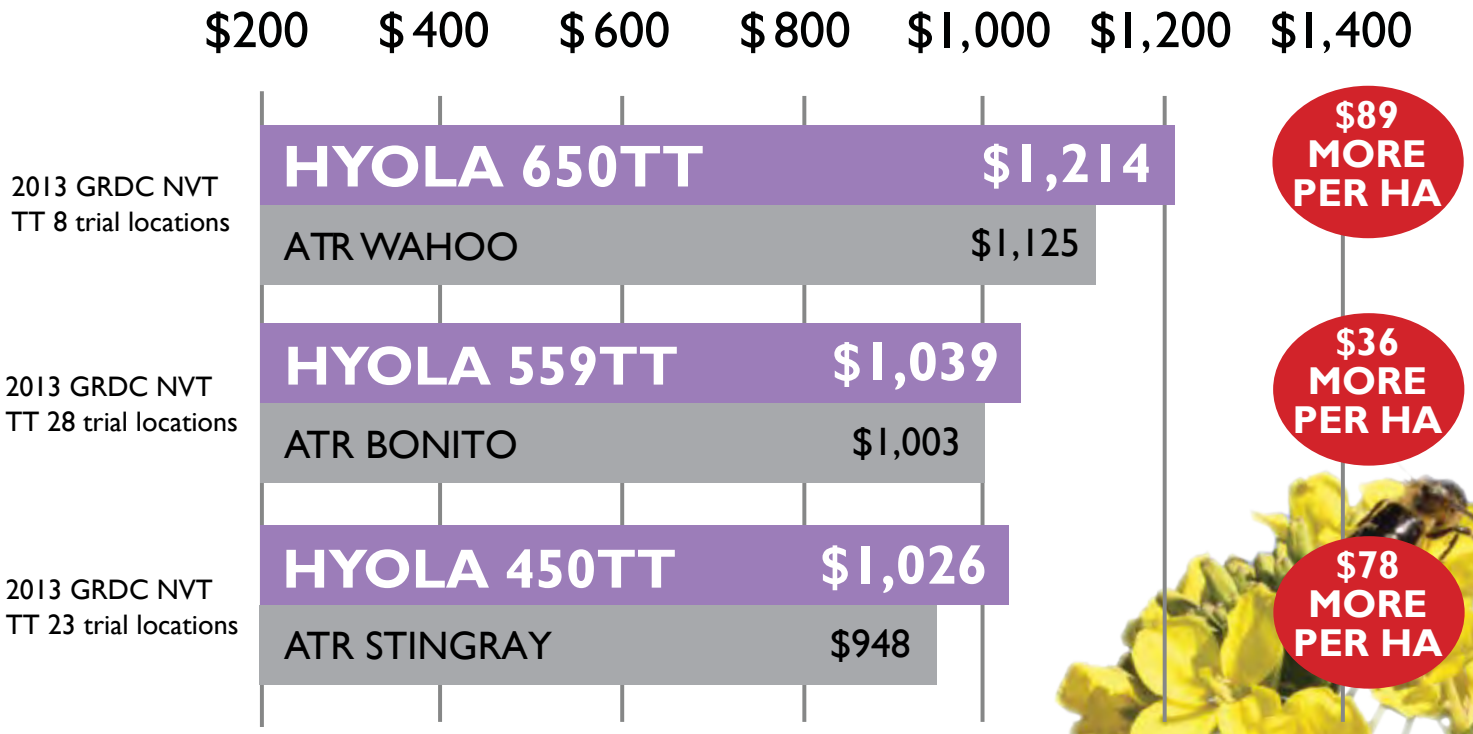
Foliar fungicides for canola, chickpea, field pea, faba bean and lupin

Example foliar fungicide trade name and manufacturer	Active ingredient	Harvest Withholding Period (WHP) – weeks/days		Rate to apply per hectare (L/ha or kg/ha)	Cost of product per Litre ($)	Size of pack (kg or L – range of pack sizes)	Canola	Chickpea	Field pea	Faba bean	Lupin
		Harvest	Grazing								
Bravo® Weather Stik – Syngenta Barrack® Betterstick – Crop Care	chlorothalonil (720 g/L)	7 days	Do not graze	1.4–2.3 L	14.50	10–100 L 5–200 L		Ascochyta blight		Chocolate spot, Rust	
Barrack® 720 – Crop Care Unite® 720 – Nufarm	chlorothalonil (720 g/L)	14 days	14 days	1.4–2.3 L (faba beans) 1.0–2.0 L (chickpeas)	14.50	5–200 L 1–1000 L		Ascochyta blight		Chocolate spot, Rust	
Echo® 900 Fungicide – Sipcam	chlorothalonil (900 g/kg)	7 days	Do not graze	1.2–1.9 kg	12.90	5–200 L				Chocolate spot, Rust	
Rovral® Liquid – Bayer CropScience Iprodione Liquid 250 – Ospray	iprodione (250 g/L)	42 days	42 days	2.0 L	15.60	2–1000 L	Sclerotinia stem rot				
Dithane® Rainshield Neo Tec Fungicide – Dow AgroSciences	mancozeb (750 g/kg)	28 days	14 days	1.0–2.2 kg	7.40	20 kg		Ascochyta blight, Botrytis grey mould	Blackspot, Ascochyta blight Botrytis grey mould, Rust	Ascochyta blight, Chocolate spot, Cercospora, Rust	Botrytis grey mould, Anthracnose
Manzate® DF – Sipcam	mancozeb (750 g/kg)	28 days	14 days	1.0–2.2 kg	7.40	20 kg		Ascochyta blight, Botrytis grey mould	Ascochyta blight, Botrytis grey mould, Blackspot, Rust	Ascochyta blight, Chocolate spot, Botrytis grey mould Black spot, Rust	Botrytis grey mould, Anthracnose
Penncozeb® 420 SC – Nufarm	mancozeb (420 g/L)	28 days	14 days	1.8–3.95 L (chickpeas) 3.5 L (faba beans)	9.90	5–1000 L		Ascochyta blight		Chocolate spot	
Polyram® DF – Nufarm	metiram (700 g/kg)	6 weeks	21 days	1.1–2.2 kg	13.35	15 kg		Ascochyta blight, Botrytis grey mould	Ascochyta blight, Botrytis grey mould, Blackspot, Rust	Ascochyta blight, Chocolate spot, Cercospora, Rust	
Fortress® 500 – Crop Care Sumisclex® Broadacre – Sumitomo	procymidone (500 g/L)	Canola not required Faba beans 9 days	9 weeks Not stated	1.0 L (canola) 0.5 L (faba bean)	47.10	1–10 L 20L	Sclerotinia stem rot			Chocolate spot	
Prosaro® 420 SC – Bayer CropScience	prothioconazole (210 g/L) + tebuconazole (210 g/L)	Not required	14 days	375–450 mL/ha	70.00	10 L	Blackleg, Sclerotinia stem rot				
Folicur® 430 SC – Bayer CropScience Hornet® – Nufarm	tebuconazole (430 g/L)	3 days PER13752 21 days	3 days PER13752 14 days	145 mL	19.25	Folicur 5–60 L Hornet 20 L			Powdery mildew	Cercospora (PER13752, expiry 30/06/16)	
Triad 125 – Adama	triadimefon (125 g/L)	14 days	Not stated	500 mL	6.00	5–1000 L			Powdery mildew		

Note: New labelling and rescheduling applies to all procymidone products. Health warnings are in place for pregnant women. Prices quoted are GST Inclusive at 15 January 2015 and approximate only. Prices will vary depending on pack size purchased.

TT HYBRIDS TOP TRIALS

CONSISTENTLY HIGHER GROSS RETURNS $/HA



Source: DATA SOURCED FROM 2013 VIC & SA AND/OR NSW GRDC NVT TT TRIALS. Varieties represented in all tables and graphs are only compared using data from identical common trial sites within the year/s referenced next to the respective bars. Varieties selected for comparisons are selected on the basis of maturity and/or adaptability and at the referenced number of locations. Assumptions: All gross return calculations are represented in $ per Ha and calculated using the published GRDC NVT Mean Yield and Oil Data for each variety. Gross returns were calculated based on a canola grain price of $500 per tonne. Oil bonification calculated on 1.5% premium or deduction for each 1% above or below 42% oil content. An EPR royalty of $5 per tonne has been applied where applicable to varieties such as ATR Bonito and ATR Wahoo. Sowing rate for hybrids 2.5kg/ha and 3kg/ha for OP varieties. A seed price of $27.50/kg for hybrids and $17.00/kg for OP varieties has been approximated.

FLEXIBLE CROPPING TECHNOLOGY

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PACIFIC SEEDS
AUSTRALIA'S HYBRID CANOLA SPECIALISTS

BMA300115

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The seed treatment that little monsters fear.

GREEN PEACH APHID (MAGNIFIED 50X)

BAYER

PONCHO® PLUS

Winter crop variety sowing guide 2015

Protect your crop above and below ground.

Even the smallest pests can create big problems for your crops. But there is one way to scare the life out of these little monsters – Poncho Plus. This innovative seed treatment protects eight crops above and below ground from eight of the worst little monsters. Tell your distributor, this year it's Poncho Plus.

Crops:	Protects against:
· Sorghum	· Wireworm
· Maize	· Cutworm
· Sweet corn	· Aphids
· Canola	· Lucerne flea
· Forage brassica	· Redlegged earth mite
· Broadleaf pasture	· Blue oat mite
· Sunflowers	· Yellowheaded cockchafer
· Grass pasture	· African black beetle

Not all pests controlled in all crops.

Bayer CropScience

Bayer SeedGrowth™
seedgrowth.bayer.com