

SECTION 2

Pre-planting

 More information

[Barley agronomy and varieties](#)

 More information

<http://www.dpi.nsw.gov.au/agriculture/broadacre/guides/winter-crop-variety-sowing-guide>

[Management effects on barley varieties - Nitrogen management and time of sowing](#)

[What's new in barley varieties for the higher rainfall cropping regions?](#)

[Getting the best from barley: agronomy and management](#)

[2015 barley variety update](#)

[Barley agronomy results 2014](#)

2.1 Varietal performance and ratings yield

2.1.1 Selecting barley varieties

When selecting a variety consider crop use, disease prevalence and herbicide tolerance.

Select a suitable variety for your planting time and area, taking into consideration yield potential and disease risks. Leaf rust, net blotches and powdery mildew are the more important diseases for which selection of resistant varieties can improve performance and reliability.

The variety chosen should be:

- appropriate for the environment
- suitable to the sowing time
- able to be segregated in the case of malting varieties ¹

Table 1: Northern region barley variety yields 2009–2011 ²

Variety	Mean yield (tonnes/hectare)
Shepherd	5.7
Oxford	5.3
Commander	5.2
Westminster	5.2
Henley	4.8
Hindmarsh	4.6
Grout	4.1
Mackay	4.0
Fitzroy	4.0
Gairdner	3.9
Grimmett	3.8

NSW DPI trials show Commander (Kate, please insert PBR symbol on both mentions) continues to perform well in northern NSW in both yield and protein

There are several new lines that are undergoing malt accreditation that are showing considerable promise in the region.

Commander and these newer lines should give growers an increased chance of achieving malt specifications through improved grain size and lower grain protein levels under higher N supply.³

¹ P Matthews, D McCaffery, L Jenkins (2014) Winter crop sowing guide 2014. NSW Department of Primary Industries, <http://www.dpi.nsw.gov.au/agriculture/broadacre/guides/winter-crop-variety-sowing-guide>

² DAFF (2013) Barley planting and disease guide, Department of Agriculture, Fisheries and Forestry Queensland, http://www.daff.qld.gov.au/_data/assets/pdf_file/0018/53019/barley-planting-disease-guide.pdf

³ GRDC (2014) Barley varieties and agronomy. <http://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2014/03/Barley-varieties-and-agronomy>

More information

See the NSW DPI 2014 trial reports:

Response of eight barley varieties to three seed and nitrogen input systems – Trangie 2013, Rohan Brill, Greg Brooke and Leigh Jenkins, page 20

Barley varieties for the north – comparing new releases, Guy McMullen and Matthew Gardner, page 22

National barley varieties– evaluating new varieties for the north, Guy McMullen and Matthew Gardner, page 27

<http://www.dpi.nsw.gov.au/agriculture/broadacre/guides/ngrt-results>

<http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2014/02/New-and-potential-malting-barley-variety-update-and-agronomic-developments>

2.1.2 Yielding ability and GRDC-funded National Variety Trials (NVT)

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

Grains industry productivity is dependent upon the continued adoption and deployment of new technologies, including the adoption of new varieties with superior yield and useful disease-resistance characteristics.

National Variety Trials (NVT) seek to collect the most relevant varieties for each region and test them alongside the elite lines from the breeding programs. For information on the released varieties in the NVT, visit the NVT website at www.nvtonline.com.au.⁴

More than 40 barley varieties are being trialled for commercial release at NVT sites from northern New South Wales (NSW) to central Queensland.

The commitment of Australian breeding companies to NVT is highlighted by the number of varieties they are entering into the 11 NVT northern region trial sites, and five companies, including InterGrain, Viterra Seeds, Seednet, Seedmark and GrainSearch, are trialling 19 varieties as part of NVT in Queensland alone.

Trials across the northern grain-growing region are testing 25 commercially released varieties and 17 unreleased lines.

The released lines being evaluated in the northern GRDC-funded trials are Fairview⁽¹⁾, Commander⁽¹⁾, Gairdner⁽¹⁾, Granger⁽¹⁾, Grimmett⁽¹⁾, Grout⁽¹⁾, Hindmarsh⁽¹⁾, Mackay⁽¹⁾, Oxford⁽¹⁾, Shepherd⁽¹⁾ and Westminster⁽¹⁾.⁵

Individual trial results from NVT provide only a snapshot in time and may lead to unsuitable varietal choice. Combining data across trials and years enhances the chance of selecting the appropriate varieties, and the current long-term analysis is based on geographic region. A new method of analysis forms environment groups from similar trials rather than geographic regions and provides the most accurate prediction of relative yield performance of varieties for an environment.⁶

⁴ NVT (2013) Queensland 2013 wheat varieties. GRDC/ Department of Agriculture, Fisheries and Forestry Queensland, <http://www.grdc.com.au/NVT-QLD-WheatVarietyGuide>

⁵ GRDC (2012) NVT tests barley varieties. GRDC Ground Cover Issue 101, Nov.-Dec. 2012, <http://www.grdc.com.au/Media-Centre/Ground-Cover/Ground-Cover-Issue-101/NVT-tests-barley-varieties>

⁶ A Kelly, A Smith, B Cullis (2013) Which variety should I grow?, GRDC Update Papers, 12 March 2013, <http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2013/03/Kelly-Alison-What-should-I-grow>

Table 2: National barley variety trial yield data summary up to 2012 (GRDC)⁷

Variety	SEQ			QLD Total		
	Yield (Kg/Ha)	% of Gairdner yield	Number of trials	Yield (Kg/Ha)	% of Gairdner yield	Number of trials
Bass	3512	95	5	3389	98	15
Binalong	3836	104	2	3515	101	8
Capstan	3501	101	4			
Commander	3981	108	6	3699	106	16
Dash	3553	102	4			
Fathom	3915	106	4	3719	107	12
Fitzroy	3642	99	6	3494	101	16
Flagship	3675	100	2	3487	100	8
Fleet	4057	110	3	3718	107	12
Flinders	3725	101	4	3484	100	12
Gairdner	3672	100	6	3465	100	20
Grimmett	3453	94	6	3288	95	20
Grout	3617	98	6	3467	100	20
Hannan	3731	101	1	3512	101	7
Henley	3939	107	6	3643	105	13
Hindmarsh	3713	101	5	3539	102	19
Kaputar	3452	99	6			
Lockyer	3946	107	2	3697	106	4
Mackay	3885	106	6	3607	104	20
Macquarie	3887	106	3	3681	106	3
Navigator	3423	93	3	3348	96	10
Oxford	4140	112	6	3790	109	16
Roe	3483	95	2	3413	98	8
Scope	3595	98	6	3395	98	12
Shepherd	3917	106	6	3627	104	20
Skiff	3820	104	2	3596	103	8
Skipper	3771	102	6	3586	103	16
Tallon	3350	96	4			
Urambie	3826	104	2	3746	108	4
Vlamingh	3642	99	2	3426	99	8
Westminster	3860	105	4	3653	105	4
Wimmera	3806	103	4	3538	102	12

For more information, see: <http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2013/03/Kelly-Alison-What-should-I-grow>

A number of GRDC apps have been developed to aid decision-making. For more information, visit: www.grdc.com.au/resources/apps.⁸

View GRDC managing director, John Harvey, discussing the *Outstanding NVT results from mixed season 2013*: <http://www.grdc.com.au/Media-Centre/GRDC-Gallery/Video/c-z5JLmf73s>

⁷ DAFF (2013) Barley planting and disease guide. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daff.qld.gov.au/_data/assets/pdf_file/0018/53019/barley-planting-disease-guide.pdf

⁸ GRDC, www.grdc.com.au/resources/apps

2.1.3 Maturity

The maturity, or length of time taken for a variety to reach flowering, depends on vernalisation, photoperiod and thermal time requirements. Recommended sowing times are arrived at by assessing the maturity of varieties in different environments and with different sowing times.

After grain-filling, the vascular system supplying the grain with water and nutrients is blocked and the grain stops growing and turns brown. This is physiological maturity. The mature barley grain comprises mainly starch (75–85%), protein (~9–12%) and water (~8–12%).

Physiological maturity occurs between 40 and 50 days after flowering. When maximum grain dry weight is achieved in the field, the loss of green colour from the glumes and peduncle is an approximate indication of physiological maturity.

A sudden decline in grain moisture occurs after physiological maturity. At ~12% moisture, the barley is ready for harvest. The current receival standards generally require delivered grain to have no more than 12.5% moisture. Storage of grain with higher moisture content is undesirable.

Barley is physiologically mature at 30–50% moisture, which is well before it is ripe enough to harvest mechanically.⁹

2.1.4 Malting and other quality traits

Malting varieties

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

WARNING: Malting barley may only be treated with phosphine, dichlorvos, fenitrothion or methoprene for insect control. Check with the end-user prior to treatment to ensure a particular pesticide is acceptable.¹⁰

Malting varieties in particular need to be planted, grown and harvested with care. Factors to take into consideration include:

Phosphorus (P):

- Too little P will limit yield and increase protein.

Nitrogen (N):

- Too little N will reduce yield and quality.
- Excessive N fertiliser can increase screenings and protein levels.

Disease:

- Appropriate and timely disease management and careful canopy management may be more important than weed control in improving the opportunity to achieve malting quality.

Timely weed control:

- Weeds compete for nutrients and moisture.
- Effective weed control reduces the risk of contamination.

⁹ DAFF (2012) Barley planting, nutrition and harvesting. Department of Agriculture, Fisheries and Forestry Queensland, <http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/barley/planting-nutrition-harvesting>

¹⁰ P Matthews, D McCaffery, L Jenkins (2014) Winter crop sowing guide 2014. NSW Department of Primary Industries, <http://www.dpi.nsw.gov.au/agriculture/broadacre/guides/winter-crop-variety-sowing-guide>

More information

http://www.daff.qld.gov.au/_data/assets/pdf_file/0018/53019/barley-planting-disease-guide.pdf

www.nvtonline.com.au

Care with harvest:

- Avoid skinning the grain.
- Try to minimise weather damage.
- Avoid varietal contamination.
- Use only grain protectants registered for malting barley.¹¹

A new commercial test developed with funding from GRDC will help growers ensure that they are growing malting barley varieties most sought after by maltsters. Malting barley varieties are increasingly more difficult to differentiate. This new test provides DNA analysis of barley seed.

For more information, visit: <http://www.graingrowers.com.au/products-services/food-industry-analysis/barley-testing>.

To listen, visit: <http://www.grdc.com.au/Media-Centre/GRDC-Podcasts/Driving-Agronomy-Podcasts/2012/03/New-Barley-Test>.

Food-grade varieties

This is a new classification introduced for the 2010 harvest by Barley Australia. Barley varieties will need to meet all of the physical quality parameters that apply to accredited malting barleys, such as protein, test weight, screenings and retention, before they can be accepted into Food Barley segregations. This classification was developed to accommodate Hindmarsh, a variety developed to supply maltsters but which failed to gain malting accreditation.

Feed varieties

NSW Feed Barley No. 1: These are 2-row varieties with white aleurone layer only.¹²

2.1.5 Other varietal traits

A coordinated disease assessment process was implemented for barley in 2012. Greg Platz, principal pathologist at Agri-Science Queensland, co-ordinates this project, following the model established for wheat.

Across Australia, a network of 11 pathologists and technicians gather data on 15 diseases of barley. For some of these diseases, such as leaf rust and net form of net blotch, at least six different pathotypes are used, providing a comprehensive evaluation of resistance.

The protocols for seed distribution, data collection and reporting mirror those used in the wheat disease-screening project, although on a smaller scale. There are only 19 NVT lines and 48 released barley varieties (commonly referred to as the AUSBAR set) in the 2012 series.

Nationally coordinated NVT disease-screenings provide a comparative evaluation of a line's performance under different environments and disease epidemics, giving increased confidence to the disease ratings applied to new varieties. This assists growers in their varietal selection and management decisions and encourages breeding entities to develop varieties with adequate multiple-disease resistance.¹³

More information

http://www.dpi.nsw.gov.au/_data/assets/pdf_file/0011/272945/winter-crop-variety-sowing-guide-2015.pdf

¹¹ P Matthews, D McCaffery, L Jenkins (2014) Winter crop sowing guide 2014. NSW Department of Primary Industries, <http://www.dpi.nsw.gov.au/agriculture/broadacre/guides/winter-crop-variety-sowing-guide>

¹² P Matthews, D McCaffery, L Jenkins (2014) Winter crop sowing guide 2014. NSW Department of Primary Industries, <http://www.dpi.nsw.gov.au/agriculture/broadacre/guides/winter-crop-variety-sowing-guide>

¹³ G Hollaway, G Platz (2012) Coordinated disease management. National Variety Trials supplement. GRDC Ground Cover Issue 101, <http://www.grdc.com.au/Media-Centre/Ground-Cover-Supplements/%7E/link.aspx?id=5D5E733823CC402E9F0950A9EB1FF9F9&z=z>

2.1.6 Varieties

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 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 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 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.

Commander 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 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 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 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 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 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^(b) 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 3–4cm taller than Gairdner, but with better lodging resistance; higher test weight; a potentially larger kernel size (2–4grams/1000grains); 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^(b) 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^(b) 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^(b) 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^(b) 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^(b) 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^(b) 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^(b) 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^(b) 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. Susceptible to loose smut – use a seed dressing. Tulla^(b) Feed. Main season variety. Acid soil tolerant. Similar yields to Tantangara on non-acid soils. Bred by NSW DPI. Waratah Seeds.

Urambie^(b) 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^(b) 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:

Admiral^(b) 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 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 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 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 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 (SMB11-1771) 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 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 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 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 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.¹⁴

For more information on varietal performance, visit:

www.nvtonline.com.au

¹⁴ NSW DPI (2015) Winter crop variety sowing guide 2015: http://www.dpi.nsw.gov.au/_data/assets/pdf/file/0011/272945/winter-crop-variety-sowing-guide-2015.pdf

<http://www.dpi.nsw.gov.au/agriculture/broadacre/guides/winter-crop-variety-sowing-guide>

<http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/barley/planting-disease-guide>

<http://www.barleyaustralia.com.au/barley-varieties-handbook>

2.2 Planting seed quality

2.2.1 Seed size

Early seedling growth relies on stored energy reserves in the seed. Good seedling establishment is more likely if seed is undamaged by insects or harvesting, is stored at suitable temperatures and moisture conditions, and comes from a plant that had adequate nutrition during its growth and grain-filling period. Seed size is also important. The larger the seed, the greater are the endosperm and starch reserves. So, although seed size does not alter germination, bigger seeds have faster seedling growth, higher numbers of fertile tillers per plant, and potentially higher grain yields. Research by Neil Fettel at Condobolin in 2008 showed that whereas small seed (25.64 g/1000 seeds) had emergence equal to 90% of that of large seeds (41.31 g/1000 seeds) when sown at 44 mm depth, emergence dropped to 67% when sown at 87 mm, and 53% when sown deep (at 112 mm).

Seed size is usually measured by weighing 1000 grains. This is known as the 1000-grain weight. The 1000-grain weights vary among varieties and from season to season. Sowing rate needs to vary according to the 1000-grain weight for each variety, and each season, in order to achieve desired plant densities. Seed grading is an effective way to separate good -quality seed of uniform size from small or damaged seeds and other impurities.¹⁵

2.2.2 Seed germination and vigour

Seed germination and vigour are highly influential to establishment and yield potential.

Germination begins when the seed absorbs water and ends with the appearance of the radicle. It has three phases:

- water absorption (imbibition)
- activation
- visible germination¹⁶

Seed vigour includes the properties of the seed that determine the level of activity and performance of the seed or seed lot during germination and seedling emergence. In any seed lot, losses of seed vigour are related to a reduced ability of seeds to carry out all of the physiological functions that allow them to perform.

This process, called physiological ageing (or deterioration), starts before harvest and continues during harvest, processing and storage. It progressively reduces performance capabilities due to changes in cell-membrane integrity, enzyme activity and protein synthesis. These biochemical changes can occur very quickly or more slowly—from a few days to a few years—depending on genetic, production and environmental factors not yet fully understood. The end-point of this deterioration is death of the seed, i.e. complete loss of germination.

¹⁵ Industry & Investment NSW Agronomists (2010) Barley growth & development, PROCROP Series, Industry & Investment NSW, 2010. http://www.dpi.nsw.gov.au/data/assets/pdf_file/0003/516180/Procrop-barley-growth-and-development.pdf

¹⁶ Industry & Investment NSW Agronomists (2010) Barley growth & development, PROCROP Series, Industry & Investment NSW, 2010. http://www.dpi.nsw.gov.au/data/assets/pdf_file/0003/516180/Procrop-barley-growth-and-development.pdf

However, seeds lose vigour before they lose the ability to germinate. That is why seed lots that have similar high germination values can differ in their physiological age (the extent of deterioration) and so differ in seed vigour and therefore the ability to perform.¹⁷

When purchasing seed request a copy of the germination and vigour analysis certificate from your supplier. For seed stored on farm you can send to a laboratory for analysis.

While a laboratory seed test for germination should be carried out before seeding to calculate seeding rates, a simple, on-farm test can be done in soil at harvest and during storage:

- Use a flat, shallow seeding tray (about 5 cm deep). Place a sheet of newspaper on the base to cover drainage holes and fill with clean sand, potting mix or freely draining soil. Ideally, the test should be done indoors at a temperature of about 20°C or lower.
- Alternatively, lay a well-rinsed plastic milk container on its side and cut a window in it, place unbleached paper towels or cotton wool in the container and lay out the seeds. Moisten and place on a window-sill. Keep moist and count as per the method outlined below.
- Randomly count out 100 seeds. Do not discard damaged ones and sow 10 rows of 10 seeds at the correct seeding depth. This can be achieved by placing the seed on the smoothed soil surface and pushing in with a pencil marked to the required depth. Cover with a little more sand/soil and water gently.
- Keep soil moist but not wet, as overwatering will result in fungal growth and possible rotting.
- After 7–10 days, the majority of viable seeds will have emerged.
- Count only normal, healthy seedlings. If you count 78 normal vigorous seedlings, the germination percentage is 78%.
- Germination of 80% is considered acceptable for cereals.
- The results from a laboratory seed germination test should be used in calculating seeding rates.¹⁸

For more information on factors affecting germination, see [Section 4: Plant growth and physiology](#).

Disease

Grain retained for seed from a wet harvest is more likely to be infected with seed-borne disease. It is also more likely to suffer physical damage during handling, increasing the potential for disease.

Seed-borne disease generally cannot be identified from visual inspection, so requires laboratory testing. Once a satisfactory germination percentage is known, seed should be tested for diseases including Fusarium head blight.

2.2.3 Seed storage

Barley is more susceptible to insect damage than many grains. Germination can be affected by grain temperature, grain-moisture content and insect infestation.

Generally, high grain temperatures and high grain-moisture content can cause low germination (< 95%). Insect infestation can have a similar effect. Ideally, malting barley would be kept free of insects, in aerated storage at grain temperatures of 10°–20°C with a moisture content <10.5%. However, this is not generally practical and being aware of the interaction between moisture and temperature is important (Table 3).

At 20°–30°C, short–medium-term storage presents some risk but once the temperature of the grain exceeds 30°C, germination is likely to be affected. Temperatures

¹⁷ ISTA Vigour Test Committee, Understanding Seed Vigour, International Seed Testing Association, 1995

¹⁸ GRDC (2011) Retaining seed: Saving weather damaged grain for seed. GRDC Fact Sheet, Jan. 2011, http://storedgrain.com.au/wp-content/uploads/2013/06/GRDC_FS_RetainingSeed2.pdf

More information

GRDC Ground Cover Article:

<http://www.grdc.com.au/Media-Centre/Ground-Cover/Ground-Cover-Issue-98-May-June-2012/Seedborne-Fusarium-tests-crown-rot-strategies>

significantly above 30°C will cause grain to become non-viable. This is why germination and vigour-testing prior to planting in the northern region is so important.

This applies for drying grain that is required to maintain its germination for malting purposes or as a seed crop. It should be dried slowly at low temperatures.

The moisture of grain in storage will affect its ability to maintain quality over time. The lower the grain moisture, the more stable its storage ability. In practical terms, it is more economical to store grain at ~12% moisture content.¹⁹

Table 3: An indication of the interaction between moisture and temperature

Barley moisture %	Storage temperature	Potential storage period
<10.5	10°–20°C	Very long, 12–18 months
	20°–30°C	Moderate, 6 months
	>30°C	Short, 3 months
10.5–>11.5	10°–20°C	Long, 12 months
	20°–30°C	Moderate, 6 months
	>30°C	Short, 3 months
11.5–>12.5	10°–20°C	Moderate, 6 months
	20°–30°C	Short, 3 months
	>30°C	Very short, <3months
>12.5	10oC-20oC	Short, 3 months
	20°–30°C	Very short, <3 months
	>30°C	Perhaps, 1 month

A seed is a living organism that releases moisture as it respire. The aim of seed storage is to preserve the viability of the seed for future sowing. Four issues need to be considered: temperature, moisture, aeration and pests. The following are required:

- Temperature <15°C. High temperatures can quickly damage seed germination and quality.
- Moisture <12%. Temperature changes cause air movements inside the silo that carry moisture to the coolest parts of the silo. Moisture is carried upwards by convection currents in the air created by the temperature difference between the warm seed in the centre of the silo and the cool silo walls, or *vice versa*. Moisture carried into the silo headspace may condense and fall back as free water, causing a ring of seed to germinate against the silo wall.
- Aeration slows the rate of deterioration of seed if the moisture content is kept at 12.5–14%. Aeration markedly reduces grain temperature and evens out temperature differences that cause moisture movement.
- Pest management. Temperature <15°C stops all major grain insect pests from breeding, slowing down their activity and resulting in less damage.²⁰

2.2.4 Safe rates of fertiliser sown with the seed

Crop species differ in tolerance to nitrogen fertiliser when applied with the seed at sowing. Recent research funded by Incitec Fertilisers has shown that the tolerance of the crop species to ammonium fertilisers placed with the seed at sowing is related to the fertiliser product (ammonia potential and osmotic potential), the application rate and to soil characteristics such as moisture content.

¹⁹ DAFF (2012) Barley planting, nutrition and harvesting. Department of Agriculture, Fisheries and Forestry Queensland, <http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/barley/planting-nutrition-harvesting>

²⁰ Industry & Investment NSW Agronomists (2010) Barley growth & development. PROCROP Series, Industry & Investment NSW, 2010. http://www.dpi.nsw.gov.au/data/assets/pdf_file/0003/516180/Procrop-barley-growth-and-development.pdf

Generally, the range of tolerance between crop species indicated in Table 4 does not appear to be large enough to recommend an increase the rates from those already suggested in fertiliser handbooks and similar publications. However, the data in the table do indicate the crop species where extra caution may be required when ammonium fertilisers are applied near the seed.

Table 4: Ranking of crop species establishment in their response to ammonia/ammonium applied in close proximity to the seed

	Germination	Root length	Shoot length
Winter crop species			
Barley	2	2	3
Canary seed	4	4	2
Canola	5	5	-
Chickpeas	1	1	-
Wheat	3	3	1
Summer crop species			
Cotton	5	2	-
Maize	1	1	1
Panicum (birdseed)	4	4	3
Sorghum	2	3	2
Sunflower	3	5	-

(1 = relatively most tolerant, 6 = relatively least tolerant)

With the advances in understanding of the interaction of fertiliser and seed establishment in recent years, and the improved technology in sowing implements, the fertiliser application rate and its interaction with the soil environment is still the prime determinant of crop establishment in most years.

For individual sites and in individual years, modest modifications to application rates according to crop species may be advised given the extra information now available. The safest application method for high rates of fertilisers with high ammonium content is to place them away from the seed by physical separation (combined N-P products) or by pre- or post-plant application (straight N products). For fertilisers with lower ammonium content, e.g. MAP, close adherence to the safe rate limits set for the crop species and the soil type is advised.²¹

High rates of nitrogen fertiliser applied at planting in contact with, or close to, the seed will severely damage seedling emergence. If high rates of nitrogen are required, then it should be applied pre-planting or applied at planting but not in contact with the seed (i.e. banded between and below sowing rows). Table 5 indicates the maximum rates of fertilisers containing nitrogen that may be applied with the seed at planting using conventional planting equipment. Rates should be reduced by 50% for very sandy soil and may be increased by 30% for heavy-textured soils or if soil moisture conditions at planting are excellent. Rates should be reduced by 50% when planting equipment with narrow disc or tine openers are used, as the fertiliser concentration is increased around the seed.²²

Table 5: Safe rates (kg/ha) to apply some nitrogen fertilisers with seed at planting (DAP, di-ammonium phosphate; MAP, mono ammonium phosphate)

Row spacing (cm)	N	Urea	DAP	MAP Starterfos®
18	25	54	130	200
25	18	39	90	138
50	9	20	45	69
75	6	13	30	46

Contact your agronomist or fertiliser supplier for other details on other blends.

²¹ Incitec Pivot Fertilisers (2014) Big N, nitrogen fertiliser placement and crop establishment. Incitec Pivot, Ltd <http://bign.com.au/Big%20N%20Benefits/Nitrogen%20Fertiliser%20Placement%20and%20Crop%20Establishment>

²² DAFF (2012) Wheat—nutrition. Department of Agriculture, Fisheries and Forestry Queensland, <http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/wheat/nutrition>