SECTION 2

Pre-planting

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]

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 those of 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 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. [2]

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. [3]

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

More information FAQ

GRDC Update Papers: Using crop competition for weed control in barley and wheat

GRDC Update Papers: New and potential malting barley variety update and agronomic developments

GRDC Update Papers: Barley agronomy results 2014

GRDC: Crop Variety Guides

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

3 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

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 rapid 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. [4]

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 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.

For more information, see: Barley Australia: Preferred varieties list

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 that a particular pesticide is acceptable. [5]

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, whereas excessive N fertiliser can increase screenings and protein levels.
- Disease. Appropriate and timely disease management and careful canopy management can improve the chance of achieving malting quality.
- Timely weed control. Weeds compete for nutrients and moisture; effective weed control reduces the risk of contamination.
- Care with harvest. Avoid skinning the grain; try to minimise weather damage; avoid varietal contamination; use only grain protectants registered for malting barley. [6]

[4] DAF Qld (2012) Barley planting, nutrition and harvesting. Department of Agriculture and Fisheries Queensland, http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/barley/planting-nutrition-harvesting

[5] P Matthews, D McCaffery, L Jenkins (2015) Winter crop sowing guide 2014. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/broadacre/guides/winter-crop-variety-sowing-guide

[6] P Matthews, D McCaffery, L Jenkins (2015) Winter crop sowing guide 2014. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/broadacre/guides/winter-crop-variety-sowing-guide

Malting barley purity test

Australia's barley industry has a global reputation as a producer of high-quality malting barley. From a trade perspective it is an enviable reputation, so the GRDC and Diversity Arrays Technology (DArT), one of the world's leading crop DNA profiling laboratories, devised a malting barley variety purity test that will ensure our reputation is maintained.

More information

GRDC Driving Agronomy Podcasts: New barley test.

The commercial test, developed with funding from GRDC, helps growers to ensure that they are growing malting barley varieties most sought after by maltsters. Malting barley varieties are increasingly more difficult to differentiate. GrainGrowers collaborated with the GRDC and DArT to deliver the DNA test, which is capable of identifying even low levels of contamination. The test can determine how pure your variety is and which other varieties may be present in a sample. For more information, visit: GrainGrowers Products and Services—Barley testing.

Food-grade varieties

This is a classification introduced for the 2010 harvest by Barley Australia. Barley varieties 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

Feed accredited varieties include any 2-row varieties with white aleurone layer. [7],[8]

2.1.5 Other varietal traits

Disease ranking for barley lines and cultivars in NVT is now carried out independently through nationally coordinated projects. A disease-assessment process was implemented for barley in 2012, following the model established for wheat.

Greg Platz, of Agri-Science Queensland, co-ordinates this project, and pathologists and technicians across Australia 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 were 19 NVT

[7] P Matthews, D McCaffery, L Jenkins (2015) Winter crop sowing guide 2014. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/broadacre/guides/winter-crop-variety-sowing-guide

[8] GTA (2013) Barley standards. 2013/2014 season. Grain trade Australia, http://www.graintrade.org.au/sites/default/files/file/Commodity%20Standards/2013_2014/Section%2002%20-%20Barley%20Standards%20201314%20Final.pdf

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. [9]

Frost ratings

Grain growers and their advisors will soon be able to reference Frost Susceptibility Ratings for many varieties of wheat and barley. The ratings are an outcome of the Australian National Frost Program, part of GRDC's Frost Initiative. For more information, see GrowNotes Barley South Section 14. Environmental issues.

2.1.6 Varieties

Admiral(ᵇ): New malting barley developed by Joe White Maltings and the University of Adelaide. It is a semi-dwarf variety with stiff straw and maturity slightly later than Gairdner, hence is suited to environments with high yield potential. Offers good resistance to net form net blotch, powdery mildew, leaf rust, and cereal cyst nematode (CCN), but is susceptible to spot form of net blotch. Can be grown under production contracts for supply to AWB and Joe White Maltings.

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

Bass(ᵇ): Malting. Baudin(ᵇ) replacement with excellent grain plumpness and high test weights, suited to districts of medium to higher rainfall. Similar maturity to Baudin(ᵇ). Moderately short variety with good straw strength and head retention. Improved disease resistance compared with Baudin(ᵇ). Restricted segregations likely. (InterGrain)

Baudin(ᵇ): Malting. 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. Susceptible to spot form of net blotch, very susceptible to powdery mildew and leaf rust. Released by the Department of Agriculture and Food Western Australia (DAFWA) in 2002. (Seednet)

[9] 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

Binalong: Feed. Good straw strength and high yield potential in the north. Medium–slow maturity. Moderate grain size. Resistant to powdery mildew. Very susceptible to net form of net blotch and susceptible to spot form of net blotch, leaf scald and leaf rust. Bred by NSW Department of Primary Industries (DPI). (Heritage Seeds)

Buloke(Þ): Malting. Excellent malting quality for export market. Tall, early–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 CCN, moderately susceptible to leaf scald and susceptible–very susceptible to leaf rust. Grain size bigger than Gairdner but smaller than that of the benchmark variety, Schooner. Exhibits sprouting tolerance similar to Gairdner and better head retention than Schooner. May lodge under conditions favouring high yield. Bred by Department of Primary Industries Victoria (DPI Vic.). (Seednet)

Capstan(Þ): Feed. Very short variety, resistant to CCN, with outstanding straw strength and head retention. Best suited to high-input farming systems targeting very high yield. Also 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. (Viterra)

Charger(Þ) (CA412402): 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 very susceptible to net form of net blotch and leaf scald. Has shown consistently high grain yield particularly in favourable environments. Contract production is exclusively managed by Australian Grain Growers Cooperative.

Commander(Þ): Malting. Malting quality variety with maturity between Schooner and Gairdner. Plump grain size compared with other malting varieties. High yield potential and lower grain protein than Schooner and Gairdner when grown under the same conditions. Resistant to CCN but susceptible to scald. May lodge under early-sown conditions. Developed by the University of Adelaide. (Viterra)

Compass(Þ) (WI4593): Developed by the University of Adelaide as an early–mid-season maturing, potential malting-quality variety. Expected to complete Barley Australia malt accreditation 2018. Closely related to Commander but significantly higher yielding based on 2012 and 2013 NVT data in South Australia and 2009–15 data in the Mallee, Victoria. Similar growth habit to Commander but earlier flowering, with superior straw strength, lodging resistance and net form of net blotch resistance. Has previously shown good resistance to leaf rust but has shown susceptibility to a strain with virulence on the *Rph3* gene. Has shown good physical grain quality with high retention and low screenings and moderate test weight. Seed available from Seednet.

Fairview(Þ): Malting. A mid–late-season variety available only under contract to Malteurop. Better straw strength and grain size than Gairdner, it has performed particularly well under irrigation. Has an export malt quality profile.

Fathom(Þ): Feed. Fathom is a feed-quality variety developed using wild barley to improve stress tolerance and water-use efficiency. Has a long coleoptile, good early vigour and with early maturity similar to Hindmarsh(Þ), is best suited to lower and medium-rainfall environments. Moderately tall variety but shows good straw strength and excellent grain plumpness with screenings levels lower than both Fleet(Þ) and Hindmarsh(Þ). Developed by the University of Adelaide. (Viterra)

Finniss(Þ): A hull-less barley released in 2009. Semi-dwarf type with a mid-maturity similar to Schooner. Good straw strength and head retention, resistance to CCN, leaf rust and scald. Very susceptible to powdery mildew. The agronomic improvements of Finniss(Þ) over current hull-less varieties is expected to improve the economic viability of hull-less barley production significantly for use in intensive livestock and niche human-food applications. (Viterra)

Fitzroy(Þ): Malting. Medium-maturing to medium–late-maturing variety with improved disease resistance over Gairdner and acceptable grain size. Semi-dwarf plant with good

seedling vigour, medium height and good straw strength. Best suited to northern New South Wales and Queensland barley-growing areas. Best results will be achieved in more favourable environments. Can exhibit low test weights under stressed conditions. (Seednet)

Flagship(Þ): Malting. Good malting qualities, particularly for South East 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 CCN and *Pratylenchus neglectus*. Prone to pre-harvest weather damage. (Heritage Seeds)

Fleet(Þ): Feed. Tall, early–mid-season variety resistant to CCN. Exhibits a good disease-resistance profile and good physical grain quality. May lodge under high-yielding conditions. Developed by the University of Adelaide. (Viterra and the Australian Field Crops Association)

Flinders(Þ): Malting. A moderately late-maturing variety. Moderately short with stiff, strong straw and good head retention. It has high levels of grain plumpness and good test weights. Susceptible to leaf scald, spot form of net blotch and net form of net blotch, resistant—moderately resistant to powdery mildew and moderately susceptible to leaf rust. Although not as high-yielding as the earlier maturing LaTrobe(Þ) or Compass (Þ), Flinders(Þ) offers a replacement for Baudin(Þ) and Gairdner with a longer season option and will be available pending final malt accreditation. Developed by InterGrain. Released 2012. Seed available from Syngenta. EPR $3.80.

Gairdner: Malting. Adapted to areas of medium to higher rainfall (>400 mm). Mid–late-season maturity and strong straw. Best sown early. Gairdner has a thin grain, producing significantly greater screenings losses than Schooner and is ~1% lower in grain protein. Resistant to *Barley yellow dwarf virus* (BYDV). Susceptible–very susceptible to the spot form of net blotch and susceptible to CCN. Developed by DAFWA. (Heritage Seeds)

Grange: Malting. A medium–late, high-yielding, broadly adapted barley with excellent malt extract and good diastatic power. Targeted for the domestic malting industry as a potential Gairdner replacement. Performs better than Oxford under late planting. On average 10 cm taller than Baudin(Þ) and 3–4 cm taller than Gairdner, but with better, larger kernel size (2–4 g/1000 grains) and lower screenings. Resistant to powdery mildew and resistant–moderately resistant to leaf rust. Variable reaction to net form of net blotch, depending on pathotype present, and susceptible to spot form of net blotch. Susceptible–moderately susceptible to barley scald, depending on region. Licensed to Heritage Seeds by Nickerson-Limagrain, UK.

Granger(Þ): A mid–late-maturing variety with strong straw, and good kernel plumpness and low screenings. Moderately susceptible–susceptible to leaf scald, moderately susceptible to spot form of net blotch, moderately resistant–moderately susceptible to net form of net blotch, resistant to powdery mildew and moderately resistant to leaf rust. Accredited as malting barley in 2013, export markets are being established and growers are advised to consult with their grain marketer about segregation and pricing. Released 2013. Tested as SMBA09-3353. Licenced by Limagrain and seed available from Heritage Seeds. EPR $2.95.

Grimmett(Þ): Malting. 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(Þ): Feed. Quick-maturing variety with good grain size, suited to northern New South Wales and Queensland. Matures up to 2 weeks earlier than Grimmett(Þ) from a mid-May to mid-June planting. Vigorous seedling with a high tillering ability and erect growth habit. Medium height with moderate standability, better than Grimmett (Þ) and similar to Mackay(Þ). Good resistance to powdery mildew. Leaf rust needs to be managed, rated as very susceptible. (Seednet)

Hindmarsh(Þ): Food. Erect, semi-dwarf variety. 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. Resistant to CCN and moderately resistant–moderately susceptible to net form of net blotch. Very susceptible to spot form of net blotch and susceptible–moderately susceptible to leaf rust. Variable response to leaf scald, depending on the pathotype present. Short coleoptile, so deep sowing should be avoided. Has been given a new classification (food) and may be segregated for human food and possibly used for shōchū (Japanese distilled spirit) and for malt production in some markets. Developed by DPI Vic. (Seednet)

Keel: Early-flowering, high-yielding, feed-quality variety released in 1999. Now generally outclassed by Hindmarsh(Þ), Fathom(Þ) and Fleet(Þ) in South Australia. Very susceptible to leaf rust and, in recent years, susceptible to net form net blotch, further detracting from this once very popular variety.

LaTrobe(Þ) (IGB1101): Malting. Early-maturing semi-dwarf variety with growth habit and plant architecture very similar to Hindmarsh(Þ). Agronomic performance has also been similar to Hindmarsh(Þ). Resistant to CCN and net form of net blotch but susceptible to spot form of net blotch like Hindmarsh(Þ). Seed available from Intergrain Pty Ltd.

Mackay(Þ): 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, depending on the pathotype present. Susceptible–very susceptible to spot form of net blotch. Partially resistant to common root rot. Bred by Department of Agriculture and Fisheries Queensland. (Heritage Seeds)

Maritime(Þ): Tall, early-maturing feed variety with CCN resistance released by the University of Adelaide in 2004. Developed specifically for manganese-deficient soils where it exhibits good adaptation. Moderate to high yield potential on other soil types, and did offer a good disease resistance profile but now very susceptible to net form net blotch. Excellent physical grain quality and early vigour, and a good option for lower rainfall environments where tall straw and high test weights are sought but in areas of low risk of net form of net blotch. Seed available through Seednet.

Navigator(Þ): Malting. A semi-dwarf variety suited to the domestic malt market. Similar in maturity to Gairdner but offers shorter straw, better physical grain quality and higher yield. Recommended for medium–high-rainfall areas. Good resistance to CCN, spot form of net blotch and net form of net blotch, and strong resistance to scald. Good resistance to lodging. Very susceptible to leaf rust. Bred by the University of Adelaide. (Viterra)

Oxford: Feed. A medium–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 to net form of net blotch and susceptible to spot form of net blotch. (Heritage Seeds)

Schooner: Malting. 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 head loss. Susceptible to powdery mildew and susceptible–very susceptible to leaf rust and showing increasing susceptibility to leaf scald.

Scope CL(Þ): Malting. Imidazolinone-tolerant barley with tolerance to label rates of Intervix® herbicide. Check current herbicide registrations for registered product rates. Tall, early–mid-season variety with a flowering time similar to Buloke(Þ). Resistant to powdery mildew and moderately resistant to net form of net blotch but susceptible to CCN. Developed by Agriculture Victoria and Seednet.

Shepherd(Þ): Feed. Slightly later maturing than Grout(Þ) but similar in growth habit with erect vigorous early growth. Suited to medium-rainfall areas of northern New South Wales and Queensland. Moderately resistant to leaf rust and with variable response to powdery mildew and net form of net blotch, depending on the pathotype present. Susceptible–very susceptible to spot form of net blotch. (Seednet)

SouthernStar(Þ): New malting barley developed by Sapporo Breweries and the University of Adelaide. Based on Flagship(Þ) and incorporates a patented novel gene

for improved beer quality. Has almost identical agronomic characteristics to Flagship ⓟ with good early vigour, CCN resistance and a strong foliar disease resistance profile. Has sensitivity to sprouting so timely harvest must be a priority. Can be grown under production contracts for supply to Barrett Burston Maltings and Joe White Maltings.

SY Rattlerⓟ: High-yielding, mid-maturity, potential malting barley with medium height and stiff straw. Good resistance to scald, powdery mildew and barley leaf rust; useful resistance to net form of net blotch. Coupled with excellent grain quality, SY Rattler has all the necessary attributes for the domestic brewing markets. Currently progressing through Barley Australia Malt Accreditation with a target accreditation date of 2017. Bred by Syngenta and seed 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. Moderately resistant to net blotch but susceptible to powdery mildew. Susceptible to loose smut—use a seed dressing.

Tullaⓟ: Feed. Main-season variety. Tolerant of acid soil. Similar yields to Tantangara on non-acid soils. Moderate resistance to leaf scald. Bred by NSW DPI. (Waratah Seeds)

Urambieⓟ: 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–mid-June, earlier if grazed. Consistent yields across seasons but low grain quality. Resistant to leaf scald and net form of net blotch. (Waratah Seeds)

Vlamingh ⓟ: Malting. Mid-season maturity between Schooner and Gairdner. Erect early growth and moderately tall. Grain plumpness is better than Gairdner. Best suited to high- and medium-rainfall zones. Good resistance to net form of net blotch. Confirm marketing arrangement for Vlamingh before planting. Released by the DAFWA. (Viterra)

Westminsterⓟ: Malting. A medium–late-maturity variety similar to Gairdner. Has exceptionally high yield potential and performs well under high-rainfall or irrigated conditions. Medium–tall variety with good straw strength and improved head retention compared to Gairdner. Good all-round disease resistance. Introduced malting barley from Nickerson International Research, licensed to GrainSearch in Australia.

Wimmeraⓟ: Malting. Mid–late-maturing variety with similar plant architecture to Gairdner. However, it has significantly higher yield potential and better physical grain quality. Wimmeraⓟ showed resistance to leaf rust until a new strain to which it is susceptible emerged in 2011. (Viterra) [10]

New releases from InterGrain are Rosalindⓟ (feed) and IGB1334Tⓟ (imidazolinone-tolerant, undergoing malt accreditation).

More information

National Variety Trial Results

Barley Australia: 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 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 Fettell 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).

[10] P Matthews, D McCaffery, L Jenkins (2015) 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

GRDC Media Centre: Select the best when saving seed for next years crops

Seed size is usually measured by weighing 1000 grains. This is known as the 1000-grain weight. The 1000-grain weight varies 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. [11]

2.2.2 Seed germination and vigour

Seed germination and vigour are highly influential for 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 germination [12]

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 through 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 fully understood. The end-point of this deterioration is death of the seed, i.e. complete loss of germination.

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. [13]

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.

A laboratory seed test for germination should be carried out before seeding to calculate seeding rates; however, 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 ~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 or soil and water gently.

[11] N Fettell, P Bowden, T McNee, N Border (2010) Barley growth & development. PROCROP Series. Industry & Investment NSW/NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0003/516180/Procrop-barley-growth-and-development.pdf

[12] N Fettell, P Bowden, T McNee, N Border (2010) Barley growth & development. PROCROP Series. Industry & Investment NSW/NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0003/516180/Procrop-barley-growth-and-development.pdf

[13] ISTA Vigour Test Committee (1995) Understanding seed vigour. International Seed Testing Association, https://www.seedtest.org/upload/prj/product/UnderstandingSeedVigourPamphlet.pdf

- Keep soil moist but not wet; 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. [14]

For more information on factors affecting germination, see GrowNotes Barley South 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 it is important to be aware of the interaction between moisture and temperature (Table 1).

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 significantly above 30°C will cause grain to become non-viable.

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. [15]

[14] GRDC (2011): Saving weather damaged grain for seed. Northern and Southern Regions. Retaining Seed Fact Sheet, GRDC Jan. 2011, http://storedgrain.com.au/wp-content/uploads/2013/06/GRDC_FS_RetainingSeed2.pdf

[15] DAF Qld (2012) Barley planting, nutrition and harvesting. Department of Agriculture and Fisheries Queensland, http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/barley/planting-nutrition-harvesting

Table 1: 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	10°–20°C	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 respires. 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 their activity and resulting in less damage. [16]

2.2.4 Safe rates of fertiliser sown with the seed

Crop species differ in tolerance to N fertiliser when applied with the seed at sowing. 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 soil characteristics such as moisture content.

Generally, the range of tolerance between crop species indicated in Table 2 does not appear to be large enough to recommend an increase in the rates from those already suggested in fertiliser handbooks and similar publications. However, the data do indicate the crop where extra caution may be required when ammonium fertilisers are applied near the seed.

[16] N Fettell, P Bowden, T McNee, N Border (2010) Barley growth & development. PROCROP Series. Industry & Investment NSW/NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0003/516180/Procrop-barley-growth-and-development.pdf

Table 2: Ranking of crop species establishment in their response (1, most tolerant; 6, least tolerant) to ammonia/ammonium applied in close proximity to the seed

Winter crop species	Germination	Root length	Shoot length
Barley	2	2	3
Canary seed	4	4	2
Canola	5	5	–
Chickpeas	1	1	–
Wheat	3	3	1

With recent advances in understanding of the interaction of fertiliser and seed establishment, and the improved technology of sowing implements, the fertiliser application rate and its interaction with the soil environment remain 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 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. mono-ammonium phosphate (MAP)), close adherence to the safe rate limits set for the crop species and the soil type is advised. [17]

High rates of N fertiliser applied at planting in contact with, or close to, the seed will severely damage seedling emergence. If high rates of N 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 3 indicates the maximum rates of fertilisers containing N 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, because the fertiliser concentration is increased around the seed. [18]

Table 3: Safe rates (kg/ha) of application of 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 details on other blends.

More information

GRDC Update Papers: Pushing the production barriers

GRDC Update Papers: Local research highlights

GRDC Update Papers: Key outcomes arising from the crop sequence project

GCTV15: Dual purpose wheat spin

[17] 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

[18] DAF Qld (2012) Wheat—nutrition. Department of Agriculture and Fisheries Queensland, http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/wheat/nutrition