BARLEY

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Introduction

The barley section of this variety guide is designed as a reference to help determine which barley variety to grow in your region. It provides market feedback, relative grain yield and grain quality comparisons, disease ratings and agronomic information for malt barley varieties segregated in Western Australia (WA), those in Stage 2 of malt accreditation with Barley Australia and varieties only deliverable as feed (Tables 1 to 15; Figures 1 to 18).

The introduction of tariffs totalling 80.5% (comprising 73.6% as an anti-dumping duty and 6.9% as countervailing duties) on barley imports into China that were imposed on 19 May 2020 has made a material change to the export options for Australian malt and feed barley. While the China tariff decision is to be contested by the Australian barley industry, it is unlikely to be resolved quickly. In the meantime, the Australian barley industry is working with current and new end-users to find alternate markets for the malt and feed barley we have been exporting to China. In the short term, reductions in the price for feed barley and smaller premiums offered for malt barley will influence the area sown to barley, barley variety choice and the management package chosen.

As with previous years, the decision of whether to grow barley with a malt or feed classification still depends on five main factors:

1. Premium paid for different varieties when segregated.
2. Relative grain yield of malt and feed grade barley varieties.
3. Differences in input costs due to their agronomic and disease characteristics.
4. Likelihood of meeting malt barley receival specifications with a malt variety.
5. Location of receival segregations for malt barley varieties.

The decision to sow wheat instead of barley depends on:

- The price spread between wheat and barley.
- Relative grain yield of malt barley, feed barley and wheat.
- Availability of premiums for malt grade barley.

At current market prices, there is likely to be a further reduction in the area sown to barley and a swing to a yield-centric, feed-quality focused production system for barley deliveries.

WA growers are fortunate that BFED1 (feed barley) receival standards only focus on hectolitre weight (minimum of 56kg/hL) as the critical quality trait. Growers in eastern Australia who deliver against Grain Trade Australia (GTA) Barley1 (feed barley) receival standards are required to meet both hectolitre weight (minimum of 62.5kg/hL) and screenings targets (maximum of 15% through a 2.2mm slotted sieve). Targeting yield and not quality supports the sowing of the highest yielding variety (regardless of its malt accreditation or segregation opportunity). The production system that maximises grain yield potential includes a May-sowing targeting a density of 180-220 plants/m^2 with nutrition, herbicide and fungicide strategies in-line with the yield potential, deficiencies and risks of the site and the variety sown. Tables 1 and 2 outline key strengths and weakness of five established malt varieties and five new varieties that are currently under Barley Australia malt quality evaluation. New varieties (Beast, Buff, Laperouse, Leabrook and Maximus CL) are lifting the yield benchmark for barley relative to RGT Planet, Rosalind and Spartacus CL (relative yield is subject to regional and seasonal variation).

Where a malt variety is being sown with a malt-focus in mind, discussions with domestic processors and the trade before planting the variety will be necessary, as well as an awareness of CBH, Bunge and private

storage options. Growers are encouraged to deliver malt barley grain between 10.5-11.0% protein (even though the receival window is 9.5-12.8%) with a maximum of 20% screenings through a 2.5mm sieve, a hectolitre weight above 64kg/hL with ryegrass ergot less than 3cm, no whole snails and no glyphosate use near harvest.

Barley varieties differ in their agronomic fit across WA. Additionally, market demand for malt barley varieties varies by port zone due to the various domestic and international markets each port zone services. This makes choosing a variety or varieties that both suit a farming business and the needs of different customers complicated.

BARLEY VARIETY CHOICE IN 2021 – WHAT SHOULD I GROW?

Figure 1 outlines the change in variety popularity from 2018 to 2019 and is marked by a notable increase in the area sown to RGT Planet and Spartacus CL. In 2020, the area planted to RGT Planet and Spartacus CL is expected to increase again at the expense of La Trobe, Scope CL and Bass, with a rise in the popularity of Buff and Rosalind.

With the change in demand for WA malt barley due to tariffs imposed by China, yield potential has become the primary driver of variety choice, with recently released varieties a more attractive option because of the reduced importance of malt accreditation and malt premiums. However, consistent varietal performance over multiple seasons remains essential.

Rosalind has been the yield benchmark in WA since its release and remains an attractive option when targeting high yielding feed barley across a range of yield potentials. RGT Planet remains a good option, particularly in higher rainfall areas where it performs increasingly well as yield potential increases.

New varieties such as Beast, Buff, Leabrook, Laperouse and Maximus CL are plausible competitors to the established varieties RGT Planet and Rosalind, based purely on yield potential. Sowing date, location, yield potential in different environments, disease pressure, soil type and herbicide systems will, however, drive individual choices.

Spartacus CL remains the most popular variety grown in WA and is likely to remain a suitable option as a malt variety in the future. Growers who are targeting feed-grade barley in an imi-herbicide management system should consider evaluating the performance of Maximus CL in their environment due to its improved yield performance in WA barley NVT (2018-2019).

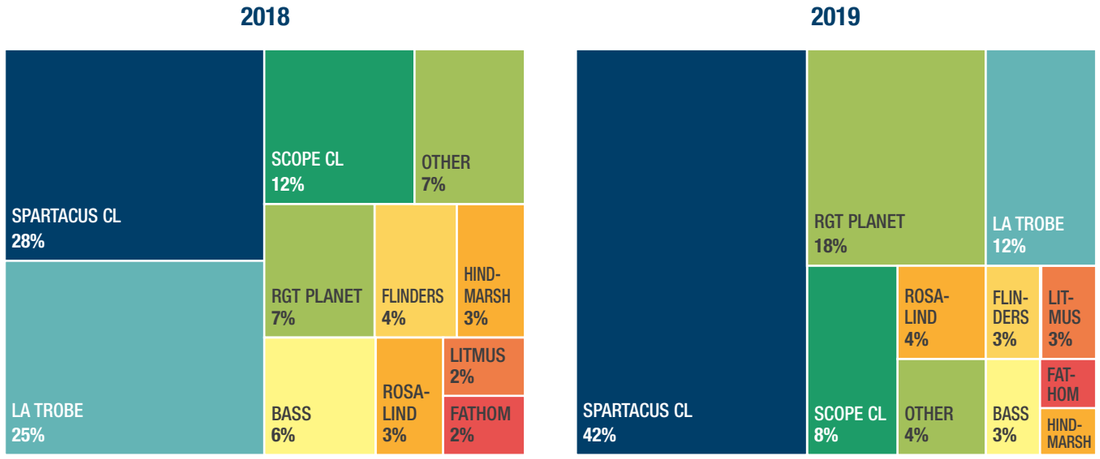

FIGURE 1. Popularity (per cent of barley area) of the top ten barley varieties plus the combined area sown to the other 20 varieties delivered in WA in 2018 and 2019. The top ten varieties occupied 93%, and 96% of the area planted to barley in 2018 and 2019 respectively.

Source: grower estimates as provided to CBH for 2018 and 2019

The preference of end-users for the quality of Bass, Flinders and La Trobe may see them remain an option for growers where malt grade barley is achievable, and malt premiums are offered (primarily in the Kwinana and Albany Port Zones). However, these varieties have been superseded for yield, and are likely to continue to decline in area sown. The domestic preference for Bass, Flinders and La Trobe may see the market offer a premium for them over RGT Planet and Spartacus CL.

There are also other options for specific agronomic situations like the sowing of Buff on soils with a sub-soil pH_{Ca} below 4.8; Scope CL for early sowing and grazing systems where an imidazolinone herbicide might be needed; Laperouse, Leabrook and Fathom where weed competition might be useful, or Fathom and Laperouse where spot-type net blotch (STNB) is a high risk.

Table 1 provides a comparison of six established barley varieties in WA, while Table 2 outlines some of the characteristics of five new barley varieties relative to Spartacus CL. More comments about each suggested barley variety for WA can be found in the variety snapshot section, with additional commentary on the newer barley varieties found in the following section 'What is new?'. For varieties received as malt, the 'Market feedback' section provides more specific market information published by the Grain Industry Association of Western Australia (GIWA).

WHAT IS NEW?

Barley lines in Stage 2 evaluation by Barley Australia that may be of interest to WA barley growers include Buff (tested as IGB1506), Leabrook (tested as WI4896), LG Alestar (tested as SMBA11-2341) and Maximus CL (tested as IGB1705T) (Table 2). As the seed of these varieties were available to growers in 2020, larger quantities of commercial seed are likely to be available in 2021. Also, SECOBRA Recherches, through SeedNet partners, will release limited quantities of Laperouse (tested as WI4592) for sale in 2021. Laperouse is in Stage 1 evaluation by Barley Australia. Commercial quantities of Beast (tested as AGTB0113), the first barley variety released by AGT, are also expected to be available for purchase in 2021. Beast has been accepted by Barley Australia for malting and brewing evaluation, with Stage 1 testing to commence in 2021.

Note that for any new variety under evaluation by Barley Australia, there is no guarantee of malt accreditation and market acceptance (and possible

TABLE 1. Summary of barley variety traits comparing Spartacus CL with five established barley varieties

Trait	Spartacus CL	Bass	Flinders	La Trobe	RGT Planet	Rosalind
First year in variety trials in WA	2014	2004	2007	2011	2016	2014
State-wide MET yield (% site mean)[1]	104%	93%	98%	105%	108%	112%
Maturity (sown in late May)	Early spring	Medium spring	Late spring	Early spring	Medium spring	Early spring
Deliverable as / accreditation stage[2]	Malt	Malt	Malt	Malt	Malt	Feed
Brewing demand (barley and malt)[3]	Acceptable	Preferred	Preferred	Preferred	Acceptable	–
Straw strength (excl. head loss)	Good	Very good	Very good	Moderately good	Good	Good
Scald	MR	MRMS	MSS	MR	MRMS	MSS
NTNB – Beecher virulent[4]	MSS	MRMS	MRMS	MS	SVS	MS
NTNB – Beecher avirulent	MS	MSS	MS	MS	MRMS	MR
NTNB – Oxford virulent	MSS	S	S	S	SVS	MSS
STNB	SVS	S	S	SVS	S	S
Powdery mildew	MRMS	MSS	R	MS	R	MRMS*
Leaf rust	MSS	SVS	MRMS (late APR)	S	MRMS (late APR)	MR

Source: Blakely Paynter, Sanjiv Gupta, GIWA and NVT Online **nvtonline.com.au**

[1]Regional differences in grain yield are masked when using a state-wide average of the WA barley NVT MET data (2015-2019). Growers are directed to Tables 4 to 10 for a more precise estimate of variety performance in their region and Figures 2 to 6 for an indication of relative variety performance at different site yields.

[2]Varieties classed as malt have been accredited by Barley Australia. Varieties classed as Stage 0, 1 or 2 are under evaluation by Barley Australia for their malting and brewing end-use. For more information, visit **barleyaustralia.com.au**.

[3]For more information on malting and brewing demand go to the section 'Market feedback'.

[4]Adult plant foliar disease abbreviations: NTNB = net-type net blotch, STNB = spot-type net blotch, PM = powdery mildew, and APR = adult plant resistance.
*Rosalind may show a susceptible reaction in the presence of some strains of PM present in WA.

TABLE 2. Summary of barley variety traits comparing Spartacus CL with five new barley varieties

Trait	Spartacus CL	Beast	Laperouse	Leabrook	LG Alestar	Maximus CL
First year in variety trials in WA	2014	2019	2016	2015	2011	2018
State-wide MET yield (% site mean)[1]	104%	110%	109%	108%	98%	108%
Maturity (sown in late May)	Early spring	Early spring	Medium spring	Early spring	Medium spring	Medium spring
Deliverable as / accreditation stage[2]	Malt	Stage 0	Stage 1	Stage 2	Stage 2	Stage 2
Brewing demand (barley and malt)[3]	Acceptable	–	–	–	–	–
Straw strength (excl. head loss)	Good	–	Good	Fair	Good	Good
Scald	MR	SVS*p*	S	MSS	S	MR
NTNB – Beecher virulent[4]	MSS	MRMS*p*	MRMS	MRMS	MS	MSS
NTNB – Beecher avirulent	MS	MR*p*	MRMS	MRMS	MRMS	MRMS
NTNB – Oxford virulent	MSS	S*p*	S	S	MSS	S
STNB	SVS	MS*p*	MRMS	MS	S	MSS
Powdery mildew	MRMS	R*p*	R	MR	MR	RMR*
Leaf rust	MSS	MRMS*p* (APR)	S	MSS	MRMS	MSS

Source: Blakely Paynter, Sanjiv Gupta, GIWA and NVT Online **nvtonline.com.au**

[1]Regional differences in grain yield are masked when using a state-wide average of the WA barley NVT MET data (2015-2019). Growers are directed to Tables 4 to 10 for a more precise estimate of variety performance in their region and Figures 2 to 6 for an indication of relative variety performance at different site yields.

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[3]For more information on malting and brewing demand go to the section 'Market feedback'.

[4]Adult plant foliar disease abbreviations: NTNB = net-type net blotch, STNB = spot-type net blotch, PM = powdery mildew, and APR = adult plant resistance. *Maximus CL may show a susceptible reaction in the presence of some strains of PM present in WA.

associated malt premiums). Therefore, be cautious in sowing large areas with the expectation of future segregations unless there is a clear agronomic or grain yield advantage for growing new varieties as a feed barley. Banks is an example of a variety failing in Stage 2 of Barley Australia accreditation. Compass is an example of a Barley Australia accredited variety not being segregated in WA.

When deciding which barley variety to sow, grain yield potential needs balancing against trade-offs with agronomy, disease resistance, grain quality, segregation opportunities and market demand. Commonly grown varieties differ in their agronomic traits and the pathways to building yield (i.e. trade-offs between tiller number, grains per ear and grain weight). These phenotypic differences may favour one variety over another variety in some seasons but not in other seasons. It is therefore vital to look across seasons and sites when assessing which variety best suits each farming business.

Why consider purchasing seed of Beast, Buff, Laperouse, Leabrook, LG Alestar and Maximus CL?

Beast

Key points:

- First barley variety released by AGT, who are well known for their wheat varieties such as Mace and Scepter.
- In Stage 0 assessment for malt accreditation in 2020, with the earliest accreditation date being March 2023.
- It is targeted for sowing in low to medium rainfall zones.
- Has only been tested in WA barley NVT for one season, so its strong performance exhibited in 2019 may or may not be representative of how it performs in subsequent and variable seasons.
- Scald and NTNB (Oxford virulent) need management.

Beast (tested as AGTB0113) is a tall height, early spring, two-row variety bred by AGT, and registered in August 2020. The breeder has advised that Beast (pedigree not yet released) is a Compass derivative, meaning Compass is one of its parents.

Beast has not yet undergone any evaluation by DPIRD in small plot trials (aside from phenology), and as such we have limited independent information to help guide growers and industry of its weaknesses and strengths. With Beast only being tested in WA barley NVT for the first time in 2019, growers should not assume that its performance in 2019 will be representative of future performance. At least three seasons of data are generally required for a sound indication of long-term performance. Across 20 WA barley NVTs in 2019, Beast yielded less than RGT Planet in 15% of trials, the same in 15% and higher in 70%. Relative to Rosalind, it yielded lower in 30%, the same in 70% and higher in 0%.

According to the breeder, Beast is suited to low to medium rainfall environments, has good early canopy size and ground coverage, a sound grain quality package and is of similar plant height to Compass.

As Beast has only been screened in NVT disease trials in WA for one season (2019 only), its disease resistance ratings are provisional. Beast appears to have useful resistance to NTNB (Beecher virulent and avirulent), PM and BLR but may need management for scald and NTNB (Oxford virulent).

Seed is available for planting in 2021 from AGT Affiliates and resellers.

Buff

Key points:

- Like Litmus, has aluminium (Al) tolerance that improves grain yield in soil with low pH and high soluble Al.
- Supersedes Litmus due to more consistent yield across a range of soils and the absence of a blue aleurone that was present in Litmus.
- Grain yield is similar to or higher than Spartacus CL on non-acidic soils and higher than Spartacus CL on soils with an acidic profile.
- STNB, PM and BLR need management.
- Completed Stage 1 assessment by Barley Australia and has progressed to Stage 2. Due to the challenging season in 2019 in Buff-growing areas, there were insufficient quantities available for malting and brewing evaluation in 2020. Therefore, the earliest possible accreditation date for Buff has been delayed until March 2022.
- Grower production of Buff is increasing, particularly in the central and northern regions of WA.

Buff ((Yambla/3*VB0330)/(VB0229/3*VB0330)/(Haruna Nijo/4*VB0330)/(VB0128/98-041D*014/3*VB0330)/(Buloke/3*VB0330)) was tested as IGB1506. Buff is a medium height, early spring, two-row barley bred by Agriculture Victoria Service, licenced to InterGrain and registered in September 2018. Physically, Buff looks similar to Mundah (with Mundah representing 50% of its pedigree through VB0330) but has different phenology, grain yield, grain characteristics and malt quality.

Buff has been in WA barley NVT since 2016 and is a direct competitor to Litmus on acidic soils and Compass, Fathom, Leabrook, Mundah, La Trobe, Rosalind and Spartacus CL (where there are no imidazolinone residues) on non-acidic soils.

Buff has similar genetics for Al tolerance to Litmus. The Al tolerance genetics increase the production of citrate from the roots of barley, allowing increased root growth and higher yields in soil with a low soil pH and increased levels of soluble Al. Aluminium is toxic to barley roots, making barley less productive on acidic soils. Unlike Litmus, Buff has a white aleurone, and its receival is not restricted as it is for Litmus (due to the blue aleurone trait in Litmus).

Buff has displayed a consistent yield advantage over Litmus, primarily on non-acidic soils. Across 27 barley NVT trials (2016-2017, 2019), Buff yielded less than Litmus in 8%, the same in 22% and higher in 70%. The overall yield advantage was 6% over Litmus across the trials (relative yield is subject to regional and seasonal variation).

The NVT multi-environment trial (MET) analysis (2016-2019) indicates that Buff has a yield potential at least equivalent to Spartacus CL on non-acidic soils and higher than Spartacus CL on soils with an acidic profile. Across 56 WA barley NVT trials (2016-2019), Buff achieved the same yield as Spartacus CL in 29% of trials, a higher yield in 50% and a lower yield in 21% of trials. Buff appears to have an increased advantage over Spartacus CL as the site yield increases. Across 56 WA barley NVT trials (2016-2018), Buff yielded less than RGT Planet in 34% of trials, the same in 20% of trials and higher in 46%. Buff has a grain yield advantage over RGT Planet when the site yield is below 4t/ha and on acidic soils.

When grown under the same management in NVT trials, Buff tends to have a lower hectolitre weight, with slightly higher screenings, improved grain brightness and a lower grain protein concentration (at the same grain yield) than grain of Spartacus CL.

Relative to Litmus, Buff has improved tolerance to scald (as an adult) and NTNB (as both a seedling and an adult) but its disease resistance profile is poorer against PM. Relative to Spartacus CL, Buff has improved resistance to NTNB (Beecher virulent and avirulent) as an adult plant but weaker resistance to PM. Fungicides may be required to manage STNB, PM and BLR. The weak PM and BLR resistance of Buff will likely limit its practical use in higher rainfall areas.

Buff appears to be an improvement over Litmus for straw strength, although preliminary data from trials at Gibson in 2018 and 2019 suggest that Buff may have a medium or higher risk of head loss.

Seed is available for planting in 2021 from Seedclub members and resellers. Seed is also free to trade farmer to farmer.

Laperouse

Key points:

- In Stage 1 assessment for malt accreditation in 2020, with the earliest accreditation date being March 2022.
- Improved adaptation, agronomic performance and grain yield over Commander in WA.
- Competitive with Rosalind for grain yield.
- Like Fathom, has intermediate resistance to STNB as an adult plant but better NTNB resistance.
- Scald and BLR need management.

Laperouse (WI4531/Commander//WI4593) was tested as WI4592. Laperouse is a medium height, medium spring, two-row barley bred by the now-defunct University of Adelaide barley-breeding program, licenced to SECOBRA Recherches, registered in September 2019, and is being commercialised by SeedNet.

Laperouse has been in WA barley NVT since 2016 and is a potential agronomic alternative to Bass, Flinders and RGT Planet (particularly where RGT Planet has been pushed as an early sowing option). In some areas, it could be an alternative to Fathom barley. Across 58 barley NVT trials (2016-2019), Laperouse has yielded less than Spartacus CL in 5% of trials, the same in 29% and higher in 66%. The overall yield advantage was 5% over Spartacus CL across these trials (relative yield is subject to regional and seasonal variation). Across 57 WA barley NVT trials (2016-2019), Laperouse yielded less than RGT Planet in 33% of trials, the same in 27% and higher in 40%. Laperouse appears to have a yield advantage over RGT Planet at sites where the site yield is below 4t/ha. Across 58 WA barley NVT trials (2016-2019), Laperouse yielded less than Rosalind in 34% of trials, the same in 57% and higher in 9%.

NVT pathology data indicates it has good tolerance to NTNB (except Oxford virulent) as an adult plant and matches Fathom for adult resistance to STNB (but Laperouse is susceptible as a seedling). Laperouse is less suited to areas where scald or BLR are regular constraints to production.

The breeder has indicated that Laperouse has good straw strength and head retention. Results from a single harvest delay trial at Gibson in 2019 concur with this observation but more data is needed to be more confident about the risk of Laperouse to lodging and head loss at harvest in WA.

Seed is available for planting in 2021 from SeedNet partners.

Leabrook

Key points:

- In Stage 2 assessment for malt accreditation in 2020, with the earliest accreditation date being March 2021.
- Similar agronomic attributes (including lodging risk) to Compass but with improved grain yield.
- BLR needs management.

Leabrook (County/Commander//Commander) was tested as WI4896. Leabrook is a tall height, early spring, two-row barley bred by the now-defunct University of Adelaide barley-breeding program, registered in September 2017, and is being commercialised by SeedNet. Due to its identical pedigree, Leabrook possesses many similar attributes to Compass including phenology, plant architecture and grain quality (i.e. lower than normal hectolitre weight combined with good grain plumpness) but with improvements in grain yield and malt quality (mostly malt extract).

Leabrook has been in WA barley NVT since 2015 and is a competitor to Buff (on non-acidic soils), Compass, Fathom, Laperouse, La Trobe and Spartacus CL (where there are no imidazolinone residues) in low to medium rainfall zones. Across 85 WA barley NVT trials (2016-2019), Leabrook yielded less than Compass in 7% of trials, the same in 48% and higher in 45%. In the same trials, Leabrook yielded less than Spartacus CL in 16% of trials, the same in 33% and higher in 51%. The overall yield advantage of Leabrook across the trials was 2% over Compass and 3% over Spartacus CL (relative yield is subject to regional and seasonal variation). Across 64 WA barley NVT trials (2016-2019), Leabrook yielded less than RGT Planet in 38% of trials, the same in 23% and higher in 39%. Leabrook appears to have a yield advantage over RGT Planet at sites where the site yield is below 3.5t/ha.

The grain quality package of Leabrook is an improvement over Spartacus CL for grain plumpness and is comparable for grain brightness. However, Leabrook has a lower hectolitre weight and grain protein concentration than Spartacus CL (at the same grain yield). Relative to RGT Planet, the grain of Leabrook is plumper and brighter, with similar hectolitre weight and grain protein concentration (at the same grain yield).

Leabrook has a good overall disease resistance profile, being rated at least MSS to all leaf diseases (and their pathotypes) except BLR where it is susceptible. Lodging data collected in WA suggests that the straw strength of Leabrook is comparable to that of Compass. Fair straw strength may pose problems in higher-yielding years, high yielding environments (i.e. above 4t/ha) and when nitrogen supply is excessive. Straw strength is not expected to be a significant impediment to Leabrook's production in low to medium rainfall areas. Germ-end staining risk appears to be similar to Compass and La Trobe, with more data needed. There is not enough data to be definitive about the risk of head loss in Leabrook, but it does not appear to have a high risk.

Seed is available for planting in 2021 from SeedNet partners.

LG Alestar

Key points:

- In Stage 2 assessment for malt accreditation in 2020, with the earliest accreditation date being March 2021.
- Similar agronomic attributes to Granger.
- Similar grain yield to Flinders, with a generally inferior grain quality package.
- STNB needs management.

LG Alestar (Henley/NSL02-4136A) was tested as SMBA11-2341. LG Alestar is a medium height, late spring, two-row barley developed by Elders through its breeding partner Edstar Genetics from a cross made by Limagrain Europe. The grain of LG Alestar has a white aleurone, even though one of its parents Henley has a blue aleurone.

LG Alestar was first entered in WA barley NVT from 2011 until 2016 before being withdrawn in 2017 and then re-entered in 2019. It is a potential competitor to Bass, Flinders, Granger, La Trobe and RGT Planet in higher rainfall areas of WA.

LG Alestar has a higher grain yield than Bass, a similar grain yield to Flinders and is slightly below that of Granger across a range of site potentials. Across 47 WA barley NVT trials (2015-2016, 2019) LG Alestar yielded less than Granger in 55% of trials, the same in 45% and higher in 0%. Across 29 WA barley NVT trials (2016, 2019), LG Alestar yielded less than RGT Planet in 79% of trials, the same in 18% and higher in 3%.

The grain quality of LG Alestar is generally inferior to Bass and Flinders, with a lower hectolitre weight, higher screenings, comparable grain brightness and a lower grain protein concentration (at the same grain yield).

Relative to Bass, LG Alestar has improved resistance to PM and BLR and a comparable resistance profile to Flinders. The mechanism for resistance to PM in LG Alestar differs from Flinders and is based on the *mlo* gene, providing it with durable resistance. LG Alestar appears to possess additional resistance genes to BLR that are not yet characterised and not present in Flinders.

Lodging data collected in WA suggests that the straw strength of LG Alestar is comparable to that of Granger but is perhaps not quite as good as Bass or Flinders (noting regional and seasonal variation in straw strength exists). There are not enough data to be definitive on the head loss risk with LG Alestar.

Seed is available for planting in 2021 from Elders.

Maximus CL

Key points:

- In Stage 2 assessment for malt accreditation in 2020 with the earliest accreditation date being March 2021.
- Maximus CL possesses the gene conferring tolerance to label application rates of registered imidazolinone products.
- Similar agronomic attributes to Spartacus CL but with a higher grain yield potential and a different grain quality package.
- Some level of tolerance to all diseases except Oxford virulent NTNB and some pathotypes of PM.

Maximus CL (pedigree not yet released) was tested as IGB1705T. Maximus CL is a medium height, medium spring, imidazolinone-tolerant, two-row barley bred by Agriculture Victoria Services, licenced to InterGrain, and registered in November 2019. The plant architecture of Maximus CL is similar to Spartacus CL.

Maximus CL has been sown in WA barley NVT since 2018 and is a competitor to Buff (on non-acidic soils), Compass, Fathom, La Trobe, RGT Planet and Spartacus CL (where there are no imidazolinone residues). Across 40 WA barley NVT (2018-2019), Maximus CL yielded the same as Spartacus CL in 55% of trials and higher in 45%. It has yet to yield less than Spartacus CL in WA barley NVT trials. Across 39 WA barley NVT trials (2018-2019) Maximus CL yielded less than RGT Planet in 31% of trials, the same in 15% of trials and higher in 54%. Maximus CL appears to have a yield advantage over Spartacus CL at sites where the site yield is above 3t/ha and over RGT Planet at locations where the site yield is below 3.5t/ha.

The grain quality of Maximus CL is an improvement over Spartacus CL for grain plumpness, similar for grain protein concentration (at the same grain yield) but weaker for grain brightness with a similar or slightly lower hectolitre weight.

The main advantage of Maximus CL over Spartacus CL for disease resistance is with STNB, where Maximus CL is rated as MSS as both a seedling and an adult plant, while Spartacus CL is rated as SVS at both growth stages. It is possible that Maximus CL has different genes for resistance to PM than Spartacus CL and, therefore, may show variable reactions in the presence of some PM pathotypes.

Lodging data collected in WA suggest that the straw strength of Maximus CL is comparable with Spartacus CL. There is not enough data to be definitive about the risk of head loss in Maximus CL, but preliminary data suggest it could be considered as low risk. Likewise, there is insufficient evidence to determine if Maximus CL has the same germ-end staining risk as Spartacus CL.

Seed is available for planting in 2021 from Seedclub members and resellers.

OTHER CONSIDERATIONS FOR BARLEY GROWERS

Changes in disease and insect pathogens

New pathotypes and new diseases detected in WA in recent years have ramifications for variety choice and fungicide strategies. Growers, particularly those on the south coast, should be watchful for the new and aggressive Oxford virulent NTNB pathotype, the newly identified leaf disease Ramularia leaf spot (RLS) and potential changes in the virulence of PM. The impact and likely distribution of fall armyworm and Russian wheat aphid (RWA) on barley production are unknown. Growers should be aware of that incursions of these new pests have been detected in the Geraldton (fall armyworm) and Esperance (RWA) port zones (as of August 2020) and be attentive when scouting. Suspected detections (or absence during scouting) should be reported using the MyPestGuide Reporter app (available at **agric.wa.gov.au/apps/mypestguide-reporter**), or by contacting the Pest and Disease Information Service (PaDIS) by calling +61 (0)8 9368 3080 or emailing **padis@dpird.wa.gov.au**.

Tips for managing grain protein in malt barley

The grain protein concentration of a crop is determined by the balance of nitrogen (N) supply and demand, a relationship that is heavily influenced by seasonal conditions. While it is common practice to apply the bulk of fertiliser N in the period from seeding up to four weeks after seeding, it is not necessarily the most effective strategy for producing both yield and protein. Strategies that can boost grain protein include applying higher levels of N fertiliser and incorporating legumes in the rotation to increase soil N supply. Variety choice and the timing of fertiliser N applications are additional management options that can assist if current practices are not consistently delivering grain above 9.5% protein. Sowing higher protein varieties, such as Bass or even Flinders or Spartacus CL (where suitable) can result in up to 1% grain protein increase over lower protein varieties (at a similar yield level). Targeting around two-thirds of the recommended N fertiliser rate for application around the stem elongation stage of crop growth can also increase grain protein with negligible impacts on grain yield. In some seasons, additional N application around flag leaf emergence can also boost grain protein. Overall, ensuring adequate and appropriate N supply is the most critical factor in maximising grain yield at a sufficient grain protein concentration. However, delayed N strategies have the added benefit of providing a greater understanding of season potential at the time of the N application.

Target plant density

When considering the rate of seed to be planted, it is essential to think in terms of target plant density (plants per square metre) rather than set machinery seeding rates (kg/ha). While plant density is a fixed target, a fixed seeding rate in kg/ha will see a variable plant density across seasons due to seed size (which varies with variety and seed source), seed viability and establishment conditions. For malt barley, a target density of 150-180 plants/m^2 is appropriate to maximise yield while maintaining grain quality. For feed barley, a higher target density of 180-220 plants/m^2 is suggested to improve the competitiveness of the crop against weeds and maximise yield. If growing feed barley in paddocks without weeds, then the target density can be adjusted down to 150-180 plants/m^2. There is, however, a 1-3% yield advantage obtained by keeping target densities at the higher density (180-220 plants/m^2) suggested for feed barley, even in the absence of weeds. The impact of sowing at a higher plant density to maximise grain yield on feed grain quality is low, with a reduction in hectolitre weight expected of less than 0.5kg/hL.

The target density in plants/m^2 determines the seeding rate in kg/ha, and is calculated using the following formula:

$$\text{Seed rate (kg/ha)} = \frac{\text{1000 kernel weight (g) x target density (plants/m}^2\text{)}}{\text{germination \% x establishment \% x 100}}$$

For example, if sowing RGT Planet barley with a kernel weight of 45g per 1000 kernels at a target density of 180 plants/m^2 with a germination of 96% and an expected establishment of 80%, then the seed rate in kg/ha required to establish 180 plants/m^2 is:

$$\text{seed rate in kg/ha} = 105 \text{ kg/ha} = \frac{45 \times 180}{0.96 \times 0.80 \times 100}$$

TABLE 3. Western Australian malt barley variety segregation recommendations by Port Zone for the 2021/22 harvest

YES	This is a recommended variety for this production zone.
Limited	Limited segregations likely due to low production hectares, limited market demand, a new variety going through market development or phasing out an old variety.
Niche	Subject to availability. Niche segregation only available if a marketer has sufficient tonnage to supply to a domestic or international customer. Marketers should contact CBH to negotiate niche segregation, and growers should contact their preferred marketer to determine availability.
NO	Variety has been phased out, or marketers are not looking to accumulate this variety in this production zone.

Port Zone	Geraldton	Kwinana			Albany		Esperance	Comments
		North (Midlands)	South	North (East)	North	South		
Bass	NO	YES	Limited	NO	NO	Limited	NO	Stable market demand with an excellent malt quality profile
Flinders	NO	NO	Niche	NO	NO	YES	Niche	Works well as a variety for post-malt blending and sugar-adjunct brewing
La Trobe	NO	Limited	Limited	Limited	Limited	Limited	Limited	Stable market demand with a recognised quality profile
RGT Planet	NO	YES	YES	NO	Limited	YES	YES	Market development for brewing end-use continuing
Spartacus CL	YES	YES	YES	YES	YES	YES	YES	Market development for brewing and shochu end-use continuing

Source: GIWA Barley Council

Market feedback

The following market feedback comes from Grain Industry Association of Western Australia (GIWA).

At the 2021/22 harvest, the following observations are relevant:

- The reduction in overall market demand for malt barley, associated with the tariffs imposed by China on the imports of Australian barley, favour the production of barley to maximise yield, reduce the focus on delivering grain suitable for segregation as Malt1, and will result in a further reduction of the total area sown to barley in 2021. Fortunately, the dominant barley varieties grown in Western Australia, RGT Planet and Spartacus CL, can be received into malt segregations, ensuring we can still respond to any increased demand for malt barley should market conditions change. Maintaining a supply of the premium malt varieties, Bass and Flinders, is critical to domestic processors and key international customers during this period of reduced demand and expected lower market price.
- Bass and Flinders will be the preferred malt barley varieties sought by the trade for malting and brewing end-use in south-east Asia and Japan, with demand for RGT Planet and Spartacus CL increasing in different market sectors.
- La Trobe is the preferred malt variety supplied to Japan for the manufacture of shochu. Associated with reduced grower production of La Trobe, limited segregations will be available for La Trobe to maintain supply to this premium market and support the needs of domestic processors.
- The rapid adoption of Spartacus CL has continued, with Spartacus CL now the most popular variety sown across all four port zones. Japan has proposed lifting the MRL for imazapyr from 0.1 to 0.7ppm. Should this occur in 2021, there is potential to export Spartacus CL to Japan for the manufacture of shochu, which would result in the phasing out of La Trobe after the 2021/22 harvest. If an import tolerance is implemented, shochu buyers will likely start making the switch over to Spartacus CL during the 2020/21 campaign.
- Scope CL has been phased out as a malt variety and will not be segregated after the 2020/21 harvest, as there is no longer any international demand for the malt profile of Scope CL barley. Growers can continue to sow Scope CL for the farming system benefits it offers and deliver it into feed segregations.
- Segregation opportunities for Bass, Flinders, La Trobe, RGT Planet, and Spartacus CL vary by port zone and for the Kwinana and Albany Ports, within a port zone (Table 3).

WHY RATIONALISE MALT VARIETIES?

In line with previous advice, the WA barley industry continues to support the long-term aim of segregating up to two major malt varieties per port zone, with limited segregations on offer for minor, new or niche malt varieties. Growing and segregating fewer malt varieties improves logistics, makes segregation planning at a bin level easier and encourages more robust demand from the trade who are unwilling to risk buying small, unsaleable parcels.

These malt barley variety receival recommendations have been developed by the Grain Industry Association of Western Australia (GIWA), through the GIWA Barley Council, in consultation with the Western Australian barley supply chain. The recommendations are a guide for growers and consultants to help with the planning of the 2021 barley cropping program. Review of the plan will occur in autumn 2021, and any changes in demand presented to growers. Malt variety recommendations in this document may differ to those in eastern Australia due to our focus on international markets.

While GIWA facilitates the publishing of industry recommendations on what malt variety to grow, it has no control over the actual segregations provided by Bunge or CBH. Some sites can only offer a single malt barley segregation, whereas other sites may be able to offer two or more malt barley segregations. Growers can support segregation planning by submitting their ‘area planted’ information and attending pre-harvest meetings.

The Australian barley industry works hard to uphold Australian malt variety quality to the end customer. It does not support the co-binning of segregated malt varieties, even if the varieties concerned have similar agronomic traits. Growers should not intentionally contaminate a malt barley stack with another variety. Correct variety declaration is a legal requirement under the Plant Breeders Rights Act, and misdeclaration is a breach of the Bulk Handling Act 1967.

MALT VARIETY-SPECIFIC RECOMMENDATIONS

With new malt varieties released and adopted by growers faster than the phasing out of old malt varieties, the rapid turnover of varieties is a common sticking point for end-users who desire long-term supply and familiarity to optimise their end-use. New varieties also create inefficiency for bulk handlers, with each new malt segregation adding to the cost of storage and handling.

The GIWA barley variety rationalisation plan attempts, therefore, to balance the benefits to growers from access to new malt varieties with the demand from customers for access to large parcels of the same malt variety over at least five years.

Each malt barley variety grown in Western Australia has unique malting attributes. Consequently, brewers purchase varieties subject to their availability, their familiarity, their price, the style of beer they produce, and the type and level of adjunct used in their brewing recipe.

Growers should use the market signals in this document to help them decide on which malt variety or varieties to sow in 2021 (Table 3). In determining malt variety choice, market demand, pricing signals and the location of segregations should be considered alongside the agronomic management required and the risk associated with delivering malt grade barley. Varieties listed as PREFERRED are more likely to attract higher premiums than ACCEPTABLE varieties. As these industry recommendations are a guide, the actual segregations implemented at the 2021/22 harvest may differ to that proposed in this document. Growers should regularly liaise with their bulk handlers to confirm segregations.

The malt barley recommendations for the 2021 season are as follows:

Bass

- Bass is the ‘market leader’ for malt quality and is preferred for export as grain and as malt but has less competitive grain yield than other malt varieties in the marketplace. However, it has the highest selection rate for malt (aside from Flinders).
- Not suitable for the manufacture of shochu in Japan.
- Bass is well recognised in the international malt barley market with stable demand. Until there is a replacement, Bass is a critical malt variety to maintain our ability to supply premium malt to key customers.
- Can be malted without the use of the growth hormone gibberellic acid, an advantageous trait.
- Bass malt has excellent extract and filterability and is suited to markets where high levels of starch-adjuncts are used in the brewing process.
- Bass grain generally has a higher grain protein concentration than other malt varieties received, enhancing its preference from starch-adjunct brewers.
- Target production zone in 2021 is Kwinana-North (Midlands) with limited segregation opportunities in Kwinana-South and Albany-South (subject to production volumes).

Flinders

- Flinders is acceptable for export as grain and preferred for export as malt.
- Not suitable for the manufacture of shochu in Japan.
- Can be malted without the use of the growth hormone gibberellic acid, an advantageous trait.
- Flinders malt has excellent malt extract and filterability but at a lower enzyme potential than Bass malt.
- Flinders performs well in markets where sugar-adjunct brewing is practiced and when blended post-malting for starch-adjunct brewing markets.

- Growers in the Albany Port Zone who like the agronomic fit of Flinders on their farm are encouraged to talk to the domestic processors and consider delivering their grain to potential niche segregations in Kwinana-South rather than trucking to segregations in Albany-South.
- Target production zone in 2021 is Albany-South with potential niche segregation opportunities in Kwinana-South and the Esperance Port Zone (subject to production and demand).

La Trobe

- La Trobe is preferred for export as grain and as malt.
- La Trobe is a preferred variety for the manufacture of shochu in Japan and of the malt varieties segregated in Western Australia, is the only one accepted for that premium end-use.
- Widely accepted by all major malting and brewing customers of WA barley and malt.
- La Trobe malt has high extract with a high enzyme potential and is suitable for starch-adjunct brewing.
- Growers should be careful not to contaminate their seed stocks or ruin the integrity of La Trobe malt stacks by mixing them with either Hindmarsh or Spartacus CL barley or any other variety.
- Should Spartacus CL be accepted for shochu in Japan, La Trobe will be phased out.
- Due to reducing production volumes, limited segregations will be offered in Kwinana, Albany, and Esperance Port Zones in 2021.

RGT Planet

- RGT Planet is acceptable for export as grain and as malt.
- Not suitable for the manufacture of shochu in Japan.
- RGT Planet is used extensively in brewing markets in Europe and South America and is rapidly gaining acceptance in south-east Asian brewing markets.
- RGT Planet malt has excellent extract with a moderate enzyme potential and is suitable for starch-adjunct brewing.
- Target production zones in 2021 are Kwinana-North (Midlands), Kwinana-South, Albany-South, and Esperance Port Zones with limited segregation opportunities in Albany-North (subject to production volumes).

Spartacus CL

- Spartacus CL is acceptable for export as grain and as malt.
- Assessment of Spartacus CL for its suitability for the manufacture of shochu in Japan is on hold until there is a change in the import tolerances for imidazolinone residues in Japan. The MRL for imazapyr in Japan may be lifted from 0.1 to 0.7ppm during 2021, allowing Spartacus CL to complete its evaluation for shochu.
- Market feedback suggests that like La Trobe, Spartacus CL has high extract with very good enzyme potential and is suitable for starch-adjunct brewing.
- Growers should be careful not to contaminate their seed stocks or ruin the integrity of Spartacus CL malt stacks by mixing them with either Hindmarsh or La Trobe barley or any other variety.
- Use only recommended imidazolinone herbicides and be aware of market advice regarding the delivery of grain from paddocks sprayed with an imidazolinone herbicide.
- Target production zones in 2021 are Geraldton, Kwinana, Albany, and Esperance Port Zones.

Grain yield

National Variety Trials (NVT) are managed by the Grains Research and Development Corporation (GRDC) to provide a nationally independent means of assessing varietal performance to enable growers to select the best variety for their environment. The results of NVT trials are available as individual site reports or as multi-environment (MET) long-term summaries. The MET analysis generates a table of performance values for each variety in comparison to the mean of the NVT site. Growers and consultants can select the state, region, location or group of locations of their choice to assist in choosing the best variety for their environment. Both the single-site and multi-year MET analyses are available at **nvtonline.com.au**.

Tables 4 to 10 present data extracted from the Long Term MET Yield Reporter available at **nvtonline.com.au**. MET data are presented for each year (2015-2019) for each of the six Agzones in WA and then combined across the six Agzones to provide a state-wide MET. If there are four or more observations, a five-year weighted average has been calculated from the MET data. Caution should be exercised when looking at the weighted average as it masks varietal performance over seasons within an Agzone.

Agzones were developed using statistical analysis by the Department of Primary Industries and Regional Development (DPIRD) to group together environmental regions that give similar crop performance in WA.

Tables 11 and 12 use single-site MET data to highlight the probability of one variety yielding less, the same, or more than another variety when grown in the same trial with the same agronomy. Grain yields are compared using the least significant difference (p=0.05) calculated from the single-site MET analysis standard error. Only barley NVT trials where both varieties have been sown and harvested are included.

It is important to note that the single-site MET analyses only represent varietal performance under one specific set of seasonal and site conditions. Growers should not use the single-site MET analysis as their sole data source when comparing the performance of a new variety. MET analyses based on the average varietal performance of Agzones can mask variety by environment (GxE) interactions across the locations (and seasons) within the Agzone. For this reason, the relative performance of varieties in each year for the period 2015 to 2019 helps explain the variability in relative varietal performance across seasons. While Agzones is a simple way to group trials across environments, it may not accurately reflect your location in every season.

Differences in comparative grain yield performance between varieties sometimes depend on the yield potential of the site. To help assess relative varietal performance at different site yields, NVT Online (through the Long Term MET Yield Reporter) presents data at half tonne yield intervals (called 'yield-groups') based on trials that match the yield range. This guide presents an alternative method of viewing yield performance at different site yields and uses data extracted from the 'State-wide tables of yield and grain quality' available at **nvtonline.com.au**. Figures 2 to 6 use linear regression to compare varieties at different yield potentials and present varietal trends as the site mean yield increases (the average yield of the varieties compared).

The graphs were developed by calculating differences between the grain yield of a variety relative to the site mean yield (the 'deviation'), with the deviation assessed for quadratic or linear trends. If the quadratic trend was significant ($p<0.05$), a quadratic polynomial was fitted to the data. If the linear trend (but not the quadratic trend) was significant ($p<0.05$), a linear polynomial was fitted to the data. If neither the quadratic nor the linear trend was significant, the grain yield response of a variety was deemed to run parallel to the site mean yield at the average deviation for that variety. It is worth noting that depending on which years and locations are analysed, the relative performance of varieties may differ. This highlights the importance of looking at more than one dataset and where possible comparing the performance of new varieties over at least three seasons.

TABLE 4. Grain yield of barley varieties in AGZONE 1 expressed as a per cent of the site mean yield for each trial year (2015-2019) and the weighted average over the five-year period (where there are four or more observations)

Year		2015	2016	2017	2018	2019	2015-2019
Site mean yield (t/ha)		1.78	4.22	2.07	4.29	1.18	3.02
Variety	(No. trials)	(1)	(2)	(2)	(2)	(1)	(8)
Deliverable as a malt variety							
Bass	(8)	87	94	93	95	91	**93**
Flinders	(6)	97	-	93	93	83	**93**
La Trobe	(8)	108	101	104	105	114	**105**
RGT Planet	(7)	-	106	101	103	100	**103**
Spartacus CL	(8)	111	99	102	103	111	**104**
Stage 2 malt accreditation							
Buff	(6)	-	111	120	116	134	**118**
Leabrook	(8)	106	107	110	113	130	**112**
LG Alestar	(2)	-	99	-	-	86	**-**
Maximus CL	(3)	-	-	-	108	120	**-**
Deliverable as a feed variety							
Banks	(8)	109	102	104	104	110	**105**
Beast	(1)	-	-	-	-	127	**-**
Compass	(8)	108	103	108	111	129	**110**
Fathom	(8)	104	106	113	114	133	**113**
Granger	(4)	102	-	95	-	85	**95**
Laperouse	(5)	-	106	-	111	125	**111**
Litmus	(6)	124	103	115	-	120	**112**
Mundah	(6)	107	-	105	102	110	**103**
Rosalind	(8)	126	106	114	113	130	**115**
Scope CL	(8)	101	99	105	103	110	**103**

Source: based on MET analysis from NVT Online, **nvtonline.com.au**

TABLE 5. Grain yield of barley varieties in AGZONE 2 expressed as a per cent of the site mean yield for each trial year (2015-2019), and the weighted average over the five-year period (where there are four or more observations)

Year		2015	2016	2017	2018	2019	2015-2019
Site mean yield (t/ha)		2.40	3.96	4.14	4.28	2.20	3.30
Variety	(No. trials)	(6)	(3)	(5)	(7)	(7)	(28)
Deliverable as a malt variety							
Bass	(27)	90	92	95	96	95	**94**
Flinders	(28)	100	94	97	96	95	**97**
La Trobe	(28)	110	99	101	105	109	**106**
RGT Planet	(21)	-	105	106	104	100	**104**
Spartacus CL	(28)	114	96	99	104	110	**106**
Stage 2 malt accreditation							
Buff	(21)	-	118	107	109	112	**110**
Leabrook	(28)	108	106	105	111	111	**109**
LG Alestar	(16)	97	99	-	-	94	**97**
Maximus CL	(14)	-	-	-	107	113	**109**
Deliverable as a feed variety							
Banks	(28)	109	102	102	104	106	**105**
Beast	(7)	-	-	-	-	114	**111**
Compass	(28)	109	102	102	109	113	**108**
Fathom	(28)	100	109	103	108	110	**106**
Granger	(21)	103	98	100	-	96	**99**
Laperouse	(19)	-	-	105	110	111	**109**
Litmus	(21)	110	108	99	-	112	**106**
Mundah	(23)	101	-	97	100	106	**101**
Rosalind	(28)	123	106	105	111	118	**114**
Scope CL	(27)	95	102	97	100	103	**99**

Source: based on MET analysis from NVT Online, **nvtonline.com.au**

TABLE 6. Grain yield of barley varieties in AGZONE 3 expressed as a per cent of the site mean yield for each trial year (2015-2019), and the weighted average over the five-year period (where there are four or more observations)

Year		2015	2016	2017	2018	2019	2015-2019
Site mean yield (t/ha)		3.80	3.59	4.40	3.63	4.28	3.96
Variety	(No. trials)	(5)	(1)	(2)	(3)	(4)	(15)
Deliverable as a malt variety							
Bass	(15)	88	90	90	94	93	**91**
Flinders	(15)	99	98	98	98	99	**99**
La Trobe	(15)	104	102	100	101	105	**103**
RGT Planet	(10)	-	111	112	109	109	**113**
Spartacus CL	(15)	103	101	99	99	106	**102**
Stage 2 malt accreditation							
Buff	(7)	-	-	-	107	105	**108**
Leabrook	(15)	110	105	105	105	108	**107**
LG Alestar	(10)	99	100	-	-	98	**99**
Maximus CL	(7)	-	-	-	103	109	**107**
Deliverable as a feed variety							
Banks	(15)	106	104	103	102	105	**104**
Beast	(4)	-	-	-	-	110	**110**
Compass	(15)	103	101	100	100	105	**102**
Fathom	(15)	98	100	100	100	100	**99**
Granger	(15)	105	103	103	102	102	**103**
Laperouse	(10)	-	107	107	106	110	**110**
Litmus	(8)	94	103	100	-	-	**98**
Mundah	(12)	89	-	93	94	96	**93**
Rosalind	(15)	114	111	108	105	112	**111**
Scope CL	(15)	88	95	94	95	94	**92**

Source: based on MET analysis from NVT Online, **nvtonline.com.au**

TABLE 7. Grain yield of barley varieties in AGZONE 4 expressed as a per cent of the site mean yield for each trial year (2015-2019), and the weighted average over the five-year period (where there are four or more observations)

Year		2015	2016	2017	2018	2019	2015-2019
Site mean yield (t/ha)		2.82	-	1.45	3.44	0.80	2.46
Variety	(No. trials)	(2)	(0)	(1)	(2)	(1)	(6)
Deliverable as a malt variety							
Bass	(6)	94	-	97	91	86	**92**
Flinders	(6)	99	-	98	94	84	**95**
La Trobe	(6)	112	-	125	97	104	**108**
RGT Planet	(4)	-	-	96	101	89	**99**
Spartacus CL	(6)	116	-	133	95	102	**110**
Stage 2 malt accreditation							
Buff	(4)	-	-	101	122	149	**117**
Leabrook	(6)	110	-	119	102	111	**109**
LG Alestar	(3)	95	-	-	-	95	**-**
Maximus CL	(3)	-	-	-	102	114	**-**
Deliverable as a feed variety							
Banks	(6)	108	-	114	102	107	**107**
Beast	(1)	-	-	-	-	117	**-**
Compass	(6)	113	-	128	100	114	**111**
Fathom	(5)	103	-	109	108	130	**110**
Granger	(4)	100	-	96	-	88	**97**
Laperouse	(3)	-	-	-	100	106	**-**
Litmus	(4)	109	-	115	-	154	**121**
Mundah	(6)	104	-	113	104	123	**109**
Rosalind	(6)	122	-	138	107	126	**120**
Scope CL	(6)	98	-	102	106	123	**106**

Source: based on MET analysis from NVT Online, **nvtonline.com.au**

TABLE 8. Grain yield of barley varieties in AGZONE 5 expressed as a percentage of the site mean yield for each trial year (2015-2019), and the weighted average over the five-year period (where there are four or more observations)

Year		2015	2016	2017	2018	2019	2015-2019
Site mean yield (t/ha)		3.42	2.61	3.63	2.89	1.97	2.96
Variety	(No. trials)	(4)	(1)	(4)	(3)	(4)	(16)
Deliverable as a malt variety							
Bass	(16)	96	89	96	92	89	**93**
Flinders	(15)	100	-	100	99	97	**99**
La Trobe	(16)	111	96	103	105	117	**108**
RGT Planet	(12)	-	117	112	109	98	**108**
Spartacus CL	(16)	114	95	101	105	124	**110**
Stage 2 malt accreditation							
Buff	(12)	-	104	100	107	115	**105**
Leabrook	(16)	113	97	108	107	112	**109**
LG Alestar	(9)	94	105	-	-	93	**96**
Maximus CL	(7)	-	-	-	109	128	**113**
Deliverable as a feed variety							
Banks	(16)	107	102	103	105	113	**107**
Beast	(4)	-	-	-	-	126	**114**
Compass	(16)	112	90	103	104	118	**108**
Fathom	(16)	100	88	99	100	107	**101**
Granger	(16)	101	111	102	103	99	**102**
Laperouse	(12)	-	101	109	109	116	**112**
Litmus	(9)	92	93	88	-	-	**102**
Mundah	(15)	96	-	91	96	113	**98**
Rosalind	(16)	117	103	105	113	136	**117**
Scope CL	(9)	92	87	91	-	-	**95**

Source: based on MET analysis from NVT Online, **nvtonline.com.au**

TABLE 9. Grain yield of barley varieties in AGZONE 6 expressed as a percentage of the site mean yield for each trial year (2015-2019), and the weighted average over the five-year period (where there are four or more observations)

Year		2015	2016	2017	2018	2019	2015-2019
Site mean yield (t/ha)		3.86	4.14	2.96	4.88	4.72	4.24
Variety	(No. trials)	(2)	(2)	(1)	(2)	(2)	(9)
Deliverable as a malt variety							
Bass	(9)	93	84	88	92	91	**90**
Flinders	(9)	104	100	110	100	101	**102**
La Trobe	(9)	102	96	87	98	101	**98**
RGT Planet	(7)	-	125	124	112	114	**118**
Spartacus CL	(9)	102	92	85	96	100	**96**
Stage 2 malt accreditation							
Buff	(4)	-	-	-	107	105	**103**
Leabrook	(9)	103	103	82	102	104	**101**
LG Alestar	(6)	101	104	-	-	101	**103**
Maximus CL	(4)	-	-	-	101	105	**101**
Deliverable as a feed variety							
Banks	(9)	103	103	97	102	103	**102**
Beast	(2)	-	-	-	-	107	**-**
Compass	(9)	97	91	72	96	98	**93**
Fathom	(9)	88	92	71	96	95	**90**
Granger	(9)	109	110	120	105	106	**109**
Laperouse	(6)	-	107	90	103	107	**104**
Litmus	(5)	84	89	84	-	-	**90**
Mundah	(7)	86	-	77	91	90	**86**
Rosalind	(9)	105	105	88	103	107	**103**
Scope CL	(5)	85	83	79	-	-	**87**

Source: based on MET analysis from NVT Online, **nvtonline.com.au**

TABLE 10. Grain yield of barley varieties averaged across AGZONE 1-6 expressed as a percentage of the site mean yield for each trial year (2015-2019), and the weighted average over the five-year period (where there are four or more observations)

Year		2015	2016	2017	2018	2019	2015-2019
Site mean yield (t/ha)		3.14	3.87	3.50	3.94	2.79	3.39
Variety	(No. trials)	(20)	(9)	(15)	(19)	(19)	(82)
Deliverable as a malt variety							
Bass	(81)	91	90	94	94	93	**93**
Flinders	(79)	100	97	98	96	97	**98**
La Trobe	(82)	108	99	101	103	108	**105**
RGT Planet	(61)	-	111	109	106	105	**108**
Spartacus CL	(82)	109	96	100	102	109	**104**
Stage 2 malt accreditation							
Buff	(54)	-	113	106	110	110	**108**
Leabrook	(82)	109	105	105	108	109	**108**
LG Alestar	(46)	97	101	-	-	96	**98**
Maximus CL	(38)	-	-	-	106	112	**108**
Deliverable as a feed variety							
Banks	(82)	107	102	103	103	106	**105**
Beast	(19)	-	-	-	-	114	**110**
Compass	(82)	107	99	101	105	109	**105**
Fathom	(81)	98	101	100	105	105	**102**
Granger	(69)	104	102	102	99	100	**101**
Laperouse	(55)	-	106	106	108	111	**109**
Litmus	(53)	98	101	97	-	108	**102**
Mundah	(69)	95	-	94	98	101	**97**
Rosalind	(82)	117	106	106	109	117	**112**
Scope CL	(70)	91	95	95	98	98	**95**

Source: based on MET analysis from NVT Online, **nvtonline.com.au**

TABLE 11. Direct comparisons between two varieties (yield difference compared using least significant difference, p=0.05, calculated using standard errors from single-site MET) – how many times (as a percentage) was variety A (comparator variety) lower-yielding, the same yield or higher-yielding than variety B (base variety) when sown together in WA barley NVT?

Variety A	Variety B	Percentage of trials			Number of trials	Comparison years	Comparison
		Variety A is lower yielding than Variety B	Variety A and B yield the same	Variety A is higher yielding than Variety B			
Comparisons with RGT Planet							
Banks	RGT Planet	48%	28%	23%	64	2016-2019	Banks ≤ RGT Planet
Bass	RGT Planet	83%	16%	2%	63	2016-2019	Bass < RGT Planet
Beast	RGT Planet	15%	15%	70%	20	2019	Beast > RGT Planet
Buff	RGT Planet	34%	20%	46%	56	2016-2019	Buff = RGT Planet
Compass	RGT Planet	47%	16%	38%	64	2016-2019	Compass = RGT Planet
Fathom	RGT Planet	48%	16%	37%	63	2016-2019	Fathom = RGT Planet
Flinders	RGT Planet	80%	18%	2%	61	2016-2019	Flinders < RGT Planet
Granger	RGT Planet	75%	23%	2%	52	2016-2019	Granger < RGT Planet
La Trobe	RGT Planet	50%	19%	31%	64	2016-2019	La Trobe = RGT Planet
Laperouse	RGT Planet	33%	26%	40%	57	2016-2019	Laperouse = RGT Planet
Leabrook	RGT Planet	38%	23%	39%	64	2016-2019	Leabrook = RGT Planet
LG Alestar	RGT Planet	79%	17%	3%	29	2016,2019	LG Alestar < RGT Planet
Litmus	RGT Planet	56%	3%	41%	34	2016-2017,2019	Litmus = RGT Planet
Maximus CL	RGT Planet	31%	15%	54%	39	2018-2019	Maximus CL = RGT Planet
Mundah	RGT Planet	55%	20%	25%	51	2017-2019	Mundah = RGT Planet
Rosalind	RGT Planet	30%	22%	48%	64	2016-2019	Rosalind = RGT Planet
Scope CL	RGT Planet	63%	18%	20%	51	2016-2019	Scope CL ≤ RGT Planet
Spartacus CL	RGT Planet	50%	19%	31%	64	2016-2019	Spartacus CL = RGT Planet
Comparisons with Spartacus CL							
Banks	Spartacus CL	31%	39%	31%	85	2015-2019	Banks = Spartacus CL
Bass	Spartacus CL	85%	14%	1%	84	2015-2019	Bass < Spartacus CL
Beast	Spartacus CL	0%	50%	50%	20	2019	Beast ≥ Spartacus CL
Buff	Spartacus CL	21%	29%	50%	56	2016-2019	Buff ≥ Spartacus CL
Compass	Spartacus CL	14%	55%	31%	85	2015-2019	Compass = Spartacus CL
Fathom	Spartacus CL	48%	23%	30%	84	2015-2019	Fathom = Spartacus CL
Flinders	Spartacus CL	63%	24%	12%	82	2015-2019	Flinders ≤ Spartacus CL
Granger	Spartacus CL	49%	21%	31%	72	2015-2019	Granger = Spartacus CL
La Trobe	Spartacus CL	7%	86%	7%	85	2015-2019	La Trobe = Spartacus CL
Laperouse	Spartacus CL	5%	29%	66%	58	2016-2019	Laperouse ≥ Spartacus CL
Leabrook	Spartacus CL	16%	33%	51%	85	2015-2019	Leabrook ≥ Spartacus CL
LG Alestar	Spartacus CL	65%	19%	17%	48	2015-2016,2019	LG Alestar ≤ Spartacus CL
Litmus	Spartacus CL	44%	31%	24%	54	2015-2017,2019	Litmus ≤ Spartacus CL
Maximus CL	Spartacus CL	0%	55%	45%	40	2018-2019	Maximus CL ≥ Spartacus CL
Mundah	Spartacus CL	75%	21%	4%	71	2015,2017-2019	Mundah < Spartacus CL
RGT Planet	Spartacus CL	31%	19%	50%	64	2016-2019	RGT Planet = Spartacus CL
Rosalind	Spartacus CL	0%	13%	87%	85	2015-2019	Rosalind > Spartacus CL
Scope CL	Spartacus CL	69%	17%	14%	72	2015-2019	Scope CL < Spartacus CL

Source: based on single-site MET data from NVT Online, **nvtonline.com.au**

TABLE 12. Direct comparisons between two varieties (yield difference compared using least significant difference, p=0.05, calculated using standard errors from single-site MET) – how many times (as a percentage) was variety A (comparator variety) lower-yielding, the same yield or higher-yielding than variety B (base variety) when sown together in WA barley NVT?

Variety A	Variety B	Percentage of trials			Number of trials	Comparison years	Comparison
		Variety A is lower yielding than Variety B	Variety A and B yield the same	Variety A is higher yielding than Variety B			
Comparisons with Rosalind							
Banks	Rosalind	79%	19%	2%	85	2015-2019	Banks < Rosalind
Bass	Rosalind	94%	5%	1%	84	2015-2019	Bass < Rosalind
Beast	Rosalind	30%	70%	0%	20	2019	Beast = Rosalind
Buff	Rosalind	45%	25%	30%	56	2016-2019	Buff = Rosalind
Compass	Rosalind	76%	24%	0%	85	2015-2019	Compass < Rosalind
Fathom	Rosalind	75%	20%	5%	84	2015-2019	Fathom < Rosalind
Flinders	Rosalind	89%	7%	4%	82	2015-2019	Flinders < Rosalind
Granger	Rosalind	71%	19%	10%	72	2015-2019	Granger < Rosalind
La Trobe	Rosalind	88%	11%	1%	85	2015-2019	La Trobe < Rosalind
Laperouse	Rosalind	34%	57%	9%	58	2016-2019	Laperouse ≤ Rosalind
Leabrook	Rosalind	54%	36%	9%	85	2015-2019	Leabrook ≤ Rosalind
LG Alestar	Rosalind	83%	8%	8%	48	2015-2016,2019	LG Alestar < Rosalind
Litmus	Rosalind	76%	15%	9%	54	2015-2017,2019	Litmus < Rosalind
Maximus CL	Rosalind	48%	53%	0%	40	2018-2019	Maximus CL ≤ Rosalind
Mundah	Rosalind	94%	6%	0%	71	2015,2017-2019	Mundah < Rosalind
RGT Planet	Rosalind	48%	22%	30%	64	2016-2019	RGT Planet = Rosalind
Scope CL	Rosalind	94%	6%	0%	72	2015-2019	Scope CL < Rosalind
Spartacus CL	Rosalind	87%	13%	0%	85	2015-2019	Spartacus CL < Rosalind

Source: based on single-site MET data from NVT Online, **nvtonline.com.au**

GRAIN YIELD – COMPARISONS

The highest yielding barley varieties in WA are Rosalind and RGT Planet (Figures 2 to 6, Tables 1, 2, 4 to 12). RGT Planet appears to have the highest yield at sites with a potential above 5t/ha. Buff has the advantage below 4t/ha and on soils with an acidic profile (pH_{Ca} below 4.8) while Rosalind has the advantage below 4.5t/ha. Banks and Compass are two other feed barley options. Neither, however, are yield competitive with RGT Planet (above 3t/ha) or Rosalind. Banks is worth considering for early sowing opportunities due to its longer duration to flower than RGT Planet and Rosalind. Compass is useful where a weed-competitive variety is beneficial in environments below 3t/ha.

RGT Planet is the highest yielding variety segregated for malt, being higher yielding in four of every five comparisons with Bass and Flinders, and in one of every two comparisons with La Trobe and Spartacus CL. The advantage of RGT Planet starts to appear above 3t/ha and becomes noticeable above 4t/ha. Still, for most growers with harvested yield most likely between 2-4t/ha, there is unlikely to be any significant difference between La Trobe, RGT Planet and Spartacus CL. Below 2t/ha, La Trobe and Spartacus CL have a clear advantage over RGT Planet.

While La Trobe and Spartacus CL yielded the same in nearly nine out of every ten WA barley NVT trials, La Trobe may have a slight advantage above 3.5t/ha. This subtle difference, however, will be relatively inconsequential when choosing whether to grow La Trobe or Spartacus CL. The need for an imidazolinone herbicide, the presence of imidazolinone residue, market signals and differences in grain quality will have a more significant bearing on which variety to grow. Growers have primarily switched to Spartacus CL over La Trobe, even in rotations where there is no imidazolinone herbicide use.

Three of the varieties undergoing Stage 2 malt accreditation (Buff, Leabrook, and Maximus CL) and one variety in Stage 1 malt accreditation (Laperouse) have a yield advantage over Bass, Flinders, La Trobe, and Spartacus CL above 1t/ha. These four varieties are also competitive with RGT Planet at higher yield potentials. Buff, Laperouse,

Leabrook and Maximus CL appear to be higher-yielding options than RGT Planet in environments where the site yield is below 4t/ha for Buff and Laperouse, and 3.5t/ha for Leabrook and Maximus CL. Current malt varieties Bass and Flinders, however, have only yielded higher ($p<0.05$) than RGT Planet at 2% of the WA barley NVT sites. La Trobe and Spartacus CL, on the other hand, have yielded higher than RGT Planet at 31% of barley NVT sites.

LG Alestar, the fourth variety in Stage 2 malt accreditation, has a similar grain yield to Flinders (yielding the same in three out of every four WA barley NVT). Based on grain yield only, LG Alestar is a less competitive option than Buff, Laperouse, Leabrook and Maximus CL. LG Alestar has yielded less ($p<0.05$) than RGT Planet in nearly four out of every five barley WA NVT trials and less than Spartacus CL in two-thirds of WA barley NVT.

Beast, a new entry in WA barley NVT in 2019, performed strongly in its first season in NVT. More years and locations of data are needed to confirm if will perform consistently in the WA environment, and where it will excel. Beast is in Stage 0 malt accreditation in 2020.

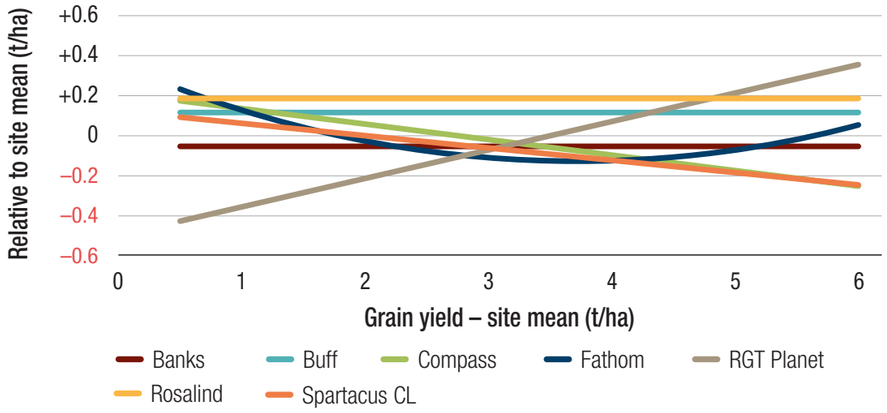

FIGURE 2. Fitted grain yield of Banks, Buff, Compass, Fathom, RGT Planet, Rosalind, and Spartacus CL at different site mean yields.

Source: based on NVT state-wide tables of yields and grain quality (2016-2019), **nvtonline.com.au**. Each variety sown in all 54 trial-years of data.

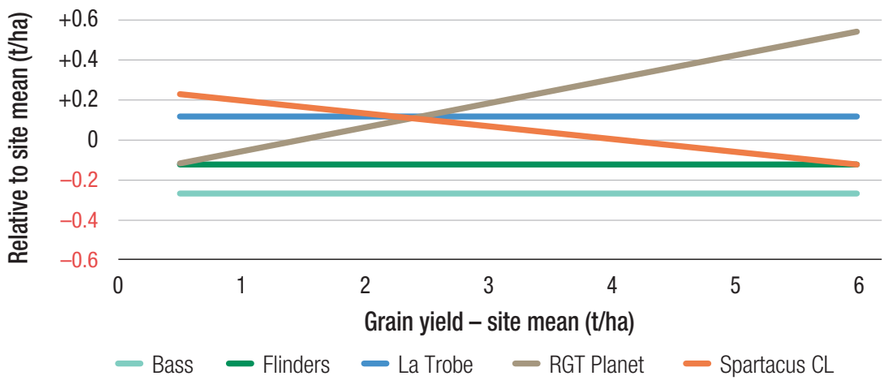

FIGURE 3. Fitted grain yield of Bass, Flinders, La Trobe, RGT Planet, and Spartacus CL at different site mean yields.

Source: based on NVT state-wide tables of yields and grain quality (2016-2019), **nvtonline.com.au**. Each variety sown in all 58 trial-years of data.

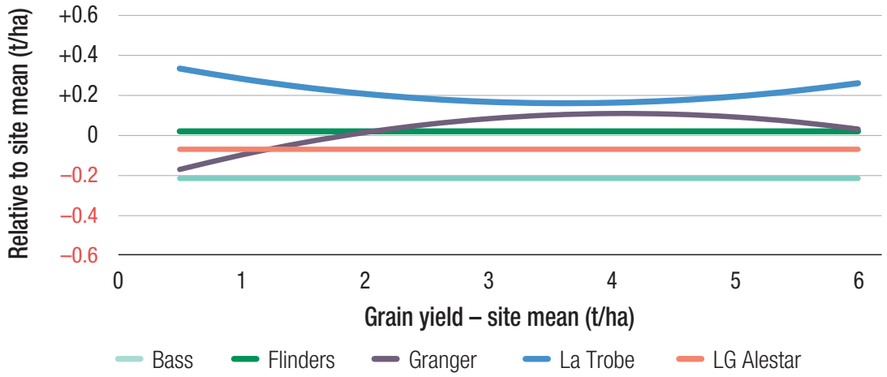

FIGURE 4. Fitted grain yield of Bass, Flinders, Granger, La Trobe, and LG Alestar at different site mean yields.

Source: based on NVT state-wide tables of yields and grain quality (2011-2016, 2019), **nvtonline.com.au**. Each variety sown in all 98 trial-years of data.

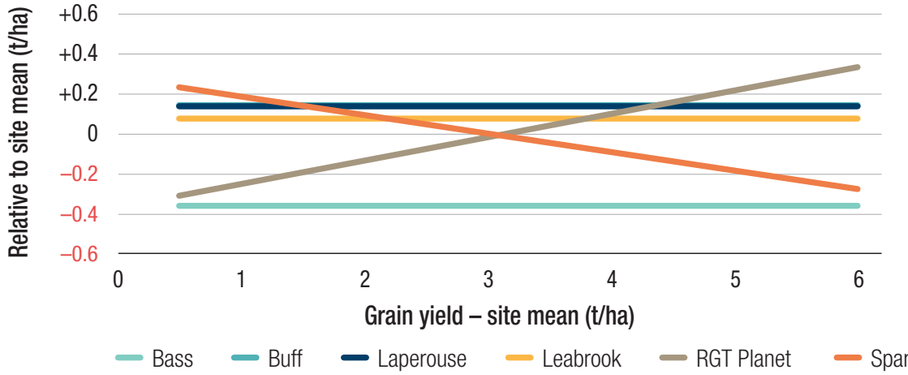

FIGURE 5. Fitted grain yield of Bass, Buff, Laperouse, Leabrook, RGT Planet, and Spartacus CL at different site mean yields.

Source: based on NVT state-wide tables of yields and grain quality (2016-2019), **nvtonline.com.au**. Each variety sown in all 50 trial-years of data.

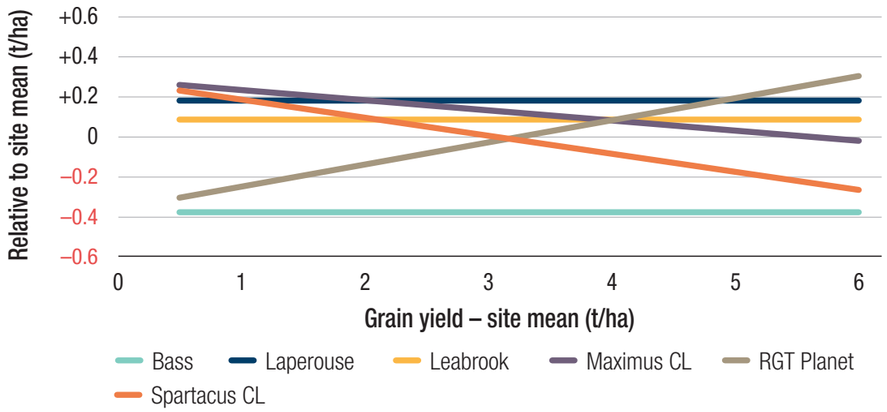

FIGURE 6. Fitted grain yield of Bass, Laperouse, Leabrook, Maximus CL, RGT Planet, and Spartacus CL at different site mean yields.

Source: based on NVT state-wide tables of yields and grain quality (2018-2019), **nvtonline.com.au**. Each variety sown in all 39 trial-years of data.

Grain quality

When comparing feed barley varieties, grain yield potential is a necessary trait to consider alongside disease resistance and agronomic features like straw strength and head loss resistance. However, while grain yield is essential when comparing varieties segregated for malt, grain quality characteristics are almost equally as important for those chasing the premium on offer for delivery as a Malt1 barley.

As with the grain yield data presented in Figures 2 to 6, the physical grain quality (hectolitre weight, screenings through a 2.5mm slotted sieve and grain brightness) of a malt variety has been plotted relative to the site mean as the site mean increases (Figures 7 to 18). The deviation from the site mean was then assessed for quadratic and linear trends. If neither the quadratic nor the linear trend was significant, the grain quality response of a variety was deemed to run parallel to the site mean quality at the average deviation for that variety. The data used for this analysis has been extracted from the NVT 'State-wide tables of yield and grain quality' tables available at **nvtonline.com.au**.

Figures 7 to 10 compare the hectolitre weight of varieties segregated for malt in WA and those under malting and brewing evaluation, Figures 11 to 14 present grain plumpness comparisons (per cent through a 2.5mm sieve), while Figures 15 and 18 depict grain brightness comparisons.

GRAIN QUALITY – HECTOLITRE WEIGHT COMPARISONS

Bass is the current benchmark variety for hectolitre weight of the five varieties segregated for malt in WA. Flinders, La Trobe, and Spartacus CL displayed a similar hectolitre weight to Bass over the four years from 2016 to 2019 (Figure 7). The hectolitre weight of RGT Planet was significantly lower, being 2-3kg/hL lower ($p<0.05$) than the other four varieties segregated for malt in WA. RGT Planet, therefore, has the highest risk of not meeting Malt1 hectolitre specifications in WA. Conditions that favour a low hectolitre weight in RGT Planet are often associated with high grain plumpness. Conversely, high hectolitre is often related to low grain plumpness in RGT Planet. Those observations reflect the elongated grain shape of RGT Planet kernels.

Of the new varieties under evaluation for their malting and brewing potential, Buff, Leabrook, and LG Alestar are like RGT Planet in displaying a lower hectolitre weight than current malt varieties (Figures 8 to 10, $p<0.05$). The hectolitre weight of Laperouse and Maximus CL appears to be very similar to that of Bass ($p>0.05$).

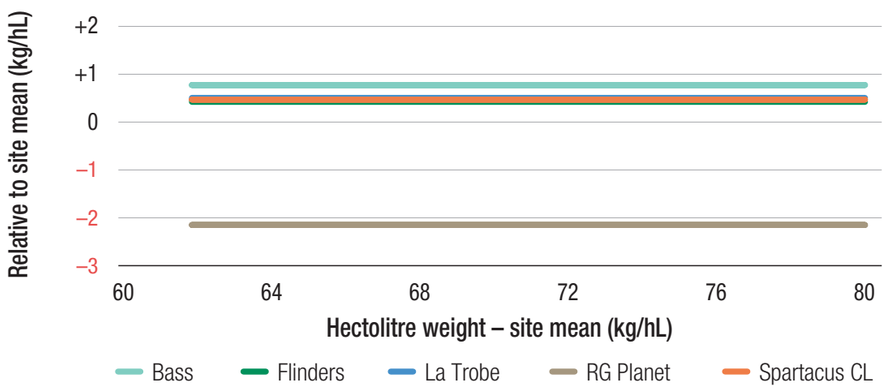

FIGURE 7. Fitted hectolitre weight of Bass, Flinders, La Trobe, RGT Planet, and Spartacus CL at different site means.

Source: based on NVT state-wide tables of yields and grain quality (2016-2019), **nvtonline.com.au**. Each variety sown in all 58 trial-years of data.

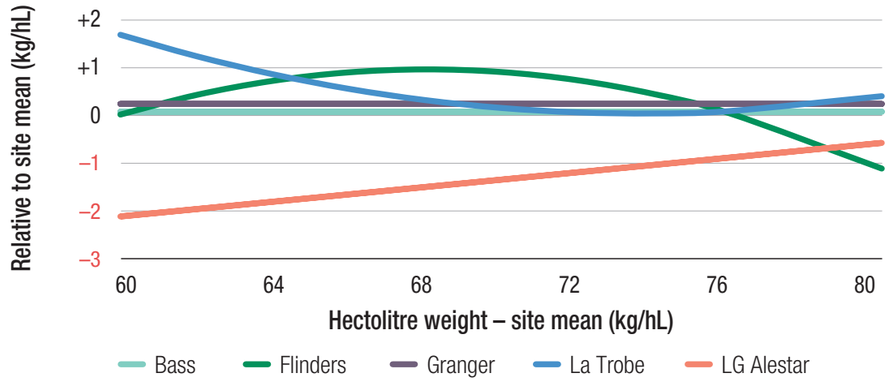

FIGURE 8. Fitted hectolitre weight of Bass, Flinders, Granger, La Trobe, and LG Alestar at different site means.

Source: based on NVT state-wide tables of yields and grain quality (2011-2016, 2019), **nvtonline.com.au**. Each variety sown in all 98 trial-years of data.

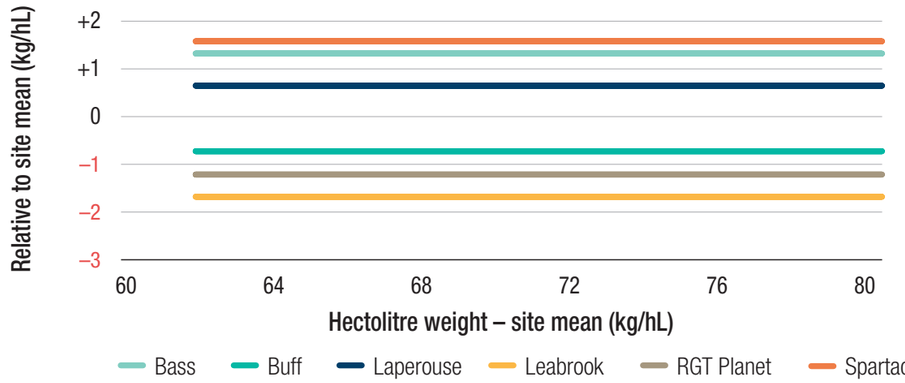

FIGURE 9. Fitted hectolitre weight of Bass, Buff, Laperouse, Leabrook, RGT Planet, and Spartacus CL at different site means.

Source: based on NVT state-wide tables of yields and grain quality (2016-2019), **nvtonline.com.au**. Each variety sown in all 50 trial-years of data.

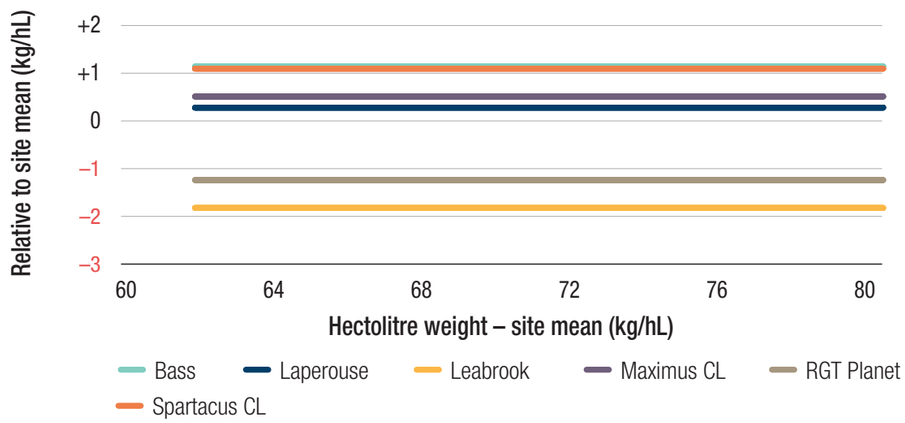

FIGURE 10. Fitted hectolitre weight of Bass, Laperouse, Leabrook, Maximus CL, RGT Planet, and Spartacus CL at different site means.

Source: based on NVT state-wide tables of yields and grain quality (2018-2019), **nvtonline.com.au**. Each variety sown in all 39 trial-years of data.

GRAIN QUALITY – GRAIN PLUMPNESS COMPARISONS

The benchmark malt variety for grain plumpness is Bass (Figure 8), showing lower screenings (per cent though a 2.5mm sieve) than the other varieties segregated for malt in WA over a range of screenings levels. Flinders, although generally less plump than Bass, showed improved plumpness compared to La Trobe and RGT Planet and was comparable to Spartacus CL from 2016 to 2019. Screenings of Spartacus CL are likely to be around 3% less than La Trobe under the same agronomy. RGT Planet appears to behave more like Baudin (data not shown) than Bass or Flinders, with screenings comparable to or slightly higher than La Trobe. At very low screenings, most varieties are similar. Around the Malt1 limit of 20% screenings, genetic differences are notable, and this may influence Malt1 selection rates across paddocks and seasons, and in response to management treatments.

Of the new varieties under evaluation for the malting and brewing potential, Laperouse, Leabrook and Maximus CL are plumper than Spartacus CL with Leabrook appearing to be plumper than Bass. Buff and LG Alestar appear to be between Spartacus CL and RGT Planet in their grain plumpness.

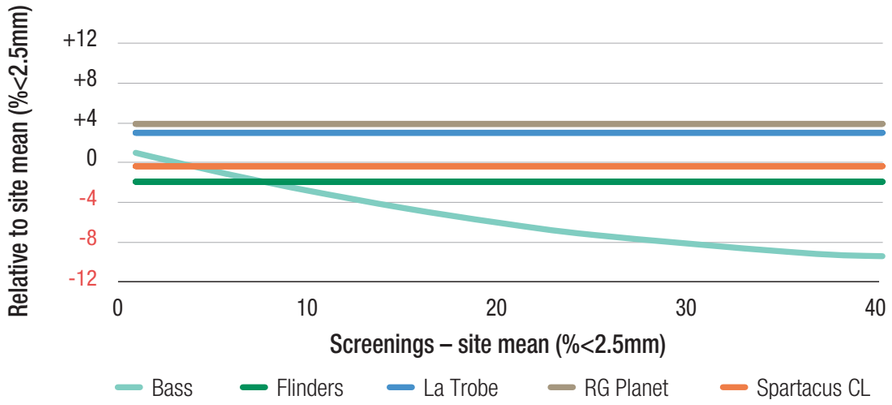

FIGURE 11. Fitted grain plumpness of Bass, Flinders, La Trobe, RGT Planet, and Spartacus CL at different site means.

Source: based on NVT state-wide tables of yields and grain quality (2016-2019), **nvtonline.com.au**. Each variety sown in all 58 trial-years of data.

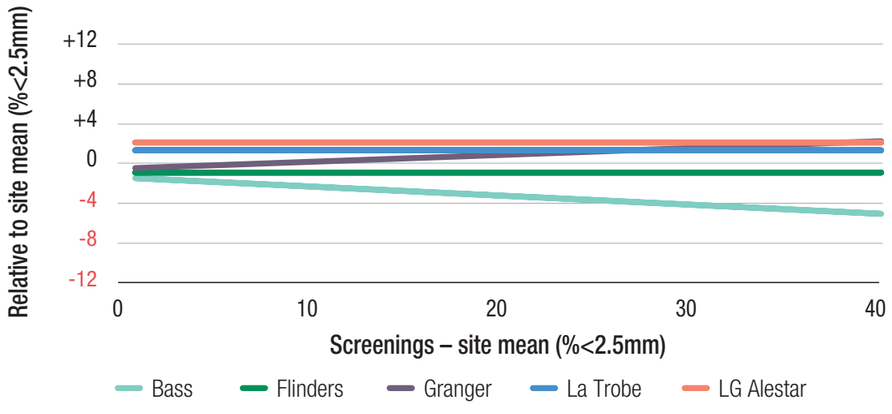

FIGURE 12. Fitted grain plumpness of Bass, Flinders, Granger, La Trobe, and LG Alestar at different site means.

Source: based on NVT state-wide tables of yields and grain quality (2011-2016, 2019), **nvtonline.com.au**. Each variety sown in all 98 trial-years of data.

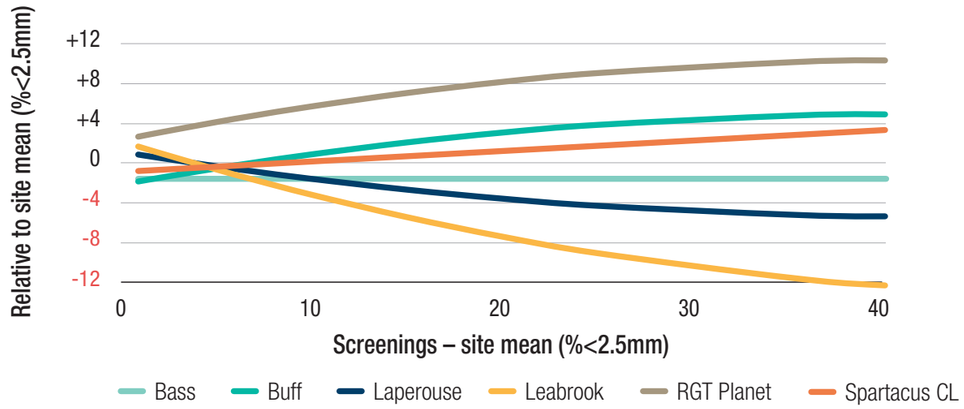

FIGURE 13. Fitted grain plumpness of Bass, Buff, Laperouse, Leabrook, RGT Planet, and Spartacus CL at different site means.

Source: based on NVT state-wide tables of yields and grain quality (2016-2019), **nvtonline.com.au**. Each variety sown in all 50 trial-years of data.

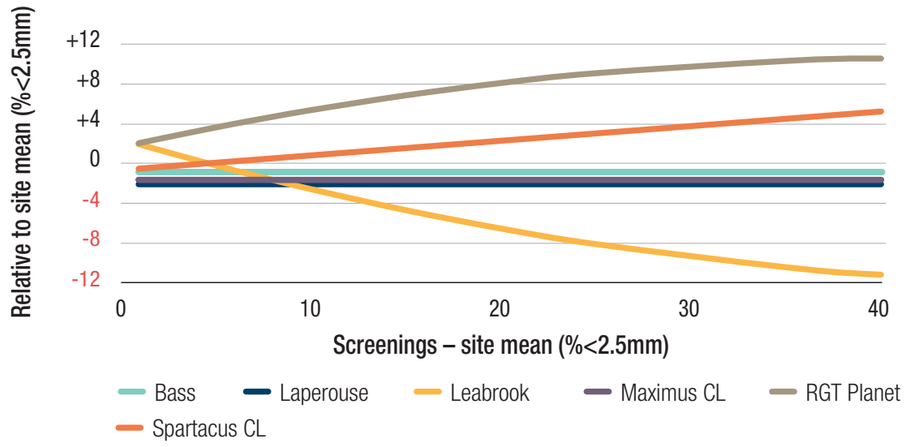

FIGURE 14. Fitted grain plumpness of Bass, Laperouse, Leabrook, Maximus CL, RGT Planet, and Spartacus CL at different site means.

Source: based on NVT state-wide tables of yields and grain quality (2018-2019), **nvtonline.com.au**. Each variety sown in all 39 trial-years of data.

GRAIN QUALITY – GRAIN BRIGHTNESS COMPARISONS

At grain brightness levels below 60‘L*’, the benchmark malt varieties are Bass and Flinders (Figures 15 and 16), which are similar to or slightly darker than the previous benchmark, Baudin (data not shown). La Trobe kernels can be up to 2‘L*’ darker than Bass kernels. The grain brightness of Spartacus CL is a slight improvement over La Trobe, being higher on average by 0.5‘L*’ ($p<0.001$) across a range of grain brightness levels. Below 60‘L*’ RGT Planet appears to have a grain brightness between Bass and La Trobe.

Of the new varieties under evaluation for their malting and brewing potential, LG Alestar is comparable to La Trobe but brighter than Granger. Below 60‘L*’ it is up to 0.5‘L*’ darker than Bass kernels (Figure 16). Buff and Laperouse appear to have good grain brightness being similar to Bass below 60‘L*’, while Leabrook is similar to Spartacus CL (Figure 17 and 18). Maximus CL has the darkest kernels of the newer varieties, being like RGT Planet. Below a grain brightness of 60‘L*’ its kernels are darker than Bass and Spartacus CL kernels.

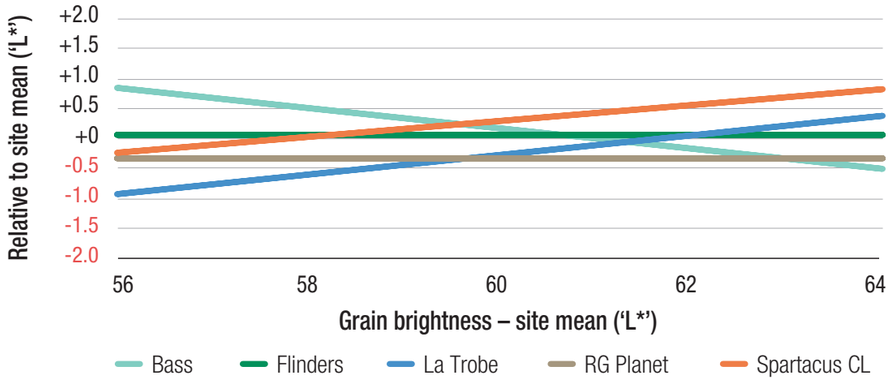

FIGURE 15. Fitted grain brightness of Bass, Flinders, La Trobe, RGT Planet, and Spartacus CL at different site means.

Source: based on NVT state-wide tables of yields and grain quality (2016-2019), **nvtonline.com.au**. Each variety sown in all 58 trial-years of data.

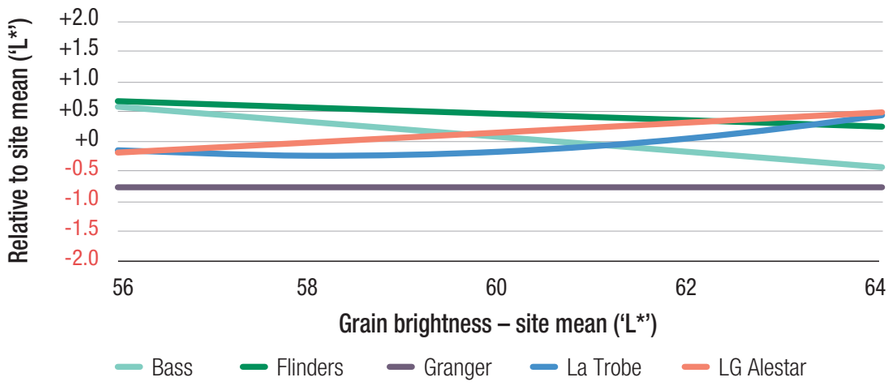

FIGURE 16. Fitted grain brightness of Bass, Flinders, Granger, La Trobe, and LG Alestar at different site means.

Source: based on NVT state-wide tables of yields and grain quality (2011-2016, 2019), **nvtonline.com.au**. Each variety sown in all 94 trial-years of data.

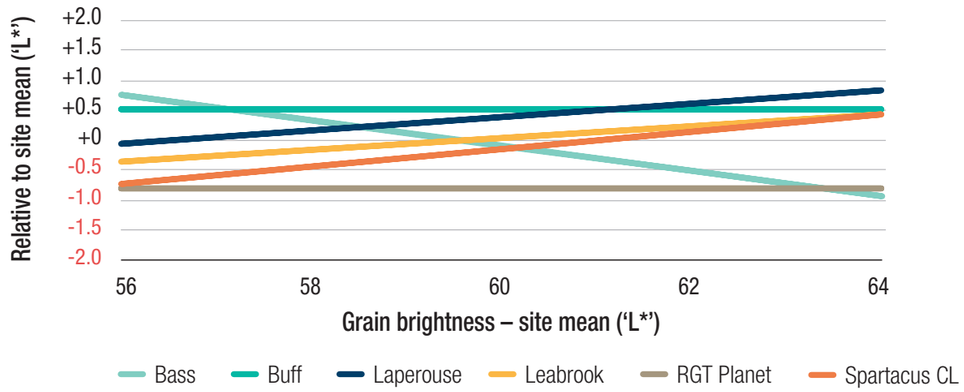

FIGURE 17. Fitted grain brightness of Bass, Buff, Laperouse, Leabrook, RGT Planet, and Spartacus CL at different site means.

Source: based on NVT state-wide tables of yields and grain quality (2016-2019), **nvtonline.com.au**. Each variety sown in all 50 trial-years of data.

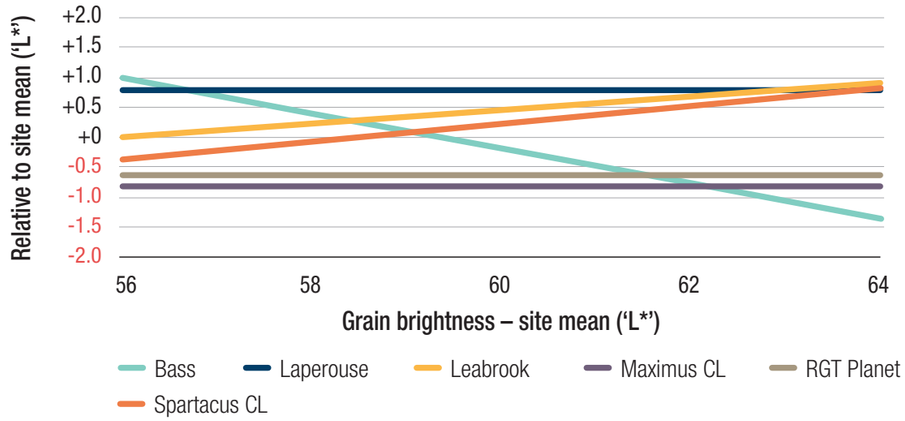

FIGURE 18. Fitted grain brightness of Bass, Laperouse, Leabrook, Maximus CL, RGT Planet, and Spartacus CL at different site means.

Source: based on NVT state-wide tables of yields and grain quality (2018-2019), **nvtonline.com.au**. Each variety sown in all 39 trial-years of data.

Disease and pest resistance

Foliar disease abbreviations

- NTNB = net-type net blotch
- STNB = spot-type net blotch
- PM = powdery mildew
- RLS = ramularia leaf spot
- BLR = barley leaf rust
- APR = adult plant resistance

Disease resistance abbreviations

- VS = very susceptible
- SVS = susceptible to very susceptible
- S = susceptible
- MSS = moderately susceptible to susceptible
- MS = moderately susceptible
- MRMS = moderately resistant to moderately susceptible
- MR = moderately resistant
- RMR = resistant to moderately resistant
- R = resistant
- *p* = provisional rating

Fungicide abbreviations

- DMI = demethylation inhibitor
- SDHI = succinate dehydrogenase inhibitor

SEEDLING AND ADULT RESISTANCE

Disease, virus and nematode resistance data are presented in Tables 13 to 15 and again in the variety snapshots. Leaf disease ratings in this guide include both seedling and adult stage resistance ratings for the foliar leaf diseases NTNB, STNB, PM and BLR. There are no seedling data for scald, so only the adult stage resistance is presented.

Seedling ratings are applicable at early growth stages (two to the three-leaf stage) and are important for making decisions on the use of seed or fertiliser applied fungicide treatments. They are also useful for assessing the likely response of a variety if there is early disease pressure. Varieties susceptible to stubble-borne diseases such as scald, NTNB and STNB are at a high risk of initial infection if sown onto one- or two-year-old barley stubble.

Adult plant ratings are applicable at later plant growth stages (after flag leaf emergence). Still, in some varieties and for some diseases the adult ratings may be relevant as early as late tillering to stem elongation. Variations in seedling and adult ratings of a variety are mostly due to the differential effectiveness of resistance genes at one stage or the other.

The ratings of varieties may vary over time. Seasonal changes occur with time mainly due to differences in disease pressure, the spread of the disease in the region, changes in climatic conditions, stubble retention and development of new pathotypes/races. There have been some minor changes in the resistance score of the varieties listed since the last sowing guide, usually up or down one resistance score. Still, there have been no significant changes in resistance score as the result of a new pathotype in this guide.

NEW PATHOTYPE – NET-TYPE NET BLOTCH (NTNB)

Be watchful for increasing NTNB with a new aggressive pathotype, named Oxford virulent, detected across the south coast. Banks and Granger have the best overall resistance to this new pathotype, being rated as MRMS as seedlings and MS as adult plants. The next best resistance is Buff (MS as seedling and adult), and Rosalind (MSS as seedling and adult).

NEW LEAF DISEASE – RAMULARIA LEAF SPOT (RLS)

Growers should also be watchful for the new leaf disease RLS caused by the fungus *Ramularia collo-cygni*. In 2018, RLS detections occurred in three separate locations across the south coast of WA. Testing in 2019 showed that it was present in seed samples from the mid-west, central and southern wheatbelt, including low rainfall areas. This disease was first detected in Tasmania in 2016 and then WA in 2018. It is also present in our neighbouring countries New Zealand (first detected in 1997) and South Africa (first detected in 2015) as well as being found in important barley growing regions in Europe and South America.

Where established, yield losses commonly up to 25% and in extreme cases up to 70% are reported through a significant decrease of kernel size and quality. The fungus is primarily a disease of barley, however, can infect a wide range of hosts including oats, wheat and some other grasses. Infected seeds are likely to be the primary source of long-distance disease spread and introduction to new areas. More localised disease spread is from airborne spores coming from infected barley and grasses. However, this generally requires prolonged periods of leaf wetness. As a result, we expect a higher level of RLS incidence in the medium and high rainfall areas.

Identification of the disease can be difficult as lesions are generally not evident until after flowering. RLS can be easily confused with other similar fungal leaf spotting diseases such as STNB or abiotic symptoms caused by physiological leaf spotting (PLS) and boron toxicity (however, these abiotic spots are not likely to respond to fungicide application). The potential impact this disease may have in WA barley crops is unknown. There are no specific management recommendations for the disease in WA at this stage although the fungicides currently used to manage net blotches in barley, when applied at the booting stage, are likely to be active on RLS. Note that RLS is at high risk of developing fungicide resistance and the sustainable rotation of fungicides should always be practised to avoid this.

NEW INSECT PEST – FALL ARMYWORM

Be watchful for the presence of a new insect pest, fall armyworm (*Spodoptera frugiperda*). Fall armyworm was first detected in WA in Kununurra in March 2020 and since then has been progressively detected at more southern locations. A single adult moth was collected in a pheromone trap located near Geraldton in late July 2020. The potential presence and impact of fall armyworm on cereals, canola and pulse crops at various growth stages are not yet known. Until we acquire a greater understanding of fall armyworm in southern grain-growing regions of WA, growers should monitor their crops for fall armyworm in a similar way as they do for existing caterpillar pests. Fall armyworm is similar in size to existing caterpillar pests and causes comparable damage to vegetative and reproductive parts of plants.

Suspected detections of fall armyworm should be reported using the MyPestGuide Reporter app (available at **agric.wa.gov.au/apps/mypestguide-reporter**), or by contacting the Pest and Disease Information Service (PaDIS) by calling **+61 (0)8 9368 3080** or emailing **padis@dpird.wa.gov.au**.

PATHOTYPE SURVEILLANCE AND FUNGICIDE RESISTANCE

Growers and consultants observing barley varieties rated as MRMS, MR or R to leaf disease that are carrying significantly higher levels of disease than expected should collect infected material for pathotype identification and fungicide resistance testing. Collect leaf samples before spraying the crop with a fungicide to ensure sample viability.

Place infected scald, NTNB, STNB and BLR leaf material in paper envelopes marked with the location, variety, disease and date collected. Fold the leaf in half so infected area is on the inside. Please do not wrap leaf material in plastic or send in plastic-lined envelopes. Unlike other leaf diseases, it is preferable for PM that infected leaves are placed into agar tubes to maintain a live culture for pathotyping. Sample collection kits for PM needs arranging before sampling and therefore before spraying.

Send scald, NTNB and STNB infected leaf material in paper envelopes to DPIRD, Locked Bag 4, Bentley Delivery Centre WA 6983 and marked attention, Simon Rogers. For more information, contact Simon Rogers via email at **simon.rogers@dpird.wa.gov.au** or phone **+61 (0)8 9368 3445**.

Forward samples of PM infected leaf material (placed into agar tubing) to the Centre for Crop and Disease Management (CCDM), Curtin University, Kent Street, Bentley, WA 6102. To arrange sample collection kits, contact Simon Ellwood via email at **simon.ellwood@curtin.edu.au** or phone **+61 (0)8 9266 9915**. Where agar tubing is not available, express post leaves infected with PM to the CCDM.

Send BLR samples in paper envelopes directly to the University of Sydney, Australian Rust Survey, Reply Paid 88076 Narellan NSW 2567. For more information, contact Professor Robert Park via email at **robert.park@sydney.edu.au** or phone **+61 (0)2 9351 8800**.

Fungicide resistant isolates of NTNB, STNB and PM are present in WA. To manage fungicide resistance, and to reduce future resistance development, fungicide mixtures should contain different modes of action including strobilurins (for example, azoxystrobin and pyraclostrobin) and SDHI (for instance, fluxapyroxad and bixafen). Avoiding repetitive applications of single active ingredients or fungicide group is another critical tool in reducing the risk of resistance. In situations of concern over disease response to fungicide control in barley crops, samples from any disease can be sent to the CCDM, Curtin University, Kent Street, Bentley, WA 6102. Contact the Fungicide Resistance Group via email at **frg@curtin.edu.au** for details on how to collect and submit a sample.

Plants with symptoms suspected to be RLS or in cases where symptoms thought to be PLS respond to fungicide application, send samples for laboratory testing to DPIRD, Locked Bag 4, Bentley Delivery Centre WA 6983 and marked attention, Jason Bradley. For more information, contact Jason Bradley via email at **jason.bradley@dpird.wa.gov.au** or phone **+61 (0)8 9368 3982**.

SCALD

Scald starts as pale grey-green, water-soaked blotches on older leaves. The blotches become elongated, often diamond-shaped, and bleached with a distinctive brown margin. Lesions usually join to form necrotic areas and eventually the entire leaf withers and dies. Scald is potentially very damaging in barley as an infection can kill leaves prematurely and reduce seed weight. Increased plantings of varieties with a susceptible rating increases the prevalence of scald, especially with early sowing opportunities. A severe initial infection can reduce the head number and grain number. Yield losses of up to 45% are possible with associated quality defects. Scald can survive between seasons on infested stubble and barley grass and is carried through infected seed.

The varieties with the highest scald risk are Banks, Beast, Laperouse, LG Alestar, Litmus and Mundah. A concern going forward is that the widespread adoption of Banks, Beast, Laperouse, and LG Alestar could see scald re-emerge in prevalence as a severe disease affecting the performance of barley in WA. Use of seed dressings and in-crop fungicides plus avoiding sowing these varieties in 'barley-on-barley' situations will be important when growing such varieties.

NET-TYPE NET BLOTCH (NTNB)

NTNB starts as pinpoint brown lesions that elongate and produce fine, dark brown streaks along and across the leaf blades, creating a distinctive net-like pattern. Older lesions continue to elongate along leaf veins. Double cropping of barley significantly increases the risk of infection. NTNB can reduce grain yield by 20-30% and impact on the quality of the grain produced.

Populations of NTNB resistant to the triazole based DMI fungicide tebuconazole and some other types of triazole fungicides such as prothioconazole and epoxiconazole have been reported by the CCDM. Resistance has been observed in the central and southern regions. There is also a population in the Esperance region with reduced sensitivity to the DMI fungicides tebuconazole and propiconazole. Fungicide management of NTNB to address current resistance issues and to reduce future resistance development increasingly requires the use of fungicide mixtures containing different modes of action including strobilurins (for example, azoxystrobin and pyraclostrobin) and SDHI (for instance, fluxapyroxad, benzovindiflupyr and bixafen). Fungicide management is often required to manage the disease when resistance in the variety is low or if there is a pathotype change.

Virulence of the NTNB pathogen can vary across time and regions depending on the varieties and resistance genes deployed. Historically, there were two distinct pathotypes of NTNB prevalent in WA, Beecher virulent (95NB100) and Beecher avirulent (97NB1). The Beecher avirulent (non-attacking) isolate is prevalent throughout the state. In contrast, the Beecher virulent (attacking) isolate is more common north of the Great Eastern Highway but is now relatively uncommon. In recent seasons, another pathotype, Oxford virulent, has become evident, particularly in the Albany and Esperance port zones.

As there are different pathotypes of NTNB present in WA, varietal responses vary accordingly. Litmus is the most vulnerable variety to NTNB, being susceptible to all three major NTNB pathotypes present in WA. In the presence of the Oxford virulent pathotype, Banks, Buff, Granger, and Rosalind have slighter better resistance, but only marginally (MS or MSS versus S). If the Oxford virulent pathotype moves further north and becomes the dominant pathotype, then fungicide and rotation become critical tools in reducing the annual risk of NTNB. This is due to the lack of seedling resistance in commercially grown varieties.

SPOT-TYPE NET BLOTCH (STNB)

STNB develops as small circular or elliptical dark brown spots that become surrounded by a chlorotic zone of varying width. These spots do not elongate to the net-like pattern characteristic of NTNB. The spots may grow to 3-6mm in diameter. Double cropping of barley significantly increases the risk of infection. STNB can reduce grain yield by 10-50% and impact on the quality of the grain produced.

The CCDM has reported the discovery of DMI resistant STNB populations in the South Stirlings region and more recently in the Esperance port zone. The compounds most affected by this resistance are tebuconazole and propiconazole. The resistant population is slightly less sensitive, however, to the newer DMIs such as prothioconazole. Fungicide management of STNB, to address current resistance issues in the southern regions and reduce future development regionally, increasingly requires the use of fungicide mixtures and alternation of products including effective DMI ingredients and alternate modes of action including strobilurins (for example, azoxystrobin and pyraclostrobin) and SDHI (for instance, fluxapyroxad and bixafen). As outlined in the disease introduction, where fungicide resistance is suspected, send samples to the CCDM for assessment.

Fathom (MR as a seedling and MRMS as an adult) has the best-combined seedling and adult resistance to STNB of the current varieties followed by Laperouse (MS as a seedling and MRMS as an adult). Compass has some tolerance to STNB, rated as MRMS as a seedling and MSS as an adult. Leabrook is MS at both growth stages.

Some varieties susceptible at the adult plant stage have some tolerance at the seedling stage (i.e. Bass has intermediate resistance at the seedling stage but is vulnerable at the adult stage). Partial tolerance at the seedling stage reduces the likelihood of severe early infection, but STNB can still infect these varieties at the adult stage. Under high disease pressure, such as sowing into barley stubble, these varieties may still exhibit significant levels of seedling disease.

POWDERY MILDEW (PM)

PM appears as fluffy white growths on the surface of the leaf. The area surrounding the spores turns yellow as the fungus depletes the leaf nutrients. Older infections become grey and may develop small black fruiting bodies. Early infection can cause yield losses of up to 25%, whereas yield losses at the end of stem elongation reduce yield by around 10%.

Genetic resistance is the best form of management against PM, especially since a mutation of the *CYP51* gene in powdery mildew has resulted in the compromised efficacy of many DMI fungicides (for example, tebuconazole, triadimefon, flutriafol) in controlling powdery mildew at label rates. Higher value DMI fungicides and alternative modes of action, such as strobilurins (for example, azoxystrobin and pyraclostrobin), SDHI (for instance, fluxapyroxad) and amines (for example, spiroxamine) have uncompromised activity against PM.

Varieties grown in WA with intermediate resistance or better (MRMS, MR and R) to PM fit into nine broad groups based on postulated or known effective genes that control their resistance to PM. Only those varieties carrying the *mlo* gene like Granger, LG Alestar, and RGT Planet have durable resistance to PM. The rest of the widely grown varieties in WA are vulnerable to mutations of the PM fungus. The diversity in resistance genes and the presence of multiple genes in some varieties means that not all varieties will be rendered susceptible at the same time if mutations occur or the known mutations become widespread. Testing by the CCDM for PM virulence on Oxford, suggests that the *Ml(St)* gene in Oxford may be compromised, rendering a susceptible reaction in the presence of this mutation. This new pathotype is currently restricted to the south coast.

The nine broad groups separated by known or postulated resistance genes that are effective (in brackets) include the following varieties:

- Group 1 (*MlGa*) – Fathom
- Group 2 (*MlLa*) – La Trobe, Lockyer, Rosalind, Spartacus CL
- Group 3 (*MlGa*, *MlLa*) – Compass, Leabrook
- Group 4 (*Mla7*, *MlLa*) – Scope CL
- Group 5 (*Mla7*, *MlLa*, *Mlk1*) – Dash
- Group 6 (*Ml(Ch)*, *Mlra*) – Yagan
- Group 7 (*Ml(St)*) – Oxford
- Group 8 (*Mla1*) – Flinders
- Group 9 (*mlo*) – Granger, LG Alestar, RGT Planet

Virulence to the *MlLa* gene has been detected in barley growing in northern NSW and Queensland resulting in varieties such as Compass, La Trobe, Rosalind, and Spartacus CL being more susceptible to PM than in previous years. Field screening of varieties with different genes, however, has not yet confirmed any significant regional variation in the field resistance of varieties to PM in WA, except for Oxford. There are reports, however, of increased virulence on varieties other than Oxford (Rosalind and possibly Maximus CL) in the South Stirlings area. Growers should report a suspected breakdown in varietal resistance for varieties rated as MRMS and above to PM.

BARLEY LEAF RUST (BLR)

BLR appears as small, circular to oval pustules with light brown powdery spores on the upper surface of leaves (rarely on the back of the leaf blade) and on leaf sheaths in cases of heavy infection. As the crop matures, pustules darken and produce black spores embedded in leaf tissue. BLR can reduce grain yield by over 30% in severe infections.

Since the detection of new BLR pathotypes in WA with virulence for the major resistance gene *Rph3* (5457 P- in 2013, 5457 P+ in 2014 and 5656 P+ in 2016), most of the barley varieties grown in WA have become susceptible (except Rosalind) to BLR. Only varieties that carry genes different from *Rph3* or APR genes have some resistance. APR genes usually provide moderate levels of resistance. As they are not pathotype specific, APR genes are unlikely to be affected by any future pathotype changes. APR only develops fully at the adult plant stage, generally after flag leaf emergence although it may be apparent from earlier growth stages in some seasons. There may still be a need to protect those varieties with APR genes at early growth stages from the initial infection. Temperature and varietal background influence the effectiveness of the *Rph20* gene. Even though Flinders, Granger and RGT Planet all carry two APR genes (*Rph20* and *Rph24*), their field reaction may vary depending on which allele they have and other minor genes they may carry. LG Alestar also possesses additional APR genes (not yet characterised). Under very high rust pressure, response to fungicide application may still be evident in the retention of green leaf area in varieties with APR resistance. The late APR resistance in Fathom only protects it late in the season, so it is still vulnerable to rust infection before heading.

Pathotype 5457 P- is now the dominant BLR pathotype across WA. The new pathotype 5656 P+ migrated from eastern Australia following detection in South Australia in 2011.

CROWN ROT

Crown rot (*Fusarium pseudograminearum*) is a fungal disease most common in continuous cereal rotations. It affects the sub crown internode, crown and lower stems and is not usually noticed until after heading when whiteheads are visible. Symptoms can include whiteheads scattered throughout the crop but not in distinct patches as would occur with take-all. In individual plants, the infected tiller bases are honey-brown in colour, especially under leaf sheaths, and a pink discolouration often forms around or in the crown or under leaf sheaths. The browning at the base of infected tillers is the most reliable indicator of crown rot as in seasons with good spring rain, whiteheads may not occur, even in infected crops. Significant yield losses can occur when high disease levels coincide with moisture stress during grain fill. Affected heads have shrivelled or no grain.

There are no fungicide options to control crown rot once the crop has established. Including non-cereals into the rotation (such as pulses, oilseed, lupin, and grass-free pasture) can reduce inoculum levels. Inter-row seeding and maintaining reasonable grass weed control in break crops and between crops are also effective measures. Varietal resistance and tolerance to crown rot are limited. Recent research in WA suggests that varietal differences in barley do exist, but most barley varieties are susceptible and suffer yield loss to crown rot. Litmus has the lowest yield loss of the varieties tested in the presence of high crown rot.

BARLEY AND CEREAL YELLOW DWARF (BYD/CYD)

Both barley yellow dwarf (BYD) and cereal yellow dwarf (CYD) viruses occur in WA. As the screening for varietal resistance occurs in the field, the resistance score reflects the rating to both being present. However, BYD is more frequent than CYD at a ratio of approximately 2:1. BYD can reduce grain yield by up to 80% with seedling infection and up to 20% with later infection. Barley plants primarily become infected from infected oat (*Rhopalosiphum padi*) or corn leaf (*Rhopalosiphum maidis*) aphids.

Varietal resistance reduces the impact of the virus on plant growth but does not reduce the effect of aphid feeding on plant growth. Varietal resistance to BYD and CYD, therefore, does not reduce the need to spray for aphids to prevent yield loss from feeding damage once they reach threshold levels in the crop (50% of tillers with 15 or more aphids).

RUSSIAN WHEAT APHID (RWA)

Russian wheat aphid (RWA, *Diuraphis noxia*) was first detected in WA in the Esperance region in August 2020 following its discovery in South Australia, then Victoria, parts of New South Wales and Tasmania in 2016. RWA injects salivary toxins during feeding that can retard crop growth resulting in reduced grain yield and can even kill the plant with heavy infestations. Affected plants often show white, yellow and red streaky leaf markings and rolling of leaves. The aphid spreads quickly by the wind and on live plant material. The development of barley varieties with resistance to RWA is one of the tools in an integrated pest management strategy that includes green bridge management, agronomic practices, strategic use of insecticides and exploitation of natural enemies of the pest. Unlike oat and corn leaf aphids, RWA is not suspected of being a significant carrier of viruses, with damage caused directly by feeding and associated toxins.

Growers should implement the 'FITE' strategy (Find, Identify, Threshold approach and Enact) and report any incursions. When detected, everyone must adopt best-practice farm hygiene procedures to retard the spread of the pest between paddocks and adjacent properties. Keeping machinery out of affected areas and minimising movement in neighbouring areas are necessary control measures.

Chemical control is the primary cultural means of reducing damage from RWA. Seed dressings such as imidacloprid and insecticides, including chlorpyrifos and pirimicarb, are registered for control. Three Australian Pesticides and Veterinary Medicines Authority (APVMA) emergency use permits control their use. Prophylactic spraying is discouraged, and growers should only spray when economic thresholds are reached. An understanding of the behaviour, reproductive cycle, damage levels, thresholds and best management practices under Australian conditions are currently being developed.

Eradication of RWA in WA is not feasible, so biosecurity responses include surveillance of spread and appropriate management in-crop. In WA, report suspected RWA detections (including scouting resulting in no detection) using the MyPestGuide Reporter app (available at **agric.wa.gov.au/apps/mypestguide-reporter**), or by contacting the Pest and Disease Information Service (PaDIS) by calling +61 (0)8 9368 3080 or emailing **padis@dpird.wa.gov.au**.

ROOT LESION NEMATODE (RLN)

Root lesion nematodes (RLN, *Pratylenchus species*) are microscopic, worm-like animals that feed on plant roots causing yield loss in susceptible crops including wheat, barley and canola. RLN can be found in approximately 6.25 million ha (or ~74%) of the winter cropping area of WA. *Pratylenchus neglectus* is the dominant species and is found in 70% of paddocks in WA, followed by *P. quasitereoides* (formerly *P. teres*) in 29% of paddocks. Nematode populations potentially limit yield in at least 54% of infested paddocks. The RLN species *P. neglectus* and *P. quasitereoides* can cause yield losses of up to 18% in barley.

The key to managing RLN is to identify paddocks with yield-limiting numbers and incorporate resistant crops and varieties to reduce their number. The *P. neglectus* and *P. quasitereoides* nematode resistance scores in this sowing guide are from WA observations only. The ratings are from both glasshouse and field trials. Provisional ratings provided for varieties with fewer than three observations, or where there has been no field trial verification of the glasshouse rating.

CEREAL CYST NEMATODE (CCN)

Cereal cyst nematode (CCN, *Heterodea avenae*) is present in cropping regions around Geraldton and the Avon Valley around Northam, but it can occur sporadically across the WA wheatbelt. Unlike RLN, barley varieties are tolerant to CCN, so yield loss is limited even when the infection does occur. The planting of CCN resistant varieties retards nematode development, leading to lower nematode levels in the soil for subsequent crops.

TABLE 13. Seedling (two to the three-leaf stage) leaf disease resistance profiles when grown in WA

Disease[1]	Scald	Net-type net blotch[4]			Spot-type net blotch	Powdery mildew[5]	Barley leaf rust
Pathotype[2]	Medina	Beecher virulent (95NB100)	Beecher avirulent (97NB1)	Oxford virulent (EDRS)	(South Perth)	(South Perth)	(5457 P-)
Growth stage[3]	Seedling	Seedling	Seedling	Seedling	Seedling	Seedling	Seedling
Deliverable as a malt variety							
Bass	-	MR	S	SVS	MRMS	MSS	SVS
Flinders	-	MRMS	MSS	SVS	MSS	R	MS
La Trobe	-	MS	MRMS	S	S	MSS	MS
RGT Planet	-	MRMS	MRMS	S	S	R	MSS
Spartacus CL	-	MS	MRMS	S	SVS	MS	MS
Stage 2 malt accreditation							
Buff	-	MS	MRMS	MS	MSS	S	SVS
Leabrook	-	MRMS	S	MS	MS	MR	SVS
LG Alestar	-	MS	S	S	SVS	RMR	MS
Maximus CL	-	MSS	MRMS	S	MSS	MR*	S
Deliverable as a feed variety							
Banks	-	MRMS	MS	MRMS	MSS	MRMS	S
Beast		MSS*p*	MRMS*p*	MSS*p*	MS*p*	MR*p*	MSS*p*
Compass	-	MRMS	S	S	MRMS	MRMS	S
Fathom	-	S	MSS	SVS	MR	MS	MSS
Granger	-	MRMS	MRMS	MRMS	S	R	MS
Laperouse	-	S	S	S	MS	R	MSS
Litmus	-	S	S	S	S	MS	S
Mundah	-	S	S	MSS	MSS	SVS	S
Rosalind	-	MR	MR	MSS	MSS	MS	MRMS
Scope CL	-	MR	MR	S	MSS	R	S

Source: Sanjiv Gupta and NVT Online, **nvtonline.com.au**

[1]Resistance rating: VS = very susceptible, S = susceptible, MS = moderately susceptible, MRMS = intermediate, MR = moderately resistant, R = resistant, *p* = provisional rating, - = no data available.

[2]Pathotype: the strain of the pathogen used in evaluating the disease reaction of the different barley varieties, which represents the most common pathotype present in WA. On-farm reactions of varieties may, therefore, differ if the pathotype present differs to the pathotype used in testing.

[3]Growth stage: the seedling resistance score reflects resistance at the two to the three-leaf stage (use data cautiously after the four-leaf stage). Varieties with a VS or S rating at the seedling stage are at a higher risk of early infection.

[4]Net-type net blotch: three pathotypes (95NB100, 97NB1 and Oxford) of NTNB are present in WA. While the Beecher avirulent (97NB1) pathotype is dominant in the State, the Beecher virulent (95NB100) can be present north of the Great Eastern Highway. In contrast, a new pathotype (Oxford) is present in the southern regions.

[5]Powdery mildew: varieties with a VS or S rating at the seedling stage (i.e. Mundah) should be treated with a seed dressing active against powdery mildew to prevent early infection during the tillering phase. *Rosalind and Maximus CL may show a susceptible reaction to some strains of PM present in WA.

TABLE 14. Adult (after flag leaf emergence) leaf disease resistance profiles when grown in WA

Disease[1]	Scald	Net-type net blotch[4]			Spot-type net blotch	Powdery mildew[5]	Barley leaf rust
Pathotype[2]	Medina	Beecher virulent (95NB100)	Beecher avirulent (97NB1)	Oxford virulent (EDRS)	(South Perth)	(South Perth)	(5457 P-)
Growth stage[3]	Seedling	Seedling	Seedling	Seedling	Seedling	Seedling	Seedling
Deliverable as a malt variety							
Bass	MRMS	MRMS	MSS	S	S	MSS	SVS
Flinders	MSS	MRMS	MS	S	S	R	MRMS (late APR)
La Trobe	MR	MS	MS	S	SVS	MS	S
RGT Planet	MRMS	SVS	MRMS	SVS	S	R	MRMS (late APR)
Spartacus CL	MR	MSS	MS	MSS	SVS	MRMS	MSS
Stage 2 malt accreditation							
Buff	MSS	MRMS	MRMS	MS	S	S	S
Leabrook	MSS	MRMS	MRMS	S	MS	MR	MSS
LG Alestar	S	MS	MRMS	MSS	S	MR	MRMS
Maximus CL	MR	MSS	MRMS	S	MSS	RMR*	MSS
Deliverable as a feed variety							
Banks	S	MS	MS	MS	S	MR	MSS
Beast	SVS*p*	MRMS*p*	MR*p*	S*p*	MS*p*	R*p*	MRMS*p* (APR)
Compass	MS	MRMS	MS	S	MSS	MRMS	S
Fathom	MR	S	MS	SVS	MRMS	MRMS	MRMS (late APR)
Granger	MSS	MS	MRMS	MS	SVS	R	MRMS (APR)
Laperouse	S	MRMS	MRMS	S	MRMS	R	S
Litmus	SVS	S	S	S	S	MR	S
Mundah	S	S	MS	S	S	MSS	S
Rosalind	MSS	MS	MR	MSS	S	MRMS*	MR
Scope CL	MS	MRMS	MRMS	S	S	R	MSS

Source: Sanjiv Gupta and NVT Online, **nvtonline.com.au**

[1]Resistance rating: VS = very susceptible, S = susceptible, MS = moderately susceptible, MRMS = intermediate, MR = moderately resistant, R = resistant, *p* = provisional rating, - = no data available.

[2]Pathotype: the strain of the pathogen used in evaluating the disease reaction of the different barley varieties, which represents the most common pathotype present in WA. On-farm reactions of varieties may, therefore, differ if the pathotype present differs to the pathotype used in testing.

[3]Growth stage: the adult resistance score reflects resistance after flag leaf emergence.

[4]Net-type net blotch: three pathotypes (95NB100, 97NB1 and Oxford) of NTNB are present in WA. While the Beecher avirulent (97NB1) pathotype is dominant in the State, the Beecher virulent (95NB100) can be present north of the Great Eastern Highway. In contrast, a new pathotype (Oxford) is present in the southern regions.

[5]Powdery mildew: *Rosalind and Maximus CL may show a susceptible reaction to some strains of PM present in WA.

TABLE 15. Crown rot yield loss and virus and nematode seedling and adult resistance profiles when grown in WA

Disease[1]	Crown rot yield loss	Barley and cereal yellow dwarf[3]	Root lesion nematode[4]	Root lesion nematode[4]	Cereal cyst nematode5
Pathotype	Fusarium pseudograminearum		Pratylenchus neglectus	Pratylenchus quasitereoides	Heterodera avenae
Growth stage[2]	Seedling and adult	Seedling and adult	Seedling and adult	Seedling and adult	Seedling and adult
Deliverable as a malt variety					
Bass	High	MS	MSS	MSS	S
Flinders	High	MRMS	MS	MS*p*	S
La Trobe	Moderate	S	MS	MSS	R
RGT Planet	-	MRMS	MSS	MS*p*	R*p*
Spartacus CL	Moderate	MSS	S	MS*p*	R
Stage 2 malt accreditation					
Buff	-	MRMS	-	MS*p*	S*p*
Leabrook	-	MSS	-	MS*p*	R
LG Alestar	-	MRMS	-	-	R
Maximus CL	-	MRMS	-	-	R
Deliverable as a feed variety					
Banks	-	MS	-	MS*p*	-
Beast	-	MS*p*	-	-	MR*p*
Compass	High	MSS	MSS	S	R
Fathom	Moderate	MRMS	MS*p*	MSS	R
Granger	High	MRMS	MS	MSS	R
Laperouse	-	MRMS	-	-	S
Litmus	Low	S	-	MS*p*	MS
Mundah	Moderate	MS	-	MS*p*	S
Rosalind	Moderate	MS	-	MS*p*	R
Scope CL	High	MRMS	MSS	MS	S

Source: crown rot – Daniel Huberli, viruses – Sanjiv Gupta, nematodes – Sarah Collins & Carla Wilkinson and NVT Online, **nvtonline.com.au**

[1]Crown rot yield loss: Low = <10% yield loss, Moderate = 10-20% yield loss, High = >20% yield loss, - = no data available. Nematode and virus resistance rating: VS = very susceptible, S = susceptible, MS = moderately susceptible, MRMS = intermediate, MR = moderately resistant, R = resistant, p = provisional rating, - = no data available.

[2]Growth stage: the resistance to barley and cereal yellow dwarf virus and the varietal impacts on nematode numbers do not differ between growth stages, it applies equally throughout the life of the plant.

[3]Barley and cereal yellow dwarf: plants become infected from infected oat and corn leaf aphids. Varietal resistance reduces the impact of the virus on plant growth but does not reduce the effect of aphid feeding on plant growth.

[4]Root lesion nematode: barley varieties vary in the impact of root-lesion nematode on their growth. A resistant variety retards nematode development, leading to lower nematode levels in the soil for subsequent crops. Pratylenchus teres has been renamed Pratylenchus quasitereoides. Ratings based on data collected in WA.

[5]Cereal cyst nematode: all barley varieties are tolerant of cereal cyst nematode, but a resistant variety retards nematode development, leading to lower nematode levels in the soil for subsequent crops.

Variety snapshots

Variety snapshots are presented for:

- five varieties (Bass, Flinders, La Trobe, RGT Planet and Spartacus CL) that can be delivered into malt segregations in WA at the 2021/22 harvest (as per the GIWA Western Australian malt barley variety receival recommendations for the 2021/22 harvest);
- four varieties undergoing Stage 2 malt accreditation with Barley Australia (Buff, Leabrook, LG Alestar and Maximus CL); and
- ten varieties that can only be delivered into feed segregations (Banks, Beast, Compass, Fathom, Granger, Laperouse, Litmus, Mundah, Rosalind and Scope CL).

Each snapshot describes essential characteristics of a variety including their yield relative to another variety, key weaknesses and strengths (including where appropriate disease resistance, straw strength and head loss) and relevant market information for varieties that are segregated as malt.

Grain yield data extracted from the Long Term MET Yield Reporter (available at NVT online, **nvtonline.com.au**) are presented relative to a control variety (typically Spartacus CL) rather than the site mean yield (as shown in Tables 4 to 10) for each year in the period 2015 to 2019. Single-site MET data has been used in the comments section to highlight the probability of one variety yielding less, the same, or more than another variety when grown under the same agronomy (in the same trial).

Disease and nematode resistance ratings are sourced from Tables 13 to 15 and presented for the seedling and adult growth stages of the plant (if known).

Phenology information is an output of the new flowering date predictive program, 'FlowerPower' barley (available at **agric.wa.gov.au** by searching for Barley module of 'Flower Power'). 'FlowerPower' barley is a statistical model that predicts the date of awn emergence (Z49) for barley in WA environments. Model predictions are based on historical temperature data back to 1966 and are provided for warmer than average (decile 8-10), normal (decile 4-7) and colder than average (decile (1-3) seasons. The phenology data presented in the snapshots are the median predicted date to Z49 (date predicted for 50% of 'normal' seasons) based on 'FlowerPower' barley version 6.1.2. Data is presented relative to a control variety (typically Spartacus CL) for four model environments (Carnamah, Cunderdin, Katanning, and Grass Patch) for four sowing dates (15-April, 05-May, 25-May and 15-June).

Agronomic traits are tabulated based on published data, data collected by DPIRD, data generated from the DPIRD-GRDC co-funded projects DAW00190 and DAW00224 and in some cases, from the breeder. Data presented include:

- coleoptile length where short = 40-60mm, medium = 60-80mm and long = 80-100mm,
- target plant density in plants/m^2 when weeds are present,
- plant height to the base of the ear (cm) at maturity. Very short = <45cm, short = 45-55cm, medium = 55-65cm and tall = 65-75cm relative to varieties such as Stirling, Buloke and Scope CL at sites where their straw was between 65-75cm long,
- straw strength based on lodging scores taken at maturity and ranked relative to control varieties,
- head loss risk assessed in small plot trials and ranked based on counting heads post-harvest at sites where high levels of head loss recorded in high-risk varieties (i.e. Scope CL), and
- grain protein deviation where lower = <-0.3%, slightly lower = -0.3 to -0.1%, average = -0.1 to +0.1%, slightly higher = +0.1 to +0.3% and higher = > +0/3%. Grain protein deviation was calculated and ranked using data from NVT trials (2005-2019) and DPIRD-GRDC funded barley agronomy trials (2006-2019). Grain protein deviation analyses the relationship between grain yield and grain protein concentration in barley varieties grown under similar management and environmental conditions in WA. There is a typical relationship in which under the same level of input, as grain yield increases, grain protein concentration decreases (because of yield dilution). Deviations from this relationship between grain yield and grain protein were used to classify varieties for their grain protein deviation and determine relative levels of inherent grain protein concentration.

Variety information including pedigree, the seed licensee, seed trading restrictions and the EPR payable sourced from breeding companies, Variety Central (**varietycentral.com.au/**) and IP Australia Plant Breeders Rights database (**pericles.ipaustralia.gov.au/pbr_db/search.cfm**).

BASS(Φ)

DELIVERABLE AS A MALT VARIETY

Comments

Bass is a short height, medium spring, malt barley preferred for export as grain and as malt but not for shochu. Bass has strong market demand from domestic maltsters and international brewing customers, which can often result in a price premium. Best suited to environments with a yield potential above 3t/ha. Across 63 WA barley NVT (2016-2019), Bass yielded less than RGT Planet in 83% of trials, the same in 15% and higher in 2%. Along with Flinders, Bass has a better physical grain quality package than La Trobe, RGT Planet and Spartacus CL (resulting in a higher strike rate into Malt1 segregations), with a good hectolitre weight, high grain plumpness and a higher grain protein potential. Can show a moderate head loss risk in the Esperance Port Zone, but not in other port zones. Fungicides may be required to manage NTNB (Oxford virulent), STNB, PM and BLR. Weed competitiveness similar to other semi-dwarf varieties. Despite strong market demand, the area sown to Bass is continuing to decline and it accounted for just under 3% of the state's barley acreage in 2019. Target production zone in 2021 is Kwinana-North (Midlands) with limited segregation opportunities in Kwinana-South and Albany-South (subject to production volumes).

Yield (% Spartacus CL)	2015	2016	2017	2018	2019
Agzone 1	78	95	91	92	82
Agzone 2	79	96	96	92	86
Agzone 3	85	89	91	95	88
Agzone 4	81	-	73	96	84
Agzone 5	84	94	95	88	72
Agzone 6	91	91	104	96	91
State-wide	83	94	94	92	85

Disease resistance	Seedling	Adult
Scald	-	MRMS
NTNB (Beecher virulent)	MR	MRMS
NTNB (Beecher avirulent)	S	MSS
NTNB (Oxford virulent)	SVS	S
STNB	MRMS	S
Powdery mildew	MSS	MSS
Leaf rust (5457P-)	SVS	SVS
BYD and CYD	MS	MS
RLN (*P. neglectus*)	MSS	MSS
RLN (*P. quasitereoides*)	MSS	MSS
CCN	S	S
Crown rot	High yield loss (>20%)	

'FlowerPower' predicted flowering date (days to Z49)	Relative to Spartacus CL			
	15-Apr	05-May	25-May	15-Jun
Carnamah	+6	+5	+4	+4
Cunderdin	+7	+6	+5	+4
Katanning	+7	+7	+5	+4
Grass Patch	+8	+6	+4	+5

Agronomic traits	
Early growth habit	Prostrate
Coleoptile length	Medium
Target plant density	150-180 plants/m^2
Plant height	Short
Straw strength	Very good
Head loss risk	Medium
Grain protein deviation	Higher

Variety information	
Pedigree	WABAR2023/Alexis
Breeder / Seed licensee	InterGrain
Access to seed	Free to trade
EPR ($/t, excl. GST)	$3.50

p = provisional assessment

FLINDERS(Φ)

DELIVERABLE AS A MALT VARIETY

Comments

Flinders is a short height, late spring, malt barley that is acceptable for export as grain and preferred for export as malt but not for shochu. Flinders has gained limited adoption by growers. It is well suited to customers wanting gibberellic acid-free malt and is useful as a post-malt blending variety to manage malt specifications to end-user requirements. Best suited to environments with a yield potential above 3t/ha and environments where short, stiff straw and good head retention are essential. Across 61 WA barley NVT (2016-2019), Flinders yielded less than RGT Planet in 80% of trials, the same in 18% and higher in 2%. Flinders has good physical grain characteristics, and is an improvement on La Trobe, RGT Planet and Spartacus CL with malt receival rates similiar to Bass. Flinders is resistant to PM (non-*mlo*) but fungicides may be required to manage NTNB (Oxford virulent), STNB and BLR (despite having APR). Weed competitiveness is similar to other semi-dwarf varieties. The area sown to Flinders is declining, and it accounted for just over 3% of the state's barley acreage in 2019. Target production zone in 2021 is Albany-South with potential niche segregation opportunities in Kwinana-South and the Esperance Port Zone (subject to production volumes and market demand).

Yield (% Spartacus CL)	2015	2016	2017	2018	2019
Agzone 1	87	-	91	90	75
Agzone 2	88	98	98	92	86
Agzone 3	96	97	99	99	93
Agzone 4	85	-	74	99	82
Agzone 5	88	-	99	94	78
Agzone 6	102	109	129	104	101
State-wide	92	101	98	94	89

Disease resistance	Seedling	Adult
Scald	-	MSS
NTNB (Beecher virulent)	MRMS	MRMS
NTNB (Beecher avirulent)	MSS	MS
NTNB (Oxford virulent)	SVS	S
STNB	MSS	S
Powdery mildew	R	R
Leaf rust (5457P-)	MS	MRMS (late APR)
BYD and CYD	MRMS	MRMS
RLN (*P. neglectus*)	MS	MS
RLN (*P. quasitereoides*)	MSS*p*	MSS*p*
CCN	S	S
Crown rot	High yield loss (>20%)	

'FlowerPower' predicted flowering date (days to Z49)	Relative to Spartacus CL			
	15-Apr	05-May	25-May	15-Jun
Carnamah	+8	+9	+8	+8
Cunderdin	+9	+10	+10	+8
Katanning	+10	+11	+9	+8
Grass Patch	+10	+9	+10	+8

Agronomic traits	
Early growth habit	Prostrate
Coleoptile length	Short
Target plant density	150-180 plants/m^2
Plant height	Short
Straw strength	Very good
Head loss risk	Low
Grain protein deviation	Slightly higher

Variety information	
Pedigree	Baudin/Cooper
Breeder / Seed licensee	InterGrain
Access to seed	Free to trade
EPR ($/t, excl. GST)	$3.80

p = provisional assessment

LA TROBE(Φ)

DELIVERABLE AS A MALT VARIETY

Comments

La Trobe is a medium height, early spring, malt barley that is preferred for export as grain, malt and for shochu. La Trobe, like Bass, is more likely to attract and maintain a premium over feed when the market is oversupplied. La Trobe is the only malt variety currently segregated in WA accepted for shochu manufacture in Japan. Best suited to environments with a yield potential below 4t/ha. Across 64 WA barley NVT (2016-2019), La Trobe yielded less than RGT Planet in 50% of trials, the same in 19% and higher in 31%. Better suited than RGT Planet to environments with a shorter grain-filling period. Like Spartacus CL, La Trobe is more responsive to applied nitrogen than other malt varieties segregated in WA. Fungicides may be required to manage smut, NTNB (Oxford virulent), STNB and BLR. Do not ruin the integrity of La Trobe seed crops or malt stacks by contaminating them with Hindmarsh or Spartacus CL barley. La Trobe was the third most popular barley variety in 2019, accounting for just over 12% of the state's barley acreage but its popularity declined in 2020. Target production zones in 2021 are Kwinana, Albany, and Esperance Port Zones where limited segregations will be offered in line with the reduced plantings.

Yield (% Spartacus CL)	2015	2016	2017	2018	2019
Agzone 1	97	102	102	102	103
Agzone 2	96	103	102	101	99
Agzone 3	101	101	101	102	99
Agzone 4	97	-	94	102	102
Agzone 5	97	101	102	100	94
Agzone 6	100	104	102	102	101
State-wide	99	103	101	101	99

Disease resistance	Seedling	Adult
Scald	-	MR
NTNB (Beecher virulent)	MS	MS
NTNB (Beecher avirulent)	MRMS	MS
NTNB (Oxford virulent)	S	S
STNB	S	SVS
Powdery mildew	MSS	MS
Leaf rust (5457P-)	MS	S
BYD and CYD	S	S
RLN (*P. neglectus*)	MS	MS
RLN (*P. quasitereoides*)	MSS	MSS
CCN	R	R
Crown rot	Moderate yield loss (10-20%)	

'FlowerPower' predicted flowering date (days to Z49)	Relative to Spartacus CL			
	15-Apr	05-May	25-May	15-Jun
Carnamah	+2	+1	+1	+0
Cunderdin	+2	+1	+1	+0
Katanning	+2	+2	+1	+0
Grass Patch	+2	+1	+1	+1

Agronomic traits	
Early growth habit	Erect
Coleoptile length	Short
Target plant density	150-180 plants/m^2
Plant height	Medium
Straw strength	Moderately good
Head loss risk	Medium
Grain protein deviation	Slightly lower

Variety information	
Pedigree	Dash/VB9409
Breeder / Seed licensee	InterGrain
Access to seed	Free to trade
EPR ($/t, excl. GST)	$4.00

p = provisional assessment

RGT PLANET(Φ)

DELIVERABLE AS A MALT VARIETY

Comments

RGT Planet is a medium height, medium spring, malt barley acceptable for export as grain and as malt but not for shochu. Accepted in most south-east Asian beer markets. Suited to environments with a yield potential above 3t/ha and, more specifically, to paddocks with a year-in-year-out potential above 5t/ha. Due to its early vigour, RGT Planet is suited to mixed farms where grain and graze is practised. Across 64 WA barley NVT (2016-2019), RGT Planet yielded less than Rosalind in 48% of trials, the same in 22% and higher in 30%. The physical grain quality package of RGT Planet is inferior to Bass, Flinders and Spartacus CL, being comparable to La Trobe. Excellent resistance to PM (due to *mlo* gene) and useful resistance to BLR (due to APR gene). Fungicides may be required to manage NTNB (Beecher virulent and Oxford virulent), STNB and BLR (under high pressure). Appears to have a similar level of weed competitiveness (tested against oats) to Compass and Fathom. RGT Planet was the second most popular barley variety in 2019, and its acreage is growing. It accounted for two out of every ten barley hectares in 2019. Target production zones in 2021 are Kwinana-North (Midlands), Kwinana-South, Albany-South, and Esperance Port Zones with limited segregation opportunities in Albany-North (subject to production volumes).

Yield (% Spartacus CL)	2015	2016	2017	2018	2019
Agzone 1	-	107	99	100	90
Agzone 2	-	109	107	100	91
Agzone 3	-	110	113	110	103
Agzone 4	-	-	72	106	87
Agzone 5	-	123	111	104	79
Agzone 6	-	136	146	117	114
State-wide	-	116	109	104	96

Disease resistance	Seedling	Adult
Scald	-	MRMS
NTNB (Beecher virulent)	MRMS	SVS
NTNB (Beecher avirulent)	MRMS	MRMS
NTNB (Oxford virulent)	S	SVS
STNB	S	S
Powdery mildew	R	R
Leaf rust (5457P-)	MSS	MRMS (late APR)
BYD and CYD	MRMS	MRMS
RLN (*P. neglectus*)	MSS	MSS
RLN (*P. quasitereoides*)	MSS*p*	MSS*p*
CCN	R*p*	R*p*
Crown rot	-	

'FlowerPower' predicted flowering date (days to Z49)	Relative to Spartacus CL			
	15-Apr	05-May	25-May	15-Jun
Carnamah	+3	+4	+4	+6
Cunderdin	+4	+5	+5	+6
Katanning	+4	+5	+5	+6
Grass Patch	+4	+4	+4	+7

Agronomic traits	
Early growth habit	Prostrate
Coleoptile length	-
Target plant density	150-180 plants/m^2
Plant height	Medium
Straw strength	Good
Head loss risk	Low
Grain protein deviation	Slightly lower

Variety information	
Pedigree	Tamtam/Concerto
Breeder / Seed licensee	RAGT Semences / Seed Force
Access to seed	Seed Force
EPR ($/t, excl. GST)	$4.00

p = provisional assessment

SPARTACUS CL(ϕ)

DELIVERABLE AS A MALT VARIETY

Comments

Spartacus CL is a medium height, early spring, malt barley acceptable for export as grain and as malt. An increase in the MRL for imidazolinone in Japan will restart its evaluation for shochu. Across 64 WA barley NVT (2016-2019), Spartacus CL yielded less than RGT Planet in 50% of trials, the same in 19% and higher in 31%. Replacing La Trobe due to its lower lodging risk, lower head loss risk, slightly plumper grain, higher grain protein and slightly brighter grain with similar phenology and germ-end staining risk. Spartacus CL is replacing Scope CL where imidazolinone herbicides are needed or have been used and where its improved agronomy is a benefit. Fungicides may be required to manage smut, NTNB (Oxford virulent), STNB and BLR. Spartacus CL appears to be a weak competitor with weeds (based on data from eastern Australia). Do not ruin the integrity of Spartacus CL seed stocks or malt stacks by contaminating it with La Trobe or Scope CL barley. Spartacus CL was the most popular barley variety in 2019, accounting for four out of every every ten barley hectares, and with increased production in 2020. Target production zones in 2021 are Geraldton, Kwinana, Albany, and Esperance Port Zones.

Yield (% La Trobe)	2015	2016	2017	2018	2019
Agzone 1	103	98	98	98	97
Agzone 2	104	97	98	99	101
Agzone 3	99	99	99	98	101
Agzone 4	103	-	106	98	98
Agzone 5	103	99	98	100	106
Agzone 6	100	96	98	98	99
State-wide	101	97	99	99	101

Disease resistance	Seedling	Adult
Scald	-	MR
NTNB (Beecher virulent)	MS	MSS
NTNB (Beecher avirulent)	MRMS	MS
NTNB (Oxford virulent)	S	MSS
STNB	SVS	SVS
Powdery mildew	MS	MRMS
Leaf rust (5457P-)	MS	MSS
BYD and CYD	MSS	MSS
RLN (*P. neglectus*)	S	S
RLN (*P. quasitereoides*)	MS*p*	MS*p*
CCN	R	R
Crown rot	Moderate yield loss (10-20%)	

'FlowerPower' predicted flowering date (days to Z49)	Relative to La Trobe			
	15-Apr	05-May	25-May	15-Jun
Carnamah	-2	-1	-1	+0
Cunderdin	-2	-1	-1	+0
Katanning	-2	-2	-1	+0
Grass Patch	-2	-1	-1	-1

Agronomic traits	
Early growth habit	Erect
Coleoptile length	Short
Target plant density	150-180 plants/m^2
Plant height	Medium
Straw strength	Good
Head loss risk	Low
Grain protein deviation	Slightly higher

Variety information	
Pedigree	Scope/4*Hindmarsh//HMVB0325-106
Breeder / Seed licensee	InterGrain
Access to seed	Seedclub members and resellers
EPR ($/t, excl. GST)	$4.25

p = provisional assessment

BUFF(ϕ)

STAGE TWO MALT ACCREDITATION

Comments

Buff (tested as IGB1506) is a medium height, early spring barley under evaluation by Barley Australia to supersede Litmus. Buff has similar Al tolerance genetics to Litmus but, unlike Litmus, it has a white aleurone. Receival of Buff will therefore not be restricted (as it is for Litmus) due to aleurone colour. Unlike Litmus, Buff is a competitor on non-acidic soils to Fathom, La Trobe (and its derivatives) and Rosalind. Across 56 WA barley NVT (2016-2019), Buff yielded less than Rosalind in 45% of trials, the same in 25% and higher in 30%. Across 27 WA barley NVT trials (2016-2017, 2019) Buff has yielded less than Litmus in 7%, the same in 23% and higher in 70%. The overall disease resistance profile of Buff is similar to Litmus with improvements in tolerance to scald and NTNB. Fungicides may be required to manage STNB, PM and BLR. Its weed competitiveness has not been tested. Straw strength is an improvement over Litmus. Preliminary head loss data suggest that Buff may be at a medium risk of head loss. Buff has passed Stage One of the Barley Australia accreditation process. Due to a lack of grain in specification Stage Two will commence in 2021, with the earliest accreditation date being March 2022.

Yield (% Spartacus CL)	2015	2016	2017	2018	2019
Agzone 1	-	112	118	113	121
Agzone 2	-	123	108	105	102
Agzone 3	-	-	-	108	99
Agzone 4	-	-	76	128	146
Agzone 5	-	109	99	102	93
Agzone 6	-	-	-	111	105
State-wide	-	118	106	108	101

Disease resistance	Seedling	Adult
Scald	-	MSS
NTNB (Beecher virulent)	MS	MRMS
NTNB (Beecher avirulent)	MRMS	MRMS
NTNB (Oxford virulent)	MS	MS
STNB	MSS	S
Powdery mildew	S	S
Leaf rust (5457P-)	SVS	S
BYD and CYD	MRMS	MRMS
RLN (*P. neglectus*)	-	-
RLN (*P. quasitereoides*)	MS*p*	MS*p*
CCN	S*p*	S*p*
Crown rot	-	

'FlowerPower' predicted flowering date (days to Z49)	Relative to Spartacus CL			
	15-Apr	05-May	25-May	15-Jun
Carnamah	-	-	-	-
Cunderdin	-	-	-	-
Katanning	-	-	-	-
Grass Patch	-	-	-	-

Agronomic traits	
Early growth habit	Erect
Coleoptile length	Medium
Target plant density	150-180 plants/m^2
Plant height	Medium
Straw strength	Moderately good
Head loss risk	-
Grain protein deviation	Slightly higher

Variety information	
Pedigree	Complex backcross to a Mundah derivative
Breeder / Seed licensee	AgVic Services / InterGrain
Access to seed	Free to trade
EPR ($/t, excl. GST)	$3.50

p = provisional assessment

LEABROOK(ϕ)

STAGE TWO MALT ACCREDITATION

Comments

Leabrook (tested as WI4896) is a tall height, early spring barley under evaluation by Barley Australia. It is potentially a better option than RGT Planet in environments with a yield potential below 4t/ha where barley leaf rust is not a year-in-year-out problem. Across 64 WA barley NVT (2016-2019) Leabrook yielded less than RGT Planet in 38% of trials, the same in 23% and higher in 39%. Leabrook is a sister line to Compass and possesses many similar agronomic attributes including phenology, plant architecture, straw strength, and grain quality but with improvements in grain yield and malt quality (mostly malt extract). While its grain has a lower hectolitre weight than Spartacus CL grain, its grain is plumper with similar brightness. Being able to hold grain size across seasons would be an advantage if segregated. There is not enough data to assess its head loss risk, but it does not appear to be high. Fungicides may be required to manage NTNB (Oxford virulent) and BLR, although it does not appear to be as susceptible as Compass to BLR. Leabrook's weed competitiveness has not been tested but is likely to be similar to Compass. Leabrook has passed Stage One of the Barley Australia accreditation process and will continue with Stage Two evaluation during 2020, with the earliest accreditation date being March 2021.

Yield (% Spartacus CL)	2015	2016	2017	2018	2019
Agzone 1	95	108	108	110	117
Agzone 2	95	110	106	107	101
Agzone 3	107	104	106	106	102
Agzone 4	95	-	89	107	109
Agzone 5	99	102	107	102	90
Agzone 6	101	112	96	106	104
State-wide	100	109	105	106	100

Disease resistance	Seedling	Adult
Scald	-	MSS
NTNB (Beecher virulent)	MRMS	MRMS
NTNB (Beecher avirulent)	S	MRMS
NTNB (Oxford virulent)	MS	S
STNB	MS	MS
Powdery mildew	MR	MR
Leaf rust (5457P-)	SVS	MSS
BYD and CYD	MSS	MSS
RLN (*P. neglectus*)	-	-
RLN (*P. quasitereoides*)	MS*p*	MS*p*
CCN	R	R
Crown rot	-	

'FlowerPower' predicted flowering date (days to Z49)	Relative to Spartacus CL			
	15-Apr	05-May	25-May	15-Jun
Carnamah	-	-	-	-
Cunderdin	-	-	-	-
Katanning	-	-	-	-
Grass Patch	-	-	-	-

Agronomic traits	
Early growth habit	Semi-erect
Coleoptile length	-
Target plant density	150-180 plants/m^2
Plant height	Tall
Straw strength	Fair
Head loss risk	-
Grain protein deviation	Slightly lower

Variety information	
Pedigree	County/Commander//Commander
Breeder / Seed licensee	University of Adelaide / SeedNet
Access to seed	SeedNet Partners
EPR ($/t, excl. GST)	$3.80

p = provisional assessment

LG ALESTAR(ϕ)

STAGE TWO MALT ACCREDITATION

Comments

LG Alestar (tested as SMBA11-2341) is a medium height, late spring barley under evaluation by Barley Australia. Best suited to environments above 3t/ha where both powdery mildew and BLR are a problem. Across 29 WA barley NVT (2016, 2019), LG Alestar yielded less than RGT Planet in 79% of trials, the same in 18% and higher in 3%. The grain of LG Alestar has a white aleurone, even though one of its parents Henley has a blue aleurone. It has many similar agronomic attributes to Granger with improved grain brightness but a lower hectolitre weight. The grain quality of LG Alestar is generally inferior to Bass and Flinders. It has durable resistance to PM (based on the *mlo* gene) and resistance to BLR (seedling and adult). Fungicides may be required to manage scald and STNB. Its weed competitiveness has not been tested. It appears to have good straw strength, but there is not enough data to assess its head loss risk. LG Alestar has passed Stage One of the Barley Australia accreditation process and will continue with Stage Two evaluation during 2020, with the earliest accreditation date being March 2021.

Yield (% Spartacus CL)	2015	2016	2017	2018	2019
Agzone 1	-	100	-	-	77
Agzone 2	85	103	-	-	85
Agzone 3	96	99	-	-	92
Agzone 4	82	-	-	-	93
Agzone 5	82	111	-	-	75
Agzone 6	99	113	-	-	101
State-wide	89	105	-	-	88

Disease resistance	Seedling	Adult
Scald	-	S
NTNB (Beecher virulent)	MS	MS
NTNB (Beecher avirulent)	S	MRMS
NTNB (Oxford virulent)	S	MSS
STNB	SVS	S
Powdery mildew	RMR	MR
Leaf rust (5457P-)	MS	MRMS
BYD and CYD	MRMS	MRMS
RLN (*P. neglectus*)	-	-
RLN (*P. quasitereoides*)	-	-
CCN	R	R
Crown rot	-	

'FlowerPower' predicted flowering date (days to Z49)	Relative to Spartacus CL			
	15-Apr	05-May	25-May	15-Jun
Carnamah	-	-	-	-
Cunderdin	-	-	-	-
Katanning	-	-	-	-
Grass Patch	-	-	-	-

Agronomic traits	
Early growth habit	Prostrate
Coleoptile length	-
Target plant density	150-180 plants/m^2
Plant height	Medium
Straw strength	Good
Head loss risk	-
Grain protein deviation	Slightly lower

Variety information	
Pedigree	Henley/NSL02-4136A
Breeder / Seed licensee	Limagrain / Elders
Access to seed	Elders
EPR ($/t, excl. GST)	$3.80

p = provisional assessment

MAXIMUS CL(Þ)

STAGE TWO MALT ACCREDITATION

Comments

Maximus CL (tested as IGB1705T) is an imidazolinone tolerant, medium height, medium spring barley under evaluation by Barley Australia. Across 39 WA barley NVT (2018-2019), Maximus CL yielded less than RGT Planet in 31% of trials, the same in 15% and higher in 54%, performing better in environments that yielded less than 4t/ha. The WA NVT MET (2015-2019) suggests that Maximus CL has a yield advantage of 4% over Spartacus CL. Maximus CL grain appears to be plumper than Spartacus CL grain with a similar hectolitre weight, although it appears to have a darker kernel. Phenology data indicates that it may reach awn emergence 2-4 days later than Spartacus CL across a range of sowing dates. Maximus CL is a general improvement over Spartacus CL for NTNB (Beecher avirulent) as an adult, STNB (as both a seedling and an adult plant) and for PM as a seedling. Fungicides may be required to manage NTNB (Oxford virulent) and some pathotypes of PM. Preliminary data suggest that Maximus CL may have a low risk of head loss. Maximus CL has passed Stage One of the Barley Australia accreditation process and will continue with Stage Two evaluation during 2020, with the earliest accreditation date being March 2021.

Yield (% Spartacus CL)	2015	2016	2017	2018	2019
Agzone 1	-	-	-	105	108
Agzone 2	-	-	-	103	103
Agzone 3	-	-	-	104	103
Agzone 4	-	-	-	107	112
Agzone 5	-	-	-	104	103
Agzone 6	-	-	-	105	105
State-wide	-	-	-	104	103

Disease resistance	Seedling	Adult
Scald	-	MR
NTNB (Beecher virulent)	MSS	MSS
NTNB (Beecher avirulent)	MRMS	MRMS
NTNB (Oxford virulent)	S	S
STNB	MSS	MSS
Powdery mildew	MR*	RMR*
Leaf rust (5457P-)	S	MSS
BYD and CYD	MRMS	MRMS
RLN (*P. neglectus*)	-	-
RLN (*P. quasitereoides*)	-	-
CCN	R	R
Crown rot	-	

'FlowerPower' predicted flowering date (days to Z49)	Relative to Spartacus CL			
	15-Apr	05-May	25-May	15-Jun
Carnamah	-	-	-	-
Cunderdin	-	-	-	-
Katanning	-	-	-	-
Grass Patch	-	-	-	-

Agronomic traits	
Early growth habit	Erect
Coleoptile length	Short
Target plant density	150-180 plants/m^2
Plant height	Medium
Straw strength	Good
Head loss risk	-
Grain protein deviation	Slightly higher

Variety information	
Pedigree	-
Breeder / Seed licensee	InterGrain
Access to seed	Seedclub members & resellers
EPR ($/t, excl. GST)	$4.25

p = provisional assessment

BANKS(Þ)

DELIVERABLE AS A FEED VARIETY

Comments

Banks (tested as IGB1305) is a short height, late spring, feed barley. Best suited to environments with a yield potential above 3t/ha. Across 64 WA barley NVT trials (2016-2019), Banks has yielded less than RGT Planet in 48% of trials, the same in 29% and higher in 23%. Banks does not have the top-end yield potential of RGT Planet, appears to yield similarly between 3-4t/ha and higher below 3t/ha. Banks has a similar plant type and phenology to Flinders, being 1-2cm taller than Bass at maturity. In some commercial crops there have been observations of brackling (buckling in the lower part of the stem) and lodging in Banks. Straw strength appears to be comparable to RGT Planet, but not as robust as either Bass or Flinders. Fungicides may be required to manage scald, STNB and BLR. Its weed competitiveness has not been evaluated. Banks failed malt accreditation and can only be delivered as a feed barley. Banks is a new feed variety and in 2019 accounted for less than 0.2% of the state's barley acreage.

Yield (% Spartacus CL)	2015	2016	2017	2018	2019
Agzone 1	98	103	102	101	99
Agzone 2	96	106	103	100	96
Agzone 3	103	103	104	103	99
Agzone 4	93	-	86	107	105
Agzone 5	94	107	102	100	91
Agzone 6	101	112	114	106	103
State-wide	98	106	103	101	97

Disease resistance	Seedling	Adult
Scald	-	S
NTNB (Beecher virulent)	MRMS	MS
NTNB (Beecher avirulent)	MS	MS
NTNB (Oxford virulent)	MRMS	MS
STNB	MSS	S
Powdery mildew	MRMS	MR
Leaf rust (5457P-)	S	MSS
BYD and CYD	MS	MS
RLN (*P. neglectus*)	-	-
RLN (*P. quasitereoides*)	MSS*p*	MSS*p*
CCN	-	-
Crown rot	-	

'FlowerPower' predicted flowering date (days to Z49)	Relative to Spartacus CL			
	15-Apr	05-May	25-May	15-Jun
Carnamah	+3	+8	+9	+9
Cunderdin	+5	+9	+11	+9
Katanning	+5	+10	+10	+9
Grass Patch	+5	+8	+10	+10

Agronomic traits	
Early growth habit	Prostrate
Coleoptile length	Short
Target plant density	180-220 plants/m^2
Plant height	Short
Straw strength	Moderately good
Head loss risk	-

Variety information	
Pedigree	WABAR2312/WABAR2332
Breeder / Seed licensee	InterGrain
Access to seed	Free to trade
EPR ($/t, excl. GST)	$4.00

p = provisional assessment

BEAST(Þ)

DELIVERABLE AS A FEED VARIETY

Comments

Beast (tested as AGTB0113) is a tall height, early spring barley. According to the breeder, Beast suits low to medium rainfall environments, has good initial canopy size and ground coverage as well as a sound grain package. In 2019, its first year of NVT testing in WA, Beast performed very well, but growers should be cautious in their expectations for this variety due to the lack of years of public data. Across 20 WA barley NVT in 2019, Beast yielded less than Rosalind in 30% of trials, the same in 70% and higher in 0%. As Beast has only been screened in NVT yield and disease trials in WA for one season (2019 only), its disease resistance ratings are provisional. Beast appears to have useful resistance to NTNB (Beecher virulent and avirulent), PM and BLR, but may need management for NTNB (Oxford virulent) and scald. Beast is in Stage Zero of Barley Australia accreditation but is being released as a feed barley while under evaluation for its malting and brewing end-use.

Yield (% Spartacus CL)	2015	2016	2017	2018	2019
Agzone 1	-	-	-	-	114
Agzone 2	-	-	-	-	104
Agzone 3	-	-	-	-	104
Agzone 4	-	-	-	-	115
Agzone 5	-	-	-	-	102
Agzone 6	-	-	-	-	107
State-wide	-	-	-	-	105

Disease resistance	Seedling	Adult
Scald	-	SVS*p*
NTNB (Beecher virulent)	MSS*p*	MRMS*p*
NTNB (Beecher avirulent)	MRMS*p*	MR*p*
NTNB (Oxford virulent)	MSS*p*	S*p*
STNB	MS*p*	MS*p*
Powdery mildew	MR*p*	R*p*
Leaf rust (5457P-)	MSS*p*	MRMS*p* (APR)
BYD and CYD	MS*p*	MS*p*
RLN (*P. neglectus*)	-	-
RLN (*P. quasitereoides*)	-	-
CCN	MR*p*	MR*p*
Crown rot	-	

'FlowerPower' predicted flowering date (days to Z49)	Relative to Spartacus CL			
	15-Apr	05-May	25-May	15-Jun
Carnamah	-	-	-	-
Cunderdin	-	-	-	-
Katanning	-	-	-	-
Grass Patch	-	-	-	-

Agronomic traits	
Early growth habit	Semi-erect
Coleoptile length	Medium
Target plant density	180-220 plants/m^2
Plant height	Tall
Straw strength	-
Head loss risk	-

Variety information	
Pedigree	-
Breeder / Seed licensee	AGT
Access to seed	AGT Affiliates
EPR ($/t, excl. GST)	$4.00

p = provisional assessment

COMPASS(Þ)

DELIVERABLE AS A FEED VARIETY

Comments

Compass is a tall height, early spring barley deliverable only into feed stacks in WA. Best suited to environments with a yield potential below 4t/ha and where weed-competitive barley is required. Compass has a similar grain yield potential to La Trobe and Spartacus CL in WA, and in about of a quarter of situations is higher yielding than Fathom and can out-yield RGT Planet where the yield potential is below 3t/ha. Across 85 WA barley NVT (2015-2019), Compass yielded less than Rosalind in 76% of trials, the same in 24% and higher in 0%. Compass is susceptible to lodging, particularly in high yielding situations. Compass has shown good physical grain quality with high grain plumpness. Fungicides may be required to control seedling infection of NTNB (Beecher avirulent and Oxford virulent), adult infection of NTNB (Oxford virulent) and BLR. Compass, like Fathom, is one of the more weed competitive barley varieties. While it was accredited as a malt variety by Barley Australia in March 2018, no malt segregations are available in WA. Therefore, Compass is received only as a feed variety in WA. Compass was the twelfth most popular barley variety in 2019, accounting for just under 1% of the state's barley acreage.

Yield (% Spartacus CL)	2015	2016	2017	2018	2019
Agzone 1	97	104	106	108	116
Agzone 2	96	106	103	105	103
Agzone 3	100	100	101	101	99
Agzone 4	97	-	96	105	112
Agzone 5	98	95	102	99	95
Agzone 6	95	99	85	100	98
State-wide	98	103	101	103	100

Disease resistance	Seedling	Adult
Scald	-	MS
NTNB (Beecher virulent)	MRMS	MRMS
NTNB (Beecher avirulent)	S	MS
NTNB (Oxford virulent)	S	S
STNB	MRMS	MSS
Powdery mildew	MRMS	MRMS
Leaf rust (5457P-)	S	S
BYD and CYD	MSS	MSS
RLN (*P. neglectus*)	MSS	MSS
RLN (*P. quasitereoides*)	S	S
CCN	R	R
Crown rot	High yield loss (>20%)	

'FlowerPower' predicted flowering date (days to Z49)	Relative to Spartacus CL			
	15-Apr	05-May	25-May	15-Jun
Carnamah	+0	+1	+2	+2
Cunderdin	+0	+1	+2	+2
Katanning	+0	+2	+2	+2
Grass Patch	+0	+1	+2	+3

Agronomic traits	
Early growth habit	Semi-erect
Coleoptile length	Medium
Target plant density	180-220 plants/m^2
Plant height	Tall
Straw strength	Fair
Head loss risk	Medium

Variety information	
Pedigree	County/Commander//Commander
Breeder / Seed licensee	University of Adelaide / SeedNet
Access to seed	SeedNet Partners
EPR ($/t, excl. GST)	$3.80

p = provisional assessment

FATHOM[ϕ]

DELIVERABLE AS A FEED VARIETY

Comments

Fathom is a medium height, medium spring, feed barley. Best suited to environments with a yield potential below 3t/ha and where there is a high risk of STNB. Across 84 WA barley NVT (2015-2019), Fathom yielded less than Rosalind in 75% of trials, the same in 20% and higher in 5%. Fungicides may be required to manage early infections of NTNB and BLR. Fathom has the highest level of resistance to STNB of current varieties. It is mixed for its head colour, having green and waxy green heads. Fathom is one of the more weed competitive barley varieties being similar to Compass and RGT Planet in eastern states' weed competition trials. Fathom was the ninth most popular barley variety in 2019, accounting for just over 1% of the state's barley acreage.

Yield (% Spartacus CL)	2015	2016	2017	2018	2019
Agzone 1	94	107	111	111	120
Agzone 2	88	114	104	104	100
Agzone 3	95	99	101	101	94
Agzone 4	89	-	82	114	127
Agzone 5	88	93	98	95	86
Agzone 6	86	100	84	100	95
State-wide	90	105	100	103	96

Disease resistance	Seedling	Adult
Scald	-	MR
NTNB (Beecher virulent)	S	S
NTNB (Beecher avirulent)	MSS	MS
NTNB (Oxford virulent)	SVS	SVS
STNB	MR	MRMS
Powdery mildew	MS	MRMS
Leaf rust (5457P-)	MSS	MRMS (late APR)
BYD and CYD	MRMS	MRMS
RLN (*P. neglectus*)	MS*p*	MS*p*
RLN (*P. quasitereoides*)	MSS	MSS
CCN	R	R
Crown rot	Moderate yield loss (10-20%)	

'FlowerPower' predicted flowering date (days to Z49)	Relative to Spartacus CL			
	15-Apr	05-May	25-May	15-Jun
Carnamah	+13	+10	+6	+3
Cunderdin	+15	+11	+8	+3
Katanning	+15	+12	+7	+3
Grass Patch	+15	+10	+7	+4

Agronomic traits	
Early growth habit	Erect
Coleoptile length	Medium
Target plant density	180-220 plants/m^2
Plant height	Medium
Straw strength	Fair
Head loss risk	Low

Variety information	
Pedigree	JE013D-020/WI3806-1
Breeder / Seed licensee	University of Adelaide / SeedNet
Access to seed	SeedNet Partners
EPR ($/t, excl. GST)	$2.00

p = provisional assessment

GRANGER[ϕ]

DELIVERABLE AS A FEED VARIETY

Comments

Granger is a medium height, medium spring barley no longer segregated as a malt variety in WA and deliverable only into feed stacks. Best suited to environments with a yield potential above 3t/ha where powdery mildew and BLR are a problem. Across 72 WA barley NVT (2015-2019), Granger yielded less than Rosalind in 71% of trials, the same in 19% and higher in 10%. Granger has resistance to PM due to the *mlo* gene and to BLR due to the *Rph20* gene. Fungicides may be required to manage STNB and early infections of BLR. Weed competitiveness appears similar to other semi-dwarf varieties. While it was accredited as a malt variety by Barley Australia in March 2013, malt segregations are no longer offered in WA. Therefore, Granger is received only as a feed variety in WA. Granger was the thirteenth most popular barley variety in 2019, accounting for just over 0.5% of the state's barley acreage.

Yield (% Spartacus CL)	2015	2016	2017	2018	2019
Agzone 1	92	-	93	-	77
Agzone 2	90	102	101	-	87
Agzone 3	102	102	104	103	96
Agzone 4	86	-	72	-	86
Agzone 5	89	117	101	98	80
Agzone 6	107	120	141	109	106
State-wide	95	106	102	97	92

Disease resistance	Seedling	Adult
Scald	-	MSS
NTNB (Beecher virulent)	MRMS	MS
NTNB (Beecher avirulent)	MRMS	MRMS
NTNB (Oxford virulent)	MRMS	MS
STNB	S	SVS
Powdery mildew	R	R
Leaf rust (5457P-)	MS	MRMS (APR)
BYD and CYD	MRMS	MRMS
RLN (*P. neglectus*)	MS	MS
RLN (*P. quasitereoides*)	MSS	MSS
CCN	R	R
Crown rot	High yield loss (>20%)	

'FlowerPower' predicted flowering date (days to Z49)	Relative to Spartacus CL			
	15-Apr	05-May	25-May	15-Jun
Carnamah	+4	+5	+5	+6
Cunderdin	+6	+7	+7	+6
Katanning	+6	+7	+6	+6
Grass Patch	+6	+6	+6	+7

Agronomic traits	
Early growth habit	Prostrate
Coleoptile length	Medium
Target plant density	180-220 plants/m^2
Plant height	Medium
Straw strength	Good
Head loss risk	Low

Variety information	
Pedigree	Braemar/Adonis
Breeder / Seed licensee	Limagrain
Access to seed	Free to trade
EPR ($/t, excl. GST)	$2.95

p = provisional assessment

LAPEROUSE[ϕ]

DELIVERABLE AS A FEED VARIETY

Comments

Laperouse (tested as WI4952) is a medium height, medium spring barley being evaluated by Barley Australia. Performs well in a range of environments, better than RGT Planet when the site yield is below 4t/ha and will be useful where STNB is a problem. Across 58 WA barley NVT (2016-2019), Laperouse yielded less than Rosalind in 34% of trials, the same in 57% and higher in 9%. Fungicides may be required to manage scald, NTNB (Oxford virulent) and BLR. Its weed competitiveness has not been evaluated. Appears to have good straw strength, and the limited data we have suggest it has a low head loss risk. Laperouse is currently being evaluated in Stage One of the Barley Australia accreditation process, with the earliest accreditation date being March 2022.

Yield (% Spartacus CL)	2015	2016	2017	2018	2019
Agzone 1	-	107	-	108	113
Agzone 2	-	-	106	106	101
Agzone 3	-	106	108	107	104
Agzone 4	-	-	-	105	104
Agzone 5	-	106	108	104	94
Agzone 6	-	116	106	107	107
State-wide	-	110	106	106	102

Disease resistance	Seedling	Adult
Scald	-	S
NTNB (Beecher virulent)	S	MRMS
NTNB (Beecher avirulent)	S	MRMS
NTNB (Oxford virulent)	S	S
STNB	MS	MRMS
Powdery mildew	R	R
Leaf rust (5457P-)	MSS	S
BYD and CYD	MRMS	MRMS
RLN (*P. neglectus*)	-	-
RLN (*P. quasitereoides*)	-	-
CCN	S	S
Crown rot	-	

'FlowerPower' predicted flowering date (days to Z49)	Relative to Spartacus CL			
	15-Apr	05-May	25-May	15-Jun
Carnamah	-	-	-	-
Cunderdin	-	-	-	-
Katanning	-	-	-	-
Grass Patch	-	-	-	-

Agronomic traits	
Early growth habit	Erect
Coleoptile length	-
Target plant density	180-220 plants/m^2
Plant height	Medium
Straw strength	Good
Head loss risk	Low

Variety information	
Pedigree	WI4531/Commander//WI4593
Breeder / Seed licensee	SECOBRA Recherches / SeedNet
Access to seed	SeedNet Partners
EPR ($/t, excl. GST)	$3.80

p = provisional assessment

LITMUS[ϕ]

DELIVERABLE AS A FEED VARIETY

Comments

Litmus is a tall height, early spring, feed barley with improved tolerance to low soil pH and high soil Al that is superseded by Buff. Best suited to environments where the sub-soil (10-30cm) has a pH_{Ca} below 4.8. Across 17 WA barley NVT (2016-2017, 2019), Litmus yielded less than Buff in 42% of trials, the same in 50% and higher in 8%. Litmus has fair straw strength, is susceptible to all leaf diseases but has the lowest yield loss in the presence of crown rot. Fungicides may be required to manage all leaf diseases except PM. Its reaction to weed competition is unknown. Due to the presence of blue aleurone in its grain, it is only deliverable to sites where active management of blue aleurone in feed barley stacks is occurring. Litmus was the seventh most popular barley variety in 2019, accounting for 3% of the state's barley acreage, with production restricted to the Geraldton and Kwinana Port Zones.

Yield (% Spartacus CL)	2015	2016	2017	2018	2019
Agzone 1	112	104	113	-	108
Agzone 2	96	113	100	-	102
Agzone 3	91	102	101	-	-
Agzone 4	94	-	86	-	151
Agzone 5	81	98	87	-	-
Agzone 6	82	97	99	-	-
State-wide	90	105	97	-	99

Disease resistance	Seedling	Adult
Scald	-	SVS
NTNB (Beecher virulent)	S	S
NTNB (Beecher avirulent)	S	S
NTNB (Oxford virulent)	S	S
STNB	S	S
Powdery mildew	MS	MR
Leaf rust (5457P-)	S	S
BYD and CYD	S	S
RLN (*P. neglectus*)	-	-
RLN (*P. quasitereoides*)	MS*p*	MS*p*
CCN	MS	MS
Crown rot	Low yield loss (<10%)	

'FlowerPower' predicted flowering date (days to Z49)	Relative to Spartacus CL			
	15-Apr	05-May	25-May	15-Jun
Carnamah	-7	-4	-3	-1
Cunderdin	-9	-5	-2	-2
Katanning	-8	-4	-3	-2
Grass Patch	-8	-4	-2	-1

Agronomic traits	
Early growth habit	Erect
Coleoptile length	Short
Target plant density	180-220 plants/m^2
Plant height	Tall
Straw strength	Fair
Head loss risk	Medium

Variety information	
Pedigree	WB229/2*Baudin//WABAR2238
Breeder / Seed licensee	InterGrain
Access to seed	Free to trade
EPR ($/t, excl. GST)	$3.80

p = provisional assessment

MUNDAH

DELIVERABLE AS A FEED VARIETY

Comments

Mundah is a medium height, very early spring, feed barley. Best suited to environments with a yield potential below 2t/ha and later sowing systems (i.e. June and July) where early season weed control is necessary. Across 71 WA barley NVT (2015, 2017-2019), Mundah yielded less than Rosalind in 94% of trials, the same in 6% and higher in 0%. Mundah can suffer from head loss and lodging. Fungicides may be required to manage scald, NTNB (Beecher virulent and Oxford virulent), STNB and BLR. Mundah appears to have similar weed competitiveness to Compass and Fathom, although it has not been tested side by side in the same trials. Mundah was the eleventh most popular barley variety in 2019, accounting for nearly 1% of the state's barley acreage.

Yield (% Spartacus CL)	2015	2016	2017	2018	2019
Agzone 1	96	-	103	99	99
Agzone 2	89	-	98	96	96
Agzone 3	86	-	94	95	91
Agzone 4	90	-	85	109	121
Agzone 5	84	-	90	91	91
Agzone 6	84	-	91	95	90
State-wide	87	-	94	96	93

Disease resistance	Seedling	Adult
Scald	-	S
NTNB (Beecher virulent)	S	S
NTNB (Beecher avirulent)	S	MS
NTNB (Oxford virulent)	MSS	S
STNB	MSS	S
Powdery mildew	SVS	MSS
Leaf rust (5457P-)	S	S
BYD and CYD	MS	MS
RLN (*P. neglectus*)	-	-
RLN (*P. quasitereoides*)	MS*p*	MS*p*
CCN	S	S
Crown rot	Moderate yield loss (10-20%)	

'FlowerPower' predicted flowering date (days to Z49)	Relative to Spartacus CL			
	15-Apr	05-May	25-May	15-Jun
Carnamah	-4	-5	-6	-3
Cunderdin	-4	-6	-5	-5
Katanning	-4	-4	-5	-5
Grass Patch	-4	-5	-5	-3

Agronomic traits	
Early growth habit	Erect
Coleoptile length	Medium
Target plant density	180-220 plants/m^2
Plant height	Medium
Straw strength	Fair
Head loss risk	Medium

Variety information	
Pedigree	Yagan/O'Connor
Breeder / Seed licensee	InterGrain
Access to seed	Free to trade
EPR ($/t, excl. GST)	No EPR payable

p = provisional assessment

ROSALIND(b)

DELIVERABLE AS A FEED VARIETY

Comments

Rosalind is a medium height, early spring, feed barley. Suits all environments where there is a low probability of delivering malt grade barley. Rosalind is the yield benchmark for barley in WA, regularly out-yielding Spartacus CL. Across 85 WA barley NVT (2015-2019), Rosalind yielded less than Spartacus CL in 0% of trials, the same in 13% and higher in 87%, with an overall yield advantage of 7% in the state-wide MET. Rosalind appears to be inferior to RGT Planet at yields above 5t/ha, but is higher-yielding below 4t/ha and in shorter growing seasons. Across 64 WA barley NVT (2016-2019), Rosalind yielded less than RGT Planet in 30% of trials, the same in 22% and higher in 48%, with an overall advantage of 4% in the state-wide MET. Good straw strength and head retention. Fungicides may be required to manage NTNB (Oxford virulent) and STNB. Growers should report powdery mildew infection on Rosalind as it may indicate the presence of a new pathotype. Its weed competitiveness is unknown. Rosalind was the fifth most popular barley variety in 2019, accounting for just over 4% of the state's barley acreage, being more popular in southern cropping areas than northern cropping areas. The popularity of Rosalind is growing.

Yield (% Spartacus CL)	2015	2016	2017	2018	2019
Agzone 1	114	107	112	110	117
Agzone 2	108	110	106	107	107
Agzone 3	111	110	109	106	106
Agzone 4	105	-	104	113	124
Agzone 5	103	108	104	108	110
Agzone 6	103	114	104	107	107
State-wide	107	110	106	107	107

Disease resistance	Seedling	Adult
Scald	-	MSS
NTNB (Beecher virulent)	MR	MS
NTNB (Beecher avirulent)	MR	MR
NTNB (Oxford virulent)	MSS	MSS
STNB	MSS	S
Powdery mildew	MS	MRMS*
Leaf rust (5457P-)	MRMS	MR
BYD and CYD	MS	MS
RLN (*P. neglectus*)	-	-
RLN (*P. quasitereoides*)	MS*p*	MS*p*
CCN	R	R
Crown rot	Moderate yield loss (10-20%)	

'FlowerPower' predicted flowering date (days to Z49)	Relative to Spartacus CL			
	15-Apr	05-May	25-May	15-Jun
Carnamah	-1	+0	+1	+1
Cunderdin	-1	+0	+1	+1
Katanning	-1	+0	+1	+1
Grass Patch	-1	-1	+1	+2

Agronomic traits	
Early growth habit	Erect
Coleoptile length	Short
Target plant density	180-220 plants/m^2
Plant height	Medium
Straw strength	Good
Head loss risk	Low

Variety information	
Pedigree	Lockyer/Dash
Breeder / Seed licensee	InterGrain
Access to seed	Free to trade
EPR ($/t, excl. GST)	$3.50

p = provisional assessment

SCOPE CL(b)

DELIVERABLE AS A FEED VARIETY

Comments

Scope CL is a tall height, medium spring barley no longer segregated as a malt variety in WA and deliverable only into feed stacks. Suited to environments where Intercept®, Intervix® and Sentry® are useful for controlling brome and barley grass or where there are imidazolinone residues. Better suited than Spartacus CL to April sowing opportunities when sowing into non-Clearfield® wheat stubble (so the in-crop wheat volunteers can be controlled). Across 72 WA barley NVT (2016-2019), Scope CL yielded less than Spartacus CL in 69% of trials, the same in 17% and higher in 4%. Fungicides may be required to manage NTNB (Oxford virulent), STNB and BLR. It should be harvested when ripe due to a high head loss risk. While it was accredited as a malt variety by Barley Australia in March 2013, malt segregations are no longer offered in WA. Scope CL is still very popular in the Kwinana Port Zone and was the fourth most popular barley variety across WA in 2019.

Yield (% Spartacus CL)	2015	2016	2017	2018	2019
Agzone 1	91	100	103	100	99
Agzone 2	83	106	98	96	94
Agzone 3	85	94	95	96	89
Agzone 4	84	-	77	112	121
Agzone 5	81	92	90	-	-
Agzone 6	83	90	93	-	-
State-wide	83	99	95	96	90

Disease resistance	Seedling	Adult
Scald	-	MS
NTNB (Beecher virulent)	MR	MRMS
NTNB (Beecher avirulent)	MR	MRMS
NTNB (Oxford virulent)	S	S
STNB	MSS	S
Powdery mildew	R	R
Leaf rust (5457P-)	S	MSS
BYD and CYD	MRMS	MRMS
RLN (*P. neglectus*)	MSS	MSS
RLN (*P. quasitereoides*)	MS	MS
CCN	S	S
Crown rot	High yield loss (>20%)	

'FlowerPower' predicted flowering date (days to Z49)	Relative to Spartacus CL			
	15-Apr	05-May	25-May	15-Jun
Carnamah	+11	+9	+6	+6
Cunderdin	+12	+10	+9	+5
Katanning	+13	+11	+8	+5
Grass Patch	+13	+9	+8	+6

Agronomic traits	
Early growth habit	Semi-erect
Coleoptile length	Short
Target plant density	180-220 plants/m^2
Plant height	Tall
Straw strength	Fair
Head loss risk	High

Variety information	
Pedigree	Franklin/VB9104//VB9104
Breeder / Seed licensee	AgVic Services / SeedNet
Access to seed	SeedNet Partners
EPR ($/t, excl. GST)	$3.50

p = provisional assessment

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