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 all malt barley varieties segregated in Western Australia (WA), those in stage 2 of malt accreditation with Barley Australia and selected feed varieties (Tables 1 to 13; Figures 1 to 11).

The decision of whether to grow barley with a malt or feed classification 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.

Identifying which option leads to the highest returns for a grower is complex. In some instances, the price premium paid for malt offsets the yield difference between malt and feed varieties. In other situations, the higher yield of feed varieties, the low likelihood of a malt variety being segregated as malt or the higher costs of growing a malt barley may justify the choice to grow a feed variety.

Barley varieties differ in their agronomic fit for different port zones and different environments. Additionally, market demand for malt barley varieties varies with the port zone due to the different domestic and international markets each port zone services. That demand influences the choice of malt variety sown regionally. No one malt or feed variety matches all farming systems or the brewing, distilling and shochu markets we service.

In 2018, four varieties, Spartacus CL$^{\Phi}$, La Trobe$^{\Phi}$, Scope CL$^{\Phi}$ and Bass$^{\Phi}$ (in order of decreasing popularity) occupied three in every four hectares sown to barley (Figure 1). In 2019, the area planted to RGT Planet$^{\Phi}$ and Spartacus CL$^{\Phi}$ has increased significantly. Between them, these two varieties could occupy nearly two-thirds of the WA barley acreage and result in a decreasing area sown to the market-accepted malt varieties Bass$^{\Phi}$, Flinders$^{\Phi}$, La Trobe$^{\Phi}$ and Scope CL$^{\Phi}$.

Changes in disease 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 aggressive Oxford virulent net-type net blotch (NTNB) pathotype, the newly identified leaf disease Ramularia leaf spot (RLS) and potential changes in the virulence of powdery mildew (PM).

Tips for managing grain protein

While it is common and logistically easier to apply the bulk of the fertiliser nitrogen (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. Two management options can assist if the current strategy of applying N up-front typically does not consistently deliver grain with more than 9.5 per cent protein.

Small plot research has shown that variety choice and N timing can increase grain protein concentration without requiring the addition of more N. The first option is to sow a higher-protein variety such as Bass$^{\Phi}$ or even Flinders$^{\Phi}$ or Spartacus CL$^{\Phi}$ (where suitable). The second option is to target around two-thirds of the recommended N for application around the stem elongation stage of crop growth. In some seasons, saving some N for use around flag leaf emergence can also boost grain protein. Should tweaking the timing of the N strategy not provide a consistent enough

protein boost, higher levels of N fertiliser should be considered as well as incorporating legumes pastures and crops in the rotation to boost soil N supply.

Target plant density

When considering how much seed to put in the ground, it is essential to think in terms of plant density (plants per square metre) rather than 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 season), seed viability and establishment conditions. Variety should influence the target plant density. For most malt varieties, a target density of 150–180 plants/m^2 is appropriate unless growing Scope CL$^{\Phi}$ where the target density is 110–130 plants/m^2. For feed barley, a higher target density of 180–220 plants/m^2 is suggested to improve the competitiveness of the crop against weeds. If growing feed barley in paddocks without weeds, then the target density can be adjusted down to 150–180 plants/m^2. The target density in plants/m^2 determines the seed 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 growing La Trobe$^{\Phi}$ barley with a germination of 94 per cent, a kernel weight of 42g per 1000 kernels at a target density of 150 plants/m^2 with an expected establishment of 80 per cent, then the seed rate in kg/ha required to establish 150 plants/m^2 is:

$$\text{seed rate in kg/ha} = 84\text{kg/ha} = \frac{\text{42g x 150 plants/m}^2}{\text{0.94 x 0.80 x 100}}$$

When deciding on which barley variety to sow, grain yield potential needs to balance trade-offs with agronomy, disease resistance, grain quality, segregation opportunities and market demand. Commonly grown varieties differ in their agronomic traits, demonstrating the many ways in which grain yield is achievable. These phenotypic differences may favour one variety over another variety in some seasons but not in other seasons. It is therefore vital to look over seasons and across sites when assessing which variety best suits the farming business.

WHAT IS NEW?

New barley lines that may be of interest to WA barley growers include Banks$^{\Phi}$ (tested as IGB1305), Buff$^{\Phi}$ (tested as IGB1506), Leabrook$^{\Phi}$ (tested as WI4896) and LG Alestar$^{\Phi}$ (tested as SMBA11-2341). Elders will no longer continue commercialising LG Maltstar$^{\Phi}$ (tested as SMBA11-1771) in WA, instead focusing on LG Alestar$^{\Phi}$.

Note that for any new variety under evaluation by Barley Australia, there is no guarantee of malt accreditation and market acceptance (and possible associated malt premiums). Be cautious in sowing large areas with the expectation of future segregations unless there is a clear agronomic or grain yield advantage as a feed barley.

Why consider purchasing seed of these new varieties?

Banks$^{\Phi}$

Key points:

- **Was in stage 2 assessment but on 11 November 2019 Barley Australia announced that Banks$^{\Phi}$ had not been accredited as a malt variety.**
- Suited to medium to high rainfall environments (similar grain yield to La Trobe$^{\Phi}$, higher-yielding than Flinders$^{\Phi}$ and Bass$^{\Phi}$).
- Barley leaf rust (BLR) requires management, as will spot-type net blotch (STNB) and scald as an adult plant.
- Its grain quality and germ end staining risk is similar to Flinders$^{\Phi}$, except screenings (higher risk).

Banks$^{\Phi}$ (WABAR2312/WABAR2332) is a short, semi-dwarf, medium-spring, two-row barley bred by InterGrain and registered in February 2018. It was under evaluation for its suitability as a malt variety. As its performance in stage 2 trials in 2018 was variable in contrast to its performance in stage 1 trials in 2017, it has been held over for further evaluation in stage 2 trials in 2019. **Barley Australia announced Banks$^{\Phi}$ had failed malt accreditation just as this sowing guide was going to print.**

Banks$^{\Phi}$ has been in WA barley National Variety Trials (NVT) since 2015 and is a potential competitor to Bass$^{\Phi}$, Flinders$^{\Phi}$, La Trobe$^{\Phi}$, RGT Planet$^{\Phi}$ and Spartacus CL$^{\Phi}$ in medium to higher rainfall areas of WA.

Banks$^{\Phi}$ has a similar plant type and phenology to Flinders$^{\Phi}$, being 1-2cm taller than Bass$^{\Phi}$ at maturity. There have been observations of brackling (buckling in the lower part of the stem) and lodging

in Banks[Φ] in some commercial crops. Straw strength appears to be comparable to RGT Planet[Φ], but not as robust as either Bass[Φ] or Flinders[Φ]. As a seedling, it has good tolerance to all leaf diseases except BLR. As an adult plant, scald, STNB and BLR may need management. Banks[Φ] has some tolerance to the new Oxford virulent NTNB.

WA barley NVT (2015–2018) suggests that Banks[Φ] has a similar grain yield to La Trobe[Φ], is higher yielding than Bass[Φ] and Flinders[Φ], but does not have the top end yield performance of RGT Planet[Φ]. Across 62 WA barley NVT (2015–2018) where they have been sown side-by-side, Banks[Φ] has yielded lower than La Trobe[Φ] in 11 per cent, the same in 79 per cent and higher in 10 per cent. Relative to RGT Planet[Φ], Banks[Φ] has yielded lower in 33 per cent, the same in 62 per cent and higher in 5 per cent of 42 WA barley NVT (2016–2018).

The hectolitre weight and grain brightness of Banks[Φ] appear to be comparable to Flinders[Φ], but its overall screenings risk is higher than both Bass[Φ] and Flinders[Φ] and slightly lower than La Trobe[Φ]. Germ end staining risk appears to be low, or similar to Flinders[Φ] and lower than Bass[Φ]. There is not enough conclusive data to be definitive on the head loss risk with Banks[Φ], but the data suggests it is more likely to be rated as a medium risk than low risk.

Seed will be available for planting in 2020 from InterGrain SeedClub members and resellers. Seed is also free to trade grower to grower.

Buff[Φ]

Key points:

- Like Litmus[Φ], has aluminium (Al) tolerance that improves grain yield in soil with low pH and high soluble Al, but kernels have a white aleurone.
- Supersedes Litmus[Φ] due to more consistent yield across a range of soils.
- Yields similarly to La Trobe[Φ] on non-acidic soils but higher than La Trobe[Φ] on soils with an acidic profile.
- STNB, PM and BLR need management.
- Under assessment by Barley Australia (stage 1 malt accreditation trials in 2019). The earliest possible accreditation date is March 2021.

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

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

Buff[Φ] has similar Al tolerance genetics to Litmus[Φ]. Unlike Litmus[Φ], it has a white aleurone, and its receival will therefore not be restricted as it is for Litmus[Φ]. 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. Al is toxic to barley's roots; hence, barley has reduced productivity on acid soils.

Buff[Φ] has displayed a consistent yield advantage over Litmus, largely on non-acidic soils, in WA barley NVT (2016-2017). Unfortunately, Litmus[Φ] was not sown in the 2018 WA barley NVT, so further comparative yield assessment over a more extended period is not possible. Litmus[Φ] was re-entered to the 2019 WA barley NVT, allowing up to ten additional direct comparisons in trials.

The NVT multi-environment trials (MET) analysis (2016–2018) indicates that Buff[Φ] has a yield potential at least equivalent to La Trobe[Φ] on non-acidic soils and higher than La Trobe[Φ] on soils with an acidic profile. Across 35 WA barley NVT (2016–2018), Buff was the same yield as La Trobe[Φ] in 69 per cent and higher in 31 per cent. To date, Buff[Φ] has not yielded lower than La Trobe[Φ] in an NVT.

Buff[Φ] has improved tolerance to scald (as an adult) and NTNB (as both a seedling and an adult) relative to Litmus[Φ], but its disease resistance profile is poorer against PM. Fungicides may be required to manage STNB, PM and BLR. Its weak PM and BLR resistance limits its practical use in higher rainfall areas.

Seed will be available for planting in 2020 from InterGrain seed club members and resellers. Seed is also free to trade grower to grower.

Leabrook[Φ]

Key points:

- In stage 2 assessment for malt accreditation, with the earliest accreditation date being March 2020.
- Similar agronomic attributes (including lodging risk) to Compass[Φ] but with improved grain yield.
- BLR will require management.

Leabrook[Φ] (County/Commander//Commander) is a tall, medium-spring, two-row barley bred

by the University of Adelaide barley breeding program, registered in September 2017. It is being commercialised by Seednet. Leabrook[Φ] possesses many similar attributes to Compass[Φ] including phenology, plant architecture and grain quality (i.e. lower-than-average hectolitre weight combined with its good grain plumpness) because of similar pedigree, but with improvements in grain yield and malt quality (mostly malt extract).

Leabrook[Φ] has been in WA barley NVT since 2015 and is a competitor to Buff[Φ] (on non-acidic soils), Compass[Φ], Fathom[Φ], La Trobe[Φ] and Spartacus CL[Φ] (where there are no imidazolinone residues) in low to medium rainfall zones. Leabrook[Φ] has had an average 4 per cent yield advantage over Compass[Φ] and La Trobe[Φ] in a state-wide MET analysis of WA barley NVT. Across 62 WA barley NVT (2016–2018), Leabrook[Φ] has yielded lower than Compass[Φ] in 5 per cent, the same in 76 per cent and higher in 19 per cent; and relative to La Trobe[Φ], lower in 6 per cent, the same in 74 per cent and higher in 19 per cent.

Leabrook[Φ] 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[Φ] is comparable to that of Compass[Φ]. Fair straw strength may pose problems in higher-yielding years, high yielding environments (i.e. above 4t/ha) and with excessive N supply, but is not expected to be a significant impediment in low-to-medium rainfall areas. Germ end staining risk is similar to Compass[Φ] and La Trobe[Φ], with more data needed. There is not enough data to be definitive on the head loss risk with Leabrook[Φ].

Seed will be available for planting in 2020 from Seednet.

LG Alestar[Φ]

Key points:

- In stage 2 assessment for malt accreditation, with the earliest accreditation date being March 2020.
- Similar agronomic attributes to Granger[Φ].
- Grain has a white aleurone.

LG Alestar[Φ] (Henley/NSL02-4136A) 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[Φ] has a white aleurone, even though one of its parents Henley has a blue aleurone.

LG Alestar[Φ] was in WA barley NVT from 2011 until 2016 before being re-entered in 2019. It is a potential competitor to Bass[Φ], Flinders[Φ], Granger[Φ], La Trobe[Φ], Lockyer[Φ], Oxford and RGT Planet[Φ] in higher-rainfall areas of WA. WA barley NVT (2012–2016) suggest that the grain yield of LG Alestar[Φ] is comparable to Granger[Φ]. Across 80 WA barley NVT (2011–2016), where they have occurred in the same trial, LG Alestar[Φ] has yielded lower than Granger[Φ] in 22 per cent, the same in 78 per cent and higher in 0 per cent. Across 82 WA barley NVT (2011–2016), LG Alestar[Φ] has yielded lower than La Trobe[Φ] in 46 per cent, the same in 49 per cent and higher in 5 per cent.

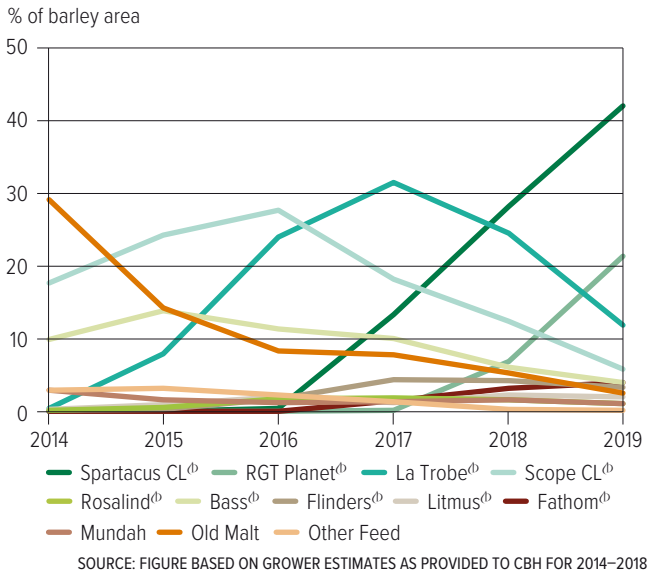
It has durable resistance to PM (based on the *mlo* gene) and resistance to BLR (seedling and adult). Lodging data collected in WA suggests that the straw strength of LG Alestar[Φ] is comparable to that of Granger[Φ]. Grain quality of LG Alestar[Φ] may be a subtle improvement over Granger[Φ] with slightly better grain plumpness and grain brightness, but more analysis of the data needed.

Seed will be available for planting in 2020 from Elders.

WHAT VARIETY SHOULD I GROW?

The following varieties should be high on the list of what to grow – Bass[Φ], Flinders[Φ], La Trobe[Φ], RGT Planet[Φ], Rosalind[Φ], Scope CL[Φ] and Spartacus CL[Φ]. There are also other options for specific agronomic situations such as the sowing of Buff[Φ] and Litmus[Φ] on soils with a subsoil pHCa below 4.8; Compass[Φ] and Fathom[Φ] where improved weed competition might be useful; or Fathom[Φ] where

FIGURE 1 Popularity (per cent of barley area) of top 10 barley varieties (ranking based on forecast area sown in 2019 season) grown in WA over the past five seasons plus forecast for the 2019 season. 'Old' malt includes Baudin[Φ], Buloke[Φ], Commander[Φ], Gairdner, Hamelin, Stirling[Φ] and Vlamingh[Φ].



SOURCE: FIGURE BASED ON GROWER ESTIMATES AS PROVIDED TO CBH FOR 2014–2018 AND FORECAST AREA FOR 2019 ESTIMATED BY BLAKELY PAYNTER, DPIRD

DPIRD GRDC

TABLE 1 Western Australian malt barley industry variety recommendations by port zone for the 2020-21 harvest.

Port zone	Geraldton	Kwinana			Albany		Esperance	Comment
		North (Midlands)	South	North (East)	North	South		
Bass$^{\Phi}$	NO	YES	YES	NO	Limited	Limited	NO	Stable market demand with an excellent malt quality profile.
Flinders$^{\Phi}$	NO	NO	Niche	NO	NO	YES	Niche	Works well as a variety for post-malt blending and sugar-adjunct brewing.
La Trobe$^{\Phi}$	NO	YES	YES	YES	YES	YES	YES	Stable market demand with a recognised quality profile.
RGT Planet$^{\Phi}$	NO	Limited	YES	NO	Limited	YES	YES	Market development for brewing end-use continuing.
Scope CL$^{\Phi}$	NO	Niche	Niche	Niche	Niche	NO	NO	Declining production and declining market demand.
Spartacus CL$^{\Phi}$	YES	YES	YES	YES	YES	YES	YES	Market development for brewing and shochu end-use continuing.

SOURCE: GIWA BARLEY COUNCIL MALT BARLEY VARIETY RECOMMENDATIONS

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.

stubble-borne STNB is a high risk. Oxford is no longer recommended as a variety to grow in WA due to the increased prevalence of NTNB and PM in this variety, along with its susceptibility to STNB. Comments about each barley variety suggested for sowing in WA can be found in the variety snapshot section. For varieties received as malt, the market feedback section provides more specific market information published by the Grain Industry Association of Western Australia (GIWA).

MARKET FEEDBACK

In line with previous advice, the GIWA malt barley variety recommendations for 2020-21 indicate that 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 stronger demand from the trade, which is unwilling to risk buying small, unsaleable parcels.

For the 2020-21 harvest, the following observations from GIWA are relevant:

- Bass$^{\Phi}$ and La Trobe$^{\Phi}$ and to a much lesser extent Flinders$^{\Phi}$ will be the main malt barley varieties sought by the trade for malting and brewing end-use in China, South-East Asia and Japan.
- La Trobe$^{\Phi}$ is the primary malt barley variety used in the manufacture of shochu in Japan and production of La Trobe$^{\Phi}$ is critical to maintaining supply to this premium market.
- The rapid grower adoption of Spartacus CL$^{\Phi}$ is exceeding market demand. International customers are not yet thoroughly familiar with its malting and brewing profile or its relevance for shochu production, but interest is growing. Spartacus CL$^{\Phi}$ is, however, not yet the first choice for buyers of Australian malt barley. Additionally, there are potential market access challenges due to the likelihood of imidazolinone residues in Spartacus CL$^{\Phi}$ grain.
- Scope CL$^{\Phi}$ is being phased out with segregations halted after the 2020-21 harvest. The decline in the planting of Scope CL$^{\Phi}$ coincides with reduced international demand and the emergence of Spartacus CL$^{\Phi}$.
- While RGT Planet$^{\Phi}$ is recognised internationally, it is new to Australian barley and malt customers. As such, they are not entirely familiar with its malting and brewing performance when grown under Australian conditions. As with Spartacus CL$^{\Phi}$, there is potential for supply to exceed market demand at the 2020-21 harvest.
- Baudin$^{\Phi}$ has been phased out as an export malt entity, with no segregations at the 2020-21 harvest. Growers who have previously supplied Baudin$^{\Phi}$ under a domestic malt barley contract should confirm any continuing demand before planting it in autumn 2020.
- Segregation opportunities for Bass$^{\Phi}$, Flinders$^{\Phi}$, La Trobe$^{\Phi}$, RGT Planet$^{\Phi}$, Scope CL$^{\Phi}$ and Spartacus CL$^{\Phi}$ vary by port zone and for the Kwinana and Albany ports, within a port zone (Table 1).

The malt barley variety receival recommendations developed by GIWA (through the GIWA Barley Council) in consultation with the WA barley supply chain are intended to be a guide for growers and consultants to help with the planning of the 2020 barley cropping program. This plan will be reviewed in autumn 2020 and any changes in demand presented to growers.

Three varieties – Banks$^{\Phi}$, Leabrook$^{\Phi}$ and LG Alestar$^{\Phi}$ – are in stage 2 of Barley Australia's accreditation process and are not included in the current 2020–21 variety receival recommendation plan. A decision on the malt accreditation of Banks$^{\Phi}$ is expected by the end of 2019 and for Leabrook$^{\Phi}$ and LG Alestar$^{\Phi}$ in March 2020. It is worth noting that malt accreditation does not guarantee segregation opportunities. For example, Compass$^{\Phi}$ is a recently accredited malt variety with no malt segregations in WA even though there are malt segregations in eastern Australia. Growers will be notified if market development segregations are to be offered at the 2020–21 harvest, should their accreditation be successful. Malt accreditation does not guarantee international markets will be willing to pay a premium for the variety or that there will be demand from customers in their brewing recipe.

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 segregation, whereas other sites may be able to offer two or more malt barley segregations. Growers can support segregation planning through submission of 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 and 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.

International market signals continue to highlight the generally low protein status of Australian malt barley. Growers are encouraged to deliver malt barley grain between 10.5-11.0 per cent protein with a maximum of 20 per cent screenings through a 2.5mm sieve, a hectolitre weight above 64 kg/hL with ryegrass ergot less than 3cm, no whole snails and no glyphosate use near harvest.

MALT BARLEY VARIETIES

New malt varieties are released faster than older malt varieties can be phased out, with rapid turnover of varieties a common sticking point for end-users who desire long-term supply and familiarity to optimise the efficiency of their malt house or brewery. New varieties also increase inefficiency for bulk handlers, with each new malt variety segregated adding to the cost of storage and handling. Therefore, the GIWA barley variety rationalisation plan is trying 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 WA has unique and different malting attributes. Consequently, brewers purchase varieties subject to their availability, 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 to assist them when deciding which malt variety or varieties to sow in 2020. Market demand, pricing signals and the location of segregations should be considered in partnership with the agronomic management required and the risk associated with delivering malt-grade barley when determining how much area to plant to each malt variety. Varieties listed as PREFERRED are more likely to attract higher premiums than ACCEPTABLE varieties. The malt barley recommendations for the 2020 season are as follows.

Bass$^{\Phi}$

- Bass$^{\Phi}$ is preferred for export as grain and malt.
- Not suitable for the manufacture of shochu in Japan.
- Bass$^{\Phi}$ is well recognised in the international malt barley market with stable demand.
- It can be malted without the use of the growth hormone gibberellic acid, a market-preferred trait.
- Bass$^{\Phi}$ malt has excellent extract and filterability and is suited to markets where high levels of starch-adjuncts are used in the brewing process.
- Grain generally has a higher grain protein concentration than other malt varieties received, enhancing its preference from starch-adjunct brewers.
- Target production zone in 2020 is Kwinana-North (Midlands) and Kwinana-South with limited segregation opportunities in the Albany Port Zone (subject to production volumes).

Flinders(Φ)

- Flinders(Φ) is suitable for export as grain and malt.
- Not suitable for the manufacture of shochu in Japan.
- It can be malted without the use of the growth hormone gibberellic acid, a market preferred trait.
- Flinders(Φ) malt has excellent malt extract and filterability but at a lower enzyme potential than Bass(Φ) malt.
- Flinders(Φ) performs well in markets where sugar-adjunct brewing is undertaken and when blended post-malting with varieties such as Bass(Φ) and La Trobe(Φ) for starch-adjunct brewing.
- The target production zone in 2020 is Albany-South with potential niche segregation opportunities in Kwinana-South and the Esperance Port Zone (subject to production and demand).

La Trobe(Φ)

- La Trobe(Φ) is preferred for export as grain and malt.
- La Trobe(Φ) is a preferred variety for the manufacture of shochu in Japan and the only malt variety accepted and segregated for that premium end use.
- It is widely accepted by all major malting and brewing customers of WA barley and malt.
- La Trobe(Φ) 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(Φ) malt stacks by mixing them with either Hindmarsh(Φ) or Spartacus CL(Φ) or any other variety.
- Target production zones in 2020 are Kwinana, Albany and Esperance port zones.

RGT Planet(Φ)

- RGT Planet(Φ) is suitable for export as grain and malt, but more work is required to gain full international acceptance.
- It is not under assessment for its suitability for the manufacture of shochu in Japan.
- Despite extensive use of RGT Planet(Φ) in brewing markets in Europe and South America, Asian customers of Australian barley and malt are still evaluating it as they would with any new malt variety they receive. The Asian market has yet to see a critical mass of RGT Planet(Φ). The time taken to approve it, however, may be quicker than an unknown malt variety.
- Limited feedback from the international market indicates that RGT Planet(Φ) malt has excellent extract with a moderate enzyme potential and is likely to be suitable for starch-adjunct brewing.
- Target production zones in 2020 are Kwinana-South, Albany-South and Esperance port zones with limited segregation opportunities in Kwinana-North (Midlands) and Albany-North (subject to production volumes).

Scope CL(Φ)

- Scope CL(Φ) is suitable for export as grain and malt.
- It is not suitable for the manufacture of shochu in Japan.
- Scope CL(Φ) malt has good extract with moderate enzyme activity but can suffer from variable filterability.
- While Scope CL(Φ) has a better production fit than Spartacus CL(Φ) with April sowing opportunities, Scope CL(Φ) is in phase-out mode by growers and the trade alike.
- Use only recommended imidazolinone herbicides and be aware of market advice concerning the delivery of grain from paddocks sprayed with an imidazolinone herbicide.
- The 2020-21 harvest is the last harvest that segregations will be offered for Scope CL(Φ) in WA, with potential niche segregation opportunities in Kwinana and Albany-North (subject to production and demand).

Spartacus CL(Φ)

- Spartacus CL(Φ) is suitable for export as grain and malt, but more work is required to gain full international acceptance.
- Assessment of Spartacus CL(Φ) 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 or imidazolinone-free Spartacus CL(Φ) barley can be sourced.
- Large quantities of Spartacus CL(Φ) accumulated in market development stacks at the 2018–19 harvest and countries such as China are still learning how to use Spartacus CL(Φ) in their malt houses and breweries.
- Market feedback suggests that like La Trobe(Φ), Spartacus CL(Φ) 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$^{\Phi}$ malt stacks by mixing them with either Hindmarsh$^{\Phi}$ or La Trobe$^{\Phi}$ 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 2020 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 are available as individual site reports or as multi-environment trial (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, site or group of sites of their choice to assist in selecting the best variety for their environment. Both the single-site and multi-year MET analyses are available at www.nvtonline.com.au.

Tables 2 to 8 present data extracted from the Long Term MET Yield Reporter available at www.nvtonline.com.au. MET data is presented for each year (2014 to 2018) for each of the six Agzones in WA and then averaged across Agzones to provide a statewide MET. Agzones were developed by the Department of Primary Industries and Regional Development (DPIRD) through statistical analysis to group together environmental regions that give similar crop performance in WA.

Tables 9 and 10 use single-site data to highlight the probability of one variety yielding less, the same or more than another variety when grown under the same agronomy. Grain yields are compared using the least significant difference (p=0.05) using only barley NVT where both varieties have been sown and harvested.

It is important to note that the single-site analyses only represent varietal performance under one specific set of seasonal and site conditions. Growers should not use the single-site analysis as their sole data source when comparing the performance of a new variety. MET analyses based on Agzones average varietal performance and 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 2014 to 2018 assists with understanding the variability in relative varietal performance across seasons. While Agzones are a simple way to group trials across environments, they may not accurately reflect your location in every season.

Differences in grain yield between varieties sometimes depend on the potential yield of the site. NVT Online, through the Long Term MET Yield Reporter, graphs data at half tonne yield intervals based on trials that match the yield range. Figures 2 to 5 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 sown at that site).

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 fitted to the data. If the linear trend (but not the quadratic trend) was significant ($p<0.05$) a linear polynomial 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.

The data used for this analysis include DPIRD–GRDC (DAW00190 and DAW00224) barley agronomy grain yield data in addition to GRDC NVT barley grain yield data. In some trials, if data for Scope CL$^{\Phi}$ was absent, it was replaced with Buloke$^{\Phi}$ data (due to the closeness of their relationships with each other). 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.

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TABLE 2 Grain yield of barley varieties in Agzone 1 expressed as a per cent of the site mean yield for each trial year (2014–18).

Year		2014	2015	2016	2017	2018
Site mean yield (t/ha)		1.19	1.78	4.17	2.07	4.29
	No. trials	(1)	(1)	(2)	(2)	(2)
DELIVERABLE AS A MALT VARIETY						
Bass(b)	(8)	93	91	94	93	94
Flinders(b)	(6)	98	95	-	93	94
La Trobe(b)	(8)	105	106	100	102	105
RGT Planet(b)	(6)	-	-	107	103	102
Scope CL(b)	(8)	94	97	99	103	103
Spartacus CL(b)	(8)	105	109	99	100	103
STAGE 2 MALT ACCREDITATION						
Banks(b)	(7)	-	109	102	103	102
Leabrook(b)	(7)	-	107	107	111	114
LG Alestar(b)	(1)	-	-	98	-	-
DELIVERABLE AS A FEED VARIETY						
Buff(b)	(5)	-	-	111	119	117
Compass(b)	(8)	106	109	103	109	111
Fathom(b)	(8)	103	103	104	110	112
Granger(b)	(4)	100	101	-	93	-
Litmus(b)	(6)	93	121	102	112	-
Lockyer(b)	(6)	104	95	-	102	104
Mundah	(6)	92	112	-	106	103
Oxford	(5)	98	85	96	89	-
Rosalind(b)	(8)	114	120	107	112	113

SOURCE: BASED ON MET ANALYSIS FROM NVT ONLINE, NVTONLINE.COM.AU

TABLE 3 Grain yield of barley varieties in Agzone 2 expressed as a per cent of the site mean yield for each trial year (2014–18).

Year		2014	2015	2016	2017	2018
Site mean yield (t/ha)		2.57	2.40	3.91	4.15	4.29
	No. trials	(5)	(6)	(3)	(5)	(7)
DELIVERABLE AS A MALT VARIETY						
Bass(b)	(25)	97	91	92	96	96
Flinders(b)	(26)	103	98	94	98	96
La Trobe(b)	(26)	104	108	98	101	105
RGT Planet(b)	(14)	-	-	106	106	103
Scope CL(b)	(25)	90	93	101	98	100
Spartacus CL(b)	(26)	105	112	94	100	104
STAGE 2 MALT ACCREDITATION						
Banks(b)	(21)	-	109	101	101	102
Leabrook(b)	(21)	-	109	107	106	111
LG Alestar(b)	(14)	100	96	98	-	-
DELIVERABLE AS A FEED VARIETY						
Buff(b)	(14)	-	-	119	107	110
Compass(b)	(26)	100	109	103	103	108
Fathom(b)	(26)	97	100	107	103	107
Granger(b)	(19)	105	103	96	99	-
Litmus(b)	(19)	79	109	107	97	-
Lockyer(b)	(21)	104	97	-	103	103
Mundah	(21)	82	104	-	96	100
Oxford	(16)	107	90	-	99	-
Rosalind(b)	(26)	108	121	105	106	111

SOURCE: BASED ON MET ANALYSIS FROM NVT ONLINE, NVTONLINE.COM.AU

TABLE 4 Grain yield of barley varieties in Agzone 3 expressed as a per cent of the site mean yield for each trial year (2014–18).

Year		2014	2015	2016	2017	2018
Site mean yield (t/ha)		4.95	3.76	3.59	4.41	3.61
	No. trials	(3)	(5)	(1)	(2)	(3)
DELIVERABLE AS A MALT VARIETY						
Bass[Φ]	(14)	98	88	91	90	93
Flinders[Φ]	(14)	102	99	97	97	98
La Trobe[Φ]	(14)	106	104	100	100	100
RGT Planet[Φ]	(6)	-	-	112	115	110
Scope CL[Φ]	(14)	92	89	96	94	96
Spartacus CL[Φ]	(14)	107	105	100	99	100
STAGE 2 MALT ACCREDITATION						
Banks[Φ]	(11)	-	108	105	104	103
Leabrook[Φ]	(11)	-	109	105	105	104
LG Alestar[Φ]	(9)	99	100	100	-	-
DELIVERABLE AS A FEED VARIETY						
Buff[Φ]	(3)	-	-	-	-	107
Compass[Φ]	(14)	103	102	101	100	101
Fathom[Φ]	(14)	97	98	101	100	100
Granger[Φ]	(14)	103	107	103	103	102
Litmus[Φ]	(11)	88	94	105	100	-
Lockyer[Φ]	(12)	102	102	-	102	101
Mundah	(11)	90	91	-	96	97
Oxford	(14)	103	99	96	98	99
Rosalind[Φ]	(14)	109	117	110	109	107

SOURCE: BASED ON MET ANALYSIS FROM NVT ONLINE, NVTONLINE.COM.AU

TABLE 5 Grain yield of barley varieties in Agzone 4 expressed as a per cent of the site mean yield for each trial year (2014–18).

Year		2014	2015	2016	2017	2018
Site mean yield (t/ha)		0.36	2.82	-	1.45	3.34
	No. trials	(2)	(2)	(0)	(1)	(2)
DELIVERABLE AS A MALT VARIETY						
Bass[Φ]	(7)	85	96	-	100	93
Flinders[Φ]	(7)	89	98	-	98	94
La Trobe[Φ]	(7)	145	110	-	123	97
RGT Planet[Φ]	(3)	-	-	-	101	103
Scope CL[Φ]	(7)	93	96	-	97	103
Spartacus CL[Φ]	(7)	162	114	-	131	94
STAGE 2 MALT ACCREDITATION						
Banks[Φ]	(5)	-	107	-	110	101
Leabrook[Φ]	(5)	-	111	-	123	105
LG Alestar[Φ]	(4)	67	93	-	-	-
DELIVERABLE AS A FEED VARIETY						
Buff[Φ]	(3)	-	-	-	97	120
Compass[Φ]	(7)	156	112	-	127	102
Fathom[Φ]	(6)	118	103	-	109	107
Granger[Φ]	(5)	90	99	-	92	-
Litmus[Φ]	(5)	159	108	-	110	-
Lockyer[Φ]	(7)	86	98	-	97	102
Mundah	(7)	143	105	-	110	105
Oxford	(5)	42	90	-	80	-
Rosalind[Φ]	(7)	185	120	-	135	104

SOURCE: BASED ON MET ANALYSIS FROM NVT ONLINE, NVTONLINE.COM.AU

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TABLE 6 Grain yield of barley varieties in Agzone 5 expressed as a per cent of the site mean yield for each trial year (2014–18).

Year		2014	2015	2016	2017	2018
Site mean yield (t/ha)		3.40	3.41	2.61	3.58	2.87
	No. trials	(4)	(4)	(1)	(4)	(3)
DELIVERABLE AS A MALT VARIETY						
Bass(b)	(16)	98	97	90	95	93
Flinders(b)	(15)	101	101	-	100	98
La Trobe(b)	(16)	108	112	96	104	104
RGT Planet(b)	(8)	-	-	121	111	112
Scope CL(b)	(13)	93	91	89	93	-
Spartacus CL(b)	(16)	107	116	97	103	105
STAGE 2 MALT ACCREDITATION						
Banks(b)	(12)	-	107	106	103	105
Leabrook(b)	(12)	-	113	97	109	108
LG Alestar(b)	(9)	95	94	107	-	-
DELIVERABLE AS A FEED VARIETY						
Buff(b)	(8)	-	-	102	101	106
Compass(b)	(16)	107	110	92	102	104
Fathom(b)	(16)	103	100	90	101	101
Granger(b)	(16)	98	101	113	102	102
Litmus(b)	(13)	79	91	97	87	-
Lockyer(b)	(16)	107	101	99	104	101
Mundah	(15)	84	93	-	88	97
Oxford	(15)	103	97	-	103	96
Rosalind(b)	(16)	111	120	105	109	113

SOURCE: BASED ON MET ANALYSIS FROM NVT ONLINE, NVTONLINE.COM.AU

TABLE 7 Grain yield of barley varieties in Agzone 6 expressed as a per cent of the site mean yield for each trial year (2014–18).

Year		2014	2015	2016	2017	2018
Site mean yield (t/ha)		2.51	3.86	4.13	2.96	4.88
	No. trials	(2)	(2)	(2)	(1)	(2)
DELIVERABLE AS A MALT VARIETY						
Bass(b)	(9)	89	95	86	92	92
Flinders(b)	(9)	101	105	100	109	99
La Trobe(b)	(9)	99	103	96	89	98
RGT Planet(b)	(5)	-	-	127	128	114
Scope CL(b)	(7)	86	87	87	81	-
Spartacus CL(b)	(9)	95	106	95	92	97
STAGE 2 MALT ACCREDITATION						
Banks(b)	(7)	-	105	106	105	103
Leabrook(b)	(7)	-	102	102	81	102
LG Alestar(b)	(6)	104	104	106	-	-
DELIVERABLE AS A FEED VARIETY						
Buff(b)	(2)	-	-	-	-	106
Compass(b)	(9)	94	96	92	75	97
Fathom(b)	(9)	97	91	93	74	98
Granger(b)	(9)	107	111	112	127	105
Litmus(b)	(7)	68	83	90	82	-
Lockyer(b)	(9)	110	101	102	96	102
Mundah	(7)	71	85	-	81	92
Oxford	(9)	114	108	107	122	103
Rosalind(b)	(9)	105	108	108	91	105

SOURCE: BASED ON MET ANALYSIS FROM NVT ONLINE, NVTONLINE.COM.AU

TABLE 8 Grain yield of barley varieties averaged across Agzones 1–6 expressed as a per cent of the site mean yield for each trial year (2014–18).

Year		2014	2015	2016	2017	2018
Site mean yield (t/ha)		2.85	3.11	3.84	3.50	3.92
	No. trials	(17)	(20)	(9)	(15)	(19)
DELIVERABLE AS A MALT VARIETY						
Bass(b)	(79)	96	93	91	94	94
Flinders(b)	(77)	102	100	97	99	97
La Trobe(b)	(80)	106	107	98	102	102
RGT Planet(b)	(42)	-	-	113	110	106
Scope CL(b)	(74)	91	91	96	95	98
Spartacus CL(b)	(80)	106	110	96	101	101
STAGE 2 MALT ACCREDITATION						
Banks(b)	(63)	-	107	103	103	102
Leabrook(b)	(63)	-	109	105	106	108
LG Alestar(b)	(43)	98	97	101	-	-
DELIVERABLE AS A FEED VARIETY						
Buff(b)	(35)	-	-	112	105	110
Compass(b)	(80)	103	106	99	102	105
Fathom(b)	(79)	99	99	101	101	105
Granger(b)	(67)	103	104	102	101	98
Litmus(b)	(61)	82	98	101	95	-
Lockyer(b)	(71)	104	100	102	102	102
Mundah	(67)	85	95	-	94	99
Oxford	(64)	104	96	99	100	95
Rosalind(b)	(80)	110	118	107	108	109

SOURCE: BASED ON MET ANALYSIS FROM NVT ONLINE, NVTONLINE.COM.AU

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TABLE 9 Comparisons between two varieties (yield difference compared using least significant difference, p=0.05) – how many times (as a per cent) was variety A (comparator variety) lower-yielding, the same yield or higher-yielding than variety B (base variety, La Trobe(Þ) or RGT Planet(Þ)) when sown together in WA barley NVT?

Variety A	Variety B	Per cent of trials			Comparison years	Number of trials	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 LA TROBE(Þ)							
Banks(Þ)	La Trobe(Þ)	11%	79%	10%	2015–2018	62	Banks(Þ) = La Trobe(Þ)
Bass(Þ)	La Trobe(Þ)	56%	44%	0%	2011–2018	130	Bass(Þ) ≤ La Trobe(Þ)
Buff(Þ)	La Trobe(Þ)	0%	69%	31%	2016–2018	35	Buff(Þ) ≥ La Trobe(Þ)
Compass(Þ)	La Trobe(Þ)	16%	70%	14%	2012–2018	114	Compass(Þ) = La Trobe(Þ)
Fathom(Þ)	La Trobe(Þ)	28%	62%	11%	2011–2018	130	Fathom(Þ) = La Trobe(Þ)
Flinders(Þ)	La Trobe(Þ)	35%	55%	10%	2011–2018	127	Flinders(Þ) ≤ La Trobe(Þ)
Granger(Þ)	La Trobe(Þ)	33%	57%	10%	2011–2018	116	Granger(Þ) ≤ La Trobe(Þ)
Leabrook(Þ)	La Trobe(Þ)	6%	74%	19%	2015–2018	62	Leabrook(Þ) = La Trobe(Þ)
LG Alestar(Þ)	La Trobe(Þ)	46%	49%	5%	2011–2016	82	LG Alestar(Þ) ≤ La Trobe(Þ)
Litmus(Þ)	La Trobe(Þ)	43%	42%	14%	2011–2017	92	Litmus(Þ) ≤ La Trobe(Þ)
Lockyer(Þ)	La Trobe(Þ)	26%	59%	14%	2011–2018	111	Lockyer(Þ) = La Trobe(Þ)
Mundah	La Trobe(Þ)	62%	36%	3%	2011–2018	118	Mundah < La Trobe(Þ)
Oxford	La Trobe(Þ)	48%	41%	11%	2011–2018	104	Oxford ≤ La Trobe(Þ)
RGT Planet(Þ)	La Trobe(Þ)	14%	48%	38%	2016–2018	42	RGT Planet(Þ) ≥ La Trobe(Þ)
Rosalind(Þ)	La Trobe(Þ)	4%	54%	43%	2014–2018	80	Rosalind(Þ) ≥ La Trobe(Þ)
Scope CL(Þ)	La Trobe(Þ)	52%	44%	4%	2011–2018	125	Scope CL(Þ) ≤ La Trobe(Þ)
Spartacus CL(Þ)	La Trobe(Þ)	11%	76%	13%	2014–2018	80	Spartacus CL(Þ) = La Trobe(Þ)
COMPARISONS WITH RGT PLANET(Þ)							
Banks(Þ)	RGT Planet(Þ)	33%	62%	5%	2016–2018	42	Banks(Þ) ≤ RGT Planet(Þ)
Bass(Þ)	RGT Planet(Þ)	61%	39%	0%	2016–2018	42	Bass(Þ) ≤ RGT Planet(Þ)
Buff(Þ)	RGT Planet(Þ)	20%	43%	37%	2016–2018	35	Buff(Þ) ≥ RGT Planet(Þ)
Compass(Þ)	RGT Planet(Þ)	36%	50%	14%	2016–2018	42	Compass(Þ) ≤ RGT Planet(Þ)
Fathom(Þ)	RGT Planet(Þ)	34%	54%	12%	2016–2018	41	Fathom(Þ) ≤ RGT Planet(Þ)
Flinders(Þ)	RGT Planet(Þ)	59%	38%	3%	2016–2018	39	Flinders(Þ) ≤ RGT Planet(Þ)
Granger(Þ)	RGT Planet(Þ)	30%	67%	3%	2016–2018	30	Granger(Þ) ≤ RGT Planet(Þ)
La Trobe(Þ)	RGT Planet(Þ)	38%	48%	14%	2016–2018	42	La Trobe(Þ) ≤ RGT Planet(Þ)
Leabrook(Þ)	RGT Planet(Þ)	24%	60%	17%	2016–2018	42	Leabrook(Þ) = RGT Planet(Þ)
LG Alestar(Þ)	RGT Planet(Þ)	63%	38%	0%	2016	8	LG Alestar(Þ) ≤ RGT Planet(Þ)
Litmus(Þ)	RGT Planet(Þ)	57%	22%	22%	2016–2017	23	Litmus(Þ) ≤ RGT Planet(Þ)
Lockyer(Þ)	RGT Planet(Þ)	35%	62%	3%	2016–2018	34	Lockyer(Þ) ≤ RGT Planet(Þ)
Mundah	RGT Planet(Þ)	43%	57%	0%	2017–2018	30	Mundah ≤ RGT Planet(Þ)
Oxford	RGT Planet(Þ)	59%	41%	0%	2016–2018	27	Oxford ≤ RGT Planet(Þ)
Rosalind(Þ)	RGT Planet(Þ)	24%	50%	26%	2016–2018	42	Rosalind(Þ) = RGT Planet(Þ)
Scope CL(Þ)	RGT Planet(Þ)	47%	50%	3%	2016–2018	36	Scope CL(Þ) ≤ RGT Planet(Þ)
Spartacus CL(Þ)	RGT Planet(Þ)	40%	50%	10%	2016–2018	42	Spartacus CL(Þ) ≤ RGT Planet(Þ)

SOURCE: NVT ONLINE, NVTONLINE.COM.AU

TABLE 10 Comparisons between two varieties (yield difference compared using least significant difference, p=0.05) – how many times (as a per cent) was variety A (comparator variety) lower-yielding, the same yield or higher-yielding than variety B (base variety, Rosalind(Φ), Bass(Φ), Flinders(Φ) or Spartacus CL(Φ)) when sown together in WA barley NVT?

Variety A	Variety B	Per cent of trials			Comparison years	Number of trials	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(Φ)							
Banks(Φ)	Rosalind(Φ)	37%	58%	5%	2015–2018	62	Banks(Φ) ≤ Rosalind(Φ)
Bass(Φ)	Rosalind(Φ)	72%	27%	1%	2014–2018	79	Bass(Φ) < Rosalind(Φ)
Buff(Φ)	Rosalind(Φ)	23%	51%	26%	2016–2018	35	Buff(Φ) = Rosalind(Φ)
Compass(Φ)	Rosalind(Φ)	39%	59%	3%	2014–2018	80	Compass(Φ) ≤ Rosalind(Φ)
Fathom(Φ)	Rosalind(Φ)	51%	44%	5%	2014–2018	79	Fathom(Φ) ≤ Rosalind(Φ)
Flinders(Φ)	Rosalind(Φ)	66%	31%	3%	2014–2018	77	Flinders(Φ) < Rosalind(Φ)
Granger(Φ)	Rosalind(Φ)	46%	51%	3%	2014–2018	67	Granger(Φ) ≤ Rosalind(Φ)
La Trobe(Φ)	Rosalind(Φ)	43%	54%	4%	2014–2018	80	La Trobe(Φ) ≤ Rosalind(Φ)
Leabrook(Φ)	Rosalind(Φ)	24%	71%	5%	2014–2018	62	Leabrook(Φ) = Rosalind(Φ)
LG Alestar(Φ)	Rosalind(Φ)	65%	35%	0%	2014–2016	43	LG Alestar(Φ) ≤ Rosalind(Φ)
Litmus(Φ)	Rosalind(Φ)	68%	25%	7%	2014–2017	60	Litmus(Φ) < Rosalind(Φ)
Lockyer(Φ)	Rosalind(Φ)	48%	46%	6%	2014–2018	71	Lockyer(Φ) ≤ Rosalind(Φ)
Mundah	Rosalind(Φ)	82%	16%	1%	2014–2016,2018	67	Mundah < Rosalind(Φ)
Oxford	Rosalind(Φ)	55%	41%	5%	2014–2018	64	Oxford ≤ Rosalind(Φ)
RGT Planet(Φ)	Rosalind(Φ)	26%	50%	24%	2016–2018	42	RGT Planet(Φ) = Rosalind(Φ)
Scope CL(Φ)	Rosalind(Φ)	72%	26%	3%	2014–2018	74	Scope CL(Φ) < Rosalind(Φ)
Spartacus CL(Φ)	Rosalind(Φ)	40%	56%	4%	2014–2018	80	Spartacus CL(Φ) ≤ Rosalind(Φ)
COMPARISONS WITH BASS(Φ)							
Banks(Φ)	Bass(Φ)	0%	39%	61%	2015–2018	61	Banks(Φ) ≥ Bass(Φ)
Flinders(Φ)	Bass(Φ)	4%	59%	37%	2011–2018	126	Flinders(Φ) ≥ Bass(Φ)
Leabrook(Φ)	Bass(Φ)	2%	26%	72%	2015–2018	61	Leabrook(Φ) > Bass(Φ)
LG Alestar(Φ)	Bass(Φ)	7%	65%	27%	2011–2016	81	LG Alestar(Φ) = Bass(Φ)
Spartacus CL(Φ)	Bass(Φ)	1%	48%	51%	2014–2018	79	Spartacus CL(Φ) ≥ Bass(Φ)
COMPARISONS WITH FLINDERS(Φ)							
Banks(Φ)	Flinders(Φ)	5%	53%	42%	2015–2018	59	Banks(Φ) ≥ Flinders(Φ)
Leabrook(Φ)	Flinders(Φ)	5%	46%	49%	2015–2018	59	Leabrook(Φ) ≥ Flinders(Φ)
LG Alestar(Φ)	Flinders(Φ)	31%	61%	8%	2011–2016	80	LG Alestar(Φ) = Flinders(Φ)
Spartacus CL(Φ)	Flinders(Φ)	6%	56%	38%	2014–2018	77	Spartacus CL(Φ) ≥ Flinders(Φ)
COMPARISONS WITH SPARTACUS CL(Φ)							
Banks(Φ)	Spartacus CL(Φ)	15%	69%	16%	2015–2018	62	Banks(Φ) = Spartacus CL(Φ)
Buff(Φ)	Spartacus CL(Φ)	9%	43%	49%	2016–2018	35	Buff(Φ) ≥ Spartacus CL(Φ)
Compass(Φ)	Spartacus CL(Φ)	14%	76%	10%	2014–2018	80	Compass(Φ) = Spartacus CL(Φ)
Fathom(Φ)	Spartacus CL(Φ)	27%	57%	16%	2014–2018	79	Fathom(Φ) = Spartacus CL(Φ)
Leabrook(Φ)	Spartacus CL(Φ)	15%	60%	26%	2015–2018	62	Leabrook(Φ) = Spartacus CL(Φ)
Litmus(Φ)	Spartacus CL(Φ)	50%	42%	8%	2014–2017	60	Litmus(Φ) ≤ Spartacus CL(Φ)
Scope CL(Φ)	Spartacus CL(Φ)	51%	43%	5%	2014–2018	74	Scope CL(Φ) ≤ Spartacus CL(Φ)

SOURCE: NVT ONLINE, NVTONLINE.COM.AU

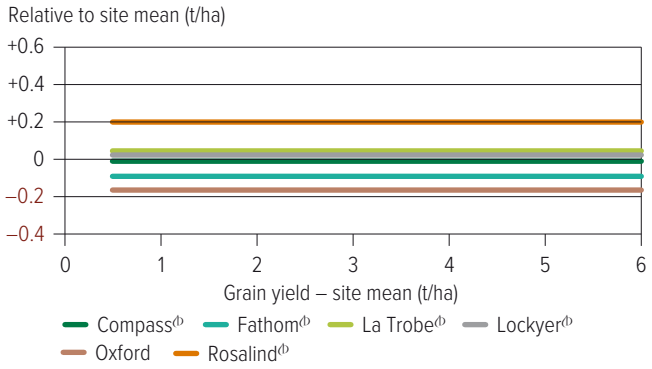
GRAIN YIELD – FEED BARLEY COMPARISONS

The highest yielding varieties in WA are Rosalind$^{\Phi}$ and RGT Planet$^{\Phi}$, with Buff$^{\Phi}$ excelling on soils with an acidic profile (Figures 2 and 3, Tables 2 to 10). RGT Planet$^{\Phi}$ appears to have the highest yield potential at sites above 4t/ha and Rosalind$^{\Phi}$ has the advantage below 2t/ha. The feed varieties Fathom$^{\Phi}$, Compass$^{\Phi}$ and Lockyer$^{\Phi}$ have comparable yields to the malt variety La Trobe$^{\Phi}$, with Compass$^{\Phi}$ appearing to do better in Agzones 1 and 4 and Lockyer$^{\Phi}$ doing better in Agzone 6 than La Trobe$^{\Phi}$. Those four varieties, however, are generally inferior to Rosalind$^{\Phi}$ and RGT Planet$^{\Phi}$. Rosalind$^{\Phi}$ and RGT Planet$^{\Phi}$ were superior to La Trobe$^{\Phi}$ in two of every five barley NVT. The average fitted yield advantage over La Trobe$^{\Phi}$ was 0.17t/ha ($p<0.01$) for Rosalind$^{\Phi}$, and 0.19t/ha ($p<0.05$) for RGT Planet$^{\Phi}$ (Figure 3).

GRAIN YIELD – MALT BARLEY COMPARISONS

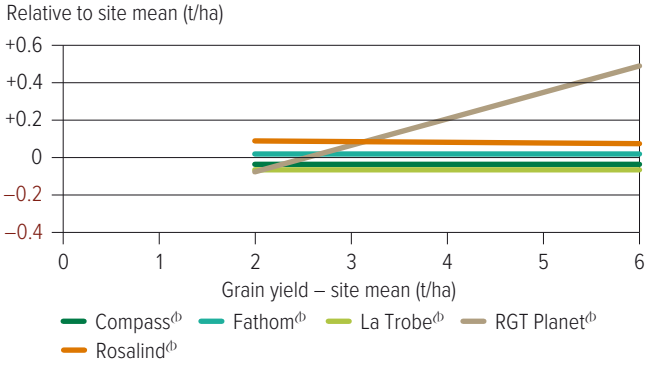
RGT Planet$^{\Phi}$ is the highest-yielding variety segregated for malt, being higher yielding in three of every five comparisons with Bass$^{\Phi}$ and Flinders$^{\Phi}$, half of the direct comparisons with Scope CL$^{\Phi}$, and two of every five comparisons with La Trobe$^{\Phi}$ and Spartacus CL$^{\Phi}$. The advantage of RGT Planet$^{\Phi}$ is apparent above 4t/ha, but for most growers whose harvested yield is most likely to be between 2–4t/ha, there is unlikely to be any significant difference between RGT Planet$^{\Phi}$, Spartacus CL$^{\Phi}$ and La Trobe$^{\Phi}$. While La Trobe$^{\Phi}$ and Spartacus CL$^{\Phi}$ appear to have similar yield, yielding the same in three out of every four barley trials, Figure 4 suggests that Spartacus CL$^{\Phi}$ may be a slightly better option below 2t/ha while La Trobe$^{\Phi}$ may have a slight advantage above 4t/ha. This subtle difference, however, is probably relatively inconsequential to choosing whether to grow La Trobe$^{\Phi}$ or Spartacus CL$^{\Phi}$. The need for an imidazolinone herbicide, the presence of an imidazolinone residue, market signals and differences in their grain quality have a more significant bearing on which variety to grow of those two than subtle differences in their grain yield.

FIGURE 2 Fitted grain yield of Compass$^{\Phi}$, Fathom$^{\Phi}$, Lockyer$^{\Phi}$, Oxford and Rosalind$^{\Phi}$ at different site mean yields (2014–2018).



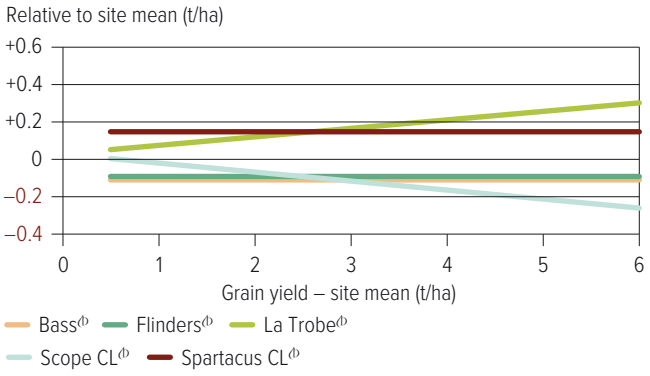
SOURCE: DATA FROM 2014–2018 DPIRD-GRDC BARLEY AGRONOMY AND 2014–2018 GRDC NVT. EACH VARIETY SOWN IN ALL 71 TRIAL-YEARS OF DATA

FIGURE 3 Fitted grain yield of Compass$^{\Phi}$, Fathom$^{\Phi}$, La Trobe$^{\Phi}$, RGT Planet$^{\Phi}$ and Rosalind$^{\Phi}$ at different site mean yields (2016–2018).



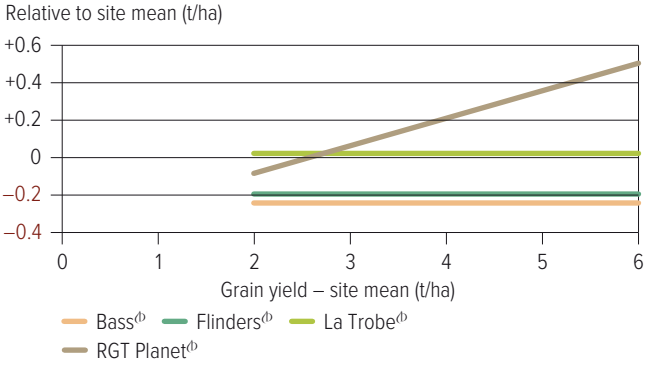
SOURCE: DATA FROM 2016, 2018 DPIRD-GRDC BARLEY AGRONOMY AND 2016–2018 GRDC NVT. EACH VARIETY SOWN IN ALL 51 TRIAL-YEARS OF DATA

FIGURE 4 Fitted grain yield of Bass$^{\Phi}$, Flinders$^{\Phi}$, La Trobe$^{\Phi}$, Scope CL$^{\Phi}$ and Spartacus CL$^{\Phi}$ at different site mean yields (2014–2018).



SOURCE: DATA FROM 2015–2018 DPIRD-GRDC BARLEY AGRONOMY AND 2014–2018 GRDC NVT. EACH VARIETY SOWN IN ALL 112 TRIAL-YEARS OF DATA

FIGURE 5 Fitted grain yield of Bass$^{\Phi}$, Flinders$^{\Phi}$, La Trobe$^{\Phi}$ and RGT Planet$^{\Phi}$ at different site mean yields (2016–2018).



SOURCE: DATA FROM 2016–2018 DPIRD-GRDC BARLEY AGRONOMY AND GRDC NVT. EACH VARIETY SOWN IN ALL 89 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 traits such as straw strength and head loss resistance. However, while grain yield is essential when comparing varieties segregated for malt, their grain quality characteristics are almost equally as important for those chasing the premium on offer for delivery as a Malt1 barley.

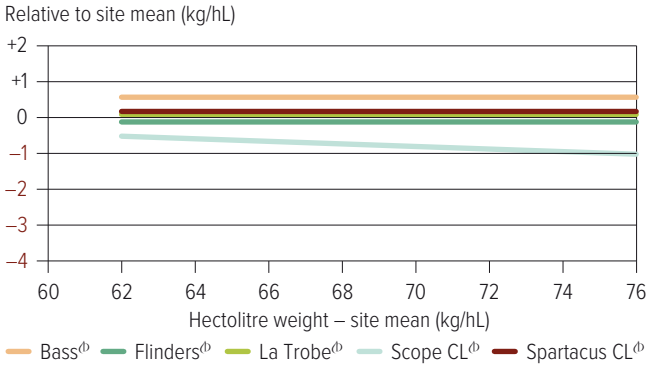
As with the grain yield data presented in Figures 2 to 5, the physical grain quality (hectolitre weight, screenings through a 2.5mm slotted sieve and grain brightness) of a malt variety was plotted relative to the site mean as the site mean increases (Figures 6 to 11). The deviation from the site mean 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 include DPIRD–GRDC (DAW00190 and DAW00224) barley agronomy grain quality data (replicated) in addition to GRDC NVT barley grain quality data (not replicated). In some trials where Scope CL$^{\Phi}$ was absent, Buloke$^{\Phi}$ data substituted (due to the closeness of their relationships with each other).

Figures 6 and 7 compare the hectolitre weight of varieties segregated for malt in WA, Figures 8 and 9 present grain plumpness (per cent through a 2.5mm sieve) comparisons, while Figures 10 and 11 graph grain brightness as the level of weather damage at a site decreased.

Grain quality – hectolitre weight comparisons

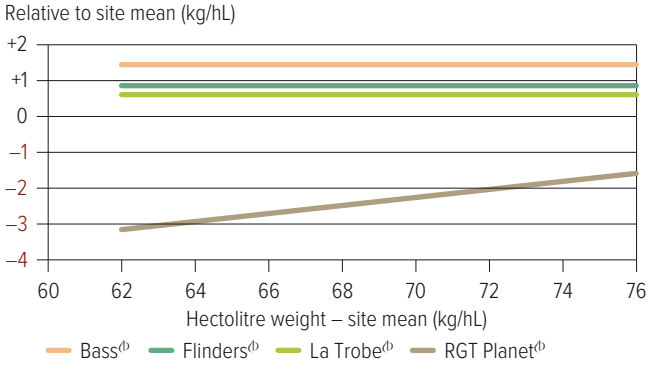
Bass$^{\Phi}$ is the current benchmark variety for hectolitre weight of the six varieties segregated for malt in WA, being slightly higher (+0.5 to 0.7 kg/hL, $p<0.05$) than Flinders$^{\Phi}$, La Trobe$^{\Phi}$ and Spartacus CL$^{\Phi}$, which are similar (Figures 6 and 7). Scope CL$^{\Phi}$ averaged nearly 1kg/hL below Spartacus CL$^{\Phi}$ ($p<0.001$), while the hectolitre weight of RGT Planet$^{\Phi}$ is significantly lower (around 2-3kg/hL lower) than the other five varieties segregated for malt in WA. RGT Planet$^{\Phi}$, therefore, has the highest risk of not meeting Malt1 hectolitre specifications in WA. Conditions that favour a low hectolitre weight in RGT Planet$^{\Phi}$ are often associated with high grain plumpness and, conversely, high hectolitre is often associated with low grain plumpness in RGT Planet$^{\Phi}$. Those observations reflect the elongated grain shape of RGT Planet$^{\Phi}$ kernels.

FIGURE 6 Fitted hectolitre weight of Bass$^{\Phi}$, Flinders$^{\Phi}$, La Trobe$^{\Phi}$, Scope CL$^{\Phi}$ and Spartacus CL$^{\Phi}$ at different site mean hectolitre weights (2014–2018).



SOURCE: DATA FROM 2015–2018 DPIRD-GRDC BARLEY AGRONOMY AND 2014–2018 GRDC NVT. EACH VARIETY SOWN IN ALL 112 TRIAL-YEARS OF DATA

FIGURE 7 Fitted hectolitre weight of Bass$^{\Phi}$, Flinders$^{\Phi}$, La Trobe$^{\Phi}$ and RGT Planet$^{\Phi}$ at different site mean hectolitre weights (2016–2018).



SOURCE: DATA FROM 2016–2018 DPIRD-GRDC BARLEY AGRONOMY AND GRDC NVT. EACH VARIETY SOWN IN ALL 89 TRIAL–YEARS OF DATA

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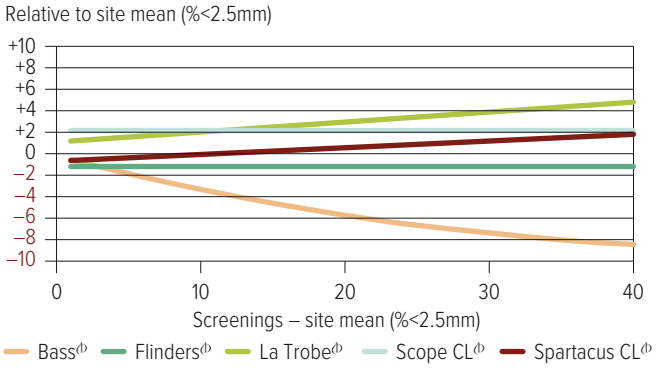
Grain quality – grain plumpness comparisons

The benchmark malt variety for grain plumpness is Bass$^{\phi}$ (Figures 8 and 9), 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$^{\phi}$, although generally less plump than Bass$^{\phi}$, shows improved plumpness compared with other malt varieties. Scope CL$^{\phi}$ shows similar plumpness to La Trobe$^{\phi}$, although both are generally inferior to Spartacus CL$^{\phi}$ for plumpness. Screenings of Spartacus CL$^{\phi}$ are likely to be around two per cent less than La Trobe$^{\phi}$ under the same agronomy. RGT Planet$^{\phi}$ appears to behave more like Baudin$^{\phi}$ (data not shown) than Bass$^{\phi}$ or Flinders$^{\phi}$, with screenings comparable to or slightly higher than La Trobe$^{\phi}$. RGT Planet$^{\phi}$ exhibits a higher risk of exceeding screenings limits compared with other malt varieties, particularly in seasons with a tight finish. At very low screenings, most varieties are similar, but around the Malt1 limit of 20 per cent screenings genetic differences are notable. This may influence Malt1 selection rates across paddocks and seasons, and in response to management treatments.

Grain quality – grain brightness comparisons

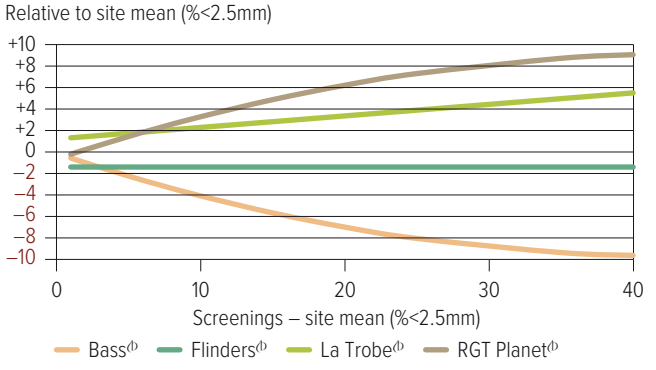
At grain brightness levels below 60 'L*', the benchmark malt varieties are Bass$^{\phi}$ and Flinders$^{\phi}$ (Figures 10 and 11), which are similar to or slightly darker than Baudin$^{\phi}$ (data not shown). La Trobe$^{\phi}$ kernels can be up to 1'L*' darker and Scope CL$^{\phi}$ kernels 0.5'L*' darker than Bass$^{\phi}$ kernels. The grain brightness of Spartacus CL$^{\phi}$ is a slight improvement over La Trobe$^{\phi}$, being higher on average by 0.4'L*' ($p<0.001$) across a range of grain brightness levels. At sites close to the receival limit for Malt1, the brightness of Spartacus CL$^{\phi}$ is comparable to Scope CL$^{\phi}$, with differences exacerbated at sites that produced brighter grain. RGT Planet$^{\phi}$ appears to have a grain brightness between Bass$^{\phi}$ and La Trobe$^{\phi}$.

FIGURE 8 Fitted screenings of Bass$^{\phi}$, Flinders$^{\phi}$, La Trobe$^{\phi}$, Scope CL$^{\phi}$ and Spartacus CL$^{\phi}$ at different site mean screenings (2014–2018).



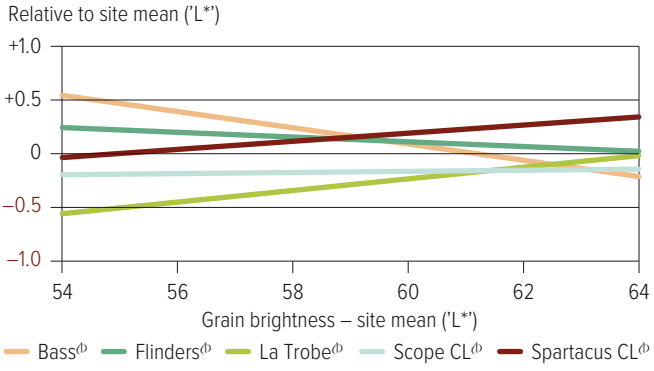
SOURCE: DATA FROM 2015–2018 DPIRD-GRDC BARLEY AGRONOMY AND 2014–2018 GRDC NVT. EACH VARIETY SOWN IN ALL 112 TRIAL-YEARS OF DATA

FIGURE 9 Fitted screenings of Bass$^{\phi}$, Flinders$^{\phi}$, La Trobe$^{\phi}$ and RGT Planet$^{\phi}$ at different site mean screenings (2016–2018).



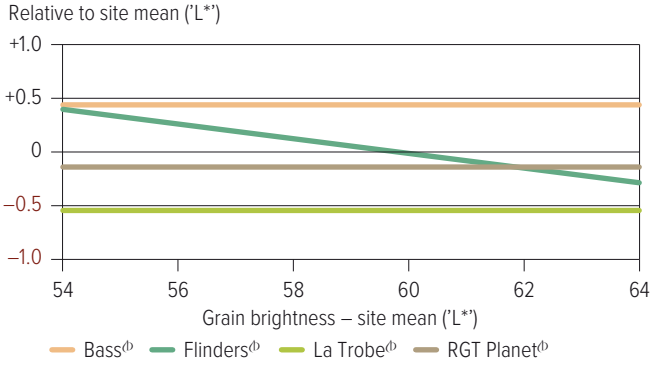
SOURCE: DATA FROM 2016–2018 DPIRD-GRDC BARLEY AGRONOMY AND GRDC NVT. EACH VARIETY SOWN IN ALL 89 TRIAL-YEARS OF DATA

FIGURE 10 Fitted grain brightness of Bass$^{\phi}$, Flinders$^{\phi}$, La Trobe$^{\phi}$, Scope CL$^{\phi}$ and Spartacus CL$^{\phi}$ at different site mean grain brightness (2014–2018).



SOURCE: DATA FROM 2015–2018 DPIRD-GRDC BARLEY AGRONOMY AND 2014–2018 GRDC NVT. EACH VARIETY SOWN IN ALL 112 TRIAL-YEARS OF DATA

FIGURE 11 Fitted grain brightness of Bass$^{\phi}$, Flinders$^{\phi}$, La Trobe$^{\phi}$ and RGT Planet$^{\phi}$ at different site mean grain brightness (2016–2018).



SOURCE: DATA FROM 2016–2018 DPIRD-GRDC BARLEY AGRONOMY AND GRDC NVT. EACH VARIETY SOWN IN ALL 89 TRIAL-YEARS OF DATA

DISEASE 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
- BYDV = barley yellow dwarf virus
- CYDV = cereal yellow dwarf virus

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

Seedling and adult resistance

Disease, virus and nematode resistance data are presented in Tables 11 to 13 and again in the variety snapshots. Leaf disease ratings in the barley section of this guide include seedling and adult-stage resistance ratings for the foliar leaf diseases NTNB, STNB, PM and BLR. There is no seedling data for scald, so only the adult-stage resistance is presented. This year adult resistance ratings (although provisional at this stage) to Oxford virulent NTNB are shown.

Seedling ratings are applicable at early growth stages (two to three-leaf stage) and are important for making decisions on the use of seed or fertiliser-applied fungicide treatments. They 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 early 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), but in some varieties and for some diseases the adult ratings may be applicable as early as late tillering to stem elongation. The variation between the seedling and adult rating of a variety is most likely due to the effectiveness of resistance genes at one or the other stage.

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 for a couple of the varieties listed since the last sowing guide, usually up or down one resistance score, but there have been no significant changes in resistance score as the result of a new pathotype.

New pathotype – NTNB

Be watchful for increased NTNB with a new aggressive pathotype, named Oxford virulent, detected across the south coast. Banks[ϕ] and Granger[ϕ] have the best overall resistance to this new pathotype, being rated as MRMS as seedlings and MS*p* as adult plants. The next best resistance is Buff[ϕ] (MS as seedling and adult), Compass[ϕ] (S as seedling and MS as an adult), Leabrook[ϕ] (MSS as seedling and adult), and LG Alestar[ϕ] (MS as seedling and MSS as an adult). Other varieties are provisionally rated as S to the Oxford virulent NTNB pathotype as adult plants.

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. They are the first recorded detections of this disease in WA. While first detected in Tasmania in 2016 it is present in our neighbouring countries New Zealand (first detected in 1997) and South Africa (first detected in 2015). It is also found in important barley-growing regions such as Scotland, mid-Europe, Argentina and Uruguay. In those environments, it is estimated to cause losses up to 25 per cent and in extreme cases up to 70 per cent of the yield potential through a significant decrease of kernel size and quality.

The fungus is primarily a disease of barley but can infect a wide range of hosts including oats, wheat and a few kinds of grass. 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

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infected barley and grasses, although this generally requires prolonged periods of leaf wetness. Identification of the disease can be difficult as lesions are generally not evident until after flowering and can be easily confused with other similar fungal leaf spotting diseases such as STNB or abiotic symptoms caused by physiological leaf-spotting and boron toxicity (although these abiotic spots are not likely to respond to fungicide application). The potential impact of this disease in WA barley crops is unknown. There are no specific management recommendations for the disease in WA at this stage; however, the fungicides used to manage net blotches in barley, applied at the booting stage, are likely to be active on RLS.

Disease surveillance

Growers and consultants observing barley varieties rated as MRMS, MR or R to scald, NTNB, STNB, PM or BLR carrying significantly higher levels of disease than expected should collect infected material for pathotype identification and fungicide resistance testing. Before spraying the crop with a fungicide, collect leaf samples 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-infected individual leaves to be placed into agar tubing to maintain a live culture for pathotyping. Sample collection kits for PM need to be sourced 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 ACRCP Annual Cereal Rust Survey, Plant Breeding Institute, 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 have been detected in WA. Fungicide management to address resistance issues and to reduce future resistance development will increasingly require the use of fungicide mixtures containing different modes of action, including strobilurins (for example, azoxystrobin and pyraclostrobin) and SDHI (for example, fluxapyroxad and bixafen); and avoiding repetitive applications of single active ingredients or fungicide group.

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 RLS 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 increase the prevalence of scald, especially with early sowing opportunities. A severe early infection can reduce the head number and grain number. Yield losses of up to 45 per cent 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$^{\Phi}$, LG Alestar$^{\Phi}$, Litmus$^{\Phi}$ and Mundah.

Net-type net blotch

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 per cent and affect the quality of grain produced.

The CCDM has discovered populations of NTNB resistant to the triazole based DMI fungicide tebuconazole and some other types of triazole fungicides in central and southern regions, including one population in the Esperance region with higher resistance to the DMI fungicides tebuconazole and propiconazole.

Fungicide management of NTNB to address resistance issues and to reduce future resistance development will increasingly require the use of fungicide mixtures containing different modes of action including strobilurins (for example, azoxystrobin and pyraclostrobin) and SDHI (for example, fluxapyroxad 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 was prevalent throughout the state, whereas the Beecher virulent (attacking) isolate was 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, the varietal response will vary accordingly. Litmus$^{\Phi}$ is the most vulnerable variety to NTNB, being susceptible to all three major pathotypes present in WA. In the presence of the Oxford virulent pathotype, Banks$^{\Phi}$, Buff$^{\Phi}$, Compass$^{\Phi}$, Granger$^{\Phi}$, Leabrook$^{\Phi}$ and LG Alestar$^{\Phi}$ have the best 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 due to the lack of seedling resistance in commercially grown varieties.

Spot-type net blotch

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 per cent and affect the quality of 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, although this resistant population is also slightly less sensitive to the newer DMIs such as prothioconazole.

Fungicide management of STNB to address resistance issues in the southern regions and reduce future development regionally will increasingly require the use of fungicide mixtures and alternating of products including effective DMI ingredients and modes of action including strobilurins (for example, azoxystrobin and pyraclostrobin) and SDHI (for example, fluxapyroxad and bixafen). As outlined in the disease introduction, where fungicide resistance is suspected samples should be sent to the CCDM for assessment.

Fathom$^{\Phi}$ (MR as a seedling and MRMS as an adult) has the best-combined seedling and adult resistance to STNB of the current varieties. Compass$^{\Phi}$ has some tolerance to STNB, rated as MRMS as a seedling and MSS as an adult. Leabrook$^{\Phi}$ is MS at both stages.

Some varieties susceptible at the adult plant stage have some tolerance at the seedling stage (i.e. Bass$^{\Phi}$ has intermediate resistance at the seedling stage but is susceptible at the adult stage). Partial tolerance at the seedling stage reduces the likelihood of severe early infection, but, like Bass$^{\Phi}$, STNB can still infect 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 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 turn grey and may develop small black fruiting bodies. Early infection can cause yield losses of up to 25 per cent, whereas yield losses at the end of stem elongation reduce yield by around 10 per cent.

The variety with the highest risk of PM is Baudin$^{\Phi}$ (but is no longer suggested to grow), although Oxford may now be susceptible in the lower Great Southern in the presence of the *Ml(St)* virulent pathotype.

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 other modes of action, such as strobilurins (for example, azoxystrobin and pyraclostrobin), SDHI (for example, fluxapyroxad) and amines (spiroxamine), have uncompromised activity against PM.

Varieties grown in WA with intermediate resistance or above (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 such as Granger$^{\Phi}$, LG Alestar$^{\Phi}$, and RGT Planet$^{\Phi}$ 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 believed to be restricted to the south coast at present.

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

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

Virulence to the *MlLa* gene has been detected in barley growing in northern NSW and Queensland, resulting in varieties such as Compass$^{\Phi}$, La Trobe$^{\Phi}$, Rosalind and Spartacus CL$^{\Phi}$ 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, although there are reports of increased virulence on varieties other than Oxford (i.e. Rosalind$^{\Phi}$) in the Stirlings to Coast area. Growers should report a suspected breakdown in varietal resistance for varieties rated as MRMS and above to PM.

Barley leaf rust

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) 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 more than 30 per cent 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$^{\Phi}$) to BLR. Only varieties that carry genes different from *Rph3* or APR genes have some resistance. APR genes usually provide moderate levels of resistance and are not pathotype specific, so are unlikely to be affected by any future pathotype changes. APR resistance 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), so there may still be a need to protect those varieties at early growth stages from early infection.

Temperature and varietal background influence the effectiveness of the *Rph20* gene. Although Flinders$^{\Phi}$, Granger$^{\Phi}$, LG Alestar$^{\Phi}$, Oxford and RGT Planet$^{\Phi}$ all carry the APR *Rph20* gene, their field reaction may vary depending on which allele they have and other minor genes they may carry. 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$^{\Phi}$ 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.

As there are no fungicide options to control crown rot once the crop has established, inoculum levels can be reduced by including non-cereals into the rotation (such as pulses, oilseed, lupin and grass-free pasture), inter-row seeding and maintaining reasonable grass weed control in break crops and between crops.

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$^{(\phi)}$ has the lowest yield loss of the varieties tested in the presence of high crown rot.

Barley and cereal yellow dwarf

Both barley yellow dwarf virus (BYDV) and cereal yellow dwarf virus (CYDV) viruses occur in WA. As the screening for varietal resistance occurs in the field, the resistance score reflects the rating to both being present, although BYDV is more frequent than CYDV at a ratio of approximately 2:1. BYDV can reduce grain yield by up to 80 per cent with seedling infection and up to 20 per cent 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 impact of aphid feeding on plant growth. Varietal resistance to BYDV and CYDV, 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 per cent of tillers with 15 or more aphids).

Russian wheat aphid

Russian wheat aphid (*Diuraphis noxia*) (RWA) has not yet been detected in WA (as of November 2019) but is present in South Australia, Victoria, Tasmania and New South Wales. 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 leaf markings and rolling 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.

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 adjacent areas are necessary control measures.

Chemical control is the primary cultural means of reducing damage from RWA. Chlorpyrifos and pirimicarb are registered for control under two Australian Pesticides and Veterinary Medicines Authority (APVMA) emergency use permits. Prophylactic spraying is discouraged and growers should only spray when economic thresholds are reached.

In WA, report RWA aphid activity (including surveillance resulting in no detection) using the MyPestGuide Reporter, available for Apple and Android smartphones and tablets. The MyPestGuide Reporter is a photographic reporting tool that lets users take up to four photos, map their pest observations and communicate directly with DPIRD.

Root lesion nematodes

Root lesion nematodes (*Pratylenchus* spp) (RLN) are microscopic, worm-like animals that feed on plant roots causing yield loss in susceptible crops including wheat, barley and canola.

At least six million hectares (74 per cent) of WA's broadacre cropping paddocks are infested with RLN, an increase of 11 per cent since an initial statewide survey conducted in 1997-98. Of the 765 paddock samples assessed in the 2014-15 seasons, at least 50 per cent of infested paddocks had RLN at potentially yield-limiting levels. *P. neglectus* was the most frequent RLN, occurring in at least 63 per cent of infested paddocks. *P. quasitereoides* (formerly *P. teres*), unique to WA, was the next most common RLN at around 26 per cent of infected paddocks surveyed.

Cereal yield losses due to RLN are seasonally dependent and are in the order of 5-30 per cent but can be higher. RLN species *Pratylenchus neglectus* and *P. quasitereoides* can cause losses of up to 18 per cent in barley crops. The actual yield loss due to RLN in different barley varieties is not

yet quantified, but the impact of different varieties on nematode populations varies.

The *P. neglectus* and *P. quasitereoides* nematode resistance scores in this sowing guide only reflect WA based observations. The ratings are based on glasshouse trials between 2009–14 for both RLN species plus field trials in 2014-15 for *P. quasitereoides* (three trials) and 2015 for *P. neglectus* (three trials). Provisional ratings are provided for varieties with fewer than three observations, or where there has been no field trial verification of the glasshouse rating.

TABLE 11 Seedling (two to 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(D)	-	MR	S	VS	MRMS	MSS	SVS
Flinders(D)	-	MRMS	MSS	SVS	MSS	R	MS
La Trobe(D)	-	MS	MRMS	S	S	MSS	MS
RGT Planet(D)	-	MRMS	MRMS	S	S	R	MSS
Scope CL(D)	-	MR	MR	S	MSS	R	S
Spartacus CL(D)	-	MS	MRMS	S	SVS	MS	MS
STAGE 2 MALT ACCREDITATION							
Banks(D)	-	MRMS	MS	MRMS	MSS	MRMS	S
Leabrook(D)	-	MRMS	MS	MSS	MS	MR	SVS
LG Alestar(D)	-	MS	MS	MS	S	RMR	MRMS
DELIVERABLE AS A FEED VARIETY							
Buff(D)	-	MRMS	MRMS	MS	MS	S	SVS
Compass(D)	-	MRMS	S	S	MRMS	MRMS	S
Fathom(D)	-	S	MSS	VS	MR	MS	MSS
Granger(D)	-	MRMS	MRMS	MRMS	MSS	R	MS
Litmus(D)	-	MSS	S	S	S	MS	S
Lockyer(D)	-	MR	MR	S	S	MS	S
Mundah	-	S	MS	MSS	MSS	SVS	S
Oxford	-	RMR	MR	S	S	R*	MSS
Rosalind(D)	-	MR	MR	MSS	MS	MS	MRMS

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/s 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 mainly north of Great Eastern Highway, while in the southern regions of WA a new pathotype (Oxford) is present.
[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 stage. *Oxford may show a susceptible reaction where virulence against the *Ml(St)* mildew gene (present in Oxford) exists. There are reports of increased virulence of powdery mildew on Rosalind(D) in the Stirlings to Coast area.

TABLE 12 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]	Adult	Adult	Adult	Adult	Adult	Adult	Adult
DELIVERABLE AS A MALT VARIETY							
Bass(ф)	MRMS	MRMS	MSS	S*p*	S	MSS	SVS
Flinders(ф)	MSS	MRMS	MS	S*p*	S	R	MRMS (late APR)
La Trobe(ф)	MR	MS	MRMS	S*p*	SVS	MS	S
RGT Planet(ф)	MRMS	SVS	MRMS	S*p*	S	R	MRMS (late APR)
Scope CL(ф)	MS	MRMS	MRMS	S*p*	S	R	MSS
Spartacus CL(ф)	MR	MS	MRMS	S*p*	SVS	MRMS	MSS
STAGE 2 MALT ACCREDITATION							
Banks(ф)	S	MS	MS	MS*p*	S	MR	MSS
Leabrook(ф)	MSS	MS	MRMS	MSS	MS	MR	S
LG Alestar(ф)	S	MS	MRMS	MSS	S	MR	MRMS
DELIVERABLE AS A FEED VARIETY							
Buff(ф)	MSS	MRMS	MRMS	MS*p*	S	S	S
Compass(ф)	MS	MRMS	MS	MS*p*	MSS	MRMS	S
Fathom(ф)	MR	S	MSS	S*p*	MRMS	MRMS	MRMS (late APR)
Granger(ф)	MSS	MS	MRMS	MS*p*	SVS	R	MRMS (APR)
Litmus(ф)	SVS	S	S	S*p*	S	MR	S
Lockyer(ф)	MRMS	MS	MRMS	S*p*	S	MS	S
Mundah	S	S	MS	S*p*	S	MSS	S
Oxford	MSS	MRMS	MR	S*p*	S	MR*	MRMS (APR)
Rosalind(ф)	MSS	MS	MR	S*p*	S	MRMS	MR

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/s 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 mainly north of Great Eastern Highway, while in the southern regions of WA a new pathotype (Oxford) is present.
[5] Powdery mildew: *Oxford may show a susceptible reaction where virulence against the *Ml(St)* mildew gene (present in Oxford) exists. There are reports of increased virulence of powdery mildew on Rosalind(ф) in the Stirlings to Coast area.

TABLE 13 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] virus	Root lesion nematode[4]		Cereal cyst nematode[5]
Pathogen	*Fusarium pseudograminearum*		*Pratylenchus neglectus*	*Pratylenchus quasitereoides*	*Heterodera avenae*
Growth stage[2]	Seedling & adult	Seedling & adult	Seedling & adult	Seedling & adult	Seeding & adult
DELIVERABLE AS A MALT VARIETY					
Bass(D)	High	MS	MSS	MSS	S
Flinders(D)	High	MRMS	MS*p*	MSS*p*	S
La Trobe(D)	Moderate	S	MS	MSS	R
RGT Planet(D)	-	MS	-	-	R*p*
Scope CL(D)	High	MRMS	MSS	MS	S
Spartacus CL(D)	Moderate	S	-	-	R
STAGE 2 MALT ACCREDITATION					
Banks(D)	-	MS	-	-	-
Leabrook(D)	-	MSS	-	-	R
LG Alestar(D)	-	MRMS	-	-	R
DELIVERABLE AS A FEED VARIETY					
Buff(D)	-	MRMS	-	-	S
Compass(D)	High	MSS	MSS	S	R
Fathom(D)	Moderate	MRMS	MS*p*	MSS*p*	R
Granger(D)	High	MS	MS	MSS	R
Litmus(D)	Low	S	-	-	MS
Lockyer(D)	-	MS	-	-	-
Mundah	Moderate	MS	-	MRMS*p*	S
Oxford	-	MRMS	-	-	S
Rosalind(D)	Moderate	MSS	-	-	R

SOURCE: CROWN ROT – DANIEL HUBERLI, VIRUS – SANJIV GUPTA, NEMATODES – SARAH COLLINS

[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 virus: 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 impact 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.

Cereal cyst nematode

Cereal cyst nematode (*Heterodea avenae*) (CCN) is present in cropping regions around Geraldton and the Avon Valley around Northam, but it can occur in any area. 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.

VARIETY SNAPSHOTS

Variety snapshots are presented for six varieties (Bass$^{\Phi}$, Flinders$^{\Phi}$, La Trobe$^{\Phi}$, RGT Planet$^{\Phi}$, Scope CL$^{\Phi}$ and Spartacus CL$^{\Phi}$) that can be delivered into malt segregations in WA at the 2020-21 harvest (as per GIWA malt barley variety receival recommendations for the 2020/21 harvest); three varieties undergoing stage 2 malt accreditation with Barley Australia (Banks$^{\Phi}$, Leabrook$^{\Phi}$ and LG Alestar$^{\Phi}$); and nine varieties that can only be delivered into feed segregations (Buff$^{\Phi}$, Compass$^{\Phi}$, Fathom$^{\Phi}$, Granger$^{\Phi}$, Litmus$^{\Phi}$, Lockyer$^{\Phi}$, Mundah, Oxford and Rosalind$^{\Phi}$).

The comment section in each snapshot describes essential characteristics of a variety including its 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, www.nvtonline.com.au) is presented relative to a control variety (typically La Trobe$^{\Phi}$) for each year in the period 2014–18. Data is tabulated using the Agzone format.

Disease and nematode resistance ratings are sourced from Tables 11 to 13 and presented for the seedling and adult growth stages of the plant (if known).

Phenology information is an output of a new flowering date predictive program, 'FlowerPower' barley (available at https://biometricsdpird.shinyapps.io/dmmodel6/). 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 is the median predicted date to Z49 (date predicted for 50 per cent of 'normal' seasons) based on FlowerPower barley version 6.1.2. Data is presented relative to a control variety (typically La Trobe$^{\Phi}$) for four model environments (Carnamah, Cunderdin, Katanning and Grass Patch) for four sowing dates (15 April, 5 May, 25 May and 15 June).

Agronomic traits are presented based on published data, data collected by DPIRD and data generated from the DPIRD-GRDC co-funded projects DAW00190 and DAW00224. Data presented includes:

- 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 Stirling, Buloke$^{\Phi}$ and Scope CL$^{\Phi}$ 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 were recorded in high-risk varieties (i.e. Scope CL$^{\Phi}$); and
- grain protein deviation where lower = <-0.3 per cent, slightly lower = -0.3 to -0.1 per cent, average = -0.1 to +0.1 per cent, slightly higher = +0.1 to +0.3 per cent and higher = > +0/3 per cent. Grain protein deviation was calculated and ranked using data from NVT and DPIRD–GRDC funded barley agronomy trials (2005–18) to analyse the relationship between grain yield and grain protein concentration in commercially available barley varieties grown under similar management and environmental conditions in WA. There is a typical relationship whereby 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 end point royalty (EPR) payable are sourced from breeding companies, Variety Central (www.varietycentral.com.au) and IP Australia Plant Breeders Rights database (https://pericles.ipaustralia.gov.au/pbr_db/search.cfm).

BASS(Þ)

DELIVERABLE AS A MALT VARIETY

Comments

Bass(Þ) is a short-height, medium-spring, malt barley acceptable for export as grain and as malt but not for shochu. It has strong market demand from brewing end users, which can often result in a price premium. Best suited to environments with a yield potential above 3t/ha. Across 41 WA barley NVT (2016–2018), Bass(Þ) has yielded lower than RGT Planet(Þ) in 61%, the same in 39% and higher in 0%. It has the best physical grain quality package of all the malt varieties segregated in WA (resulting in a higher strike rate into Malt 1 segregations), with a good hectolitre weight, high grain plumpness and a higher grain protein potential (typically 0.5% higher than La Trobe(Þ) at same yield). It 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 is similar to other semi-dwarf varieties. Target production zone in 2020 is Kwinana-North (Midlands) and Kwinana-South with limited segregation opportunities in the Albany Port Zone (subject to production volumes).

Yield (% La Trobe(Þ))	2014	2015	2016	2017	2018
Agzone 1	89	86	94	91	90
Agzone 2	93	84	94	95	91
Agzone 3	92	85	91	90	93
Agzone 4	59	87	-	81	96
Agzone 5	91	87	94	91	89
Agzone 6	90	92	90	103	94
Statewide	91	87	93	92	92

Disease resistance	Seedling	Adult
Scald	-	MRMS
NTNB (Beecher virulent)	MR	MRMS
NTNB (Beecher avirulent)	S	MSS
NTNB (Oxford virulent)	VS	S*p*
STNB	MRMS	S
Powdery mildew	MSS	MSS
Leaf rust (5457P-)	SVS	SVS
BYDV and CYDV	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 La Trobe(Þ)			
	15 Apr	5 May	25 May	15 Jun
Carnamah	+4	+4	+3	+4
Cunderdin	+5	+5	+4	+4
Katanning	+5	+5	+4	+4
Grass Patch	+6	+5	+3	+4

Agronomic traits	
Early growth habit	Prostrate
Coleoptile length	Medium
Target plant density	150–180 plants/m²
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, exc. GST)	$3.50

p = provisional assessment.

FLINDERS(Þ)

DELIVERABLE AS A MALT VARIETY

Comments

Flinders(Þ) is a short-height, late-spring, malt barley that is acceptable for export as grain and as malt but not for shochu. Flinders(Þ) has gained limited adoption by growers. 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 39 WA barley NVT (2016–18), Flinders(Þ) has yielded lower than RGT Planet(Þ) in 59%, the same in 38% and higher in 3%. It has good physical grain characteristics, being an improvement over La Trobe(Þ) and RGT Planet(Þ). It is resistant to PM (non-*mlo*). Fungicides may be required to manage NTNB (Oxford virulent), STNB and BLR (despite having APR). Weed competitiveness is similar to other semi-dwarf varieties. Target production zone in 2020 is Albany-South with potential niche segregation opportunities in Kwinana-South and the Esperance Port Zone (subject to production and demand).

Yield (% La Trobe(Þ))	2014	2015	2016	2017	2018
Agzone 1	93	90	-	91	90
Agzone 2	99	91	96	97	91
Agzone 3	96	95	97	97	98
Agzone 4	61	89	-	80	97
Agzone 5	94	90	-	96	94
Agzone 6	102	102	104	122	101
Statewide	96	93	99	97	95

Disease resistance	Seedling	Adult
Scald	-	MSS
NTNB (Beecher virulent)	MRMS	MRMS
NTNB (Beecher avirulent)	MSS	MS
NTNB (Oxford virulent)	SVS	S*p*
STNB	MSS	S
Powdery mildew	R	R
Leaf rust (5457P-)	MS	MRMS (late APR)
BYDV and CYDV	MRMS	MRMS
RLN (*P. neglectus*)	MS*p*	MS*p*
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 La Trobe(Þ)			
	15 Apr	5 May	25 May	15 Jun
Carnamah	+6	+8	+7	+8
Cunderdin	+7	+9	+9	+8
Katanning	+8	+9	+8	+8
Grass Patch	+8	+8	+9	+7

Agronomic traits	
Early growth habit	Prostrate
Coleoptile length	Short
Target plant density	150–180 plants/m²
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, exc. GST)	$3.80

p = provisional assessment.

LA TROBE(Φ)

DELIVERABLE AS A MALT VARIETY

Comments

La Trobe(Φ) is a medium-height, early spring, malt barley that is suitable for export as grain, as malt and for shochu. Established malt varieties such as La Trobe(Φ) (and Bass(Φ)) are more likely to attract and maintain a premium over feed when the market is oversupplied. La Trobe(Φ) is the only malt variety currently segregated in WA accepted for shochu manufacture in Japan. it is best suited to environments with a yield potential below 4t/ha. Across 42 WA barley NVT (2016–18), La Trobe(Φ) has yielded lower than RGT Planet in 38%, the same in 48% and higher in 14%. Like Spartacus CL(Φ), La Trobe(Φ) 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(Φ) seed crops or malt stacks by contaminating them with Hindmarsh(Φ) or Spartacus CL(Φ) barley. Target production zones in 2020 are Kwinana, Albany and Esperance port zones.

Yield (% Spartacus CL(Φ))	2014	2015	2016	2017	2018
Agzone 1	105	106	100	102	105
Agzone 2	99	96	104	101	101
Agzone 3	99	99	100	101	100
Agzone 4	90	96	-	94	103
Agzone 5	101	97	99	101	99
Agzone 6	104	97	101	97	101
Statewide	100	97	102	101	101

Disease resistance	Seedling	Adult
Scald	-	MR
NTNB (Beecher virulent)	MS	MS
NTNB (Beecher avirulent)	MRMS	MRMS
NTNB (Oxford virulent)	S	S*p*
STNB	S	SVS
Powdery mildew	MSS	MS
Leaf rust (5457P-)	MS	S
BYDV and CYDV	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(Φ)			
	15 Apr	5 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, exc. GST)	$4.00

p = provisional assessment.

RGT PLANET(Φ)

DELIVERABLE AS A MALT VARIETY

Comments

RGT Planet(Φ) is a medium height, medium spring, malt barley accepted for export as grain and as malt but not for shochu. More work is required to gain full international acceptance for RGT Planet(Φ) in our brewing markets. It is well suited to environments with a yield potential above 3t/ha, and more specifically paddocks with a year-in-year-out potential above 5t/ha. Good early vigour suggests it is suited to mixed farms where grain and graze is practised. Across 42 WA barley NVT (2016–18), RGT Planet(Φ) has yielded lower than Rosalind(Φ) in 26%, the same in 50% and higher in 24%. The physical grain quality package of RGT Planet(Φ) is inferior to Bass(Φ) and Flinders(Φ) and is in some respects comparable with La Trobe(Φ). 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). Research from eastern Australia suggests RGT Planet(Φ) has a similar level of weed competitiveness (tested against oats) to Compass(Φ) and Fathom(Φ). Target production zones in 2020 are Kwinana-South, Albany-South and Esperance port zones with limited segregation opportunities in Kwinana-North (Midlands) and Albany-North (subject to production volumes).

Yield (% La Trobe(Φ))	2014	2015	2016	2017	2018
Agzone 1	-	-	107	101	97
Agzone 2	-	-	108	105	98
Agzone 3	-	-	112	115	110
Agzone 4	-	-	-	82	106
Agzone 5	-	-	126	107	108
Agzone 6	-	-	132	144	116
Statewide	-	-	115	108	104

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

FlowerPower predicted flowering date (days to Z49)	Relative to La Trobe(Φ)			
	15 Apr	5 May	25 May	15 Jun
Carnamah	+1	+3	+3	+6
Cunderdin	+2	+4	+4	+6
Katanning	+2	+3	+4	+6
Grass Patch	+2	+3	+3	+6

Agronomic traits	
Early growth habit	Prostrate
Coleoptile length	-
Target plant density	-
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, exc. GST)	$4.00

p = provisional assessment.

DPIRD GRDC

SCOPE CL(ϕ)

DELIVERABLE AS A MALT VARIETY

Comments

Scope CL(ϕ) is a tall height, medium spring, malt variety suitable for export as grain and as malt but not for shochu. Scope CL(ϕ) is being phased out with segregations halted after the 2020-21 harvest. It is suited to environments where Intercept®, Intervix® and Sentry® are useful for controlling brome and barley grass or where there are imidazolinone residues. It is better suited than Spartacus CL(ϕ) to April sowing opportunities when sowing into non-Clearfield® wheat stubble (so the in-crop wheat volunteers can be controlled). Across 74 WA barley NVT (2014–18), Scope CL(ϕ) has yielded lower than Spartacus CL(ϕ) in 52%, the same in 43% and higher in 5%. 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. Do not ruin the integrity of Scope CL(ϕ) seed stocks or malt stacks by contaminating them with Buloke or Spartacus CL(ϕ) barley. The 2020-21 harvest is the last harvest that segregations will be offered for Scope CL(ϕ) in WA with potential niche segregation opportunities in Kwinana and Albany-North (subject to production and demand).

Yield (% La Trobe(ϕ))	2014	2015	2016	2017	2018
Agzone 1	90	92	99	101	98
Agzone 2	87	86	103	97	95
Agzone 3	87	86	96	94	96
Agzone 4	64	87	-	79	106
Agzone 5	86	81	93	89	-
Agzone 6	87	84	91	91	-
Statewide	86	85	98	93	96

Disease resistance	Seedling	Adult
Scald	-	MS
NTNB (Beecher virulent)	MR	MRMS
NTNB (Beecher avirulent)	MR	MRMS
NTNB (Oxford virulent)	S	S*p*
STNB	MSS	S
Powdery mildew	R	R
Leaf rust (5457P-)	S	MSS
BYDV and CYDV	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 La Trobe(ϕ)			
	15 Apr	5 May	25 May	15Jun
Carnamah	+9	+8	+5	+6
Cunderdin	+10	+9	+8	+5
Katanning	+11	+9	+7	+5
Grass Patch	+11	+8	+7	+5

Agronomic traits	
Early growth habit	Semi-erect
Coleoptile length	Short
Target plant density	110–130 plants/m²
Plant height	Tall
Straw strength	Fair
Head loss risk	High
Grain protein deviation	Average

Variety information	
Pedigree	Franklin/VB9104//VB9104
Breeder/seed licensee	AgVic Services/Seednet
Access to seed	Seednet
EPR ($/t, exc. GST)	$3.50

p = provisional assessment.

SPARTACUS CL(ϕ)

DELIVERABLE AS A MALT VARIETY

Comments

Spartacus CL(ϕ) is a medium height, early spring, malt barley suitable for export as grain and as malt, gaining international acceptance. Assessment for the manufacture of shochu in Japan is on hold. It is suited to environments where Intercept®, Intervix® and Sentry® are useful for controlling brome and barley grass or where there are imidazolinone residues. Across 80 WA barley NVT (2014–18), Spartacus CL(ϕ) has yielded lower than La Trobe in 11%, the same in 76% and higher in 13%. Key agronomic differences to La Trobe(ϕ) include 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. The main aesthetic difference is the lack of anthocyanin pigmentation present on its flag leaf auricles, leaf sheaths, awns and head during spring. Fungicides may be required to manage smut, NTNB (Oxford virulent), STNB and BLR. Spartacus CL(ϕ) appears to be a weak competitor with weeds (based on data from eastern Australia). Do not ruin the integrity of Spartacus CL(ϕ) seed stocks or malt stacks by contaminating it with La Trobe(ϕ) or Scope CL(ϕ) barley. Target production zones in 2020 are Geraldton, Kwinana, Albany and Esperance port zones.

Yield (% La Trobe(ϕ))	2014	2015	2016	2017	2018
Agzone 1	100	103	99	98	98
Agzone 2	101	104	96	99	99
Agzone 3	101	101	100	99	100
Agzone 4	112	104	-	107	97
Agzone 5	99	104	101	99	101
Agzone 6	96	103	99	103	99
Statewide	100	103	98	99	99

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

FlowerPower predicted flowering date (days to Z49)	Relative to La Trobe(ϕ)			
	15 Apr	5 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/m²
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	Seed club members and resellers
EPR ($/t, exc. GST)	$4.25

p = provisional assessment.

BANKS(Φ)

FAILED STAGE 2 MALT ACCREDITATION

Comments

Banks(Φ) (tested as IGB1305) is a short height, late spring barley under evaluation by Barley Australia. It is best suited to environments with a yield potential above 3t/ha. Across 42 WA barley NVT (2016–18), Banks(Φ) has yielded lower than RGT Planet(Φ) in 33%, the same in 62% and higher in 5%. Banks(Φ) does not have the top-end yield potential of RGT Planet(Φ); it appears to yield similarly between 3-4t/ha and maybe higher-yielding below 3t/ha. Banks(Φ) has a similar plant type and phenology to Flinders(Φ), being 1-2cm taller than Bass(Φ) at maturity. There have been observations of brackling (buckling in the lower part of the stem) and lodging in Banks(Φ) in some commercial crops. Straw strength appears to be comparable to RGT Planet(Φ), but not as robust as either Bass(Φ) or Flinders(Φ). Physical grain characteristics appear to be comparable to La Trobe(Φ) but with slightly improved grain brightness and grain protein. Fungicides may be required to manage scald, STNB and BLR. Its weed competitiveness has not been evaluated. Banks(Φ) is undergoing stage 2 malt evaluation with Barley Australia. Stage 2 accreditation will happen out of the cycle and is expected to be completed by the end of 2019. On 11 November 2019 Barley Australia announced Banks(Φ) failed stage 2 assessment and has not been accredited as a malt variety.

Yield (% La Trobe(Φ))	2014	2015	2016	2017	2018
Agzone 1	-	103	102	101	97
Agzone 2	-	101	103	100	97
Agzone 3	-	104	105	104	103
Agzone 4	-	97	-	89	104
Agzone 5	-	96	110	99	101
Agzone 6	-	102	110	118	105
Statewide	-	100	105	101	100

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

FlowerPower predicted flowering date (days to Z49)	Relative to La Trobe(Φ)			
	15 Apr	5 May	25 May	15 Jun
Carnamah	+1	+7	+8	+9
Cunderdin	+3	+8	+10	+9
Katanning	+3	+8	+9	+9
Grass Patch	+3	+7	+9	+9

Agronomic traits	
Early growth habit	Prostrate
Coleoptile length	Short
Target plant density	-
Plant height	Short
Straw strength	Moderately good
Head loss risk	-
Grain protein deviation	Slightly higher

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

p = provisional assessment.

LEABROOK(Φ)

STAGE 2 MALT ACCREDITATION

Comments

Leabrook(Φ) (tested as WI4896) is a tall height, medium spring barley under evaluation by Barley Australia. It is best suited to environments with a yield potential below 4t/ha where barley leaf rust is not a year-in-year-out problem. Leabrook(Φ) possesses many similar agronomic attributes to Compass(Φ) including pedigree, phenology, plant architecture, straw strength and grain quality, but with improvements in grain yield and malt quality (mostly malt extract). Across 62 WA barley NVT (2016–18), Leabrook(Φ) has yielded lower than Compass(Φ) in 5%, the same in 76% and higher in 19%; and relative to La Trobe(Φ), lower in 6%, the same in 74% and higher in 19%. Fungicides may be required to manage BLR. Its weed competitiveness has not been tested. Leabrook(Φ) has passed stage 1 of the Barley Australia accreditation process and will continue with stage 2 evaluation during 2019, with the earliest accreditation date being March 2020.

Yield (% La Trobe(Φ))	2014	2015	2016	2017	2018
Agzone 1	-	101	107	109	109
Agzone 2	-	101	109	105	106
Agzone 3	-	105	105	105	104
Agzone 4	-	101	-	100	108
Agzone 5	-	101	101	105	104
Agzone 6	-	99	106	91	104
Statewide	-	102	107	104	106

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

FlowerPower predicted flowering date (days to Z49)	Relative to La Trobe(Φ)			
	15 Apr	5 May	25 May	15 Jun
Carnamah	-	-	-	-
Cunderdin	-	-	-	-
Katanning	-	-	-	-
Grass Patch	-	-	-	-

Agronomic traits	
Early growth habit	Semi-erect
Coleoptile length	-
Target plant density	-
Plant height	Tall
Straw strength	Fair
Head loss risk	-
Grain protein deviation	Lower

Variety information	
Pedigree	County/Commander//Commander
Breeder/seed licensee	University of Adelaide/Seednet
Access to seed	Seednet
EPR ($/t, exc. GST)	$3.80

p = provisional assessment.

DPIRD GRDC

LG ALESTAR$^{\Phi}$

STAGE 2 MALT ACCREDITATION

Comments

LG Alestar$^{\Phi}$ (tested as SMBA11-2341) is a medium height, late spring barley being evaluated by Barley Australia. It is best suited to environments above 3t/ha where both powdery mildew and BLR are a problem. The grain of LG Alestar$^{\Phi}$ has a white aleurone, even though one of its parents Henley has a blue aleurone. Across 80 WA barley NVT (2011–16), LG Alestar$^{\Phi}$ has yielded lower than Granger$^{\Phi}$ in 22%, the same in 78% and higher in 0%. Across 82 WA barley NVT (2011–16), LG Alestar$^{\Phi}$ has yielded lower than La Trobe$^{\Phi}$ in 46%, the same in 49% and higher in 5%. 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 we do not have enough data to assess its head loss risk. LG Alestar$^{\Phi}$ has passed stage 1 of the Barley Australia accreditation process and will continue with stage 2 evaluation during 2019, with the earliest accreditation date being March 2020.

Yield (% La Trobe$^{\Phi}$)	2014	2015	2016	2017	2018
Agzone 1	-	-	98	-	-
Agzone 2	96	89	100	-	-
Agzone 3	93	96	100	-	-
Agzone 4	46	85	-	-	-
Agzone 5	88	84	111	-	-
Agzone 6	105	101	110	-	-
Statewide	92	91	103	-	-

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

FlowerPower predicted flowering date (days to Z49)	Relative to La Trobe$^{\Phi}$			
	15 Apr	5 May	25 May	15 Jun
Carnamah	-	-	-	-
Cunderdin	-	-	-	-
Katanning	-	-	-	-
Grass Patch	-	-	-	-

Agronomic traits	
Early growth habit	Prostrate
Coleoptile length	-
Target plant density	-
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, exc. GST)	$3.80

p = provisional assessment.

BUFF$^{\Phi}$

DELIVERABLE AS A FEED VARIETY

Comments

Buff$^{\Phi}$ is a medium height, early spring barley under evaluation by Barley Australia that supersedes Litmus$^{\Phi}$. Buff$^{\Phi}$ has similar Al tolerance genetics to Litmus$^{\Phi}$, but unlike Litmus$^{\Phi}$, it has a white aleurone. Receival of Buff$^{\Phi}$ will therefore not be restricted due to aleurone colour like it is for Litmus$^{\Phi}$. Unlike Litmus$^{\Phi}$, Buff$^{\Phi}$ is a competitor on non-acidic soils to Fathom$^{\Phi}$, La Trobe$^{\Phi}$ (and its derivatives) and Rosalind$^{\Phi}$. Across 35 WA barley NVT (2016–18), Buff$^{\Phi}$ has yielded lower than Rosalind$^{\Phi}$ in 23%, the same in 51% and higher in 26%. In those same trials, Buff$^{\Phi}$ yielded lower than La Trobe$^{\Phi}$ in 0%, same in 69% and higher in 31%. Across 17 WA barley NVT trials (2016-2017), Buff$^{\Phi}$ has yielded lower than Litmus in 0%, the same in 41% and higher in 59%. The overall disease resistance profile of Buff$^{\Phi}$ is similar to Litmus$^{\Phi}$ with improvements in its tolerance to scald and NTNB. Fungicides may be required to manage STNB, PM and BLR. Its weed competitiveness has not been tested. Buff$^{\Phi}$ is undergoing stage 1 malt accreditation trials with Barley Australia during 2019, with the earliest accreditation date being March 2021.

Yield (% La Trobe$^{\Phi}$)	2014	2015	2016	2017	2018
Agzone 1	-	-	111	117	111
Agzone 2	-	-	121	106	105
Agzone 3	-	-	-	-	107
Agzone 4	-	-	-	79	124
Agzone 5	-	-	106	97	102
Agzone 6	-	-	-	-	108
Statewide	-	-	114	103	108

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

FlowerPower predicted flowering date (days to Z49)	Relative to La Trobe$^{\Phi}$			
	15 Apr	5 May	25 May	15 Jun
Carnamah	-	-	-	-
Cunderdin	-	-	-	-
Katanning	-	-	-	-
Grass Patch	-	-	-	-

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

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

p = provisional assessment.

COMPASS(Ф)

DELIVERABLE AS A FEED VARIETY

Comments

Compass(Ф) is a tall height, early spring barley only deliverable into feed stacks in WA. It is best suited to environments with a yield potential below 4t/ha and where weed-competitive barley is required. Compass(Ф) has a similar grain yield potential to La Trobe(Ф) and Spartacus CL(Ф) in WA, and in about one-quarter of situations is higher yielding than Fathom(Ф), but rarely out-yields Rosalind(Ф). Across 80 WA barley NVT (2014–18), Compass(Ф) has yielded lower than Rosalind(Ф) in 39%, the same in 59% and higher in 3%. Across 114 WA barley NVT (2012–18), Compass(Ф) has yielded lower than La Trobe(Ф) in 16%, the same in 70% and higher in 14%. Compass(Ф) is susceptible to lodging, particularly in high-yielding situations. Compass(Ф) 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) and BLR. Compass(Ф), like Fathom(Ф), 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(Ф) is received as a feed variety in WA.

Yield (% La Trobe(Ф))	2014	2015	2016	2017	2018
Agzone 1	101	103	103	107	106
Agzone 2	96	101	105	102	103
Agzone 3	97	98	101	100	101
Agzone 4	108	102	-	103	105
Agzone 5	99	98	96	98	100
Agzone 6	95	93	96	84	99
Statewide	97	99	101	100	103

Disease resistance	Seedling	Adult
Scald	-	MS
NTNB (Beecher virulent)	MRMS	MRMS
NTNB (Beecher avirulent)	S	MS
NTNB (Oxford virulent)	S	MS*p*
STNB	MRMS	MSS
Powdery mildew	MRMS	MRMS
Leaf rust (5457P-)	S	S
BYDV and CYDV	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 La Trobe(Ф)			
	15 Apr	5 May	25 May	15 Jun
Carnamah	-2	+0	+1	+2
Cunderdin	-2	+0	+1	+2
Katanning	-2	+0	+1	+2
Grass Patch	-2	+0	+1	+2

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
EPR ($/t, exc. GST)	$3.80

p = provisional assessment.

FATHOM(Ф)

DELIVERABLE AS A FEED VARIETY

Comments

Fathom(Ф) 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 113 WA barley NVT (2012–18), Fathom(Ф) has yielded lower than Compass in 22%, the same in 67% and higher in 11%. Across 79 WA barley NVT (2014–18), Fathom(Ф) has yielded lower than Rosalind(Ф) in 51%, the same in 44% and higher in 5%. Fungicides may be required to manage early infections of NTNB and BLR. Fathom(Ф) 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(Ф) is one of the more weed-competitive barley varieties being similar to Compass(Ф) and RGT Planet(Ф) in eastern state weed competition trials. Fathom(Ф) was the 10th most popular barley variety in 2018, accounting for 2% of the state's barley acreage, but was primarily grown in the Esperance Port Zone and nowhere else.

Yield (% La Trobe(Ф))	2014	2015	2016	2017	2018
Agzone 1	98	97	104	108	107
Agzone 2	93	93	109	102	102
Agzone 3	92	94	101	100	100
Agzone 4	81	94	-	89	110
Agzone 5	95	89	94	97	97
Agzone 6	98	88	97	83	100
Statewide	93	93	103	99	103

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

FlowerPower predicted flowering date (days to Z49)	Relative to La Trobe(Ф)			
	15 Apr	5 May	25 May	15 Jun
Carnamah	+11	+9	+5	+3
Cunderdin	+13	+10	+7	+3
Katanning	+13	+10	+6	+3
Grass Patch	+13	+9	+6	+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	Low

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

p = provisional assessment.

GRANGER(ф)

DELIVERABLE AS A FEED VARIETY

Comments

Granger(ф) is a medium height, medium spring barley no longer segregated as a malt variety in WA and deliverable only into feed stacks. It is best suited to environments with a yield potential above 3t/ha where powdery mildew and BLR are a problem. Across 67 WA barley NVT (2014–18), Granger(ф) has yielded lower than Rosalind(ф) in 46%, the same in 51% and higher in 3%. Across 30 WA barley NVT (2016–18), Granger(ф) has yielded lower than RGT Planet(ф) in 30%, the same in 67% and higher in 3%. It has resistance to PM due to *mlo* gene and to BLR due to *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(ф) is received as a feed variety in WA.

Yield (% La Trobe(ф))	2014	2015	2016	2017	2018
Agzone 1	95	95	-	91	-
Agzone 2	101	95	98	98	-
Agzone 3	97	103	103	103	102
Agzone 4	62	90	-	75	-
Agzone 5	91	90	118	98	98
Agzone 6	108	108	117	143	107
Statewide	97	97	104	99	96

Disease resistance	Seedling	Adult
Scald	-	MSS
NTNB (Beecher virulent)	MRMS	MS
NTNB (Beecher avirulent)	MRMS	MRMS
NTNB (Oxford virulent)	MRMS	MS*p*
STNB	MSS	SVS
Powdery mildew	R	R
Leaf rust (5457P-)	MS	MRMS (APR)
BYDV and CYDV	MS	MS
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 La Trobe(ф)			
	15 Apr	5 May	25 May	15 Jun
Carnamah	+2	+4	+4	+6
Cunderdin	+4	+6	+6	+6
Katanning	+4	+5	+5	+6
Grass Patch	+4	+5	+5	+6

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, exc. GST)	$2.95

p = provisional assessment.

LITMUS(ф)

DELIVERABLE AS A FEED VARIETY

Comments

Litmus(ф) is a tall height, early spring, feed barley with improved tolerance to low soil pH and high soil Al that is superseded by Buff(ф). Best suited to environments where the sub-soil (10-30cm) has a pHCa below 4.8. Across 17 WA barley NVT trials (2016-2017), Litmus(ф) has yielded lower than Buff(ф) in 59%, the same in 41% and higher in 0%, with no head-head comparisons available from the 2018 season. Litmus(ф) has fair straw strength, is susceptible to all leaf diseases but has the lowest yield loss in the presence of crown rot. 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(ф) was the ninth most popular barley variety in 2018, accounting for 2% of the state's barley acreage, being more popular in the Geraldton and Kwinana port zones than in the Albany and Esperance port zones.

Yield (% La Trobe(ф))	2014	2015	2016	2017	2018
Agzone 1	89	114	102	110	-
Agzone 2	76	101	109	96	-
Agzone 3	83	90	105	100	-
Agzone 4	110	98	-	89	-
Agzone 5	73	81	101	84	-
Agzone 6	69	81	94	92	-
Statewide	77	92	103	93	-

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

FlowerPower predicted flowering date (days to Z49)	Relative to La Trobe(ф)			
	15 Apr	5 May	25 May	15 Jun
Carnamah	-9	-5	-4	-1
Cunderdin	-11	-6	-3	-2
Katanning	-10	-6	-4	-2
Grass Patch	-10	-5	-3	-2

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, exc. GST)	$3.80

p = provisional assessment.

LOCKYER(ф)

DELIVERABLE AS A FEED VARIETY

Comments

Lockyer(ф) is a short, late spring, feed barley best suited to environments with a yield potential above 4t/ha (i.e. Agzone 6). Across 71 WA barley NVT (2014–18), Lockyer(ф) has yielded lower than Rosalind(ф) in 48%, the same in 46% and higher in 6%. Across 34 WA barley NVT trials (2016-2018), Lockyer(ф) has yielded lower than RGT Planet(ф) in 35%, the same in 62% and higher in 3%. Lockyer(ф) has one of the most prolonged durations to awn peep of commercial spring barley varieties. Fungicides may be required to manage NTNB (Oxford virulent), STNB and BLR. Its reaction to weed competition is unknown.

Yield (% La Trobe(ф))	2014	2015	2016	2017	2018
Agzone 1	99	90	-	100	99
Agzone 2	100	90	-	102	98
Agzone 3	96	98	-	102	101
Agzone 4	59	89	-	79	105
Agzone 5	99	90	103	100	97
Agzone 6	111	98	106	108	104
Statewide	98	93	104	100	100

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

FlowerPower predicted flowering date (days to Z49)	Relative to La Trobe(ф)			
	15 Apr	5 May	25 May	15 Jun
Carnamah	+15	+14	+9	+7
Cunderdin	+17	+16	+12	+7
Katanning	+17	+16	+11	+7
Grass Patch	+16	+13	+11	+6

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

Variety information	
Pedigree	Tantangara/VB9104
Breeder/seed licensee	InterGrain
Access to seed	Free to trade
EPR ($/t, exc. GST)	$1.50

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 where early season weed control is necessary. Across 67 WA barley NVT (2014–15, 2017–18), Mundah has yielded lower than Rosalind(ф) in 83%, the same in 16% and higher in 1%. Mundah can suffer from head loss and lodging. Fungicides may be required to manage scald, NTNB (Beecher virulent and Oxford virulent), STNB, PM and BLR. Mundah appears to have similar weed competitiveness to Compass(ф) and Fathom(ф), although it has not been tested side by side in the same trials.

Yield (% La Trobe(ф))	2014	2015	2016	2017	2018
Agzone 1	88	106	-	104	98
Agzone 2	79	96	-	95	95
Agzone 3	85	88	-	96	97
Agzone 4	99	95	-	89	108
Agzone 5	78	83	-	85	93
Agzone 6	72	83	-	91	94
Statewide	80	89	-	92	97

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

FlowerPower predicted flowering date (days to Z49)	Relative to La Trobe(ф)			
	15 Apr	5 May	25 May	15 Jun
Carnamah	-6	-6	-7	-3
Cunderdin	-6	-7	-6	-5
Katanning	-6	-6	-6	-5
Grass Patch	-6	-6	-6	-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	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.

DPIRD GRDC

OXFORD

DELIVERABLE AS A FEED VARIETY

Comments

Oxford is a short height, late spring, feed barley best suited to environments with a yield potential above 4t/ha (i.e. Agzone 6). Oxford performs best with late April or early May planting, but its yield potential falls rapidly as seeding is delayed. Across 64 WA barley NVT (2014–18), Oxford has yielded lower than Rosalind$^{\Phi}$ in 55%, the same in 41% and higher in 4%. Across 27 WA barley NVT (2016–18), Oxford has yielded lower than RGT Planet$^{\Phi}$ in 59%, the same in 41% and higher in 0%. Oxford appears to be sensitive to flowering frost. Fungicides may be required to manage NTNB (Oxford virulent), STNB and early season BLR. There is evidence of increasing virulence of PM on Oxford barley, mainly on the south coast. Weed competitiveness is similar to other semi-dwarf varieties. Oxford is superseded by newer varieties such as Rosalind$^{\Phi}$ and RGT Planet$^{\Phi}$.

Yield (% La Trobe$^{\Phi}$)	2014	2015	2016	2017	2018
Agzone 1	93	80	96	87	-
Agzone 2	103	83	-	98	-
Agzone 3	97	95	96	98	99
Agzone 4	29	82	-	65	-
Agzone 5	95	87	-	99	92
Agzone 6	115	105	111	137	105
Statewide	98	90	101	98	93

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

FlowerPower predicted flowering date (days to Z49)	Relative to La Trobe$^{\Phi}$			
	15 Apr	5 May	25 May	15 Jun
Carnamah	+16	+12	+7	+7
Cunderdin	+18	+13	+9	+6
Katanning	+19	+15	+8	+6
Grass Patch	+18	+12	+9	+6

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

Variety information	
Pedigree	Tavern/Chime
Breeder/seed licensee	Limagrain
Access to seed	Free to trade
EPR ($/t, exc. GST)	$2.50

p = provisional assessment.
* May show a susceptible reaction where virulence against the *Ml(St)* mildew gene (present in Oxford) exists.

ROSALIND$^{\Phi}$

DELIVERABLE AS A FEED VARIETY

Comments

Rosalind$^{\Phi}$ is a medium height, early spring, feed barley that suits all environments where there is a low probability of delivering malt-grade barley. Rosalind$^{\Phi}$ is the yield benchmark for barley in WA, regularly out-yielding La Trobe$^{\Phi}$ and Spartacus CL$^{\Phi}$. Across 80 WA barley NVT (2014–18), Rosalind$^{\Phi}$ has yielded lower than La Trobe$^{\Phi}$ in 4%, the same in 54% and higher in 43%. Rosalind$^{\Phi}$ appears to be inferior to RGT Planet$^{\Phi}$ at yields above 4t/ha and better below 3t/ha. Across 42 WA barley NVT trials (2016-2018), Rosalind$^{\Phi}$ has yielded lower than RGT Planet$^{\Phi}$ in 24%, the same in 50% and higher in 26%. 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$^{\Phi}$ as it may indicate the presence of a new pathotype. Its weed competitiveness is unknown. Rosalind$^{\Phi}$ was the eigth most popular barley variety in 2018, accounting for 3% of the state's barley acreage and being comparable in popularity across port zones.

Yield (% La Trobe$^{\Phi}$)	2014	2015	2016	2017	2018
Agzone 1	109	113	107	110	108
Agzone 2	104	112	107	105	106
Agzone 3	103	113	110	109	107
Agzone 4	128	109	-	110	107
Agzone 5	103	107	109	105	109
Agzone 6	106	105	113	102	107
Statewide	104	110	109	106	107

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

FlowerPower predicted flowering date (days to Z49)	Relative to La Trobe$^{\Phi}$			
	15 Apr	5 May	25 May	15 Jun
Carnamah	-3	-1	+0	+1
Cunderdin	-3	-1	+0	+1
Katanning	-3	-2	+0	+1
Grass Patch	-3	-2	+0	+1

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, exc. GST)	$3.50

p = provisional assessment.

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