WHEAT

By Brenda Shackley, Dion Nicol, Jeremy Curry, Manisha Shankar and Geoff Thomas, DPIRD

Introduction

Wheat is Western Australia's largest crop, with about 4.5M hectares sown each year. WA's wheat industry is supported by significant investment in variety improvement through pre-breeding, breeding and research carried out by private and public institutions. This guide provides an independent source of information to support the wheat industry with decisions on variety selection and management. It summarises the yield performance of varieties in the GRDC National Variety Trials (NVT) along with their disease resistance ratings and agronomic information for their management. At the back of the wheat section there are variety snapshots for 20 of the most common and recently released wheat varieties.

As Scepter is represented in all five years of trials used in the NVT Long Term Multi Environment Trial (MET) analysis (Tables 6 to 11) and is the most popular variety grown in WA (50% of the area sown to wheat in WA in 2020), it is used as the comparison variety for yield (in the variety snapshots) and days to flowering data (Table 13).

When deciding whether to adopt a new variety into a farming system, it is important to determine whether the change will be advantageous. A new variety should provide:

- an improvement in yield, grain quality and/or disease
- diversity or risk mitigation within a farming system
- suitable characteristics for current markets.

As environmental conditions are a major driver of crop performance, it is important to review variety performance over multiple years to better understand how a variety might perform across variable seasons for your region/location.

In addition, it is important to consider how varietal differences can be used to advantage, such as matching a variety's maturity with its best time of sowing (and likely germination) to mitigate the risks of frost or terminal drought. Finally, it is important to be aware of whether a variety can access specific quality segregations. For example, Calingiri will only be received as a feed grade wheat in WA from the 2022 harvest and beyond (see Variety Classification section).

WHAT IS NEW?

Calibre is an AH wheat released by Australian Grains Technologies (AGT) in 2021, which is derived from Scepter with a slightly shorter maturity, similar to Mace. Calibre was included in the WA NVT for the first time in 2020, where it was one of the highest yielding varieties. It has a similar disease package to Scepter with provisional ratings of RMR*p* for stem and stripe rust, S*p* for leaf rust and powdery mildew but a slightly poorer yellow spot rating (MS*p*) than Scepter. Calibre has a longer coleoptile than Scepter and Mace, similar to Magenta.

LRPB Avenger is an APW and APWN wheat variety released by Longreach in 2021. LRPB Avenger offers a maturity between Corack and Vixen. LRPB Avenger has been tested in the NVT since 2019, where it outyields Scepter and Mace under tight finishes when yield potentials are <2.5t/ha. Disease ratings are MS for yellow spot and stem rust, MRMS for stripe rust and S for leaf rust, with provisional rating of S*p* for powdery mildew. LRPB Avenger has a longer coleoptile length similar to Magenta.

Valiant CL Plus is an imidazolinone herbicide tolerant AH wheat released by InterGrain in 2021. Valiant CL Plus was included in the WA NVT for the first time in 2020, in Agzones 2, 3, 5 and 6. InterGrain suggests that Valiant CL Plus has

a slower/longer maturity than Cutlass and has provisional ratings of RMR*p* for stripe rust, MR*p* for stem rust and MSS*p* for leaf rust. Valiant CL Plus yields similar to Cutlass and Denison when sown in NVT main season trials and slightly lower than other CL Plus varieties of shorter/quicker maturity in main season sowing times. Valiant CL Plus provides a longer coleoptile length and is a new option for maximising early sowing opportunities in a Clearfield system.

Note: There are no grower-to-grower sales permitted for any CL Plus varieties.

VARIETY CLASSIFICATION

Source: Wheat Quality Australia

Removal of varieties: Wheat Quality Australia (WQA) rationalise the Wheat Variety Master List with annual reviews of varieties that are more than 10 years-old and which have accounted for less than 0.1% of deliveries over the previous four seasons. In 2021, the varieties Binnu, Clearfield JNZ, Clearfield STL, Endure, Tammarin Rock, Yandanooka and Zippy are to be removed from the master list, which means they will no longer be deliverable into their respective wheat classification segregations beyond 2021 and instead will only be deliverable as feed. These varieties have been surpassed in yield performance and are no longer recommended varieties.

In September 2020, it was announced that Calingiri would be removed from the master list in 2022.

Calingiri will continue to be received as ANW for the 2021 harvest but will only be received as a feed grade wheat in WA from the 2022 harvest onwards.

Australian Premium White Noodle (APWN) is a quality class created to allow varietal control of the hard wheat component of the export blends with Australian Standard Noodle Wheat (ANW) and to optimise end-use quality for the premium Japanese udon noodle market. APWN classification has been determined for the following AH and APW varieties: Chief CL Plus, Cutlass, Devil, EGA Bonnie Rock, King Rock, LRPB Avenger, LRPB Envoy, LRPB Havoc, LRPB Trojan, LRPB Scout, Mace, RockStar, Sheriff CL Plus, Vixen, Westonia and Wyalkatchem.

WHAT VARIETY SHOULD I GROW?

Scepter dominates the WA planting area of wheat, accounting for half of all hectares sown to wheat and superseding Mace, which continues to decline in area (Table 1). In 2020 there was an increased area sown to Chief CL Plus and recently released varieties with fast-mid maturity including LRPB Havoc and Devil. About one million hectares of wheat is still being sown to varieties that have been superseded for yield, disease and quality attributes. These varieties include Mace, Calingiri, Magenta and several other less popular varieties that together account for a significant 17% of WA's wheat crop. In some cases, these long-retained varieties are slower maturity types that are being retained to take advantage of earlier sowing opportunities. In recent years, there has been a significant yield improvement of varieties within the mid–slow maturity class and growers are encouraged to compare the performance of these varieties and consider their uptake (Figure 1).

TABLE 1. Percentage of planned area sown to wheat varieties for the 2016 to 2020 WA growing seasons

Variety	2016	2017	2018	2019	2020
Scepter	0.1	14.6	37.8	52.4	53.2
Mace	66.5	54.5	30.5	16.9	12.0
Chief CL Plus	-	0.0	1.0	4.9	6.3
Ninja	-	0.2	3.4	5.1	5.2
Zen	1.3	4.3	6.3	4.2	5.0
LRPB Havoc	-	-	0.1	1.5	3.2
Devil	-	-	-	0.3	2.6
Calingiri	8.2	7.3	5.7	3.1	2.5
Magenta	4.1	4.0	2.7	1.6	1.4
Yitpi	3.0	2.5	1.5	1.1	1.2
Corack	2.4	1.8	1.8	1.7	1.1
Cutlass	0.0	0.2	0.4	0.8	0.9
Cobra	1.9	1.7	1.3	0.9	0.6
Westonia	0.5	0.3	0.4	0.3	0.4
Wyalkatchem	2.9	1.2	1.3	0.7	0.4
Machete	0.3	0.1	0.1	0.5	0.4
LRPB Trojan	0.9	1.8	0.9	0.4	0.4
Kinsei	-	-	-	0.0	0.3
DS Pascal	-	0.0	0.1	0.5	0.3
Illabo	-	-	-	0.1	0.3
Emu Rock	0.6	0.4	0.6	0.2	0.3

Source: Data from CBH Group

Varieties with less than 0.2% of total crop area in 2020 season are not included.

While many farming operations seek to limit the number of varieties on-farm, it is important to consider the opportunities that a diverse range of varieties can provide, particularly when matched with appropriate management. Several traits differ between well-adapted varieties and when these are used correctly, they can increase production and/or reduce risk. For example:

- selecting varieties of slower or faster maturity to optimise production across a range of sowing time opportunities and frost risk profiles.
- selecting varieties with improved or diverse disease resistance ratings to reduce disease risk.
- growing varieties of multiple quality grades that may respond to different pricing signals.

In addition to diversification within the wheat program, diversification of crop types can also provide additional management options to reduce risk and improve overall productivity.

When selecting wheat varieties, it is important to consider:

- yield performance in a specific environment over multiple seasons
- matching variety maturity to a targeted sowing time
- varietal herbicide tolerance and weed control options
- varietal disease resistance ratings, particularly for prevalent diseases. Please note: due to the incursion of new strains and mutations of pathogens already present in WA, it is essential to review disease ratings of existing varieties each year as these may change.
- susceptibility to pre-harvest sprouting (presented as falling number index ratings) and blackpoint.

Tables 2 to 5 compare varieties with Scepter to assist in variety selection across various agronomic types. The preferred agronomic characteristics and disease traits will vary in priority depending on the pressures present in the target environment and farming system. In Tables 2 to 5, the statewide MET yield (presented as a percentage of site mean) is combined across the six Agzones and a five-year weighted average has been calculated from the MET data. Caution should be exercised when examining the weighted average as it may mask important variety-by-environment interactions (i.e. how a variety performance changes under different environmental conditions). Refer to Tables 6 to 11 for a more precise estimate of variety performance in specific regions.

AH and APW quick–mid season varieties

With the release of Calibre and LRPB Avenger in 2021, growers now have a wider range of wheat varieties to choose from that are suitable for May/June sowing times. Growers are encouraged to adopt varieties with a range of maturity lengths to allow flexibility in response to available sowing opportunities and/or take advantage of varietal herbicide or disease tolerance.

Scepter is still a strong overall package that achieves consistently high yields and has relatively good disease and pre-harvest sprouting resistance (see Tables 2 and 21). Within the main season NVT, LRPB Avenger, Sting and Vixen achieve higher yields than Scepter in lower-yielding environments (i.e.<2.5t/ha).

Calibre's predicted mean yield (2016-2020) is the highest overall (Table 2), however 2020 was the first time Calibre was included in the NVT where it yielded similar or slightly lower then a number of key varieties (Tables 6 to 11).

Calibre and LRPB Avenger also have a slightly longer coleoptile length than Scepter, similar to Magenta but inferior to the very long coleoptile wheats like Halberd (see Variety Traits for more detail).

Calibre offers an improved provisional stem and stripe rust rating in this maturity group. Apart from Calibre and LRPB Avenger, which are provisionally rated MS*p* for yellow spot, all other varieties competing in this maturity class are MRMS for yellow spot and most are susceptible to powdery mildew and the new strain of leaf rust. LRPB Havoc has the highest powdery mildew rating in the group following an increased rating to MS in 2021 (Table 2).

Quick maturity wheats have often been seen as a way to avoid drought stress, particularly when sowing late. However, they make up only a small component of the WA crop primarily because quick to mid maturity varieties like Scepter yield similarly in seasons with later emergence and the quick maturity wheats do not perform as well in seasons with late end of season rainfall or early germination.

Vixen offers a quick maturity alternative in this group. In 2020, Vixen sown in mid to late May flowered, on average, nine days before Scepter (see Maturity). Vixen is more yield competitive over

TABLE 2. Relative performance of top-yielding quick and quick–mid maturity wheat varieties compared to Scepter

	Scepter	Calibre	Vixen	Devil	Sting	LRPB Avenger	LRPB Havoc	Mace
Statewide MET yield (% site mean)[1]	110%	114%^	111%	110%	110%	108%	106%	104%
Maturity	Quick–mid	Quick–mid	Quick	Quick–mid	Quick	Quick	Quick–mid	Quick–mid
Classification	AH	AH	AH(N)	AH(N)	AH	APW(N)	AH(N)	AH(N)
Falling no. index	5	-	3	3	-	-	3	5
Stem rust	MRMS	RMR*p*	MRMS	MS	MRMS	MS	S	MRMS
Stripe rust	MR*	RMR*p*	MRMS	MR	MR	MRMS	MR	RMR*
Leaf rust	MSS	S*p*	SVS	SVS	SVS	S	S	MSS
Powdery mildew	S	S*p*	S	SVS	S*p*	S*p*	MS	MSS
Yellow spot	MRMS	MS*p*	MRMS	MRMS	MRMS	MS	MRMS	MRMS

[1]Regional differences in yield are masked when using a statewide average of the WA wheat NVT MET data (2016–2020). Readers are directed to Tables 6 to 11 for a more precise estimate of variety performance in their region. (N) = Denotes supplementary classification of APWN. * = Some races in eastern Australia can attack these varieties. *p* = provisional rating. ^ = single year of NVT data in 2020. Falling no. index please refer to page 32.

several seasons than predecessors in the quick maturity group such as Emu Rock and is likely to be the preferred option when choosing a quick season wheat. Vixen should be targeted to later sowing and scenarios with higher risk of terminal drought (e.g. shallow soils and/or low rainfall environments).

CL Plus wheats

Wheat varieties denoted with 'CL Plus' are varieties with two resistance genes for imidazolinone herbicides and are registered for spraying with label rates of Intervix®.

In 2021, InterGrain released the slow maturity Valiant CL Plus that provides growers with a more appropriate variety for use with the Clearfield system in earlier sowing opportunities. Only tested in the main season NVT in 2020, Valiant CL Plus has yielded similarly to Cutlass (Table 4), but lower than Razor CL Plus, Hammer CL Plus, Chief CL Plus and Sheriff CL Plus (Table 3). InterGrain report that Valiant CL Plus has a slightly later maturity than Cutlass and a longer coleoptile than Scepter.

The yields of Razor CL Plus, Hammer CL Plus, Chief CL Plus and Sheriff CL Plus were competitive with Mace in the NVT and far out-yielded previous CL Plus varieties. However their yields are inferior to some non-imidazolinone resistant varieties such as Scepter, Calibre, Devil, Vixen and Sting. Hammer CL Plus is an AH, while Chief CL Plus and Sheriff CL Plus are both classified as APW and APWN and Razor CL Plus is classified as ASW. NVT results to date indicate the slightly quicker maturity Razor CL Plus performs slightly better than Hammer CL Plus and Chief CL Plus. In the lower yielding NVTs, Chief CL Plus performance was lower than Razor CL Plus and Hammer CL Plus. Disease packages vary significantly within Clearfield varieties and this may drive adoption of certain varieties.

Note: there are no grower-to-grower sales permitted for any CL Plus varieties.

Mid–slow maturity varieties

Mid–slow maturity wheats, as their name suggests, show a delayed rate of development compared to the widely grown quick–mid types. With early sowing opportunities they enable flowering to be maintained at an optimum date. When sown on main-season/May sowing dates, mid–slow maturity wheats exhibit delayed development which can help to avoid frost.

Denison and Valiant CL Plus are recent releases which have been nominally classified as slow maturity (later than Yitpi or Cutlass). Although Denison is typically slower developing than Cutlass when sown in May, DPIRD trials in 2020 showed that Denison sown early to mid-April has a maturity similar to or earlier than Cutlass (see section – Maturity page 21).

RockStar and Catapult performed well in the main season NVT, with RockStar yielding similar to Scepter despite its slightly later maturity (average of six days in 2020 – see Maturity section). Catapult and Kinsei have achieved superior yields to other mid–slow varieties such as Yitpi, Magenta and LRPB Trojan since their entry into the NVT in 2018 and 2017. The average yields of Denison, Valiant CL Plus and Cutlass fall between the two groups mentioned above.

TABLE 3. Relative performance of CL Plus wheat varieties compared to Scepter

	Scepter	Razor CL Plus	Hammer CL Plus	Chief CL Plus	Sheriff CL Plus	Valiant CL Plus
Statewide MET yield (% site mean)[1]	110%	104%	103%^	102%	101%	98%^
Maturity	Quick–mid	Quick–mid	Quick–mid	Mid	Mid	Slow(*p*)
Classification	AH	ASW	AH	APW(N)	APW(N)	AH
Falling no. index	5	4*p*	-	4	4*p*	-
Stem rust	MRMS	MR	MR	MR	MS	MR*p*
Stripe rust	MR*	RMR	RMR	S	MS	RMR*p*
Leaf rust	MSS	S	S	MR*	SVS	MSS*p*
Powdery mildew	S	MSS	SVS*p*	S	SVS	–
Yellow spot	MRMS	MSS	MRMS	MRMS	MRMS	MRMS*p*

[1]Regional differences in yield are masked when using a statewide average of the WA wheat NVT MET data (2016–2020). Readers are directed to Tables 6 to 11 for a more precise estimate of variety performance in their region. (N) = Denotes supplementary classification of APWN. * = Some races in eastern Australia can attack these varieties. *p* = provisional rating. ^ = single year of NVT data in 2020. Falling no. index please refer to page 32.

It should be noted that the yield advantage of these mid–slow varieties over their quicker maturity counterparts can be significant in earlier sowing opportunities (late April to early May). However, this yield advantage is not always represented in the main season NVT, which are commonly sown at a date best suited to quick–mid maturity varieties (see – Sowing time response and Early season NVT, pages 23 and 25). In addition, the newer mid–slow varieties have a much lower risk of poor yields when sowing/emergence is delayed compared to the superseded mid–slow maturity varieties such as Magenta and Yitpi (as seen in Figure 1 and their NVT performance in Tables 6 to 11).

Catapult, RockStar and Valiant CL Plus (provisional ratings) have superior stem (MR) and stripe (RMR) rust resistance ratings compared to Kinsei (MSS and MRMS, respectively) and Denison (MS and MR, respectively). Apart from Cutlass (RMR), Kinsei (MSS) and Valiant CL Plus (MSS*p*), other recent mid–slow releases are all susceptible (S) to the new pathotype of leaf rust. However Cutlass and Kinsei have inferior yellow spot ratings compared to other mid–slow varieties, which are all MRMS/MRMS*p*. RockStar has the highest powdery mildew rating (MSS) for this group of new releases.

Provisional falling number index ratings suggest RockStar is at higher risk of low falling number than Catapult. In opportunistic sampling of DPIRD trials in 2020, the falling number of RockStar was below 300 seconds when sown in April at Mullewa, Katanning and Gibson.

TABLE 4. Relative performance of mid–slow maturity wheat varieties compared to Scepter

	Scepter	Rockstar	Catapult	Kinsei	Denison	Cutlass	Valiant CL Plus	Yitpi
Statewide MET yield (% site mean)[1]	110%	108%	104%	103%	100%^	98%	98%^	93%
Maturity	Quick–mid	Mid–slow	Mid–slow	Mid–slow	Slow(*p*)	Mid–slow	Slow(*p*)	Mid–slow
Classification	AH	AH(N)	AH	ANW	APW	APW(N)	AH	AH
Falling no. index	5	3*p*	6*p*	4	-	4	-	5
Stem rust	MRMS	MR	MR	MSS	MS	R	MR*p*	S
Stripe rust	MR*	RMR	RMR	MRMS	MR	RMR*	RMR*p*	MRMS
Leaf rust	MSS	S	S	MSS	S	RMR*	MSS*p*	S
Powdery mildew	S	MSS	S	S	S*p*	S	–	MS
Yellow spot	MRMS	MRMS	MRMS	MS	MRMS	MSS	MRMS*p*	SVS

[1]Regional differences in yield are masked when using a statewide average of the WA wheat NVT MET data (2016–2020). Readers are directed to Tables 6 to 11 for a more precise estimate of variety performance in their region. (N) = Denotes supplementary classification of APWN. * = Some races in eastern Australia can attack these varieties. *p* = provisional rating. ^ = single year of NVT data in 2020. Falling no. index please refer to page 32.

TABLE 5. Relative performance of noodle wheat varieties compared to Scepter

	Scepter	Ninja	Kinsei	Zen	Calingiri
Statewide MET yield (% site mean)[1]	110%	105%	103%	102%	94%
Maturity	Quick–mid	Mid	Mid–slow	Mid–slow	Mid–slow
Classification	AH	ANW	ANW	ANW	Feed (2022)
Falling no. index	5	4	4	3	4
Stem rust	MRMS	S	MSS	S	S
Stripe rust	MR*	MS	MRMS	MRMS	SVS
Leaf rust	MSS	S	MSS	S	S
Powdery mildew	S	S	S	S	S
Yellow spot	MRMS	MRMS	MS	MRMS	MS

[1]Regional differences in yield are masked when using a statewide average of the WA wheat NVT MET data (2016–2020). Readers are directed to Tables 6 to 11 for a more precise estimate of variety performance in their region. (N) = Denotes supplementary classification of APWN. * = Some races in eastern Australia can attack these varieties. *p* = provisional rating. ^ = single year of NVT data in 2020. Falling no. index please refer to page 32.

ANW

ANW is WA's premium wheat product. Recent changes in the blend of noodle wheat for the Japanese market has seen an increase from the relatively stable and long term 60:40 ratio of ANW to APW. For the past two years, the ratio has ranged from 80:20 to 90:10, which has increased the volume/proportion of ANW to the premium Japanese market.

Calingiri is due for removal from the Wheat Variety Master List in 2022, which means that the 2021 harvest will be the final year it will be received as ANW in WA. While Calingiri was popular for its ability to take advantage of early sowing opportunities, Kinsei supersedes it for yield in April sowings and has also proven to be a lower risk in later emerging situations (such as in the main season NVTs). Ninja and Zen are competitive varieties for May plantings and are superior to Calingiri in these scenarios.

Ninja remains the highest yielding ANW in the main season NVT, yielding just below Scepter over the past five years (Table 5). The slower maturing Kinsei has also performed well, with both varieties having improved yields over all other ANW varieties. Ninja is marginally quicker in maturity than Zen and Calingiri, while Kinsei is slightly later in maturity. Zen is consistently low for small grain screenings in the NVT data (results not shown). As Ninja and Zen are S for stem and leaf rust, disease should be actively monitored and managed. Kinsei's disease ratings are marginally better than Zen and Ninja, particularly for stem and stripe rust.

YIELD IMPROVEMENT AND GRAIN PROTEIN

Wheat yield increases through breeding and management have been impressive since breeding commenced in Australia. While the gains in yield directly related to genetics can often be obscured by advances in crop management, mechanisation and crop sequences, they become clear when yields of varieties are shown in comparison to their year of release (Figure 1). Top performing varieties in WA NVT (May–early June sowing) are commonly quick to mid maturing with yield improvements over the last twenty years equating to about 0.7% per year. However, there have been notable improvements in the performance of mid–slow maturing varieties released in the last five years. This should give growers confidence when utilising these longer maturity types to chase earlier germination opportunities, that should germination be later than ideal, the yield trade-off will be lower than with older mid–slow maturity varieties.

Yield increases come with an inevitable decline in grain protein concentration. WA often produces vast quantities of low protein wheat, particularly in favourable/above average seasons. The combination of higher yielding varieties and good seasons lead to many questions about the protein efficiency of new varieties.

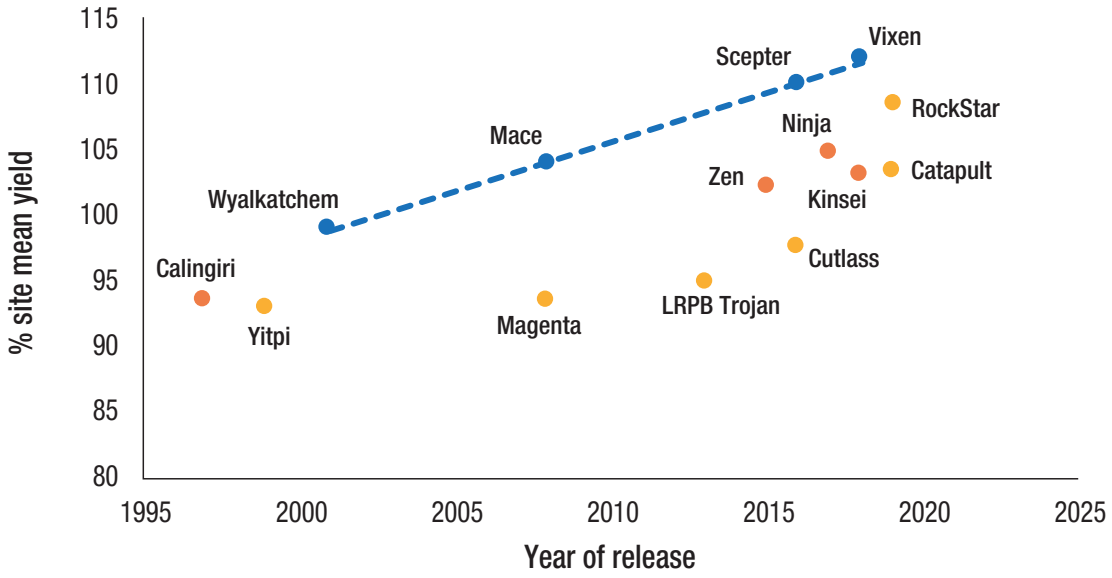

FIGURE 1. Wheat yield improvement in WA shown by relative site mean yield by variety year of release in NVT MET analysis 2017-2020 for all agzones (161 NVT sites). Blue dots are the leading quick to mid-maturity varieties, orange dots are ANW varieties and yellow dots are mid–slow maturing varieties.

Source: NVT Online, **nvtonline.com.au**

There is an average decline in mean protein concentration of around 0.3% for each additional 10% of yield (Figure 2). This relationship is not strong and the relative differences in yield are greater than for protein. An alternative method to compare varieties is through protein yield, a measure of the total production of grain protein produced per hectare. Protein yield is calculated by multiplying yield (kg/ha) by protein concentration (%).

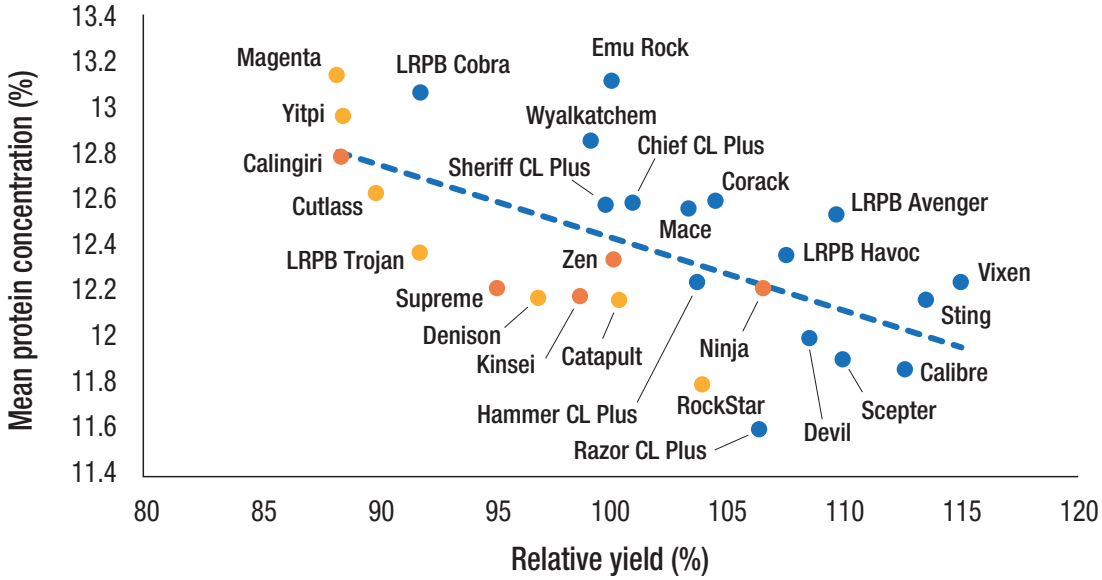

FIGURE 2. Mean protein concentration by relative yield for released varieties in WA (based on single sites in 2020, 43 NVT sites). Blue dots are quick and quick–mid maturing varieties, orange dots are ANW varieties and yellow dots are mid–slow maturing varieties. The blue dotted line represents the trend.

Source: NVT Online, **nvtonline.com.au**

Note: this data uses single site yield data to compare with the composite quality data (i.e. single sample protein value of each site).

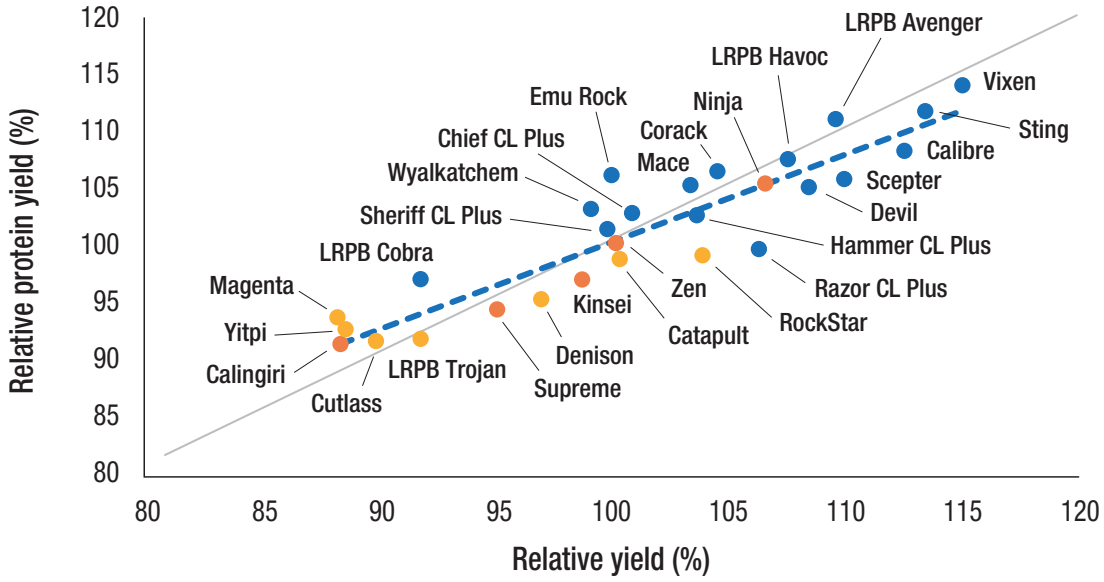

FIGURE 3. Relationship between relative protein yield and relative yield in WA (based on single sites in 2020, 43 NVT sites). Blue dots are quick and quick–mid maturing varieties, orange dots are ANW varieties and yellow dots are mid–slow maturing varieties. The blue dotted line represents the trend, and the solid line represents a 1:1 relationship between yield and protein yield.

Source: NVT Online for 2020 single site means, nvtonline.com.au

Analyses of NVT data and DPIRD time of sowing trials have demonstrated that the highest yielding varieties are typically among the best for the total quantity of protein produced per hectare. The results of the 2020 NVT single site relative grain yields and relative protein yields are presented for released varieties that were at all sites (Figure 3). This indicates that higher yielding varieties have a higher protein yield, suggesting that most of the reductions in grain protein concentration are driven by increases in yield (protein dilution).

Phenology is also a very important factor, with later flowering times tending to have lower yield and a higher protein concentration but overall, less protein per hectare (protein yield). This is supported by the fact that most of the mid–slow varieties have a lower protein yield (Figure 3). Therefore, any comparisons between varieties should consider their maturity differences and when they are likely to be sown. Early sowing of long season wheats will ensure a higher yield and therefore protein yield in general. Both methods of analyses show two varieties that are furthest from the trend line, Emu Rock which has a higher protein than expected for its yield and Razor CL Plus which has a lower protein and protein yield than expected for its yield.

Yield has a larger impact on profit than protein with price differences between grades being minor in recent seasons. Deferred nitrogen strategies in which the majority of N is applied during stem elongation can increase protein, but seasonal conditions are key for effective application and uptake of later N and economic analysis continues to support that yield rather than protein is ‘king’. Consult your agronomist for more specific advice on nitrogen, protein and economic return.

GRAIN YIELD

GRDC’s National Variety Trials (NVT) provide an independent means of assessing varietal performance in WA. NVT results can be viewed as individual site reports or as multi-environment (MET) long-term summaries that can provide insight into a variety’s yield performance across environments and seasons. Tables 6 to 11 are outputs extracted from nvtonline.com.au and provide the MET data for the six Agzones in WA between 2016 and 2020. Where there is more than one year of data or four or more observations, a five-year weighted average has been calculated from the MET data, including the predicted yields for varieties that were absent at a site or in a season.

The overall performance of a variety within an agzone does not necessarily capture the variation in relative yield performance of varieties in response to that environment. A major driver in the relative performance of a variety is its maturity, its germination timing, the amount and timing of rainfall and abiotic stresses such as drought stress, heat shock and frost damage. Growers are encouraged to consider the predominant environmental conditions experienced in any given season in their region when interpreting relative varietal performance in local NVTs.

Visit app.nvtonline.com.au to access the NVT Online Long Term Yield Reporter.

TABLE 6. Grain yield of wheat varieties in AGZONE 1 expressed as a percentage of site mean yield for each trial year (2016–2020) and the weighted average over the five-year period (where there is more than one year of data or four or more observations)

Year			2016	2017	2018	2019	2020	2016–2020
Site mean yield (t/ha)			4.05	2.59	3.65	1.24	3.62	
Variety	Maturity	(No. trials)	(5)	(5)	(6)	(5)	(4)	(25)
Australian Hard								
Emu Rock	Quick	(25)	96	87	100	96	95	**95**
Vixen (N)	Quick	(20)	-	93	115	116	105	**107**
Sting	Quick	(9)	-	-	-	114	106	**107**
LRPB Havoc (N)	Quick–mid	(25)	104	96	111	109	100	**104**
Mace (N)	Quick–mid	(25)	100	98	105	106	100	**102**
Hammer CL Plus	Quick–mid	(4)	-	-	-	-	103	**-**
Devil (N)	Quick–mid	(20)	-	104	109	113	107	**108**
Calibre	Quick–mid	(4)	-	-	-	-	108	**-**
Scepter	Quick–mid	(25)	106	103	109	113	108	**108**
RockStar (N)	Mid–slow	(15)	-	-	107	110	108	**108**
Catapult	Mid–slow	(15)	-	-	100	105	104	**103**
Yitpi	Mid–slow	(25)	91	101	90	92	93	**93**
Valiant CL Plus	Slow(p)	(0)	-	-	-	-	-	**-**
Australian Premium White								
LRPB Avenger (N)	Quick	(9)	-	-	-	113	100	**104**
Corack	Quick–mid	(25)	101	97	108	108	99	**103**
Chief CL Plus (N)	Mid	(25)	101	103	103	103	98	**102**
Sheriff CL Plus (N)	Mid	(19)	102	103	-	101	101	**102**
LRPB Trojan (N)	Mid–slow	(25)	98	100	94	93	100	**97**
Magenta	Mid–slow	(25)	96	103	91	91	99	**96**
Cutlass (N)	Mid–slow	(25)	96	107	93	97	99	**98**
Denison	Slow(p)	(4)	-	-	-	-	101	**101**
Australian Noodle Wheat								
Ninja	Mid	(25)	105	104	104	106	107	**105**
Zen	Mid–slow	(25)	102	102	103	103	100	**102**
Calingiri	Mid–slow	(25)	97	103	92	91	96	**96**
Kinsei	Mid–slow	(20)	-	108	102	104	105	**105**
Australian Standard White								
Razor CL Plus	Quick–mid	(20)	-	92	106	105	102	**101**

(N) = Denotes supplementary classification of APWN, (*p*) = provisional
Source: based on MET analysis from NVT Online, nvtonline.com.au

TABLE 7. Grain yield of wheat varieties in AGZONE 2 expressed as a percentage of site mean yield for each trial year (2016–2020) and the weighted average over the five-year period (where there is more than one year of data or four or more observations)

Year			2016	2017	2018	2019	2020	2016–2020
Site mean yield (t/ha)			3.67	3.45	4.02	2.24	2.79	
Variety	Maturity	(No. trials)	(8)	(16)	(14)	(16)	(14)	(68)
Australian Hard								
Emu Rock	Quick	(68)	95	97	93	101	99	**97**
Vixen (N)	Quick	(60)	-	111	109	118	114	**112**
Sting	Quick	(30)	-	-	-	115	112	**111**
LRPB Havoc (N)	Quick–mid	(68)	97	107	105	110	107	**106**
Mace (N)	Quick–mid	(68)	99	104	103	107	104	**104**
Hammer CL Plus	Quick–mid	(14)	-	-	-	-	104	**-**
Devil (N)	Quick–mid	(60)	-	109	110	111	110	**110**
Calibre	Quick–mid	(14)	-	-	-	-	113	**-**
Scepter	Quick–mid	(68)	108	109	110	111	110	**110**
RockStar (N)	Mid–slow	(44)	-	-	110	107	107	**108**
Catapult	Mid–slow	(44)	-	-	104	103	102	**103**
Yitpi	Mid–slow	(68)	95	92	93	94	91	**93**
Valiant CL Plus	Slow(p)	(14)	-	-	-	-	95	**-**
Australian Premium White								
LRPB Avenger (N)	Quick	(30)	-	-	-	116	109	**109**
Corack	Quick–mid	(68)	96	106	104	110	105	**105**
Chief CL Plus (N)	Mid	(68)	96	103	103	103	101	**102**
Sheriff CL Plus (N)	Mid	(54)	100	101		100	101	**101**
LRPB Trojan (N)	Mid–slow	(68)	101	95	96	92	95	**95**
Magenta	Mid–slow	(68)	102	93	95	90	93	**64**
Cutlass (N)	Mid–slow	(68)	102	96	99	96	95	**97**
Denison	Slow(p)	(30)	-	-	-	96	97	**99**
Australian Noodle Wheat								
Ninja	Mid	(68)	107	104	106	103	105	**105**
Zen	Mid–slow	(68)	99	103	103	102	102	**102**
Calingiri	Mid–slow	(68)	97	94	95	91	92	**93**
Kinsei	Mid–slow	(60)	-	103	106	100	102	**103**
Australian Standard White								
Razor CL Plus	Quick–mid	(60)	-	104	101	107	106	**104**

(N) = Denotes supplementary classification of APWN, (*p*) = provisional
Source: based on MET analysis from NVT Online, **nvtonline.com.au**

TABLE 8. Grain yield of wheat varieties in AGZONE 3 expressed as a percentage of site mean yield for each trial year (2016–2020) and the weighted average over the five-year period (where there is more than one year of data or four or more observations)

Year			2016	2017	2018	2019	2020	2016–2020
Site mean yield (t/ha)			3.15	4.23	2.97	3.33	3.76	
Variety	Maturity	(No. trials)	(3)	(4)	(3)	(4)	(5)	(19)
Australian Hard								
Emu Rock	Quick	(19)	93	91	95	97	92	**93**
Vixen (N)	Quick	(12)	-	-	111	114	106	**108**
Sting	Quick	(9)	-	-	-	111	106	**107**
LRPB Havoc (N)	Quick–mid	(19)	96	102	110	110	103	**104**
Mace (N)	Quick–mid	(19)	98	100	104	106	101	**102**
Hammer CL Plus	Quick–mid	(5)	-	-	-	-	101	**-**
Devil (N)	Quick–mid	(16)	-	111	110	111	110	**110**
Calibre	Quick–mid	(5)	-	-	-	-	111	**-**
Scepter	Quick–mid	(19)	108	111	109	110	109	**109**
RockStar (N)	Mid–slow	(12)	-	-	109	108	111	**110**
Catapult	Mid–slow	(12)	-	-	102	103	105	**104**
Yitpi	Mid–slow	(19)	95	91	91	94	94	**93**
Valiant CL Plus	Slow(p)	(5)	-	-	-	-	102	**-**
Australian Premium White								
LRPB Avenger (N)	Quick	(9)	-	-	-	114	104	**105**
Corack	Quick–mid	(19)	95	100	108	110	102	**103**
Chief CL Plus (N)	Mid	(19)	96	101	105	105	102	**102**
Sheriff CL Plus (N)	Mid	(16)	101	103	-	101	102	**102**
LRPB Trojan (N)	Mid–slow	(19)	102	98	93	92	97	**96**
Magenta	Mid–slow	(19)	103	97	92	91	97	**96**
Cutlass (N)	Mid–slow	(19)	103	99	96	98	100	**99**
Denison	Slow(p)	(9)	-	-	-	101	105	**103**
Australian Noodle Wheat								
Ninja	Mid	(19)	108	108	104	103	106	**106**
Zen	Mid–slow	(19)	99	102	105	104	103	**103**
Calingiri	Mid–slow	(19)	97	96	94	93	96	**95**
Kinsei	Mid–slow	(16)	-	108	105	103	107	**106**
Australian Standard White								
Razor CL Plus	Quick–mid	(16)	-	100	103	104	100	**101**

(N) = Denotes supplementary classification of APWN, (*p*) = provisional

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

TABLE 9. Grain yield of wheat varieties in AGZONE 4 expressed as a percentage of site mean yield for each trial year (2016–2020) and the weighted average over the five-year period (where there is more than one year of data or four or more observations)

Year			2016	2017	2018	2019	2020	2016–2020
Site mean yield (t/ha)			3.05	2.15	3.24	1.19	2.36	
Variety	Maturity	(No. trials)	(4)	(9)	(9)	(9)	(11)	(42)
Australian Hard								
Emu Rock	Quick	(42)	100	95	97	104	103	**100**
Vixen (N)	Quick	(38)	-	109	112	124	118	**116**
Sting	Quick	(20)	-	-	-	121	115	**113**
LRPB Havoc (N)	Quick–mid	(42)	106	103	107	109	113	**108**
Mace (N)	Quick–mid	(42)	102	104	104	109	106	**105**
Hammer CL Plus	Quick–mid	(11)	-	-	-	-	105	**-**
Devil (N)	Quick–mid	(38)	-	110	110	114	109	**110**
Calibre	Quick–mid	(11)	-	-	-	-	111	**-**
Scepter	Quick–mid	(42)	109	109	109	115	109	**110**
RockStar (N)	Mid–slow	(29)	-	-	108	107	105	**107**
Catapult	Mid–slow	(29)	-	-	103	106	99	**103**
Yitpi	Mid–slow	(42)	88	98	92	94	88	**92**
Valiant CL Plus	Slow(*p*)	(0)	-	-	-	-	-	**-**
Australian Premium White								
LRPB Avenger (N)	Quick	(20)	-	-	-	120	113	**112**
Corack	Quick–mid	(42)	102	104	105	110	109	**107**
Chief CL Plus (N)	Mid	(42)	99	101	102	99	102	**101**
Sheriff CL Plus (N)	Mid	(24)	101	-	-	98	101	**100**
LRPB Trojan (N)	Mid–slow	(42)	97	96	95	93	93	**94**
Magenta	Mid–slow	(42)	94	97	93	91	89	**92**
Cutlass (N)	Mid–slow	(42)	93	103	97	97	90	**96**
Denison	Slow(*p*)	(11)	-	-	-	-	95	**-**
Australian Noodle Wheat								
Ninja	Mid	(42)	107	104	105	104	104	**105**
Zen	Mid–slow	(42)	101	101	102	99	103	**101**
Calingiri	Mid–slow	(42)	93	95	94	87	90	**92**
Kinsei	Mid–slow	(38)	-	103	104	97	100	**101**
Australian Standard White								
Razor CL Plus	Quick–mid	(38)	-	101	104	111	109	**106**

(N) = Denotes supplementary classification of APWN, (*p*) = provisional
Source: based on MET analysis from NVT Online, **nvtonline.com.au**

TABLE 10. Grain yield of wheat varieties in AGZONE 5 expressed as a percentage of site mean yield for each trial year (2016–2020) and the weighted average over the five-year period (where there is more than one year of data or four or more observations)

Year			2016	2017	2018	2019	2020	2016–2020
Site mean yield (t/ha)			3.41	3.20	2.43	2.09	2.12	
Variety	Maturity	(No. trials)	(2)	(5)	(4)	(4)	(6)	(21)
Australian Hard								
Emu Rock	Quick	(21)	95	96	97	100	102	**99**
Vixen (N)	Quick	(19)	-	112	118	120	122	**117**
Sting	Quick	(10)	-	-	-	118	118	**115**
LRPB Havoc (N)	Quick–mid	(21)	95	102	106	109	114	**107**
Mace (N)	Quick–mid	(21)	100	104	107	108	108	**106**
Hammer CL Plus	Quick–mid	(6)	-	-	-	-	106	**-**
Devil (N)	Quick–mid	(19)	-	112	115	114	113	**113**
Calibre	Quick–mid	(6)	-	-	-	-	119	**-**
Scepter	Quick–mid	(21)	108	112	115	114	113	**113**
RockStar (N)	Mid–slow	(14)	-	-	111	109	108	**109**
Catapult	Mid–slow	(14)	-	-	109	107	102	**106**
Yitpi	Mid–slow	(21)	98	96	96	95	89	**94**
Valiant CL Plus	Slow(*p*)	(6)	-	-	-	-	92	**-**
Australian Premium White								
LRPB Avenger (N)	Quick	(10)	-	-	-	118	118	**114**
Corack	Quick–mid	(21)	96	102	107	109	112	**107**
Chief CL Plus (N)	Mid	(21)	95	98	100	101	103	**100**
Sheriff CL Plus (N)	Mid	(17)	100	100	-	99	100	**100**
LRPB Trojan (N)	Mid–slow	(21)	102	97	94	93	91	**94**
Magenta	Mid–slow	(21)	103	97	94	91	87	**93**
Cutlass (N)	Mid–slow	(21)	104	102	102	99	92	**99**
Denison	Slow(*p*)	(10)	-	-	-	95	95	**97**
Australian Noodle Wheat								
Ninja	Mid	(21)	107	107	106	104	104	**105**
Zen	Mid–slow	(21)	98	99	100	100	103	**100**
Calingiri	Mid–slow	(21)	97	93	90	89	88	**91**
Kinsei	Mid–slow	(19)	-	103	101	99	100	**101**
Australian Standard White								
Razor CL Plus	Quick–mid	(19)	-	104	106	108	110	**107**

(N) = Denotes supplementary classification of APWN, (*p*) = provisional
Source: based on MET analysis from NVT Online, **nvtonline.com.au**

TABLE 11. Grain yield of wheat varieties in AGZONE 6 expressed as a percentage of site mean yield for each trial year (2016–2020) and the weighted average over the five-year period (where there is more than one year of data or four or more observations)

Year			2016	2017	2018	2019	2020	2016–2020
Site mean yield (t/ha)			4.06	3.68	3.74	4.30	3.70	
Variety	Maturity	(No. trials)	(2)	(2)	(2)	(1)	(3)	(10)
Australian Hard								
Emu Rock	Quick	(10)	94	91	92	88	89	**91**
Vixen (N)	Quick	(6)	-	-	105	105	106	**104**
Sting	Quick	(4)	-	-	-	105	106	**104**
LRPB Havoc (N)	Quick–mid	(10)	94	95	102	106	105	**100**
Mace (N)	Quick–mid	(10)	99	100	101	101	102	**101**
Hammer CL Plus	Quick–mid	(3)	-	-	-	-	100	**-**
Devil (N)	Quick–mid	(8)	-	107	109	111	111	**109**
Calibre	Quick–mid	(3)	-	-	-	-	111	**-**
Scepter	Quick–mid	(10)	107	107	108	110	110	**108**
RockStar (N)	Mid–slow	(6)	-	-	110	113	113	**110**
Catapult	Mid–slow	(6)	-	-	105	104	105	**106**
Yitpi	Mid–slow	(10)	99	101	95	91	92	**96**
Valiant CL Plus	Slow(p)	(3)	-	-	-	-	104	**-**
Australian Premium White								
LRPB Avenger (N)	Quick	(4)	-	-	-	103	104	**102**
Corack	Quick–mid	(10)	95	97	101	104	104	**100**
Chief CL Plus (N)	Mid	(10)	96	98	102	106	105	**101**
Sheriff CL Plus (N)	Mid	(8)	100	101	-	104	104	**102**
LRPB Trojan (N)	Mid–slow	(10)	103	101	98	95	95	**98**
Magenta	Mid–slow	(10)	104	103	98	95	95	**99**
Cutlass (N)	Mid–slow	(10)	105	107	101	99	100	**103**
Denison	Slow(p)	(4)	-	-	-	110	108	**105**
Australian Noodle Wheat								
Ninja	Mid	(10)	106	105	106	107	107	**106**
Zen	Mid–slow	(10)	98	99	102	106	105	**102**
Calingiri	Mid–slow	(10)	98	99	97	97	97	**98**
Kinsei	Mid–slow	(8)	-	105	106	110	109	**107**
Australian Standard White								
Razor CL Plus	Quick–mid	(8)	-	97	99	97	98	**98**

(N) = Denotes supplementary classification of APWN, (*p*) = provisional
Source: based on MET analysis from NVT Online, **nvtonline.com.au**

SUGGESTED SOWING TIMES

Suggested sowing times for varieties (Table 12) have been developed to support variety decisions in relation to sowing time preferences or opportunities. The suggestions are based on knowledge of the varieties and their performance in NVT and agronomy trials (see *Sowing time response of wheat varieties in WA* on page 23). The suggested sowing times were developed in consultation with breeding companies and researchers. For varieties not listed in the table, refer to the maturity class of the variety.

Note: spring wheats generally have a lower yield potential if sown before late April in WA.

The number of days to flowering of a variety relative to Scepter are provided in the variety snapshots at the end of this guide. Understanding varietal maturity length can assist with decisions on planting order of wheat varieties and help optimise variety development with typical seasonal conditions.

Table 12 does not suggest sowing time of wheat varieties where frost may be an issue. Frost risk is extremely variable within the landscape and across environments. Delaying sowing time and choice of variety or crop are still the most reliable ways of reducing yield losses in frost prone areas. Key management strategies for frost are available on the GRDC and DPIRD websites.

MATURITY

In WA, spring wheat varieties are broadly classified according to their flowering time into maturity categories of quick, quick–mid, mid and mid–slow. While there are later maturing spring wheats and winter wheats, these are not commonly grown in WA. Most spring wheat varieties grown in WA have a minimal vernalisation requirement (responding to an accumulation of cold temperatures) and photoperiod sensitivity (response to daylength), which means their development is mainly driven by temperature (warmer temperatures increase development rate).

This predominant maturity type has been developed because of its suitability to traditional sowing times in mid-May. Spring wheat varieties with a higher, albeit still limited, response to vernalisation (such as Magenta) or photoperiod (such as Cutlass) can be sown from late April as their maturity is delayed, and many of these varieties fall into the mid–slow maturity class. In recent years, very slow spring (such as LRPB Nighthawk) and winter wheats (such as Illabo) with greater adaptation to the WA environment have been released, offering unique maturity characteristics for very early sowing.

Sowing spring wheats into April may result in an advanced rate of development (due to warmer temperatures and longer daylengths) and a reduced duration to flowering. For this reason, winter wheats are seen as having more appropriate development times for an early April sowing in WA, primarily due to their vernalisation requirement.

TABLE 12. Suggested sowing times of wheat varieties in WA (assumes low frost risk)

AGZONES 1-6	April				May				June			
	wk 1	wk 2	wk 3	wk 4	wk 1	wk 2	wk 3	wk 4	wk 1	wk 2	wk 3	wk 4
Mid–slow and slow: Calingiri, Catapult, Cutlass, Denison, Kinsei, Magenta, RockStar, Yitpi, Valiant CL Plus, Zen												
Quick–mid to mid: Calibre, Chief CL Plus, Devil, Hammer CL Plus, LRPB Havoc, Mace, Ninja, Scepter												
Quick: Emu Rock, LRPB Avenger, Sting, Vixen												

= earlier than ideal = optimum sowing time = later than ideal but acceptable

TABLE 13. Duration of days from sowing to flowering (relative to Scepter) at selected NVT and DPIRD trials in 2020

Variety	Maturity	Northern NVTs*	Mullewa	Merredin	Katanning	Gibson	Average
Sowing date		**25-May**	**21-May**	**14-May**	**12-May**	**15-May**	
Emu Rock	Quick	-14	-15	-15	-11	-14	**-14**
Vixen	Quick	-12	-8	-9	-8	-12	**-10**
LRPB Avenger	Quick	-8	-7	-9	-9	-9	**-9**
Sting	Quick	-7	-9	-6	-7	-6	**-7**
Mace	Quick–mid	-4	-1	-4	-3	-6	**-4**
Devil	Quick–mid	-2	-2	-3	-2	-2	**-2**
Hammer CL Plus	Quick–mid	0	0	-1	-2	0	**-1**
Scepter	Quick–mid	0	0	0	0	0	**0**
Chief CL Plus	Mid	0	2	-1	-2	1	**0**
Ninja	Mid	3	5	-1	-1	-2	**1**
Magenta	Mid–slow	6	3	3	7	3	**4**
Calingiri	Mid–slow	6	3	2	2	2	**3**
RockStar	Mid–slow	8	6	3	4	2	**5**
Kinsei	Mid–slow	8	6	4	7	5	**6**
Catapult	Mid–slow	9	9	8	7	8	**8**
Cutlass	Mid–slow	11	9	7	10	13	**10**
Denison	Slow(*p*)	15	14	14	10	14	**13**
Scepter's flowering date		**27-Aug**	**19-Aug**	**27-Aug**	**17-Sep**	**10-Sep**	

*NVT sites include Oglivie, Yuna, Nabawa, Eradu and Mullewa. (*p*) = provisional

Scepter is classified as quick–mid maturity and Table 13 illustrates how other varieties compared in northern NVT sites and DPIRD experiments in 2020 when sown mid to late May. A more detailed flowering comparison between Scepter and other varieties can be found in the variety snapshots (pages 35 to 44).

Flowering dates change with sowing date, location and from season to season due to differences in temperatures. Figure 4 shows the large difference in flowering date measured in mid–slow spring and winter wheats at two locations (differences are greatest with an April and early May sowing time). Given the genetic control of flowering is complex and is driven by environmental conditions that differ from season to season, it is important to consider data from multiple sites and seasons to better understand a variety's maturity.

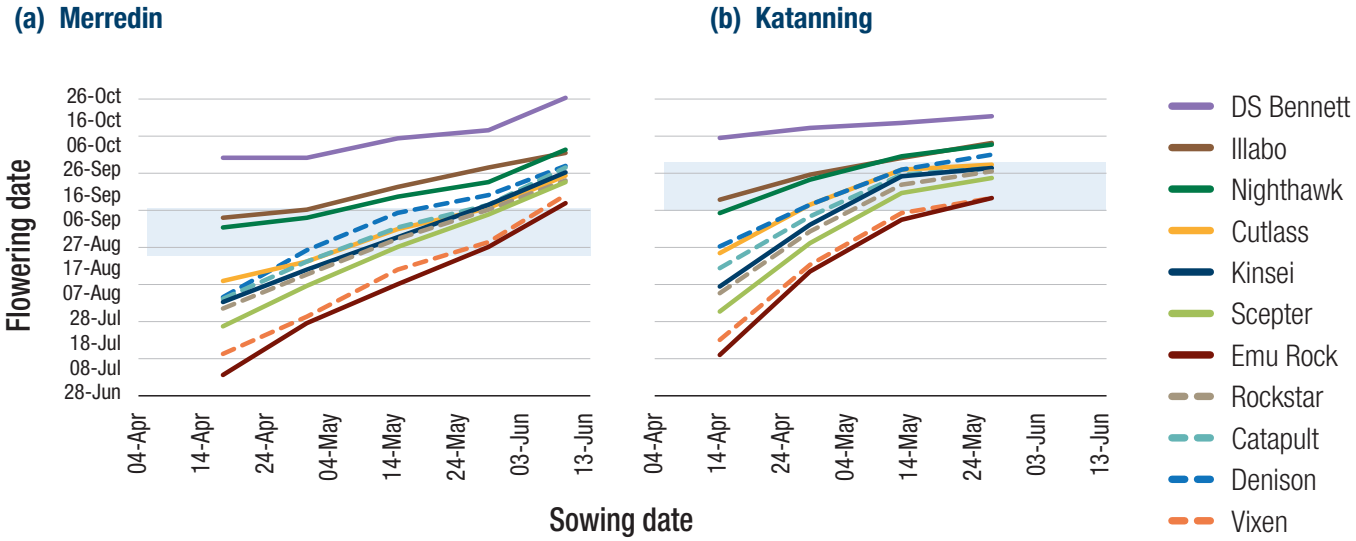

FIGURE 4. Flowering date response of varieties sown on a range of sowing dates (mid-April to early June) at a) Merredin and b) Katanning in 2020.

Shaded area is the estimated optimum flowering window.

SOWING TIME RESPONSE OF WHEAT VARIETIES IN WA

Matching varieties to their appropriate sowing date is the key to maximising wheat yield potential in WA. However, as the environmental constraints of each season differ in significance, prevalence and timing, the perfect match of sowing date and variety development is difficult to achieve. For example, many wheat growing areas in WA have had both early, dry finishes and cool, late finishes over the last few years, which changes the developmental timings of wheat crops and results in one maturity type being favoured over another for any given sowing date. Despite this, there are some consistencies that occur over several seasons that can guide appropriate variety choice for any sowing opportunity.

Most of the main season wheat NVTs are germinated from mid-May onwards, a time best suited to the shorter maturity varieties that currently dominate WA's wheat area. From 2015 to 2020, DPIRD and GRDC funded agronomy research assessed the optimal variety choices for any given sowing date and the best match of variety maturity types to sowing opportunities in specific environments.

Even at the vastly different locations of Katanning, Mullewa, Merredin and Gibson peak yields generally occurred from an early May sowing (Figure 5).

However, the variety combinations to maximise yield from each sowing date at each site varied significantly.

At the northern Mullewa site, the maximum yields across sowing times were maintained by sowing Kinsei or Cutlass, Scepter and Vixen in their recommended sowing window. Even at early April sowing dates, the slower maturity varieties, LRPB Nighthawk and EGA Wedgetail, were not competitive due to their later development causing grain fill to occur during dry and warmer conditions in September and October.

At Merredin, in the eastern wheatbelt, it was the quick–mid and mid–slow spring wheats that once again maximised yield potential across the sowing window. By sowing a mid–slow variety (like Cutlass or Kinsei) in April before switching to quick–mid varieties (like Scepter) in the mainstream May sowing period, high yield potential can be maintained across sowing dates.

At the cool and wet Gibson environment on the south coast, maximum yields were also produced from May sowings, typically with quick–mid and mid–slow maturing varieties. However, even at this south coastal site, these spring types were penalised when sown too early into April, because they were unable to produce the adequate biomass required for high yields. In this environment, slower maturing varieties like Longsword generated higher yields when sown in early April.

At Katanning, a frost prone site in the south-west, quick–mid and mid–slow maturity varieties achieved the highest grain yields but were severely penalised when sown too early and exposed to frost during critical development times (near flowering). In this environment, delayed sowing of these types until at least May resulted in the best yields, while earlier sowing opportunities were best captured by using slower maturing varieties such as winter wheats.

Results of the trials across the WA wheatbelt show that the optimum combination of variety (and particularly maturity type) for any given sowing date will change with site and season. However, even at these vastly different sites with a range of environmental constraints, there are opportunities to maintain high yields across the sowing window by matching varieties to a given sowing date.

In addition, growers should consider the whole farming system and acknowledge that sowing wheat may not be the most appropriate decision, particularly with early sowing times. Sowing a different crop type or taking the opportunity for improved weed control before sowing may result in greater returns overall.

It should be noted that while it is common to group varieties of the same maturity together when considering their response to sowing time, varietal differences do occur even within the same maturity group. For example, Scepter, despite its quick–mid maturity, appears to be more adaptable across a range of sowing times than some other quick–mid varieties, however it is still at risk of frost or increased disease when sown too early. Similarly, not all mid–slow varieties will perform the same in any given environment, with Catapult, Cutlass and RockStar generally having higher yields than DS Pascal, Magenta and Yitpi.

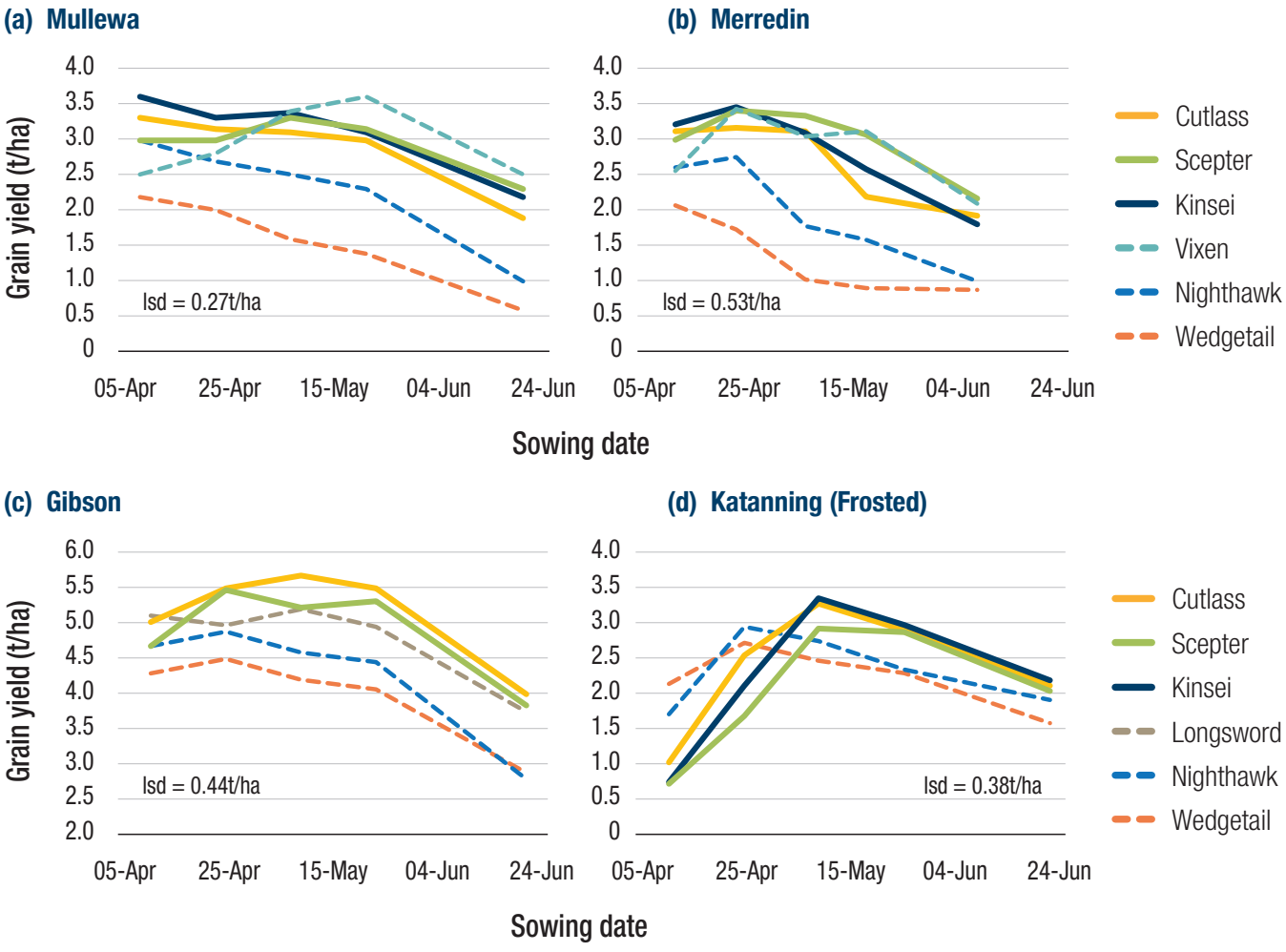

FIGURE 5. Grain yield (t/ha) response of varieties sown on five sowing dates (early April to mid-June) at a) Mullewa (2018 and 2020), b) Merredin (2018–2020), c) Gibson (2017–2018) and d) Katanning (frosted 2017–2018).

Irrigation was used at the early sowing dates to ensure timely germination. Source: DPIRD/GRDC Tactical Wheat Agronomy for the West Project (2015–2018) and DPIRD Wheat agronomy research (2020).

EARLY SEASON NVT

Since 2017, an 'early season' wheat NVT series in WA has evaluated the performance of slower maturing varieties when sown at an earlier sowing date.

Between 2017 and 2020 the 'early-season' series was generally sown in late April, a timing favourable to varieties with a mid–long maturity but potentially not early enough for the long spring or winter varieties.

Cutlass and Kinsei have consistently been amongst the highest yielding varieties across all the early-season sites in the past three years. Catapult has been included since 2018, yielding similarly to Kinsei and Cutlass (Table 14), however Catapult tends to yield higher than Cutlass in Agzones 2,3,5 and 6 compared to Agzones 1 and 4 (Tables 15 and 16). RockStar was one of the highest yielding varieties in this trial series in 2019 and competitive with Denison in 2020 (single year of data only available). Denison has a longer maturity than RockStar and more data is required to confirm their comparative performances in this late-April sowing window. Scepter was also included in the early-season NVT in 2018 and 2019 and performed similarly to the mid–long maturing varieties at some sites. However, it is important to note, there is more risk involved with earlier sowing of quicker maturing varieties in areas prone to frost, higher disease burden or low biomass.

The 'early-season' trial series demonstrated that Yitpi, Magenta, LRPB Trojan and DS Pascal yields are inferior to more recent mid–slow maturing varieties such as Catapult, Cutlass, Denison, Kinsei and RockStar (Tables 15 and 16). While Yitpi, Magenta, LRPB Trojan and DS Pascal offer unique agronomic characteristics such as improved pre-harvest sprouting resistance and/or improved powdery mildew resistance, these benefits should be weighed against the greater yield potential of some of the newer mid–slow varieties.

The suitability of winter wheats and slower spring varieties is still being assessed, however, they appear to be more competitive when sown at more southern and/or frost-prone locations (Figure 6).

TABLE 14. Relative performance of slower maturity wheat varieties compared with Scepter in EARLY SEASON NVT

	Scepter	RockStar	Denison	Kinsei	Catapult	Cutlass	LRPB Nighthawk	Illabo
Statewide MET yield (% site mean)[1]	107%	118%	119% ^	113%	112%	110%	96%	94%
Maturity	Quick-mid	Mid–slow	Slow(p)	Mid–slow	Mid–slow	Mid–slow	Very slow	Fast winter
Classification	AH	AH(N)	APW	ANW	AH	APW(N)	APW	AH
Falling no. index	5	3*p*	-	4	6*p*	4	-	6*p*
Stem rust	MRMS	MR	MS	MSS	MR	R	RMR	MRMS
Stripe rust	MR*	RMR	MR	MRMS	RMR	RMR*	RMR	RMR
Leaf rust	MSS	S	S	MSS	S	RMR*	MSS	S
Powdery mildew	S	MSS	S*p*	S	S	S	MSS	R
Yellow spot	MRMS	MRMS	MRMS	MS	MRMS	MSS	MRMS	MS

[1]Regional differences in yield are masked when using a statewide average of the WA wheat EARLY SEASON NVT MET data (2017–2020). Readers are directed to Tables 15 to 16 for a more precise estimate of variety performance in their region.

(N) = Denotes supplementary classification of APWN, (*p*) = provisional

^ = single year of NVT data in 2020.

* = Some races in eastern Australia can attack these varieties. Falling no. index please refer to page 32.

TABLE 15. Relative performance of varieties in the Early season NVT for AGZONES 1 and 4 (2017–2020), expressed as a percentage of site mean yield

Agzone			1				4				
Year			2017	2018	2019	2020	2017	2018	2019	2020	2020
Site			Ogilvie	Ogilvie	Ogilvie	Ogilvie	Bencubbin	Bencubbin	Moorine Rock	Bencubbin	Kalannie
Sowing date			20-Apr	20-Apr	17-Apr	4-May	24-Apr	30-Apr	11-Apr	21-Apr	21-Apr
Site mean yield (t/ha)			3.50	4.00	1.90	4.00	1.20	2.90	2.10	2.20	2.46
Variety (order of maturity)	Classification	Maturity									
Scepter	AH	Quick–mid	-	92	105	-	-	111	95	-	-
RockStar	AH (N)	Mid–slow	-	-	116	117	-	-	118	114	114
LRPB Trojan	APW (N)	Mid–slow	94	101	104	107	103	109	103	104	100
Magenta	APW	Mid–slow	100	99	102	108	106	105	100	104	100
Catapult	AH	Mid–slow	-	104	111	109	-	115	106	109	103
Kinsei	ANW	Mid–slow	111	103	115	114	120	113	105	114	106
DS Pascal	APW	Mid–slow	107	107	100	-	98	100	106	-	-
Yitpi	AH	Mid–slow	94	99	96	105	99	104	100	99	99
Cutlass	APW (N)	Mid–slow	108	110	110	111	111	114	112	110	112
Denison	APW	Slow(*p*)	-	-	-	113	-	-	-	117	117
LRPB Nighthawk	APW	Very slow	-	103	98	90	-	89	100	97	106
Longsword	Feed	Fast winter	115	97	105	85	101	85	92	99	98
Illabo	AH	Fast winter	97	100	95	69	77	81	95	86	96
Forrest	ASW	Very slow	-	103	99	-	-	96	103	-	-
EGA Wedgetail	APW	Mid winter	83	91	79	60	61	68	86	72	84
DS Bennett	Feed	Mid–long winter	-	-	79	-	-	-	82	-	-

(*p*) = provisional

TABLE 16. Relative performance of varieties in the Early season NVT for AGZONES 2, 3, 5 and 6 (2017–2020), expressed as a percentage of site mean yield

Agzone			2			3		5		6	
Year			2017	2019	2020	2017	2019	2019	2020	2018	2020
Site			Eneabba	Wickepin	Eneabba	York	Narrogin	Hyden	Hyden	Gibson	Gibson
Sowing date			20-Apr	18-Apr	22-Apr	24-Apr	18-Apr	16-Apr	30-Apr	2-May	23-Apr
Site mean yield (t/ha)			2.80	3.20	4.30	4.10	3.50	2.40	2.10	3.10	4.00
Variety (order of maturity)	Classification	Maturity									
Scepter	AH	Quick–mid	-	120	-	-	97	127	-	104	-
RockStar	AH (N)	Mid–slow	-	118	115	-	109	134	130	-	134
LRPB Trojan	APW (N)	Mid–slow	105	107	109	111	100	114	115	102	104
Magenta	APW	Mid–slow	104	105	103	106	99	104	109	97	98
Catapult	AH	Mid–slow	-	117	111	-	105	122	122	115	119
Kinsei	ANW	Mid–slow	120	117	114	114	106	112	116	115	119
DS Pascal	APW	Mid–slow	101	94	-	93	103	97	92	103	107
Yitpi	AH	Mid–slow	97	97	98	102	96	103	106	89	90
Cutlass	APW (N)	Mid–slow	115	107	109	107	106	113	111	110	120
Denison	APW	Slow(*p*)	-	-	116	-	-	-	111	-	136
LRPB Nighthawk	APW	Very slow	-	90	96	-	103	81	76	-	104
Longsword	Feed	Fast winter	103	105	101	91	106	85	81	120	113
Illabo	AH	Fast winter	89	95	91	86	105	91	76	120	111
Forrest	ASW	Very slow	-	86	-	-	100	74	-	86	-
EGA Wedgetail	APW	Mid winter	67	79	77	75	94	78	84	95	80
DS Bennett	Feed	Mid–long winter	-	82	-	-	103	76	45	-	102

(*p*) = provisional

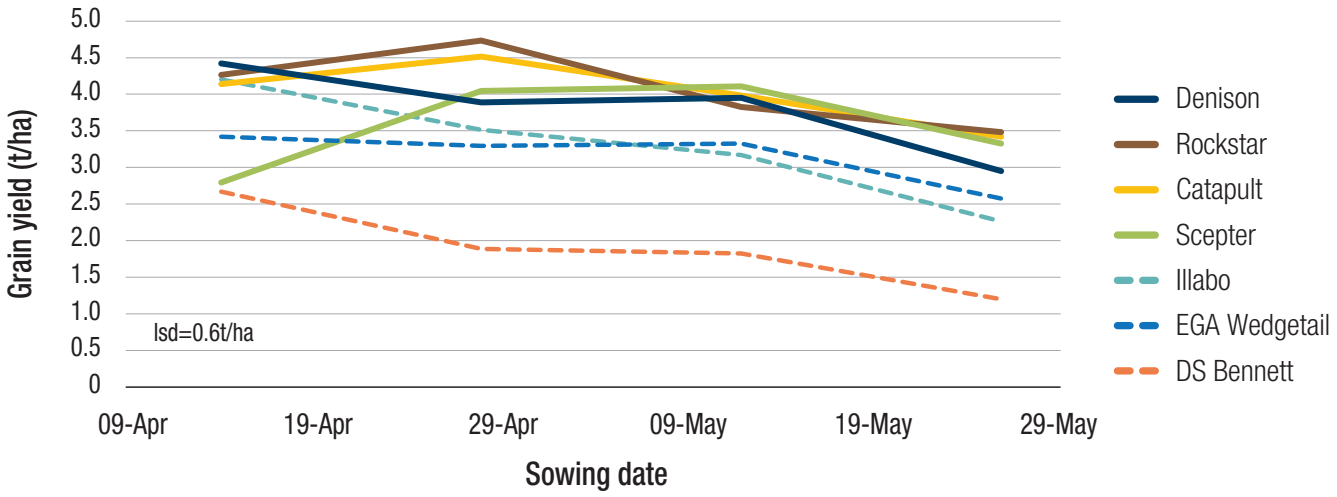

FIGURE 6. Grain yield (t/ha) response of mid–slow spring and winter wheat varieties sown on four sowing dates at Katanning in 2020.

Source: DPIRD Wheat Agronomy research

DISEASE RESISTANCE

Key points:

- It is important to be aware of a variety's disease package so that in-season disease management can be planned.
- Do not plant a susceptible variety into a high disease risk paddock.
- Diversify wheat varieties and crop type.

When selecting a wheat variety, it is important to consider the yield and potential quality grade along with the disease resistance of each variety (Table 19). Higher resistance ratings reduce disease severity and potential yield loss. Avoiding susceptible or very susceptible varieties significantly reduces chances of disease outbreaks and the need for in-season management.

For a disease to become damaging in-season, there needs to be:

- the presence of inoculum, which is usually carried over from last season
- favourable weather conditions for disease proliferation
- a susceptible host crop to become infected.

Depending on the disease in question, inoculum can be carried on infested stubble or trash, a green bridge, in seed or in the soil (Table 17).

TABLE 17. Examples of wheat diseases carried over from different inoculum sources

Inoculum carryover source	Disease
Infested stubble or trash	Yellow spot, Septoria nodorum blotch and crown rot.
Green bridge	Rusts, powdery mildew and viruses.
Seed	Loose smut.
Soil borne	Root lesion nematode, CCN, rhizoctonia root rot, take-all, flag smut and common bunt.

Choose varieties for each paddock based on their varietal disease resistance strengths and weaknesses and the disease risk of that paddock. Disease risk of a paddock is related to the potential presence of disease inoculum and to the favourability of the environment for the disease. For example, it is not advisable to sow Yitpi, which is rated SVS for yellow spot, onto wheat stubble.

Table 18 provides the suggested minimum resistance to five of the common leaf diseases for wheat varieties in different disease risk profiles. This table is a useful guide when selecting a suitable variety in problem paddocks.

Planning for and understanding the disease strengths and weaknesses of a variety enables more effective disease management during the season. For example, Scepter is susceptible to powdery mildew and in a season or environment conducive to powdery mildew it could be prudent to use seed dressing or in-furrow fungicide and proactively monitor for the presence of disease to enable a rapid and appropriate response if disease is detected.

Using a diverse range of varieties with different disease resistance traits reduces the risk that the whole farm will require disease management at the same time. Diversification also reduces the risk associated with the emergence of a new pathotype that could render a significant proportion of a farm or region susceptible, requiring region-wide management responses.

Disease ratings provided in this guide reflect the expected response to the most common or dominant pathotype or strain of a disease in Western Australia. For most diseases, very little variability in response is evident between seasons or regions, but occasionally mutations or incursions of rusts can significantly change variety ratings. For example, leaf rust ratings in Table 19 are for pathotypes that entered WA in 2015 (104-1,3,4,6,7,8,10,12 +Lr37) and 2017 (104-1,3,4,5,7,9,10,12 +Lr37).

Ratings for powdery mildew reflect expected resistance to the general mildew population, however varietal response may differ on rare occasions when a more virulent isolate occurs.

TABLE 18. Suggested minimum resistance of wheat varieties to common leaf diseases in different disease risk areas

Disease risk*	Stem rust	Stripe rust	Leaf rust	Yellow spot	Nodorum blotch
Low risk	MSS	MS	MS	MSS	S
Medium risk	MS	MRMS	MRMS	MS	MS
High risk	MR	MR	MR	MRMS	MRMS

*Determined by considering factors such as disease history in previous years, presence and amount of primary inoculum and prevailing weather conditions (temperature, rainfall and relative humidity).

Nodorum blotch causes characteristic necrotic lesions on leaves and can also cause glume blotch, dark brown to black lesions or staining on the heads associated with infection. Varieties can differ in disease expression on foliage and heads so in this guide variety rankings have been included for both plant parts (Table 19). Susceptible varieties are more likely to suffer glume blotch in seasons where disease is present in the foliage and weather favourable to disease occurs after head emergence.

FUNGICIDES

Application of fungicide can help control disease and limit yield impacts. A rapidly developing issue for the Australian grains industry is development of fungicide resistance in a range of wheat and barley pathogens. Using good Integrated Disease Management (IDM) approaches, including varietal disease resistance, can help reduce reliance on fungicides for disease management. More information on fungicide resistance is available from The Australian Fungicide Resistance Extension Network (https://afren.com.au/)

For more information:

- Crop diseases – forecasts and management at https://agric.wa.gov.au/n/2319
- Wheat disease ratings at https://agric.wa.gov.au/n/3353
- Download the 'Australian Field Crop Disease Guide App' which is available for both Apple and Android.
- Download the 'MyCrop App' which is available for both Apple and Android.

TABLE 19. Disease resistance ratings for wheat varieties grown in Western Australia

Variety	Grade	Yellow spot	Nodorum blotch (leaf)	Nodorum blotch (glume)	Rust			Powdery mildew
					Stem	Stripe	Leaf	
Arrino	ANW	MS	MS	MS	SVS	S	VS	MRMS
Calibre	AH	MS*p*	–	–	RMR*p*	RMR*p*	S*p*	S*p*
Calingiri	ANW	MS	MSS	MS	S	SVS	S	S
Catapult	AH	MRMS	MS	MRMS	MR	RMR	S	S
Chief CL Plus	APW (N)	MRMS	MS	MR	MR	S	MR*	S
Corack	APW	MRMS	MSS	MRMS	MR	MS	SVS	SVS
Cutlass	APW (N)	MSS	MRMS	MRMS	R	RMR*	RMR*	S
Devil	AH (N)	MRMS	MRMS	MRMS	MS	MR	SVS	SVS
Denison	APW	MRMS	MRMS*p*	MRMS*p*	MS	MR	S	S*p*
DS Bennett	Feed	MRMS	MRMS	MR*p*	MRMS	R	SVS	R
DS Pascal	APW	MS	MRMS	MRMS	MSS	RMR	MS	RMR
EGA Bonnie Rock	AH (N)	MRMS	MS	MS	MSS	VS	SVS	S
EGA Wedgetail	APW	MSS	MRMS	MRMS*p*	MRMS	MS	MSS	MS*p*
Emu Rock	AH	MRMS	SVS	MR	MS	MRMS	SVS	S
Hammer CL Plus	AH	MRMS	MS*p*	MR*p*	MR	RMR	S	SVS*p*
Illabo	AH	MS	MRMS	MR	MRMS	RMR	S	R
Kinsei	ANW	MS	MRMS	MR	MSS	MRMS	MSS	S
Longsword	Feed	MRMS	MRMS	MRMS	MR	RMR	MS*	MS
LRPB Avenger	APW (N)	MS	MSS*p*	MRMS*p*	MS	MRMS	S	S*p*
LRPB Cobra	AH	MRMS	MRMS	MS	MR	MSS	MRMS*	MSS
LRPB Havoc	AH (N)	MRMS	MS	MRMS	S	MR	S	MS
LRPB Nighthawk	APW	MRMS	MRMS	MRMS	RMR	RMR	MSS	MSS
LRPB Trojan	APW (N)	MSS	MS	MS	MRMS	MR	MRMS*	S
Mace	AH (N)	MRMS	MS	MRMS	MRMS	RMR*	MSS	MSS
Magenta	APW	MR	MRMS	MRMS	RMR	MSS	RMR*	MRMS
Ninja	ANW	MRMS	MS	MRMS	S	MS	S	S
Razor CL Plus	ASW	MSS	MS	MRMS	MR	RMR	S	MSS
RockStar	AH (N)	MRMS	MRMS	MR	MR	RMR	S	MSS
Scepter	AH	MRMS	MS	MS	MRMS	MR*	MSS	S
Sheriff CL Plus	APW (N)	MRMS	MS	MRMS	MS	MS	SVS	SVS
Sting	AH	MRMS	MSS*p*	MRMS*p*	MRMS	MR	SVS	S*p*
Valiant CL Plus	AH	MRMS*p*	–	–	MR*p*	RMR*p*	MSS*p*	–
Vixen	AH (N)	MRMS	MSS	MS	MRMS	MRMS	SVS	S
Westonia	APW (N)	MSS	MS	MS	SVS	VS	S	S
Wyalkatchem	APW (N)	MR	MSS	MRMS	MSS	S	S	SVS
Yitpi	AH	SVS	MS	MRMS	S	MRMS	S	MS
Zen	ANW	MRMS	MRMS	MR	S	MRMS	S	S

[Table 19. continued following page...]

TABLE 19. Disease resistance ratings for wheat varieties grown in Western Australia (cont'd)

Variety	Grade	Septoria tritici blotch	Flag smut	Common bunt	Root lesion nematode#		Cereal cyst nematode	Crown rot
					P. neglectus	*P. quasitereoides*		
Arrino	ANW	MSS	MSS	MS	S	S	–	–
Calibre	AH	–	–	–	–	–	–	–
Calingiri	ANW	MSS	RMR	MRMS	SVS	S	–	S
Catapult	AH	MSS	RMR	MRMS	S	MS*p*	R	MS*p*
Chief CL Plus	APW (N)	S	SVS	MR	MRMS	MS	MS	MSS
Corack	APW	S	S	MSS	MSS	MSS	RMR	S
Cutlass	APW (N)	MSS	MSS	S	MSS	MS*p*	MR	S
Devil	AH (N)	S	SVS	MR	S	MS*p*	MSS	MSS
Denison	APW	MS*p*	R*p*	MR*p*	S	–	MSS	MSS
DS Bennett	Feed	MR	SVS	RMR	S	–	S	VS
DS Pascal	APW	MS	S	SVS	S	–	S	S
EGA Bonnie Rock	AH (N)	SVS	S	MS	VS	S	S	–
EGA Wedgetail	APW	MSS	–	–	S	–	S	S
Emu Rock	AH	S	MR	SVS	MSS	MS	S	MSS
Hammer CL Plus	AH	MS	RMR	RMR	MS	–	MRMS	MS*p*
Illabo	AH	MR	R	MS	S	MS	MRMS	S
Kinsei	ANW	MSS	RMR	MR	S	S	MSS	MSS
Longsword	Feed	MRMS	MRMS	RMR	MRMS	–	MRMS	MSS
LRPB Avenger	APW (N)	S*p*	S	S	MSS	–	MSS	S*p*
LRPB Cobra	AH	MSS	MS	VS	MSS	MSS	MS	S
LRPB Havoc	AH (N)	MRMS	MS	R	S	MRMS*p*	S	MSS
LRPB Nighthawk	APW	MRMS	MSS	RMR	MSS	MS*p*	MS	MSS
LRPB Trojan	APW (N)	S	SVS	SVS	MSS	MS*p*	MS	MS
Mace	AH (N)	S	S	MRMS	MS	MRMS	MRMS	S
Magenta	APW	MS	MSS	SVS	MSS	MSS	S	MSS
Ninja	ANW	MS	MR	RMR	S	S*p*	MS	S
Razor CL Plus	ASW	SVS	RMR	RMR	S	–	MR	S
RockStar	AH (N)	S	VS	MR	MRMS	MS*p*	MSS	S
Scepter	AH	S	MSS	MSS	S	MS	MRMS	MSS
Sheriff CL Plus	APW (N)	S	S	RMR	MRMS	MS	MS	S
Sting	AH	S	SVS	S	MRMS*p*	–	MS	S*p*
Valiant CL Plus	AH	–	–	–	–	–	–	–
Vixen	AH (N)	MSS	SVS	RMR	MRMS	MSS*p*	MSS	S
Westonia	APW (N)	SVS	SVS	S	SVS	S	S	S
Wyalkatchem	APW (N)	S	S	MR	MRMS	MSS	S	S
Yitpi	AH	MRMS	MR	S	MSS	MS	MR	S
Zen	ANW	S	MS	MR	MRMS	MS	S	S

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.

No score '-' = no rating is currently available. *p* = Provisional assessment.

* Some races in eastern Australia can attack these varieties, including races with Yr17 virulence for stripe rust and races with Lr24 virulence for leaf rust.

Use *P. neglectus* ratings as a guide only as not all varieties have been tested in WA. *P. quasitereoides* ratings are from DPIRD WA glasshouse and field trials.

Cereal Cyst Nematode data from **nvtonline.com.au**

Crown rot ratings from SARDI, USQ and DPI NSW data.

VARIETY TRAITS

Coleoptile length and seeding depth

Seeding into moisture at a seeding depth of 2–4cm is the preferred option in WA to ensure quick establishment and maintain yield potential. However, with expanding seeding programs and increased variability in the timing and amount of autumn rainfall, dry seeding has dramatically increased in WA.

- Avoid sowing deeper than 5cm as this has the potential to delay and reduce emergence, causing weaker seedlings and an overall reduction in yield.

Longer coleoptiles can increase establishment rate if seeding depth increases. The ability to establish wheat crops from seed placed deeper in the soil can be useful in situations where the soil surface is dry, but the subsoil is moist. Varieties have inherently different coleoptile lengths. Table 21 provides a guide to the coleoptile group and replaces previous reporting of coleoptile index. Coleoptile length is known to be influenced by several factors other than variety, including seed size, seed source, temperature, soil water, soil strength, certain seed dressings and the type of coleoptile length assessment (Table 20). Coleoptile groups are collectively identified as short (S), medium (M), long (L) or very long (VL).

- Halberd is currently the only variety in the very long coleoptile group, with potential replacements in the breeding pipeline.
- Varieties with long coleoptile lengths include Cutlass, Magenta and Yitpi. Calibre, LRPB Avenger and Valiant CL Plus are provisional 'Longs' with limited testing.
- The impact of deep sowing on grain yield depends on growing season conditions and whether lower plant density and vigour can be compensated through increases in other yield components such as tiller number, grains per ear and grain weight.
- Increasing seeding rates may help to reduce the yield penalty caused by reduced establishment with deeper sowing.
- Not all seeding systems are equal for deep sowing, so ensure depth is monitored as conditions change.

TABLE 20. Coleoptile length (cm) and plant establishment of a range of varieties germinated on filter paper 'cigars' or sown at 10cm at Katanning in 2021

Variety (Coleoptile group)	Coleoptile length (cm)		Establishment % at 10cm deep
	Filter paper	Sown at ~10cm	
DS Pascal (S)	6.3	4.9	27
Scepter (S)	7.5	5.5	31
Calibre (Lp)	8.5	6.7	48
Yitpi (L)	9.4	6.8	58
Halberd (VL)	12.3	7.8	100
lsd			30

Germination cabinet set at 15°C and average soil temp = 14.7°C for the 15 days from 'seeding' to measurement. Plant establishment determined at 21 days after sowing, sown 5th May. Variable seed sources and grain weights.

Grain quality

Hectolitre weights and small grain screenings for individual varieties can vary from site to site and year to year. As the measurements are environmentally driven, there is a limited ability to conclude the risks of new varieties and are therefore not presented in this guide.

Details can be found at nvt.online.com.au.

Falling Number Index

The falling number index (FNI) is a rating system that reflects the risk of a wheat variety exhibiting a low falling number at harvest (Table 21). There are several causes of low falling number in wheat, and these are controlled by complex interactions between genotype and the environment. An example is pre-harvest sprouting, a common cause of low falling number where mature grain begins to germinate in the paddock in response to rainfall. The wheat variety grown, stage of maturity, and the timing and intensity of seasonal rainfall and growing conditions (temperature/humidity) will all influence the falling number of a variety upon receival.

DPIRD has carried out research since 2013 to better understand the susceptibility of wheat varieties to low falling number, both in response to growing conditions and rainfall in the pre- and post-grain maturation period.

The FNI determines the risk of a variety exhibiting low falling number. On a 1–9 scale, the higher the rating the more likely a variety is to maintain falling number and the lower the risk of downgrade at grain delivery.

The pre-harvest sprouting (PHS) tolerance of Mace and now Scepter has enabled their widespread adoption across WA, even into areas of high PHS risk; this is reflected in their FNI of 5. DS Pascal is considered the variety of lowest risk, reflected in its FNI of 7. New varieties that have received a provisional rating include Catapult (rated 6p), Illabo (6p), Razor CL Plus (4p), RockStar (3p) and Sheriff CL Plus (4p).

Research carried out by DPIRD has found crops that mature earlier in the harvest period (such as spring wheats sown in April) have a higher risk of low falling number and incidence of black point.

Further research is being carried out to understand the drivers of this risk and how it varies across WA's wheat growing regions.

TABLE 21. Black point ratings, falling number index and coleoptile group of wheat varieties in 2021

Variety	Black point	Falling number index	Coleoptile index (cm)
Arrino	MS	2	M
Calibre	-	-	L*p*
Calingiri	MS	4	S
Catapult	MSS	6*p*	M*p*
Chief CL Plus	MS	4	M*p*
Corack	S	4	M
Cutlass	MS	4	L
Denison	MS*p*	-	M*p*
Devil	MSS	3	M*p*
DS Bennett	MSS		S*p*
DS Pascal	MS	7	S
EGA Bonnie Rock	MR	4	S
EGA Wedgetail	MS	-	-
Emu Rock	MSS	2	S
Hammer CL Plus	MRMS*p*		M*p*
Illabo	MRMS	6*p*	M*p*
Kinsei	S	4	M*p*
LRPB Avenger	MS*p*	-	L*p*
LRPB Cobra	MSS	2	S
LRPB Havoc	MS	3	-
LRBP Nighthawk	MS	-	-
LRPB Trojan	MS	5	-
Mace	MRMS	5	M
Magenta	MSS	3	L
Ninja	MRMS	4	M*p*
Razor CL Plus	MS	4*p*	-
Rockstar	MSS	3*p*	M*p*
Scepter	MS	5	S
Sheriff CL Plus	MS	4*p*	-
Sting	S*p*		M*p*
Valiant CL Plus	-	-	L*p*
Vixen	MSS	3	M*p*
Westonia	MS	2	M
Wyalkatchem	MS	3	S
Yitpi	MS	5	L
Zen	MRMS	3	S

Black point ratings are provided through the NVT project and based on the research of Dr Tara Garrard at the Field Crop Pathology Unit (SARDI).

Coleoptile groups are collectively identified as short (S), medium (M), long (L) or very long (VL). Coleoptile groups are based filter paper 'cigars' germinated at 15°C for 15 days. Groups combine information previously supplied as part of an NVT project and DPIRD research in 2021.

p = provisional rating based upon a single year of data and limited data hence results to be treated with caution.

Variety snapshots

Variety snapshots are presented for 20 varieties in order of quality classification.

Each snapshot includes a general description of the variety's essential characteristics and highlights key strengths and weaknesses. Grain yields relative to Scepter for each year between 2016 and 2020 for each agzone are presented as extracted from **nvtonline.com.au**. Disease ratings are as per Table 19.

Flowering information is sourced from DPIRD experiments in 2018, 2019 and 2020 and NVT sites when other data is not available. All information is presented relative to Scepter.

Variety information including pedigree, seed licensee, seed trading restrictions and end point royalty (EPR) payable is sourced from breeding companies and Variety Central (**varietycentral.com.au**).

If seeking information for any varieties not included in the snapshots, please consult **varietycentral.com.au**, **nvtonline.com.au** or the respective breeding company.

ACKNOWLEDGEMENTS

The information contained in this guide is based on the work carried out by many research scientists, technical officers, plant breeders and service providers. The authors would like to thank the following groups and staff:

- **DPIRD wheat agronomy:** Rod Bowey, Helen Cooper and Melanie Kupsch.
- **DPIRD biometrics:** Andrew van Burgel.
- **DPIRD plant pathology:** Donna Foster, Ryan Varischetti, Hossein Golzar, Dorthe Jorgensen, Jason Bradley.
- **DPIRD fungal soilborne diseases and nematology:** Sarah Collins, Carla Wilkinson and Daniel Huberli.
- **DPIRD research support:** Carnarvon, Manjimup, Shenton Park (UWA), Geraldton, Merredin, Katanning and Esperance.
- **Breeding companies:** Australian Grain Technologies, InterGrain and LongReach Plant Breeders
- **GRDC:** NVT trials (grain yield data) and their service providers.
- Dr Tara Garrard at the Field Crop Pathology Unit (SARDI) for the black point data as part of a NVT project.

CALIBRE(Þ)

AH

Comments

Calibre is the first Scepter cross to be released by AGT in 2021. It is a quick–mid maturing AH variety with a longer coleoptile than its parent Scepter (similar to Magenta). Calibre was included in the NVT for the first time in 2020, yielding similar to or slightly higher than Scepter, and was competitive with Vixen, Rockstar and Devil across the various agzones.

Yield (% of Scepter)	2016	2017	2018	2019	2020
Agzone 1	-	-	-	-	100
Agzone 2	-	-	-	-	103
Agzone 3	-	-	-	-	102
Agzone 4	-	-	-	-	102
Agzone 5	-	-	-	-	105
Agzone 6	-	-	-	-	101
Disease resistance	**Adult rating**				
Yellow spot	MS*p*				
Nodorum blotch (leaf)	–				
Nodorum blotch (glume)	–				
Stem rust	RMR*p*				
Stripe rust	RMR*p*				
Leaf rust	S*p*				
Powdery mildew	S*p*				
Septoria tritici blotch	–				
Flag smut	–				
Common bunt	–				
RLN (*P. quasitereoides*)	–				
RLN (*P. neglectus*)	–				
CCN	–				
Crown rot	–				
Flowering	**Days after/before Scepter**				
2019 & 2020 DPIRD trials	**11-Apr**	**26-Apr**	**10-May**	**24-May**	**17-Jun**
Agronomic traits					
Coleoptile group	Long(*p*)				
Black point	–				
Falling number index	–				
Maturity	Quick-mid				
Variety information					
Pedigree	Derived from a Scepter cross				
Breeder/Seed licensee	AGT				
Access to seed	AGT Affiliates, retailers, or Seed Sharing				
EPR ($/t, excl GST)	$3.50				

p = provisional assessment

CATAPULT(Þ)

AH

Comments

Catapult is a mid–slow maturity AH variety released by AGT in 2019. Catapult was included in the NVT for the first time in 2018, yielding higher than alternatives such as Denison, Cutlass, LRPB Trojan and Magenta, but lower than Scepter in the main season trials. In the early season NVT trials, Catapult has yielded similiar to Kinsei with a more robust performance in agzones 2, 3, 5 and 6 compared to agzones 1 and 4. Catapult is S to leaf rust and powdery mildew. With a provisional falling number rating of 6, Catapult appears to be a lower risk of pre-harvest sprouting. In good growing conditions, Catapult can exhibit a speckling on the leaves or what has previously been known as 'Mace yellows'. This is not a disease but a physiological response which typically has no effect on yield.

Yield (% of Scepter)	2016	2017	2018	2019	2020
Agzone 1	-	-	92	93	96
Agzone 2	-	-	95	93	93
Agzone 3	-	-	94	94	96
Agzone 4	-	-	94	92	91
Agzone 5	-	-	95	94	90
Agzone 6	-	-	97	95	95
Disease resistance	**Adult rating**				
Yellow spot	MRMS				
Nodorum blotch (leaf)	MS				
Nodorum blotch (glume)	MRMS				
Stem rust	MR				
Stripe rust	RMR				
Leaf rust	S				
Powdery mildew	S				
Septoria tritici blotch	MSS				
Flag smut	RMR				
Common bunt	MRMS				
RLN (*P. quasitereoides*)	MS*p*				
RLN (*P. neglectus*)	S				
CCN	R				
Crown rot	MSS*p*				
Flowering	**Days after/before Scepter**				
2019 & 2020 DPIRD trials	**11-Apr**	**26-Apr**	**10-May**	**24-May**	**17-Jun**
Northern	+11	+9	+9	+10	+4
Eastern	+14	+13	+10	+3	+4
Katanning	+13	+8	+5	+4	-
Gibson	+15	+12	+6	+7	+4
Agronomic traits					
Coleoptile group	Medium(*p*)				
Black point	MSS				
Falling number index	6*p*				
Maturity	Mid–slow				
Variety information					
Pedigree	Mace/Corack				
Breeder/Seed licensee	AGT				
Access to seed	AGT Affiliates, retailers, or Seed Sharing				
EPR ($/t, excl GST)	$3.25				

p = provisional assessment

DEVIL(b)

AH (N)

Comments

Devil is a quick–mid maturity AH (N) which was released in 2018. Devil has been in the NVT since 2017 and has yielded similarly to Scepter in all years and agzones. Devil is SVS to the latest leaf rust pathotype and powdery mildew. DPIRD trials suggest that Devil has different maturity triggers to Scepter resulting in earlier flowering when sown in April or in the northern regions. A falling number rating of 3 so not recommended for areas prone to pre-harvest sprouting.

Yield (% of Scepter)	2016	2017	2018	2019	2020
Agzone 1	-	101	100	100	99
Agzone 2	-	100	100	100	100
Agzone 3	-	100	101	101	101
Agzone 4	-	101	101	99	100
Agzone 5	-	100	100	100	100
Agzone 6	-	100	101	101	101
Disease resistance	**Adult rating**				
Yellow spot	MRMS				
Nodorum blotch (leaf)	MRMS				
Nodorum blotch (glume)	MRMS				
Stem rust	MS				
Stripe rust	MR				
Leaf rust	SVS				
Powdery mildew	SVS				
Septoria tritici blotch	S				
Flag smut	SVS				
Common bunt	MR				
RLN (*P. quasitereoides*)	MS*p*				
RLN (*P. neglectus*)	S				
CCN	MSS				
Crown rot	MSS				
Flowering	**Days after/before Scepter**				
2019 & 2020 DPIRD trials	**11-Apr**	**26-Apr**	**10-May**	**24-May**	**17-Jun**
Northern	-6	-4	-4	-3	-4
Eastern	+1	+0	+1	-1	-3
Katanning	-4	-1	-2	-2	–
Gibson	-6	-6	-2	-1	-2
Agronomic traits					
Coleoptile group	Medium(*p*)				
Black point	MSS				
Falling number index	3				
Maturity	Quick–mid				
Variety information					
Pedigree	IGW3110/Mace				
Breeder/Seed licensee	InterGrain				
Access to seed	Free to trade				
EPR ($/t, excl GST)	$3.50				

EMU ROCK(b)

AH

Comments

Quick maturity AH wheat best suited mid to late sowings in low rainfall environments. Useful tolerance to crown rot. Large grain size. Amongst most susceptible varieties to nodorum blotch. Susceptible to low falling numbers after pre-harvest rain, hence not suited to areas that experience pre-harvest rainfall. Consistently lower yielding than Mace and many other varieties with similar characteristics. Now superceded by the recently released quick maturing varieties such as Vixen, Sting and LRPB Avenger.

Yield (% of Scepter)	2016	2017	2018	2019	2020
Agzone 1	91	84	92	85	88
Agzone 2	88	89	85	91	90
Agzone 3	86	82	87	88	84
Agzone 4	92	87	89	90	94
Agzone 5	88	86	84	88	90
Agzone 6	88	85	85	80	81
Disease resistance	**Adult rating**				
Yellow spot	MRMS				
Nodorum blotch (leaf)	SVS				
Nodorum blotch (glume)	MR				
Stem rust	MS				
Stripe rust	MRMS				
Leaf rust	SVS				
Powdery mildew	S				
Septoria tritici blotch	S				
Flag smut	MR				
Common bunt	SVS				
RLN (*P. quasitereoides*)	MS				
RLN (*P. neglectus*)	MSS				
CCN	S				
Crown rot	MSS				
Flowering	**Days after/before Scepter**				
2019 & 2020 DPIRD trials	**11-Apr**	**26-Apr**	**10-May**	**24-May**	**17-Jun**
Northern	-19	-15	-17	-12	-12
Eastern	-17	-13	-7	-9	-4
Katanning	-	-10	-7	-8	-
Gibson	-	-	-	-	-
Agronomic traits					
Coleoptile group	Short				
Black point	MSS				
Falling number index	2				
Maturity	Quick				
Variety information					
Pedigree	96W657-37/Kukri				
Breeder/Seed licensee	InterGrain				
Access to seed	Free to trade				
EPR ($/t, excl GST)	$3.50				

p = provisional assessment

(N) denotes the supplementary classification of APWN

HAMMER CL PLUS®

AH

Comments

Hammer CL Plus is an AH imidazolinone tolerant variety recently released in 2020 by AGT. Hammer CL Plus has been included in the WA NVT for the first time in 2020 where it yielded 4 to 9% lower than Scepter depending on the agzone. Overall, it is slightly higher yielding than Chief CL Plus and Sheriff CL Plus and slightly lower yielding than Razor CL Plus. Hammer CL Plus is closely related to Mace with a similar maturity. Hammer CL Plus is RMR for stripe rust, MR for stem rust, S for leaf rust and SVS for powdery mildew. Registered for label rate applications of Intervix® herbicide. Note: There are no grower to grower sales permitted for any CL Plus varieties.

Yield (% of Scepter)	2016	2017	2018	2019	2020
Agzone 1	-	-	-	-	95
Agzone 2	-	-	-	-	95
Agzone 3	-	-	-	-	93
Agzone 4	-	-	-	-	96
Agzone 5	-	-	-	-	94
Agzone 6	-	-	-	-	91
Disease resistance	**Adult rating**				
Yellow spot	MRMS				
Nodorum blotch (leaf)	MS*p*				
Nodorum blotch (glume)	MR*p*				
Stem rust	MR				
Stripe rust	RMR				
Leaf rust	S				
Powdery mildew	SVS*p*				
Septoria tritici blotch	MS				
Flag smut	RMR				
Common bunt	RMR				
RLN (*P. quasitereoides*)	-				
RLN (*P. neglectus*)	MS				
CCN	MRMS				
Crown rot	MSS*p*				
Flowering	**Days after/before Scepter**				
2019 & 2020 DPIRD trials	**14-Apr**	**27-Apr**	**12-May**	**27-May**	**11-Jun**
Northern	-	-	-	+0	-1
Eastern	-	-2	-1	-3	-1
Katanning	-	-2	-2	+1	-
Gibson	-	+2	+0	+0	+1
Agronomic traits					
Coleoptile group	Medium(*p*)				
Black point	MRMS*p*				
Falling number index	-				
Maturity	Quick–mid				
Variety information					
Pedigree	Clearfield donor backcrossed to Mace derivative				
Breeder/Seed licensee	AGT				
Access to seed	AGT Affiliates or retailers				
EPR ($/t, excl GST)	$4.25				

p = provisional assessment

LRPB HAVOC®

AH (N)

Comments

LPRB Havoc was released by Long Reach in 2017, as an AH and now an APWN. Over the last five years the variety has yielded well in comparison to Mace and slightly below Scepter in agzones 1-4. Havoc is slightly quicker in maturity than Mace. Havoc has a low falling number index rating. It's important for growers of Havoc to take note of this variety's stem and leaf rust ratings, it is S to both rust types but MR to stripe rust. Havoc is now MS to powdery mildew, the highest rating amongst the quick–mid maturity group.

Yield (% of Scepter)	2016	2017	2018	2019	2020
Agzone 1	98	93	102	96	93
Agzone 2	90	98	95	99	97
Agzone 3	89	92	101	100	94
Agzone 4	97	94	98	95	104
Agzone 5	88	91	92	96	101
Agzone 6	88	89	94	96	95
Disease resistance	**Adult rating**				
Yellow spot	MRMS				
Nodorum blotch (leaf)	MS				
Nodorum blotch (glume)	MRMS				
Stem rust	S				
Stripe rust	MR				
Leaf rust	S				
Powdery mildew	MS				
Septoria tritici blotch	MRMS				
Flag smut	MS				
Common bunt	R				
RLN (*P. quasitereoides*)	MRMS*p*				
RLN (*P. neglectus*)	S				
CCN	S				
Crown rot	MSS				
Flowering	**Days after/before Scepter**				
2019 & 2020 DPIRD trials	**10-Apr**	**24-Apr**	**08-May**	**22-May**	**20-Jun**
Northern	-9	-7	-9	-4	-5
Eastern	-5	-6	-3	-4	-4
Katanning	-	-4	-3	-4	-3
Gibson	-	-12	-6	-6	-6
Agronomic traits					
Coleoptile group	-				
Black point	MS				
Falling number index	3				
Maturity	Quick–mid				
Variety information					
Pedigree	Mace/LPB07-0980				
Breeder/Seed licensee	LongReach Plant Breeders				
Access to seed	Seed associate and farmer to farmer (WA)				
EPR ($/t, excl GST)	$4.00				

(N) denotes the supplementary classification of APWN

MACE

AH (N)

Comments

Mace is a quick–mid maturity AH (N) variety with a Wyalkatchem background. Previously the benchmark variety for yield in WA, it has been very popular and was widely planted. Scepter has now superceded Mace as the dominant variety sown in WA with Mace yielding on average 95% of Scepter in agzones 1-5 or 91% in agzone 6. Mace is a relatively low risk for pre-harvest sprouting, as indicated by it's Falling Number Index of 5.

Yield (% of Scepter)	2016	2017	2018	2019	2020
Agzone 1	94	95	96	94	93
Agzone 2	92	95	94	96	95
Agzone 3	91	90	95	96	93
Agzone 4	94	95	95	95	97
Agzone 5	93	93	93	95	96
Agzone 6	93	93	94	92	93
Disease resistance	**Adult rating**				
Yellow spot	MRMS				
Nodorum blotch (leaf)	MS				
Nodorum blotch (glume)	MRMS				
Stem rust	MRMS				
Stripe rust	RMR*				
Leaf rust	MSS				
Powdery mildew	MSS				
Septoria tritici blotch	S				
Flag smut	S				
Common bunt	MRMS				
RLN (*P. quasitereoides*)	MRMS				
RLN (*P. neglectus*)	MS				
CCN	MRMS				
Crown rot	S				
Flowering	**Days after/before Scepter**				
2019 & 2020 DPIRD trials	**11-Apr**	**26-Apr**	**10-May**	**24-May**	**17-Jun**
Northern	-3	-1	-4	-1	-6
Eastern	-2	-2	-2	-4	-3
Katanning	-3	-2	-2	-3	-
Gibson	-4	-2	-3	-3	-3
Agronomic traits					
Coleoptile group	Medium				
Black point	MRMS				
Falling number index	5				
Maturity	Quick–mid				
Variety information					
Pedigree	Wyalkatchem/Stylet//Wyalkatchem				
Breeder/Seed licensee	AGT				
Access to seed	AGT Affiliates, retailers, or Seed Sharing				
EPR ($/t, excl GST)	$3.00				

* = Some races in estern Australia can attack these varieties
(N) denotes the supplementary classification of APWN

ROCKSTAR

AH (N)

Comments

RockStar is a mid–slow AH (N) released in 2019 by InterGrain. It was included in the NVT for the first time in 2018, yielding similar to Scepter and higher than other mid–slow alternatives such as Catapult, Cutlass, Denison, LRPB Trojan and Magenta. RockStar is MRMS to yellow spot and S to leaf rust. RockStar was amongst the highest yielding varieties in the early season NVTs. RockStar has different maturity triggers than other mid–slow varieties such as Cutlass, hence, caution is recommended if sown in April. A provisional falling number rating of 3 so appears to be a higher risk to pre-harvest sprouting.

Yield (% of Scepter)	2016	2017	2018	2019	2020
Agzone 1	-	-	98	97	100
Agzone 2	-	-	100	96	97
Agzone 3	-	-	100	98	102
Agzone 4	-	-	99	93	96
Agzone 5	-	-	97	96	96
Agzone 6	-	-	102	103	103
Disease resistance	**Adult rating**				
Yellow spot	MRMS				
Nodorum blotch (leaf)	MRMS				
Nodorum blotch (glume)	MR				
Stem rust	MR				
Stripe rust	RMR				
Leaf rust	S				
Powdery mildew	MSS				
Septoria tritici blotch	S				
Flag smut	VS				
Common bunt	MR				
RLN (*P. quasitereoides*)	MS*p*				
RLN (*P. neglectus*)	MRMS				
CCN	MSS				
Crown rot	S				
Flowering	**Days after/before Scepter**				
2019 & 2020 DPIRD trials	**11-Apr**	**26-Apr**	**10-May**	**24-May**	**17-Jun**
Northern	+4	+4	+4	+7	+1
Eastern	+9	+6	+6	+3	+1
Katanning	+6	+5	+2	+2	-
Gibson	+9	+7	+1	+2	+2
Agronomic traits					
Coleoptile group	Medium(*p*)				
Black point	MSS				
Falling number index	3p				
Maturity	Mid–slow				
Variety information					
Pedigree	IGW3119/Mace/IGW3176				
Breeder/Seed licensee	InterGrain				
Access to seed	Intergrain Seed Club Members or Seed Retailers				
EPR ($/t, excl GST)	$3.50				

p = provisional assessment
(N) denotes the supplementary classification of APWN

SCEPTER(b)

AH

Comments

Scepter, released in 2015, remains the yield benchmark in WA NVT, although it is similiar in yield to Devil or slightly lower than Vixen in agzones 4 and 5. This variety is MSS to the latest strain of leaf rust, which is an advantage over Calibre, Devil, Vixen, LRPB Havoc, and Corack which are more susceptible. Scepter appears to have a similar pre-harvest sprouting resistance to Mace, but its powdery mildew and black point ratings are poorer than Mace (which is one of its parents). Due to a consistent increase in yield, grain protein is on average lower for this variety, and additional nitrogen may benefit the yield and protein performance of this variety.

Yield (% of Mace)	2016	2017	2018	2019	2020
Agzone 1	106	105	104	107	108
Agzone 2	109	105	107	104	106
Agzone 3	110	111	105	104	108
Agzone 4	107	105	105	106	103
Agzone 5	108	108	107	106	105
Agzone 6	108	107	107	109	108
Disease resistance	**Adult rating**				
Yellow spot	MRMS				
Nodorum blotch (leaf)	MS				
Nodorum blotch (glume)	MS				
Stem rust	MRMS				
Stripe rust	MR*				
Leaf rust	MSS				
Powdery mildew	S				
Septoria tritici blotch	S				
Flag smut	MSS				
Common bunt	MSS				
RLN (*P. quasitereoides*)	MS				
RLN (*P. neglectus*)	S				
CCN	MRMS				
Crown rot	MSS				
Flowering	**Days after/before Mace**				
2019 & 2020 DPIRD trials	**11-Apr**	**26-Apr**	**10-May**	**24-May**	**17-Jun**
Northern	+3	+1	+4	+1	+6
Eastern	+2	+2	+2	+4	+3
Katanning	+3	+2	+2	+3	-
Gibson	+1	+2	+2	+4	+2
Agronomic traits					
Coleoptile group	Short				
Black point	MS				
Falling number index	5				
Maturity	Quick–mid				
Variety information					
Pedigree	RAC1480//Mace				
Breeder/Seed licensee	AGT				
Access to seed	AGT Affiliates, retailers, or Seed Sharing				
EPR ($/t, excl GST)	$3.25				

* = Some races in estern Australia can attack these varieties

STING(b)

AH

Comments

Sting is a quick maturity, AH released in 2020 by AGT. It was present in the NVT for the first time in 2019, and although its average yield is similiar to Scepter, its performance is variable depending on the site. Generally, its performance is superior to Scepter in scenarios with late sowing or earlier onset of terminal drought. Sting's maturity is similar to Corack and not as quick as Vixen. Sting is SVS to leaf rust.

Yield (% of Scepter)	2016	2017	2018	2019	2020
Agzone 1	-	-	-	101	98
Agzone 2	-	-	-	104	102
Agzone 3	-	-	-	101	97
Agzone 4	-	-	-	105	106
Agzone 5	-	-	-	104	104
Agzone 6	-	-	-	95	96
Disease resistance	**Adult rating**				
Yellow spot	MRMS				
Nodorum blotch (leaf)	MS*p*				
Nodorum blotch (glume)	MRMS*p*				
Stem rust	MRMS				
Stripe rust	MR				
Leaf rust	SVS				
Powdery mildew	S*p*				
Septoria tritici blotch	S				
Flag smut	SVS				
Common bunt	S				
RLN (*P. quasitereoides*)	-				
RLN (*P. neglectus*)	MRMS*p*				
CCN	MS				
Crown rot	S*p*				
Flowering	**Days after/before Scepter**				
2019 & 2020 DPIRD trials	**14-Apr**	**27-Apr**	**12-May**	**27-May**	**11-Jun**
Northern	-	-	-10	-9	-6
Eastern	-	-8	-6	-7	-5
Katanning	-	-9	-7	-6	-
Gibson	-	-10	-6	-5	-7
Agronomic traits					
Coleoptile group	Medium(*p*)				
Black point	S*p*				
Falling number index	-				
Maturity	Quick				
Variety information					
Pedigree	Mace backcross				
Breeder/Seed licensee	AGT				
Access to seed	AGT Affiliates, retailers, or Seed Sharing				
EPR ($/t, excl GST)	$3.50				

p = provisional assessment

VALIANT CL PLUS(b)

AH

Comments

Valiant CL Plus is an AH imidazolinone tolerant variety released in 2021 by InterGrain. Valiant CL Plus was included in limited WA NVT for the first time in 2020 where it yielded 5 to 19% lower than Scepter depending on the agzone. InterGrain suggest Valiant CL Plus to be a slow maturity, offering unique traits of IMI tolerance and a long coleoptile (similiar to Magenta) for an April sowing. Valiant CL Plus is MRMSp for yellow spot, RMRp for stripe rust, MRp for stem rust and MSSp for leaf rust. Registered for label rate applications of Intervix® herbicide.

Note: There are no grower to grower sales permitted for any CL Plus varieties.

Yield (% of Scepter)	2016	2017	2018	2019	2020
Agzone 1	-	-	-	-	-
Agzone 2	-	-	-	-	86
Agzone 3	-	-	-	-	94
Agzone 4	-	-	-	-	-
Agzone 5	-	-	-	-	81
Agzone 6	-	-	-	-	95
Disease resistance	**Adult rating**				
Yellow spot	MRMS*p*				
Nodorum blotch (leaf)	-				
Nodorum blotch (glume)	-				
Stem rust	MR*p*				
Stripe rust	RMR*p*				
Leaf rust	MSS*p*				
Powdery mildew	-				
Septoria tritici blotch	-				
Flag smut	-				
Common bunt	-				
RLN (*P. quasitereoides*)	-				
RLN (*P. neglectus*)	-				
CCN	-				
Crown rot	-				
Flowering	**Days after/before Scepter**				
Agronomic traits					
Coleoptile group	Long(*p*)				
Black point	-				
Falling number index	-				
Maturity	Long(*p*)				
Variety information					
Pedigree	Complex cross				
Breeder/Seed licensee	InterGrain				
Access to seed	Intergrain Seed Club Members or Seed Retailers. No grower to grower trading permitted				
EPR ($/t, excl GST)	$4.35				

p = provisional assessment
(N) denotes the supplementary classification of APWN

VIXEN(b)

AH (N)

Comments

Vixen is a quick maturity, AH (N) released in 2018 by InterGrain. It has been in the NVT for four years where its yields are comparable to Scepter or higher in agzones 4 and 5. However, its yields have been more variable as a result of Vixen's different maturity that is favourable with later sowing and tighter finishes to the season (refer to Agzone 1 data below). MRMS to stem and stripe rust but SVS to the latest strain of leaf rust. A falling number rating of 3 so not recommended for areas prone to pre-harvest sprouting.

Yield (% of Scepter)	2016	2017	2018	2019	2020
Agzone 1	-	90	106	103	97
Agzone 2	-	102	99	106	104
Agzone 3	-	-	102	104	97
Agzone 4	-	100	103	108	108
Agzone 5	-	100	103	105	108
Agzone 6	-	-	97	95	96
Disease resistance	**Adult rating**				
Yellow spot	MRMS				
Nodorum blotch (leaf)	MSS				
Nodorum blotch (glume)	MS				
Stem rust	MRMS				
Stripe rust	MRMS				
Leaf rust	SVS				
Powdery mildew	S				
Septoria tritici blotch	MSS				
Flag smut	SVS				
Common bunt	RMR				
RLN (*P. quasitereoides*)	MSS*p*				
RLN (*P. neglectus*)	MRMS				
CCN	MSS				
Crown rot	S				
Flowering	**Days after/before Scepter**				
2019 & 2020 DPIRD trials	**11-Apr**	**26-Apr**	**10-May**	**24-May**	**17-Jun**
Northern	-16	-9	-13	-6	-8
Eastern	-8	-6	-3	-6	-4
Katanning	-16	-9	-5	-8	-
Gibson	-9	-15	-10	-9	-6
Agronomic traits					
Coleoptile group	Medium(*p*)				
Black point	MSS				
Falling number index	3				
Maturity	Quick				
Variety information					
Pedigree	Mace/IGW3119				
Breeder/Seed licensee	InterGrain				
Access to seed	Intergrain Seed Club Members or Seed Retailers				
EPR ($/t, excl GST)	$3.50				

p = provisional assessment
(N) denotes the supplementary classification of APWN

CHIEF CL PLUS(Þ)

APW (N)

Comments

Chief CL Plus is an APW imidazolinone tolerant variety which was released in 2016. At release this variety was the highest yielding APW imidazolinone tolerant variety but now slightly lower yielding than the recently released Hammer CL Plus and Razor CL Plus. Chief CL Plus is resistant to both pathotypes of leaf rust, but S to the Lr24 virulent pathotype which is not present in WA (*). Registered for label rate applications of Intervix® herbicide.

Note: There are no grower to grower sales permitted for any CL Plus varieties.

Yield (% of Scepter)	2016	2017	2018	2019	2020
Agzone 1	95	100	94	91	91
Agzone 2	89	94	94	93	92
Agzone 3	89	91	96	95	94
Agzone 4	91	93	94	86	94
Agzone 5	88	88	87	89	91
Agzone 6	90	92	94	96	95
Disease resistance	**Adult rating**				
Yellow spot	MRMS				
Nodorum blotch (leaf)	MS				
Nodorum blotch (glume)	MR				
Stem rust	MR				
Stripe rust	S				
Leaf rust	MR*				
Powdery mildew	S				
Septoria tritici blotch	S				
Flag smut	SVS				
Common bunt	MR				
RLN (*P. quasitereoides*)	MS				
RLN (*P. neglectus*)	MRMS				
CCN	MS				
Crown rot	MSS				
Flowering	**Days after/before Scepter**				
2019 & 2020 DPIRD trials	**11-Apr**	**26-Apr**	**10-May**	**24-May**	**17-Jun**
Northern	+2	+1	-1	+2	+0
Eastern	+8	+2	+4	-1	-1
Katanning	+2	+0	-2	-1	-
Gibson	+4	+0	+1	+0	+2
Agronomic traits					
Coleoptile group	Medium(*p*)				
Black point	MS				
Falling number index	4				
Maturity	Mid				
Variety information					
Pedigree	Wyalkatchem derivative				
Breeder/Seed licensee	InterGrain				
Access to seed	Intergrain Seed Club Members or Seed Retailers. No grower to grower trading permitted				
EPR ($/t, excl GST)	$4.25				

p = provisional assessment

* = Some races in estern Australia can attack these varieties

(N) denotes the supplementary classification of APWN

CUTLASS(Þ)

APW (N)

Comments

Cutlass is a variety which provides growers with a later season APW option. Over the last five years, Cutlass has outyielded Yitpi, another mid–slow maturing variety commonly grown in WA. DPIRD and early season NVT show that Cutlass is best suited to sowing from late April to early May and is competitive with other mid–slow types in this window. Cutlass is resistant to all three rusts, is MSS to yellow spot and S to powdery mildew. Appears to be a higher risk of pre-harvest sprouting than Yitpi.

Yield (% of Scepter)	2016	2017	2018	2019	2020
Agzone 1	91	104	85	86	92
Agzone 2	94	88	90	86	86
Agzone 3	95	89	88	89	92
Agzone 4	85	94	89	84	83
Agzone 5	96	91	89	87	81
Agzone 6	98	100	94	90	91
Disease resistance	**Adult rating**				
Yellow spot	MSS				
Nodorum blotch (leaf)	MRMS				
Nodorum blotch (glume)	MRMS				
Stem rust	R				
Stripe rust	RMR*				
Leaf rust	RMR*				
Powdery mildew	S				
Septoria tritici blotch	MSS				
Flag smut	MSS				
Common bunt	S				
RLN (*P. quasitereoides*)	MS*p*				
RLN (*P. neglectus*)	MSS				
CCN	MR				
Crown rot	S				
Flowering	**Days after/before Scepter**				
2019 & 2020 DPIRD trials	**11-Apr**	**26-Apr**	**10-May**	**24-May**	**17-Jun**
Northern	+24	+23	+18	+12	+8
Eastern	+17	+17	+11	+6	+7
Katanning	+13	+12	+7	+4	-
Gibson	+26	+17	+10	+11	+9
Agronomic traits					
Coleoptile group	Long				
Black point	MS				
Falling number index	4				
Maturity	Mid–slow				
Variety information					
Pedigree	RAC1316//Fang				
Breeder/Seed licensee	AGT				
Access to seed	AGT Affiliates, retailers, or Seed Sharing				
EPR ($/t, excl GST)	$3.00				

* = Some races in estern Australia can attack these varieties

(N) denotes the supplementary classification of APWN

DENISON(Þ)

APW

Comments

Denison is a slower maturing APW variety released by AGT in 2020. Denison was tested in a limited number of NVT sites in 2019 and all sites in 2020, yielding similiar to Cutlass in agzones 1, 2, 5 and 6 and slightly higher than Cutlass in agzone 3. Denison was one of the highest yielding varieties in the early season NVT in 2020. Denison's maturity is slightly later than Cutlass or Yitpi in main season sowing but can be quicker than Cutlass when sown early to mid-April in the central and northern areas. Denison is rated S to leaf rust.

Yield (% of Scepter)	2016	2017	2018	2019	2020
Agzone 1	-	-	-	-	94
Agzone 2	-	-	-	86	88
Agzone 3	-	-	-	92	96
Agzone 4	-	-	-	-	87
Agzone 5	-	-	-	83	84
Agzone 6	-	-	-	100	98
Disease resistance	**Adult rating**				
Yellow spot	MRMS				
Nodorum blotch (leaf)	MRMS*p*				
Nodorum blotch (glume)	MRMS*p*				
Stem rust	MS				
Stripe rust	MR				
Leaf rust	S				
Powdery mildew	S*p*				
Septoria tritici blotch	MS*p*				
Flag smut	R*p*				
Common bunt	MR*p*				
RLN (*P. quasitereoides*)	-				
RLN (*P. neglectus*)	S				
CCN	MSS				
Crown rot	MSS				
Flowering	**Days after/before Scepter**				
2019 & 2020 DPIRD trials	**14-Apr**	**27-Apr**	**12-May**	**27-May**	**11-Jun**
Northern	-	17	18	14	11
Eastern	12	15	14	8	7
Katanning	27	15	10	9	-
Gibson	-	23	14	15	6
Agronomic traits					
Coleoptile group	Medium(*p*)				
Black point	MS*p*				
Falling number index	-				
Maturity	Slow(*p*)				
Variety information					
Pedigree	Complex cross with Mace and Corack as key parents				
Breeder/Seed licensee	AGT				
Access to seed	AGT Affiliates, retailers, or Seed Sharing				
EPR ($/t, excl GST)	$3.40				

p = provisional assessment

LRPB AVENGER(Þ)

APW (N)

Comments

LRPB Avenger is quick maturing APW and APWN variety released by LongReach in 2021. LRPB Avenger has been included in the NVTs since 2019 where it is showing to be better suited to the quick and hard finishes in agzones 1, 2, 4 and 5. LRPB Avenger has a longer coleoptile length similar to Yitpi and Magenta, it is MS to stem rust, MRMS to stripe rust, S to leaf rust, MS to yellow spot and S*p* to powdery mildew.

Yield (% of Scepter)	2016	2017	2018	2019	2020
Agzone 1	-	-	-	100	93
Agzone 2	-	-	-	105	99
Agzone 3	-	-	-	104	95
Agzone 4	-	-	-	104	104
Agzone 5	-	-	-	104	104
Agzone 6	-	-	-	94	95
Disease resistance	**Adult rating**				
Yellow spot	MS				
Nodorum blotch (leaf)	MSS*p*				
Nodorum blotch (glume)	MRMS*p*				
Stem rust	MS				
Stripe rust	MRMS				
Leaf rust	S				
Powdery mildew	S*p*				
Septoria tritici blotch	S*p*				
Flag smut	S				
Common bunt	S				
RLN (*P. quasitereoides*)	-				
RLN (*P. neglectus*)	MSS				
CCN	MSS				
Crown rot	S*p*				
Flowering	**Days after/before Scepter**				
2019 & 2020 DPIRD trials	**10-Apr**	**24-Apr**	**08-May**	**22-May**	**20-Jun**
Northern	-	-8	-11	-7	-6
Eastern	-	-9	-9	-8	-5
Katanning	-	-8	-9	-6	-
Gibson	-	-9	-9	-5	-4
Agronomic traits					
Coleoptile group	Long(*p*)				
Black point	MS*p*				
Falling number index	-				
Maturity	Quick				
Variety information					
Pedigree	Corack and Mace cross				
Breeder/Seed licensee	LongReach Plant Breeders				
Access to seed	Seed associate and farmer to farmer (WA)				
EPR ($/t, excl GST)	$4.00				

p = provisional assessment
(N) denotes the supplementary classification of APWN

CALINGIRI

FEED (2022 HARVEST)

Comments

Calingiri has remained a popular mid–slow maturing ANW. It's yields are superseded by the more recently released ANW varieties, Zen, Ninja and Kinsei. Calingiri is SVS to stripe rust and S to stem rust, leaf rust and powdery mildew. The 2022 harvest will see Calingiri received as a FEED variety due to Wheat Quality Australia's rationalisation of the Wheat Variety Master List.

Yield (% of Scepter)	2016	2017	2018	2019	2020
Agzone 1	92	100	84	81	89
Agzone 2	90	86	86	82	84
Agzone 3	90	86	86	85	88
Agzone 4	85	87	86	76	83
Agzone 5	90	83	78	78	78
Agzone 6	92	93	90	88	88
Disease resistance	**Adult rating**				
Yellow spot	MS				
Nodorum blotch (leaf)	MSS				
Nodorum blotch (glume)	MS				
Stem rust	S				
Stripe rust	SVS				
Leaf rust	S				
Powdery mildew	S				
Septoria tritici blotch	MSS				
Flag smut	RMR				
Common bunt	MRMS				
RLN (*P. quasitereoides*)	S				
RLN (*P. neglectus*)	SVS				
CCN	–				
Crown rot	S				
Flowering	**Days after/before Scepter**				
selected NVT trials					
2016 (av sowing date May 8)	+4				
2017 (av sowing date May 24)	+4				
2018 (av sowing date May 28)	+4				
Average	+4				
Agronomic traits					
Coleoptile group	Short				
Black point	MS				
Falling number index	4				
Maturity	Mid-slow				
Variety information					
Pedigree	Chino/Kulin//Reeves				
Breeder/Seed licensee	InterGrain				
Access to seed	Free to trade				
EPR ($/t, excl GST)	nil				

KINSEI(p)

ANW

Comments

Kinsei is a mid–slow maturity noodle wheat released by InterGrain in 2018. It is well suited to early sowing opportunities and has also performed well in the NVT main season plantings. Kinsei has been in the NVTs for four years where it yields slightly less than Ninja, similiar to Zen but out yields Calingiri. Kinsei is among the highest yielding varieties in the early season NVT, only outyielded by RockStar and Denison in 2020. Kinsei is S for blackpoint which may be an issue if sowing the variety in April in susceptible environments. Kinsei's disease ratings are marginally better than Ninja and Zen.

Yield (% of Scepter)	2016	2017	2018	2019	2020
Agzone 1	-	105	94	92	97
Agzone 2	-	94	96	90	93
Agzone 3	-	97	96	94	98
Agzone 4	-	94	95	84	92
Agzone 5	-	92	88	87	88
Agzone 6	-	98	98	100	99
Disease resistance	**Adult rating**				
Yellow spot	MS				
Nodorum blotch (leaf)	MRMS				
Nodorum blotch (glume)	MR				
Stem rust	MSS				
Stripe rust	MRMS				
Leaf rust	MSS				
Powdery mildew	S				
Septoria tritici blotch	MSS				
Flag smut	RMR				
Common bunt	MR				
RLN (*P. quasitereoides*)	S				
RLN (*P. neglectus*)	S				
CCN	MSS				
Crown rot	MSS				
Flowering	**Days after/before Scepter**				
2019 & 2020 DPIRD trials	**14-Apr**	**27-Apr**	**12-May**	**27-May**	**11-Jun**
Northern	+5	+7	+6	+7	+2
Eastern	+13	+11	+8	+4	+2
Katanning	+9	+8	+5	+4	-
Gibson	+8	+7	+3	+8	+3
Agronomic traits					
Coleoptile group	Medium(*p*)				
Black point	S				
Falling number index	4				
Maturity	Mid–slow				
Variety information					
Pedigree					
Breeder/Seed licensee	InterGrain				
Access to seed	Free to trade				
EPR ($/t, excl GST)	$4.00				

p = provisional assessment

NINJA(b)

ANW

Comments

Ninja a noodle wheat variety released by InterGrain in 2016 with a Calingiri and Wyalkatchem background. Ninja is the highest yielding ANW variety and has outyielded Mace in the last five years, yielding slightly behind Scepter. Although the stem rust rating for Ninja has been upgraded from VSV to S, it has the lowest rust ratings of the newer ANW varieties. Rusts should be actively monitored and managed. Rated MRMS to black point.

Yield (% of Scepter)	2016	2017	2018	2019	2020
Agzone 1	99	101	95	94	99
Agzone 2	99	95	96	93	95
Agzone 3	100	97	95	94	97
Agzone 4	98	95	96	90	95
Agzone 5	99	96	92	91	92
Agzone 6	99	98	98	97	97
Disease resistance	**Adult rating**				
Yellow spot	MRMS				
Nodorum blotch (leaf)	MS				
Nodorum blotch (glume)	MRMS				
Stem rust	S				
Stripe rust	MS				
Leaf rust	S				
Powdery mildew	S				
Septoria tritici blotch	MS				
Flag smut	MR				
Common bunt	RMR				
RLN (*P. quasitereoides*)	S*p*				
RLN (*P. neglectus*)	S				
CCN	MS				
Crown rot	S				
Flowering	**Days after/before Scepter**				
2019 & 2020 DPIRD trials	**10-Apr**	**24-Apr**	**08-May**	**22-May**	**20-Jun**
Northern	+9	+4	+2	+6	+0
Eastern	+9	+6	+4	+0	+1
Katanning	+4	+3	+0	+0	-
Gibson	+1	+3	-1	+2	-1
Agronomic traits					
Coleoptile group	Medium(*p*)				
Black point	MRMS				
Falling number index	4				
Maturity	Mid				
Variety information					
Pedigree	Calingiri/Wyalkatchem				
Breeder/Seed licensee	InterGrain				
Access to seed	Free to trade				
EPR ($/t, excl GST)	$4.00				

p = provisional assessment

ZEN(b)

ANW

Comments

Zen is a noodle variety with a Calingiri and Wyalkatchem background. Although Zen's yields are generally lower than Kinsei, they are not significantly different. Zen is S to powdery mildew, stem and leaf rust, so diseases should be actively monitored and managed. It has a useful black point and RLN (*P.neglectus*) rating but has a weaker falling number index rating than Ninja and Kinsei. Zen is consistently low for small grain screenings in the NVT data.

Yield (% of Scepter)	2016	2017	2018	2019	2020
Agzone 1	96	99	94	91	93
Agzone 2	92	94	94	92	93
Agzone 3	92	92	96	95	94
Agzone 4	93	93	94	86	94
Agzone 5	91	88	87	88	91
Agzone 6	92	93	94	96	95
Disease resistance	**Adult rating**				
Yellow spot	MRMS				
Nodorum blotch (leaf)	MRMS				
Nodorum blotch (glume)	MR				
Stem rust	S				
Stripe rust	MRMS				
Leaf rust	S				
Powdery mildew	S				
Septoria tritici blotch	S				
Flag smut	MS				
Common bunt	MR				
RLN (*P. quasitereoides*)	MS				
RLN (*P. neglectus*)	MRMS				
CCN	S				
Crown rot	S				
Flowering	**Days after/before Scepter**				
2019 & 2020 DPIRD trials	**10-Apr**	**24-Apr**	**08-May**	**22-May**	**20-Jun**
Northern	+9	+4	+5	+6	+4
Eastern	+7	+8	+5	+2	+0
Katanning	+6	+4	+0	+0	+0
Gibson	-	-	-	-	-
Agronomic traits					
Coleoptile group	Short				
Black point	MRMS				
Falling number index	3				
Maturity	Mid–slow				
Variety information					
Pedigree	Calingiri/Wyalkatchem				
Breeder/Seed licensee	InterGrain				
Access to seed	Free to trade				
EPR ($/t, excl GST)	$3.85				

Notes