Department of Primary Industries

Phenology of commercial and new release canola varieties in 2020

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Key findings

- Canola varieties varied markedly in the time it took from sowing/emergence to the start of flowering.
- Warmer than average temperatures throughout May and June resulted in early sown varieties meeting their thermal requirement and starting to flower earlier than usual.

Introduction

An important management strategy to maximise yield potential for canola is to sow varieties within the correct sowing window so they start flowering within the optimum flowering period for a particular location. Flowering too early increases the risk of frost damage, upper canopy blackleg and sclerotinia stem rot infection. Flowering too late increases the risk of damage from heat or moisture stress or both, potentially reducing yield.

The optimum start of flowering (determined as 50% of plants with one open flower) differs for each location. The optimum start of flowering for Wagga Wagga is between 31 July and 1 September, with the optimum date around 14 August. This means a variety's phenology needs to be understood so growers can sow varieties in the correct window for flowering to start during the optimum time and maximise yield potential.

An experiment at Wagga Wagga in 2020 examined the phenology of 34 commercial and newly released varieties sown on two dates.

Site details

Location	Wagga Wagga Agricultural Institute
Soil type	Red kandosol
Previous crop	Barley
Rainfall	• Fallow (November 2019–March 2020): 143 mm • In-crop (April 2020–October 2020): 305 mm • In-crop long-term average: 330 mm
Soil nitrogen (N)	227 kg N/ha (0–180 cm, 27 March)

Treatments

Variety

Table 1 lists the details of varieties examined in this experiment.

Sowing date (SD)

SD1: 26 March 2020

SD2: 27 April 2020

Table 1 Characteristics of varieties examined in the Wagga Wagga experiment in 2020.

Variety	Phenology	Maturity	Herbicide tolerance *	Plant type
ATR Bonito$^{\Phi}$	Mid–fast	Early	TT	Open-pollinated
ATR Wahoo$^{\Phi}$	Mid–slow	Mid	TT	Open-pollinated
GT 53	Mid	Mid	RR	Hybrid
Hyola 350TT	Fast	Early	TT	Hybrid
Hyola 410XX	Mid–fast	Early–mid	Truflex RR	Hybrid
Hyola 540XC	Mid–fast	Early–mid	Truflex RR/CLF	Hybrid
Hyola 580CT	Fast	Mid	CLF/TT	Hybrid
Hyola Enforcer CT	Mid	Early–mid	CLF/TT	Hybrid
Hyola Garrison XC	Mid	Early–mid	Truflex RR/CLF	Hybrid
HyTTec Trident	Mid–fast	Early	TT	Hybrid
HyTTec Trifecta	Mid	Mid	TT	Hybrid
HyTTec Trophy	Mid	Mid	TT	Hybrid
InVigor R 4022P	Mid–fast	Early–mid	Truflex RR	Hybrid
InVigor R 4520P	Mid–fast	Mid	Truflex RR	Hybrid
InVigor R 5520P	Mid–slow	Mid	RR	Hybrid
InVigor T 3510	Mid–fast	Early	TT	Hybrid
InVigor T 4510	Mid–fast	Early–mid	TT	Hybrid
InVigor T 6010	Mid–late	Mid-late	TT	Hybrid
Nuseed Diamond	Fast	Early	Conventional	Hybrid
Nuseed Quartz	Mid	Early–mid	Conventional	Hybrid
Pioneer® 43Y29 (RR)	Mid–fast	Early	RR	Hybrid
Pioneer® 43Y92 (CL)	Mid–fast	Early	CLF	Hybrid
Pioneer® 44Y27 (RR)	Mid–fast	Early–mid	RR	Hybrid
Pioneer® 44Y90 (CL)	Mid–fast	Early–mid	CLF	Hybrid
Pioneer® 44Y94 (CL)	Mid	Early–mid	CLF	Hybrid
Pioneer® 45Y28 (RR)	Mid–slow	Mid	RR	Hybrid
Pioneer® 45Y91 (CL)	Mid–slow	Mid–late	CLF	Hybrid
Pioneer® 45Y93 (CL)	Mid–slow	Mid	CLF	Hybrid
Saintly CL	Mid–fast	Early	CLF	Hybrid
SF Ignite TT	Mid–slow	Mid–late	TT	Hybrid
SF Spark TT	Fast	Early	TT	Hybrid
Victory V75-03CL	Mid–slow	Mid	CLF	Hybrid
Xseed Condor	Mid–fast	Mid	Truflex RR	Hybrid
Xseed Raptor	Mid–fast	Early–mid	Truflex RR	Hybrid

*CLF = Clearfield, TT = Triazine tolerant, RR = Roundup Ready®.

Results

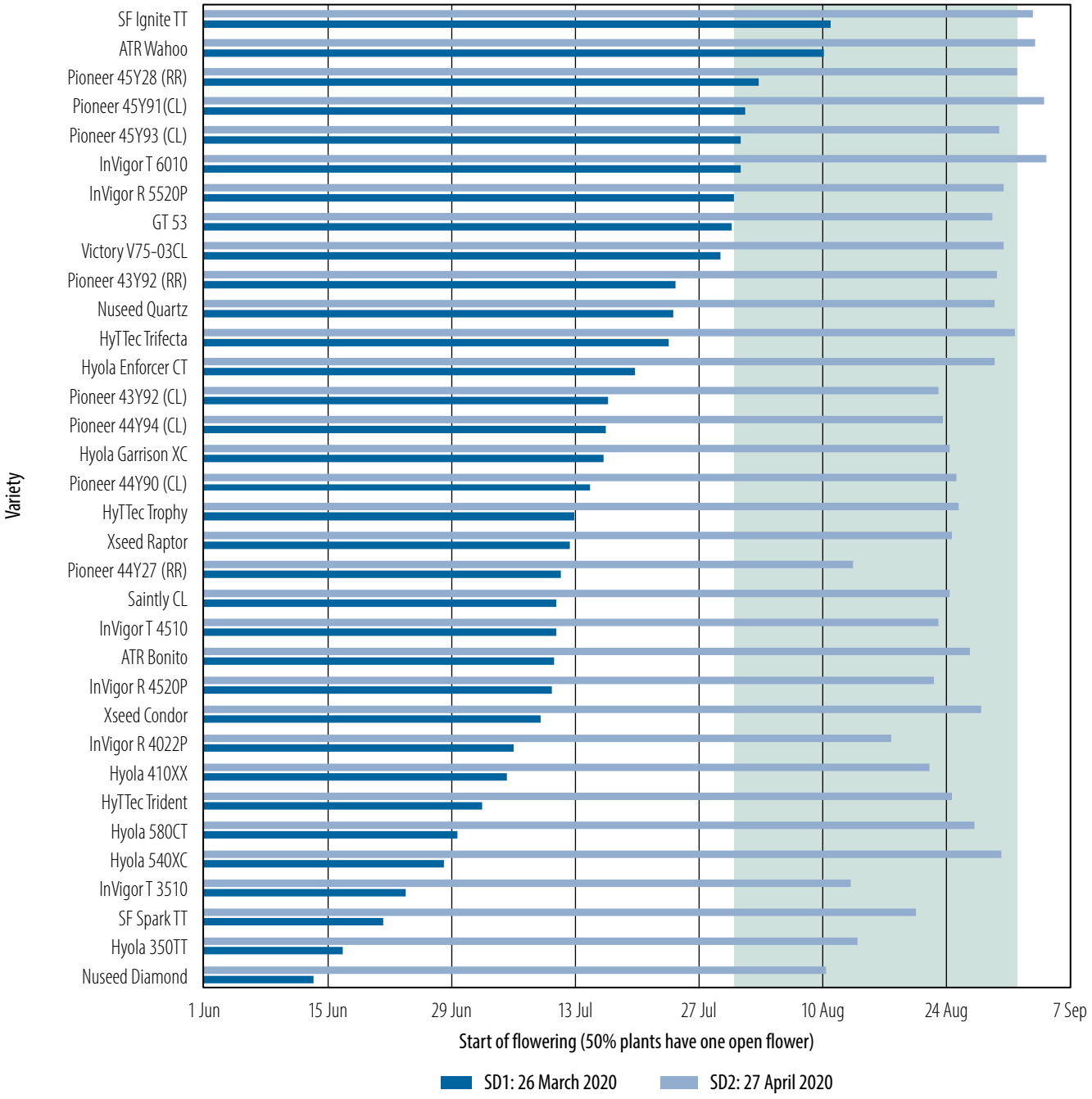
Seasonal conditions

Wagga Wagga recorded 305 mm growing season rainfall, 25 mm less than the long-term average.

Frost was not a major issue at Wagga Wagga in 2020, with only 11 days below 0 °C recorded between June and September at the experiment site. The lowest recorded temperature was –1.5 °C on 6 August. The long-term average number of days below 0 °C for Wagga Wagga is 18 (CliMate 2021).

Phenology

Nuseed Diamond was the first to flower from SD1. It flowered on 13 June, 48 days before its optimum start of flowering period of 31 July (shaded area, Figure 1). The varieties to flower after 31 July from SD1 were InVigor R 5520P, InVigor T 6010, Pioneer® 45Y93 (CL), Pioneer® 45Y91 (CL), Pioneer® 45Y28 (RR), ATR Wahoo$^{\Phi}$ and SF Ignite TT. ATR Wahoo$^{\Phi}$ and SF Ignite TT were the latest to start flowering, on 10 August. When the start of flowering begins through June and July, it increases the risk of the crop being damaged by frost, upper canopy blackleg infection and sclerotinia stem rot. Warmer than average early season temperatures meant that varieties had reached their thermal time requirement earlier than usual, with the plants switching from the vegetative to the reproductive stage earlier in the season, leading to earlier flowering dates for SD1.



Shaded area shows the optimum start of flowering period (when 50% of plants have one open flower) for Wagga Wagga (31 July to 1 September).

Note: Some varieties are protected under the Plant Breeders Rights Act 1994. See Table 1.

Figure 1 Flowering dates of 34 canola varieties sown on two dates at Wagga Wagga in 2020.

Delaying the sowing date to late April (SD2) resulted in most varieties starting to flower within the optimum flowering period for Wagga Wagga (31 July–1 September), the earliest being Nuseed Diamond on 10 August. Pioneer® 45Y91 (CL) and InVigor T 6010 were the last varieties to reach the start of flowering on 4 September (Figure 1). Delaying the sowing of these varieties much later than SD2 would increase the risk of heat and/or moisture stress during their critical growth period (around 350 degree days following the start of flowering date) (Kirkegaard et al. 2018).

Thermal time in 2020 accumulated quicker than previous years, which has resulted in varieties flowering earlier than in previous seasons. Figure 2 shows the difference in thermal time and vernal time to flowering for Nuseed Diamond and Pioneer® 45Y91 (CL) for SD1 in 2018, 2019 and 2020 at Wagga Wagga. All varieties reached the start of flowering earlier than usual in 2020 where the vernal time requirement was met faster in SD1. In SD2, these differences were reduced.

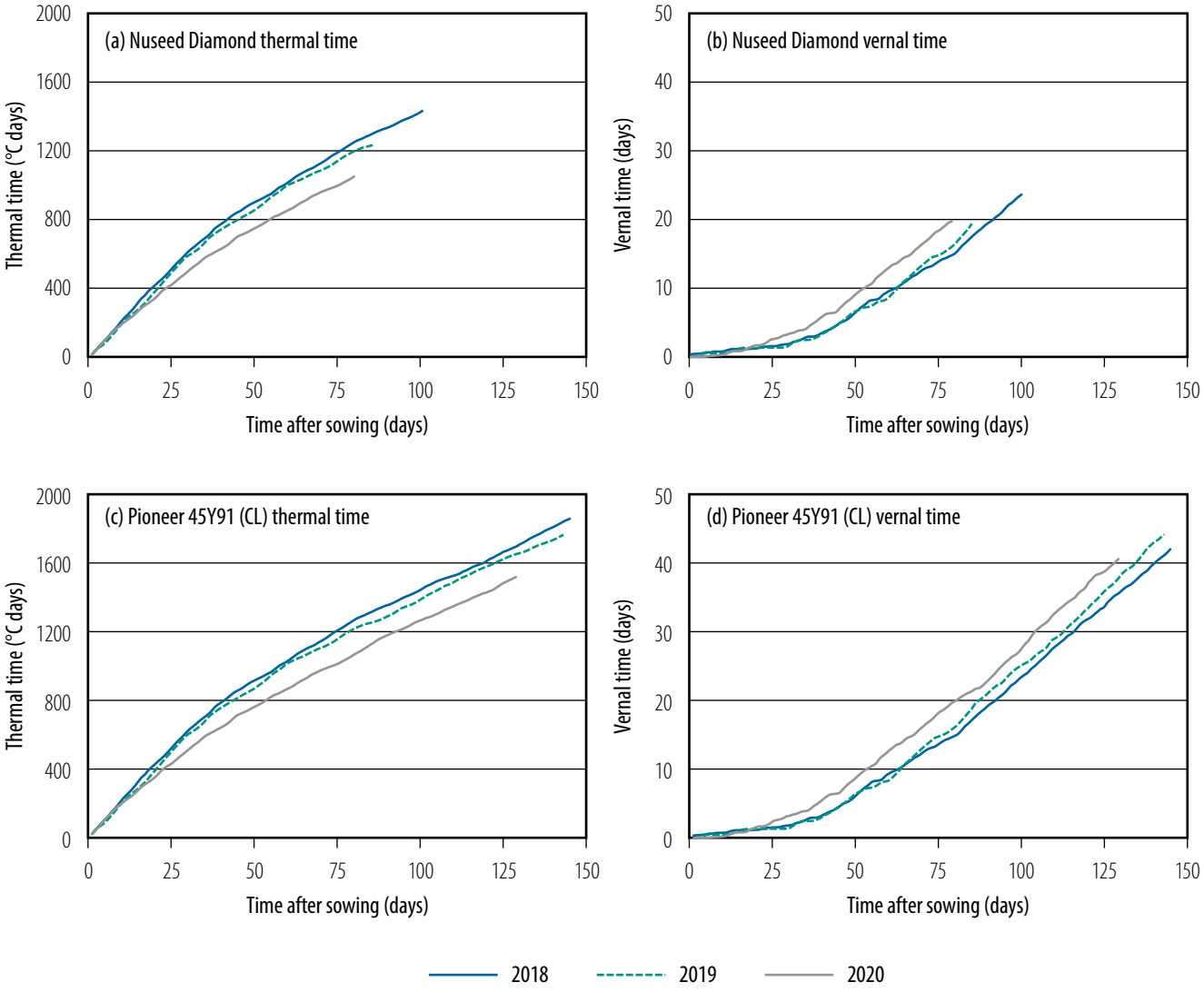


Figure 2 Thermal time accumulation and vernal time accumulation to flowering for Nuseed Diamond (a and b) and Pioneer 45Y91 (CL) (c and d) for SD1 in 2018, 2019 and 2020 at Wagga Wagga.

Yield and quality

The highest yielding variety in 2020 was Pioneer® 45Y28 (RR) (3.51 t/ha, SD2), closely followed by InVigor R 4520P (3.43 t/ha, SD1) (Table 2). The average site yield was 2.80 t/ha. Generally, the fast-developing varieties performed better when sown later (SD2), with the slower varieties being consistent in their yield across both sowing dates in the 2020 season.

Table 2 Yield and grain quality of 34 commercial and new release canola varieties at Wagga Wagga in 2020.

Variety	Grain yield[#] (t/ha)		Oil content[#] (%)		Protein content[#] (%)		Seed weight (g/1000 seeds)	
	SD1	SD2	SD1	SD2	SD1	SD2	SD1	SD2
ATR Bonito[Φ]	2.59	2.83	43.3	43.7	21.9	20.8	4.24	3.73
ATR Wahoo[Φ]	2.10	3.05	41.4	41.2	22.4	24.5	4.22	4.26
GT 53	2.56	2.88	41.9	41.7	20.3	19.9	3.65	3.34
Hyola 350TT	2.42	2.62	41.2	42.3	23.0	21.9	5.15	4.40
Hyola 410XX	2.69	2.99	45.5	45.7	20.4	19.9	4.24	3.87
Hyola 540XC	2.29	2.71	41.4	41.3	22.4	22.1	4.45	3.87
Hyola 580CT	2.13	2.55	41.5	40.3	22.2	22.5	4.41	3.89
Hyola Enforcer CT	2.84	2.87	42.1	42.7	21.8	21.1	4.37	4.08
Hyola Garrison XC	2.10	3.11	42.7	44.1	21.8	20.0	4.39	3.98
HyTTec Trident	2.61	2.39	42.6	41.2	20.5	20.2	3.81	3.33
HyTTec Trifecta	3.01	3.21	43.1	42.3	20.9	22.4	4.05	3.89
HyTTec Trophy	2.63	2.93	41.8	42.1	21.8	20.8	3.52	3.20
InVigor R 4022P	3.16	3.08	43.3	43.1	20.5	20.5	4.45	3.77
InVigor R 4520P	3.43	3.28	42.2	41.9	20.8	20.0	3.74	3.29
InVigor R 5520P	2.71	2.66	43.0	42.3	20.3	20.6	3.43	3.09
InVigor T 3510	2.45	2.62	39.3	41.2	23.5	21.4	4.37	3.67
InVigor T 4510	2.62	2.80	41.1	41.4	21.3	20.8	4.19	3.57
InVigor T 6010	2.80	3.16	41.2	41.7	21.5	21.6	3.88	3.65
Nuseed Diamond	2.54	2.97	40.2	42.4	23.6	20.6	5.08	3.89
Nuseed Quartz	3.05	3.07	43.2	43.4	20.5	19.2	4.09	3.88
Pioneer 43Y29 (RR)	2.88	3.35	43.0	42.5	19.9	20.7	4.36	4.26
Pioneer 43Y92 (CL)	2.75	3.13	42.5	42.8	20.9	20.5	4.29	4.03
Pioneer 44Y27 (RR)	3.27	2.93	43.2	42.1	19.8	20.1	4.24	3.68
Pioneer 44Y90 (CL)	3.13	3.19	43.2	43.0	20.5	20.2	4.20	3.87
Pioneer 44Y94 (CL)	3.33	3.28	44.2	43.3	18.9	18.7	4.00	3.84
Pioneer 45Y28 (RR)	3.18	3.51	45.1	44.8	19.9	20.2	3.90	3.86
Pioneer 45Y91 (CL)	2.64	2.88	42.9	42.9	21.2	21.0	4.14	3.83
Pioneer 45Y93 (CL)	3.25	3.40	43.0	41.7	20.4	20.7	3.98	3.84
Saintly CL	3.12	3.12	43.4	44.0	20.5	19.4	4.35	3.76
SF Ignite TT	2.59	2.93	41.0	40.4	21.4	22.9	3.75	3.73
SF Spark TT	2.61	2.62	43.3	42.3	21.0	20.7	3.95	3.52
Victory V75-03CL	2.92	2.62	42.7	42.3	20.2	20.6	4.22	3.82
Xseed Condor	3.16	3.12	45.2	45.4	20.5	19.9	4.24	3.92
Xseed Raptor	2.97	3.20	42.8	42.5	20.9	20.2	3.64	3.16
l.s.d. ($P = 0.05$)								
Variety	0.29		0.8		0.8		0.10	
Sowing date	0.07		n.s.		0.2		0.02	
Variety × sowing date	0.41		1.14		1.1		0.14	

[#] calculated at 6% moisture content.
l.s.d. = least significant difference; n.s. = not significant.

There were differences in oil concentration between varieties with values ranging from 39% to 45%. Hyola 410XX and Xseed Condor achieved oil contents over 45%. The site average was 42%. Varieties did not differ noticeably in their oil concentration between the two sowing dates (Table 2).

Seed weight differed between both varieties and sowing dates, with SD1 typically having higher thousand seed weights (TSW). Hyola 350TT and Nuseed Diamond sown early had the highest seed weights.

Discussion

Flowering within a defined period for a given location is one of the most important drivers of grain yield potential and grain quality in canola. Understanding a variety's phenology and how that variety responds to temperature influences how the variety will perform in different environments and the correct window in which that variety should be sown.

During canola's leaf production stages, varieties can be influenced by thermal time or vernal time. While winter varieties have a requirement for vernalisation, the spring varieties do have a response to vernal time that influences the accumulated thermal time. Spring varieties differ in the amount of accumulated thermal and vernal time they need before they will switch from the vegetative stage (leaf production) to the reproductive growth stage (bud and flower production).

Thermal time also influences the time taken within the reproductive stage for buds to elongate and initiate flowers. There is no vernalisation requirement within the reproductive stage.

Differences observed in flowering times in 2020 and previous years of similar experiments show that the varieties still have different thermal requirements and respond differently to vernal time accumulated before they will begin flowering. Figure 2 shows that in 2020 at Wagga Wagga both fast and slow developing varieties responded to the cooler than normal autumn days with lower minimum temperatures releasing the 'handbrake' on their vernal time requirement, thereby reducing the amount of thermal time required to switch from the vegetative growth stage to the reproductive growth stage. As a result, from the early sowing date (SD1), these varieties flowered earlier than in previous seasons.

Varieties sown in different environments will change the length of time it takes to begin flowering. In warmer environments, accumulated thermal time will be quicker than for a cooler environment, therefore sowing varieties that have slow phenologies too late will cause them to run into possible moisture stress resulting in a lower yield potential.

While frost was not a major issue in 2020, yield penalties were measured in varieties such as Nuseed Diamond, Hyola 350TT and InVigor T 3510 when sown early (Table 2). Due to these varieties flowering earlier, the developing pods were exposed to a −1.5 °C frost (measured in canopy at −5 °C) in early August. The season in 2020 at Wagga Wagga had a mild finish, with good moisture and no heat stress, which contributed to higher yields from the later sowing date (SD2), even in the slow maturing varieties.

Conclusion

Canola varieties differ in their flowering times depending on where and when they are sown. Understanding how a variety responds to thermal time and photoperiod and therefore knowing a variety's phenology will influence the decision on when to sow a variety to avoid flowering when there is an increased risk of frost, disease or moisture stress.

Matching a variety's phenology to its sowing time is critical for flowering to start during the optimum flowering period for each region, which is when environmental and disease risks are minimised for the highest yield potential. More information on sowing windows to suit variety phenology can be found in NSW DPI's Winter crop variety sowing guide.

References

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