

# Annual Results Report

## 2025

### NGN- Cereal Crop Phenology Investigation

**Project code:** FAR2504-002SAX

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## REPORT SENSITIVITY

Does the report have any of the following sensitivities?

Intended for journal publication YES  NO

Results are incomplete YES  NO

Commercial/IP concerns YES  NO

Embargo date YES  NO

## KEY MESSAGES

- *A mild season with good starting soil moisture and a soft finish (581mm GSR April-November) supported grain yields of between 2.81 –5.51t/ha, across three cereal species and three sowing dates on forest gravel in the Albany Port Zone.*
- *Very wet soil conditions in July and August may have reduced the overall value of the higher-than-average GSR through transient anaerobic conditions; however direct water logging effects were not noted in the trial.*
- *Cereals sown early may have suffered cold temperatures during flowering in late August and early September.*
- *Neo CL spring barley was the highest yielding variety at every sowing date (9<sup>th</sup> April, 28<sup>th</sup> April & 20<sup>th</sup> May), showing stable performance and consistently the greatest profitability.*
- *Spring barley compensated for yield in the early April sowing through strong tillering during the whole growing season.*
- *Early April sowing produced significantly lower yields for spring wheat and oat varieties, due to rapid development, early flowering and low photothermal quotient (PTQ) leading up to flowering.*
- *Spring wheat and oat varieties gave their highest yields when sown in late May, while winter wheats, AGTB1007 winter barley and Neo CL spring barley gave no significant response in yield to changing sowing window.*
- *Fungicide programs effectively controlled disease in wheat and barley, but oats experienced severe Septoria avenae blotch (SAB), especially Minnie, with up to 46% infection, plus high lodging and grain loss. Oat grain loss and lodging were highest in early sowing.*
- *Phenology differences between winter and spring types were most pronounced in early April and became more similar by the late May sowing. For example, AGTB1007 winter barley developed slowly in early sowing but faster than some spring types in late May.*
- *NDVI showed stronger early canopy growth in early sowing and variety dependent senescence patterns across sowing times.*
- *Grain quality was strongly influenced by time of sowing, with wheat quality generally declining in late May sowing due to higher screenings and lower protein. Barley generally went feed, apart from Neo CL in late May sowing that had higher test weights. Oat test weights drove grade improvements with later sowing having higher quality than earlier sowing.*
- *Profitability largely followed yield, except for longer season spring wheats maintaining stronger margins in late April sowing due to higher grain quality.*

## SUMMARY

An early break, soft finish and a growing season rainfall of 581mm (April-November) in Frankland River provided ideal conditions for testing cereal phenology at different sowing windows. The trial compared winter wheat and barley germplasm compared to spring germplasm of wheat, barley and

oats across three sowing times in the WA High Rainfall Zone, to understand differences in phenology and how it influences yield and profitability. Neo CL spring barley was the strongest performer, producing the highest and most stable yields and gross margins across all sowing dates. Early April sowing (9<sup>th</sup> April) reduced overall yields of spring wheats and oats which developed too quickly and flowered under low photothermal conditions, while winter cereals in general were better suited to this time of sowing. Oats suffered significant *Septoria avenae* blotch (SAB), grain loss and lodging, highlighting their need for more intensive disease and canopy management, particularly when sown early. Phenology differences between winter and spring types were largest in early April but had converged by the late May sowing on the 20<sup>th</sup> May. Grain quality responses varied by species and sowing time: wheat quality declined sharply in the late May sowing due to low protein and high screenings, barley quality was generally stable with Neo CL achieving malt status in late May sowing, and oat quality was driven by test weight, with Goldie consistently outperforming Minnie. Profitability closely followed yield, with Neo CL being the most profitable at all sowing dates and long season spring wheats achieving better margins sown in late April due to improved grain quality. Overall, aligning germplasm and phenology with sowing opportunity is essential: winter germplasm for early sowing, spring germplasm for later sowing, and spring barley, especially Neo CL remains the most robust and profitable option across varying sowing conditions.

## BACKGROUND

This two-year investment follows on from a one-year pilot project run in the Esperance and Albany port zones run in 2024 (FAR 2403 001SAX). The project will look at maximising the productivity of early sown cereals by looking at the role of winter wheat and winter barley cultivars versus spring wheat, barley and oat germplasm when sowing date is moved from late March/early April to mid-May in the Frankland River region of the Albany Port Zone.

Although the project does not treat management inputs as a variable in the trial, it is planned to observe the need for agrichemical inputs and nutrition, recognising that earlier sowing particularly in the Albany Port Zone will increase disease pressure in crops such as barley.

The project is designed to be a platform for productivity and profitability data and will be used for extension to regional growers and advisers during the course of the year.

## OBJECTIVES

- To examine the role of wheat, barley and milling oats in rotations of the WA High Rainfall Zone (HRZ) Albany Port Zone.
- To explore the role of winter germplasm in relation to spring germplasm and to observe how phenology of these different cereal species changes in relation to sowing date.
- At the different sow dates covering late March to mid-May compare the profitability and productivity of the three cereal species.
- To evaluate the different management needs of winter germplasm (both wheat and barley) in relation to the other cereal groups being tested.

## METHODS

<b>Trial Location:</b>	<b>Frankland River, Western Australia</b>
<b>FAR code:</b>	FAR WAA W25-10
<b>GPS:</b>	-34.3299358, 117.2432211
<b>Rotation position:</b>	2024 Canola
<b>Sowing Dates:</b>	<b>TOS 1:</b> 9-April (emergence 17 April)
	<b>TOS 2:</b> 28-April (emergence 3-5 May)
	<b>TOS 3:</b> 20-May (emergence 27 May)
<b>Seed rate:</b>	All plots established at 200 seeds/m <sup>2</sup>
<b>Harvested:</b>	<b>Barley:</b> 12-Dec
	<b>Wheat and Oats:</b> 18-Dec

This two-year investment includes field trials, extension and communications taking place across 2025 and 2026, leading to a series of trial results that can be communicated to the regional farming communities in southwest WA in the first three months of 2026 and 2027.

One trial with three times of sowing (early April (9<sup>th</sup>), late April (28<sup>th</sup>), and mid-late May (20<sup>th</sup>)) took place at Frankland River in the Albany Port Zone in the 2025 season. It explored the value of early sowing and the role of winter wheat and barley germplasm compared to spring germplasm of wheat, barley and oats. Development (phenology) of the different cereal species and types (spring vs winter) were monitored weekly, reflectance (NDVI) throughout the season, disease pressure at flag leaf and grain fill, dry matter content at harvest, the crop canopy composition (tillering) and grain yield and quality were all assessed. The site was based on forest gravel soil over clay in the high rainfall zone (HRZ), GSR 581mm (April – November).

Trials were sown over three dates, early April (9 April), late April (28 April) and late May (20 May). The site was set up in autumn 2025 to compare 12 varieties from 5 groups of cereal species as the first cereal following canola in the rotation.

	Spring	Winter
<b>Wheat</b>	- Shotgun ( <i>main season</i> ) - Brumby ( <i>main season</i> ) - Genie ( <i>long season</i> ) - Denison ( <i>long season</i> )	- Brighton - Mowhawk
<b>Barley</b>	- Neo CL ( <i>main season</i> ) - Ember (tested as IGB21130, <i>long season</i> )	- AGTB1007* - KWS Donau*
<b>Oats</b>	- Goldie - Minnie	

\*Winter barley lines tested are not commercially available. KWS is a long season European winter barley, whereas AGTB1007 is a shorter season Australian bred winter barley

The 2025 trial had 36 treatments (12 cereal species/varieties x 3 times of sowing) replicated 4 times giving a total of 144 plots (12 x 3 x 4 = 144).

All sowing dates in the trial were subject to the same level of agronomic input in terms basal fertiliser, overall nitrogen and agrichemical input, although the enormous range in phenology (see results section) meant the timings of products varied on occasions, particularly disease management. See table 12 for overall inputs applied to the trial.

## LOCATION

Site #	Latitude (decimal degrees)	Longitude (decimal degrees)	Nearest town
Trial Site #1	-34.3299358	117.2432211	Frankland River

Research	Benefiting GRDC region (select up to three)	Benefiting GRDC agro-ecological zone	
NGN- Cereal Crop Phenology Investigation	Western Region	<input type="checkbox"/> Qld Central <input type="checkbox"/> NSW NE/Qld SE <input type="checkbox"/> NSW Vic Slopes <input type="checkbox"/> Tas Grain <input type="checkbox"/> SA Midnorth-Lower Yorke Eyre <input type="checkbox"/> WA Northern <input type="checkbox"/> WA Eastern <input type="checkbox"/> WA Mallee	<input type="checkbox"/> NSW Central <input type="checkbox"/> NSW NW/Qld SW <input type="checkbox"/> Vic High Rainfall <input type="checkbox"/> SA Vic Mallee <input type="checkbox"/> SA Vic Bordertown-Wimmera <input checked="" type="checkbox"/> WA Central <input type="checkbox"/> WA Sandplain

## RESULTS

### Yield

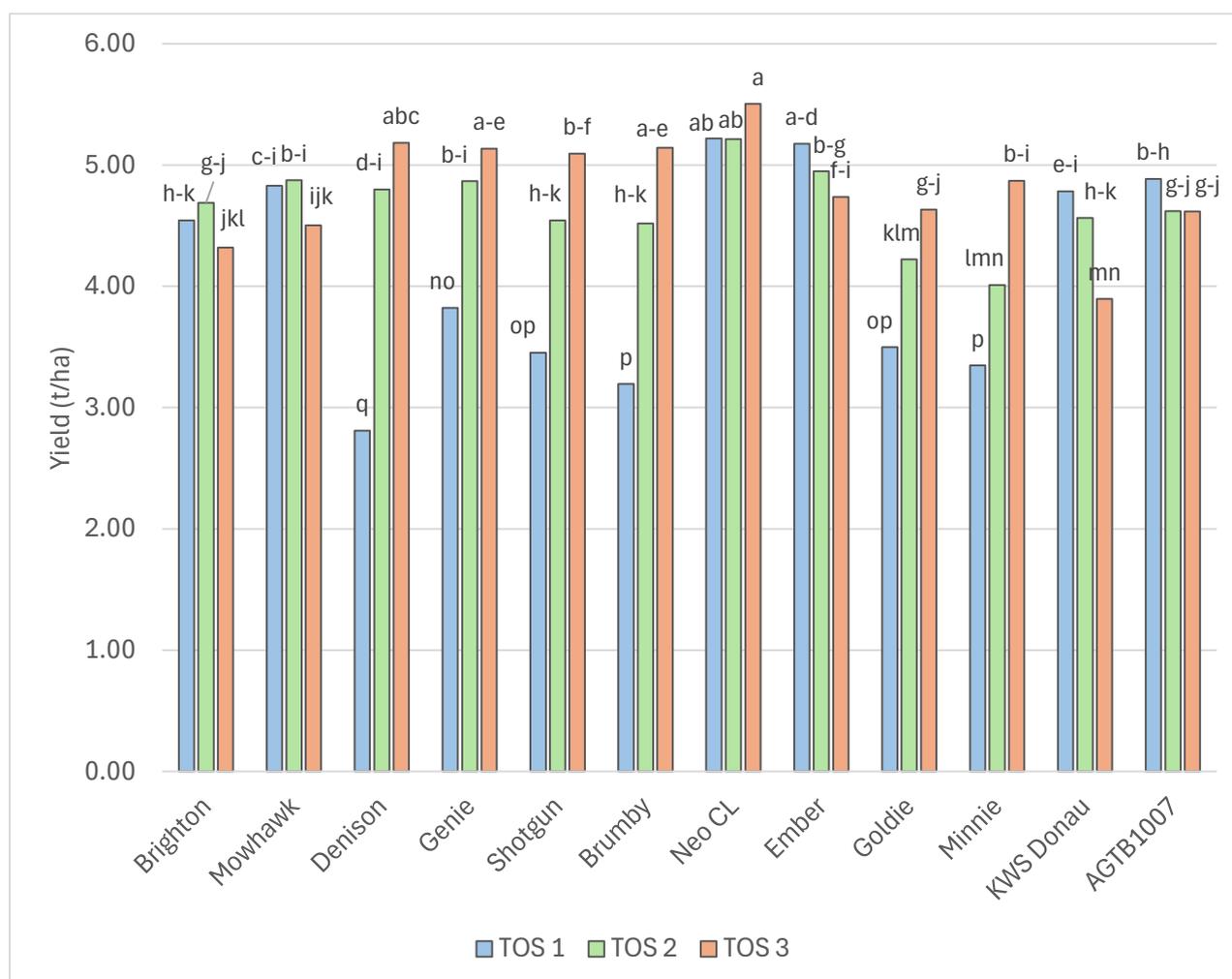
Neo CL was the highest yielding variety in every time of sowing (TOS), and its yields were not statistically different across the TOS, consistently yielding over 5t/ha (table 1). Only spring wheats Denison, Genie and Brumby in TOS 3, and long season spring barley Ember in TOS 1 gave statistically similar yields to Neo CL. Neo CL showed adaptability to early April sowing by producing more heads/m<sup>2</sup> (table 4), averaging 6.4 heads/plant by the time the crop had matured (appendix, table 14).

Ember had significantly higher yields when sown in early April compared to late May. Likewise, the European winter barley KWS Donau yielded higher when sown in April (TOS 1 and 2), whereas the yields of the Australian winter barley AGTB1007 and Australian winter wheats Brighton and Mowhawk were more stable across the three sowing dates. Although the yields for each variety were not significantly different across the three sowing dates, early April sowing slightly favoured AGTB1007 and late April slightly favoured the two winter wheats.

Overall, spring varieties gave bigger yield differences to sowing time compared to winter wheats and barley varieties. Spring wheats and oats were not suited to early April sowing, yielding the lowest at this sowing date, in stark contrast to the long season KWS Donau which was the only variety to show significantly more yield sown in early April compared to the later time of sowings.

**Table 1.** Influence of time of sowing (TOS 1, 2 and 3) and variety on grain yield (t/ha). Harvested: barley- 12 December 2025, wheat and oats- 18 December 2025.

Variety	Yield (t/ha)							
	TOS 1		TOS 2		TOS 3		Mean	
<b>Brighton (winter wheat)</b>	4.54	h-k	4.69	g-j	4.32	jkl	4.52	cde
<b>Mowhawk (winter wheat)</b>	4.83	c-i	4.88	b-i	4.50	ijk	4.74	bc
<b>Denison (spring wheat)</b>	2.81	q	4.80	d-i	5.18	abc	4.26	fg
<b>Genie (spring wheat)</b>	3.82	no	4.87	b-i	5.14	a-e	4.61	cd
<b>Shotgun (spring wheat)</b>	3.45	op	4.54	h-k	5.10	b-f	4.36	ef
<b>Brumby (spring wheat)</b>	3.20	p	4.52	h-k	5.14	a-e	4.29	fg
<b>Neo CL (spring barley)</b>	5.22	ab	5.22	ab	5.51	a	5.31	a
<b>Ember (spring barley)</b>	5.18	a-d	4.95	b-g	4.74	f-i	4.95	b
<b>Goldie (spring oat)</b>	3.50	op	4.22	klm	4.63	g-j	4.12	g
<b>Minnie (spring oat)</b>	3.35	p	4.01	lmn	4.87	b-i	4.08	g
<b>KWS Donau (winter barley)</b>	4.78	e-i	4.56	h-k	3.90	mn	4.41	def
<b>AGTB1007 (winter barley)</b>	4.89	b-h	4.62	g-j	4.62	g-j	4.71	c
<b>Mean</b>	<b>4.13</b>	<b>b</b>	<b>4.66</b>	<b>a</b>	<b>4.80</b>	<b>a</b>	<b>4.53</b>	
<b>LSD Variety p = 0.05</b>	0.22		<b>P value</b>	<0.001				
<b>LSD TOS p = 0.05</b>	0.26		<b>P value</b>	0.002				
<b>LSD Variety x TOS. p = 0.05</b>	0.38		<b>P value</b>	<0.001				



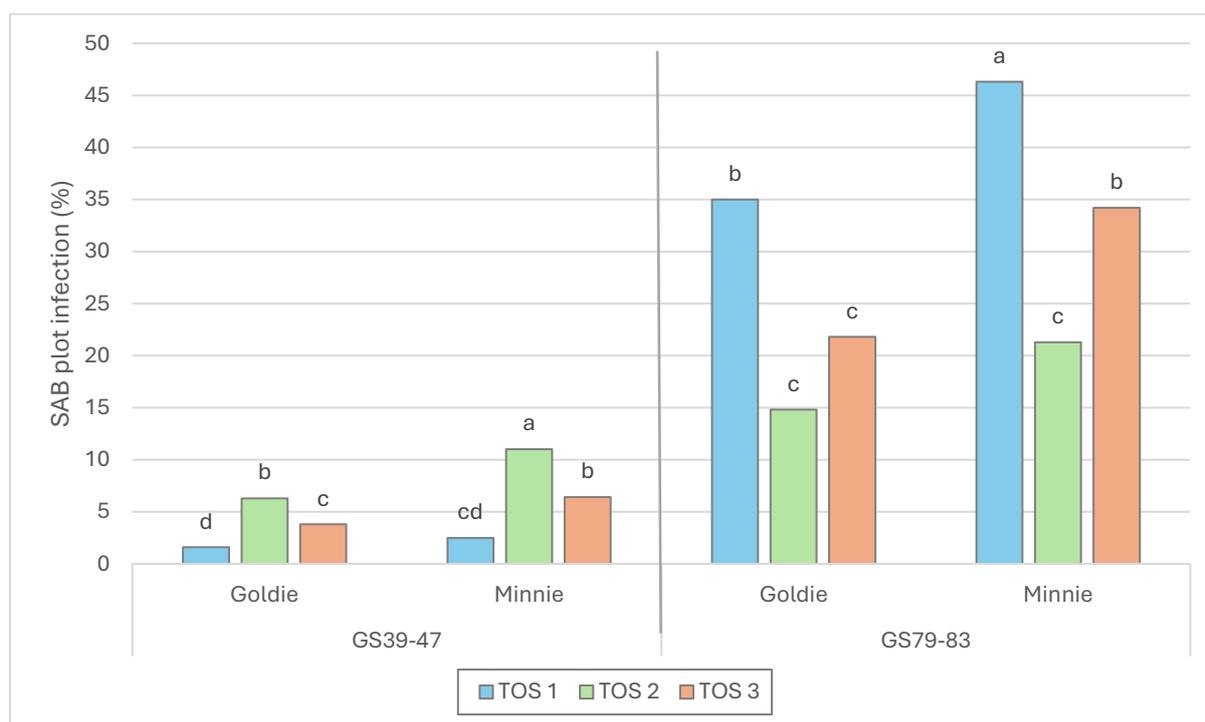
**Figure 1.** Influence of time of sowing (TOS 1, 2 and 3) and variety on grain yield (t/ha).

### **Disease and lodging**

The two-spray fungicide program gave good control of disease in barley and wheat. Less than 2% plot infection of yellow leaf spot, *Stagonospora nodorum* blotch, net form net blotch or spot form net blotch was seen in any variety at any time of sowing (results not shown). However, the fungicide program did not control the high level of *Septoria avenae* blotch (SAB) observed in Goldie and Minnie (figure 2).

There were no significant differences in yield between the two oat varieties within the times of sowing (table 1), however there was significantly more SAB in Minnie in TOS 1 and 3 (46.3% and 35.0% plot infection respectively) than Goldie at grain fill timing (figure 2). Goldie had a significantly higher grain loss/m<sup>2</sup> and lodging index than Minnie across the three TOS (table 2 and 3), which may have equalled out the yield loss from disease in Minnie.

There was a trend of higher oat grain loss/m<sup>2</sup> in TOS 1 and 2 than TOS 3 (table 2), and oats had a significantly higher lodging index than the wheat and barley (table 3).



**Figure 2.** Influence of time of sowing (TOS 1, 2 and 3) and variety on Septoria avenae blotch (SAB) infection (% plot infection). First assessment timing at GS39-47 (P value=0.007, LSD=1.5) and second assessment timing at GS79-83 (P value=0.032, LSD=6.5).

**Table 2.** Influence of time of sowing (TOS 1, 2 and 3) and variety on oat grain loss (per m<sup>2</sup>). Counted after harvest on 19 December.

Variety	Oat grain loss/m <sup>2</sup>			
	TOS 1	TOS 2	TOS 3	Mean
Goldie	238.0 -	283.0 -	125.0 -	215.3 a
Minnie	206.0 -	103.0 -	37.0 -	115.3 b
<b>Mean</b>	<b>222.0 -</b>	<b>193.0 -</b>	<b>81.0 -</b>	<b>165.3</b>
<b>LSD Variety p = 0.05</b>	<b>88.7</b>	<b>P value</b>	<b>0.031</b>	
<b>LSD TOS p = 0.05</b>	<b>ns</b>	<b>P value</b>	<b>0.230</b>	
<b>LSD Variety x TOS. p = 0.05</b>	<b>ns</b>	<b>P value</b>	<b>0.342</b>	

With a typical TGW of 40g the above losses would equate to no more than 0.113 t/ha (based on 283 grains/m<sup>2</sup> loss).

**Table 3.** Influence of time of sowing (TOS 1, 2 and 3) and variety on lodging index (0-500).

Variety	Lodging index (0-500)			
	TOS 1	TOS 2	TOS 3	Mean
Brighton	5.5 -	0.0 -	0.0 -	1.8 c
Mowhawk	2.0 -	12.5 -	0.0 -	4.8 c
Denison	0.0 -	0.0 -	0.8 -	0.3 c
Genie	0.0 -	1.3 -	0.0 -	0.4 c
Shotgun	0.0 -	3.8 -	0.0 -	1.3 c
Brumby	0.0 -	0.0 -	0.0 -	0.0 c
Neo CL	1.8 -	0.8 -	0.0 -	0.8 c
Ember	2.5 -	0.0 -	0.0 -	0.8 c
Goldie	216.3 -	127.8 -	150.3 -	164.8 a
Minnie	77.8 -	18.8 -	65.0 -	53.8 b
KWS Donau	0.0 -	0.0 -	0.0 -	0.0 c
AGTB1007	0.0 -	0.8 -	0.0 -	0.3 c
<b>Mean</b>	<b>25.5 -</b>	<b>13.8 -</b>	<b>18.0 -</b>	<b>11.2</b>
<b>LSD Variety p = 0.05</b>	26.7	<b>P value</b>	<0.001	
<b>LSD TOS p = 0.05</b>	ns	<b>P value</b>	0.477	
<b>LSD Variety x TOS. p = 0.05</b>	ns	<b>P value</b>	0.578	

### Canopy structure

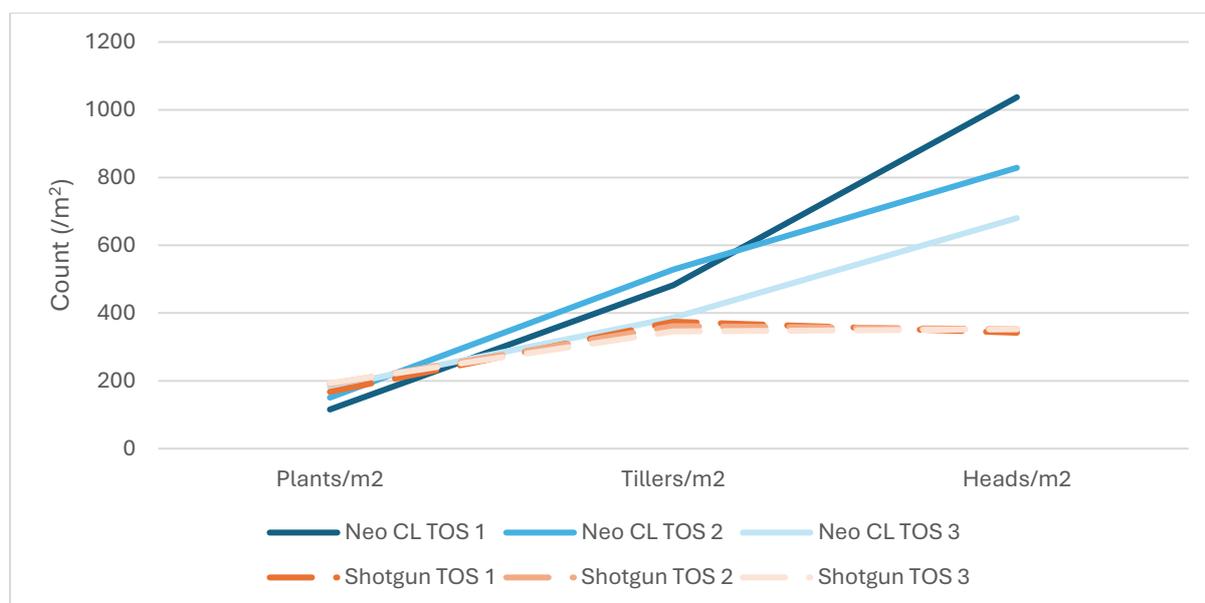
Overall, plant establishment was stable with no interaction between variety and time of sowing (table 4). The largest influence on early season plant counts was variety, with KWS Donau showing lower plant emergence than all the other varieties (data not shown). There was a significant interaction between sowing date and variety for both tillers and heads/m<sup>2</sup>. This reflects differences in how individual varieties and species responded to sowing window and their inherent capacity for canopy compensation. The spring barley Neo CL demonstrated a heightened capacity for compensatory tillering, particularly when sown early. With similar stable plant count numbers across sowing dates, Neo CL produced 482.5 tillers/m<sup>2</sup> (assessed at GS31-33) when sown in early April yet matured 1,037 heads/m<sup>2</sup> (assessed at crop maturity)—more than double its tiller count. This is a striking level of reproductive compensation and indicates that Neo CL was able not only to retain a high proportion of its fertile tillers but also continue producing and carrying late tillers to maturity when sown at what would be considered a sowing date too early for a spring barley variety. It produced significantly more heads/m<sup>2</sup> than the late April sowing which in turn had significantly more heads/m<sup>2</sup> than the late May sowing, although thousand grain weights (table 5) indicated that the grain in April sowings (TOS 1 & 2) was significantly smaller than in TOS 3 in late May, opposing yield components that resulted in similar yields but totally different canopy structures. This contrasted to the spring wheats which generally showed a similar number of tillers/m<sup>2</sup> and heads/m<sup>2</sup> and occasions a small net loss (tiller mortality) which is generally expected (figure 4). For example, Shotgun produced 374.5 tillers/m<sup>2</sup> when sown in early April and went on to produce 341.7 heads/m<sup>2</sup> which was not significantly different across sowing dates for either tiller counts or head count.

**Table 4.** Influence of time of sowing (TOS) and variety on crop emergence, number of tillers and number of mature heads (per m<sup>2</sup>). Plant counts conducted at GS12, tiller counts at GS32-33 and head counts at GS89.

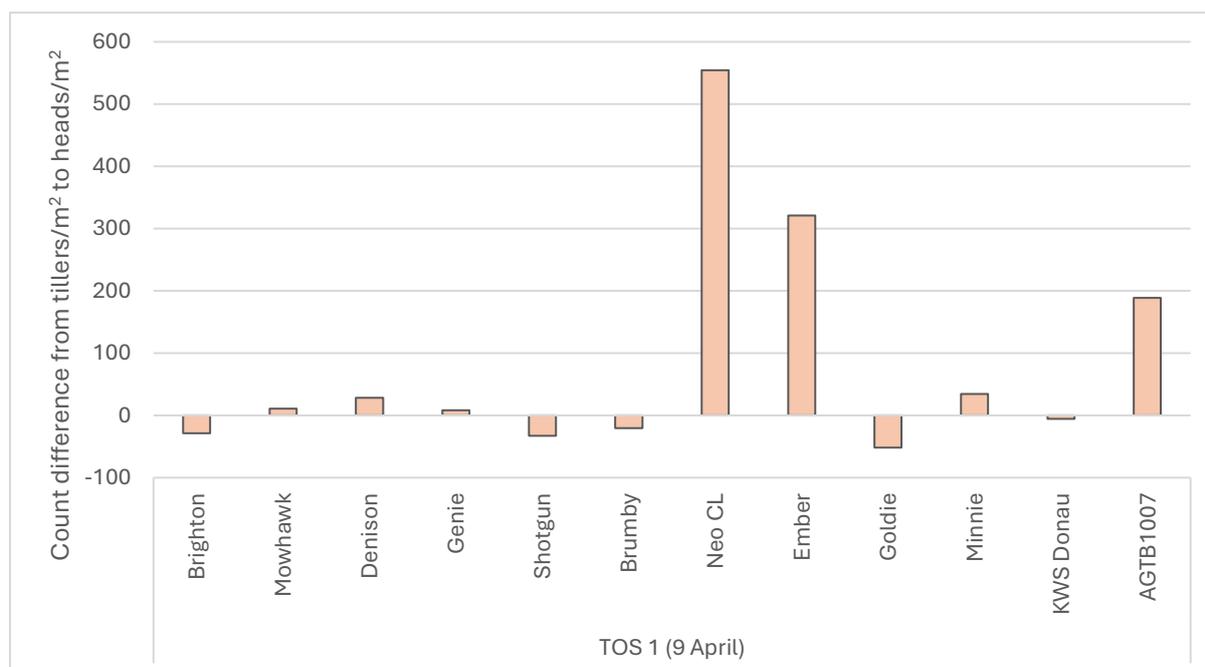
		Plants/m <sup>2</sup>	Tillers/m <sup>2</sup>	Heads/m <sup>2</sup>
TOS 1 (9 April)	Brighton	195.0 -	535.5 b-h	506.8 g-j
	Mowhawk	181.5 -	382.5 m-p	393.3 j-m
	Denison	179.5 -	415.0 k-p	443.5 i-l
	Genie	179.5 -	564.5 a-g	572.8 fgh
	Shotgun	167.5 -	374.5 m-p	341.7 lmn
	Brumby	146.0 -	439.0 i-o	418.5 i-l
	Neo CL	115.5 -	482.5 g-k	1037.0 a
	Ember	167.0 -	534.5 b-h	855.5 b
	Goldie	170.5 -	457.0 h-m	405.5 i-l
	Minnie	184.0 -	435.5 i-o	470.0 h-k
	KWS Donau	125.0 -	610.0 ab	604.3 efg
	AGTB1007	173.0 -	583.0 a-e	772.0 bcd
	<b>Mean</b>	<b>165.3 -</b>	<b>484.5 -</b>	<b>568.4 a</b>
TOS 2 (28 April)	Brighton	167.0 -	572.0 a-f	508.0 g-j
	Mowhawk	197.0 -	480.0 g-k	439.5 i-l
	Denison	175.0 -	441.0 i-o	433.5 i-l
	Genie	152.0 -	452.0 h-n	470.8 h-k
	Shotgun	190.5 -	361.5 op	352.0 lm
	Brumby	179.5 -	415.5 j-p	353.5 lm
	Neo CL	150.5 -	529.0 b-h	828.8 bc
	Ember	142.5 -	590.0 a-d	714.3 cde
	Goldie	191.5 -	391.0 l-p	288.3 mn
	Minnie	198.0 -	356.0 op	377.3 klm
	KWS Donau	115.5 -	639.0 a	664.0 def
	AGTB1007	182.0 -	598.0 abc	653.3 ef
	<b>Mean</b>	<b>170.1 -</b>	<b>485.4 -</b>	<b>506.9 b</b>
TOS 3 (20 May)	Brighton	185.5 -	517.0 c-i	489.5 g-k
	Mowhawk	174.5 -	501.5 e-j	510.0 ghi
	Denison	202.5 -	479.5 g-k	500.3 g-j
	Genie	206.0 -	505.5 d-i	473.5 h-k
	Shotgun	193.0 -	346.0 p	352.3 lm
	Brumby	174.5 -	480.5 g-k	433.3 i-l
	Neo CL	181.5 -	386.5 m-p	680.3 def
	Ember	174.0 -	581.0 a-e	709.3 de
	Goldie	156.5 -	366.5 nop	234.5 n
	Minnie	217.0 -	473.5 h-l	333.7 lmn
	KWS Donau	110.5 -	492.5 f-k	492.0 g-k
	AGTB1007	171.5 -	605.0 ab	635.8 ef
	<b>Mean</b>	<b>178.9 -</b>	<b>477.9 -</b>	<b>487.0 b</b>
	<b>Variety LSD (p=0.05)</b>	36.6	49.8	67.2
	<b>TOS LSD (p=0.05)</b>	ns	ns	43.6
	<b>Var x TOS LSD(p=0.05)</b>	ns	86.2	116.0
	<b>Variety P Value</b>	0.004	<0.001	<0.001
	<b>TOS P Value</b>	0.101	0.840	0.009
	<b>Var. x TOS P Value</b>	0.925	<0.001	<0.001

**Table 5.** Influence of time of sowing on Neo CL thousand grain weight (TGW).

Variety	Thousand Grain Weight (g)		
	TOS 1	TOS 2	TOS 3
Neo CL	43.96 b	43.79 b	48.04 a
	LSD TOS. $p = 0.05$ 2.49	P value	0.009

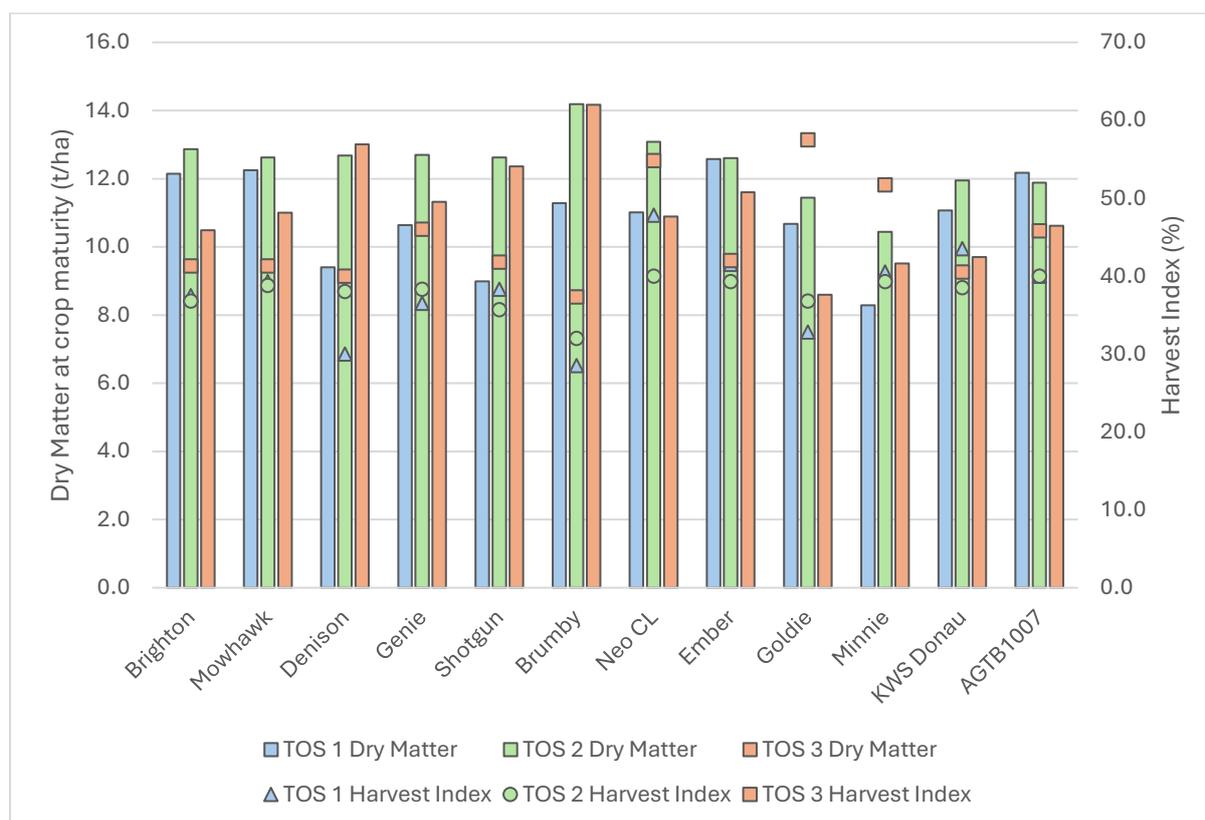


**Figure 3.** Comparison of canopy structure between a spring barley (Neo CL) and a spring wheat (Shotgun) showing relative adaptability through compensatory tillering in early sowing scenarios. Plant counts conducted at GS12, tiller counts at GS32 and head counts at GS89.



**Figure 4.** Net change in canopy structure (tillers/m<sup>2</sup> to heads/m<sup>2</sup>) in cereals sown in early April.

Final harvest dry matters ranged from 8.3-14.2 t/ha (figure 3). Spring wheats in general produced higher biomass at the TOS 2 and TOS 3 sowing dates which in general correlated to higher yields. Brumby had high final dry matters but lower harvest index. Neo CL had the highest harvest index at each sowing date, though not significantly higher than the two oat varieties in the late May sowing (appendix, table 15) which compensated with more grains on fewer tillers (table 4).



**Figure 5.** Influence of time of sowing (TOS 1, 2 and 3) and variety on dry matter (t/ha, P value=0.006, LSD=2.7) and harvest index (% , P value=0.034, LSD=8.7) at crop maturity. Harvest cuts done on 4 December.

### Phenology

The differences in development (phenology) between winter and spring germplasm was most notable at the early April sowing (figure 6) and with more similar phenology when sown in later May (figure 8). Interestingly, AGTB1007 winter barley had a quicker development than some of the spring germplasm sown in late May but developed slowly in the earlier sowing. Ember and Neo CL had similar phenology in TOS 1 despite the longer season nature of Ember. The later development of Ember was more noticeable in TOS 2 and 3, to the detriment of Ember yields which were significantly lower than Neo CL sown in late April and May, but not when early sowings were compared.

**Table 6.** Variety phenology progression (Zadoks Growth Stage, 0-99) across three times of sowing.

		6-Jun	25-Jun	8-Jul	22-Jul	5-Aug	21-Aug	1-Sep	23-Sep	6-Oct	20-Oct
<b>TOS 1 (9 April)</b>	<b>Shotgun</b>	31	33	55	61	65	74	77	88	89	91
	<b>Brumby</b>	30	33	51	59	61	71	73	85	87	89
	<b>Genie</b>	30	32	49	55	61	71	71	85	86	89
	<b>Denison</b>	23	32	39	51	55	69	69	82	86	89
	<b>Mowhawk</b>	24	25	30	32	32.5	45	49	61	76	82
	<b>Brighton</b>	24	24	30	31	37	43	46	65	75	83
	<b>Neo CL</b>	31	33	49	55	58	65	78	88	91	91
	<b>Ember</b>	31	32	49	55	55	61	72	88	88	91
	<b>AGTB1007</b>	25	29	31	32	37	44	62	79	84	89
	<b>KWS Donau</b>	28	29	29	29	29	29	32	49	69	81
	<b>Goldie</b>	30	31	41	47	55	65	71	83	89	91
	<b>Minnie</b>	31	32	41	49	55	63	77	84	89	91
<b>TOS 2 (28 April)</b>	<b>Shotgun</b>	21	30	37	41	49	59	66	82	85	85
	<b>Brumby</b>	21	30	31	37	39	53	59	69	82	85
	<b>Genie</b>	22	23	31	39	45	59	59	75	83	86
	<b>Denison</b>	22	23	31	32	39	45	52	68	77	85
	<b>Mowhawk</b>	24	26	26	30	32	33	41	56	73	82
	<b>Brighton</b>	22	25	30	31	31	37	39	56	69	82
	<b>Neo CL</b>	22	23	32	32	41	51	68	83	88	89
	<b>Ember</b>	22	25	32	32	33	41	51	75	84	89
	<b>AGTB1007</b>	22	29	29	32	32	37	44	71	83	87
	<b>KWS Donau</b>	23	29	29	29	29	28	31	47	67	82
	<b>Goldie</b>	21	22	31	32	39	49	52	81	84	85
	<b>Minnie</b>	21	30	32	32	39	46	54	82	83	88
<b>TOS 3 (20 May)</b>	<b>Shotgun</b>	11	21	22	31	31	37	41	59	68	82
	<b>Brumby</b>	12	21	23	30	31	37	33	58	69	83
	<b>Genie</b>	11	21	23	30	31	32	33	51	72	78
	<b>Denison</b>	12	21	23	23	24	32	33	45	61	78
	<b>Mowhawk</b>	12	21	24	25	25	30.5	32	43	59	76
	<b>Brighton</b>	12	21	23	23	24	31	32	39	57	75
	<b>Neo CL</b>	12	21	23	24	31	31	43	65	81	87
	<b>Ember</b>	12	22	25	25	30	32	37	51	65	85
	<b>AGTB1007</b>	12	22	27	27	30	32.5	37	52	78	85
	<b>KWS Donau</b>	12	22	26	29	29	28	29	32	49	76
	<b>Goldie</b>	11	14	22	30	31	32	37	51	65	82
	<b>Minnie</b>	11	14	22	30	31	37	38	51	61	83

*Please note that soil moisture was sufficient to ensure that all sowing dates emerged relative to planting date.*

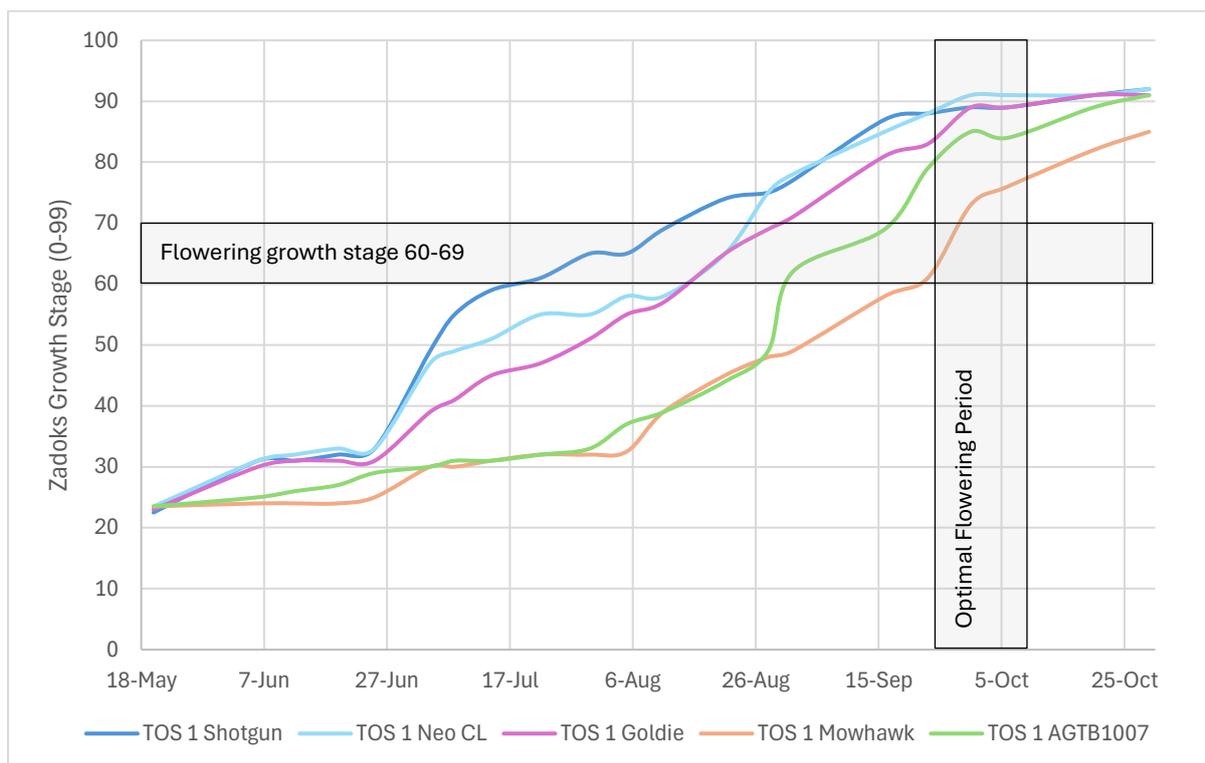


Figure 6. Influence of early April (9<sup>th</sup>) sowing (TOS 1) on phenology.

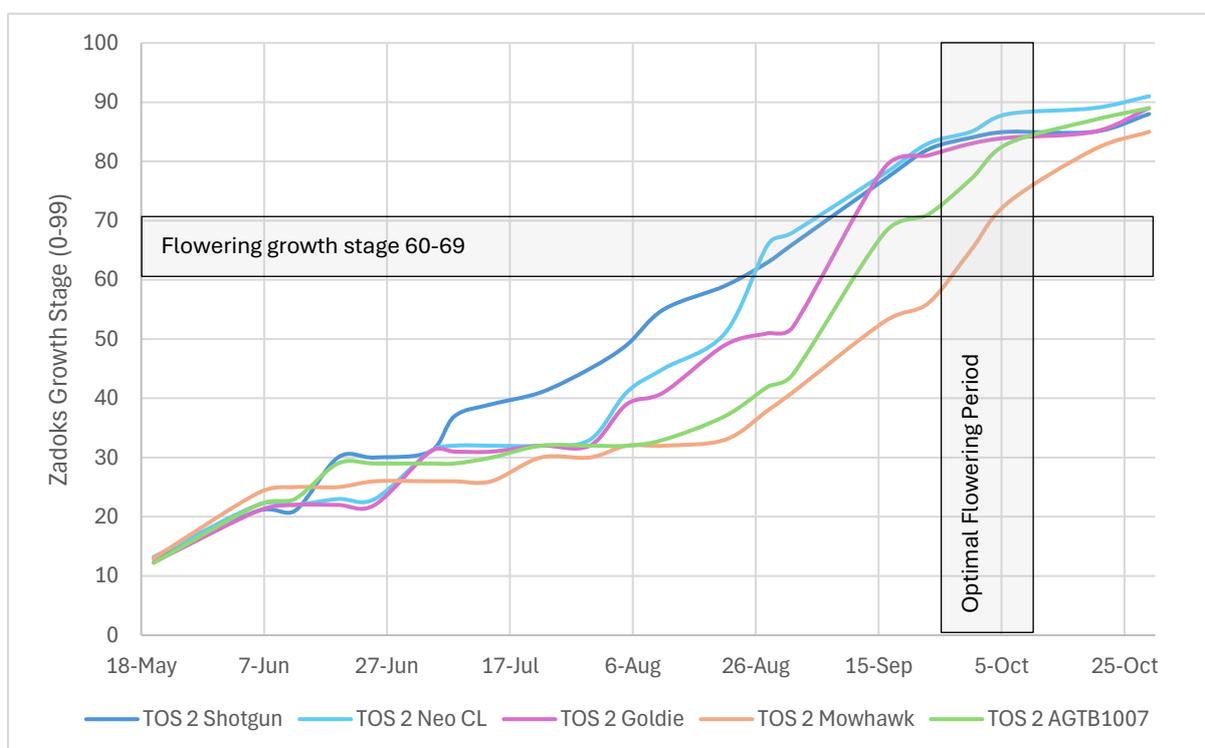
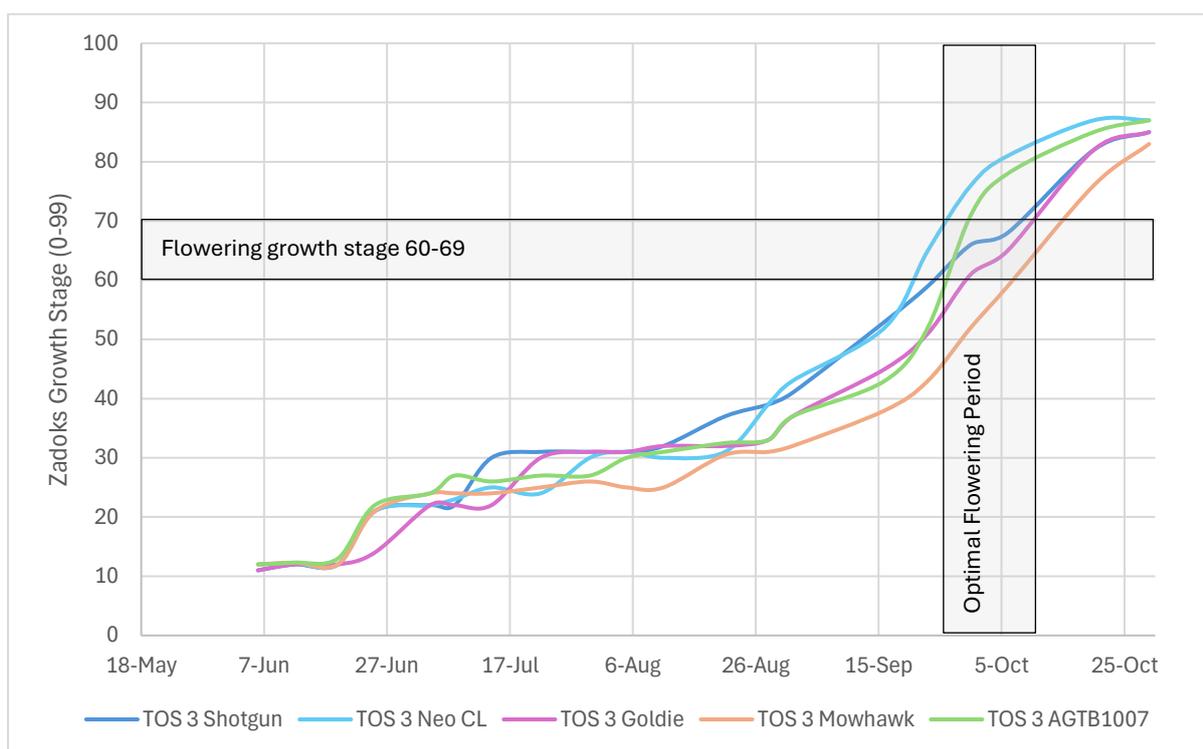
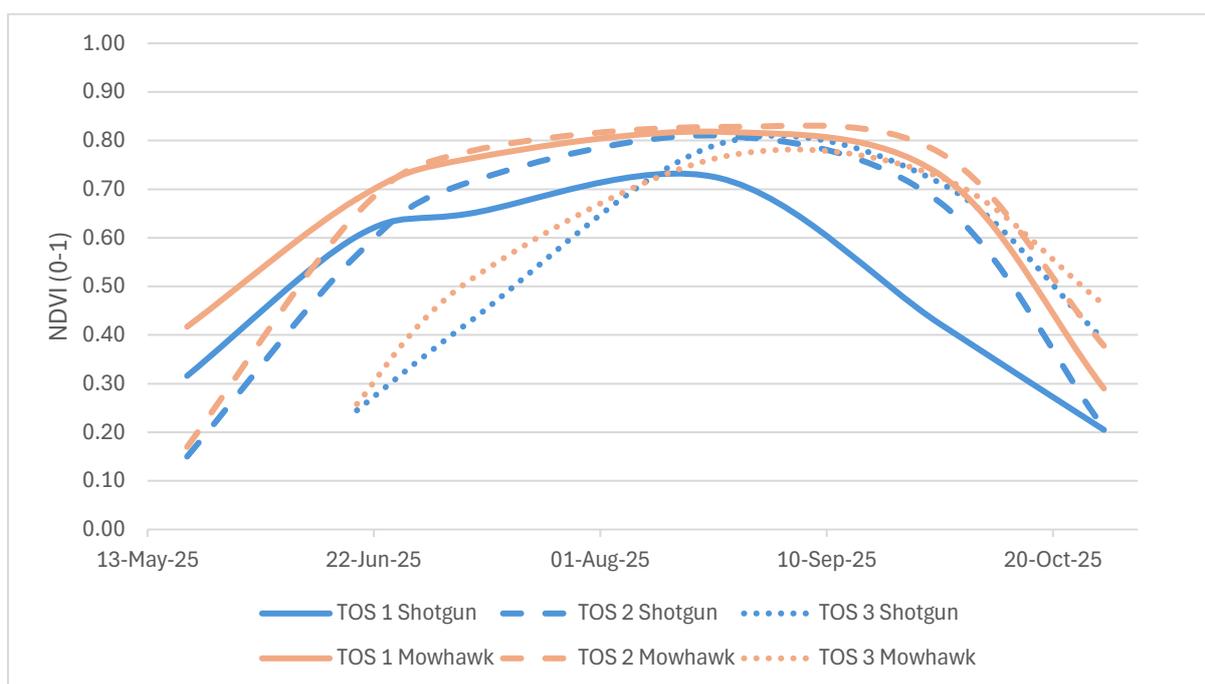


Figure 7. Influence of late April (28<sup>th</sup>) sowing (TOS 2) on phenology.

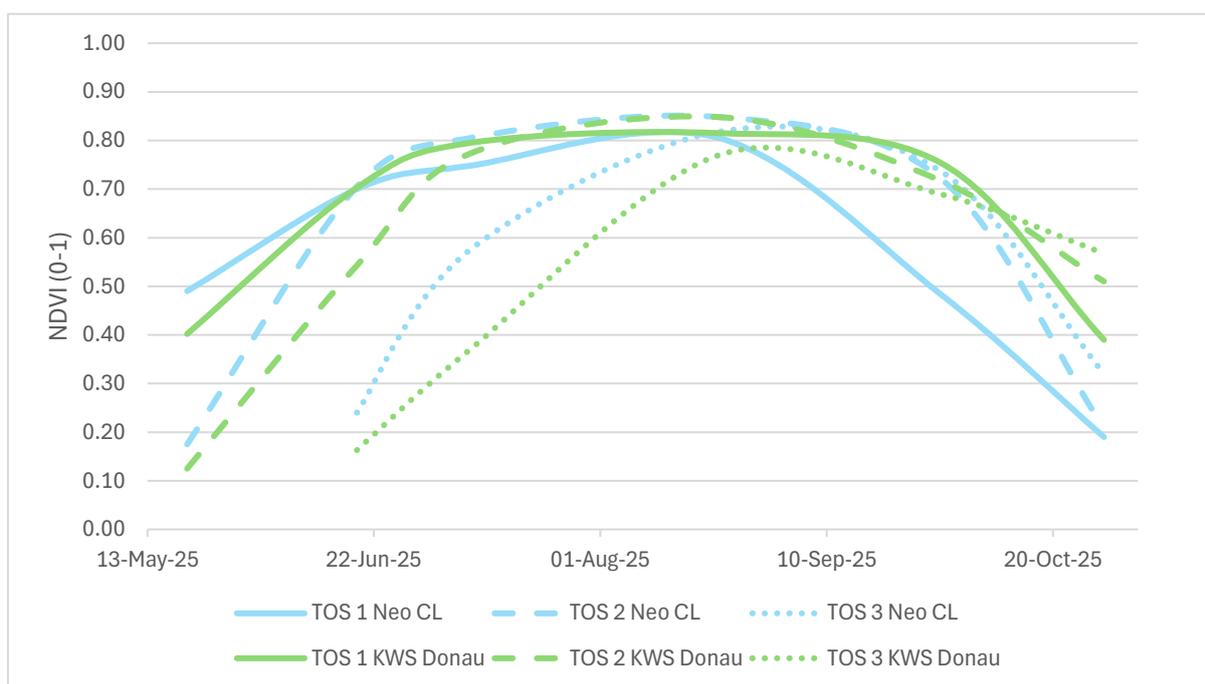


**Figure 8.** Influence of late May (20<sup>th</sup>) sowing (TOS 3) on phenology.

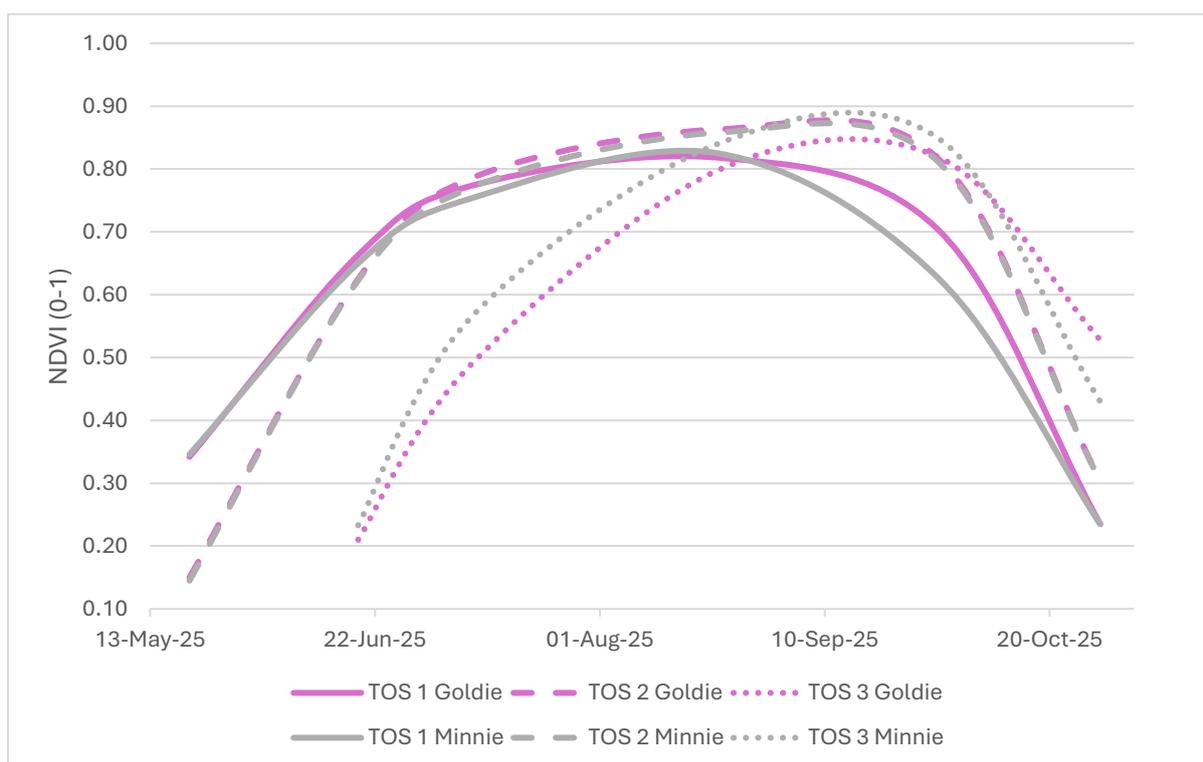
NDVI showed stronger early canopy development on 9<sup>th</sup> April sowing and variety-dependent senescence patterns across sowing times. A key feature across all cereal types was the delay in canopy development when crops were sown on 20<sup>th</sup> May (TOS 3), with NDVI curves starting and rising later. This reflects the shorter growing window and cooler establishment conditions of late May sowing, which compresses the vegetative phase of the crops development and shortens the time before the crop transitions to stem elongation and heading, especially in spring type varieties. By late September, the greenness of the later sown crops had largely recovered, showing similar NDVI figures to crops sown in early and late April. Mowhawk had greater NDVI than Shotgun in early and late April TOS (figure 9), whereas the barley and oats had similar NDVIs across TOS 1 and 2 but differed significantly in TOS 3 with Neo CL and Minnie being higher than KWS Donau and Goldie respectively (figures 10 & 11). Spring varieties sown early generally displayed NDVIs that declined sooner compared to winter type counterparts, consistent with earlier maturity through lack of vernalisation requirements. In early sowing (TOS 1), Shotgun achieved a stable respectable canopy but still could not match Mowhawk's duration of green leaf area.



**Figure 9.** Influence of time of sowing (TOS 1, 2 and 3) and variety (quick-mid spring wheat Shotgun and quick winter wheat Mowhawk) on crop reflectance (NDVI).

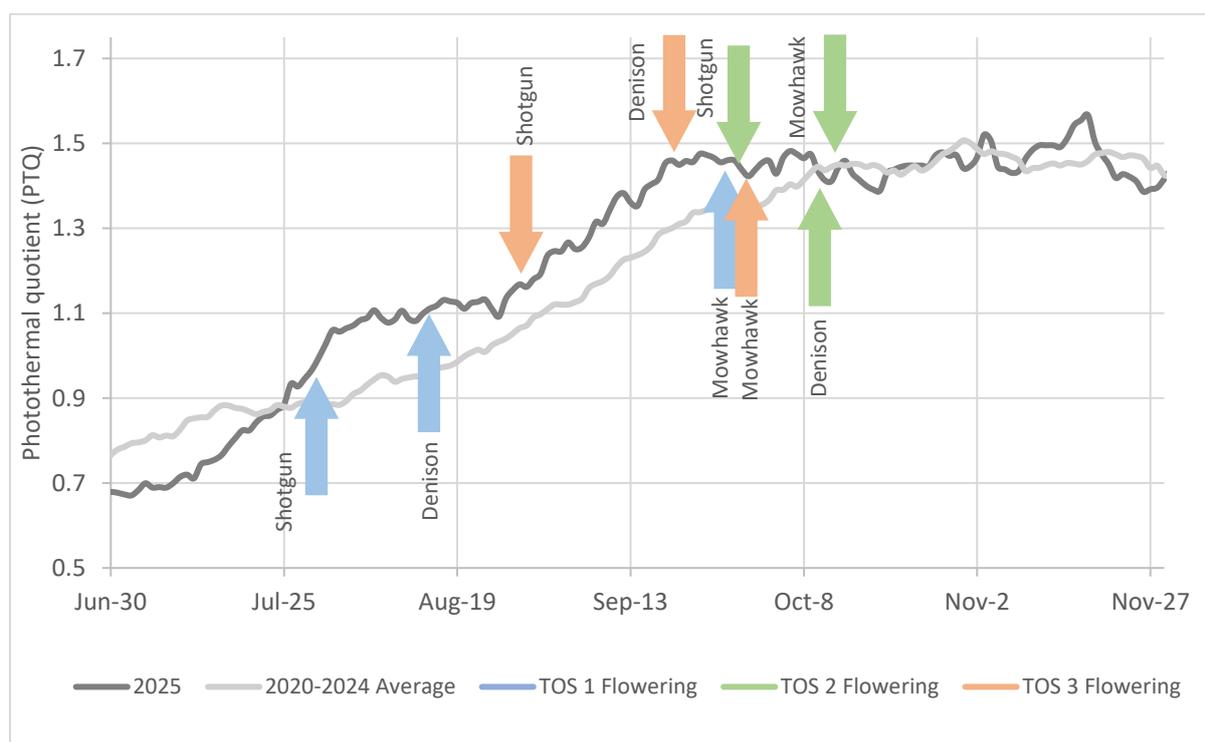


**Figure 10.** Influence of time of sowing (TOS 1, 2 and 3) and variety (spring barley Neo CL and winter barley KWS Donau) on crop reflectance (NDVI).



**Figure 11.** Influence of time of sowing (TOS 1, 2 and 3) and oat variety (Goldie and Minnie) on crop reflectance (NDVI).

Spring wheats showed less suitability for early April sowing because they developed quickly and flowered during late July and August when the photothermal quotient (PTQ) was still low due to reduced solar radiation - shorter day length paired with cloudier conditions in 2025 associated with wetter than average rainfall months (figure 12). These cultivars yielded highest when sown on the 20<sup>th</sup> May and flowering coincided with late September/early October when PTQ was higher by virtue of longer days and milder temperatures. Winter wheat Mowhawk showed much more stable flowering times across varying sowing dates with just over 2 weeks difference in flowering date between TOS 1 and TOS 3 despite a 40-day difference in emergence.



**Figure 12.** Photothermal quotient (PTQ) for 2025, and 2020-2024 5-year average at DPIRD weather station (Frankland River) in relation to the 2025 estimated flowering dates of Shotgun, Denison and Mowhawk at all times of sowing.

PTQ in the critical period is related to yield potential (or more precisely potential grain number). When soil moisture is not a limiting factor higher solar radiation combined with cooler conditions gives greater yield potential than lower solar radiation and higher temperatures in the critical period of approximately three weeks before flowering and one week of flowering (for cereals).

### Grain Quality

There were significant interactions between time of sowing and variety for all wheat quality parameters, including protein, test weight and screenings (table 7, 8 and 10). Quality generally declined by TOS 3. Test weights were consistently above 74.0 kg/hL apart from Shotgun and Brumby in TOS 1 which recorded significantly lower test weights that downgraded them to AUH2. In TOS 1, spring wheats had significantly higher protein than winter wheats, and Denison recorded a grade of H1 as a result. Wheat quality was generally good in TOS 2, except for Shotgun, which was downgraded to AUH2 due to elevated screenings. By TOS 3, screenings had increased and wheat protein levels were lower which was likely influenced by November rainfall prolonging green leaf area and increasing yield, resulting in all varieties except Brumby falling to AWW2 grade. A later nitrogen application may have helped increase TOS 2 and TOS 3 protein levels, although it is not possible to predict such soft finishes.

Protein, test weight, screenings and retention all showed significant varietal differences to TOS in barley (table 7, 8, 9 and 10). Protein and retention consistently met malt standards across all sowing dates, apart from Ember in TOS 3 which had significantly lower retention, below the 80% malt threshold. Interestingly, there were no significant quality differences among the winter barleys across sowing times, however Neo CL achieved significantly higher test weights in TOS 3 and was supported by the higher TGW (table 5). This allowed Neo CL to achieve malt status in TOS 3.

For oats, protein and screenings did not change significantly in response to sowing time, however all were of OAT1 grade (table 7 and 8). Test weights were the only parameter in oats affecting grade, with significant increases at later TOS, allowing higher grades. Goldie consistently recorded higher test weights than Minnie at every sowing date, resulting in Goldie achieving OAT2 grade and Minnie FEED in TOS2, and Goldie OAT1 and Minnie OAT2 in TOS 3.

**Table 7.** Influence of time of sowing (TOS 1, 2 and 3) and variety on protein (%). Harvested: barley- 12 December 2025, wheat and oats- 18 December 2025.

Variety	Protein (%)						Mean
	TOS 1		TOS 2		TOS 3		
Brighton	10.6	h-k	11.5	e-h	10.2	i-l	10.8 e
Mowhawk	11.4	e-h	11.3	f-i	9.7	kl	10.8 de
Denison	13.4	b	11.6	e-h	9.6	kl	11.5 bc
Genie	12.9	bcd	11.6	e-h	9.8	kl	11.4 cd
Shotgun	13.2	bc	11.5	e-h	9.6	kl	11.4 cd
Brumby	14.9	a	11.9	d-g	9.8	kl	12.2 a
Neo CL	12.2	b-f	12.0	d-g	10.0	jkl	11.4 cde
Ember	12.5	b-e	12.1	c-g	12.0	d-g	12.2 ab
Goldie	9.4	l	9.8	kl	9.4	kl	9.5 f
Minnie	10.0	jkl	10.2	i-l	9.9	jkl	10.0 f
KWS Donau	11.6	e-h	11.6	e-h	11.0	g-j	11.4 cde
AGTB1007	12.5	b-e	12.1	c-g	12.0	d-g	12.2 a
<b>Mean</b>	<b>12.04</b>	<b>a</b>	<b>11.42</b>	<b>b</b>	<b>10.24</b>	<b>c</b>	<b>11.2</b>
<b>LSD Variety p = 0.05</b>	0.7		<b>P value</b>		<0.001		
<b>LSD TOS p = 0.05</b>	0.4		<b>P value</b>		<0.001		
<b>LSD Variety x TOS p = 0.05</b>	1.2		<b>P value</b>		<0.001		

**Table 8.** Influence of time of sowing (TOS 1, 2 and 3) and variety on test weight (kg/hL). Harvested: barley- 12 December 2025, wheat and oats- 18 December 2025.

Variety	Test weight (kg/hL)							
	TOS 1		TOS 2		TOS 3		Mean	
Brighton	78.3	d-g	78.2	d-g	81.2	ab	79.23	a
Mowhawk	76.2	hi	78.2	d-g	80.3	abc	78.23	ab
Denison	75.5	i	77.6	e-h	81.2	ab	78.08	bc
Genie	76.5	ghi	79.2	cde	79.9	bcd	78.51	ab
Shotgun	73.6	j	77.3	f-i	81.7	a	77.51	bc
Brumby	72.3	j	79.0	c-f	80.2	abc	77.15	c
Neo CL	60.0	pq	60.5	opq	64.0	k	61.5	e
Ember	58.7	q	60.1	pq	61.1	nop	59.96	f
Goldie	46.8	t	50.0	s	51.9	r	49.58	g
Minnie	43.9	u	46.9	t	49.7	s	46.81	h
KWS Donau	61.8	m-p	62.0	l-o	62.0	l-o	61.9	e
AGTB1007	62.8	k-n	63.7	kl	63.2	klm	63.22	d
<b>Mean</b>	<b>65.52</b>	<b>c</b>	<b>67.71</b>	<b>b</b>	<b>69.69</b>	<b>a</b>	<b>67.6</b>	
<b>LSD Variety p = 0.05</b>	1.1		<b>P value</b>	<0.001				
<b>LSD TOS p = 0.05</b>	0.4		<b>P value</b>	<0.001				
<b>LSD Variety x TOS p = 0.05</b>	1.9		<b>P value</b>	<0.001				

**Table 9.** Influence of time of sowing (TOS 1, 2 and 3) and variety on barley retention (%). Harvested 12 December 2025.

Variety	Retention (%)							
	TOS 1		TOS 2		TOS 3		Mean	
Neo CL	87.0	ef	87.8	def	93.3	abc	89.4	b
Ember	88.6	c-f	84.5	f	72.7	g	82.0	c
KWS Donau	92.5	a-d	94.2	ab	97.1	a	94.6	a
AGTB1007	94.9	ab	95.9	ab	90.8	b-e	93.9	a
<b>Mean</b>	<b>90.8</b>	<b>-</b>	<b>90.6</b>	<b>-</b>	<b>88.5</b>	<b>-</b>	<b>90.0</b>	
<b>LSD Variety p = 0.05</b>	3.0		<b>P value</b>	<0.001				
<b>LSD TOS p = 0.05</b>	ns		<b>P value</b>	0.100				
<b>LSD Variety x TOS p = 0.05</b>	5.2		<b>P value</b>	<0.001				

**Table 10.** Influence of time of sowing (TOS 1, 2 and 3) and variety on screenings (%). Harvested: barley- 12 December 2025, wheat and oats- 18 December 2025.

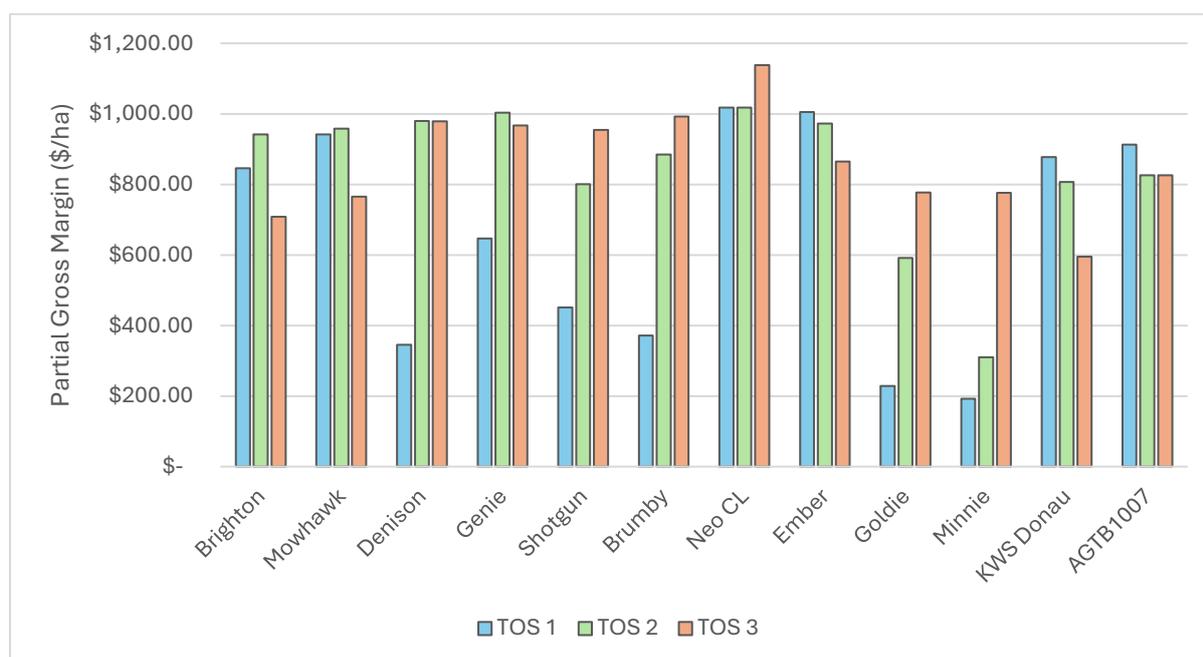
Variety	Screenings (%)				Mean
	TOS 1	TOS 2	TOS 3		
Brighton	3.1 j-n	3.5 g-l	5.7 a-d	4.1 cd	
Mowhawk	4.7 c-g	5.5 a-e	5.8 a-d	5.3 a	
Denison	3.7 f-k	4.6 d-h	5.4 a-e	4.6 bc	
Genie	4.6 d-g	4.9 b-e	5.5 a-e	5.0 ab	
Shotgun	3.3 h-m	6.2 ab	5.9 abc	5.1 ab	
Brumby	2.1 mno	4.7 c-g	4.4 e-i	3.7 d	
Neo CL	3.2 i-n	2.8 k-n	1.4 op	2.5 e	
Ember	3.1 j-n	3.0 k-n	6.2 a	4.1 cd	
Goldie	4.9 c-f	4.6 d-g	4.3 e-j	4.6 abc	
Minnie	5.1 a-e	5.3 a-e	5.2 a-e	5.2 ab	
KWS Donau	2.0 nop	1.4 op	0.8 p	1.4 f	
AGTB1007	1.4 op	1.2 op	2.4 l-o	1.6 f	
<b>Mean</b>	<b>3.4 b</b>	<b>4.0 ab</b>	<b>4.4 a</b>	<b>3.9</b>	
<b>LSD Variety p = 0.05</b>	0.7	<b>P value</b>	<0.001		
<b>LSD TOS p = 0.05</b>	0.7	<b>P value</b>	0.028		
<b>LSD Variety x TOS p = 0.05</b>	1.3	<b>P value</b>	<0.001		

### **Profitability**

There was a strong positive correlation between yield and partial gross margin (extra income gained minus extra variable costs), with Neo CL having the highest partial gross margin at all times of sowing. The spring wheat longer season varieties Denison and Genie had better quality in TOS 2 than 3, with both achieving H2 grade in TOS 2 compared to AWW2 in TOS 3. This meant that there was no difference in Denison gross margin between TOS 2 and 3, and a higher gross margin in Genie TOS 2 than 3.

**Table 11.** Influence of time of sowing (TOS) and variety on partial gross margin (total input & application costs). Grain prices (APW1 \$330, H1 \$355, H2 \$3340, AUH2 \$320, AWW2 \$315, ASW9 \$320, BFED1 \$320, MALT1 \$325, OAT2 \$285, OAT1 \$300, oat FEED \$240) based off average 25/26 FIS Albany zone rates from local grain marketer.

		Yield (t/ha)	Grade	Income (\$)	Cost (\$)	Partial Gross margin (\$/ha)
TOS 1 (9 April)	Brighton	4.54	APW1	\$1,498.20	\$652.32	\$845.88
	Mowhawk	4.83	APW1	\$1,593.90	\$652.32	\$941.58
	Denison	2.81	H1	\$997.55	\$652.32	\$345.23
	Genie	3.82	H2	\$1,298.80	\$652.32	\$646.48
	Shotgun	3.45	AUH2	\$1,104.00	\$652.32	\$451.68
	Brumby	3.20	AUH2	\$1,024.00	\$652.32	\$371.68
	Neo CL	5.22	BFED1	\$1,670.40	\$652.32	\$1,018.08
	Ember	5.18	BFED1	\$1,657.60	\$652.32	\$1,005.28
	Goldie	3.50	FEED	\$840.00	\$611.52	\$228.48
	Minnie	3.35	FEED	\$804.00	\$611.52	\$192.48
TOS 2 (28 April)	KWS Donau	4.78	BFED1	\$1,529.60	\$652.32	\$877.28
	AGTB1007	4.89	BFED1	\$1,564.80	\$652.32	\$912.48
	Brighton	4.69	H2	\$1,594.60	\$652.32	\$942.28
	Mowhawk	4.88	APW1	\$1,610.40	\$652.32	\$958.08
	Denison	4.80	H2	\$1,632.00	\$652.32	\$979.68
	Genie	4.87	H2	\$1,655.80	\$652.32	\$1,003.48
	Shotgun	4.54	AUH2	\$1,452.80	\$652.32	\$800.48
	Brumby	4.52	H2	\$1,536.80	\$652.32	\$884.48
	Neo CL	5.22	BFED1	\$1,670.40	\$652.32	\$1,018.08
	Ember	4.95	BFED1	\$1,584.00	\$611.52	\$972.48
TOS 3 (20 May)	Goldie	4.22	OAT2	\$1,202.70	\$611.52	\$591.18
	Minnie	4.01	FEED	\$962.40	\$652.32	\$310.08
	KWS Donau	4.56	BFED1	\$1,459.20	\$652.32	\$806.88
	AGTB1007	4.62	BFED1	\$1,478.40	\$652.32	\$826.08
	Brighton	4.32	AWW2	\$1,360.80	\$652.32	\$708.48
	Mowhawk	4.50	AWW2	\$1,417.50	\$652.32	\$765.18
	Denison	5.18	AWW2	\$1,631.70	\$652.32	\$979.38
	Genie	5.14	AWW2	\$1,619.10	\$652.32	\$966.78
	Shotgun	5.10	AWW2	\$1,606.50	\$652.32	\$954.18
	Brumby	5.14	ASW9	\$1,644.80	\$652.32	\$992.48
Neo CL	5.51	MALT1	\$1,790.75	\$652.32	\$1,138.43	
Ember	4.74	BFED1	\$1,516.80	\$652.32	\$864.48	
Goldie	4.63	OAT1	\$1,389.00	\$611.52	\$777.48	
Minnie	4.87	OAT2	\$1,387.95	\$611.52	\$776.43	
KWS Donau	3.90	BFED1	\$1,248.00	\$652.32	\$595.68	
AGTB1007	4.62	BFED1	\$1,478.40	\$652.32	\$826.08	



**Figure 13.** Influence of variety and time of sowing on partial gross margin (\$/ha).

### Trial Inputs

**Table 12.** Trial input and management details.

<b>Sowing date:</b>	TOS 1- 9-Apr; TOS 2- 29-Apr; TOS 3- 20-May	
<b>Harvest date:</b>	Barley- 12-Dec; Wheat and Oats- 18-Dec	
<b>Seed rate:</b>	200 seeds/m <sup>2</sup>	
<b>Basal fertiliser:</b>	9-Apr, 28-Apr, 20-May	125 kg/ha MAP/MOP (80/20) blend
<b>Seed Treatment</b>	Rancona Dimension 320 mL/100 kg Cruiser 350 200 mL/ha	
<b>Pre-em herbicide:</b>	9-Apr, 28-Apr, 20-May	TriflurX 2.0 L/ha Overwatch 1.2 L/ha (not on the oats)
<b>Post-em herbicide:</b>	22-May 2-Jul	Bromoxynil 800 mL/ha MCPA Amine 750 600 mL/ha
<b>Insecticide:</b>	22-May	Trojan 10 mL/ha
<b>Nutrition:</b>	3-Jun 1-Jul 14 July 5-Aug 18-Aug	Urea/MOP 65:35 110 kg/ha Urea 110 kg/ha (50.6 kg N/ha) Urea 110 kg/ha (50.6 kg N/ha) Urea 60 kg/ha (27.6 kg N/ha) Rapisol Mn 1 kg/ha
<b>Fungicide:</b>	GS 31-32 GS 39-45	Prosaro 300 mL/ha Aviator Xpro 500 mL/ha

## CONCLUSIONS

**Provide a summary of findings, including implications and future activities.**

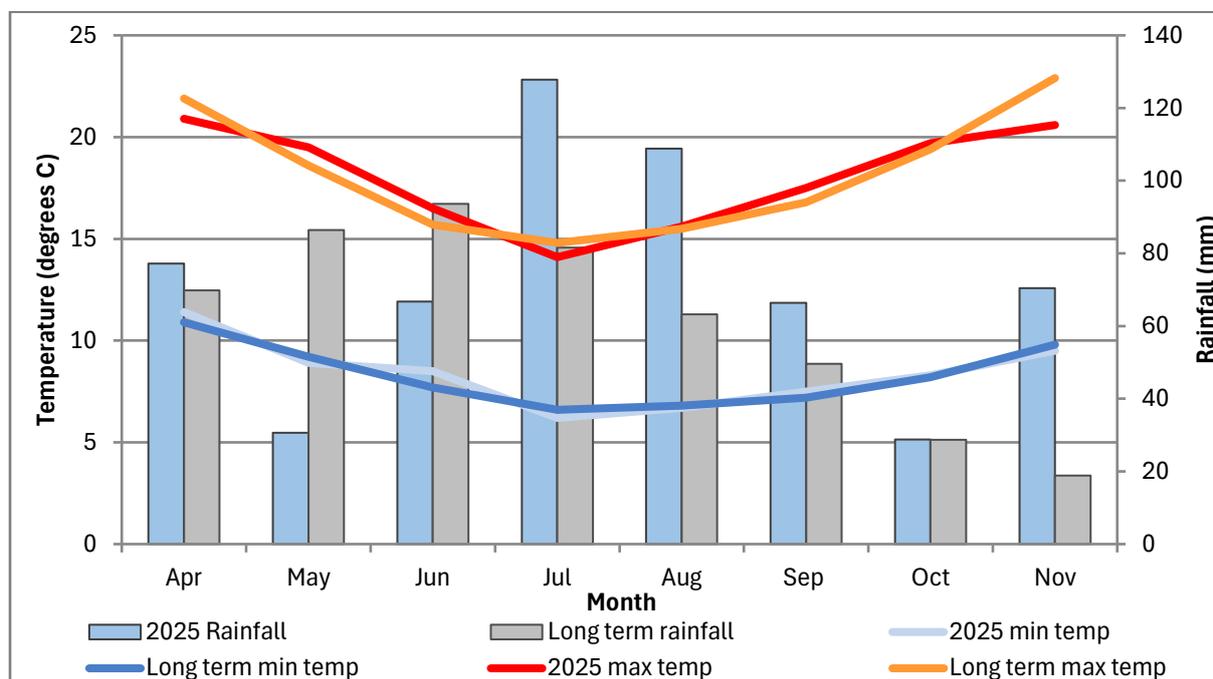
The results from the first year of the project reinforce key messages from the previous NGN pilot project 'FAR 2403 001SAX' on the importance of aligning germplasm choice with sowing opportunity to maximise productivity and profitability. Corresponding to a similar trial in 2024, spring barley germplasm was more productive than winter germplasm (barley and wheat) when sown in an early commercial sowing window of early April, despite seemingly not suiting the phenology of spring germplasm. Poor adaptation to very early sowing causes rapid, unrestrained development of spring wheat, barley and oat germplasm resulting in poor growing conditions (lower solar radiation and increased frost risk) coinciding with the critical period in the lead up to flowering. Even though this phenomenon caused reduced productivity in the spring wheat and oat varieties, the spring barley varieties adapted strongly by increasing side tiller growth that developed later than the main stem. This compensatory growth which led to higher final head numbers was sufficient to ensure that spring barley germplasm was more profitable than winter germplasm (wheat or barley) in the early sowing window.

Winter wheats and barleys maintained a more stable and seasonally appropriate phenology in the early sowing treatment, however the developmental gap between winter and spring types narrowed considerably in the later sowing dates where phenology became more aligned. There was not a significant yield benefit to sowing winter germplasm earlier than late April (possibly as a result of a soft finish), though profitability was maximised for winter wheats in the late April sowing and for winter barleys in the early April sowing.

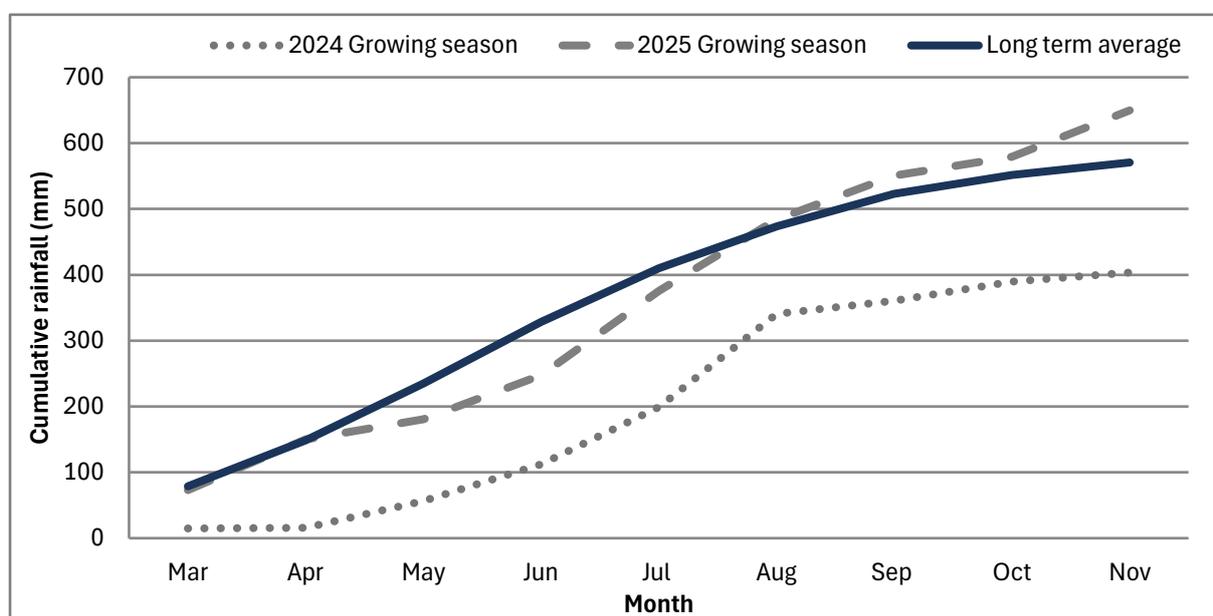
Unlike the winter germplasm, oat varieties presented clear management sensitivities in the HRZ of Albany port zone, including heightened disease pressure and lodging tendencies compared to wheat and barley under all times of sowing. This presented a need for targeted agronomy when including oats into programs, including mid-late May sowing, a more robust fungicide program and plant growth regulators (PGR).

All spring wheats yielded higher in later sowings, however long season spring wheats maintained stronger margins in late April sowing due to better grain quality.

## APPENDIX A: Meteorological Data



**Figure 14.** 2025 growing season (Apr-Nov) and long-term rainfall and minimum and maximum temperatures recorded at Frankland River (rainfall and temperature) *Rainfall April to November = 580.6mm.*



**Figure 15.** Cumulative growing season rainfall for 2024, 2025 and the long-term average for the growing season.

1.3°C and 2.4°C mornings were recorded on 27<sup>th</sup> August and 8<sup>th</sup> September respectively at an elevated site at Gunwarrie weather station.

## APPENDIX B: Supporting Trial Data

**Table 13.** Influence of time of sowing (TOS 1, 2 and 3) and variety on tillers/plant measured at GS31-33.

Variety	Tillers/plant (GS31-33)			
	TOS 1	TOS 2	TOS 3	Mean
Brighton	3.3 -	2.8 -	2.8 -	3.0 c
Mowhawk	2.0 -	2.4 -	2.8 -	2.4 de
Denison	2.4 -	2.5 -	2.5 -	2.4 cde
Genie	3.2 -	2.6 -	2.6 -	2.8 cd
Shotgun	2.3 -	2.3 -	2.0 -	2.2 e
Brumby	3.0 -	3.0 -	2.9 -	3.0 c
Neo CL	3.0 -	2.9 -	2.0 -	2.6 cde
Ember	3.4 -	3.9 -	3.4 -	3.6 b
Goldie	2.7 -	2.1 -	2.3 -	2.4 de
Minnie	2.5 -	1.9 -	2.2 -	2.2 e
KWS Donau	7.4 -	8.4 -	6.3 -	7.3 a
AGTB1007	3.4 -	3.6 -	3.8 -	3.6 b
<b>Mean</b>	<b>3.2 a</b>	<b>3.2 a</b>	<b>3.0 b</b>	<b>3.1</b>
<b>LSD Variety p = 0.05</b>	0.6	<b>P value</b>	<0.001	
<b>LSD TOS p = 0.05</b>	0.2	<b>P value</b>	0.010	
<b>LSD Variety x TOS. p = 0.05</b>	ns	<b>P value</b>	0.147	

**Table 14.** Influence of time of sowing (TOS 1, 2 and 3) and variety on heads/plant measured at crop maturity (GS99).

Variety	Heads/plant (GS99)			
	TOS 1	TOS 2	TOS 3	Mean
Brighton	3.1 g-k	2.5 i-o	2.7 i-m	2.8 d
Mowhawk	2.0 k-o	2.2 k-o	2.8 i-m	2.4 def
Denison	2.5 i-o	2.5 i-o	2.5 i-n	2.5 de
Genie	3.3 g-j	2.7 i-m	2.1 k-o	2.7 d
Shotgun	2.3 j-o	2.4 j-o	2.0 l-o	2.2 def
Brumby	2.9 h-l	2.6 i-n	2.7 i-m	2.7 d
Neo CL	6.4 bc	4.6 de	3.5 f-i	4.8 b
Ember	5.5 cd	4.6 de	4.1 efg	4.7 bc
Goldie	2.4 i-o	1.6 no	1.5 o	1.8 f
Minnie	2.6 i-n	1.8 mno	1.5 no	2.0 ef
KWS Donau	7.2 b	8.7 a	6.2 bc	7.4 a
AGTB1007	4.5 def	3.9 e-h	4.1 efg	4.2 c
<b>Mean</b>	<b>3.7 a</b>	<b>3.3 b</b>	<b>3.0 c</b>	<b>3.3</b>
<b>LSD Variety p = 0.05</b>	0.6	<b>P value</b>	<0.001	
<b>LSD TOS p = 0.05</b>	0.3	<b>P value</b>	0.002	
<b>LSD Variety x TOS. p = 0.05</b>	1.1	<b>P value</b>	0.002	

**Table 15.** Influence of time of sowing (TOS 1, 2 and 3) and variety on dry matter (t/ha).

Variety	Dry Matter (t/ha)							
	TOS 1		TOS 2		TOS 3		Mean	
Brighton	12.1	a-g	12.9	a-d	10.5	g-k	11.8	bc
Mowhawk	12.3	a-g	12.6	a-f	11.0	c-j	12.0	bc
Denison	9.4	i-l	12.7	a-f	13.0	abc	11.7	bc
Genie	10.6	e-k	12.7	a-e	11.3	b-i	11.6	bc
Shotgun	9.0	jkl	12.6	a-f	12.4	a-g	11.3	bcd
Brumby	11.3	b-i	14.2	a	14.2	a	13.2	a
Neo CL	11.0	b-j	13.1	ab	10.9	d-j	11.7	bc
Ember	12.6	a-f	12.6	a-f	11.6	b-h	12.3	ab
Goldie	10.7	e-j	11.4	b-i	8.6	kl	10.2	de
Minnie	8.3	l	10.4	g-k	9.5	i-l	9.4	e
KWS Donau	11.1	b-i	11.9	b-g	9.7	h-l	10.9	cd
AGTB1007	12.2	a-g	11.9	b-g	10.6	f-k	11.6	bc
<b>Mean</b>	<b>10.9</b>	<b>b</b>	<b>12.4</b>	<b>a</b>	<b>11.1</b>	<b>b</b>	<b>11.5</b>	
<b>LSD Variety p = 0.05</b>	1.2		<b>P value</b>	<0.001				
<b>LSD TOS p = 0.05</b>	0.9		<b>P value</b>	0.010				
<b>LSD Variety x TOS. p = 0.05</b>	2.1		<b>P value</b>	0.006				

**Table 16.** Influence of time of sowing (TOS 1, 2 and 3) and variety on harvest index (%). Calculated with yields at 0% moisture.

Variety	Harvest Index (%)							
	TOS 1		TOS 2		TOS 3		Mean	
Brighton	37.5	e-j	36.8	g-k	41.3	d-h	38.5	cd
Mowhawk	39.3	d-i	38.8	e-i	41.3	d-h	39.8	bcd
Denison	30.0	jk	38.0	e-j	40.0	d-i	36.0	de
Genie	36.5	g-k	38.3	e-j	46.0	cde	40.3	bcd
Shotgun	38.3	e-j	35.7	g-k	41.8	d-g	38.6	cd
Brumby	28.5	k	32.0	ijk	37.3	f-j	32.6	e
Neo CL	47.8	bcd	40.0	d-i	54.8	ab	47.5	a
Ember	41.5	d-g	39.3	d-i	42.0	d-g	40.9	bcd
Goldie	32.8	h-k	36.8	g-k	57.5	a	42.3	bc
Minnie	40.5	d-i	39.3	d-i	51.7	abc	43.8	ab
KWS Donau	43.5	c-g	38.5	e-j	40.5	d-i	40.8	bcd
AGTB1007	40.0	d-i	40.0	d-i	45.8	c-f	41.9	bc
<b>Mean</b>	<b>38.0</b>	<b>b</b>	<b>37.8</b>	<b>b</b>	<b>45.0</b>	<b>a</b>	<b>40.3</b>	
<b>LSD Variety p = 0.05</b>	5.0		<b>P value</b>	<0.001				
<b>LSD TOS p = 0.05</b>	2.7		<b>P value</b>	0.001				
<b>LSD Variety x TOS. p = 0.05</b>	8.7		<b>P value</b>	0.034				

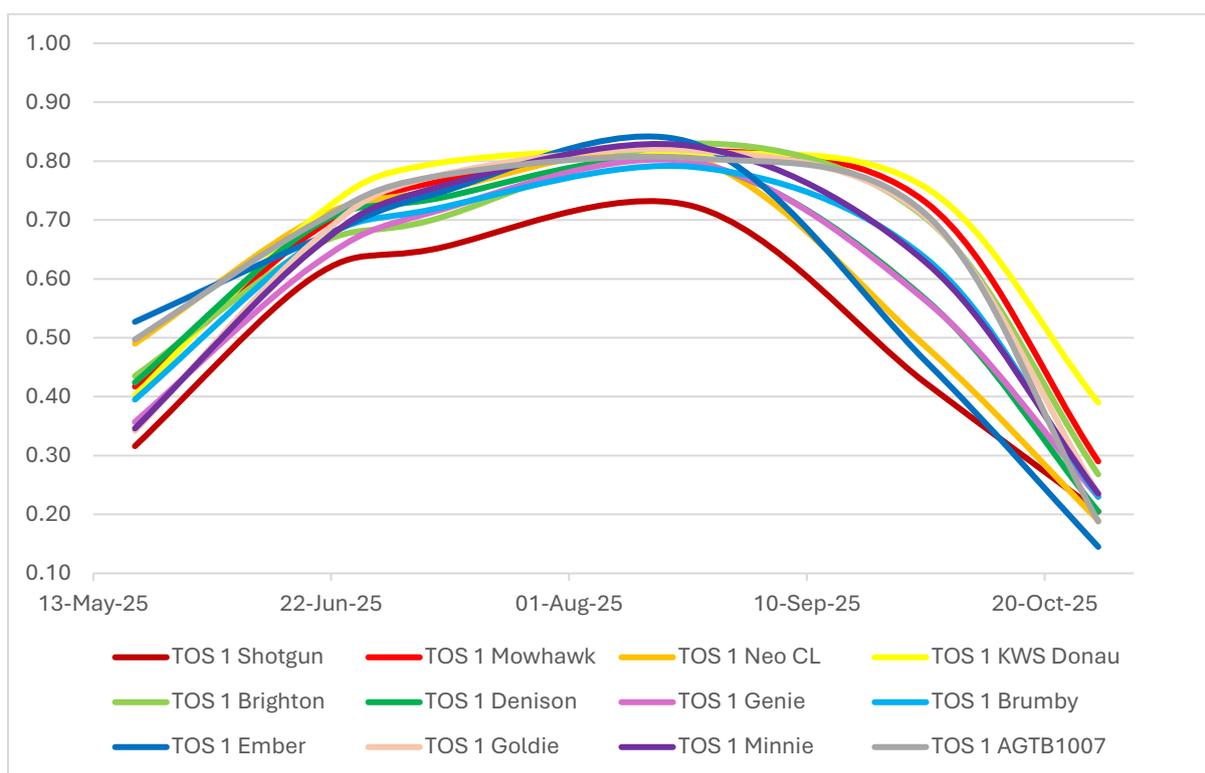


Figure 16. Influence of TOS 1 and variety on crop reflectance (NDVI).

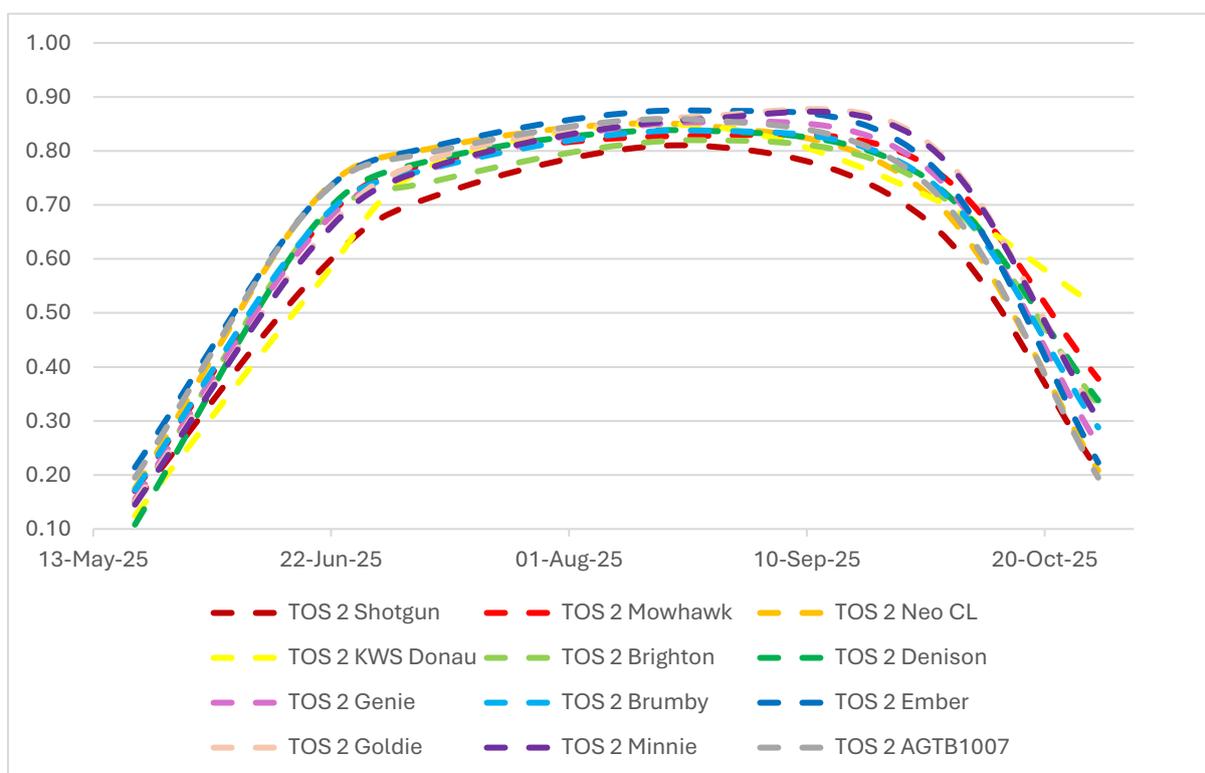
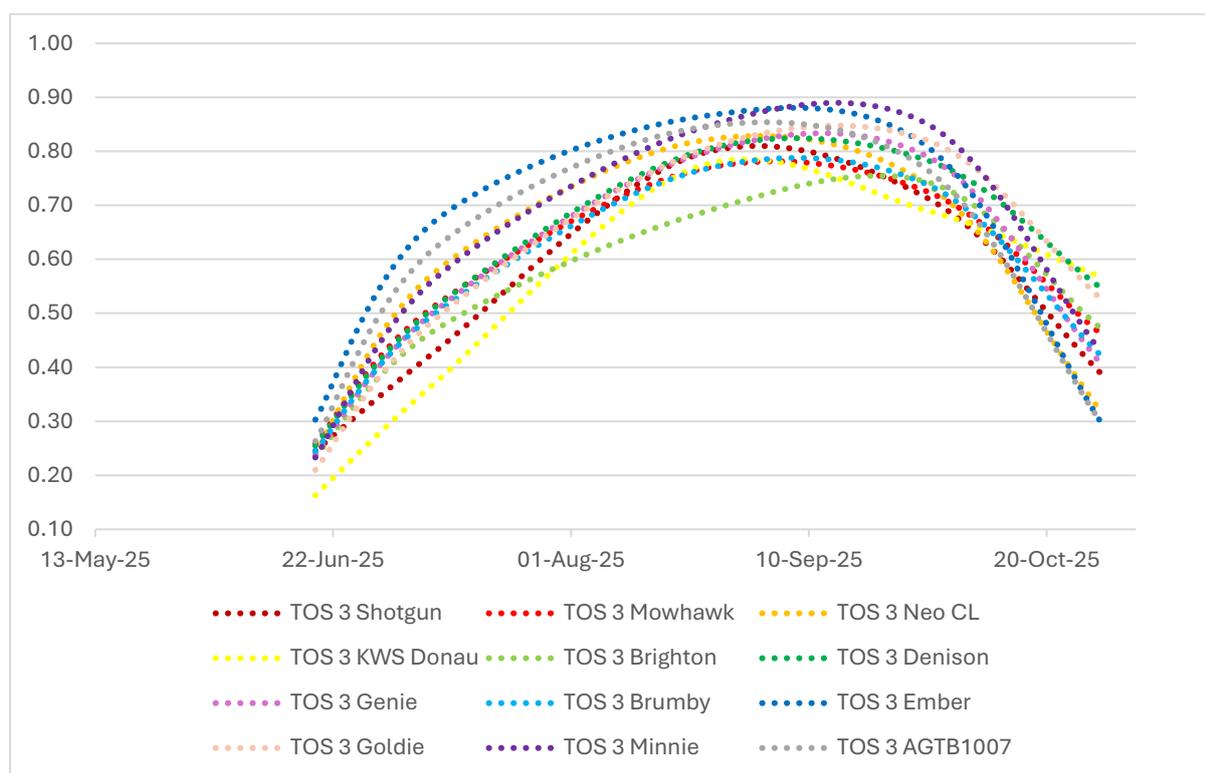


Figure 17. Influence of TOS 2 and variety on crop reflectance (NDVI)



**Figure 18.** Influence of TOS 3 and variety on crop reflectance (NDVI).

**Table 17.** Summary of input and application costs used in partial gross margin analysis.

	Cost (\$)	Unit
<b>Seed Treatment</b>		
Cruiser	\$9.36	/100 kg seed
Rancona Dimension	\$3.60	/100 kg seed
<b>Herbicide</b>		
TriflurX	\$11	/ha
Overwatch	\$40.8	/ha
MCPA Amine 750	\$5.40	/ha
Bromoxynil	\$8.80	/ha
<b>Insecticide</b>		
Trojan	\$1.07	/ha
<b>Fungicide</b>		
Prosaro	\$4.50	/ha
Aviator Xpro	\$20.69	/ha
<b>Nutrition</b>		
Urea	\$815.00	/t
MAP/MOP (80/20) blend	\$97.63	/ha
Urea/MOP (65:35) blend	\$86.02	/ha
Rapisol Manganese	\$14.25	/ha
<b>Applications</b>		
Spraying (per application)	\$14.00	/ha
Spreading (per application)	\$8.50	/ha

## APPENDIX C: Photos



**Image 1.** TOS 1 plots, GS30, 6 June. Variety: Brumby



**Image 2.** TOS 2 plots, GS21, 6 June. Variety: Minnie



**Image 3.** TOS 3 plots, GS12, 6 June. Variety: KWS Donau



**Image 4.** TOS 1 plots, GS51, 8 July. Variety: Brumby



**Image 5.** TOS 2 plots, GS32, 8 July. Variety: Minnie



**Image 6.** TOS 3 plots, GS26, 8 July. Variety: KWS Donau



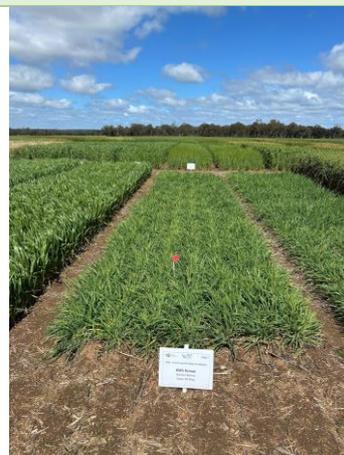
**Image 7.** TOS 1 plots, GS63, 7 August. Variety: Brumby



**Image 8.** TOS 2 plots, GS39, 7 August. Variety: Minnie



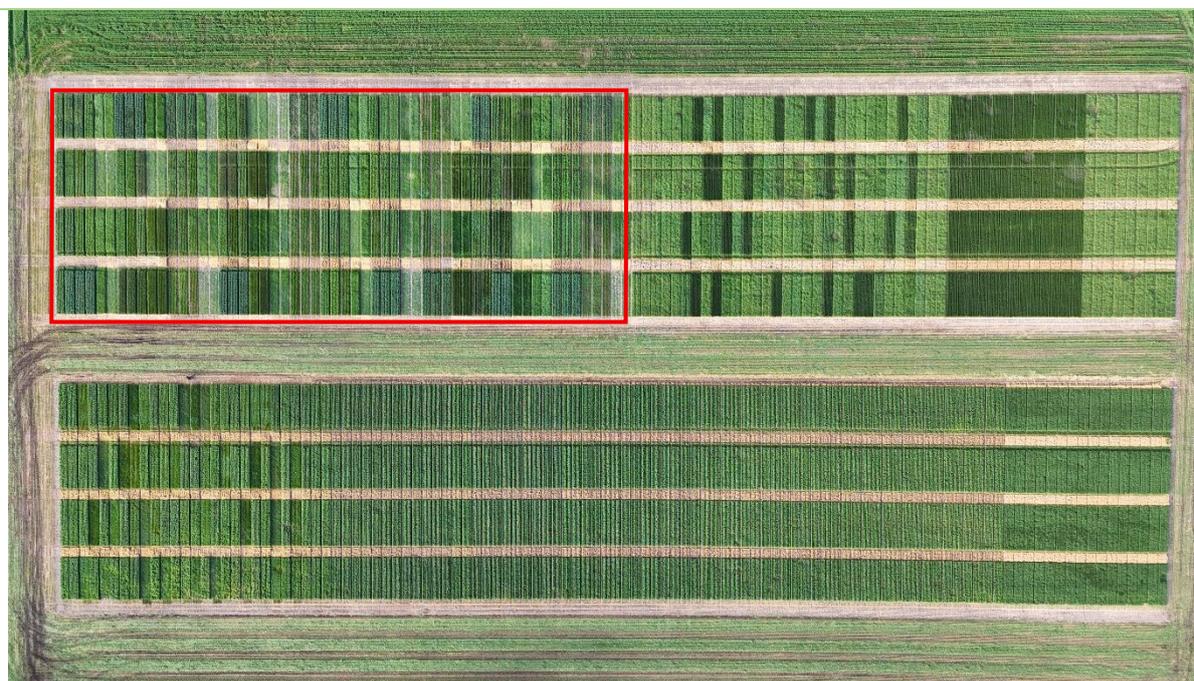
**Image 9.** TOS 3 plots, GS29, 7 August. Variety: KWS Donau



**Image 10.** TOS 1 plots, GS73, 16 September. Variety: Brumby

**Image 11.** TOS 2 plots, GS54, 16 September. Variety: Minnie

**Image 12.** TOS 3 plots, GS30, 16 September. Variety: KWS Donau



**Image 13.** Trial at Frankland River Crop Technology Centre (CTC), 13 August 2025



**Image 14.** Trial at Frankland River CTC main field day, 11 September 2025



**Image 15.** Trial at Frankland River CTC, 6 October 2025

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## REFERENCES AND USEFUL LINKS

### Winter Wheat Investigation on the Southcoast of Western Australia (2024)

- Link as follows: <https://www.farmtrials.com.au/trial/38190>