

NSW research results

RESEARCH & DEVELOPMENT – INDEPENDENT RESEARCH FOR INDUSTRY

The following paper is from an edition of the Northern or Southern New South Wales research results book.

Published annually since 2012, these books contain a collection of papers that provide an insight into selected research and development activities undertaken by NSW DPI in northern and southern NSW.

Not all papers will be accessible to readers with limited vision.
For help, please contact: Carey Martin at carey.martin@dpi.nsw.gov.au

©State of NSW through the Department of Regional New South Wales, 2023

Published by NSW Department of Primary Industries,
a part of the Department of Regional New South Wales.

You may copy, distribute, display, download and otherwise freely deal with this publication for any purpose, provided that you attribute the Department of Regional New South Wales as the owner. However, you must obtain permission if you wish to charge others for access to the publication (other than at cost); include the publication advertising or a product for sale; modify the publication; or republish the publication on a website. You may freely link to the publication on a departmental website.

Disclaimer

The information contained in this publication is based on knowledge and understanding at the time of writing. However, because of advances in knowledge, users are reminded of the need to ensure that the information upon which they rely is up to date and to check the currency of the information with the appropriate officer of the Department of Regional New South Wales or the user's independent adviser.

Any product trade names are supplied on the understanding that no preference between equivalent products is intended and that the inclusion of a product name does not imply endorsement by the department over any equivalent product from another manufacturer.

Long coleoptile durum wheat experiment – Riverina 2024

Tony Napier¹, Daniel Johnston¹, Mitch Clifton² and Steven Simpfendorfer²

¹NSW DPIRD, Yanco Agricultural Institute, Private Mail Bag, Yanco NSW 2703

²NSW DPIRD, Tamworth Agricultural Institute, 4 Marsden Park Road, Calala NSW 2340

Key findings

- With adequate soil moisture, sowing durum wheat earlier in the season (27 May) at the shallow depth (4 cm) produced a higher yield compared with either later (17 June) or deeper sowing (12 cm).
 - When there is not enough soil moisture to sow at a shallower depth, there is a choice between increasing the sowing depth in search of adequate soil moisture or to delay the sowing time and hope for rain to enable shallow sowing.
 - Results of this experiment demonstrated that increasing the sowing depth to 12 cm and sowing earlier produced a similar yield to delaying sowing by 3 weeks and sowing shallower at 4 cm.
 - In 2024, the commercial durum variety DBA Vittaroi[®] outperformed the new long coleoptile durum breeding line V190245-6 at both sowing depths and times of sowing.
 - Results in 2024 gave similar results as in 2023 when comparing commercial durum varieties to long coleoptile durum varieties. The new long coleoptile durum line did not demonstrate any advantage in crop establishment or grain yield. In the 2 durum wheat experiments over both years, the use of a new long coleoptile durum line resulted in a yield penalty.
 - In 2024, there was an average 13–15% grain yield loss in all treatments due to fusarium crown rot (FCR) infection. Neither sowing depth nor time of sowing (TOS) affected the severity of yield loss in 2024.
-

Keywords

Durum, variety, grain yield, sowing depth, time of sowing, biomass, FCR

Introduction

In seasons when the autumn break is delayed, growers might consider the option to sow cereals deeper than the normal 4–5 cm in search of adequate soil moisture to allow seed germination and emergence. When sowing depth is increased to 12 cm, there is the potential for wheat varieties with genetically longer coleoptiles to improve crop establishment and productivity. This experiment assessed yield and fusarium crown rot (FCR) outcomes associated with planting at 2 different depths for both earlier and later sowing within the recommended window for the Riverina.

Materials and method

Site details

Location	Leeton Field Station (LFS)
Soil type	Self-mulching medium clay
Previous crop	Field pea
Soil starting nitrogen (N)	140 kg N/ha (60 cm)
Starter fertiliser	100 kg/ha of mono-ammonium phosphate (MAP) (10 kg N/ha)
Time of sowing (TOS)	<ul style="list-style-type: none">TOS1: 27 May 2024TOS2: 17 June 2024
Row spacing	350 mm
Target plant density	100 plants/m ²
In-season rainfall	<ul style="list-style-type: none">Autumn: 73 mmWinter: 86 mmSpring: 64 mm
Fungicides	<ul style="list-style-type: none">Soprano (125 g/L epoxiconazole) at 125 mL/ha.Prosaro 420 (210 g/L prothioconazole and 210 g/L terbuconazole) at 300 mL/ha.
Herbicides	<ul style="list-style-type: none">Trilogy (480 g/L trifluralin) at 1.7 L/ha.Boxer Gold (800 g/L prosulfocarb and 120 g/L S-metolachlor) at 2.5 L/ha.Achieve (400 g/kg tralkoxydim) at 500 g/ha.Axial Xtra (50 g/L pinoxaden and 12.5 g/L cloquintocet-mexyl) at 600 mL/ha.L.V.E. Agritone (570 g/L MCPA present as the 2-ethylhexyl ester) at 1.8 L/ha.
Harvest date	2 December 2024

Treatments

The experiment was a split-split-plot design with main plots as time of sowing (TOS), then split for sowing depth and genotype (minus and plus FCR) randomised within subplots (Table 1). Each interaction (TOS × sowing depth × genotype × FCR) had 3 replications across the experiment area. With 3 replicates of 3 varieties × 2 FCR treatments × 2 sowing depths × 2 sowing dates, there were a total of 72 plots. All plots were 1.4 m wide (4 rows at 35 cm apart) and 12 m long. The experiment was sown using a cone seeder for both seed placement and base fertiliser application.

Table 1 Treatments (time of sowing, target sowing depth, FCR status and genotype) evaluated in the 2024 LFS long coleoptile durum wheat (LCDW) experiment.

Treatment	Comment
Time of sowing	
TOS1: 27 May	Early in the sowing window for the Riverina
TOS2: 17 June	Late in the sowing window for the Riverina
Target sowing depth	
4 cm	Actual depth averaged 3.9 cm
12 cm	Actual depth averaged 10.5 cm
FCR status	
Minus FCR	FCR inoculum NOT added with seed at sowing
Plus FCR	FCR inoculum added with seed at sowing
Genotype	
Scepter ^d	Commercial bread variety
DBA Vittaroj ^d	Commercial durum variety
V190245-6	Long coleoptile durum breeding line

Measurements

Plant counts were conducted 3 times per week to determine emergence date and plant density. The date for emergence was determined when at least 50% of the final plant density had emerged. Final plant density was assessed 5 weeks after sowing. Early biomass accumulation was assessed using hand cuts at the GS31 growth stage. Early biomass samples were collected evenly across all 4 plant lines. Biomass samples were dried, weighed and expressed as grams per square metre (g/m²).

All plots were sown 12 m long and cut back to 10 m before harvest. The 10 m plots were harvested using a Kingaroy plot header with all 4 rows harvested to determine grain yield. Subsamples from the machine harvest were collected and used to determine grain quality with yield calculated at 12% grain moisture.

Results

Emergence, establishment and early growth

Average soil temperatures at TOS1 were very stable across both sowing depths and still very similar at TOS2 with only a 0.3 °C increase in temperature between 4 cm and 12 cm depths (Table 2).

Increasing sowing depth from 4 cm to 12 cm delayed emergence by an average of 5.4 days in TOS1 and an average of 6.2 days in TOS2.

A large variation in early biomass accumulation at the GS31 growth stage was observed between time of sowing and sowing depth. The average early biomass accumulation for TOS1 at 4 cm was 111.2 g/m². Delaying sowing or increasing the sowing depth significantly decreased biomass accumulation. The average early biomass accumulation for TOS2 at 12 cm depth was 35.3 g/m², which is only 31.7% of TOS1 at 4 cm (Table 2).

Table 2 Measured soil temperature at 2 sowing depths and 2 times of sowing and the effect on days to emergence and early growth for the 2024 LCDW experiment at LFS.

Sowing depth	Soil temperature (°C)		Emergence (days)		Early biomass (g/m ²)	
	TOS1	TOS2	TOS1	TOS2	TOS1	TOS2
4 cm	12.1	9.7	13.3 ^a	15.2 ^{ab}	111.2 ^a	78.2 ^b
12 cm	12.1	9.4	18.7 ^b	21.4 ^c	41.0 ^c	35.3 ^c

Values followed by the same letter are not significantly different at the 95% confidence level.

Scepter[®] sown at 4 cm had the highest plant density with 139.0 plants/m² and was statistically similar to V190245-6 at 4 cm which had an average density of 126.2 plants/m² (Table 3). DBA Vittaroi[®] sown at 12 cm had the lowest average density with 48.1 plants/m² and was statistically similar in density to Scepter[®] sown at 12 cm with 60.1 plants/m².

Table 3 Effect of 2 sowing depths on establishment (plants/m²) for the 2024 LCDW experiment at LFS.

Genotype	Sowing depth: establishment (plants/m ²)	
	4 cm	12 cm
Scepter	139.0 ^a	60.1 ^d
DBA Vittaroi	110.6 ^b	48.1 ^d
V190245-6	126.2 ^{ab}	79.4 ^c
Average	125.3	62.5

Values followed by the same letter are not significantly different at the 95% confidence level.

Both TOS1 and TOS2 sown at 4 cm achieved the highest average density with 125.0 plants/m² and 125.5 plants/m², respectively (Table 4). TOS1 at 12 cm had the lowest density with 55.1 plants/m² and was significantly lower in density than all other combinations of TOS and sowing depth.

Table 4 Effect of 2 times of sowing on establishment (plants/m²) at 2 sowing depths for the 2024 LCDW experiment at LFS.

Sowing depth	Time of sowing: establishment (plants/m ²)	
	TOS1	TOS2
4 cm	125.0 ^a	125.5 ^a
12 cm	55.1 ^c	69.8 ^b

Values followed by the same letter are not significantly different at the 95% confidence level.

Grain yield

Grain yield averaged 3.95 t/ha across all varieties, sowing date, depth and FCR treatments. The bread wheat variety Scepter[®] was the highest yielding cereal entry when averaged across all treatments at 4.31 t/ha and was significantly higher yielding than either of the durum entries (Table 5). The long coleoptile durum line V190245-6 had the lowest average yield of 3.54 t/ha.

Table 5 Average grain yield (t/ha) in the 2024 LCDW experiment at LFS.

Genotype	Yield (t/ha)
Scepter	4.31 ^a
DBA Vittaroi	4.00 ^b
V190245-6	3.54 ^c
Average	3.95

Values followed by the same letter are not significantly different at the 95% confidence level.

TOS1 sown at 4 cm achieved the highest average grain yield of 4.82 t/ha and was significantly higher yielding than all other combinations of TOS and sowing depth (Table 6). TOS2 sown at 12 cm had the lowest grain yield with 3.47 t/ha, but was statistically similar in yield to TOS1 sown at 12 cm.

Table 6 Effect of 2 times of sowing on yield (t/ha) at 2 sowing depths for the 2024 LCDW experiment at LFS.

Sowing depth	Time of sowing: yield (t/ha)	
	TOS1	TOS2
4 cm	4.82 ^a	3.82 ^b
12 cm	3.69 ^{bc}	3.47 ^c

Values followed by the same letter are not significantly different at the 95% confidence level.

Scepter^ϕ at TOS1 achieved the highest grain yield with 4.57 t/ha and was statistically similar to DBA Vittaroi^ϕ at TOS1 with an average yield of 3.92 t/ha (Table 7). V190245-6 at TOS2 had the lowest average grain yield with 3.17 t/ha. V190245-6 also had the lowest average grain yield compared with the 2 other varieties at TOS1. All 3 varieties had a significant lower yield at TOS2 compared with TOS1.

Scepter^ϕ sown at 4 cm achieved the highest grain yield with 4.91 t/ha. Scepter^ϕ at 4 cm was significantly higher yielding compared with when sown at 12 cm and significantly higher yielding than either durum entry when sown at either 4 cm or 12 cm (Table 7).

V190245-6 sown at 12 cm was the lowest yielding treatment with 3.44 t/ha but had a statistically similar yield to both other varieties sown at 12 cm. V190245-6 was the only entry that did not have a significantly lower yield when sown at 12 cm compared with the 4 cm sowing depth.

Table 7 Average effect of 2 times of sowing and 2 sowing depths on yield (t/ha) of 3 cereal entries for the 2024 LCDW experiment at LFS.

Genotype	Time of sowing: yield (t/ha)		Sowing depth: yield (t/ha)	
	TOS1	TOS2	4 cm	12 cm
Scepter	4.57 ^a	4.05 ^{bc}	4.91 ^a	3.74 ^c
DBA Vittaroi	4.28 ^{ab}	3.72 ^c	4.40 ^b	3.60 ^c
V190245-6	3.92 ^c	3.17 ^d	3.64 ^c	3.44 ^c
Average	4.26	3.65	4.32	3.59

Values followed by the same letter are not significantly different at the 95% confidence level.

Fusarium crown rot

TOS1 minus FCR achieved the highest average grain yield with 4.55 t/ha and was significantly higher yielding than TOS1 plus FCR with 3.97 t/ha (Table 8). TOS2 minus FCR achieved a grain yield of 3.94 t/ha which was significantly higher than TOS2 plus FCR with 3.34 t/ha.

The sowing depth of 4 cm minus FCR achieved the highest average grain yield with 4.66 t/ha and was significantly higher yielding than the 4 cm sowing depth plus FCR with 3.97 t/ha (Table 9). The presence of FCR also had a significant effect on yield at 12 cm. Sowing depth 12 cm minus FCR achieved a grain yield of 3.83 t/ha which was significantly higher yielding than the 12 cm plus FCR treatment with an average yield of 3.33 t/ha.

Table 8 Effect of 2 times of sowing on yield (t/ha) with and without the presence of FCR for the 2024 LCDW experiment at LFS.

FCR	Time of sowing: yield (t/ha)	
	TOS1	TOS2
Minus FCR	4.55 ^a	3.94 ^b
Plus FCR	3.97 ^b	3.34 ^c

Values followed by the same letter are not significantly different at the 95% confidence level.

Table 9 Effect of 2 sowing depths on yield (t/ha) with and without the presence of FCR for the 2024 LCDW experiment at LFS.

FCR	Sowing depth: yield (t/ha)	
	4 cm	12 cm
Minus FCR	4.66 ^a	3.83 ^b
Plus FCR	3.97 ^b	3.33 ^c

Values followed by the same letter are not significantly different at the 95% confidence level.

Summary

There was a significant yield loss due to late sowing with an average yield penalty of 1.00 t/ha (21%) at the 4 cm sowing depth when sowing was delayed from 27 May to 17 June. There was no significant difference in yield when sowing was delayed in the 12 cm deep treatments. All varieties demonstrated a significant response to delayed sowing. V190245-6 had the biggest response with an average yield reduction of 0.75 t/ha (19%) associated with delayed sowing when averaged across both sowing depths.

There was a significant yield penalty when the sowing depth was increased at both sowing dates. For TOS1, there was an average yield penalty of 1.13 t/ha (23%) when the sowing depth was increased from 4 cm to 12 cm. For TOS2, the increase in sowing depth resulted in an average yield penalty of 0.35 t/ha (9%).

A significant interaction between varieties and sowing depth was observed. Both Scepter^ϕ and DBA Vittaroi^ϕ demonstrated a yield reduction between the 4 cm and 12 cm sowing depths when averaged across both sowing dates, while V190245-6 demonstrated no yield penalty between the 4 cm and 12 cm sowing depths.

There was a significant yield penalty associated with the presence of FCR infection. For the 4 cm sowing depth there was an average yield loss of 0.69 t/ha (15%) with the presence of FCR and at the 12 cm sowing depth the average yield loss was 0.50 t/ha (13%). For TOS1 there was an average yield loss of 0.58 t/ha (13%) with the presence of FCR and in TOS2 there was an average yield loss of 0.60 t/ha (15%). In the previous year's experiment, earlier sowing was identified as a possible strategy to minimise yield loss from FCR in higher risk paddocks. Results from this year's experiment has shown that this might not always be the case. Yield reduction from FCR due to delayed sowing in this experiment was similar at both sowing depths. However, earlier sowing (TOS1) in the presence of FCR infection provided equivalent yield to delayed sowing (TOS2) in the absence of FCR inoculation. Consequently, in high risk FCR paddocks this experiment highlights that a grower can still obtain a 0.63 t/ha (19%) yield benefit from earlier sowing (TOS1) in the presence of this disease.

Acknowledgements This research is part of the 'Integrating long coleoptile wheat into Australian farming systems through an integrated understanding of genetics, management and environment' project (CSP2212-007RTX) with shared investment from GRDC and NSW Department of Primary Industries and Regional Development.

More information Tony Napier
Yanco Agricultural Institute, Yanco
tony.napier@dpird.nsw.gov.au
0427 201 839