On-row sowing for brome grass competition on non-wetting sand

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RESEARCH

Searching for answers

Location
Karoonda - Loller Partners
Rainfall
Av. Annual: 337 mm
Av. GSR: 237 mm
2017 Total: 399 mm
2017 GSR: 236 mm
Paddock History
2016: Wheat
2015: Wheat
2014: Wheat
Soil Type
Dune sand
Plot Size
2 m x 20 m x 5 reps

Key messages

- **For the fourth year running, on-row sowing proved it has potential as a brome grass management tool on non-wetting sands, reducing brome grass seed set by 55%.**
- **The use of trifluralin with metribuzin reduced the brome density in July but did not reduce seed set.**
- **On-row sowing resulted in more soil water and nitrogen supply potential near the crop, improved crop establishment and higher crop biomass.**
- **On-row sowing did increase root disease incidence, but there were low levels of disease for both on- and inter-row sowing in 2017.**

Why do the trial?

Brome grass is the most costly weed to grain production in the Mallee region despite herbicide resistance being relatively low. For growers looking to sow earlier and reduce reliance on Group B herbicides, pre-emergence herbicides can be an important part of brome grass management strategies, but trifluralin often has low efficacy. Previous trials at the Mallee Sustainable Farming (MSF) Karoonda site looking at a range of pre-emergence herbicides have shown the potential for greater than 75% brome grass control from some pre-emergence options, but also the potential for variability under different early-season conditions. Improving crop competition can greatly improve herbicide efficacy. Other trials on non-wetting sandy soil at the Karoonda site have shown the potential for better crop establishment (e.g. 60% higher establishment in 2016) and large reductions in brome grass seed set suppression through seeding the crop on or near last year's crop row (McBeath *et al*. 2016).

How was it done?

Following demonstrated benefits of increased water and nutrient harvesting along with reduced brome grass populations for on-row sowing on water repellent sands, on-row or inter-row seeding was tested with and without a pre-emergent herbicide package of trifluralin + metribuzin (Table 1). All plots were sown on 8 May into cereal stubble with 28 cm row spacing and received DAP (18:20:0:0) @ 50 kg/ha and urea @ 24 kg/ha on a water repellent dune soil. In addition 33 kg/ha potassium sulfate was applied pre-sowing and in-crop foliar application of Cu, Zn and Mn occurred at early tillering.

Measurements included disease risk, disease incidence, starting nitrogen (N) and water, microbial activity, N supply potential, crop emergence, biomass, weed density and biomass and crop yield.

What happened?

Pre-sowing soil water and crop establishment

Measurements of sowing soil profile water indicated that the on-row position had an extra 18 mm soil water to 60 cm depth, with nearly twice as much water in the top 20 cm for on-row sowing (15 vs 8 mm).

Table 1. Sowing and pre-emergent herbicide treatments.

Treatments	Sowing	Pre-emergent herbicide
1	On-row	Nil
2	Inter-row	Nil
3	On -row	trifluralin @ 1.5 L/ha + metribuzin @ 100 g/ha
4	Inter-row	trifluralin @ 1.5 L/ha + metribuzin @ 100 g/ha

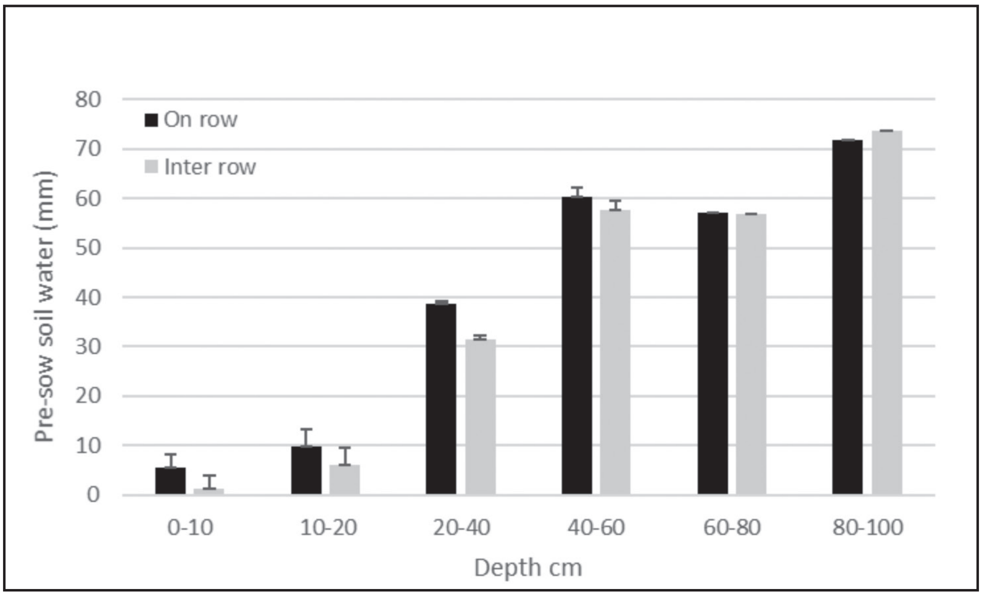

Figure 1. Pre-sowing soil water (mm). At each sampling depth the on-row and inter-row sowing treatment was compared using a paired t-test. The 95% confidence interval for means that were significantly different are presented as error bars on the figure.

Table 2. Crop establishment in response to sowing row and herbicide treatment.

Treatment	Establishment 30 May (plants/m²)	Establishment 21 June (plants/m²)
On-row	66	89 a
Inter-row	44	68 b
LSD (P=0.05)	*20*	*11*
Minus pre-em	55	91 a
Plus pre-em	56	66 b
LSD (P=0.05)	*ns*	*11*

**Significantly different treatments are annotated with a different letter. The interaction between sowing position and herbicide is not presented as it was not significant for any of the measurements.*

The benefit of extra topsoil water with on-row sowing appears to have increased crop establishment with 30% more plants for on-row sown plots (Table 2). Pre-emergent herbicide was found to reduce crop establishment (Table 2).

Brome grass population, crop biomass and yield

Both on-row sowing and pre-emergent herbicide treatments reduced the brome grass density in July but there was no interaction between the two treatments (Table 3). On-row sowing led to a 55% reduction in brome grass seed set compared to inter-row sowing. The pre-emergence herbicide did not significantly reduce seed set despite causing a reduction in early brome density. This can be partly explained by on-row sowing resulting in 70% more crop biomass at GS31 and 29% more at GS65 delivering an ongoing competition benefit. However, the greater biomass did not translate into a significant difference (P=0.09) in grain yield (Table 3).

Nitrogen

Pre-sowing mineral N levels in the surface 10 cm depth were similar at both the row positions, and similarly soil N to 1 m depth was the same for both row positions averaging 65 kg N/ha/m. However, higher levels of microbial biomass and over 30% more N supply potential on-row confirmed previous observations of the potential for higher soil fertility at the on-row position (Table 4). The higher microbial biomass on-row in the presence of wide C:N cereal crop residues has the potential to cause immobilisation (tie-up) of mineral N (average 17 kg/ha) including that from fertiliser early in the growing season. Although seedlings sown in the inter-row position avoid microbial immobilisation of nutrients, they may require more N from fertiliser to compensate for the lower N supply potential including N released from the microbial biomass during the growing season.

Disease

Soilborne pathogen inoculum levels for the three major pathogens (e.g. *Rhizoctonia solani* AG8, Ggt and *Fusarium pseudograminearum*) were generally higher on-row compared to inter-row which reflected in disease incidence, but the incidence was low for both treatments on the relative scale (0.6-1.4 on a scale of 0-5) (Table 5).

Table 3. Crop biomass at first node (GS31), and anthesis (GS65), grain yield and grain protein in response to sowing treatments.

Sowing	July brome (plants/m^2)	GS31 crop biomass (t/ha)	GS65 crop biomass (t/ha)	Maturity brome (seeds/m^2)	Grain yield (t/ha)	Grain protein (%)
On-row	15 ^{b}	1.09 ^{a}	5.35 ^{a}	1960 ^{b}	1.99	8.74
Inter-row	31 ^{a}	0.64 ^{b}	4.14 ^{b}	4339 ^{a}	1.66	8.61
LSD (P=0.05)	*12*	*0.15*	*0.83*	*1660*	*ns*	*ns*
Minus pre-em	31 ^{a}	0.92	4.68	3240	1.74	8.44 ^{b}
Plus pre-em	15 ^{b}	0.81	4.81	3059	1.91	8.91 ^{a}
LSD (P=0.05)	*12*	*ns*	*ns*	*ns*	*ns*	*0.25*

**Within a treatment factor significantly different treatments are annotated with a different letter. The interaction between sowing position and herbicide is not presented as it was not significant for any of the measurements.*

Table 4. Microbial biomass carbon (C), mineral N and N supply potential on-row and inter-row at the time of sowing during May 2017.

Sowing	Microbial biomass	N supply potential (kg N / ha)		Mineral N
	(kg C/ha)	<decile 5	>decile 5	(kg N/ha)
On-row	231	30	46	21
Inter-row	183	22	35	18
LSD (P=0.05)	*29*	*3*	*5*	*ns*

Table 5. Soilborne disease risk ratings for Take all (Ggt), Rhizoctonia (RsAG8) and Fusarium crown rot in soil measured in the on-row and inter-row sowing position at the time of sowing in 2017 and a combined disease incidence rating measured at first node (GS31).

Sowing Treatment	Disease risk from pathogen inoculum			Disease incidence Root rating (0-5 scale)
	Rhizoctonia	Take all (Ggt)	Fusarium crown rot	
On-row	High	Medium	High	1.4 ± 0.2
Inter-row	Low	Low	Low	0.6 ± 0.1

What does this mean?

Four years of on-row sowing on non-wetting sands showed consistent effects of increased sowing surface soil moisture, crop establishment, crop biomass and crop-brome competition reducing brome grass seed set. Our next steps are to consider the profit-risk outcomes and practicalities of implementing on-row sowing at the paddock scale in Mallee environments. The extent to which these effects will express on other types of sand and modifications that might assist with capturing a consistent yield effect (at $P<0.05$) remain to be explored.

Acknowledgements

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References

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