USING SOWING DIRECTION AND ROW SPACING FOR WEED MANAGEMENT IN THE MALLEE

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TAKE HOME MESSAGE

- Yields were significantly higher under narrow row spacing, but sowing direction had no influence on yield.
- Weeds had a significant effect on yield, but the scale of yield penalty (t/ha yield loss) did not alter with row spacing or sowing direction in 2015.
- Weeds established faster where row spacings were wider, however by late tillering, all treatments had similar weed numbers and biomass levels.

BACKGROUND

The reliance of farming systems on agrochemicals, particularly herbicides, has increased over time.

As a result, the number of weed populations with some level of resistance to herbicides is increasing.

This is motivating growers to seek alternatives to herbicides for weed management.

Previous experiments have shown that crop sowing direction and row spacing have an impact on weed growth and seed production. However, these experiments have only been conducted in environments that differ in many ways to that of the Mallee. The reported findings suggest narrow rows and sowing in an east-west direction better suppresses weeds. The aim of this experiment was to determine if this was also true in the Mallee, and is there any benefits from combining the two practices.

AIM

To determine if sowing direction and row spacing can be used to influence grass weed populations and growth, and their impact on crop performance in the Mallee.

TRIAL DETAILS

LOCATION	Jil Jil
SOIL TYPE	Sandy clay loam
ANNUAL RAINFALL	191mm
GSR (APR-OCT)	129mm
CROP TYPE	Mace wheat
SOWING DATE	23 May
SEEDING EQUIPMENT	Knife points and press wheels set at 22.5cm (9 inch), 30.5cm (12 inch) and 38cm (15 inch) row spacings.
TARGET PLANT DENSITY	150 plants/m^2
HARVEST DATE	11 November
TRIAL AVERAGE YIELD	0.9t/ha

TRIAL INPUTS

FERTILISER	Granulock Supreme Z @ 50kg/ha at sowing
HERBICIDE	Dual Gold @ 500ml/ha + Diuron @ 500g/ha (PSPE)
Pests and diseases were controlled to best management practice.	

METHOD

One replicated trial was sown as a split plot design with sowing direction as the main plot and row spacing by weeds as the sub plot. A weed treatment was applied as tame oats broadcast prior to sowing, targeting a weed density of 75 plants/m2.

The trial was located within a grower's paddock of Mace wheat sown at the same time so that overall management could be carried out easily. The previous crop was brown manure peas, grazed over summer, and topdressing in 2015 was not required given the seasonal outlook and background nitrogen status.

Assessments carried out in crop included emergence counts of crop and weeds 40 days after sowing, bio Hmass cuts at GS30 (end of tillering) and GS65 (flowering) and maturity crop head and weed panicle numbers. Plots were harvested and processed for standard yield and grain quality assessments.

RESULTS AND INTERPRETATION

Growing season rainfall in 2015 was decile 1 which resulted in a reasonably low yielding trial. Rainfall just before and after sowing resulted in good crop and weed establishment in all treatments, however by the end of the season, many wheat plants had failed to tiller, and around 30-50 per cent of the oats sown as weeds had also died while the remaining oats were short and only produced one to two panicles at best.

SOWING DIRECTION

Sowing direction in the Jil Jil trial had no influence on crop yield, quality, weed biomass production or weed seed set. Given the seasonal conditions, and the observation that wheat plants largely did not tiller, this can most likely be attributed to the fact that the crop did not offer more significant competition for light and nutrients in one direction than the other that may otherwise occur in a more substantial canopy.

ROW SPACING

Row spacing did influence crop establishment. In plots sown on 22.5cm and 30.5cm (9 and 12 inch) rows, 10 and 12 more plants/m2 established than in plots sown at 38 cm (15 inch) respectively (p=0.03, LSD=9.3, CV=11.3).

The narrower spaced treatments also achieved a lower within-row (plants/m of row) density, suggesting there was less competition between neighboring plants.

As row spacing widens, the competition between crop plants increases as there are more seeds per meter of row. This can result in reduced plant stands. However, it was found that by maturity, this did not affect the number of heads/m2 in any of the treatments, suggesting plants grown at a wider row spacing did compensate with greater tiller production.

The tillers that did form were very small, so although they did increase the head count, they did not increase yield proportionately to having more plants established to begin with.

Crops sown on narrow row spacings produced more biomass by anthesis, and resulted in higher yields in a weed free situation, with 38cm (15 inch) row spacing yielding 0.13t/ha less than the other two spacings which were not significantly different from each other (Figure 1).

It has long been known that narrower row spacing increases yield, however this was believed to be less important in low yielding environments. The more uniform pattern of crop present in 22.5cm and 30.5cm results in greater radiation interception, reducing evaporative losses and increasing dry matter production which leads to higher yields.

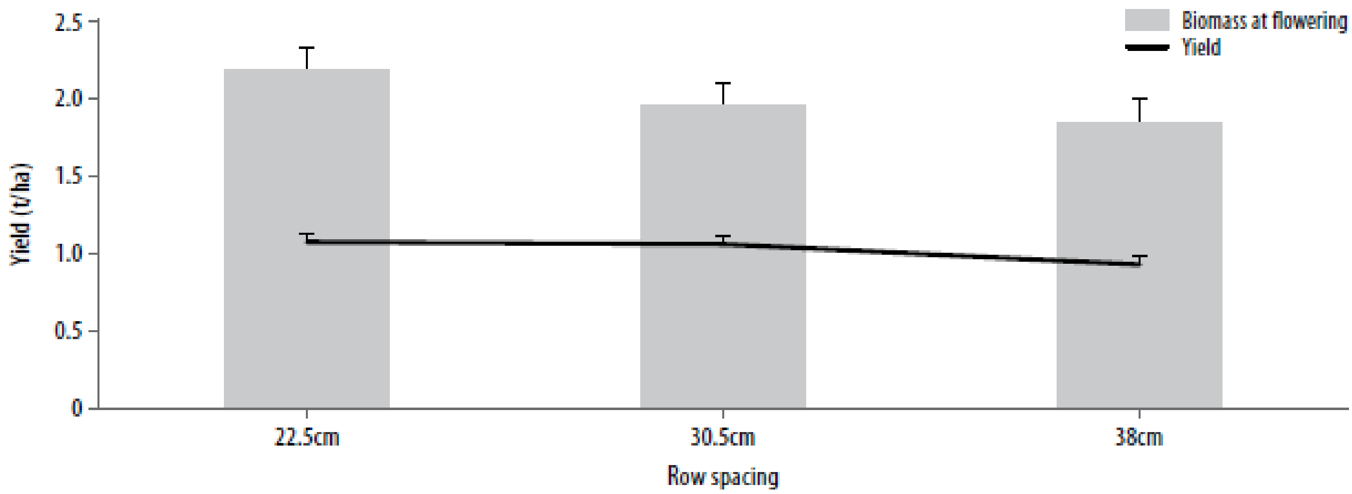

Figure 1: *Biomass at flowering and yield as influenced by row spacing (weed free plots). Stats: Biomass P<0.001, LSD = 0.15, CV = 18.7%; Yield P = 0.01, LSD = 0.09, CV = 7.9%.*

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One of the arguments in favour of wider row spacing is that it can potentially increase grain yield in low yielding situations (Blackwell et al. 2006; Jones and O'Halloran 2006). This is believed to be because it takes time for the roots to grow and access the reserves in the inter-row area, meaning water is 'rationed' to crops at wider row spacings. The resulting reduced biomass production earlier in the season allows water to be conserved for use by the crop after anthesis, potentially increasing harvest index (Scott et. al., 2013). Given the limited stored moisture and in-crop rainfall in 2015, the ability of wide row spacing to do this was restricted.

Although there were differences in biomass production by anthesis, the work in 2015 showed no difference in greenness as measured by NDVI at mid-late grain fill, and there were no significant differences in screenings or protein at any row spacing. Grain weight (GW) was also measured and revealed that 38cm spacings actually produced significantly smaller grain (GW=33mg) than 22.5cm (GW=34.1mg) or 30.5cm (GW=33.9mg) (P = 0.016, LSD 0.9, CV = 4.5%). To put this in perspective, at these grain sizes, one milligram difference in GW equates to approximately 26kg/ha difference in yield.

Given this result, differences in yield were attributed to a combination of grain size and grain number.

PRESENCE OF WEEDS IN A DRY SEASON – WHAT IS THE COST?

Row spacing influenced early weed emergence with wider row spacings having higher weed density when measured 40 days after sowing (Table 1). However by mid tillering weed populations and biomass production was similar in all treatments (data not shown).

Harvest assessments revealed that all row spacings and sowing directions produced a similar number of panicles/m2, and oat grain yield in weedy plots was not significantly different regardless of row spacing or sowing direction.

Differences at emergence could be attributed to higher levels of soil throw into the inter-row which may have seen weeds buried a little deeper and taking a bit longer to emerge (in narrower rows). If this is repeatable it could be seen as an advantage in terms of the crop getting a head-start on the weeds.

The reasons behind the weed populations leveling out between treatments by harvest, as measured by panicle numbers, could be attributed to the dry conditions and compensation of lower density weeds producing more panicles.

ROW SPACING	WEEDS/M2	PANICLES/M2
22.5cm	34.8	41.7
30.5cm	43.5	40.9
38cm	48.4	38.3
Sig. diff. LSD CV%	0.007 7.7 16.7	NS

Table 1: *Weed density measured 40 days after sowing and panicle number at maturity as impacted by row spacing.*

Although the aim was to try and establish 75 weed plants/m2, average weed establishment was only 42/m2, however this was enough to have significant impacts on the growth of the crop right through the growing season. Crop biomass production was lower at the end of tillering in weedy plots and this followed on to impact yield and some quality parameters. The severity of this impact late in the season however was not influenced by sowing direction or row spacing, but just whether or not the weeds were present, with all row spacings being equally affected by weeds.

The presence of weeds in 2015 resulted in a 0.23t/ha yield penalty, and also impacted on test weight due to oat seeds being present in the sample. Screenings were also 3.6 per cent higher than nonweedy plots (Table 2).

	YIELD (T/HA)	CROP HEADS (M2)	TEST WEIGHT (KG/HL)	PROTEIN (%)	SCREENINGS (%)	GRAIN WEIGHT (MG)
No weeds	1.02	167.4	79.3	13.4	3.4	33.62
Weeds	0.79	155.8	74.2	13.5	7.01	32.80
Sig. diff. LSD CV%	<0.001 0.05 9.6	0.03 10.3 10.6	<0.001 2.4 5.2	NS	<0.001 0.9 28	0.033 0.6 2.8

Table 2: *Influence of weeds on yield and quality parameters.*

The yield reduction in the case of weed presence could be attributed to both a reduction in grain number as a result of lower head numbers produced, as well as a reduction in grain weight (Table 2).

This illustrates well that competition for light and nutrient resources, particularly in a poor season, can have dramatic effects on crop yields, not to mention the carryover effects of weed seeds leading into the next crop.

COMMERCIAL PRACTICE

This trial was intended to find out whether growers can use sowing direction or row spacing to manage weed populations, however the low yields in 2015 meant that differences between treatments, where significant, are small.

In 2015 crops did not achieve good canopy cover, something that can be considered a key driver to the success of row spacing or sowing direction for weed management. Results from more seasons are required before growers could base management decisions on these data, and this trial will be repeated in 2016.

Things that can be taken from this trial are that even relatively low weed populations can have a large impact on yields, with 0.23t/ha yield loss from populations of around 40 plants/m2. So the tolerance to weeds in the farming systems still needs to remain low, and if paddocks are getting out of hand, rotations of crops or herbicides, or the use of alternative weed management tactics such as using competitive crops or harvest weed seed management needs to be considered.

In terms of yield, even in a poor year, there are penalties from very wide row spacing, with 38cm being lower yielding than 22.5 or 30.5cm row spacing. When choosing or adjusting row spacing, potentially through the purchase of new machinery, growers should weigh up the reasons they are looking to go wider (ie. trash management or inter-row spraying, timeliness of operations etc.) and determine whether the benefits outweigh the costs.

ON-FARM PROFITABILITY

Looking at the profitability aspects of the trial there are a few things to consider. Firstly, narrow row spacings produced more yield and in most cases of slightly better quality. On top of this, adding weeds to the mix, further reduced income through either lower yields or downgrading due to quality issues.

When analysed it was found that narrow row spacing with good weed management offered the best returns, and that management of weeds was more critical than management of row spacing with a $80/ha better return from weed management (Table 3).

ROW SPACING	WEEDS		AVERAGE
	Weeds	**No weeds**	
22.5cm	$212.80	$284.60	$248.70
30.5cm	$185.50	$279.30	$232.40
38cm	$170.30	$245.30	$207.80
Average	$189.5	$269.7	
Sig. diff. **Row spacing** Weeds Row spacing x weeds **LSD (P=0.05)** Row spacing Weeds Row spacing x weeds **CV%**		 P<0.001 P<0.001 NS $16.85 $17.54 - 12.3	

Table 3: *Income $/ha for different row spacing and weed scenarios in 2015 (yields used from trial with prices allocated depending on grade achieved from grain prices table on pp.19).*

Income from the crop however is only one aspect to consider. Wider row spacings have lower machinery costs due to fewer components, improved timeliness of operations due to faster travel speeds and better trash handling with potentially reduced fuel usage as a result of lower draught.

Given the reduction in plant establishment there may also be opportunity to lower seeding rates to reduce seedling losses. But what are the potential risks associated with these benefits? In the Mallee there have been an increasing number of conversations around wider rows not offering a competitive advantage against weeds, resulting in increased herbicide use and costs, and higher risks of resistance due to greater reliance on herbicides.

When deciding the best system in terms of profitability it is necessary to weigh up the pros and cons of all these elements, identifying the biggest threats to production, and minimising the risk associated with these factors. Herbicide resistance is on the increase, and the development of new chemistries is a slow process. Can we really afford to negate cultural weed management practices like row spacing and sowing direction?

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ACKNOWLEDGEMENTS

This research was funded by the GRDC as part of the 'Overdependence upon agrochemicals' project (CWF00020).

Agrochemicals project (CWF00020), which is led by CWFS.