Effect of row spacing, nitrogen and weed control on crop and weed in a wheat – lupin or wheat – chickpea rotation

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KEY MESSAGES
- Despite a very dry season in 2012, dimethenamid (e.g. Outlook®) herbicide in a lupin or chickpea crop was more effective on annual ryegrass than simazine in the two long-term rotational trials at Cunderdin and Merredin. This has resulted in an increase in grain yield of lupin crop in Outlook® treatment at Cunderdin.
- Sakura® reduced annual ryegrass head numbers more effectively than trifluralin at N25 and flexi N50 compared to N50 at Merredin.
- Grain yields of both crops at Merredin were very poor. Despite poor grain yields of crops at Merredin, yields of both crops were greater at 44 cm row spacing than at 22 cm row spacing.

AIMS
The ACIAR-funded international collaborative project (2012-2016) on “Overcoming agronomic and mechanisation constraints to development and adoption of conservation agriculture in diversified rice-based cropping in Bangladesh (LWR/2010/080)” between Bangladesh and Australia, undertakes the majority of its research in Bangladesh in collaboration with a range of Bangladeshi institutional collaborators. Improving small scale machineries such as the Versatile Multi-Crop Planter (VMP), and the agronomy and weed management in conservation agriculture in Bangladesh are the major aims of the project.

The Australian component of the research on the interaction of row spacing, weed control and nitrogen application is undertaken by DAFWA and Murdoch University. Limited information is available on the interaction of nitrogen (N) application and weed control options under normal and wide row spacing in a wheat – lupin or wheat – chickpea rotation for the low and medium rainfall zones within the WA wheatbelt.

So, the aim of this study in WA is to examine the effect of nitrogen and herbicide on the crop performance and weed control under normal and wide row spacing in a wheat – lupin rotation at Cunderdin and wheat – chickpea rotation at Merredin.

METHOD
In 2012, rotation trials of three years duration were initiated at Cunderdin (wheat – lupin) and at Merredin (wheat – chickpea) to examine the effect of crop row spacing, herbicides and applied nitrogen (in wheat only) on crops and weeds.

Treatments
In the wheat – lupin rotation at Cunderdin, wheat (cv. Mace) in 2012 was sown on 13 June 2012 at two row spacings (22 cm and 44 cm) with two herbicides (trifluralin 2 L/ha and Sakura® 118 g/ha) and three nitrogen treatments: N25 (25 kg N/ha drilled in front of tynes as urea), N50 (50 kg N/ha drilled in front of tynes as urea) and Flexi N50 (50 kg N/ha placed at about 7 to 8 cm depth as flexi N). Lupin (cv Gunyidi) was sown on 21 May 2012 at two row spacings (22 cm and 44 cm) with two herbicides (simazine 2 L/ha and Outlook® (dimethenamid) 1 L/ha)).

In the wheat – chickpea rotation at Merredin, wheat crop (cv. Wyalkatchem) treatments were same as those at Cunderdin. Chickpea (cv. PB Slasher) treatments at Merredin were also same as those in the lupin rotation at Cunderdin. Both crops at Merredin were sown on 14 June 2012.

Both the trials were conducted in a randomised complete block design with four replications.

Measurements
The measurements taken across the trials were crop weed emergence (4 quadrats per plot; 66 cm x 50 cm quadrant size for 22 cm row spacing and 88 cm x 50 cm quadrant size for 44 cm row spacing of wheat crop; 66 cm x 100 cm quadrant size for 22 cm row spacing and 88 cm x 100 cm for quadrant size
for 44 cm row spacing of lupin crop), weed emergence (4 quadrats per plot; Cunderdin site: 50 cm x 50 cm quadrat size for medium density and 25 cm x 25 cm quadrat size for high density weeds; Merredin site: 100 cm x 100 cm quadrat size), weed control by visual assessments and by weed count, crop and weed biomass at anthesis.

Data analysis
Data were subjected to ANOVA by Genstat 15th Edition. Means were separated by LSD.

RESULTS
The season of 2012 was very dry with significantly less than average rainfall during the growing season. During the 2012 growing season, Cunderdin site had 50% of the average rainfall of 261.9 mm from April to September and Merredin site had 60% of the average rainfall of 193 mm from April to September. As such crop growth, particularly wheat, was very poor at both locations.

Cunderdin site
Weed control: Density and growth of annual ryegrass were very high at Cunderdin as herbicides such as trifluralin or Sakura® were not as effective. To reduce the excessive seed production of annual ryegrass in the wheat crop at Cunderdin, the crop was sprayed out at about anthesis stage of wheat.

No significant effect of row spacing was found on annual ryegrass control. Even though Sakura® was marginally more effective on annual ryegrass than trifluralin, the maximum weed control achieved by Sakura® was about 50% (data not presented). Since seasonal rainfall was low, Sakura® - good herbicide for annual ryegrass, did not work as effectively due to lack of adequate soil moisture. No effect of N application on weed control was found in wheat crop.

Table 1. Effect of herbicides on weed plant number at six weeks after crop emergence and weed control (visual assessment) at crop flowering stage in lupin at Cunderdin in 2012

<table>
<thead>
<tr>
<th>Herbicides</th>
<th>Annual ryegrass plants/m²</th>
<th>Annual ryegrass control (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simazine</td>
<td>794</td>
<td>41</td>
</tr>
<tr>
<td>Outlook®</td>
<td>391</td>
<td>79</td>
</tr>
<tr>
<td>LSD (05%)</td>
<td>83.1</td>
<td>10.9</td>
</tr>
</tbody>
</table>

Even though annual ryegrass weed burden was very high at Cunderdin, Outlook® in lupin crop provided 79% control of annual ryegrass as compared to 41% by simazine (Table 1).

Lupin grain yield: Better weed control by Outlook® herbicide in lupin crop has also resulted in greater lupin grain yield than with simazine treatment (Table 2). On the average, lupin grain yield was 137 to 284 kg/ha greater with Outlook® herbicide than simazine. Row spacing did not influence lupin grain yield. Since lupin grain yield in Outlook® was higher at 22 cm row spacing than 44 cm, it appears that row spacing did affect yield, in an interaction with herbicide efficiency, presumably due to greater competitiveness of the crop against weeds at 22 cm spacing (Table 2).

Table 2. Effect of row spacing and herbicide on the grain yield of lupin crop at Cunderdin in 2012

<table>
<thead>
<tr>
<th>Row spacing</th>
<th>Simazine 2 L/ha</th>
<th>Outlook® 1 L/ha</th>
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<tbody>
<tr>
<td>22 cm</td>
<td>406</td>
<td>666</td>
</tr>
<tr>
<td>44 cm</td>
<td>382</td>
<td>543</td>
</tr>
<tr>
<td>LSD (5%)</td>
<td></td>
<td>121.1</td>
</tr>
</tbody>
</table>

Merredin site
Weed control: In the wheat crop, annual ryegrass was the main weed species but the average weed density of annual ryegrass was only 2 plants/m². This means that both the herbicides effectively controlled annual ryegrass with no significant difference between trifluralin and Sakura®.

Despite no difference in initial weed control efficacy, Sakura® reduced annual ryegrass head numbers more effectively than trifluralin, particularly at N25 and flexi N50 compared to N50 (Figure 1). It may be possible that under low rainfall situations, surviving ryegrass plants had greater access to applied N at N50 than N25 or flexi N50 resulting in a greater
number of annual ryegrass heads produced per unit area. No influence of crop row spacing was found on weed control.

In the chickpea crop, Outlook® controlled annual ryegrass plants measured at 4 weeks after emergence, more effectively than simazine (Outlook® 2 plants/m² versus simazine 8 plants/m² of annual ryegrass).

**Crop grain yield:** The overall grain yield of both wheat and chickpea crops were very low due to extremely poor crop growth. It was also too difficult to lift and harvest such a short crop by the harvester.

On the average, wheat grain yield was 257 kg/ha and chickpea grain yield was 90 kg/ha. Despite very poor crop growth, wheat and chickpea grain yields at 44 cm row spacing were significantly greater than at 22 cm indicating the benefit of wide row cropping in low rainfall areas (data not presented). No effect of herbicides or applied nitrogen was found on wheat yield.

**CONCLUSIONS**

Rainfall was extremely low at both sites in the 2012 season leading to very poor crop growth. Dimethenamid (e.g. Outlook®) herbicide was more effective on annual ryegrass than simazine in lupin and chickpea crops resulting in greater lupin grain yield at Cunderdin. Even though grain yields of crops were very low, yields of both crops at Merredin were greater at 44 cm row spacing than at 22 cm row spacing. These results showed the benefit of wide row spacing in a dry season like 2012 in low rainfall areas such as Merredin. However, under high weed competition at Cunderdin, narrow row spacing appeared more productive with Outlook® herbicide than wide row spacing.

Further results from the two rotation trials will be communicated in future as the study progresses.

**KEY WORDS**

Row spacing, weed control, nitrogen effect, grain yield

**ACIAR Project No.:** LWR/2010/080

**Paper reviewed by:** Dr Catherine Borger