Conference on Conservation Agriculture for Smallholders in Asia and Africa

7-11 December, 2014

CONFERENCE PROCEEDINGS

Proceedings of the Conference on Conservation Agriculture for Smallholders in Asia and Africa

Published in 2014

Published as an e-book on USB. For enquiries please contact Prof. Richard Bell

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Citation

The correct reference for papers presented at this conference is:

Entire proceedings
Vance WH, Bell RW, Haque ME (2014) Proceedings of the Conference on Conservation Agriculture for Smallholders in Asia and Africa. 7-11 December 2014, Mymensingh, Bangladesh. Published as an E-book. p xx.Paper in proceedings

Paper in proceedings
[Authors] (2014) [Title of Paper] In: Proceedings of the Conference on Conservation Agriculture for Smallholders in Asia and Africa. 7-11 December 2014, Mymensingh, Bangladesh. (Eds. WH Vance, RW Bell, ME Haque). pp xx-xx.

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Row Spacing, Herbicides and Nitrogen Effect on Crop-Weed Competition in Cereal-Broadleaf Crop Rotation

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Introduction

Proximity factors such as row spacing change the spatial distribution of crop plants and alters the intensity of crop-weed competition (Fischer and Miles 1973). Narrow row spacing is likely to facilitate crop plants with greater competitive ability than weeds, compared to wide row spacing (Hashem et al. 1998). In dry land conservation agriculture (CA), wide rows may ensure some temporal and spatial water availability at critical crop growth stages to ensure profitable yields. However, good weed management becomes critical to the success of wide row systems, as failure to control water-using weeds defeats the purpose of wide row cropping where water conservation is the focus. Management of nitrogen (N) also greatly affects the growth of weeds. While weeds may have easy access to applied N if top-dressed on the soil surface at sowing time, strategic N application technique may maximise the access of crop plants to N compared to weed plants such as annual ryegrass. This study was undertaken to examine the interaction of N rate (and N application technique) and weed control options under normal and wide row spacing in a wheat –lupin–canola rotation in CA.

Materials and Methods

To complement research and development on CA in Bangladesh, a three-year rotation trial (wheat (*Triticum aestivum* L.)– lupin (*Lupinus angustifolius* L.) –canola (*Brassica napus* L.)) was conducted at Cunderdin [117.14E, 31.39S], Western Australia to examine the effect of crop row spacing, herbicides and applied N on crops and weeds. N was applied in wheat and canola but not in lupin.

Treatments

Rotations: Both wheat and lupin crops were grown in separate plots in 2012. Wheat plots of 2012 were rotated to lupin in 2013 while lupin plots of 2012 were rotated to wheat in the 2013 season. Roundup Ready® (RR) canola crop was grown in the 2014 season in all wheat and lupin plots of 2013.

Row spacing, herbicide and nitrogen (N): Crops were sown at 22 cm and 44 cm row space in each growing season (May to November). Triflur X® (trifluralin 480 g/L) at 2 L/ha and Sakura® (pyroxasulfone 850 g/kg) at 118 g/ha were applied to wheat crop. Gesatop Granules® (simazine 900 g/ha) at 1 kg/ha and Outlook® (dimethenamid-P 720 g/L) at 1 L/ha were applied in lupin crop. Roundup Ready® (glyphosate 690 g/L) was applied at 900 g/ha in 2014 RR Canola at 2- and 5-leaf stages. Double super (17.5% P) at 50 kg/ha was applied in all crops. Wheat and canola crops received three nitrogen treatments viz., N_{25} (25 kg N/ha), N_{50} (50 kg N/ha) (N drilled in front of tynes as urea (46% N), and Flexi N_{50} (50 kg N/ha as Flexi N (urea-ammonium nitrate (32%N)) solution placed at 7 cm depth for wheat and 4.5 cm for canola). The trials were conducted in a randomised complete block design with four replications using a unit plot of 20 m by 2 m under minimum tillage systems.

Data analysis

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

Results and Discussion

The main weed species was annual ryegrass (*Lolium rigidum*) with 610 plants/m^2 in 2012 growing season, 80 plants/m^2 in 2013, and 480 plants/m^2 in 2014. Increases in row spacing from 22 cm to 44 cm reduced wheat yield by 29% in 2013 season while row spacing did not influence lupin grain yield in either season, suggesting that unlike wheat plant, lupin plant growth is more plastic to produce vegetative growth and yield. Sakura® was more effective on weeds in wheat than trifluralin while Outlook® was more effective than simazine in lupin, leading to increases in grain yield of wheat and lupin in both seasons. The extent of wheat grain yield increase due to Sakura® was greater in 44 cm than 22 cm. Flexi N_{50} had higher initial weed plants than N_{25} or N_{50}, indicating a possible stimulation of annual ryegrass emergence by Flexi N. The weed plant number was lower in 22 cm row space than 44 cm under flexi N.

Table 1. Effect of row spacing (RS), herbicide (H) and nitrogen (N) on the weed control and grain yield in wheat in 2012 and 2013 seasons and effect of RS and H on weed control and grain yield in lupin in 2012 and 2013 at Cunderdin, Western Australia. Wheat crop was not harvested in 2012. ns = Not significant; "-" indicates N was not applied in lupin crop.

Treatment	Weed control in wheat crop (p-values)		Wheat yield in 2013 (p-values)	Weed control in lupin (p-values)		Lupin yield (p-values)	
	2012	2013		2012	2013	2012	2013
RS	ns	ns	<0.001	ns	<0.001	ns	ns
H	0.003	0.01	<0.001	<.001	ns	<0.001	0.01
N	ns	0.06	ns	-	-	-	-
RS*H	ns	0.03	ns	0.03	ns	ns	ns
RS*N	0.01	ns	ns	-	-	-	-
H*N	0.03	ns	ns	-	-	-	-
RS*H*N	0.04	0.05	ns	-	-	-	-

Complex three-way interactions occurred for weed control in wheat crop in both seasons. No interaction between herbicides and row spacing on weed control was found in lupin in either season, suggesting that lateral vegetative growth of lupins effectively suppressed weeds in wide row lupin. No significant effect of N on wheat was found in 2013 season, probably due to a possible N saturation resulted from residual N of 2012 lupin crop. In summary, herbicides reduced weeds and increased grain yield in wheat and lupin crops. Close rows (22 cm) reduced weeds and increased grain yield in wheat crop but not in lupin. So, small holders in CA should practise chemical and cultural weed control options to optimise cereal yield.

References

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