Effect of row spacing, nitrogen and weed control on crop and weed in low rainfall zones of western Australia

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Introduction

Wide rows essentially ensure some temporal and spatial water availability in water-limiting crop environments, thus minimising the risk of water deficits at critical crop growth stages to ensure profitable yields (Whish et al., 2005). Presence of weeds will have a major impact on water availability to crops irrespective of planting geometries. Decreasing crop plant population and increasing row spacing decreases crop competitive ability against weeds, and generally wider row spacing will reduce crop competition for homogeneously distributed production factors, as postulated mathematically by Fischer and Miles, (1973). Hence 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. With a perceived decline in rainfall in central and eastern wheat belt of Western Australia (WA), wide row cropping practices may prove more productive if weeds can be managed by appropriate herbicides and depriving weeds from applied nitrogen (N). We examined the effect of nitrogen and herbicide on the crop performance and weed control under normal and wide row spacing in a wheat – lupin– canola rotation at Cunderdin and wheat – chickpea rotation at Merredin, WA.

Materials and Methods

In 2012, rotation trials of three years' duration were initiated at Cunderdin (Rotation 1. Wheat – lupin– canola or Rotation 2. Lupin - wheat - canola) and at Merredin (Rotation 1. Wheat – chickpea or Rotation 2. Chickpea - wheat) in a randomised complete block design with four replications. For all crops row spacing treatments were 22 cm or 44 cm. In the wheat crop, there were two herbicide treatments (trifluralin 2 Lha^{-1} (trilfluralin 480 g L^{-1}) and Sakura® 118 g ha^{-1} (Pyrasulfotole 850 g Kg^{-1}) and three nitrogen treatments: N25 (25 kg N ha^{-1} drilled in front of tynes as urea), N50 (50 kg N ha^{-1} 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). In the lupin and chickpea crops there were two herbicide treatments (simazine 2 L ha^{-1} (simazine 500 g L^{-1}) and Outlook® (dimethenamid 720 g L^{-1}) 1 L ha^{-1})), with nitrogen for all plots. All crops were sown by a cone seeder, 1.54m wide.

At the Cunderdin site in 2014, annual ryegrass density was quite high and control of this weed was poor in wheat crop in 2012. To reduce the seed bank of ryegrass, stubble of all 2012 wheat plots and stubble of all 2013 wheat and lupin were burnt in April each year. In 2014, all plots at Cunderdin were sown to Roundup Ready® (RR) canola. The nitrogen treatments were the same as those for the wheat crop in 2012 or 2013. Roundup Attack® (Glyphosate 690 g/L) was applied at 900 g/ha each at the 2- and 5-leaf stage of the canola. At Merredin, about a ton of wheat and less than a ton of chickpea stubble were retained in each crop. The measurements taken across the trials were crop and weed emergence, weed control by visual assessments and by weed count, crop and weed biomass at anthesis.

Results and Discussions

Rainfall was extremely low at both sites in the 2012 season leading to very poor crop growth. Dimethenamid (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.

At Cunderdin wide rows (44 cm) reduced crop establishment by 20-25% in all crops compared to 22 cm row spacing. Wide rows also reduced grain yield of wheat but grain yield of lupin and canola remained unaffected by row spacing. Alternative herbicides provided better level of weed control (68-80%) in wheat and lupin but weed control in canola was 99-100%. Flexi N banded below crop seed at sowing time of canola reduced canola establishment by 25% but increased crop vigor by 15% and grain yield by 12%. Management factors including rotation of crops and herbicides reduced annual ryegrass by 99.5% (Fig. 1). Once annual ryegrass burden has reduced to a low level, it is highly important that it should be maintained at a low level to sustain grain productivity.

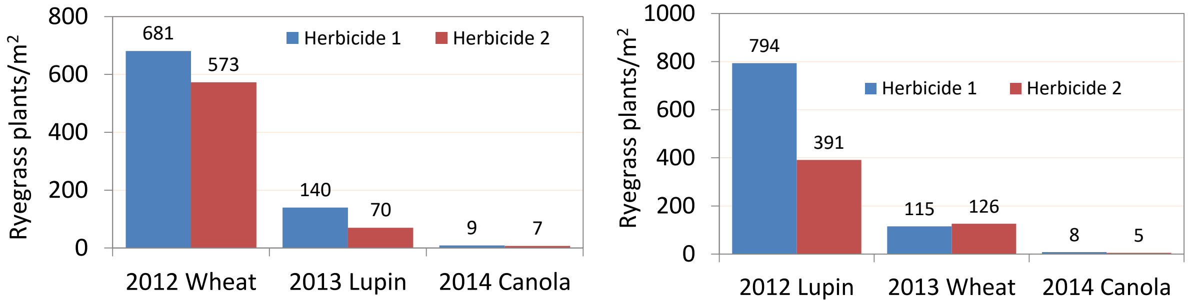

Figure 1. Effect of crop rotations and rotations of herbicides on the population dynamics of annual ryegrass from 2012 to 2014 in Rotation 1 (left graph) and Rotation 2 (right graph) at Cunderdin, Western Australia. Blue bar represents annual ryegrass number per m^2 in herbicide 1 and red bar in herbicide 2. Herbicide 1 was simazine for lupin and trifluralin in wheat while herbicide 2 was Outlook® for lupin and Sakura® for wheat crop. The only herbicide used in RR canola was Roundup Attack®.

References

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