MANAGEMENT OF WILD OATS AND PARADOXA GRASS WITH REDUCED DEPENDENCE ON HERBICIDES

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Abstract

Wild oats and paradoxa grass are the major grass weeds of winter cropping in the sub-tropical grain region. We are investigating whether these weeds can be controlled effectively in wheat and barley using lower herbicide dose rates and higher crop densities.? Crops were sown at approximately 50, 100 and 150 plants/m^2, and the weeds were sprayed at 0, 25, 50 and 100% of the recommended herbicide rate. Crop species, crop density and herbicide rate all had a significant effect on weed seed production at crop maturity. Barley was considerably more competitive than wheat. Increasing crop density from 50 to 100 plants/m^2 reduced the average wild oat seed production from 550 to 230 seeds/m^2 in wheat and from 21 to 7 seeds/m^2 in barley. Weed seed production was either minimal or prevented with the application of the 25% herbicide rate in the higher densities of barley. However, the 100% rate was needed for similar effects in wheat. The long-term effects of these strategies on the weed seed bank are being investigated in rotation experiments.

Key words: Wild oats, paradoxa grass, crop competition, integrated weed management.

Wild oats (*Avena fatua* and *A. ludoviciana*) and paradoxa grass (*Phalaris paradoxa*) are the major grass weeds of winter cropping in the sub-tropical grain region (2). Weeds on average account for some 30% of the variable costs of grain production, and farmers are increasingly reliant on herbicides for weed control, particularly in minimum and zero-tillage systems (2). A new large project aims to develop integrated weed management systems for this region that reduce both the cost of weed control and reliance on herbicides. Part of the project is investigating whether wild oats and para-doxa grass can be controlled effectively in wheat and barley using lower herbicide dose rates and higher crop densities. This paper reports on findings from the initial two seasons work.

Materials and methods

Sites

Two field experiments were located on a cracking black earth near Toowoomba, Queensland. Wild oats (400 seed/m^2) and turnip weed (2000 seed/m^2) were scattered across Site 1 in late May 1995, and paradoxa grass (600 seed/m^2) was scattered across Site 2 (adjacent to Site 1) in early June 1996. Site 1 had 316 and 313 mm rainfall in the preceding fallow and during the growing season, whereas site 2 had 934 and 117 mm rainfall.

Treatments

Experimental design at each site was 3 x 4 factorial with 3 replications in blocks that were duplicated for 2 crops, wheat cv. Pelsart and barley cv. Tallon. The treatments were 3 crop densities (aimed for 50, 100 and 150 plants/m2) and 4 herbicide doses (0, 25, 50 and 100% of the recommended rate). Plots, consisting of 9 rows with 25 cm spacing and 10 m long, were sown 2 weeks following the addition of the weed seeds. Weeds emerged approximately 1 week after crop emergence.

Tralkoxydim (as Achieve? 400 g a.i./kg, CropCare Australasia), thifensulfuron methyl + metsulfuron methyl (as Harmony Msymbol? 682 + 68 g a.i./kg, Du- Pont Australia), and clodinafop propargyl (as Topik? 300 g a.i./L, Novartis and DowElanco) were applied to the wild oats, turnip weed, and paradoxa

grass respectively (Table 1). Herbicides were applied with the recommended adjuvants using a hand-held boom deliver- ing 140 L/ha at 200 kPa.

Measurement and analyses

Crop and weed densities were assessed (2 quadrats 1 m x 0.5 m) before herbicide application. Wild oats, paradoxa grass and crop tiller density and turnip weed plant density (3 quadrats 1 m x 0.5 m), seeds per weed tiller or plant, grain yield (7 rows x 10 m), and grain size (g/1000 seed) were measured at weed and crop maturity. Weed seed production per unit area (m^2) were calculated from the measured data. Weed data were subjected to a log (x + 1) transformation prior to the analyses of variance. Data were analysed separately for each crop.

Results

Crop and weed emergence

Wheat densities at both sites and barley at site 2 were within 22% of the targeted populations, but barley densities at site 1 was 35 - 54% higher. Weed densities were comparable to those found in commercial fields, and weed sizes were optimum for herbicide application (Table 1). Weed density, particularly for wild oats, tended to be less in barley than in wheat.

Weed seed production

Seed production of wild oats and paradoxa grass was influenced by crop species, crop density, and herbicide rate. The reduction in weed seed production was 95 - 100% greater in barley than wheat, and was 60 - 100% greater when crop density was increased from approximately 50 to 100 plants/m^2 (Table 2). There was a trend towards lower seed production when crop density was increased from approximately 100 to 150 plants/m^2.

Herbicide rate had a highly significant effect on both weed species (Table 2). Seed production in wild oats and paradoxa grass was either prevented or very low (10 seeds/m^2) from the 25% herbicide rate in barley. However, in wheat, the greatest reduction in seed production (25 seeds/m^2) was only achieved at the highest herbicide rate.

Turnip weed was fully controlled with the lowest herbicide rate in all sowing densities of wheat and barley.

Yield

Overall, yields of wheat and barley were much greater in the wetter 1996 season than in 1995 (Table 3). When averaged across the herbicide treatments, crop density had no effect on grain yield in the drier season. However, in 1996, wheat tiller density and grain yield increased with the higher crop densities. Barley yield was reduced by 4% with the increase from 100 to 150 plants/m^2, as a result of decreased grain size.

Uncontrolled wild oats and turnip weed resulted in 86 to 94% reduction in wheat yield, with the greatest reduction at the lowest crop density. The competitive effects of these weeds were eliminated when herbicides at 50% of the recommended rate were applied. Barley yield was not significantly affected by uncontrolled wild oats and turnip weed, although there was a trend towards a reduction at the lowest crop density. Uncontrolled paradoxa grass resulted in a significant 6% wheat yield reduction, but had no adverse effects on barley yield.

Discussion

Weed control in the winter cereal farming systems of the sub-tropical grain region can be improved substantially by growing more competitive crops. Increasing crop density to at least 100 plants/m^2, but

preferably 150 plants/m^2 (equivalent to 1 and 1.5 million/ha), was an effective option for reducing the competitive effects of wild oats and paradoxa grass and for minimising their seed production. These preliminary data agree with earlier Queensland research by Radford *et al.* (3), who showed that the optimum seeding rate for wheat in the presence of wild oats was about 150 plants/m^2.

These experiments have highlighted that weed control for yield conservation differs from weed management to minimise weed seed production and the subsequent increases in the weed seed bank in the soil. The competitive effects of weeds in wheat were eliminated with herbicides at lower rates, but higher rates were needed to minimise weed seed production. On the other hand, high densities of barley were able to successfully out-compete these grass weeds without using herbicides. Only a very low rate of herbicide was needed in barley to minimise or eliminate weed seed production.

This greater competitive ability of barley than wheat is in contrast with that found by Lemerle *et al.* (1) with annual ryegrass (*Lolium rigidum*). They found little difference between barley and wheat under conditions of southern Australia.

However in the sub-tropics, rotations with densely planted barley appears to be a useful option for integrated weed management. As well as reducing the overall need for herbicides, it should reduce the weed pressure in following less competitive crops such as chickpeas. It would be also useful when rotating to other crops, such as sorghum, which are sensitive to residues of many herbicides often used in winter cereals. The long-term effects of the strategic use of increased sowing densities of crops, together with lower herbicide rates, are being investigated in rotation experiments, particularly with regard to the impact on the weed seed bank.

Conclusions

The combination of high sowing densities of crops and low rates of herbicides is an effective weed management strategy for grasses.

References

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