Barley grass, an emerging weed threat in southern Australian cropping systems

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Abstract

There is growing evidence that barley grass has become a serious threat to cropping in South Australia. This conclusion was supported by a grower survey that found barley grass to be in the top five most problematic weeds in Eyre Peninsula and Upper North regions. Underlying reasons for its increased prevalence were investigated by examining seed dormancy of barley grass populations sampled from farmer fields. Seed dormancy varied greatly between populations ranging from 100% germination by mid April in the least dormant population, to only 7% germination by August in the most dormant population. The highly dormant populations were found to require cold stratification (chilling) to trigger seed germination. In the most dormant population of barley grass, there was only 1.3% germination in the absence of chilling but the germination increased sharply to 59%, 96% and 98% when seeds were exposed to 1, 3 and 5 week chilling. These results indicate that seed dormancy of barley grass could enable it to evade pre-sowing weed control and contribute to its increased prevalence in cropping systems. These results were also supported by a field study where a 3-week delay in sowing resulted in 75% reduction in weed infestation in wheat. In studies on selective control of barley grass in wheat, pyroxasulfone (Sakura) consistently provided effective control (>90%) of this weed species. Integration of information on seed dormancy with the use of new selective herbicides should enable farmers to effectively manage this weed in cropping systems.

Key Words

Barley grass, weed ecology, weed management

Introduction

In southern Australia, Barley grass (*Hordeum glaucum* Steud.) tends to be a weed of annual pastures (Cocks et al.1976) where sometimes it is seen as a valuable early feed for grazing animals. Early experience indicated that this species was unlikely to be problematic in crops due to a lack of long-term seed dormancy, resulting in the majority of seeds germinating with early autumn rains (Popay, 1981). Hence, it should be feasible to control it effectively with pre-sowing knockdown herbicides. However, there have been several recent reports of barley grass infesting cereal crops in South Australia. This conclusion was supported by distribution of a survey to 1800 growers in January 2009 (10% response rate). The respondents reported that barley grass is now in the top five most problematic weeds in Eyre Peninsula and Upper North cropping regions of South Australia. These lower rainfall cropping districts are prone to grass weed infestation as crop rotations are cereal-based due to a lack of suitable alternative crop species. In cereal cropping, barley grass can strongly compete with crops, act as a host to several diseases (Cocks et al. 1976) and there are very limited herbicide options for its selective control. Studies on seed dormancy were undertaken to determine underlying reasons for increased prevalence of barley grass populations in cropping fields. Field studies were also conducted to identify suitable herbicide options for selective control of this weed species in wheat.

Methods

Seed dormancy study

Barley grass seed was collected from cropping fields prior to harvest in November 2008. Populations were sampled from Eyre Peninsula (EP - Yaninee, Minnipa, and Buckleboo), and Lower North (Owen and

Roseworthy). Barley grass seed heads were collected whole from the field and stored in the lab under dry conditions at room temperature (20-25?C). Seed dormancy for each population was tested at 44, 71, 103, 149, 182, and 216 days from 1st of January 2009. Seed dormancy was checked at each time point by placing 25 fully formed seeds (selected on light table) in 150 mm petri-dishes with six replicates per population. The petri dishes were lined with two Whatman No.1 filter papers and 10 mL of distilled water added; the dishes were sealed with parafilm and covered with aluminium foil to maintain complete darkness. The dishes were placed in an incubator for 10 days in a 12 hour day/12 hour night cycle of 20/12?C. Germinated seeds (>1mm radical emerged) were counted and germination expressed as a percentage of viable seed. Seed viability was determined by a tetrazolium staining test.

Cold stratification response

The effect of cold stratification (chilling) on the germination of three barley grass populations from Buckleboo, Minnipa, and Roseworthy Campus (RAC-E4) was examined. Cold stratification treatments included 0, 1 week, 3 weeks, and 5 weeks chilling at 3-4?C after seeds had imbibed for 24 hours. Petri dishes were then placed in the incubator at 20/12? C (12 hour / 12 hour) for 14 days and germination assessed as above.

Barley grass control in wheat – a field study

Herbicide efficacy was evaluated in a field trial at Buckleboo on the Eyre Peninsula. Plot size was 6m wide by 14.4 m long with the seeding pass running perpendicular to plot arrangement. Pre-emergent herbicides were applied no more than 24 hours prior to seeding and incorporated by seeding (PRE) and post-emergent herbicides (POST) were applied when crop reached Z13 growth stage (see Table 1 for herbicide treatments). Surfactant was added to POST treatments in line with label recommendations. Seeding was done on the 22nd of April 2009 with farmer's seeder with crop row spacing of 30 cm. Wyalkatchem wheat was direct drilled at a seed rate of 40 kg/ha with 10.8 kg N and 4.8 kg P/ha fertiliser. In addition to crop and weed density assessments, weed seed production was estimated from a linear regression developed between panicle length and seed production per panicle. Seed set estimate was based on a sample of 25plants/plot. Wheat yield was also measured.

Table 1. Herbicide treatments evaluated for barley grass control; pre-emergent herbicides = PRE; post emergent herbicides = POST.

Herbicide Treatments
1. Control (only knockdown herbicide)
2. Trifluralin (480 g/L) @ 1.6 L/ha (PRE)
3. Trifluralin (480 g/L) @ 1 L/ha + Logran (triasulfuron 750 g/kg) @ 30 g/ha (PRE)
4. Metribuzin (750 g/kg) @ 150 g/ha (PRE)
5. Trifluralin (480 g/L) @ 1 L/ha + Diuron (900 g/kg) @ 500 g/ha (PRE)
6. Metribuzin (750 g/kg) @ 150 g/ha + Diuron (900 g/kg) @ 250 g/ha + Logran (triasulfuron 750 g/kg) @ 30 g/ha (PRE)

7. Monza (sulfosulfuron 750 g/ha) @ 25 g/ha (POST)

8. Atlantis (mesosulfuron-methyl 30 g/L) @ 0.33 L/ha (POST)

9. Boxer Gold (prosulfocarb 800 g/L, S-metolachlor 120 g/L) @ 2.5 L/ha (PRE)

10. Sakura (pyroxasulfone 850 g/kg) @ 118 g/ha (PRE)

Results

There was large variation in seed dormancy between barley grass populations (Figure 1A). The Yaninee population reached 80% germination in March (71 days), which is consistent with Popay (1981) who reported barley grass to lack long-term seed dormancy. In contrast, other populations such as Minnipa, located only 15km from Yaninee, and the Buckleboo population, showed very little germination at 20/12?C (<5%) despite having >90% viable seed. Two Lower North populations showed an intermediate response in the pattern of dormancy loss (Figure 1A). This large variation between barley grass populations in the pattern of seed dormancy could explain why some barley grass populations are becoming more prevalent under cropping situations. Increased seed dormancy could result in barley grass establishing much later after the crop has been sown, thus avoiding knockdown herbicides used for weed control.

Further studies on seed dormancy revealed that cold stratification (chilling at 4^{o} C) caused a large increase in germination in even the most dormant populations of barley grass (Figure 1B). Just 1 week of cold stratification increased germination from 1 to 55% in Buckleboo and from 1 to 59% in the Minnipa population. The five-week cold stratification treatment resulted in >98% germination in both populations. These findings were also supported in the field at Buckleboo where barley grass density declined by 75% as sowing was delayed from 22nd April to 15th of May 2009 (data not shown). This large reduction in barley grass density due to delayed sowing could have been caused by three weeks of cooler moist conditions that would have satisfied cold stratification requirement for germination.

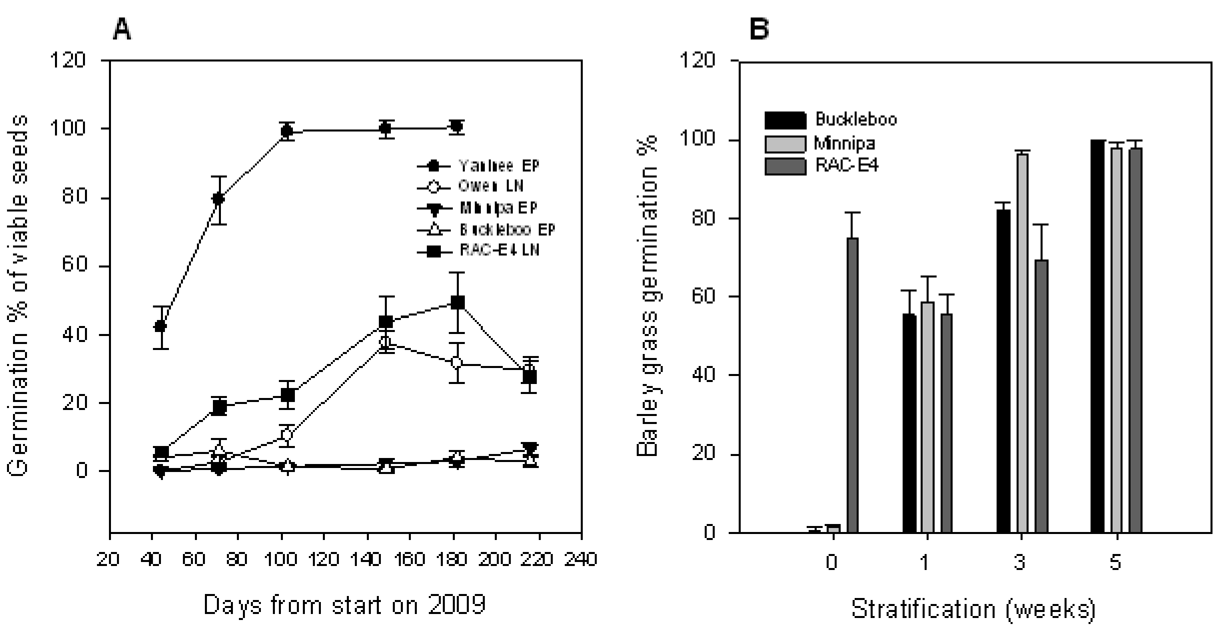

Figure 1. A: The germination pattern of five barley grass populations, Yaninee, Minnipa and Buckleboo from Eyre Peninsula and RAC-E4 and Owen from Lower North cropping regions. B: Effect of cold stratification treatment on the germination of three barley grass populations.

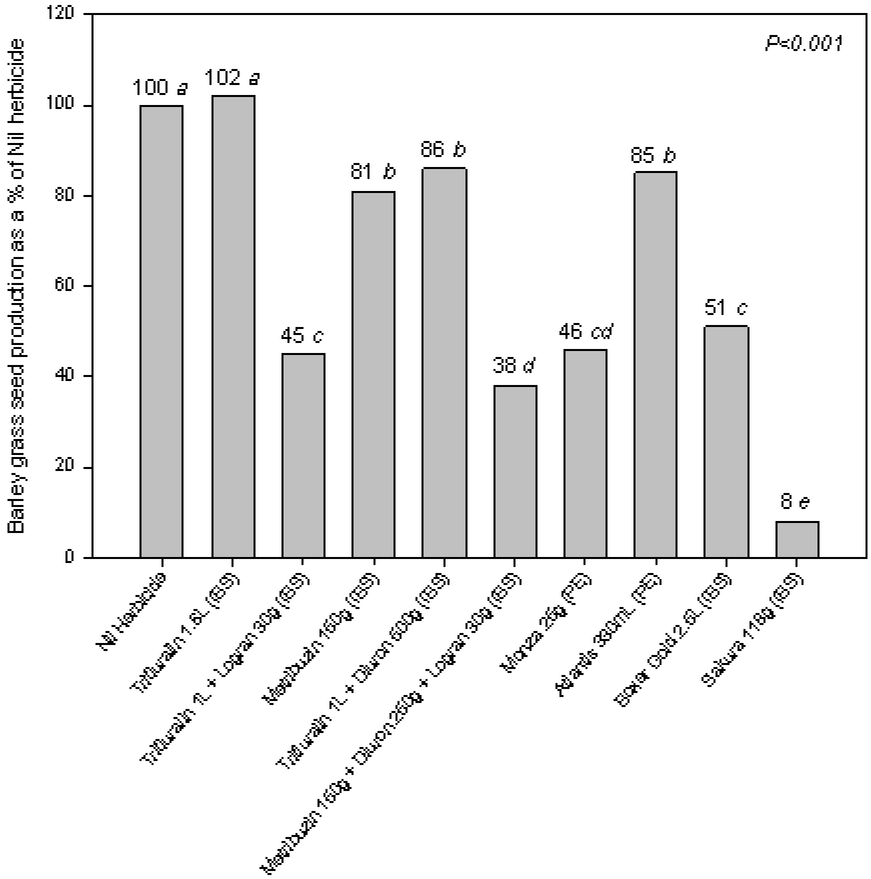

Figure 2. The effect of different herbicide treatments on barley grass seed set (% of Nil herbicide); PRE = pre-emergence, POST = post-emergence. Columns showing different letters differ significantly at P<0.001.

Herbicide treatments applied to wheat at Buckleboo resulted in significant differences in barley grass control (Figure 2). In the absence of control (Nil treatment) more than 376 plants/m^2 of barley grass produced in excess of 8702 seeds/m^2. Seed production in all other treatments has been expressed as a percentage of the nil herbicide treatment. Herbicide mixtures commonly used by farmers such as trifluralin + logran and the metribuzin + diuron + logran were relatively ineffective and reduced barley grass seed set by only 50%. POST sulfonylurea (group B) herbicides had differing activity with Monza performing better than Atlantis. Sakura, a new herbicide to be released next year, was found to have the highest activity against barley grass and reduced its seed set by as much as 92% ($P<0.01$).

Conclusion

Barley grass has become a serious weed of cropping in many districts of South Australia. Increased prevalence of barley grass appears to be related to high levels of seed dormancy in many paddock populations. High seed dormancy and cold (stratification) requirement in barley grass would enable these populations to avoid knockdown herbicides and germinate in cereal crops where control options are limited. Field studies showed that the new herbicide Sakura provided the highest and most consistent weed control.

References

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