Ecology and Management of Brome Grass (*Bromus rigidus* Roth and *Bromus diandrus* Roth) in Cropping Systems of Southern Australia

SAMUEL GEORGE LLOYD KLEEMANN

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School of Agriculture, Food and Wine

Faculty of Sciences

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ABSTRACT

Brome grass species *Bromus rigidus* (rigid brome) and *B. diandrus* (great brome) are winter annual grasses that have proliferated in recent years to become serious weeds of crops and pastures in southern Australia. Until recently there had been few studies on the population ecology of *B. rigidus* and *B. diandrus* and the research that had been done tended to focus on populations that had naturalised in Western Australia. Increased knowledge of the behaviour of *B. rigidus* and *B. diandrus* under current farming systems in southern Australia and the impact of management strategies on population ecology and seedbank dynamics would facilitate development of more effective weed control programs.

A field survey was undertaken in 2003 on the Yorke and Eyre Peninsulas of South Australia to determine relative distribution of these two brome grass species. *Bromus rigidus* was found more frequently and at higher densities in South Australian crops than *B. diandrus*. Field populations of both spp. were shown to possess much longer seed dormancy than what had been previously reported in Australian literature. Germination of dormant seeds of *B. rigidus* and *B. diandrus* was overcome with the addition of gibberellic acid (0.001 M GA_3) rather than upon removal of the husk (i.e. lemma and palea) protecting the seed; indicating that dormancy is most likely under hormonal control within the embryo. Dormant populations of *B. diandrus* from cropping fields were highly responsive to cold stratification (i.e. chilling), a process which has been shown to increase GA synthesis within the seed. Populations of *B. diandrus* from cropping fields also showed much longer seed dormancy than those collected from adjacent fence-lines. The large differences in germination pattern between these cropping and adjacent fence-line populations provide some evidence to suggest that management practices being used by growers in crop production are selecting for increased dormancy in *B. diandrus*. In cropping fields, there could be considerable adaptive value of dormancy mechanisms (i.e. cold stratification requirement, light inhibition) that delay

germination and seedling emergence until after pre-sowing weed control tactics have been used. Dormant populations of both *B. rigidus* and *B. diandrus* also showed strong inhibition of seed germination when exposed to light. This is the first Australian study to report the inhibitory effect of light on seed germination of *Bromus* spp. and provides a possible explanation for their increasing prevalence in southern Australia since the adoption of no-till farming.

Selection of greater dormancy in *Bromus* spp. is likely to contribute to the development of a more persistent seedbank. A 3-year field experiment undertaken at Lock on the Eyre Peninsula of South Australia from 2003 to 2005 showed that about 20% of *B. rigidus* seedbank can persist from one season to the next. In this field study, management strategies that combined effective herbicides (ACCase-inhibitors and imidazolinone Clearfield™ technology) and crop competition over consecutive years provided effective control of *B. rigidus* population and depleted its seedbank to low levels (from 1748 to <5 seeds m^{-2}) within 3 years.

In field studies, metribuzin, and metribuzin plus pendimethalin incorporated by sowing provided safe and effective control of *B. rigidus* (>75%) in barley. Post-emergent applications of imidazolinone herbicides, imazapyr, imazapyr plus imazapic and imazapyr plus imazamox, to imidazolinone-tolerant wheat (Clearfield™) also provided consistent and high levels of *B. rigidus* control (≥87%). Effective management of *Bromus* spp. will require a major change in cropping systems used by growers in southern Australia and will involve combining effective herbicide technologies (i.e. Clearfield™) with more competitive crops and more diverse rotations, where possible.

DECLARATION

This work contains no material that has been accepted for the award of any other degree or diploma in any university or other institution to Samuel George Lloyd Kleemann and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

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4. Samuel G.L. Kleemann and Gurjeet S. Gill (2008). Applications of metribuzin for the control of rigid brome (*Bromus rigidus*) in no-till barley crops of southern Australia. *Weed Technology* **22**, 34-37.

5. Samuel G.L. Kleemann and Gurjeet S. Gill (2009). The role of imidazolinone herbicides for the control of *Bromus rigidus* (rigid brome) in wheat in southern Australia. *Crop Protection* **28**, 913-916.

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- S.G.L. Kleemann and G.S. Gill (2006). Differences in the distribution and seed germination behaviour of populations of *Bromus rigidus* and *Bromus diandrus* in South Australia: adaptations to habitat and implications for weed management. *Australian Journal of Agricultural Research* **57**, 213-219.

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ACRONYMS

ANOVA	Analysis of variance
AUS	Australia
C	Celsius
CLF	Clearfield™
CS	Cropping systems
d	Days
DAP	Diammonium phosphate
EP	Eyre Peninsula
GA	Gibberellic acid
GSR	Growing season rainfall
h	Hours
IBS	Incorporated by sowing
kPa	Kilopascals
LSD	Least significant difference
M	Molar
mo	Months
POST	Post-emergence
SA	South Australia
SEM	Standard error of mean
VIC	Victoria
WAP	Weeks after planting
wks	Weeks
YP	Yorke Peninsula