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

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Bachelor of Agricultural Science (General)

A thesis by prior publications submitted to The University of Adelaide, South Australia

In the fulfilment of the degree of DOCTOR OF PHILOSOPHY

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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 GA₃) 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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Samuel George Lloyd Kleemann .................................................. Date **20-07-2013**
PUBLICATIONS ARISING FROM THIS THESIS


ACKNOWLEDGMENTS

I would like to thank my supervisors Associate Professor Gurjeet Gill and Dr. Art Diggle for their advice and guidance throughout the course of this project. I am indebted to my principal supervisor Gurjeet for his constant support, insightful direction, encouragement and friendship.

In particular, I would like to thank Andrew and Jenny Polkinghorne, and Allen and Mark Edwards for their hospitality, friendship and for providing experimental sites. I am especially grateful to Daniel Radulovic, Michael Burdett and Malinee Thongmee for field and technical assistance. I would also like to thank staff from the University’s School of Agriculture, Food and Wine and from the Minnipa Agricultural Centre for their assistance during the project.

I would like to offer a special note of appreciation to Professor David Coventry for his encouragement, friendship and kind reminders to stay the course and complete.

I am obliged to the Grains Research and Development Corporation for funding the research.

Finally and most sincerely I wish to deeply thank my family, for their constant patience, support, encouragement and understanding throughout. Dad, thanks for everything, you’re the greatest. To my beautiful wife Sarah and son Doshie I can’t thank you guys enough for your continual love and support, you’re my inspiration.
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<thead>
<tr>
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<tbody>
<tr>
<td>ANOVA</td>
<td>Analysis of variance</td>
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<tr>
<td>AUS</td>
<td>Australia</td>
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<td>C</td>
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<td>CLF</td>
<td>Clearfield™</td>
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<td>CS</td>
<td>Cropping systems</td>
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<td>d</td>
<td>Days</td>
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<tr>
<td>DAP</td>
<td>Diammonium phosphate</td>
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<tr>
<td>GA</td>
<td>Gibberellic acid</td>
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<tr>
<td>GSR</td>
<td>Growing season rainfall</td>
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