Factors affecting seedbank dynamics of *Lolium rigidum* Gaudin and other cropping weeds of northern NSW

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A thesis submitted for the degree of
Doctor of Philosophy
of the
University of New England

2007

Declaration

I certify that the substance of this thesis has not already been submitted for any degree and is not currently being for any other degrees or qualifications.

I certify that any help received in preparing the thesis, and all sources used, have been acknowledged in this thesis.

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Acknowledgements

It is indeed a matter of immense pleasure to express my esteemed and profound sense of gratitude to my supervisors Brian Sindel and Robin Jessop for their invaluable consultations, precious guidance, sagacious advice, constant and constructive criticism and sustained encouragement during the course of this investigation. Special thanks to Brian who encouraged me to cultivate the art of writing superior English. Also, gratitude to Brian for helping me to obtain the UNERA-INDIA scholarship and weeds CRC top up scholarship, without which it would have been impossible to study and survive in Armidale.

I owe my sincere thanks to Andrew Storrie, Tony Cook and Bruce Terrill who tendered pertinent guidance and steadfast help in accomplishing my work at the DPI, Tamworth Agriculture Institute. I would also thank Bob Martin for allowing me to undertake my studies at DPI, Tamworth.

My sincere thanks to Dave Edmonds for his endless help in the field and Mick Faint for his help in the glasshouse that helped my project run smoothly. Thanks also to George Henderson and other technical staff for their valuable guidance and encouragement from time to time.

I am extremely grateful to the farmers on the Liverpool Plains who generously allowed me to sample their fields for 3 years.

The help provided by Michael Walsh from the University of Western Australia, Deirdre Lemerle from NSW DPI, Wagga Wagga, and Christopher Preston from the University of Adelaide in planning my experiments is greatly appreciated. Also thanks to Sally Peltzer and Kathryn Steadman for useful information from time to time. Thanks to Craig Birchall for technical support in the spraying of my weeds.

I gratefully acknowledge the statistical support of Paul Kristiansen and Nam-Ky Nguyen. Special thanks to Paul for spending time teaching me the use of the R and SPlus software and how to do final thesis settings.

I shall be failing in my duty if I do not express my cordial thanks to my friends Avishek, Subhadip, Vinod, Gunasekhar, Dalvinder, Suresh and Mohammad Khusro for their untiring help, whole hearted co-operation and nice company during these studies.

Silence is the counterpart of 'Love' and that silence is the only language in which I can express my regards and love to my mother and respected sisters Shashi and Sneh, my dearest brothers in law, Vijay and Birender, and two cute angels, Riya and Pratyush for their sacrifices, encouragement, affection and unflagging inspiration.

Very special thanks go to my wife Sapna for her fervent inspirations, unsurpassable patience, love and preparedness to face the odds. These have been a beacon to me. Bundles of love and kisses to my new born daughter Anushka for bearing with me during my busy schedule.

Many thanks to The University of New England and Cooperative Research Centre for Australian Weed Management for providing me a scholarship to undertake the PhD without which, this project would not have been possible.

I dedicate my thesis to my father, the Late. Dr. Dharam Singh (Principle Scientist Plant Pathology) who although not in this world had always been with me constantly supporting me with the blessings and everlasting wishes to achieve my goals. His great values and teachings bestowed on me will always hold me up in my future endeavours.

Above all I humbly pay my gratitude to the Almighty who always graced me with his choicest blessings.

Abstract

Annual ryegrass (*Lolium rigidum* Gaudin) is one of the most important weeds of the grain cropping regions of southern Australia. The over reliance on herbicides with similar modes of action has resulted in the evolution of herbicide resistance in many *L. rigidum* populations. Recently, glyphosate-resistant *L. rigidum* was discovered on the Liverpool Plains near Tamworth in northern NSW. Little published work exists on the current status of the size and composition of glyphosate resistant *L. rigidum* seedbanks and other weeds identified as at risk of developing resistance on the Liverpool Plains. Also, there is little information available about the factors affecting dormancy and viability of *L. rigidum* seeds or the effects of modified management (alternative tillage and burning) options on glyphosate resistant *L. rigidum* seedbank dynamics, particularly in the northern grain region.

The extent of resistance in *L. rigidum* seed collected from the Liverpool Plains was evaluated against a range of herbicides, including glyphosate, in a glasshouse experiment in 2005 and repeated in 2006. Another commercial seed lot originating from Victoria and presumed to be susceptible to glyphosate was purchased localy for comparison with the glyphosate resistant seed lot. Both populations had cross resistance to group A herbicides (diclofop-methyl and tralkoxydim) as well as multiple resistance to group B (chlorsulfuron) and M (glyphosate) herbicides. Sulfometuron provided substantial control of *L. rigidum* collected from the Liverpool Plains but not from the Victorian populations.

Characterisation and monitoring of *L. rigidum* and other weed species seedbanks was undertaken for three consecutive years from 2004 to 2006 on the Liverpool Plains. Four properties (sites) were selected for sampling and either 3 or 4 paddocks were sampled from each site where *L. rigidum* was known to occur. The seedbank species remained unchanged over the 3 years under the management systems employed. Greatest *L. rigidum* numbers were found in the top 0-2 cm of soil which may affect their longevity and seed emergence patterns. At most of the properties, farmers adopted strategies such as alternate use of herbicides to restrict the *L. rigidum* seedbank numbers to low levels. *Polygonum aviculare* and *Sonchus oleraceus* with variable numbers across properties stand at risk of acquiring resistance to herbicides and so need to be controlled with alternative methods. *Crassula colorata* and *Lamium amplexicaule* numbers, although not in the high risk list, are still there in numbers that pose a threat of increasing populations if not treated.

Factors affecting seed longevity and emergence of *L. rigidum* seedlings were examined under polyhouse conditions and as indicated by the monitoring work above, seeds either with summer or winter dominant rainfall lost all viability after 16 months of burial. Maximum emergence in the polyhouse occurred in mid autumn within the 18 to 20°C maximum temperature range. Longevity of *L. rigidum* seeds was also tested under field conditions at Tamworth and found to be restricted to within 15 months of burial whether at 0, 5 or 10 cm depth. Seeds germinated quickly with rainfall received soon after sowing and lost more than 90% dormancy within the first 6 months of burial.

The WEEDEM model was assessed for its potential application in northern New South Wales. Emergence patterns of seed of *L. rigidum* from two sources, including a population from the Liverpool Plains, with cultivation and seed burial, were compared with the predicted emergence by a WEEDEM in a no-till situation. The *L. rigidum* emergence predictions by this model are likely to be reasonably accurate for no-till situations in the northern grain region but the model is not calibrated to predict emergence under cultivated or ploughed field conditions, which is a limitation of the program if more farmers begin to again cultivate judiciously to control herbicide resistant weeds.

Three field experiments were conducted over 2 years to examine the value of alternative tillage and burning treatments on weed emergence and the soil seed bank of *L. rigidum* and other prominent weeds from the northern grains region. One year of stubble burning with chisel ploughing (SBC) and mould board ploughing (MBP) alone provided substantial control of *L. rigidum*, *Avena fatua*, *Hibiscus trionum* and *Phalaris paradoxa*. *Lolium rigidum* was found to have low dormancy and longevity in the cropped situations which should enable farmers to exhaust the seedbanks within 2 years. *Polygonum aviculare*, *L. amplexicaule* and *Melilotus indica* responded best to MBP, while *P. paradoxa* had greatest reductions with SBC. Alternative management strategies to herbicides helped in decreasing or at least restricting the seedbanks of *L. rigidum* and other important weeds.

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