
Evaluation of *Dorycnium* spp. as Alternative Forage Plants.

by

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Submitted in fulfilment of the requirements for the degree of Doctor of Philosophy

University of Tasmania
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May 2005

Declaration

I declare that this thesis contains no material which has been accepted for the reward of any other degree or diploma in any other tertiary institution and, to the best of my knowledge and belief, contains no copy or paraphrase previously published or written by any other person except where due reference is made in the text of the thesis.

Simon R. Davies

May 2005

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Publications From this Project

Refereed Journal Article:

Davies, S.R., Yates, R.J., Howieson, J.G., and Lane, P.A., (2003), Selection and evaluation of root nodule bacteria for *Dorycnium* spp., Submitted: *Australian Journal of Experimental Agriculture*, 2005

Refereed Conference Paper:

Davies, S.R., and Lane, P.A., (2003), Seasonal changes in feed quality of *Dorycnium* spp., 11th Australian Agronomy Conference, 2-6th February Geelong, 2003

Refereed Conference Poster Papers:

Davies, S.R., Yates, R.J., Howieson, J.G., and Lane, P.A., (2002), Selection and Evaluation of Root Nodule Bacteria for *Dorycnium* spp., 5th European Nitrogen Fixation Conference, 6-10th September Norwich, 2002

Davies, S.R., Yates, R.J., Howieson, J.G., and Lane, P.A., (2002), Field Evaluation of Root Nodule Bacteria for *Dorycnium* spp., 13th Australian Nitrogen Fixation Conference, 24-27th September Adelaide, 2002

Abstract

The genus *Dorycnium* L. consists of a number of species of perennial leguminous shrubs known to be relatively drought tolerant. Low rainfall areas (i.e. <600 mm annually) of Australia under agricultural use are subject to periods of feed shortage during summer and autumn, and hence animal production is limited at this time. *Dorycnium* spp. have been identified as having the potential to be integrated into Australian grazing systems as a source of forage when little or no other feed is available. This project was established to further investigate a number of key issues related to the agronomic and forage characteristics of this potentially important genus. Research was undertaken into *Dorycnium* spp. to examine three important factors associated with the evaluation of a legume, seed germination characteristics, the nutritional value of the forage, and rhizobial associations.

Dorycnium hirsutum Ser. accessions TAS1002 and TAS2001 were subjected to a range of germination experiments examining the level of pod maturity, harvest season, and the effect of pre-germination treatments. The seed coat of *D. hirsutum* was found to influence germination behaviour, with the use of pre-germination scarification treatments improving germination behaviour by increasing the percentage germination (PG) and lowering the mean time to complete germination (MTG) and percentage hard seed. Mechanical scarification of TAS2001 for 20 seconds was found to increase ($P<0.05$) PG from 86 to 96 %, lower the MTG from 6.0 to 2.7 days, and reduce the percentage hard from 13.6 to 1.9 % in relation to untreated seed. Mechanical and chemical scarification techniques were found to be the most effective in promoting rapid and uniform germination, were simple to apply and were repeatable. In general, inherent differences in seed lot germination characteristics were believed to be associated with the influence of environmental factors and the natural characteristics of selected accessions with indeterminate flowering.

Established plots of *D. rectum* Ser., *D. hirsutum* and *D. pentaphyllum* Scop. were sampled along with an area of lucerne (*Medicago sativa* L.) on a regular basis throughout the spring/summer period of 2001/2002. Samples were analysed using

near infrared reflectance spectroscopy (NIRS) and wet chemistry for crude protein (CP), neutral detergent fibre (NDF) and dry matter digestibility (DMD) and metabolisable energy (ME). Over the course of the sampling period forage of *Dorycnium* spp. generally displayed decreases in CP, ME, DMD and increases in NDF. Typical CP values ranged from 4 – 18 % of dry matter (DM), NDF 21 – 72 % of DM, DMD 32 – 75 %, and ME 4.1 – 11.0 MJ/Kg/DM. The nutritive value of *Dorycnium* spp. forage appeared to be influenced by environmental and developmental characteristics, with the growth stage identified as a useful tool for predicting forage quality. Although *Dorycnium* plants were of lower forage value than lucerne, their forage can provide livestock with an important source of nutrition in areas of low rainfall and during periods where there are feed gaps.

Experimental plots of *Dorycnium* spp. at three Tasmanian sites were sampled every six weeks throughout the spring/summer period of 2002/2003 and analysed using a modified butanol-HCl method for condensed tannins (CT). The CT content of *D. hirsutum* was found to fluctuate from 3.2 to 16.6 % of the DM. *Dorycnium rectum* and *D. pentaphyllum* were found to contain CT levels of at least 7.7 and 6.8 % of DM respectively during the sampling period. The CT levels observed were considered to be high in general, with only *D. hirsutum* containing levels that may be considered to be low and possibly beneficial at certain stages of development. Increases in CT levels were associated with the initiation of flowering, and interactions between the environment and species were observed, although no common factor was identified as influencing CT levels.

A glasshouse experiment was undertaken to assess the nitrogen fixing ability of the commercial *Lotus corniculatus* L. inoculant SU343 with *Dorycnium* spp. against a range of alternative inoculants. The host/rhizobia interactions of *Dorycnium* spp. along with six important pasture legumes and a range of inoculants was assessed. Strains WSM1284, WSM2323 and WSM2338, along with SU343 were found to be suitable inoculants for *Dorycnium* spp. examined. However, negative interactions between these inoculants and important pasture legumes were identified. Inoculant strains, WSM1284, WSM2323, WSM2338 and SU343 were selected to undergo evaluation under Tasmanian field conditions with *D. hirsutum* and *D. rectum*. In the field all strains were found to fix adequate amounts of atmospheric nitrogen.

Inoculant SU343 was confirmed to be a suitable inoculant for *D. rectum* in terms of performance and commercial viability, however, WSM2338 and WSM1284 were found to be equally suitable. The inoculation of *Dorycnium hirsutum* with the Tasmanian isolate WSM2323, was found to be a significantly ($P<0.05$) superior strain to SU343 in terms of nitrogen fixation. The inoculation of *D. hirsutum* did not affect ($P>0.05$) plant DM production in the field. The ability of the inoculants to compete with a background population of root nodule bacteria was found to be of concern, and may have serious implications for the long-term performance from a single inoculation event. It was proposed that a combination of rhizobial strains may be more effective as a commercial inoculant rather than relying on the single *L. corniculatus* inoculant SU343.

Acknowledgements

The undertaking of this PhD project would not have been possible without the support of a number of individuals and organizations, and I would like to thank the following:

Dr Peter Lane for his supervision, support and guidance with the undertaking of this project. Without his assistance this would not have been possible.

Eric Hall (DPIWE/TIAR) for sharing his knowledge, and providing technical assistance with seed collection and field work.

Rural Industries Research and Development Corporation (RIRDC) for providing the financial support for the conduct of this project and the University of Tasmania for providing me a scholarship that enabled me to return to this University and undertake my PhD.

Associate Professor John Howieson and Ron Yates (Centre for *Rhizobium* Studies, Murdoch University) for providing their knowledge and technical expertise in undertaking the rhizobia studies.

Professor Rob Clark for providing me with advice for my personal and professional development. This has enabled me to not only enjoy my PhD candidature, but improve a wide range of skills and generally ‘get involved.’

Dr’s Alistair Gracie and David Ratowsky for their assistance with the statistical analysis of my results.

Dr’s Michael Friend and Lesley Mutch for their assistance in editing Chapters.

Bill Peterson for assisting me whenever I needed help with building devices, finding materials or general advice, nothing was ever too much trouble.

To my friends who have followed my progress over the past few years and provided support and encouragement.

Finally, and most importantly to my family;

Mum, thankyou for your continuous words of encouragement and support.

Dad, thankyou for your ongoing advice and encouragement. Your experience with completing a PhD was very helpful and inspirational.

My brother Andrew, thankyou for supporting, and putting up with me over the past few years.

Nan, thankyou for your words of encouragement.

I can’t thank you all enough.

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