AN EVALUATION OF LUPINS (*Lupinus* spp.) FOR SEED PROTEIN PRODUCTION

a thesis presented in partial fulfilment of the requirements for the degree of Doctor of Philosophy at Massey University, Palmerston North, New Zealand.

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1979

ABSTRACT

Since 1972 there has been interest in the greater use of seed protein in grain-based meals for stock. Lupins were one of the crops proposed to fill this requirement. This study was initiated to provide information on the agronomic requirements of *Lupinus angustifolius*, *L. luteus* and *L. albus* for seed production with emphasis on the southern North Island of New Zealand. In addition, some more basic studies on carbon and nitrogen translocation and the response of lupins to water stress were also carried out to provide a better understanding of the lupin plant and its response to its environment.

Initially some field experiments were laid down to measure responses to sowing date, plant density, defoliation and cultivar. At wide spacing, *L. angustifolius* showed an approximately linear decrease in seed yield/plant as sowing date moved from April to October. At normal densities, however, sowing in late July gave the best seed yield. Autumn sowings were affected by disease. It was concluded that, in the absence of disease, seed yield was largely determined by the length of the period of favourable environmental conditions between the start of flowering and the finish of reproductive development. This period determined the number of lateral inflorescences produced which, in turn, determined the number of pods producing seed. Pod number was the main component influencing seed yield. Thus, early sowing and reliable summer rainfall or irrigation seem to be the factors determining high lupin seed yields.

Responses to density were variable. In one experiment there was no response in seed yield by four cultivars over these sowing times to densities ranging from 50-140 pl/m^2. In a further experiment, increases in seed yield were obtained as plant density increased from 25-100 pl/m^2.

Removal of the main stem growing point early in growth briefly stimulated lateral stem growth but the effect on lateral stem seed yield was insufficient to compensate for the loss of the main stem seeds.

There was little difference between the *L. angustifolius* cultivars Uniharvest, Uniwhite and Unicrop when sown early but, with late spring sowing, Unicrop flowered earlier which was an advantage under dry early summer conditions. In one experiment comparing a range of legume species, *L. albus* and *Pisum sativum* produced the highest seed yield but *L. albus* and *L. luteus* yielded the most protein per unit area. The peak rate of nitrogen accumulation in all species was similar and the main factor influencing protein yield appeared to be the duration of nitrogen accumulation. Provided each crop utilised similar durations of the growing period, the yield of seed protein/ha from various legume crops is likely to be similar; the main difference being the composition of the seed. It was suggested that, for maximum seed protein yield, indeterminate cultivars may have some advantage over more determinate cultivars provided appropriate management procedures are adopted.

Studies on water stress indicated that it plays an important role by influencing the distribution of assimilate between vegetative and reproductive growth. Mild water stress tended to stop vegetative growth and increase the rate of seed growth. When sufficiently severe, water stress appeared to initiate the senescence of the plant, the timing of which determined the potential seed yield for that situation. Water deficit had its main effect on seed yield by reducing pod number. Other yield components were relatively stable.

Day temperatures of 28^{o}C, when imposed early in growth, reduced vegetative and seed yield in *L. albus*. As the plant developed, however, the adverse effects of high temperature decreased until growth was stimulated during first order lateral flowering. No direct effect of high temperature on pod abscission was apparent and it was suggested that pod loss under high temperatures which have been reported occurred largely because of an associated water stress.

A ^{14}C translocation study indicated that most movement of photosynthate in *L. albus* was into the branch on which the labelled leaf was inserted, or into lower branch orders directly connected to it. Results suggest that, in *L. albus* cv. Ultra, lower order stems are a more important competitor with the inflorescence for photosynthate than the new, rapidly developing, higher order lateral branches.

A possible strategy for growing lupin in a commercially viable situation in the Southern North Island is discussed.

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ACKNOWLEDGEMENTS

Financial support from research contracts with Dalgety (N.Z.) Ltd, and DSIR and from grants by the Palmerston North City Corporation Economic Development and the Pork Industry Council made it possible to obtain more information in this, and other studies on lupins and this assistance is gratefully acknowledged.

To my supervisors, Prof. B.R. Watkin and Dr B.J. Forde who so willingly provided guidance and support, I would like to express my grateful thanks.

Technical assistance was provided at critical times by a number of people but in particular I wish to thank Lois Mather and Terry Lynch who provided reliable and valuable assistance over much of the experimental period and to Joan Hay for typing the thesis.

I am grateful for the use of controlled climate facilities at the Plant Physiology Division, DSIR and I would like to thank Mrs Liz Edge, Mr Ian Warrington and other members of the Climate Room Support Group for their help and interest.

Finally a big thank you to my wife, Marie, and my three boys for their patience and support. My heartfelt apologies also for neglecting them for so long.

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