CHEMICAL MANIPULATION OF *LOTUS ULIGINOSUS* SCHK. CV. 'GRASSLANDS MAKU' GROWN FOR SEED PRODUCTION.

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ABSTRACT

This thesis reports results of experiments conducted at Massey University, Palmerston North, New Zealand on seed production of 'Grasslands Maku' lotus (***Lotus uliginosus*** Schk. syn. *Lotus pedunculatus* Cav.). Both field (2 years) and single plant (1 year) studies were conducted, and plant responses to the effects of three plant growth regulating chemicals applied at different rates and times, and the effects of hand cutting, were recorded.

Chapter 3 records an analysis of growth of individual Maku lotus plants and outlines the morphological characteristics which may limit seed yield potential. One major factor influencing seed yield, in addition to the crop's long indeterminate flowering and pod shattering characteristics, was the competition which developed between vegetative and reproductive growth for photosynthetic assimilate. The plant continuously produced new main shoots which, along with the growth and development of lateral shoots, cumulatively added to the dense vegetative 'bulk' during the early summer under increasing conditions of daylength and temperature. Intense lateral branching occurred at the same sites as inflorescences also appeared in November. Intensive vegetative and reproductive growth developed simultaneously during the flowering months (December and January). As a result, physiological compensation became important and was expressed in floret bud, floret and pod abortion which decreased potential seed yield. Reproductive abortion was more prevalent in the early and late season flowers. Main shoots originating from September to December contributed most to final seed yield.

Chapter 4 deals with results of a two-year field experiment (1988-90) investigating the effects of foliar-applied plant growth regulators (paclobutrazol and cycocel for two years, Alar for one year), at different rates and times of application; and hand cutting (for one year) at the same times as chemical application. Paclobutrazol significantly altered vegetative shoot development by reducing shoot internode length and total dry matter yield, and by inhibiting apical dominance thus inducing lateral branching which subsequently increased reproductive sites. Paclobutrazol application rates of 0.5 or 1.0 kg ai/ha in early October (50 days before

the onset of flowering) significantly increased seed yield by 53.7 and 75.9% respectively in 1988-89 and at 54.8 and 111.9% respectively in 1989-90. These yield increases were due to increased numbers of flowers in the first year and an increase in numbers of pods per umbel and seeds per pod in the second year. Paclobutrazol (1.0 kg ai/ha) applied in November or December also significantly increased seed yield by 63.3 and 53.7% respectively in the first year and by 68.6 and 67.2% respectively in the second year. Residual effects of paclobutrazol on the succeeding crop of Maku lotus also significantly increased seed yield by about 79.4% compared to the untreated plants but analysis of yield components did not clearly explain why.

Cycocel application did not retard internode length or increase flowering. However, application at 2.5 kg a.i./ha in early October (50 days before flowering) significantly increased seed yield in both years (89.6 and 92.2%, respectively). Cycocel applied in November and December and at a lower rate (1.25 kg ai/ha) also increased seed yield but to a lesser extent and was less consistent in its effect. These yield increases resulted from an improvement in seed yield components, particularly enhanced pods per umbel and seeds per pod. Although cycocel did not reduce the dense vegetative 'bulk' of the crop, its cost-effectiveness makes it a cheaper alternative (about 94% cost saving) than paclobutrazol.

Alar application and hand cutting which were used only during the first year, did not affect main shoot internode length, seed yield components or germination percentage. Alar applied in October at two rates (2.0 and 4.0 kg ai/ha) increased seed yield by 76.6 and 86.1% as a result of increased main and lateral shoot production which consequently increased the number of flowers per unit area. Later application (November and December) did not produce this effect. Hand cutting, especially in December, delayed flowering and depressed seed yield due to the removal of earlier-formed main shoots (September, October and November) which are major contributors to seed yield.

The plant responded positively to the applications of paclobutrazol and cycocel during the mid-season flowering by decreasing reproductive abortion as shown by the increased number of pods per umbel and seeds per pod. The early and late season flowers did not respond to the effects of these chemicals.

Chapter 5 reports single plant studies on the effects of paclobutrazol and cycocel applied at 1.0 or 1.25 kg a.i./ha, respectively on shoot growth and reproductive development. Both chemicals significantly altered shoot growth in favour of reproductive growth. Paclobutrazol applied in early October (48 days prior to flowering) significantly reduced the number of main shoots following treatment, but increased the number of lateral shoots and altered the plant structure by inducing earlier branching at lower nodes on main shoots. Cycocel applied at the same plant growth stage did not alter the shoot numbers but, like paclobutrazol, induced the earlier formation of lateral shoots prior to flowering. Both chemicals effectively altered the time of vegetative and reproductive growth, reduced competition for assimilates in favour of seed yield, and increased pods per umbel and seeds per pod. The same PGRs applied later (November and December) did not alter plant structure or time of occurrence of vegetative and reproductive growth. The implications of crop manipulation for improving seed yield in *Lotus uliginosus* are discussed.

Chapter 6 highlights the major conclusions and recommendations from this study, and suggests areas for future research.

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ROGER

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