EFFECTS OF PLANT GROWTH REGULATORS ON VEGETATIVE DEVELOPMENT AND SEED PRODUCTION OF BIRDSFOOT TREFOIL (*Lotus corniculatus. L*)

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ABSTRACT

Effects of chemical manipulation of a crop of birdsfoot trefoil (*Lotus corniculatus* L.) grown for seed in two consecutive years were investigated in this study. In the first year, treatments included Cultar (paclobutrazol) at 0.5 or 1.0 kg a.i./ha, Cycocel (chlormequat chloride) at 1.5 or 3.0 kg a.i./ha and Alar (daminozide) at 2.0 or 4.0 kg a.i./ha applied twice at either the late vegetative stage (October) or at the early flowering stage (November). None of these treatments affected seed yield (average 549 kg/ha),or umbel components (pods per umbel, seeds per pod and thousand seed weight).

In the second year, at the same stages of plant development, Cultar and Cycocel were applied at the same rates as previously, with an additional treatment added using RSW-0411 (triapenthenol) at 0.5 or 1.0 kg a.i./ha. Again, no seed yield improvement was obtained by any chemical treatment, but average seed yield being increased 27% from 769 kg/ha by 6 days delay in harvesting from 41 to 47 DAPF. Shoot length was reduced by chemical applications, especially at the time of rapid growth, and Cultar had the strongest and longest retarding capability. However, plant branching was not improved by any treatment. Although early flowering pattern was increased by October Cultar application at the higher rate and peak flowering pattern by November Cultar application at either rate, total reproductive structures at harvest in treated plants were similar to those in untreated plants due to flower abortion. Cultar applications in the first year had no carry-over effects on seed production in the second year, but delayed early plant growth in terms of ground cover. Plant growth regulators had no effect on the quality of the subsequently harvested seeds.

Effects of Cultar, Cycocel and RSW-0411 applied at higher rates in October on reproductive abortion were examined in flowers produced during the flowering season in the second year. Chemical treatments increased flower abortion by 20%, especially in the early flowers. However, there was no effect on abortion of pods in an umbel, on abortion of ovules or seeds in a pod, or on seed weight. Time of flowering also modified flower abortion rate (late flowers having up to 48% greater flower survival than early flowers), and seed development rate (being slower in early season flowers), had no effect on pod abortion and seed abortion (average 44% and 70%, respectively). Flower abortion was first found as early as 10 DAOF. Pod abortion occurred consistently after flower opening, and ovule or seed abortion occurred particularly in the early stages of seed development.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF APPENDICES

GENERAL INTRODUCTION

Birdsfoot trefoil (*Lotus corniculatus L.*) is a perennial herbage legume introduced into New Zealand about one hundred years ago. It grows and persists on most soil types but has special value in marginal soils. Its superiority in herbage production and persistency compared to other conventional legumes, such as white clover, red clover and lucerne, has been recorded when the species was grown under infertile, acid, dry or poorly drained soils (Chevrette *et.al.*, 1960; Hunt and Wagner,1963; Charlton *et.al.*, 1978; Morton, 1981; Scott and Charlton, 1983; Chariva, 1986; Widdup, *et.al.*, 1987; Enright and Floate, 1988; Fraser, *et.al.*, 1988; Chapman *et.al.*, 1990a). Nutritive value of this species also compares favourably with other commonly used legumes (MacDonald, 1946; Smith, 1964; John and Lancashire, 1981) and declines less rapidly with advancing maturity (Mays and Washco, 1960; Taylor *et.al.*, 1973; Collins, 1982), and therefore it can be used for summer grazing to provide a more even availability of forage throughout the grazing season. The non-bloating characteristic of this species, makes it a good substitute or alternative for lucerne in improving pasture productivity (Marten and Jordan, 1979; Marten *et.al.*, 1987).

Because of these merits, birdsfoot trefoil will likely become an important species in current development of low input sustainable agriculture. Uncertain wool and meat market conditions in recent years has resulted in a dramatic decline in fertilizer use in New Zealand (Nicholls *et.al.*, 1990). This situation is confounded by the need to develop pasture on marginal soils. It could therefore be expected that this species will become a better alternative to more conventional species which need high soil fertility. A similar trend has occurred in the USA (Knight, 1985). In addition, favourable climatic conditions for seed production offer promise to New Zealand farmers by allowing them to benefit from birdsfoot trefoil seed production for selfsustainability and for export in the future (Hampton *et.al.*, 1990)

The widespread use of *Lotus corniculatus* in pastoral systems, however, has been reportedly slow, and inconsistent. Unreliable seed production has been considered to be the major limiting factor. Commercial seed yields reportedly range from 50 to 400 kg/ha with 100 kg/ha considered average and 400 kg/ha excellent (McGraw and Beuselink, 1983). The best seed yields obtained, however, are still considerably lower than the crop's seed yield potential of 675-1125 kg/ha estimated by Seaney and Henson (1970) from crops grown under favourable environmental conditions.

A number of aspects have been identified as major factors which may be responsible for poor seed production in birdsfoot trefoil (McGraw and Beuselink, 1983). In particular, the protracted flowering period of the plant causes difficulty in defining the proper harvest time. Also, low assimilate distribution to reproductive parts combined with the pod dehiscence nature of the plant can contribute to great losses of seed during harvesting.

Successful seed production in birdsfoot trefoil depends on seed yields which are governed by the number of shoots and subsequently the number of inflorescences produced during the period of peak flowering (Li and Hill, 1988). Management practices for improving seed yields can probably be directed through manipulating plant structure, particularly through maximizing the number of potentially fertile shoots. Mechanical manipulation through cutting or grazing the plant at any time during spring has been found to have detrimental effects on seed production (Anderson and Metcalfe, 1957; Bader and Anderson, 1962a), since cutting simply removes older shoots and new crown-shoots grow and replace them (Li, 1989).

Chemical manipulation by the use of plant growth regulators has been proven to increase seed yields in several plants. Cultar (paclobutrazol) has been successfully used in *Lotus uliginosus* (Clifford and Hare, 1987); RSW-0411 (triapenthenol) in oil seed rape (Child, 1987);Cycocel (chlormequat chloride) in wheat and barley (Kust, 1986); and Alar (daminozide) in red clover (Jakesova and Svetlik, 1986). The effects of these chemicals have occurred particularly through increasing and synchronizing branching or tillering, and by shortening shoot growth and hence reducing lodging. The present study examined the value of plant growth regulators as a shoot manipulator for improving seed yield in *Lotus corniculatus*. Their effects on reproductive structure and abortion was also investigated during the flowering season of the plant.