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**DEFOLIATION MANAGEMENT OF
BIRDSFOOT TREFOIL (*Lotus corniculatus* L.)**

**A thesis presented in partial fulfilment of the requirements for the
degree of Doctor of Philosophy,
Institute of Natural Resources, Massey University, New Zealand**

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2001

*This Thesis is dedicated to my wife Rossy, and our daughters Agustina and Bianca
for their love, help and support*

ABSTRACT

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Birdsfoot trefoil (*Lotus corniculatus* L.) is a forage legume widely cultivated around the world, adapted to grow on infertile, drought-prone or acid soils, and with a high feeding value and bloat safe forage. However, its persistence is poor, limited by the management of defoliation and disease incidence. Adjustments in defoliation strategies, reproductive processes and population dynamics are seen as alternatives to increase production and persistence of birdsfoot trefoil swards. The objectives of this research were to determine appropriate defoliation strategies for different birdsfoot trefoil cultivars, in terms of the frequency, intensity and timing of defoliation, and to quantify morphological and physiological adaptations and population changes in response to defoliation. A series of three field and one glasshouse experiments were conducted in Massey University, Palmerston North, New Zealand (latitude 40°23'S) and INIA Treinta y Tres, Uruguay (latitude 33°54' S) from 1997 to 2000. The cultivars evaluated were San Gabriel (Brazil), INIA Draco (Uruguay), Grasslands Goldie (New Zealand) and Steadfast (USA). Management varied in intensity of defoliation from 2 to 10 cm height, in frequency from 20 to 40 days, and in timing the start of defoliation in the first year from vegetative to late mature stages. Also, combinations of rest periods in autumn, winter and summer were studied on pure and mixed birdsfoot trefoil swards.

A preliminary short term study with Grasslands Goldie in New Zealand, showed that hard defoliation (2 cm) in spring reduced birdsfoot trefoil spring production (17%) and plant population (21%) compared with the average of laxer defoliation (6 and 10 cm). Root mass, crown mass, primary and total number of shoots/m² and root reserves were all reduced under hard defoliation. Early autumn rest (last cut in April) improved plant root reserves and increased spring herbage production (17%). The effects of intensity of defoliation were confirmed under controlled glasshouse conditions, where lax regimes

(6 and 10 cm) increased herbage production over intensive defoliation (2 cm) when defoliated at 20 day intervals. In spring, intensive and frequent defoliation (2 cm-20 days) reduced production and plant survival, and lax and less frequent defoliation (10 cm-40 days) resulted in herbage losses by excessive accumulation. Limited and short term plant adjustments in relative growth rate, leaf area, specific leaf area and number of leaves per plant were not enough to compensate for the excessive loss of plant tissues under severe defoliation (2 cm). The effects of defoliation intensity increased over time, reducing crown size, root mass, root diameter and root reserves of birdsfoot trefoil plants.

Cultivars evaluated in a two years study in Uruguay differed in plant habit (from semi-prostrate to erect types), winter activity (active and dormant types) and morphology. The presence of rhizomes in cv. Steadfast was observed in 17% of individual plants tested. Cultivars San Gabriel and INIA Draco were 2.6 and 2.5 times more productive than introductions from New Zealand and USA in the first and second year respectively. The group of cultivars tested showed adequate standards of forage quality, varying from 590-720 g/kg DM for digestibility of organic matter, 25-39 g/kg DM for nitrogen, 230-400 g/kg DM for acid detergent fibre and 22-31 g/kg DM for condensed tannins. In contrast with previous results, herbage production was higher for plots defoliated at 4 cm height than at 8 cm during the first year and there were no differences in the second year. Contrasts with previous experiments were attributable to an extended defoliation interval (40 days) and rest periods of approximately 6 months in the year that allowed plants to rebuild enough reserves for successive regrowths.

When growing in competition with white clover, birdsfoot trefoil production was improved by autumn rest and lax grazing (10 cm). Plant density was reduced by intensive grazing (4 cm) and by strategies that grazed swards between 9 and 12 times a year compared with those where grazing was 6 times a year. Summer spelling increased seed production of birdsfoot trefoil, achieving 11110 viable seeds/m² if a winter rest was also used. However, seedling emergence from soil seed reserves was only between 5-13% under grazing conditions during autumn and winter, demanding additional management practices to increase recruitment of new individuals.

The results of these studies were used to define practical management strategies to optimise the production and persistence of birdsfoot trefoil swards, and plant characteristics appropriate to Uruguayan and New Zealand conditions.

Keywords: *Lotus corniculatus* L.; birdsfoot trefoil; cultivars; defoliation management; forage production; nutritive value; persistence; plant morphology; carbohydrate root reserves; seed production; soil seed reserves; seedling emergence.

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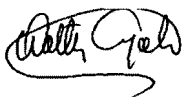
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