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**QUANTITATIVE GENETICS OF SHEEP
PREFERENCE IN RED CLOVER (*TRIFOLIUM
PRATENSE* L.) UNDER SPACED PLANT AND
SWARD CONDITIONS**

A thesis presented in partial fulfilment of the
requirements for the degree of
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ABSTRACT

Nine populations of diploid Red clover (*Trifolium pratense* L.) (Erect: Turkish, Hamua and Quiñiquelli; Semi-erect: Colenso, Kenland and E116; Prostrate: F.2419, Astred and Turoa) representing material from the main temperate regions of the world were used in experiments conducted at Massey University (New Zealand) and INIA-La Estanzuela (Uruguay).

Population seedlings were sampled under glasshouse conditions (one at each site) to raise representative samples for cloning for two field studies. Principal components were used to ensure representativeness of the sample.

Field designs and statistical models were developed specifically to meet the requirements for genotype evaluation under grazing conditions, and to estimate genotypic parameters of plant characteristics influencing selective grazing behaviour.

A preliminary grazing management experiment was conducted at Massey University with spaced plants (9 populations x 80 plants), where four stocking densities (2, 3, 5 and 9 sheep/18m² for one hour) at two times of grazing (morning or evening) were imposed on the nursery, in order to determine optimum measurement of sheep grazing preference. It was found that the preferred grazing management was to graze until an average of 40% leaf remained in the residual plant material (equivalent to a stocking density of 5 sheep/18m²) for one hour, at either morning or evening. This achieved a 94% sampling intensity. This regime was used subsequently in the further three grazing experiments.

Two spaced-planted experiments (one at each site) were conducted in three blocks of 324 plants each (9 populations x 12 genets x 3 ramets) which were completely randomised in a 0.75m grid in each block, using the optimum grazing management. Pre-grazing plant measurements were taken on some characters (habit, leaf size, flowering and density); while pre- and post-grazing measures were taken on others (height, spread

and leafiness). Subsequently to the experimental defoliation, all plants were defoliated to a uniform 20% leaf residual, by mob stocking. The statistical design was a diffuse randomised complete block with plants nested inside populations at the whole plot level, with a split-plot in time and pooled across sites. The results demonstrated that grazing animals were grazing selectively, rather than grazing at random: the four most grazed populations were Quiñiquelli, E116, Kenland and Turoa and the least grazed were Astred and Turkish. The preferred populations had the highest levels of crude protein and digestibility, and the least grazed populations had the lowest values. Post-grazing leafiness was considered the most suitable morphological character to determine grazing preference because it was highly significant in the analyses of variance for the Population and Plant effects, and demonstrated heritability values > 0.2 , allowing modest genetic progress.

A sward experiment was conducted at INIA-La Estanzuela with a subset of six populations sown in three blocks, each with three internal replicates of 12.25 m² each and four internal sub-samples. The same random principle was applied to give a random offer to the grazing animals, but at a plot level. The efficacy of selecting for swards in spaced plant nurseries was examined through the ratio of the correlated genetic advance in swards of selecting under spaced conditions to the direct genetic advance of selecting in sward conditions. Plant density, post-grazing leafiness, difference between pre- and post-grazing leafiness, and index of intake achieved greater genetic advance when selection was done as spaced plants: while for pre- and post-grazing height the opposite result was found. For all other characters, the best conditions to select in depended on the selection intensity achievable.

It is concluded that the breeding of Red clover to improve its grazing preference should not be based on simple morphological characters. Rather, it should be based on a measurement of forage removal such as post-grazing leafiness, and under spaced plant conditions, even considering that the final use is under sward conditions.

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