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Genotypic Variability in Yorkshire Fog Grass

(*Holcus lanatus* **L.**)

A thesis

presented in partial fulfilment of the requirements

for the degree of

Master of Agricultural Science

in Agronomy

at

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ABSTRACT

Plant to plant genotypic variation in New-Zealand Yorkshire-Fog grass was examined in order to quantify the relative importance of average gene effects, dominance, epistasis and environment. The plant variability was contrasted also against topodeme variation.

Plants were grown under glasshouse conditions (20^{o} - 25^{o}C), using vernalization and sixteen hour daylight to encourage growth and flowering. The confounding effect of bench position was removed by regression adjustment.

Fifty half-sib lines representing ten diverse New Zealand topodemes were examined in a one-way mating design, laid out as a randomized complete block experiment.

In general, half-sib and plant variances were much larger than the topodeme variance. This supports earlier findings that there are no major topodeme differences in New Zealand Yorkshire Fog grass germplasm.

The broad-sense heritability estimates which indicated total genotypic contribution varied from low to high. Most botanical, flowering and tillering characters had a medium to high values while the agronomic characters had medium to low estimates.

The attributes with medium to high narrow-sense heritability are several measures of leaf size, tiller development, purple colour, plant height and erectness, flavanols and panicle width. Breeding methods, such as mass selection, line selection, line breeding or simple recurrent selection should ,therefore, be appropriate for these.

The attributes with medium to high heterotic-sense heritability are leaf tensile strength, leaf hairiness, old disease, (rust) flowering period, panicle length and compactness and several aspects of tiller production. Breeding methods, such as recurrent selection with progeny testing or top cross progeny tests for high specific

combining ability should be useful, including synthetic cultivars and some kinds of recurrent bulks.

Of particular interest was the finding that there was more genetic variability for the duration of tillering and flowering periods than for tiller numbers or flower initiation. There was also evidence that the genetic activity controlling tiller number changed as the tillers aged.

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INTRODUCTION

Yorkshire Fog grass has been judged as one of the significant grasses for farm productivity (Basnyat, 1957; Munro, 1961). It has always been valuable as a pioneer grass in drained peat swamp areas (Basnyat, 1957). It is also useful in infertile, unstable, poorly drained soil (Munro, 1961; Davies *et al.*, 1971; Morrison and Idle, 1972; Rumball, 1983). It is capable of establishing well in humid hill county, and on unploughable steep hills (Basnyat, 1957; Hughes and Nicholson, 1961;). On such area, *H. lanatus* is one of the earliest grasses to start growth in the spring and its subsequent growth was also notable (Herriot, 1975). It has been proposed as a 'nurse' species for sown *L. perenne* and *Trifolium rapens*, for which it would consolidate the soil, protect over grazing, and speed up the fertility cycle (Thomas, 1936; Davies, 1940). Furthermore, its good persistence has been used to control erosion (Dunbar, 1974; Hornung, 1976).

Yorkshire Fog grass is more suitable for less intensive farming system, typically dairy pasture and upland sheep farms (Munro, 1961). Its growth habit and vegetative-reproductive cycle make it a good candidate for a lenient system of defoliation (Levy, 1955; Beddows, 1961). Its grazing tolerance lies between perennial ryegrass and cocksfoot (Mitchell, 1956). In mixed swards and under infrequent grazing regime, *H. lanatus* dominated *L.perenne* (Watt, 1987) and its ground cover over 4 year in Oxford has increased from 18% to 43% (Haggars and Ellliot, 1978).

Yorkshire Fog grass is believed to have been introduced into New Zealand either as a seed impurity or a hay grass in eighteenth century (Cheeseman, 1923), and since then as a volunteer, it contributed much of New Zealand's pasture production (Munro, 1961). Massey University has been interested in Yorkshire Fog grass since 1950 (Basnyat, 1957). The first synthetic variety "Massey Basyn" was released and proved to be prominent in several areas (Robinson *et al.*, 1980; McAdam, 1984; Watt, 1987). Evaluation on Yorkshire Fog grass germplasm of New Zealand collection was carried on by Teow (1978). In addition, factors involving sheep palatability were determined by Cameron (1979). The broad-sense heritability estimates were also initially figured out pertinent to topodeme basis.

Following previous studies, this investigation has been set up to increase the genetical knowledge of Yorkshire Fog grass. An attempt has been made to unravel the heritabilities pertinent to individual plant basis. Comparison between plant variation and topodeme variation was also carried out.