In the name of GOD the most beneficent the most merciful

QUANTITATIVE GENETICS OF PROSTRATENESS AND OTHER RELATED ATTRIBUTES IN RED CLOVER (*Trifolium pratense* L.)

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ABSTRACT

Three major experiments were conducted to investigate quantitative genetic aspects of prostrateness and related attributes in red clover (*Trifolium pratense* L.) during the years 1991-1993. These were done on several red clover genotypes with prostrate growth habit, nodal rooting ability, and early flowering characteristics, together with several other genotypes from semierect and erect types.

Three types of experiments were carried out:

1) Since genotype environment interaction is believed to be ubiquitous in affecting the performance of plants, a series of experiments were carried out in order to get general information on a range of red clover germplasm representative of the three distinct types of red clover. Twelve genotypes (four per type) were studied in a randomized complete block design with three replications at two sites for two successive years. Several techniques of univariate and multivariate analysis were applied in order to quantify and qualify the magnitude and pattern of the possible genotype-environment interaction effects. Phenotypic and genotypic correlation values were estimated for each year and type separately as well as for the whole data set in genotype-environment interaction experiment.

As a result of GE interaction analysis, a large amount of genetic variation was found in the genotypes examined. Several attributes presented significant first and second order interaction effects. Multivariate discriminant analysis based on these effects revealed discriminant scores by which the contribution and importance of each attribute in the response of genotypes examined in the environments was studied. Cluster analysis revealed that each of the three red clover types have their own particular responses to the environment effect. Phenotypic and genotypic correlation patterns were different from year to year and type to type. Prostrate growth habit reduced dry matter yield through significant negative correlation with yield components.

2) One accession from each of the two extreme types, erect and prostrate, were examined using a hierarchical mating design to investigate their genetic structure and to obtain more detailed genetic information on a narrower germplasm. Nine random plants from each type were cloned and used as male parent. Each male parent was crossed to six different random plants as female parents, three from the same population and three from opposite population. In other words four sets of crosses, two intra- and two inter-population sets, were made. To evaluate the 108 progeny families produced, male groups were divided into six sets, each containing three male groups from the same type. Each set was examined in a randomized

complete block design with three replications. Various genetic parameters including genetic variance components and heritability of several morphological attributes were estimated.

The two plant populations examined by the mating design, presented different patterns of genetic variation. Although the prostrate population did not have much genetic variation, its additive genetic variance components were of more importance than dominant components. However, in the erect population, dominance components of variance were more important than additive. In inter-population crosses, additive components were more important than dominance components. Stem length, number of internodes, number of branches, and plant diameter presented high level of heterosis. Number of stems, plant height, and stem thickness presented fairly high hybrid depression (negative heterosis).

Heritability broad sense and narrow sense were estimated in genotype-environment interaction experiment and hierarchical mating design. Heritability values in GE interaction experiment were different from the heritability broad sense values in hierarchical mating design for most of the attributes, indicating the influence of GE interaction effect. This difference was not noticeable in prostrateness. Heritability narrow sense estimated in hierarchical mating design varied from intra- to inter-population crosses.

3) Three sets of generation mean analysis were carried out to obtain the most detailed genetic information including function of genes, and number of genes controlling the attributes. To achieve these, three pairs of parent plants were used (one erect and one prostrate in each pair) to produce F_1, F_2, Bc_1, and Bc_2. Several attributes which were distinct enough in the two types so that it could be assumed that parent populations were nearly homozygous in opposite directions, were studied in these crosses. Three, six, and the best parsimonious models were presented for the studied attributes.

Prostrateness and stem thickness were partially to completely dominant over erectness and stem thinness. Small leaf size was over-dominant over large leaf size. There were strong evidences for additive x additive non-allelic interaction for stem thickness, additive x dominance interaction for leaf size, and dominance x dominance interaction for prostrateness and leaf size. Nodal rooting ability, prostrateness, and stem thickness seemed to be controlled by a low number of genes, whereas leaf size seemed to be controlled by several genes.

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