QUANTITATIVE INHERITANCE OF LEAF SHAPE CHARACTERS IN TOBACCO (*Nicotiana tabacum* L.)

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ABSTRACT

An F_1 half diallel cross experiment with 8 parents (i.e. $\frac{1}{2}$ p (p + 1) combinations) was used to study the quantitative inheritance of leaf shape characters in tobacco (Nicotiana tabacum L.). The effect of stalk positions on the inheritance of these characters was also included. The study was carried out under a glasshouse conditions. The parental lines used in the crosses represent a random sample of leaf shape characters available in New Zealand germplasm collection.

Except for wing area (2nd leaf), phenotypic analysis showed that there was a high genetic variability for other characters.

The genetic analysis of the diallel indicated that inter-locus interaction (epistasis) was of little importance for most of the characters studied. Additive genetic variance was the main component of the total genetic variance. Heritability estimates ranged from moderate (approximately 40 %) to moderately high (approximately 70 %) for most characters. Near similar values were obtained from both the narrow and broad-sense heritability estimates. Very little hybrid vigour was observed for both leaf area and leaf dry weight.

Both the phenotypic and genotypic correlation coefficients between selected pairs of characters were in good agreement with each other in terms of direction and levels of significance. The estimates were generally high and highly significant.

The components of genetic variance (i.e. additive and dominance genetic variance), heritability and correlation coefficient estimates were generally larger in the middle as compared to the top or bottom leaves.

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1. INTRODUCTION

The genus Nicotiana, which has about sixty four recognised species is a member of family Solanaceae (Smith, 1968, 1974). Of these species, tobacco, Nicotiana tabacum L. is the only species which is commercially grown and has never been found wild (Goodspeed, 1954). Tobacco is far the most important in modern agriculture and international trade as compared to other Nicotiana species.

Tobacco is the most widely grown non-food crop where only its leaves are of commercial value (Akehurst, 1981). As a result, much attention has been given to leaf characters. The total leaf area per plant is always high even though the leaf size varies from one cultivar to another. The individual leaf area depends on its position on the stalk of the plant. The plant is generally pyrimidical in shape with the biggest leaf just above the ground (Lapham, 1975). As quoted by Garner (1946), a favourably grown tobacco leaf of many cultivars in America ranged from 93 to 139 cm^2 in area. A plant which has about 18 leaves therefore would produce a total area of about 1.7 m^2 to 2.5 m^2 Went (1957) has shown that the top : root ratio of tobacco is higher than any other cultivated species.

The economic yield and quality of the crop are determined by: the number and size of harvestible leaves, thickness and uniformity of the lamina, various other leaf shape characters and several biochemical factors. Leaf shape is important since it will determine the ratio

of lamina-to-midrib and lamina-to-vein. A measure of leaf area is also essential since it would be useful as an index of growth for the intermediate stages in agronomical and physiological studies (Hunt, 1978). An estimate of leaf area per hectare will aid in the correct application of fungicides and insecticides. Other characters such as the presence of auricles, petioles and characteristics of the veins are also important traditionally. Some of these characters have been used by some breeders as criteria of evaluation (Jones and Collins, 1959) and to characterise cultivars (Van der Veen, 1957; Van der Veen and Bink, 1961; Humphrey et al., 1965; Gordon, 1967, 1969; Eugechi, 1971, 1972).

Leaf shape ranges from very broad to very narrow, at both the lamina and the petiole wing. Leaves may have petioles or be sessile; auricles may be present or absent; lamina may be flat or bubbled; and vein-angles may be acute or obtuse.

Qualitative genetics of these leaf shape characters have been studied widely (Van der Veen, 1957; Van der Veen and Bink, 1961; Humphrey et al., 1965; Gordon, 1969; Eugechi, 1971, 1972). It has been shown that three major pairs of alleles (Pdpd, Ptpt and Brbr) affect leaf width, wing width, petiole length and size of auricle. The dominant genes Pd and Pt cause a longer petiole, narrower wing, narrower leaf blade and a more acute angle of veination as compared to the recessive pt and pd genes. Brbr, on the otherhand, affects wing width to a relatively large extent but was found to have insignificant effect on the other characters. The BrBr genotypes have petioles

(no wing) and brbr were sessiled (winged). With these three major pairs of alleles in combination, a range of leaf shape phenotypes can be obtained. The expression of these phenotypes was also affected by their stalk positions.

Of these characters, only leaf width and length have been studied quantitatively. It has been shown that additive genetic variance was the main variance component for these characters. However, the quantitative inheritance of other leaf shape characters such as wing width, petiole length, auricle area and characteristics of the veins has not been studied. This is of particular interest with respect to the range of genotypes and environments found in New Zealand.

This project was carried out to study the quantitative inheritance of these leaf shape characters using cultivars potentially of use in New Zealand. The effect of leaf positions, that is 'lug', 'cutter', 'leaf', and 'tip' on the quantitative inheritance of these characters was also examined.