Diallel analysis of varying late season night temperatures on the development of a range of flue-cured tobacco (*Nicotiana tabacum* L.) genotypes.

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ABSTRACT

A study was conducted in the climate room facilities, at D.S.I.R. Plant Physiology Division, Palmerston North, on the effect of varying late season night temperatures on the development of a range of flue-cured tobacco genotypes.

The study involved imposing three night temperatures, 10°C, 15°C and 20°C, when the plants came into flower. Ten F1 genotypes of a five parent diallel cross (no parents, no reciprocals) were grown at each night temperature with three replications per temperature. Fourteen morphological, physical and chemical characters were measured.

The effect of late season night temperature was negligible but there was some evidence of genotype x environment interaction for some of the characters.

The experiment was conducted using single plants as plots and the statistical analysis showed acceptable coefficients of variation for biological studies.

The genetic analysis of the diallel showed that general combining ability variance is the most important type of genetic variance in the characters examined. This agrees with the majority of other tobacco diallel studies. As general combining ability variance is largely a measure of additive genetic variance, breeding homozygous lines from a heterozygous base population should be the best approach to follow.

Heritability values were of sufficient size for several of the commercially important characters to indicate that improvement through selection was possible.

General combining ability and phenotypic simple correlations between pairs of characters were generally in good agreement, demonstrating that phenotypic selection will result in altering the genotypes in the desired direction for the characters in question. The experiment showed a large negative correlation between the two economically important characters, yield and total nicotine alkaloids. This result is in agreement with similar studies carried out by other workers in this field.

The experiment revealed a number of improvements which could be useful in the conduct of future tobacco climate room studies.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Of the 65 presently recognised species in the Genus Nicotiana (Smith 1968; Ohashi 1976), only one, N. tabacum L. is of major commercial value. N. tabacum, or tobacco, is grown solely for its leaf, and is the most widely grown non-food plant in the world. It occupies a unique position in that it has considerable influence on the economics, finances and politics of many countries. Upon the discovery of the Americas by the Europeans, N. tabacum was quickly distributed round the world. The species has proved to be an extremely adaptable one and since its world-wide distribution in the 16th Century it has evolved into a number of distinct types, each with distinctive characteristics of commercial importance. In the evolution of N. tabacum to its highly specialized forms of today, artificial selection pressure, cultural and management practices, soils and climate have all influenced the formation of present types. The dominating feature of world tobacco production over the last three decades has been flue-cured tobacco. Flue-cured tobacco is the main constituent used in the cigarette industry. The distinguishing feature of flue-cured tobacco in comparison to other types is that it contains considerable amounts of soluble sugars as mono-and disaccharides. This is the result of artificial heat used during the flue-curing process, which prevents the enzymatic breakdown of sugars once they have been converted from starch.

N. tabacum is of sub-tropical origin (Goodspeed 1954) but has a wide range of temperature tolerance. The temperate climate of the Motueka district in the Nelson Province is one of the most extreme climatic areas of the world in which N. tabacum is grown commercially. The major type of tobacco grown in New Zealand is flue cured. The Motueka Coastal Plain and adjacent valleys produce, from 1750 hectares, approximately half of the country's requirements of leaf for cigarette production, thereby saving valuable overseas exchange. Each area of the world produces flue-cured tobacco with its own particular characteristics. The distinguishing features of New Zealand flue cured tobacco are its relatively high content of reducing sugars and large weight per unit area, in comparison with leaf produced in other areas of the world. Blick (1943) examined certain grades of USA and New Zealand leaf for various physical and chemical characters. He found that N.Z. leaf was heavier and had a greater specific leaf weight than corresponding USA grades. James (1973) reported a three year study on the chemical composition of New Zealand flue-cured tobacco. Sugar

levels were relatively high by world standards. Another survey of New Zealand commercial tobacco has revealed similar trends (Rohrbach, pers. comm.).

The growing season in New Zealand is noted for its long hours of sunshine and short cool nights (Weybrew and Woltz 1975); a combination of its latitude and temperate climate. As the harvesting season progresses both day and night temperatures decline. It has been postulated that the long days (more photosynthesis) and cool nights (less respiration) may be part of the reason for the lemon coloured, high sugar, heavy bodied tobacco produced in New Zealand.

The aim of the thesis study was to examine the effect of one environmental factor, late season night temperatures, on the development of a range of flue-cured tobacco genotypes. The controlled environment facilities of Plant Physiology Division, DSIR, Palmerston North were used for the study which included a study of inheritance, heritability, and genotype x temperature interaction of the various characters measured. Recommendations on conducting future climate room tobacco studies as a result of findings from this first experimental work, was also an aim.