GROWTH AND COMPETITION STUDIES WITH SNAP BEANS (*Phaseolus vulgaris* L.)

A Thesis presented in partial fulfilment
of the requirements for a Masterate
in Horticultural Science at
Massey University.

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1980

ACKNOWLEDGEMENTS

I wish to thank my supervisor Dr. M.A. Nichols for his guidance and encouragement; the staff of the Department of Horticulture for their help; the staff of the library for help with reference material; the D.S.I.R. and Arthur Yates Company for financial assistance, also my friends who helped me with this project, and my sister Domenti for typing the thesis.

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ABSTRACT

Overseas work suggests that substantial yield increases can occur when the density is increased and the rectangularity is changed to unity. Two trials were carried out to examine some effects of growing snap beans at four densities.

The $\overline{R.G.R.}$ fell with time until pod swell where it showed a slight increase and then fell again. The $\overline{N.A.R.}$ followed a similar pattern whereas the $\overline{L.A.R.}$ increased and then fell earlier than either the $\overline{N.A.R.}$ or the $\overline{R.G.R.}$, indicating the dependence of the R.G.R. on the $\overline{N.A.R.}$ The $\overline{L.A.R.}$ appears to be dependent on the $\overline{L.W.R.}$ component rather than the $\overline{S.L.A.}$ component.

Fertilizer had no effect on the $\overline{R.G.R.}$ or the $\overline{N.A.R.}$ As the level of fertilizer increases, the S.L.A. decreases and the $\overline{L.W.R.}$ increases, indicating that more leaves are produced and the leaves are 'thicker'. Both the L.W.R. and the $\overline{L.A.R.}$ are maintained at a higher level with increasing amounts of fertilizer.

As density increases, the $\overline{R.G.R.}$, $\overline{N.A.R.}$ and $\overline{L.W.R.}$ fall whereas the $\overline{L.A.R.}$, $\overline{S.L.A.}$ and $\overline{L.A.I.}$ all increase. This shows that at the higher densities, more leaves are produced but they are less efficient at producing and/or utilising assimilates.

As density increases, the maturity of the beans tend to be delayed, yield/plant at high density is decreased through fewer flowers/plant, higher flower and pod abortion rate and a lower bean weight, all probably due to the lower N.A.R. There is also a

negative correlation between the number of pods and pod size.

The recipricol yield density relationships showed fertilizer to have no effect on the A and B parameters for either total plant dry matter or bean dry matter. The allometric log plant weight to log bean weight showed the ratio of beans to total plant weight decreases with increasing density.

Fertilizer had no effect on the yield of beans. Density was also shown to have no effect on the yield of beans when the yields were compared at the same seed length. When yields were compared at the same chronological time, density did have an effect. The mean mature bean yield was 13.95 tonnes/ha but the mean harvestable yield was 18.6 tonnes/ha.

INTRODUCTION

1518 ha of snap beans (Phaseolus vulgaris L.) were grown in New Zealand in 1978. 1416 ha of these were grown for processing; 67 % for quick freezing and 33% for canning. The average yield of snap beans in 1978 was 7.98 t/ha. 21% of the frozen snap beans were exported to 22 countries with Australia importing 50% of the exported beans. The area of beans grown for processing has almost doubled between 1971 and 1977 as has the gross yield, but the yield per ha has shown little change over this period. (Anon, 1978).

Horticulture has moved towards systems of high yield and intensive production. The rapid increases in the cost of production must be met by more efficient production and higher yields. The scarcity of good land close to processing factories, with an abundant supply of water, tends to put a premium on high productivity per unit area. According to Bleasdale (1969), this is one incentive for having a comprehensive knowledge of the yield-density relationships of vegetable crops and to use the knowledge to devise highly productive cultural systems.

Overseas work has suggested that yields may be increased significantly by reducing the rectangularity and increasing the plant population (Jones, 1967, Mack and Hatch, 1968). A parabolic relationship between pod yield and density is apparent. The density at which maximum yield occurs will vary with the environment, cultural practices and cultivar. The time taken for the crop to mature, which varies with density, irrigation practices, and other factors, must be taken into consideration when comparing yield differences.

Often there is an interactive effect between density and fertilizer, and between fertilizer and other cultural and environmental factors; for example, as plant density increases, a greater amount of fertilizer is required to produce the maximum yield (Lang, Pendleton and Duncan, 1956). This factor, combined with the effect of soil type on fertilizer response, has made the interpretation of fertilizer trial results difficult.

Growth analysis is a technique that may be used to gain an insight into the physiological basis for yield differences using relative growth rates, net assimilation rates. leaf area ratios, specific leaf areas and leaf weight ratios. Yield differences may also be analysed morphologically using the number of pods m^2 and the mean weight per bean.

The aim of the project was to attempt to relate yield differences due to density and fertilizer to physiological and morphological changes.