GENOTYPE VARIATION IN SENSITIVITY TO DAYLENGTH AND AIR TEMPERATURE OF *GLYCINE MAX*. (L) MERRILL.

A thesis presented in partial fulfilment of
the requirements for the degree of
Master of Agricultural Science in Plant Science
at
Massey University

LOIS VALENTINE TURNBULL

1977

ABSTRACT

Thirteen cultivars of *Glycine max.* (L) Merrill, each representing one of the maturity groups from 00 to 11*, were grown under field conditions at Massey University, Palmerston North, New Zealand. The cultivars were sown at 14 day intervals from the 12th October 1974, to the 18th January 1975, inclusive. Daily plant observations were made to record the dates of seedling emergence, flowering onset, pod emergence, cessation of flowering and pod maturity. With the maturity groups 1 and 4 cultivars, a separate apical bud dissection study was made of the morphological changes occurring during floral initiation and subsequent bud development. Multiple regression analysis was used to study the effects of daylength and air temperature on the phasic growth patterns of each of the thirteen cultivars.

In all cultivars, germination increased at an exponential rate as air temperatures rose from 12°C to 21°C. Temperatures above 21°C inhibited germination in the maturity groups 2, 4, 6 and 8 cultivars and were inhibitory above 25°C for all other cultivars.

In all cultivars, transition from the vegetative to the reproductive state was accelerated by declining daylengths and rising temperatures. Sensitivity to daylength during the pre-flowering phase increased with genetic lateness of maturity among the cultivars. From the apical dissection studies, daylength and temperature were shown to affect both rates of floral initiation and subsequent bud development. In the absence of an adequate daylength stimulus, plant age became the main determinant of the rate of floral development.

Pod emergence showed a negative response to daylength in the maturity groups 00 to 5 cultivars and a positive response in the groups 8 to 10 cultivars. Temperature was the main determinant of podding duration, rates of pod development decreasing with decline in temperature as the season progressed.

Both flowering and podding duration increased with decline in daylength. The photoperiod response during these growth phases was not associated with genetic lateness of maturity among the cultivars tested.

* USA classification or its estimated equivalent

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Soybean cultivars differ widely in their sensitivity to daylength (Johnson et al., 1960; Criswell and Hume, 1972; Hartwig, 1973). In the absence of a strong photoperiodic response, temperature may have a significant effect on the various phases of plant growth (Lawn and Byth, 1972; Polson, 1972; Major et al., 1975). However, photoperiod and temperature effects are rarely distinct; rather, it appears that the plant responds to the interaction of these two stimuli (Blaney and Hamner, 1957; Huxley and Summerfield, 1973).

Soybean cultivation in New Zealand is based almost entirely on American introductions, comprised mainly of cultivars in the early to medium maturity classes. i.e. USA grades 00 to 4. Although these cultivars have been tested in latitudes similar to those for which they were developed in the USA, cultivation in New Zealand has been successful in only a few areas, mainly in the North Island. Cultivar-sowing date trials have suggested that this adaptation limitation is due to the lower temperatures experienced in New Zealand, particularly at night, compared to those of the soybean belt in North America (Gerlach, 1967; Robb, 1968; Okereke, 1970; Gerlach et al., 1971; McCormick, 1974, 1975, 1976). However, little effort has been made to define more precisely the source of this problem of selecting cultivars which give both consistently high yields and mature within the practical limits of the New Zealand growing season (McCormick, 1974, 1975, 1976; Robb, 1968; Turnbull, 1976).

This study attempts to provide some basic phenological information for a diverse range of soybean genotypes, grown in the field, under the varying daylength and temperature conditions experienced during the growing season in New Zealand. Thirteen cultivars were used in the trial, each representing one of the maturity grades 00 to 11; (USA classification or its estimated equivalent).