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Effects of duration of water stress at different growth stages
on growth and yield of Soybeans (*Glycine max* (L.) Merrill)

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Abstract

Four soybean cultivars (*viz.* Evans, Geiso, Maple Arrow and S.J.4) were subjected to water stress at three different reproductive growth stages: i) entire reproductive growth stages (R1 to R7) ii) early reproductive growth stages (R1 to R4) and iii) late reproductive growth (R4 to R7). The experiment was conducted in the climate laboratory at the Plant Physiology Division D.S.I.R. Palmerston North, New Zealand, with 31⁰/23⁰c (day/night temperature) 70/90% RH (day/night relative humidity) and 14 hours photoperiod.

The growth and development of the soybeans were markedly affected by water stress. Leaf area, final plant length, number of nodes and total plant dry weight from the stress treatments were reduced.

Seed yield per plant from the three stress treatments were only 10.7, 49.6, and 24.1% relative to that of control treatment. The response of soybean yield depended on both the timing and the duration of stress in relation to growth stages whilst some other plant characters such as plant length and the number of nodes responded more to the timing rather than the duration of stress. Cultivars with the determinate growth type (*viz.* Evans and Maple Arrow) were apparently more sensitive to stress at the early phase of reproductive growth (R1 to R4) whilst the indeterminate growth type (*viz.* Geiso and S.J.4) were more sensitive to water stress at the later phase of reproductive growth (R4 to R7). The number of pods per plant was the most important yield component in determining yield although in Evans and the early stress treatment the average seed weight was the most important component.

The rank of cultivars, from low to high sensitivity to water stress is Maple Arrow, Evans, Geiso and S.J.4. S.J.4 also reacted differently from

the other three cultivars in many aspects.

The drought tolerance test estimated through a measurement of electrolyte leakage from the cells was used and discussed.

Two methods of genotype x environment interaction analysis (regression analysis and discriminant analysis) were used. The discriminant analysis had some advantages in the study of GE interaction e.g. it could be done with several characters at once and compared with the regression method it could be used with a much lesser number of cultivars and environments.

Key words: Soybeans, water stress, growth stages, yield and yield components, drought tolerance test, GE interaction, discriminant analysis, principal component analysis.