ABSTRACT

Maize, *Amaranthus* and several other plant species have high rates of photosynthesis and low CO_2 Compensation Points-near 0 ppm ("efficient" species). In contrast, many other species have low photosynthetic rates and high Compensation Points ("inefficient species). A simple and rapid method reported by Menz et al (1969) which was based on the correlation between low CO_2 Compensation Points and high photosynthetic efficiency was used for screening seedlings for photosynthetic efficiency. *Amaranthus* species, and *Ipomoea batatas* plants were used in this study and were characterised by these parameters.

After classifying *Amaranthus* as "efficient" and *Ipomoea batatas* (Sweet potato) as "inefficient" species by the Menz et al method, CO_2 Compensation Points of single and detached leaves of these plants were measured in a closed system using an Infra Red Gas Analyser. CO_2 Compensation Points were found to be 0 ppm for *Amaranthus* while Sweet Potato plants had Compensation Points of 24 ppm to 30 ppm at 22^{0}C. Ninety varieties of *Ipomoea batatas* were tested for Compensation Points and were found to all posses high Compensation Points.

CO_2 Compensation Points were measured at different temperatures ranging from 20^{0}C to 50^{0}C for *Amaranthus* spp. and 20^{0}C to 40^{0}C for *Ipomoea batatas* in order to investigate the effect of temperature on CO_2 Compensation Points. In *Amaranthus* species, CO_2 Compensation Points remained at 0 to 3 ppm even at 50^{0}C., but in *Ipomoea batatas*, a gradual increase in CO_2 Compensation Point was observed with increase of leaf temperature. It was also found

that this effect was greater if the plants were deprived of essential mineral elements.

Plant age and leaf age showed little effect on CO_2 Compensation Points in both *Amaranthus* and *Ipomoea batatas*. Only minor differences in Compensation Points (1 to 3 ppm) were observed between young and old plants and between upper, middle and lower leaves.

The effect of moisture stress induced by applying Mannitol solutions to leaf petioles, was marked. No immediate effect was observed, but the application of Mannitol solutions to the leaf petioles for longer periods (4 to 24 hours) resulted in a gradual increase in Compensation Point.

Spraying potassium-napthenate solution on the leaves of *Ipomoea batatas* plants did not cause any change in CO_2 Compensation Points and the removal of the root tuber of rooted leaves of Sweet Potato likewise caused no change in CO_2 Compensation Points.

Inducement of mineral deficiency resulted in an increase in CO_2 Compensation Points in *Amaranthus* and Sweet Potato plants; the deficiency of Ca, Mg, and Fe had no effect on Compensation Points in *Amaranthus* but the deficiency of K,P,N and S resulted in an increase in Compensation Points in this species. In Sweet Potato, K, P and N deficiency showed a greater effect on CO_2 Compensation Points than the deficiency of Ca, Mg, Fe and S. In *Amaranthus gracilis*, the removal of the mineral deficiency by the application of complete nutrient solution to the mineral deficient plants was found to have an effect of decreasing CO_2 Compensation Points of the mineral deficient plants to the low values (0 to 3 ppm) which were found in healthy specimens of this species. The application of the deficient mineral element solution to a single leaf

from certain mineral deficient plants showed a similar effect (a decrease in Compensation Points) in *Amaranthus*.

These results are discussed in terms of their possible application to elucidation of the differences between "efficient" (C_4) and "inefficient" (C_3) species.