Application Note

Measurement of photosynthetic performance in crop plants under South African climatic conditions

A key objective of the research conducted by Dr Riekert van Heerden (riekert.vanheerden@nwu.ac.za) at North-West University, Potchefstroom, South Africa and Drs Kobie de Ronde (and team members) and Joseph Asiwe at the Agricultural Research Council (ARC–Vegetable and Ornamental Plant Institute & ARC–Grain Crop Institute) is to increase the production of crops important for the livelihoods of South African people. Drought is one of the most difficult challenges faced by resource-poor farmers and agriculture in general in South Africa. The sustainability and predictability of crop production in South Africa is severely restricted by drought. Moreover, it is predicted that sub-Saharan Africa is heading for a period of even more prolonged drought, which researchers warn could be among the most severe in decades. The need for crop plants with enhanced tolerance to water deficits is thus real and urgent. The current research is designed to identify sweet potato and cowpea genotypes with enhanced drought tolerance for immediate use in drier areas of South Africa as well as for breeding programmes aimed at developing more drought tolerant genotypes.

Since carbon metabolism plays such an important role in plant growth and productivity a key objective of their research is to assess the effects of drought stress on photosynthesis in selected cowpea and sweet potato genotypes. For these field experiments portable and highly reliable equipment, which can operate for extended periods of time under often extremely hot and dusty South African conditions, is an absolute necessity. Dr van Heerden uses the CIRAS-2 portable differential CO_2/H_2O IRGA for these experiments and finds the instrument ideally suited for his research. The superior portability and stability of the CIRAS-2 under these harsh climatic conditions deserves special mention. The CIRAS-2 is used in combination with a cuvette featuring precise and simultaneous control of light intensity, relative humidity and CO_2 concentration (Fig. 1). Experiments have revealed large genotypic variation in photosynthetic response in these two crops under drought/dry-land conditions. Selected results obtained in some of these experiments are shown in Figs. 2 and 3.

Fig. 1. Measurement of automated CO_2 response curves with the CIRAS-2 in sweet potato genotypes cultivated under a rainout shelter at the ARC-Vegetable and Ornamental Plant Institute.

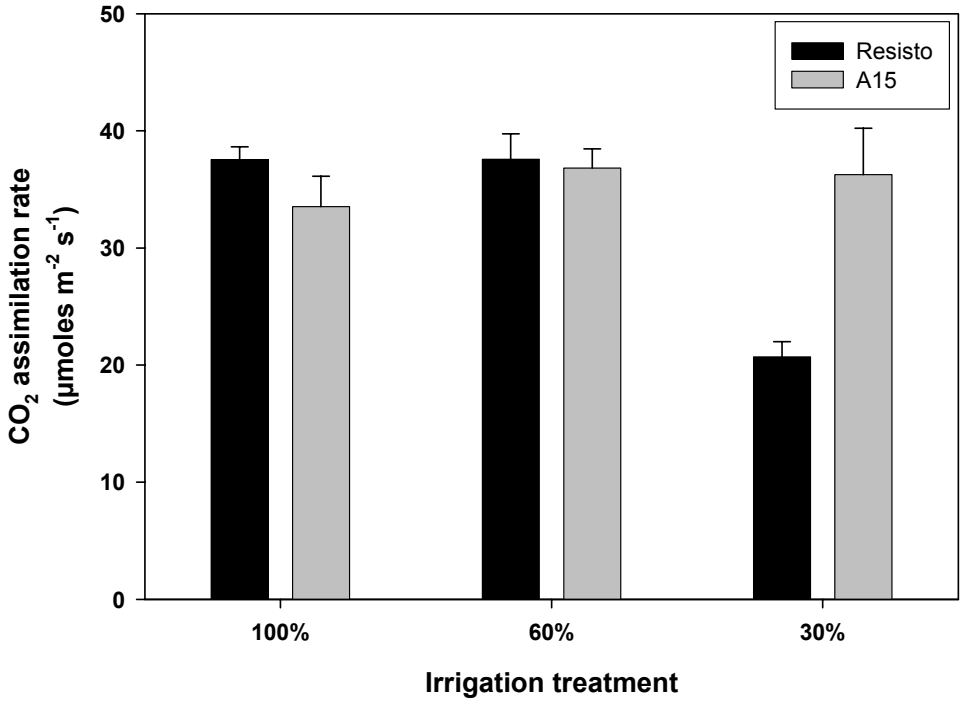

Fig. 2. Light and CO_2 saturated rates of photosynthesis in two sweet potato genotypes (Resisto and A15) after four months of growth under three irrigation treatments (100%, 60% and 30% water supply).

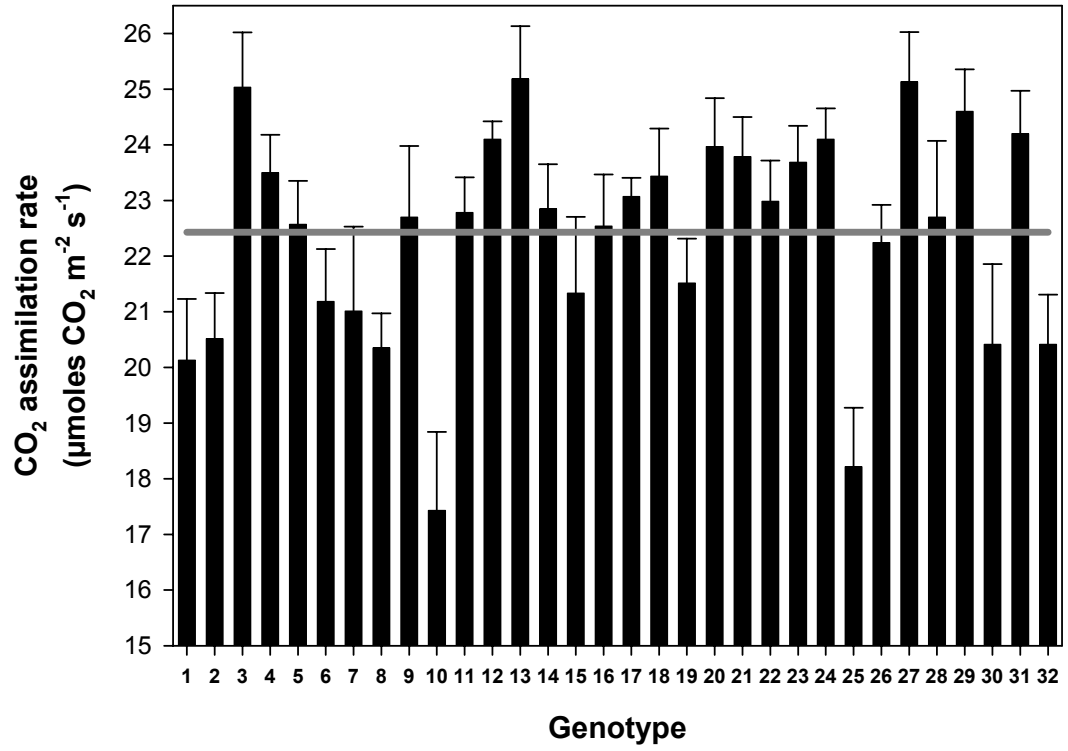

Fig. 3. Light saturated rates of photosynthesis in 32 cowpea genotypes grown under dry-land conditions. The grey horizontal line indicates the average photosynthetic rate for all genotypes. Certain genotypes performed better/worse than the average under these conditions.

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