STUDIES ON THE EFFECT OF AMMONIUM SULPHATE AND SODIUM NITRATE ON CRASSULACEAN ACID METABOLISM (CAM) IN KALANCHOE SPECIES.

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ABSTRACT

K.longiflora (var. coccinea), *K.longiflora* (var. longiflora) and *K.fedischenkoi* were grown for 4 months in pots containing soil analysed for various nutrients. The plants were transplanted to vermiculite supplied with nutrient solution containing 10mM sodium nitrate or 10mM ammonium sulphate as the sole nitrogen source and cultured for another 4 months. Control plants were grown in well watered soil of known nutrient composition. Each treatment had a sample population of 30 plants. Both the treated plants and the controls were kept in the open air and shielded with a white transparent polythene paper.

Leaf samples were taken from 3 lots of plants selected at random every two weeks for 4 months and analysed for titratable acidity, malate content, Phosphoenol pyruvate carboxylase (PEP-Carboxylase) activity, soluble protein content and nitrate content. Water potential and CO_2 exchange were measured at the same intervals.

Nitrate-grown plants and the controls had greater leaf areas while the ammonium-grown plants had small leaf areas and exhibited toxicity symptoms, characterised by marginal necrosis. Therefore, nitrate-grown plants and the controls had better growth.

Both nitrate and ammonium nitrogen induced accumulation of high levels of titratable acidity and malate content. This was more pronounced in the nitrate-grown than the ammonium-grown plants. Both these nitrogen sources induced greater diurnal fluctuations in

in the nitrate-grown plants. The diurnal changes in titratable acidity and malate content followed the same patterns in all the 3 *Kalanchoe* species and variations in these parameters measured from the different species was insignificant. However, variations in the 2 parameters with respect to time, among different treatments, was significant.

The diurnal patterns in CO_2 exchange among the 3 Kalanchoe species was basically similar. However, the net CO_2 uptake at night was higher in the treated plants than the controls, with the highest levels observed in the nitrate-grown plants. The variations in net CO_2 uptake with respect to time, among the different treatments was significant.

The PEP-Carboxylase activity, soluble protein content and nitrate content followed a similar trend to that of titratable acidity and malate content. Significantly higher levels were observed in treated plants than the controls. This was still more pronounced in plants grown with nitrate. The variations in PEP-Carboxylase activity became significant during the night. During the day, the variations in enzyme activity from the different treatments was insignificant as compared to controls.

There was a good correlation between total soluble protein content and PEP-Carboxylase activity; CO_2 uptake and malate content; CO_2 uptake and PEP-Carboxylase activity. The detection of nitrate in the leaves of ammonium-grown plants was associated with nitrification which might have taken place in these plants during the treatment period.

There was some apparent difference in the leaf succulence of the *Kalanchoe* species in different treatments which might have been associated with leaf water potential changes observed during the treatment period. The leaf tissues of the nitrate-grown plants had significantly higher water potentials than the ammonium-grown plants and the controls.

The results of this study showed that there was a functional coupling of two metabolic processes: the reduction of an inorganic anion (NO_3^-) and the synthesis of an organic anion (malate). Therefore, a possible mechanism of nitrate action on CAM activity seems to be through increased activity of NR induced by accumulation of NO_3^- in the tissues. This resulted in increased synthesis of enzymatic proteins, hence the concentration of key CAM enzymes like PEP-Carboxylase was also increased. The increased level of PEP-Carboxylase activity was coupled with increased fixation of CO_2 to form malate, which accumulated in leaf cell vacuoles to restore electroneutrality. Therefore, assimilation of NO_3^- ions may be one of the environmental factors responsible for induction of CAM in *Kalanchoe* species.