# MITIGATING EFFECTS OF LYCOPENE ON GROWTH AND PRODUCTIVITY OF *AMARANTHUS HYBRIDUS* UNDER ALUMINIUM TOXICITY INDUCED STRESS

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## INTRODUCTION

Soil acidity limits agricultural production globally especially in Sub-Saharan Africa. Different kinds of stresses, mainly Al stress, generated from acid soils affect plant growth and result in food shortage and production (Foy *et al*., 1992). Trivalent aluminium ($Al^{3+}$) is one of the most toxic forms of soluble Al and is known to damage root cells at sites in the apoplast and cytosol that rapidly inhibit root growth ( Hede *et al*., 2001). It is often assumed that since plants can synthesize diverse anti-oxidants, they may not need supplementation to cope with stresses. To investigate this assumption, this present study explored the mitigating effects of supplemented lycopene on the growth and productivity of *Amaranthus hybridus.*

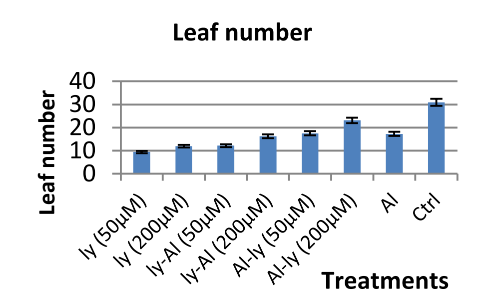


Fig.1 Treatment Effects on Leaf Number

## OBJECTIVES

To determine whether pre and post supplementary application of lycopene could mitigate oxidative stress in *A. hybridus* plants exposed to Al toxicity.

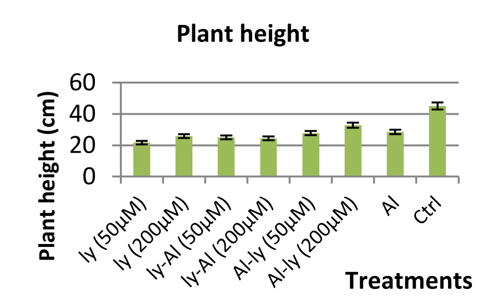


Fig.2 Treatment Effects on Plant Height

## MATERIALS AND METHOD

Aluminium chloride (AlCl3) at, 3× 10-2 M concentration, 4.6 pH and 25°C was used for the hydroponic Al- induced stress studies. Lycopene was extracted from round-shaped tomatoes and high performance liquid chromatography (HPLC) was used to determine its peak absorbance at 375nm. Thiobarbithuric acid (TBA) method was used to determine the antioxidant activity of lycopene. Two lycopene concentrations, 50 and 200µM, were used for the studies. Pre- and post- antioxidant treatments were applied to *Amaranthus hybridus* seedlings (fig. 6) before and after Al treatment for 72 h.

## DATA COLLECTION AND ANALYSIS

The following data were collected: Number of leaves, Plant height, Length of inflorescence, Inflorescence number, Fresh weight of inflorescence, Dry weight of inflorescence, Fresh weight of shoot, Dry weight of shoot, Root length, Fresh weight of root, Dry weight of root. Data collected from growth studies were analyzed with one-way analysis of variance (ANOVA). Duncan multiple range test (DMRT) was used to separate means at $P \leq 0.05$ level of significance. SPSS v16, Microsoft excel 2010 and Gen-Stat packages were used for computation, data analysis and graphics.

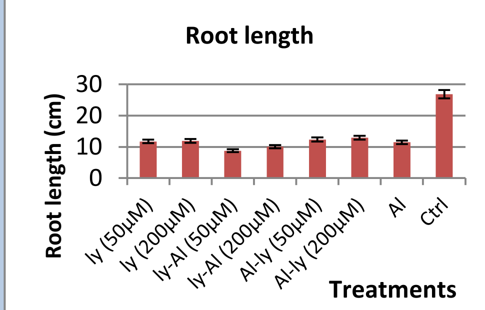


Fig.3 Treatment Effects on Root Length

## RESULTS AND DISCUSSION

The results of this study revealed that Al toxicity compromised growth and productivity of *A. hybridus* and decreased biomass production. Visible symptoms include-overall stunting of plants and roots', yellowing of leaves, reduced number of leaves, stubby and brittle browny roots (figs. 7 & 8). It also showed that post-lycopene treatments significantly alleviated Al stress in *A. hybridus* more than pre-lycopene treatments. Apart from control treatments, the highest growth was observed with 200µM post-lycopene treatment (*Al-ly* 200 µM) except in dry weights of roots and inflorescence. At the molecular level, Al stress is known to cause drastic changes in the expression patterns of genes, some of which are quite important in responses to oxidative stress (Maron *et al*., 2008). It is thus inherent that exposure of plants to Al elicits the production of ROS, which may damage cellular components if antioxidant defenses are jeopardized (Sharma and Dubey, 2007). The results strongly suggests that though *A. hybridus*, could naturally synthesize its own antioxidants, it is however susceptible to Al toxicity-induced stress; and that post lycopene supplementation could alleviate the stress situation and, enhance growth and productivity.

## SUMMARY AND CONCLUSION

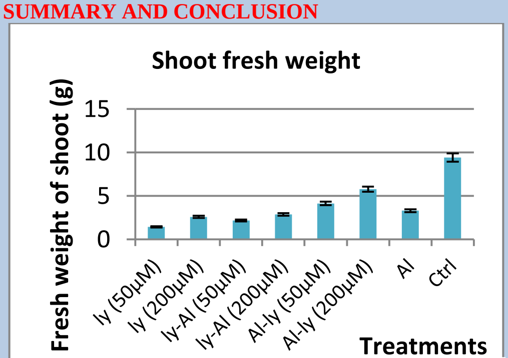


Fig.4 Treatment Effects on Shoot Fresh Wt.

Independent antioxidant applications without Al stress; which did not show significant growth effects, suggests that *Amaranthus* plants may not require extra antioxidant when not under Al stress. Increasing lycopene concentrations were directly proportional to increases in, leaf number, plant height, length and number of inflorescence, fresh and dry weights of shoot, root and inflorescence. This indicates that lycopene may have played the role of mopping up the free radicals generated from Al stress and that the experimental plants absorbed more lycopene, apart from their intrinsic antioxidants, to combat the stress condition. Extending this study to other plants, as well as the use of other antioxidants, could provide vital information on the possibilities and dynamics of anti-oxidants role in stress management.

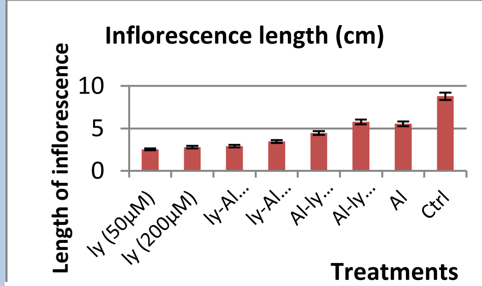


Fig. 5 Treatment Effects on Inflores. Length

Fig. 6. *A. hybridus* growing in hydroponics

Fig. 7.Roots of Control Plants

Fig. 8.Roots of Al Treated Plants

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