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ORIGINAL ARTICLE

COMBINED APPLICATION OF TRIA AND POTASSIUM STIMULATES THE GEL CONTENT, MORPHOLOGICAL AND BIOCHEMICAL CHARACTERISTICS OF ALOE VERA

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Abstract:

Aloe barbadensis (A. barbadensis L.) Miller, commonly known as aloe vera is extensively used as a base element in preparation of medicine, cosmetics and food supplements. The objective of this study was to find out the stimulatory effect of varying levels of triacontanol (TRIA) in combination with different concentrations of potassium (K) on morphological and biochemical characteristics of aloe vera plants. Treatments included four levels of TRIA (10-0, 10-5, 10-6 and 10-7M) together three concentrations of K (K0, K50 and K100kg/ha). K was applied through basal application whereas TRIA was given by foliar application using a hand spryer. After 12 months growing leaf length, width, number and fresh weight, shoot fresh weight, gel content, nitrogen, potassium and protein contents were measured. Results indicate that the all growth and biochemical characteristics of aloe Vera were highest with the treatment K5010-6M TRIA. Among the TRIA treatments all characteristics were increases from 10-7 to 10-6 but 10-5 have inhibitory effect at which growth and biochemistry of aloe vera were slightly decreases. Among K treatment K50 proved optimum along with 10-6M TRIA.

KEYWORDS:

Aloe vera; Triacontanol; Potassium; Gel content; Growth; Protein content; N and P contents.

INTRODUCTION:

Plants have been the most important source of medicine even the dawn of human civilization. Among the medicinal plants, aloe vera (A. barbadensis L.) occupies prominent position both in ancient and modern system of medicines. The exudates of aloe vera have been used for numerous medicinal and cosmetic applications since ancient times Morton (1961). It is the member of family Aloeaceae in the Liliales that are cultivated for medicinal, vegetable, and cosmetic purposes in Africa, North America, and Southeast Asia. Approximately 400 species have been described in the genus Aloe but aloe vera is the most commonly grown aloe. It has a history of use in folk medicine for skin and other disorders, which date back thousands of years. (Morton 1961, Crosswhite and Crosswhite 1984). Today, the processing of aloe vera gel, derived from the leaf pulp of the plant for medicinal and cosmetic use, has become a big world. Aloe gel appears to relieve pain, burning and itching sensations, stimulate rapid granulation and formation new tissues. Fresh aloe gel has domestic medicinal value, thus also called as burn first aid. It used in skin ulcer conditions, purities, ulcers of mammary gland carcinoma and skin cancer. It also mainly used to reduce hair fall and can be used to rub skull and hair ending as cosmetic Skousen (1982). Aloe vera is a well-known anti-inflammatory and wound healer, accelerating the rapid growth of epithelial tissue (Davis et al. 1994). Aloe vera is known to have a marked effect in the treatment of scar tissue and the prevention of scar formation following injury to the skin.

K is a macronutrient which is essential for the growth of the plants and its importance in plant

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nutrition and agricultural crop production has been well recognized and reviewed by many workers Kanwar (1976). Generally the crop response to K application is expected, where potassium content is low in soil. But, there are numerous reports, where crop response to K fertilization is positive even in soils high in K status thus there are various other factors other than the level of available K in surface soil can influence the growth of the plant and ability of the soil to provide high rate of K supply to the roots during rapid growth of the crop. These factors includes soil PH, fixation and release of K and K supplying power of the soil, present K saturation, interaction of K with other elements, sources of K supply etc. Works of Boussingault, Sprengel, Liebig, Levis and Gilbert led to the appreciation of the role of K in plant nutrition. K ion dose not enter into the permanent organic combinations in plant, but apparently exists as soluble inorganic and organic salts. Evidence is now available which shows that K influences the synthesis of simple sugar, starch and protein, translocation of carbohydrates, reduction of nitrates, cell division, imparting disease and insect resistance in plants and maintenance of the cell turgor of the plants. It also plays an important role in the development of reproductive parts of plants.

The use of plant growth regulators (PGRs) is considered profitably for augmenting the production and quality of crops (Kende and Zeevaart 1997, Jaleel et al. 2007, Naeem et al. 2007, 2010). TRIA is a natural growth promoter with is a straight chain fatty alcohol [CH3 (CH2)28 CH2OH] of 30 carbon atoms and it has been recognized as prominent chemical for plant growth promotion of many agricultural and horticultural crops (Ries et al. 1977, Ries 1985). It exists as constituent of cuticular waxes (Kolattukudyn and Walton 1973). Many researchers have reported the enhanced growth and yield of different plants with application of TRIA (Nagoshi and Kawashima 1996, Muthuchelian et al. 1997, Borowski et al. 2000, Chen et al. 2002). The major growth regulatory effects of TRIA include photosynthesis stimulation and enhanced water and nutrient uptake (Ries 1991, Savithry et al. 1992, Kumaravelu et al. 2000, Khan et al. 2007). It also stimulates several enzyme activities (Iyanoy and Angeloy 1997). Keeping these points in view, the present investigation to find out whether the foliar spray of TRIA, together with different doses of K could augment crop productivity and quality attributes of aloe vera. Thus due to medicinal and commercial value of aloe, there is great pressure on the cultivation of aloe vera and one of the aim of the present study was to find out the influence of K on the plant because if the hypothesis proves positive, we can cultivate the plants successfully on large scale in the soil of A.M.U. fort which is rich in K.

MATERIALAND METHODS

A pot experiment was carried out in the net house of plant physiology, department of botany, aligarh muslim university, Aligarh during to study the combined effect of TRIA and K on growth, physiology and gel content of aloe vera (A. barbadensis L.). The aim of experiment was to work out whether K through soil application and TRIA in the form of foliar sprays on the aloe plants could ameliorate the leaf length and width, number of leaves plant-1, fresh weight of leaf and shoot, leaf gel content, leaf nitrogen, potassium and protein contents. One month old small plants about 7-8 inches in height having 3-4 leaves were transplanted into 36 pots containing the A.M.U. fort soil. The design of this experiment was completely randomized design with two factors (K and TRIA) with three replicates. Three levels of K (K0, K50 and K100) were given through soil application whereas four concentrations of TRIA [10-0 (control), 10-7, 10-6 and 10-5M] were given through foliar application using a hand sprayer at the interval of 25 days. The spray treatment was started 60 days after transplanting. The plants were kept free from weeds, and watered as and when required. All parameters were studied one year after transplanting when plants were fully matured. The plants taken out of each pot were washed gently to remove the adhering soil then leaf length and width, leaf number, shoot and leaf fresh weight were measured. After few days of sun drying the leaves were then oven dried at 700 C until constant weight and finally ground by using grinding machine. The plant samples were digested to prepare plant extract following the method of Jackson (1962). Chemical analysis included the estimation of protein and mineral nutrients such as nitrogen and potassium. Total leaf nitrogen content was determined by Lindner (1944). Potassium concentrations in digested samples were determined directly with the use of flame photometer Hald (1946). For estimation of gel content fresh uprooted leaves of aloe were taken and bottom white coloured of each leaf and the upper tip portion were removed by cutting carefully. The leaves were kept upright in a tray and yellow sap coming out from bottom of the leaves was allowed to drain overnight in a pre-weighted clean glass beaker and final weight was taken next day. The difference in two weights was recorded and the gel content was calculated on fresh weight basis. The data were statistical analysed, for significant data Standard Error (SE) was calculated at 5% Duncan, s multiple range test was used to separate means using SPSS software 10th version, USA. Level of significance is represented at $P<0.05$.

RESULT AND DISCUSSION

Foliar spray of four different concentrations of TRIA together with soil application of three different doses of K significantly increased the growth, gel content as well as biochemical characteristics of aloe vera. Out of four concentrations of TRIA 10-6M proved better than the others whereas 10-5M TRIA had an inhibitory effect among all treatments. The growth promoting effects of TRIA on various attributes of many medicinal plants has been explored by many workers (Kumaravelu et al. 2000, Gridhar et al. 2005, Chaudhary et al. 2006). Significant enhancement in TRIA treated plants could presumably be ascribed to the well known effect of exogenously applied TRIA on elongation of internodes through the cell division and cell extensibility (Taiz and Zeiger 2004). Among K doses K50 proved optimum along with 10-6M TRIA, thus in this study among various combined treatments of TRIA and potassium K5010-6 proved best and being add par with K10010-6, significantly affected all the traits of aloe vera. K5010-6 recorded an increase of 44.07% and 70.36% in leaf fresh weight and shoot fresh weight respectively, in comparison to control (Figure 1). K5010-6 also enhanced the leaf length, leaf width and leaf number by 85.18%, 73.34% and 26.98% respectively, when compared to control plants (Figure 1). The significant increase in growth characteristics (leaf fresh weight, leaf number, leaf length and width, shoot fresh weight) treated with combined application of K and TRIA may be traced due to the beneficial role of TRIA and K in plants. Earlier studied have reported in various crops that the foliar application of the plant growth regulator increased the shoot length and root length by increasing the cell division (Moore 1991, Mishra and Srivastava 1991, Khan et al. 2006, Taize and Zeiger 2006, Aftab et al. 2010). K is one of the major plant nutrients essential for the growth of the plants and played a key role in soil fertility. Highest concentrations of K are found in young developing tissues and reproductive organs indicative of its high activity in cell metabolism and growth (Sadia and Zayad 1994). K is necessary for the metabolism and translocation of carbohydrates from leaves to root system. K as nutrient element also increases the content of glucose, fructose, sucrose, xylose and maltose in strawberry (Chouretah and Bunemann 1970). K activates numerous enzymes that involving energy metabolism, protein synthesis and solute transport (Mengel and Kirkby 2001, Amtmann et al. 2008). Biochemical parameters are significantly affected by the application of the TRIA, the positive effect of TRIA application on enzyme activity i.e; nitrate reductase (Muthuchelian et al. 2003, Aftab et al. 2010, Naeem et al. 2009) and carbonic anhydrase activity (Hashmi et al. 2011) has been seen in different crops. TRIA also positively influences carban dioxide fixation (Shrivestav and Sharma 1990, Mishra and Srivastava 1991), photosynthetic rate (Kumaravelu et al. 2000; Muthuchelian et al. 2003). It is established fact that TRIA elicited a secondary messenger which rapidly translocated throughout the plant and effect on various physiological attributes of plant (Ries 1985, Khan et al. 2007, Naeem et al. 2009). Earlier studies revealed that K increased many growth characteristics of aloe vera. Plant height, leaf length, number and fresh weight of aloe vera were increases with the increase of K concentration but after an optimum dose it will be diereses (Hossain et al. 2007). Thus an increase in leaf length, width, number, fresh weight of leaf and shoot of the plant treated with foliar spray of TRIA and soil application of K is according to the fact that exogenous application of plant growth regulator promotes the intrinsic genetic potential of the plants causing increase in growth of the plant as a consequences of the cell division and cell wall extensibility (Khan et al. 2006, Taiz and Zeiger 2006). The gel of the leaves of aloe vera has immense value and in present study K50 along with 10-6 TRIA also increases the gel content by 119.26% over control (Figure 2), the improved gel content of the plants could be due to increased uptake of nutrients and improved translocation of metabolites and photosynthates to the reproductive organs. K also increases the active ingredients of aloe vera Ahmad (2011). The leaf N and K contents were also substantially affected by this treatment; it elevated leaf N and K contents compared to control by 18.05% and 22.22% respectively. The higher content of leaf N and K content of TRIA and K treated plants could be attributed by the higher metabolic activity that might be related to enhanced water and nutrient uptake from soil (Sharma et al. 2002). In addition TRIA also mediates the activation of a number of membrane-bound enzymes (Moore et al. 1991, Ries and Houtz 1983). TRIA application also leads the compositional and chemical changes in plants that leading to alteration nitrogen concentration (Knowles and Ries 1981). In cells K is needed in the maintained of transmembrane voltage gradients for cytoplasmic PH homeosynthsis and in the transport of inorganic anions and metabolites (White and Karley 2010). Amongst biochemical parameters K5010-6 M TRIA favourably influenced the protein content of aloe vera and recorded an increase of 22.88% in comparison to control (Figure 2). The ameliorative effect of TRIA on protein content might be ascribed to the increased N content in leaves that might have promoted amino acid biosynthesis (Knowles and Ries 1981, Shripathy et al. 1997, Muthuchelien et al. 2003, Naeem et al. 2010).

CONCLUSION:

Foliar application of 10-6M TRIA along with K50 improved the overall performance of the crop. It proved considerably important for increasing crop growth, gel content, N, P and K contents of the aloe vera. However, TRIA concentration higher than 10-6M (10-5M) showed inhibitory effects on all attributes. Thus 10-6M TRIA along with K50 might presumably be recommended for maximizing the gel content and growth of aloe vera as well as there is further hope for using TRIA in combination of K and many others mineral nutrients in enhancing yield and quality of other medicinal plants.

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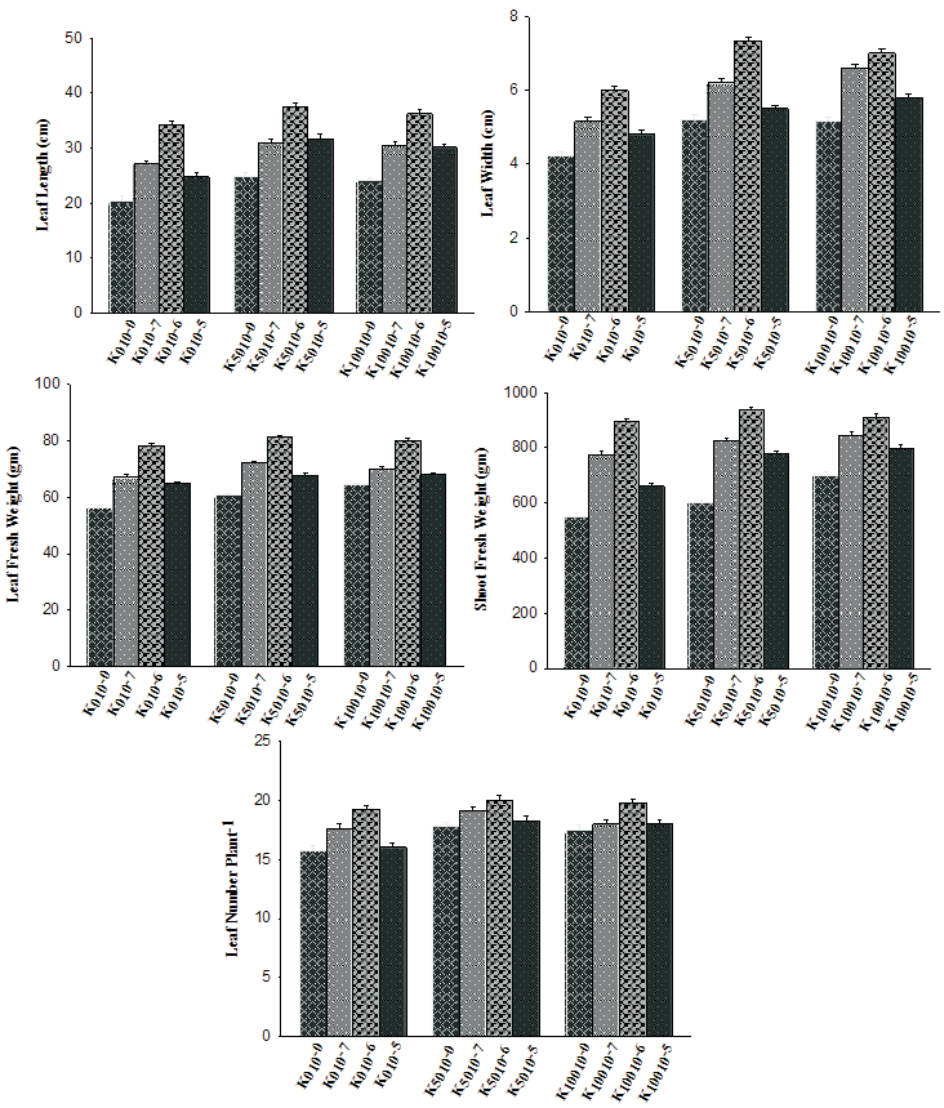

Figure 1: Effect of combined application of varying levels of TRIA together different concentrations of potassium on leaf length, width, number and fresh weight and shoot fresh weight.