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Full Length Research Paper

Investigating the effects of humic acid and acetic acid foliar application on yield and leaves nutrient content of grape (*Vitis vinifera*)

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In order to study the effects different concentration of humic acid and acetic acid foliar application on yield and leaves nutrient content of grape (*Vitis vinifera*), a field experimental in randomized complete block design with three replications was conducted in 2010. Foliar application treatments were T_1: Control, T_2: Acetic acid (1000 mg kg^{-1}), T_3: Humic acid (300 mg kg^{-1}), T_4: Acetic acid (1000 mg kg^{-1}) + Humic acid (300 mg kg^{-1}). Obtained results showed that: Spray treatments had significant effect on yield, cluster length and diameter and Iron, Potassium and Phosphor leaves content of grape. Maximum and minimum amount of fruits yield was obtained in T_3 (Humic acid) and T_1 (Control) treatments respectively. Highest amount of length and diameter of grape cluster and leaves Iron content was recorded in T_4 (Acetic acid) + Humic acid) but maximum of phosphor and potassium was recorded in T_3 (Acetic acid) and minimum amount of all characters was recorded in T_1 (Control).

Key words: Humic acid, acetic acid, zinc, foliar application, grape, yield.

INTRODUCTION

Grapes are the most widely grown commercial fruit crop in the world, and also one of the most popular fruit crops for home production. Though grapes are adapted to a wide range of climates, the best production occurs in regions that meet certain specific climatic conditions. A large number of diverse materials can serve as sources of plant nutrients. The majority of nutrient input to agriculture comes from commercial mineral fertilizers. Organic manures are considered to play a significant but lesser role in nutrient contribution, leaving aside their beneficial effects on soil physicochemical and biological properties. foliar feeding is a relatively new and controversial technique of feeding plants by applying liquid fertilizer directly to their leaves Iran's agricultural soils organic matter with less than 0.3% is quite low in semi-arid environments (Ayoubi and Alizadeh, 2007). However, standard amount of soil organic matter is between 1.5 to 2% (Woodwell, 1984). Humic acids (HAs) are termed polydisperse because of their variable chemical features. From a three dimensional aspect these complex carbon containing compounds are considered to be flexible linear polymers that exist as random coils with cross-linked bonds. On average 35% of the humic acid (HA) molecules are aromatic (carbon rings), while the remaining compounds are in the form of aliphatic (carbon chains) molecules. The molecular size of humic acids range from approximately 10,000 to 100,000. The effects of humic substances on numerous plants such as tomato (Adani et al., 1998; Padem and Ocal, 1999), forage turnip (Albayrak and Carnas, 2005), spinach (Ayas and Gulser, 2005), bentgrass (Cooper et al., 1998), blackgram (Natesan et al., 2006) have been investigated. Atiyeh et al. (2002) stated that humic acid could enhance seedling growth of tomato and cucumber plant. In another research Ayas and Gulser (2005) reported the increase of yield and nutrient content of spinach (*Spinacia oleracea* var. spinoza) by application of humic acid at medium levels (250 g/m^2). They concluded that increased

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nitrogen uptake caused by humic acid application was the main reason of enhanced vegetation growth of spinach. The positive effects of the humic substances were also observed on the studies such as dry matter yield increases on corn and oat seedling (Celik et al., 2008), yield increases on radish and green bean seedlings (Russo and Berlyn, 1992). Albayrak and Camas (2005) found that increasing application of humic acid up to1200 (ml/ha) has significantly promoted root and leaf yield of forage turnip (*Brassica rape* L.), however, yield of forage turnip indicated descending trend beyond 1200 (ml/ha) application levels. The effect of HA on the availability of P and micronutrients has been given particular attention because of observed increases in uptake rates of these nutrients following application of HA (Ayuso et al., 1996).

Application of humic acid increased head weight of lettuce (*Lactuca sativa* L. *var. longifolia*) by increasing the availability of phosphorus and nitrogen (Cimrin and Yilmaz, 2005). Recent studies on the subject summarize the effects of humic substances on plant growth and mineral nutrition, underlining, above all positive effects on seed germination, seedling growth, root initiation, root growth, shoot development and the uptake of some macro (for example, K, Ca, P) and microelements (for example, Fe, Zn, Mn) Nardi et al. (2002) and Eyheraguibel et al. (2008). The main aims of this study were to investigate the impacts of different levels of humic acid and acetic acid concentration and on yield and yield component of grape in Kashmar region.

MATERIALS AND METHODS

This experiment was conducted during 2010 and 2011 cropping season in a grape orchard at Kashmar region. The site lies at longitude 57°27, and latitude 35°11 and the altitude of the area is 1090 m above sea level. The experimental design in this research was randomized complete block design (RCBD) with three replications. Foliar application treatments were T_1: Control, T_2: Acetic acid (1000 mg kg^{-1}), T_3: Humic acid (300 mg kg^{-1}), T_4: Acetic acid (1000 mg kg^{-1}) + Humic acid (300 mg kg^{-1}). Grape trees (*Vitis vinifera*) in a private orchard at Kashmar region. The total humic acid application rate in all treatment was 300 mg kg^{-1} and Acetic acid application rate in all treatment was 1000 mg kg^{-1}. All selected trees for this research were healthy, nearly uniform in growth vigour and fruiting. All trees had received regularly the same common cultural practices already give to the tree. Selected trees were sprayed 2 times during fruit set. Foliar sprays were applied using a hand pressure sprayer. Each treatment was surrounded with two rows as guard trees. The following parameters were determined in the seasons of the study are yield, cluster length and diameter and iron, potassium and phosphorus leaves content of grape. Samples at twenty leaves from the middle part of the shoots were randomly selected from each replicate. Fruits were harvested at maturity stage (the first week of June) from each tree of various replicates and yield was recorded as a weight in Kilograms. Samples of 10 randomly mature fruits from each experimental unit were used for measuring various fruit quality attributes such as Iron, Potassium and Phosphor leaves. Fruit samples were collected after harvesting time then washed, oven dried ground and extracted with wet acid digestion method and analyzed for elemental content of Iron, potassium and phosphor by atomic spectrophotometer, model-2380 (Jones and Case, 1990) and The data were analyzed using SAS software; mean comparison was done using Duncan Multiple Comparison at 5% probability level.

RESULTS AND DISCUSSION

Fruits yield and yield component

Acetic acid and humic acid foliar application significantly increased grape fruits yield (Figure 1). Obtained results showed that using acetic acid and humic acid as a foliar application method increased yield of grape in compared to T_1 (control treatment) but there was no difference between T_2 (acetic acid) T_3 (Humic acid) and T_4 (humic acid and acetic acid). Acetic acid (T_2) and humic acid (T_3) with mean of 7.1 and 7.2 (Kg $plant^{-1}$) increased grape fruits yield 20.83% in compared to control treatment with mean of 5.7 (Kg $plant^{-1}$). In T_4 (Acetic acid and humic acid) grape yield was 6.8 (Kg $plant^{-1}$) and there was no significant difference between T_4 and T_2 and T_3 as shown in Figure 1. The highest Length of cluster was obtained in T_3 (humic acid) and T_4 (acetic acid + humic acid) with mean of 19.1 and 19 cm respectively. Recorded results in this part showed that using humic acid in T_3 and both acetic acid and humic acid in T_4 increased length of grape cluster 12.04% in compared to T_1 (control) and T_2 (acetic acid) with mean of 16.8 and 17.1 cm respectively. This results shows humic acid had a significant effect on length of cluster and the highest length of grape cluster was obtained in each treatment that had humic acid (T_3 and T_4). All treatment of foliar application had significant effect on cluster diameter of grape and foliar application of acetic acid and humic acid in alone (T_2 (acetic acid) and T_3 (humic acid)) or with combination with each other (T_4) with mean of 7.5 and 7.8 and 7.5 cm respectively increased diameter of cluster in compared to control treatment (T_1) with mean of 6.5 cm. This increase was about 14.66% (Figures 2 and 3). These results are in line with the findings of Ayas and Gulser (2005) reported that the increase of yield of spinach (*Spinacia oleracea*, var. spinoza) by application of humic acid. Ayas and Gulser (2005) concluded that increased nitrogen uptake caused by humic acid application was the main reason of enhanced vegetation growth of spinach. The positive effects of the humic substances were also observed on the studies such as dry matter yield increases on corn and oat seedling (Celik et al., 2008), yield increases on radish and green bean seedlings (Russo and Berlyn, 1992). In another study Cimrin and Yilmaz (2005) stated that application of humic acid increased head weight of lettuce (*Lactuca sativa* L. var. longifolia) by increasing the availability of phosphorus and nitrogen.

Leaves iron content

The highest concentration of Fe (iron) was obtained in T_4 (acetic acid + humic acid) with mean of 400 mg/kg as

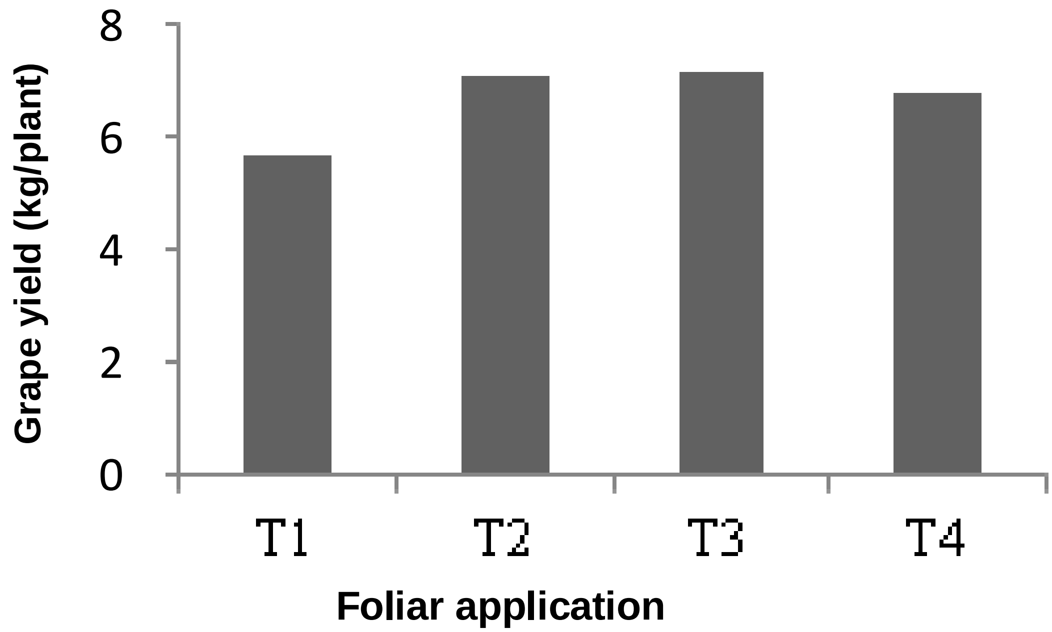

Figure 1. Effect of acetic acid and humic acid foliar application on grape yield.

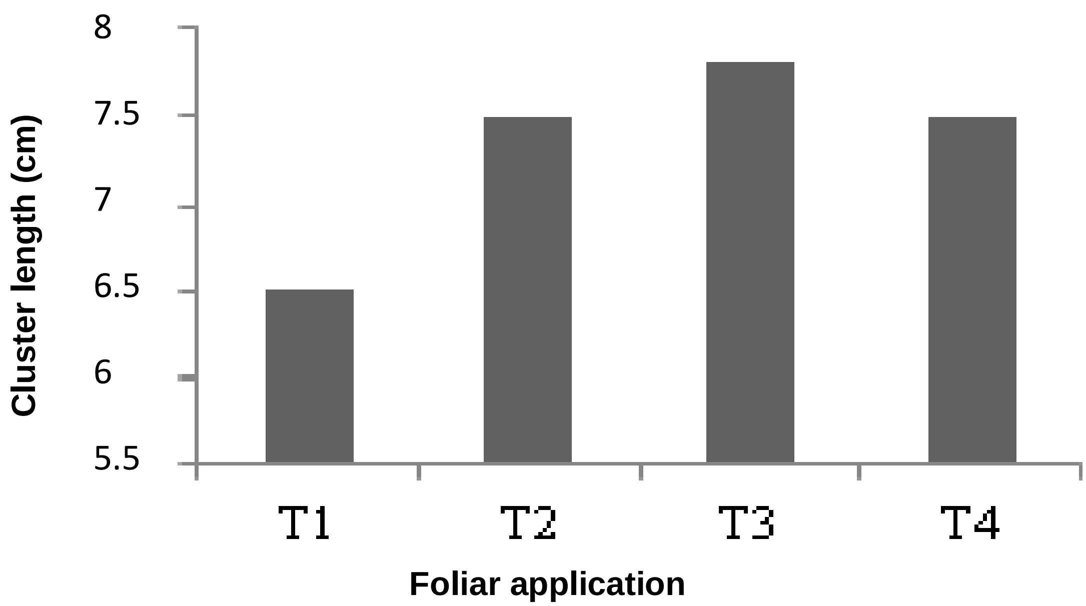

Figure 2. Effect of acetic acid and humic acid foliar application on cluster length.

shown in Figure 4. Recorded results in this part showed that all treatments increased Fe concentration of grape leaves in compare to T_1 (control). This results shows using acetic acid in T_2 with mean of 280 mg/kg and humic acid in T_3 with mean of 350 mg/kg and both acetic acid and humic acid in T_4 with mean of 400 mg/kg increased Fe concentration in compare to control in T_1 with mean of 220 mg/Kg about 17.87, 37.14 and 45% respectively (Figure 4). These results are in line with the findings of (Petronio et al., 1982). He stated that addition of HA to soil increases the rate of absorption of ions on root surfaces and their penetration into the cells of the plant tissue.

Leaves potassium content

Foliar application of acetic acid and humic acid had

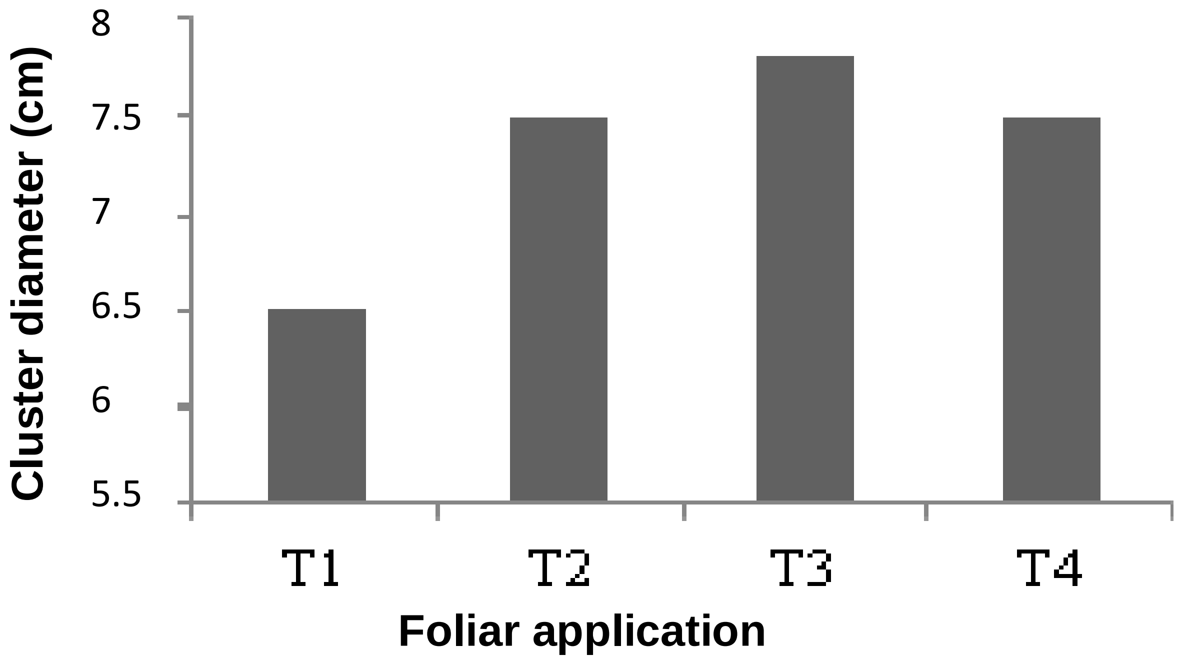

Figure 3. Effect of acetic acid and humic acid foliar application on cluster diameter.

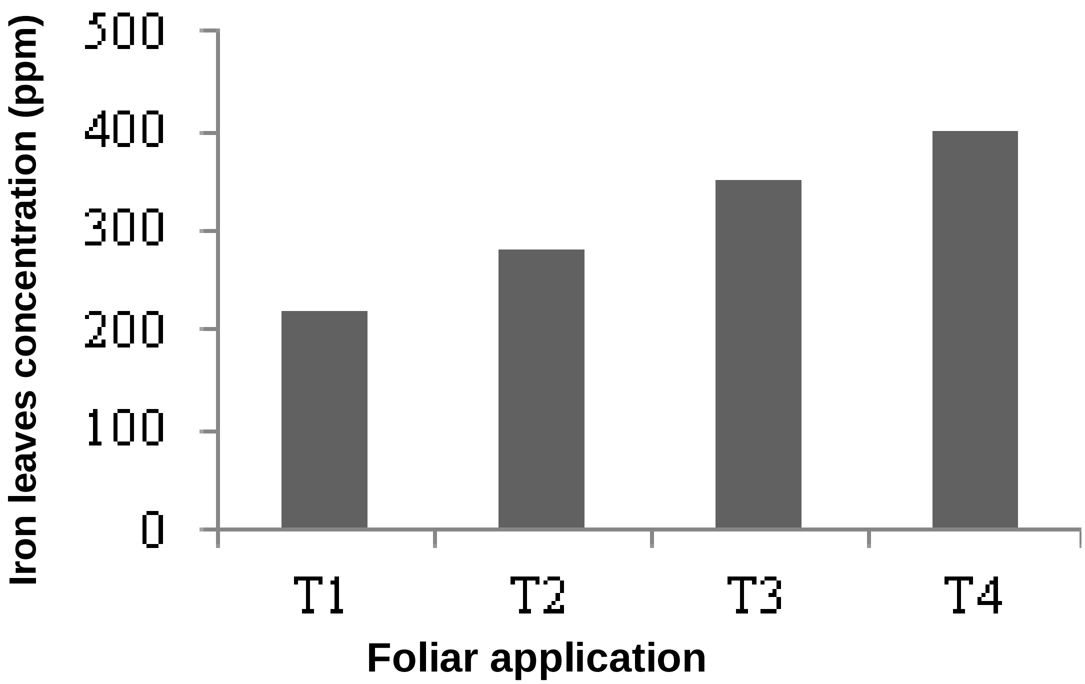

Figure 4. Effect of acetic acid and humic acid foliar application on iron leaves concentration.

significant effect on potassium concentration in grape leaves. All treatment increased potassium in comparison to control treatment (Figure 5). Obtained results in this part showed that meant of potassium concentration in T_1 (control), T_2 (acetic acid), T_3 (humic acid) and T_4 (acetic acid and humic acid) was 0.85, 1.1, 1.18 and 0.89 ppm respectively. The increasing in potassium concentration in compare to control treatment impressed using acetic

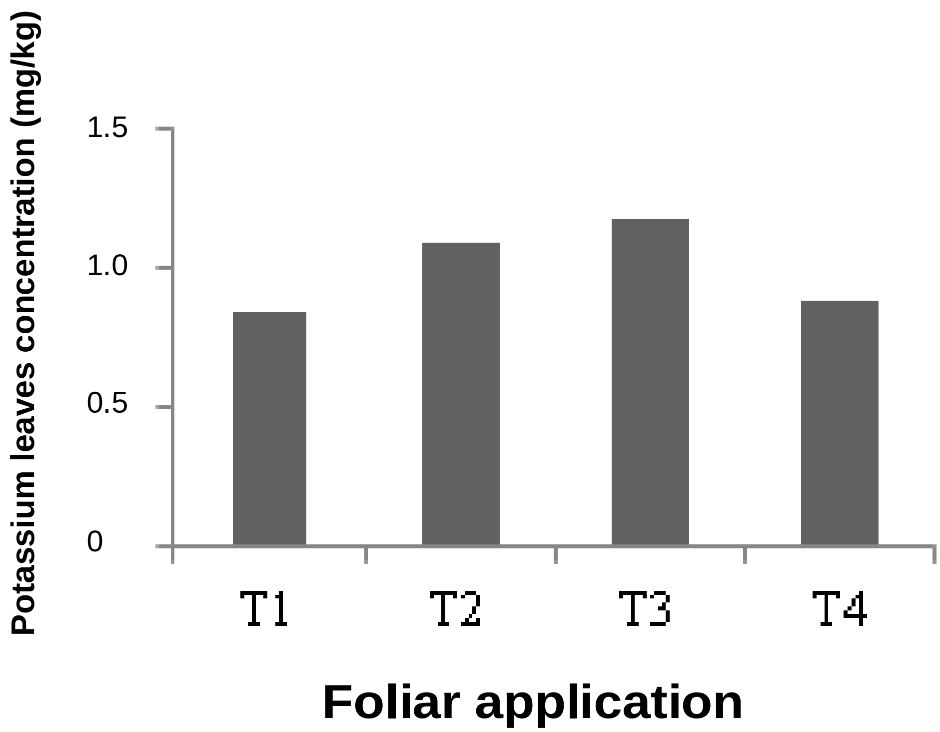

Figure 5. Effect of acetic acid and humic acid foliar application on potassium leaves concentration.

acid was 22.72%, using humic acid was 27.96% and using both acetic acid and humic acid was 4.49% as shown in Figure 5. These results indicate that humic acid is effective than acetic acid in uptake of potassium from soil and increasing potassium concentration in grape leaves.

Leaves phosphorus content

Foliar application of acetic acid and humic acid significantly increased grape leaves phosphor concentration (Figure 6). Recorded results in this part showed that meant of phosphorus concentration in T_1 (control), T_2 (acetic acid), T_3 (humic acid) and T_4 (acetic acid and humic acid) was 0.18, 0.2, 0.23 and 0.14 ppm respectively. All treatment except T_4 (acetic acid + humic acid) increased phosphorus in compare to T_1 (control treatment). The increasing in phosphorus concentration for acetic acid (T_2) and humic acid (T_3) was 10 and 21.73% respectively in compare to control treatment (T_1) (Figure 6). The effect of HA on the availability of P and micronutrients has been given particular attention because of observed increases in uptake rates of these nutrients following application of HA (Ayuso et al., 1996). Cimrin and Yilmaz (2005) stated that application of humic acid increased head weight of lettuce (*Lactuca sativa* L. *var. longifolia*) by increasing the availability of phosphorus and nitrogen.

Conclusion

This study confirms the role of humic acid and acetic acid in increasing growth and fruits yield and leaves nutrient concentration of grape. Humic substances play a vital role in soil fertility and plant nutrition. Plants grown on soils which contain adequate humin, humic acids (HAs), and fulvic acids (FAs) are less subject to stress, are healthier, produce higher yields; and the nutritional quality of harvested foods and feeds are superior. The value of humic substances in soil fertility and plant nutrition relates to the many functions these complex organic compounds perform as a part of the life cycle on earth. The life-death cycle involves a recycling of the carbon containing structural components of plants and animals - through the soil and air - and back into the living plant. It may have both direct and indirect effects on the plant growth. Indirect effects involve improvements of the soil properties such as aggregation, aeration, permeability, water holding capacity, micronutrient

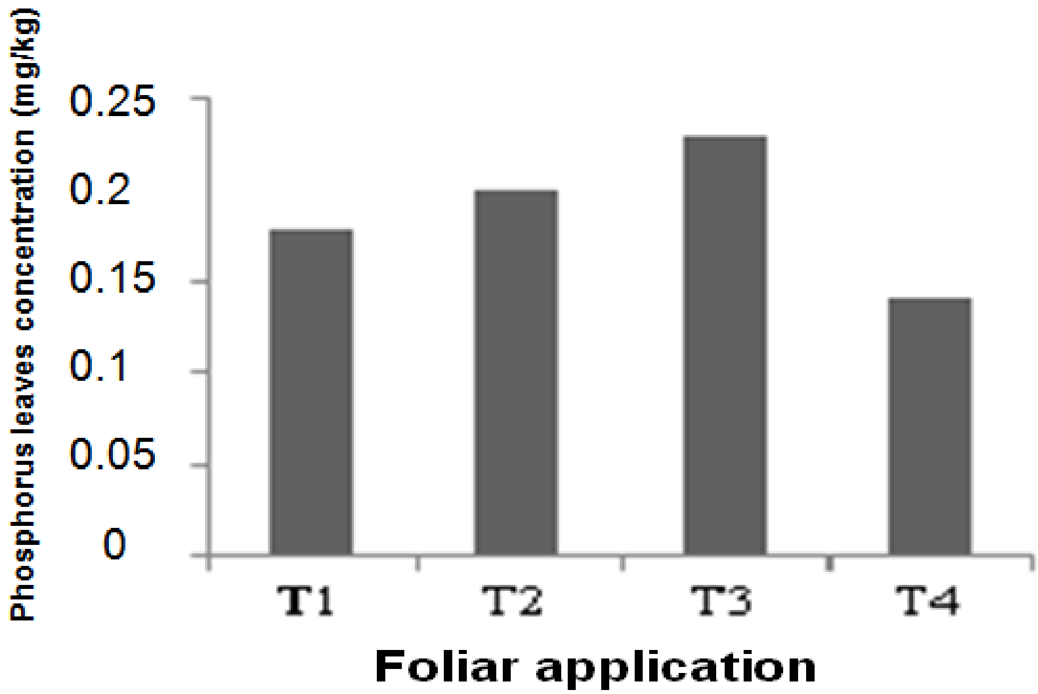

Figure 6. Effect of acetic acid and humic acid foliar application on Phosphorus leaves concentration.

transport and availability. Direct effects are those, which require uptake of humic substances into the plant tissue resulting in various biochemical effects.

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