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# Changes of qualitative and quantitative properties of radish (*Raphanus sativus* L.) under foliar spraying through amino acid

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**Abstract**

Application of biologically active amino acids would be environmentally friendly approach in achieving sustainable agriculture. In this study effect of biologically active amino acids including Humiforteh; Fesnotron; Kadostim at concentration of 0, 1500 and 3000 ppm on yield and qualitative properties of radish (*Raphanus sativus* L.) was investigated. The results indicated that the yield of radish affected by amino acid, significantly. The highest yield was obtained from Humiforteh (H) at 3000 ppm compared with control. Also, the length of root affected by amino acid, so that the longest root was in radish treated with Kadostim (K) at 1500 ppm with 9.36 cm. The results indicated that pH of radish was higher in those which treated with amino acids compared with control ($P< 0.05$). The content of Total Soluble Solid (TSS) and vitamin C was higher in radish following treatment with amino acid. The results indicated that the highest value of these qualitative properties was in H at 1500 ppm and K at 3000 ppm. There results emphasized the positive roll of biologically active amino acids in enhancing yield and qualitative properties in radish plant.

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## Introduction

Radish (*Raphanus sativus* L.) is one of the main fibrous vegetable of cruciferae family. The relatively short time in which radish developed, high yield and presence of a range of varieties which could be resistance against different climates like temperature and rainfall made it a suitable plant for growing through out of the year. In agricultural production, obtaining higher yield is due to application of fertilizers and among those, chemicals are so applied. But recently, following increase of public awareness and more regards toward human health, application of these chemicals have been limited. It seems that application of biological fertilizers would be a promising approach which led to environmentally friendly sustainable agriculture. Generally biofertilizers is a well alternative by which plant growth and development stimulated, naturally. In addition, fixation of nitrogen, mobilization of phosphate, decreasing pH of soil is attributed to the biofertilizers (Saber, 1993). Not only the use of biofertilizers could reduce effect of environmental stress, but also increased yield and vegetative growth and water content of soil (Li and Ni, 1996; Fisher and Wilson, 1975). One of the main components which affected plant growth is protein, which contained of sequence of amino acids. Synthesization of amino acids is through primary elements like Carbon, Oxigen, Hydrogen and Nitrogen which and biochemical pathways in plant. The amino acids are essential components which contributed to the growth and quality of crops. In foliar application of amino acids, plants absorb amino acids through stomas. There are around of 20 important amino acids which influenced the physiological activities of the plant. Foliar Nutrition Of plant through biologically active amino acids could provide a source of building blocks for protein synthesis in plants. Humiforteh, Fesnotron and Kadostim are liquid formula containing rich collection of free amino acids and oligopeptides, biologically active for rapid absorption which activates and regulates the plant metabolism. Several attempts have been made to indicate that whether biofertilizers containing amino acids were effective in enhancing yield and physiological properties. Slawik (2005) and Glinicki (2010) pointed the positive role of biologically active amino acid in enhancing yield in various crops (Slawik, 2005; Glinicki, 2010). In fact, amino acids are main chains in structure of protein, in turn, evolved in development of plant growth (Hounsome *et al.,* 2008). Among amino acids, tryptophan is the precursor of plant secondary metabolites which called phytohormones (Glawischnig *et al.,* 2000). However, these units of protein are main roll in synthesis of other metabolites in plant such as enzymes, vitamins, alkaloids, trepenoids and etc (Ibrahim *et al.,* 2010). Physiologically, amino acids are accounted for inducing growth, protection against ammonia toxicity and as a source of carbon and energy (Abdel Aziz *et al.,* 2010). Slawik (2005) applied humiforte to stimulate shoot growth of Norway spruce. Alaei (2011) investigate effect of Kadostim on wheat plant under drought stress, while Glinicki (2010) reported beneficial effect of biostimulant Resistim on strawberry fruit. Also, Mostafa *et al.* (2010) investigated the effect of arginine on wheat growth with delayed planted. From the best of author's knowledge it seems that beneficial effect of these amino acids well documented about some crops. But questions have been raised whether these amino acids were effective in improving yield of radish plant. So, the experiment was conducted to investigate the effect of three kinds on biologically active amino acids (Humiforteh, Fesnotron, Kadostim) on yield of radish (*Raphanus sativus* L) and qualitative properties such as TSS and vitamin C.

## Material and method

*Plant Materials*

The present study was conducted In Jiroft latitude 26° 43'- 29° 35' N, longitude 56° 17'- 59° 2' E), Iran in 2011. The experiments were laid out in a randomized complete block design (RCBD) with three replications. The texture of soil was loam- sandy and there was no limitation about salinity level. After tillage and primary preparation, super phosphate triple (100 kg/ha) added to soil as basal fertilizers. The radishes were cultured in line (5 m) with 4 cm between plant and 10 cm between rows. There were

10 samples for each replication.

*Treatments*

The treatments consisted of biological fertilizers containing amino acid which including Humiforteh (H), Fesnotron (F), Kadostim (K) in 0, 1500 and 3000 ppm. The treatments were applied in 3-4 leaves. Total 3 foliar spraying with 3 days interval were applied. The fruits were harvested after 35 days.

*Measurements*

Then Weight of single fruit and yield were measured using digital scale 0.01 G. Diameter of fruit and Length of root were measured using digital culis and meter. To evaluate fruit quality, fruit juice mixture was centrifuged at 4000 g for 6 min and the supernatant was analyzed for TSS (total soluble solid), pH and TA (total titratable acidity). TSS was evaluated at 20 ˚C with an Atago 8469 hand-refractometer (Atago Co. Ltd., Tokyo, Japan). PH was measured and TA was determined in fruit juice by titrating to pH 8.2 using 0.1N NaOH. Vitamin C was measured by the titration method and 10 ml fruit juice.

*Statistical analysis*

Data were statistically analyzed using ANOVA appropriate for RCBD with SAS ver. 9.1. Means were compared using Duncan's multiple range test at 0.05 level of probability when the F values were significant (Steel and Torrie, 1984).

**Results**

*Length of root*

Length of root affected by biofertilizers (P< 0.01). The longest root was in radish treated by K1500 ppm (9.36 cm), while the shortest was in control (6.33 cm). The results indicated that there was no significant difference among K 1500 ppm, H 1500 ppm treatments (Fig 1).

*Diameter of fruit*

The results showed that spraying amino acid had significant effect on diameter of fruit (P< 0.01). The maximum and minimum of fruit diameter was in F 1500 ppm and control (19 and 16.33 mm, respectively). Our results indicated that the diameter of fruit was the same when H 1500 ppm and H 3000 ppm was applied. Also K (1500 ppm and 3000 ppm) had the same effect on diameter of radish fruit (Fig 2).

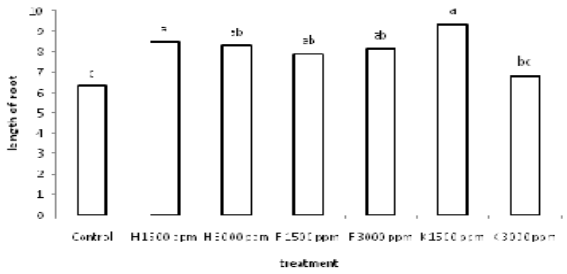


**Fig. 1.** Effect of biofertilizers Humiforteh (H), Fesnotron (F), Kadostim (K) in 0, 1500 and 3000 ppm on length of root. Means within columns followed by the same letter do not differ significantly at p<0.05 according to Duncan's Multiple Range Test.

*Weight of single fruit*

The results indicated that biologically active amino acid had significant effect on weight of fruit (P< 0.01). The highest value of fruit weight was in H 3000 ppm, and the lowest was in control by 9.16 and 6.5 g, respectively (Fig. 2).

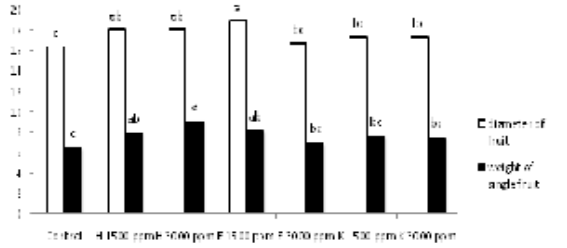

**Fig. 2.** Effect of biofertilizers Humiforteh (H), Fesnotron (F), Kadostim (K) in 0, 1500 and 3000 ppm on diameter of fruit and weight of single fruit. Means within columns followed by the same letter do not differ significantly at p<0.05 according to Duncan's Multiple Range Test.

*Yield per m²*

Yield of treated radish affected by amino acid significantly (P< 0.01). The highest yield was in radish treated by H 3000 ppm (5.98 kg/m2), compared with control (3.6 kg/m2). According to Duncan Multiple range test, the potential of H 1500 ppm, F 3000 ppm and K 1500 ppm was the same in

enhancing yield of radish in m² (Fig. 4).

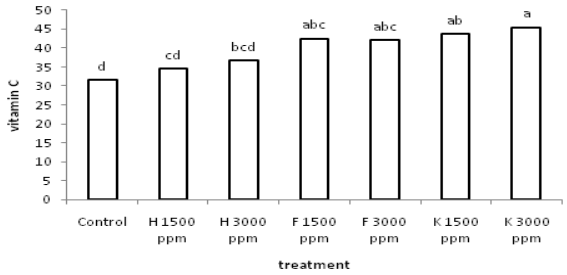


**Fig. 3.** Effect of biofertilizers Humiforteh (H), Fesnotron (F), Kadostim (K) in 0, 1500 and 3000 ppm on vitamin C. Means within columns followed by the same letter do not differ significantly at p<0.05 according to Duncan's Multiple Range Test.

*PH*

The results indicated that biofertilizers affected pH of radish significantly (P<0.05). Comparison of means showed that there were no significant differences among biofertilizers and all of them enhanced pH of radish rather than control. However the highest value of pH was in H 3000 ppm, while the lowest was in control (6.51 and 5.5, respectively) (Fig. 5).

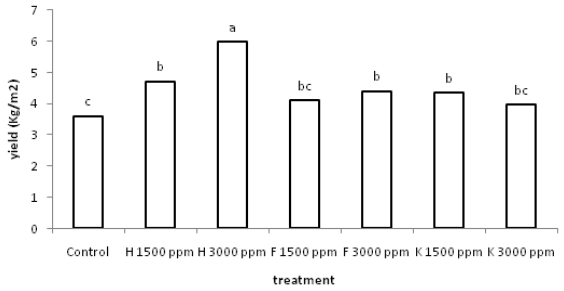


**Fig. 4.** Effect of biofertilizers Humiforteh (H), Fesnotron (F), Kadostim (K) in 0, 1500 and 3000 ppm on yield. Means within columns followed by the same letter do not differ significantly at p<0.05 according to Duncan's Multiple Range Test.

*TSS*

The results indicated that the TSS content of radish affected by biologically active amino acid, significantly (P<0.05). The highest value of TSS was in H 1500 and K 3000 ppm, while the lowest was in control (5.16 and 4.43, respectively) (Fig. 5).

*Vitamin C*

Vitamin C content of radish increased following foliar spraying with amino acid, significantly (P<0.05). The highest value of Vitamin C was in K 3000 ppm, while the lowest was in control (45.46 and 31.64, respectively). According to the results, there were no significant differences among different concentrations of K. (Fig. 3).

**Discussion**

The biofertilizers which used in this study contained amino acid. The overall results of this study presented this compound the new approach for increasing yield and qualitative properties of radish plants. In fact, the biofertilizers of which consisted amino acid improved growth of plants by increasing mRNA transcription up to 2.5x, activation of hormones which evolved in reproductive growth, increasing absorption and transition of element and protein (Anonymous, 2011). The increase in photosynthetic pigment perhaps was due to the role of amino acids on metabolism instigation and metabolical processes to increases plant efficiency (Starck, 2007).

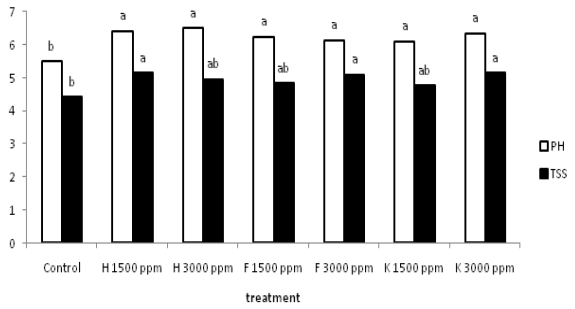


**Fig. 5.** Effect of biofertilizers Humiforteh (H), Fesnotron (F), Kadostim (K) in 0, 1500 and 3000 ppm on pH and TSS. Means within columns followed by the same letter do not differ significantly at p<0.05 according to Duncan's Multiple Range Test.

Our results showed that although application of amino acids increased yield of radish, the highest value was seen in H 3000 ppm .treatment (5.98 kg/m²) compared with control. Also the diameter of fruits were higher in amino acid treatment (Figure 2).This result emphasized the key roll of amino acid in growth of crop plant. In fact, phytohormones and growth substances which significantly correlated with yield and its components, contained from amino acids. So, it seems that in order to achieve higher yield in agricultural products, application of amino

acids through foliar spraying would be a reasonable approach.

Our results indicated that application of amino acids led to longer root. Noctor and Foyer, (1998) reported that the amount of antioxidant such as Ascorbate and glutathione were higher in plants which treated with amino acids. In fact presence of Ascorbate accounted for root elongation, cell vacuolarization, regulation of the cell cycle and cell wall expansion (Noctor and Foyer, 1998). The carbohydrates synthesized through photosynthesis by chlorophyll and through light energy. It is clear that lower photosynthesis rate led to lower growth of plant and finally its death. Two main fundamental metabolites in the process of formation of vegetable tissue and chlorophyll synthesis are glycine and glutamic acid which accounted for increasing chlorophyll content in plant which led to higher photosynthesis, indirectly.

Our results showed that when amino acids sprayed on foliar of radish plant, the value of TSS increased significantly (Figure 5). Also, vitamin C content enhanced in radishes following treatment with amino acids. This increase may be attributed to the key roll of amino acids in biosynthesis of chlorophyll molecules (Abdel Aziz *et al.,* 2010; Ibrahim *et al.,* 2010). Thomas *et al.* (2009) reported that Application of Aminol-Forte led to improvements in the values of stomatal conductance, diffusion resistance and chlorophyll contents, while Neuberg *et al.,* (2010) pointed positive correlation between photosynthesis rates and nitrogen contents in leaves. Foliar application of putresin and glutamine significantly elevated plant growth elements, soluble sugars, sulphur compounds, soluble phenols, free amino acids, photosynthetic pigment contents in leaves as well as yield of onion and quality of bulbs (Amin *et al.,* 2011). Amino acids are involved in the synthesis of other organic compounds, such as protein, amines, purines and pyrimidiens, alkaloids, vitamins, enzymes and terpenoids (Hounsome *et al.,* 2008). Alkaloids are interesting because of their noticeable physiological and medicinal properties (Hounsome *et al.,* 2008).

It seems that the amino acids which sprayed on trial plant affect the plant physiological processes, which led to improvement of yield and its component as well as qualitative properties. Our results also supported the works of some scholars who pointed the positive rolls of amino acids in increasing yield in various plant and condition. For example, the results were in agreement with Alaei *et al.* (2012) who concluded the biological fertilizers containing amino acids had positive effects on germination indices of wheat varieties under drought stress.

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