



## RESEARCH PAPER

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## Effect of chemical fertilizers and bio-stimulators containing amino acid on quality and quantitative and qualitative characteristics of tomato (*Lycopersicon esculentum*) var. Cal.j

Moslem Raeisi<sup>1\*</sup>, Zahra Babaie<sup>2</sup>, MahbobePalashi<sup>3</sup>

<sup>1</sup>Young Researchers and Elite Club, Jiroft Branch, Islamic Azad University, Jiroft, Iran

<sup>2</sup>Ramin Agricultural and Natural Recourses University, Horticultural department, Ahvaz, Iran

<sup>3</sup>Agricultural Department, Jiroft Branch, Islamic Azad University, Jiroft, Iran

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### Abstract

With due attention to importance of sustainable agriculture and protect the environment from pollution, application of bio-stimulators compounds can causing of improvement the qualitative and quantitative growth of plants and reducing of effects of environmental stresses. The purpose in this study is determination effect of chemical fertilizers and bio-stimulators compounds containing Amino acid on quantity and quality of tomato. This experiment was performed in factorial base on a completely randomized blocks design (CRBD) with three replications during 2011 in Jiroft. Treatments was included three concentration 0 (control), 2000 and 4000 ppm of chemical fertilizers including (NPK<sub>20,20,20</sub> , NPK<sub>15,5,30</sub> ) and bio-stimulators compounds including humi-forte, kadostim and fosnutern via foliar application at three stages. The result indicated that the effect of bio-stimulators compounds on number of fruit, yield per m<sup>2</sup> and number of flower at 1% probability and on yield per bush, TSS, TA and was significant at 5% probability. Effect of bio-stimulators compounds on the traits like weight of single fruit, diameter of fruit, length of plant, PH and vitamin C was not significant. The best treatments in present study were humi forte at concentration 2000 ppm that lead to bush yield and yield per m<sup>2</sup>.

\* Corresponding Author: Moslem Raeisi ✉ [moslem.r2007@gmail.com](mailto:moslem.r2007@gmail.com)

## Introduction

Tomato (*Lycopersicon esculentum*) is the Solanaceae family. Tomato is one of the most important, popular and widely grown vegetables in the world ranking second after potato. Tomato is a good source of minerals and vitamins, especially vitamin 'C' and carotenoids, which are consumed throughout the world in the form of fresh as well as processed products (Balemi, 2008; Chaurasia, 2005). Planting tomato is as an important vegetable and high yield crop in many part of iran (Anonymous, 2004). The Cal J variety is a compact and determinate and the plant is vigorous and highly productive. The fruits are square and have hard skin that in this respect suitable for transfer to far areas (Peyvast, 2009). In order to increase of agriculture crops production per unit area, conducted the different agriculture operations such as application of chemical fertilizers (Golzade *et al.*, 2011). Fertilizers are sources of plant nutrients that can be added to soil to supply its natural fertility. They are intended to supply plant needs directly rather than indirectly through modification of such properties as soil PH and structure. There is usually a dramatic improvement in both quantity and quality of plant growth when appropriate fertilizers are added (Abd El-Aziz, 2007). Nitrogen, P and K, among others are known to affect yield (Isitekhale *et al.*, 2013). The result of this activities were crisis environmental pollution especially pollution of water and soil sources that its entered as chain to food source of humans and threat the health of humans (Golzade *et al.*, 2011; Rahmnaï, 2011). Application of renewable sources and products is a principle of permanent agriculture that causes the maximum of crop productivity and minimum of environmental risks (Eidizadeh *et al.*, 2011). Biostimulators are biological factors with very low concentration that able to improve the main bio-chemical processes in plants and soil, and finally they causes growth and development of plants. Generally biostimulators are materials that cause stimulation of metabolism and metabolic processes in order to increase of efficiency (Golzade *et al.*, 2011). Nowadays most researches focused on different applications of amino acids and low molecular weight oligopeptides. Amino acids with

free form are conductor of positive and negative charge. these substances after entrance into plant cell membranes formed the oscillating particles and plants entered into cells this substances due to very much purity of amino acids and also them participated like part of own structure in all metabolic processes. This process gives to plant the possibility of energy saving and as a result its show the metabolic stability against environmental stress. In addition to, this conditions causes increases of growth, improved of amino acids biosynthesis in plant and increases qualitative and quantitative crops (6, 12, 20 and 24). This technology is collection of 20 active amino acids and oligopeptides including short chains of protein consisting three amino acids as oligopeptides with low molecular weight to inside of cell plant. Each of the 4 products: aminol forte, humi forte, fosnutren and kadostim have especially application and efficiency with micro and macro elements tailored to plant requirements in different growth stages (Anonymous, 2010). Adediran and Akande ( 2005) reported that significantly difference there was in growth yield and plant efficiency due to application of bio stimulators and mineral fertilizer. Other researchers suggested that application of high amount of mineral fertilizer can reduced with biostimulators application. And when mineral fertilizers and bio stimulators together applied were highest yield of tomato. Applications of new techniques in agriculture are necessary In order to permanent agriculture, optimization of chemical fertilizers application and improved plant yields. With due attention to this reality, the present investigation was aimed to improvement of tomato nutrition condition and highest yield via application of biostimulators that recommended if possible biostimulators as replacement of chemical fertilizers.

## Materials and methods

### *Plant materials*

The study was carried out in experimental field of Islamic Azad University, Jiroft branch, Jiroft, Iran in 2011. The area of jiroft are about 50 thousands Km<sup>2</sup> at east sought of kerman province( 56', 17' to 59' 2' longitude and 26' 43' to 29' 35' latitude, 625.6 m

ASL, mean of relative humidity 55-65%, 48°C maximum of temperature, 0°C minimum of temperature, 150 mm Average annual precipitation). The experiment was conducted with completely randomized block design at three replicates. After field preparation 100 Kg/ha triple super phosphate added to soil. Seeds were planted directly in field in late of November. Cultivation method was furrow system including 11 rows length of 20 m, width 1 m, spacing between plants were 50 cm, distance of each treatment were 6 m and spacing between treatments were 1 m. cultivation was conducted currently as irrigation, weeding, earthing up spraying poison (spraying poison against Tomato leaf miner with dimilin 1 per 1000).

#### *Treatments*

Treatments was included there concentration 0 (control), 2000 and 4000 ppm of chemical fertilizers including (NPK<sub>20,20,20</sub>, NPK<sub>15,5,30</sub>) and bio-stimulators compounds including humi-forte, kadostim and fosnutren via foliar application at there stages that two stages were before flowering With a time interval of 7 days and other stage was after flowering.

#### *Measurements*

Tomato harvesting began in May and 3 harvest conducted in a month. Each Harvested tomato were placed separately in plastic bags and translated to laboratory after measurement and their weight. In harvesting, Characteristics including fruit number, fruit length, fruit diameter, weight of single fruit, yield per bush, yield per m<sup>2</sup>, flower number and plant height were measured. For measurement of weight of single fruit, yield per bush and yield per m<sup>2</sup> were used digital scale with readability 0.01 g. fruit length and fruit diameter were measured with caliper and plant height was measured by meter. TSS with portable refractometer, pH with pH meter, Total titrable acidity (TA) with NaOH 1% N and vitamin C with idometric titration.

#### *Statistical analysis*

Data were analyzed using SAS ver 9.1 for analysis of variance and Duncan's multiple range test was

employed for the mean comparisons.

### **Results and discussion**

The results indicated that effect of bio stimulants (humiforte, kadostim, fosnutren) on fruit number, yield per m<sup>2</sup> and flower number were significant at 1% probability and on characters as fruit length, yield per bush, TSS and TA were significant at 5% probability and effect of bio stimulants on characteristics as plant length, fruit diameter, weight of single fruit, pH and vitamin C were not significant (table 1). This experiment indicated that biostimulator treatments were significant difference on qualitative and quantitative yield and most yield was obtained via application of biostimulators. Sanchez *et al.* reported that effect of biological fertilizers on species medicinal chamomile and pot marigold causes increase of flower yield and improvement of medicinal quality in pot marigold while in chamomile causes increase of flower yield but not effective on quality. Wu *et al.* reported that application of biological fertilizers causes improvement of nutrition status and soil features. With due attention to fact that amino acids in formulation of biostimulators causes to increase mRNA synthesis up to 2.5 fold, activation of effective hormones in reproductive growth and process of formation carbohydrate, increasing the absorption rate nutrients and increase in the cell's ability to synthesis proteins that allow to improvement of qualitative and quantitative characteristics in the shorter duration especially in stress conditions (Anonymous, 2010; Xing-Quan, 2008; Adediran and Akande, 2005). Golzade *et al.* (2011) expressed that in their experiment, application of biostimulants increased qualitative and quantitative yield such as essential oil per hectare, chamazolene content and total flavonoid. Darzi *et al.* (2008) reported that application biological fertilizers caused to be most umbel per plant and biologic yield in fennel. Alaei *et al.* (2012) showed that use of two biological fertilizers (Amniol forte and Fosnutren) have significant differences for average duration of germination, germination speed, final germination percent and average daily germination of wheat and fosnutren than other treatments, can have a positive effect on

wheat germination indices.

*Fruit number*

Effect of biostimulators treatments on fruit number was significant at 1% probability (table1). The result of mean comparison on fruit number (table 2) showed that humi forte 4000 ppm with 21 values had the highest and control treatment with 9.33 had the lowest value of this trait. According these results can

say that humi forte containing free amino acid, oligopeptides and NPK elements causes increase product and decrease during the harvest period. Its also containing microelements and NPK for increasing the fertility and soil structure improvement which affected plant yield. Karkaurat *et al.* (2009) reported that Humic acid might successfully be used to obtain higher fruit yield and can significantly enhanced fruit quality in papper.

**Table 1.** Results of Analysis of variance for studied traits.

S.O.V	D.F	Mean squares										
		number of fruit	diameter of fruit(cm)	weight of single fruit(g)	of yield bush(kg)	per yield m <sup>2</sup> (kg)	number of flower	length of plant(cm)	of PH	TSS	TA	vitamin C
Blok	2	3.75 <sup>ns</sup>	0.05 <sup>ns</sup>	182.93 <sup>ns</sup>	0.50 <sup>ns</sup>	3.86 <sup>ns</sup>	89.48 <sup>ns</sup>	57.54 <sup>ns</sup>	0.001 <sup>ns</sup>	0.109 <sup>ns</sup>	0.46 <sup>ns</sup>	5.73 <sup>ns</sup>
Treat	10	32.32 <sup>**</sup>	0.02 <sup>ns</sup>	83.95 <sup>ns</sup>	1.51 <sup>*</sup>	30.55 <sup>**</sup>	624.49 <sup>**</sup>	28.09 <sup>ns</sup>	0.006 <sup>ns</sup>	0.032 <sup>*</sup>	0.36 <sup>*</sup>	8.56 <sup>ns</sup>
error	20	8.05	0.023	121.80	0.62	7.02	102.35	33.04	0.005	0.01	0.15	4.43
C.V		19.43	9.71	11.12	16.66	10.62	12.14	12.72	0.71	4.16	14.66	7.38

ns: non significant differences; \*: significant at p<0.05; \*\*: significant at p<0.01.

*Yield per bush*

Results showed that biostimulators significantly affected yield per bush in  $p \leq 0.01$  (table 1). highest yield was seen in humi forte 2000 ppm (7.4

kg), while it was lowest in control (3.07 kg) (table 2). Hasan Panah *et al.* (2007) reported that application of kadostimin second cultivation of potato var. Sante causes increasing yield of tuber.

**Table 2.** Means comparison of effect chemical fertilizers and biostimulators on qualitative and quantitative traits of tomato var Cal. j.

treat	number of fruit	of diameter of fruit(cm)	weight of single fruit(g)	of yield bush(kg)	per yield m <sup>2</sup> (kg)	per number of flower	of length of plant(cm)	of PH	TSS	TA	vitamin C
Control	9.33e	5.06ab	97.33a	3.07c	19.33e	67.00e	46.66a	4.43ab	2.66c	2.14d	24.64b
Humifrote 2000 ppm	17.33ab	4.80ab	109.00a	5.65a	27.46ab	69.00ed	49.66a	4.47ab	2.80bc	2.73abcd	27.90ab
Humifrote 4000 ppm	21.00a	5.30ab	93.33a	4.75ab	31.06a	83.33cde	40.66a	4.45ab	2.76bc	2.39bcd	28.45a
Fosnotren 2000 ppm	12.33cde	5.10ab	96.33a	5.14ab	22.90cde	104.66ab	44.00a	4.47a	2.66c	2.34cd	29.62a
Fosnotern 4000 ppm	16.33abcd	5.13ab	97.33a	4.77ab	26.33bcd	114.00a	46.66a	4.49a	2.80bc	2.64abcd	30.80a
Kadostim 2000 ppm	16.66abc	4.70ab	92.66a	4.34abc	27.06abc	85.33dc	47.33a	4.34b	2.70bc	3.02ab	29.92a
Kadostim 4000 ppm	12.66bcde	5.06ab	101.33a	4.63ab	23.10bcde	88.00bc	44.33a	4.48a	2.73bc	3.15a	28.74a
Npk(15) ppm 2000	16.33bcd	5.23	100.33a	4.22bc	26.60abcd	80.66cde	48.66a	4.39ab	3.00a	2.47bcd	27.57ab
Npk(15) 4000 ppm	14.33bcd	4.66	108.00a	5.60a	24.83bcd	76.66cde	49.00a	4.43ab	2.76bc	2.89bcd	29.92a
Npk(20) ppm 2000	12.66bcde	5.46a	93.33a	4.87ab	23.13bcde	76.66cde	43.66a	4.41ab	2.86ab	2.90abc	29.04a
Npk(20) 4000 ppm	11.66de	4.53b	93.33a	5.02ab	22.40de	71.00cde	41.33a	4.37ab	2.66c	3.15a	27.28ab

Means with similar letters in each column are not significantly different.

*Yield per m<sup>2</sup>*

As shown in Table 1, there was significant difference among treatments at 1% of probability level. The result of mean comparison on yield per m<sup>2</sup> (table 2) showed that humiforte 2000 ppm with 27.46 kg per m<sup>2</sup> had the maximum of yield and control treatment with 19.32 kg per m<sup>2</sup> had the minimum of this trait. Slavik (2005) applied humiforte to stimulate shoot growth of Norway spruce. The Positive effects exists between biostimulants application and growth, shoots and root development speed.

*Number of flower*

According to results (Table 1) was observed between biostimulants and number of flower was significant difference at 1% probability. The result of mean comparison (table 2) showed that maximum number of flowers was in fosnutren 2000 ppm (n=114), while the least number was in control (n=67). Anonymous (2008) reported that foliar application of kadostim on olive was cause increase of flower parameters such as number of inflorescence at branch and number of flower at inflorescence and somewhat effective in enhancement percent of complete flower. According these results can say that fosnutren containing biologically active oligo-peptides and high absorption phosphorus. Where plays a critical role such as development of flowers, roots, storage organs, fruits and seeds.

*TSS*

Results showed that biostimulators significantly affected TSS in  $p \leq 0.01$  (table 1). highest TSS was seen in NPK<sub>20</sub> 2000 ppm 3.00 values, while it was lowest in control, fosnutren 2000 ppm and NPK<sub>20</sub> 4000 ppm with 2.66 (table 2). Jafari Haghighi *et al.* (2010) stated that integrated application of biological and chemical fertilizers increase yield and its components such as Grain yield, kernel number per ear, 1000 kernel weight and crop growth rate of corn under drought stress.

*TA*

As shown in Table 1, there was significant difference among treatments at 1% of probability level. Highest

TA was seen in NPK<sub>20</sub> and kadostim 4000 ppm with 3.15 values, while it was lowest in control with 2.14 values (table 2). Mohammadi Zade *et al.* (2009) reported that foliar application of biostimulators increased chlorophyll content, total solid soluble, poroline and qualitative indices on tomato plants.

**Conclusion**

The results showed that the use of chemical fertilizers and biostimulators containing amino acids have positive effect on qualitative and quantitative characteristics tomato var. Cal.j. in this experiment, the best treatment was humiforte at concentration 2000 ppm that lead to most yield per m<sup>2</sup> and bush and highest number of fruit. Application of biological fertilizers is a promising approach in reducing environmental pollution and achieving sustainable agriculture. Long term studies indicated that excessive use of chemical fertilizers causes decrease yield of crop plants. It's due to soil acidification, reducing of soil biological activities, reducing of soil physical characteristics and lack of micronutrients in NPK fertilizers (adediran and Akande, 2005). With due attention to possibility of change environmental factors (light and temperature) and agriculture factors (pruning, irrigation, etc) from year to year Recommended similar experiments can be done during two or more consecutive years.

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