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The effects of fulvic acid and sugar cane molasses on yield and qualities of tomato

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ABSTRACT: To study the effects of molasses and Fulvic acid extracted from sugar beet molasses in the cultivation of Nunhemz tomato varieties, a factorial experiment in a completely randomized design with three replications in greenhouse was conducted in Karaj Soil and Water Research Station. Fulvic acid and molasses as a soil application and foliar levels of consumption were used. The results showed that the effect of experimental treatments on quantitative and qualitative characteristics of the plant was significant at five percent. In this respect, the impact Fulvic acid on nutrient concentration and yield of tomato shoots were higher than molasses and control.
Keywords: Tomato- Fulvic acid- Molasses- Nutrient concentration-Yield

INTRODUCTION

Sugar beet molasses is produced annually in a large amounts and were used in different industries including animal feeding, alcohol and fertilizer and so on. One of the problems in the alcohol industry is the release of industrial effluents on the land adjacent and subsequently contaminating water supplies (due to high BOD) and other environmental issues like soil and plants. The use of sugar beet molasses in agriculture,causes nutrient elements uptake efficiency and soil biological activity increases. Numerous studies have shown that the Molasses, organic acids, amino acids, Humic and Fulvic acids have a significant effects on plant growth. In sugar beet molasses there are different amounts of humic, fulvic and amino acids. Fulvic acid due to the small molecular structure is more efficient to penetrate to the plant roots. Pujar (1995) reported that foliar application of molasses increased uptake of Zn, Cu, Fe and Mn in corn and wheat compared to the control. Chandraju (2008) reported that the use of a diluted solution of molasses will increase nutrient uptake and yield of leafy vegetables like cabbage. Mohammadi Torkashvand (2008) reported that use of molasses increased total nitrogen and potassium and decreased available phosphorus in soil .Chen and Aviad (1990) observed that the use of humic and Fulvic acid in nutrient solution or spraying it at the concentrations of 25 to 300 mg/lit increased the shoot growth in many plants. Rauthan and Schnitzer (1981) reported that Fulvic acid increased the uptake of N, P, K, Ca, Mg, in cucumbers and the maximum uptake in plant was at rates of 100 -300 mg/lit.Tan (1978) in a study showed that Humic and fulvic acids can release potassium from illite and montmorillonite clay in a more amounts. Xudan (1986) in a pot experiment showed that, foliar applicationof Fulvic acid on wheat increased labeled P uptake by roots . Fuhr and Sauerbeck (1967) showed that the transfer of Fulvic acid to the shoot is more than humic acid. Piccolo (1992) in their research showed that hormone-like effects of humic compounds is more in acidic groups and smaller molecules than aliphatic ones. Fulvic acid has smaller molecules and more acidic groups than humic acids.

The purpose of this study was to investigate the effects of Fulvic acid extracted from molasses with respect to sugar beet molasses on tomato plant.

MATERIALS AND METHODS

To study the effects of molasses and Fulvic acid extracted from sugar beet molasses in the cultivation of Nunhemz tomato varieties, a factorial experiment in a completely randomized design with three replications in greenhouse condition. Fulvic acid and molasses as a soil and foliar application were used.

Treatment includes

Fulvic acid: Soil application at three levels: FS_1 = 20, FS_2 =40 and FS_3 =60 lit./ha. Fulvic acid: Foliar application at three levels: F_1 =2, F_2 = 4 and F_3 = 6 per cent. molasses: Soil application at three levels 1) MS_1 = 20, 2) MS_2 = 40 and 3) MS_3 = 60 lit./ha. molasses: Foliar application at two levels 1) MF_1 = 4 and MF_2 =6 percent. Control: Con.

Before the implementation a composite sample of soil was taken and sent to the laboratory for measurement of physical and chemical properties. All tomatoes fertilizers requirements were uniformly treated according to soil test. Irrigation was in the basis of fifty percent depletion of soil F.C. Soil consumption of Fulvic acid and molasses were at two stages :1) five-leaf stages and 2) eight-leaf stages. Foliar application was conducted at three and six leaves stages. During the growth period, the necessary operations such as irrigation, breaking the crust was done and at the end of the experiment (12 weeks), the micro and macro elements in plant tissues were measured. Results were analyzed using SPSS statistical software and the means comparison by Duncan's multiple range test were performed.

RESULTS AND DISCUSSION

Table 1. Analysis of variance of mean squares of the experimental treatments

Sources changes	d.f	Wet weight	Chloro phyll	Cu	Mn	Zn	Fe	K	P	N
Treatments	11	441.8*	512*	72.4*	3814*	731*	2508110*	0.199*	0.001 n.s	0.337*
Error	22	17.48	83	16.2	1174	89	79563	0.051	0.001	0.031
C.V		8.29	10.20	12.8	21.1	11.19	33.25	10.90	9.91	8.07

n.s= no significance, *: significant at the five percent level

Test results (Table 1) showed that all experimental treatments other than phosphorous have been affected by Fulvic acid and molasses and their differences was statistically significant with respect to control (α = 5%).

Cu ,Fe,Mn and Zn concentration in shoots of tomato

The effects of different treatments on the concentration of Cu,Fe,Mn and Zn in tomato shoots was statistically significant (α = 5%) (Table 2). The highest concentration of these elements in plant was achieved by soil application of fulvic acid at a rate of 20 lit/ha and its variation with respect to concentration in all of the treatments was sigmoid. Foliar application of molasses increased Cu and Mn concentration but fulvic acid increased Fe and Zn in plant. Soil application of fulvic acid was more effective than molasses.

Table 2. Effects of fertilizer treatments on nutrient elements , shoot weight and chlorophyll content of tomato plant .

Treatments	f.w gr/pot	Chlorophyll reading	K %	P	N	Zn mg/Kg	Mn	Fe	Cu
F_1	56.41 b	45a	2.28 ab	0.11 ab	2.82 a	96.93 abc	139.3 bcd	502.0 ef	25.23 d
F_2	72.14 a	42b	2.13 abcd	0.14 ab	2.55 ab	95.80 abcd	157.7 bcd	1483. bc	29.00 bcd
F_3	53.32 bc	37bc	1.93 bcde	0.16 a	2.18 cd	93.53 abcd	121.3 cd	931.3 de	26.33 d
FS_1	58.07 b	38bc	2.19 abc	0.15 ab	2.16 cd	105.9 a	237.7 a	3583. a	39.03 a
FS_2	36.86 f	40bc	1.62 e	0.11 ab	1.49 f	99.80 ab	205.0 ab	1913. b	38.17 a
FS_3	67.50 a	35cd	2.15 abcd	0.10 ab	1.80 e	80.37 cd	169.0 bcd	1538. bc	28.97 bcd
MS_1	47.75 cd	38bc	2.37 ab	0.13 ab	2.15 cd	57.33 e	135.3 cd	768.7 def	29.50 bcd
MS_2	34.33 f	36c	2.31 ab	0.15 ab	2.39 bc	77.73 d	161.0 bcd	1481. bc	34.27 abc
MS_3	44.64 de	33d	1.75 de	0.13 ab	2.03 de	82.17 bcd	176.7 abcd	1197. cd	34.97 abc
MF_1	40.57 def	37bc	1.95 bcde	0.14 ab	2.13 cd	88.83 abc	187.0 abc	327.7 f	35.70 ab
MF_2	55.67 b	33d	2.43 a	0.12 ab	2.22 cd	81.93 bcd	141.3 bcd	369.7 f	27.37 cd
Con.	38.34 ef	28e	1.84 cde	0.13 ab	2.13 cd	56.33 e	115.1 d	462.0 ef	26.17 d

N , P and K concentration in tomato shoots

The effects of different treatments on the concentration of N and K in tomato shoots was statistically significant (α = 5%) (Table 2) .The highest concentration of nitrogen and potassium in plant respectively was observed in F_1 and MF_2 treatments.The nitrogen content in plant was at least in soil application of fulvic acid. The effects of fertilizer treatments on P concentration was not significant.

Chlorophyll content in tomato

The effects of different treatments on Chlorophyll content in tomato shoots was statistically significant (α = 5%) (Table 2). Maximum content of chlorophyll in tomato was in F_1 which had significant differences with respect to control. Foliar application of fulvic acid for increasing chlorophyll in plant was more effective compared to other treatments.

Shoot fresh weight of tomato plants

The effects of different treatments on Shoot fresh weight of tomato was statistically significant (α = 5%) (Table 2). The highest amounts of shoot fresh weight was observed in F_2 and minimum was in MS_2 . The effects of fulvic acid on Shoot fresh weight was more than molasses .

CONCLUSIONS

The results showed that sugar beet molasses and Fulvic acid had significant effects on Shoot fresh weight and nutrient uptake compared with control. In this respect, the impact of fulvic acid on quantitative and qualitative characteristics of plant was greater than molasses. Accordingly, the use of these compounds in agriculture for improving soil fertility and plant yield can be considered.

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