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EFFECT OF CYANOBACTERIA AS A BIOFERTILIZER ON QUALITATIVE AND QUANTITATIVE CHARACTERISTICS OF TOMATO VARIETIES

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ABSTRACT : During the agricultural season of 2018, five tomato cultivars were cultivated in Mahaweel district, Babil Province to study the effect of different treatment methods of Cyanobacteria (control, bacterial vaccine and addition to the soil) on growth and yield. Complete randomized design (CRD) was used with four replicates. The results showed that the interaction of cyanobacteria with Marwa var. gave the highest rate of yield traits (number of fruits, fruit weight and total yield) reached to 6.89, 153.2 g and 74.40 t.ha⁻¹). As well as total soluble solids (TSS), total acidity, vitamin C and fruit content of carotene and lycopene (5.62, 0.46, 11.94 mg/100 ml juice, 4.61 and 2.78). On the contrary, Jinan variety at control treatment gave the lowest results for all the mentioned traits (3.36 fruit, 80.66 g, 32.52 t.ha⁻¹, 3.22, 0.20, 10.05 mg/100 ml juice, 3.02 and 2.11), respectively.

Key words : Biofertilizer, cyanobacteria, tomato varieties, fruit qualities.

INTRODUCTION

In development of the cultural progress and the increase in the world population growth, the adoption of a specific strategy to improve the nutritional situation become an urgent and necessary by some methods like using modern techniques and methods of fertilization in order to raise the nutritional value. Vegetable plants are high in protein, starch, fatty acids, vitamins and organic acids as well as containing the essential elements, especially calcium, magnesium and potassium (Majid, 2013). Tomato is one of the important vegetable crops, and be the third largest crop of cultivated vegetables in tropical, subtropical and temperate regions.

There are more tomato varieties differ in planting dates and fruits ripening, that makes it available in the markets throughout the year and it differ in fruit quality depends on variety, harvest time, the level of nutrition during the growing season, environmental and water stress. In general, open cultivation give better fruits than greenhouses (Mikkelsen, 2005).

Biofertilizers as soil vaccine or seeds inoculation with micro organizations are useful by its releasing of plant growth regulators as well as their contribution of essential nutrients needed by the plant and its physical and chemical changes in soils contribute to improve soil fertility (Maslat

and Musleh, 2015). Ali *et al* (2012) found that cucumber seeds inoculated with cyanobacteria, caused significant increase in all studied traits (plant yield, fruit length and diameter, fruit content of chlorophyll, betacarotene and total soluble solids content). This research aims to study quantitative and qualitative characteristics of five tomato varieties and its suitability to the conditions of the agricultural area in trend towards organic fertilization without chemical applications.

MATERIALS AND METHODS

The study was carried out in a private green house in Mahaweel city (20 km north of Babylon governorate). Five tomato varieties (Sun seed, Royal Sluis, Jinan, Red Clud, Marwa) were obtained from the national program for growing tomatoes in Iraq for the agricultural season 2017/2018. The seeds were planted in 21 February 2018 in dishes (209 hills filled with peat). The seedlings were produced in plastic tunnels and then planted in plastic house (25 m × 9 m) when the seedlings reached 10-15 cm (3-4 real leaves) at 26/3/2015. The seedlings were planted 40 cm apart and 75 cm between lines. Cyanobacteria obtained from the laboratories of Agriculture College, University of Kufa was loaded on peat was used in three treatments (control, seeds inoculated for two hours before planting, applied to soil at a depth of 5 cm from the place of planting the seedlings).

Complete randomized design (CRD) with 15 treatments and three replications. Each experiment unit included 10 plants. The means were compared according to the least significant difference ($LSD_{0.05}$), (Sahuki and Wahib, 1990). The following characteristics were studied:

Fruit qualitative

1. Total soluble solids T.S.S. : Measured by refractometer.

2. Acidity: according to Ranganna (1977).

3 - Vitamin C: according to Ranganna (1977).

Carotene and Lycopene content according to Sharma and Lemaguer (1996), estimated in mg/100 g fresh weight.

Production qualities included:

1. Number of fruits.cluster⁻¹.

2. Fruit weight (g)

3. Total yield t.ha⁻¹.

RESULTS AND DISCUSSION

Table 1 showed that Marwa, Sun Seed and Red Clud gave the highest number of fruits per cluster, reached to 5.90, 5.42 and 5.06 fruits, respectively.

Seed inoculated gave the highest number of fruits per cluster (5.46 fruits) compared to control treatment, which gave the lowest average of 4.07 fruits.

The seed inoculated of Marwa cultivar gave higher fruits per cluster (6.89 fruits), while the control treatment of Jinan cultivar gave the lowest mean of 3.36 fruits.

Table 2 shows that the cultivars Royal Sluis, Red Clud, Sun Seed and Marwa were superior in fruit weight reached to 132.5, 129.7, 128.16 and 124.86 g respectively

compared to Jinan cultivar which gave the lowest weight (114.05 g). Seed inoculated treatment gave the highest average of 150.4 g compared to control treatment (108.6 g).

Seed inoculated treatment of Marwa cultivar was superior to 153.2 g while control treatment of Jinan cultivar gave lowest average of 80.66 g.

Table 3 showed that Marwa, Red Clud and Sun Seed gave the highest yield of 15.52, 14.26, 14.32 and 13.42 t.donum⁻¹ respectively, while Jinan gave the lowest average of 11.66 tons.Dunem⁻¹.

Seed inoculated treatment gave the highest yield of 15.72 tons compared to control treatment, which gave the lowest yield of 11.90 tons. Seed inoculated treatment of Marwa gave the highest yield of 18.60 tons.Dunm⁻¹, while control treatment of Jinan cultivar gave the lowest yield of 8.13 tons.

Table 4 showed that Marwa cultivar was superior in TSS reached to 5.01%, while Jinan gave the lowest percentage of 4.49%

Seed inoculated treatment gave the highest percentage of 5.46% compared to control treatment, which gave the lowest percentage of 3.57%. Seed inoculated treatment of Marwa was superior (5.62%), while control treatment of Jinan cultivar gave the lowest average of 3.22%.

Table 5 showed that Marwa and Sun Seed were superior in acidity, reached to 0.40 and 0.35% respectively, while Jinan gave an average of 0.28%.

Seed inoculated treatment gave the highest percentage of 0.41% compared to control treatment,

Table 1 : Effect of biofertilizer and varieties on fruits number.cluster⁻¹.

Cultivars Bio-fer	Sun seed	Marwa	Red clud	Jinan	Royal sluis	Mean
Control	4.05	4.68	4.62	3.36	3.66	4.07
Seed inoculated	6.35	6.89	5.36	3.64	5.11	5.46
Added to soil	5.34	6.15	5.22	3.37	4.78	4.97
Mean	5.42	5.90	5.06	3.45	4.51	
LSD _{0.05}	Var: 1.23 interaction: 1.56					0.94

Table 2 : Effect of Biofertilizer and varieties on fruit weight.

Cultivars Bio-fer	Sun seed	Marwa	Red clud	Jinan	Royal sluis	Mean
Control	91.00	92.3	101.6	80.66	103.6	108.6
Seed inoculated	149.6	153.2	150.3	147.6	151.3	150.4
Added to soil	134.6	139.0	137.2	113.9	142.6	133.46
Mean	124.86	128.16	129.7	114.05	132.5	
LSD _{0.05}	Var: 18.40 interaction: 23.14					10.11

Table 3 : Effect of Biofertilizer and varieties on fruit yield t.donum⁻¹.

Cultivars Bio-fer	Sun seed	Marwa	Red clud	Jinan	Royal sluis	Mean
Control	12.66	13.15	12.92	8.13	12.68	11.90
Seed inoculated	13.85	18.60	15.93	13.56	16.68	15.72
Added to soil	13.75	14.81	13.86	13.29	13.43	13.82
Mean	13.42	15.52	14.32	11.66	14.26	
LSD _{0.05}	Var: 2.26 interaction: 2.75					1.53

Table 4 : Effect of Biofertilizer and varieties on TSS%.

Cultivars Bio-fer	Sun seed	Marwa	Red clud	Jinan	Royal sluis	Mean
Control	3.33	4.28	3.78	3.22	3.26	3.57
Seed inoculated	5.36	5.62	5.47	5.42	5.45	5.46
Added to soil	5.27	5.42	5.25	4.84	5.28	5.21
Mean	4.65	5.01	4.83	4.49	4.66	
LSD _{0.05}	Var:0.25 interaction: 0.29					0.19

Table 5 : Effect of Biofertilizer and varieties on acidity%.

Cultivars Bio-fer	Sun seed	Marwa	Red clud	Jinan	Royal sluis	Mean
Control	0.27	0.29	0.26	0.20	0.28	0.26
Seed inoculated	0.42	0.46	0.42	0.34	0.44	0.41
Added to soil	0.37	0.45	0.32	0.30	0.31	0.35
Mean	0.35	0.40	0.33	0.28	0.34	
LSD _{0.05}	Var:0.6interaction: 0.81					0.19

which gave the lowest percentage of 0.26%. Seed inoculated treatment of Marwa was superior (0.46%), while control treatment of Jinan cultivar gave the lowest average of 0.20%.

Table 6 showed that cultivars had no significant effect on fruit content of vit. C.

Seed inoculated treatment gave the highest percentage of 11.27% compared to control treatment, which gave the lowest percentage of 10.19%. Seed inoculated treatment of Marwa was superior (11.94%), while control treatment of Jinan cultivar gave the lowest average of 10.05%.

Table 7 showed that Marwa, Sun Seed and Royal Sluis were superior in carotene reached to 4.16, 4.04 and 4.00% respectively, while Jinan gave an average of 3.61%.

Seed inoculated treatment and soil treatment gave the highest percentage of 4.42% and 2.97% compared to control treatment, which gave the lowest percentage of 4.52%. Seed inoculated treatment of Marwa was superior (3.02%), while control treatment of Jinan cultivar gave the lowest average of %.

Table 8 showed that cultivars had no significant effect on fruit content of lycopin.

Biofertilizer treatment had no significant effect. Seed inoculated treatment of Marwa was superior (2.47%), while control treatment of Jinan cultivar gave the lowest average of 2.18%.

The difference of cultivars in quantitative and qualitative characteristics may be due to the genetic differences that distinguish each species from the other, and this was agreed with Hassoon and others (2018) and Hussain and Hassoon (2018)

The increases of yield quantity and quantity by addition of bacterial vaccine may be due to the ability of bacteria to synthesize of cytokinin and IAA. This helps to increase the leaves chlorophyll content and thus reflected on increasing yield quality and quantity, helps to enhance plant immune side and increase plant strength through increasing plant resistance to diseases and fungi by their effect on enzymes. It also activates the physiological events such as cell division and size by influencing on some growth regulators such as auxin, as well as its role in stabilizing nitrogen for vital processes such as photosynthesis, which increases the content of

Table 6 : Effect of Biofertilizer and varieties on vit. C%.

Cultivars Bio-fer	Sun seed	Marwa	Red clud	Jinan	Royal sluis	Mean
Control	10.28	10.14	10.32	10.05	10.17	10.19
Seed inoculated	11.16	11.94	11.72	10.51	11.05	11.27
Added to soil	11.02	11.14	11.09	10.90	10.88	11.00
Mean	10.82	11.07	11.04	10.04	10.70	
LSD _{0.05}	Var:n.sinteraction: 1.45					1.02

Table 7 : Effect of Biofertilizer and varieties on carotene%.

Cultivars Bio-fer	Sun seed	Marwa	Red clud	Jinan	Royal sluis	Mean
Control	3.23	3.36	3.17	3.02	3.09	2.97
Seed inoculated	4.47	4.61	4.32	4.06	4.52	4.39
Added to soil	4.42	4.51	4.11	3.76	4.41	4.42
Mean	4.04	4.16	3.86	3.61	4.00	
LSD _{0.05}	Var: 0.98interaction: 1.03					0.66

Table 8 : Effect of Biofertilizer and varieties on lycopin%.

Cultivars Bio-fer	Sun seed	Marwa	Red clud	Jinan	Royal sluis	Mean
Control	2.15	2.22	2.27	2.11	2.19	2.18
Seed inoculated	2.74	2.78	2.68	2.25	2.74	2.63
Added to soil	2.36	2.42	2.44	2.19	2.40	2.36
Mean	2.41	2.47	2.46	2.18	2.44	
LSD _{0.05}	Var: 0.98interaction: 1.03					N.S.

processed carbohydrates and thus increase vegetative growth (Kulik, 1995). This results are agreed with Ali *et al* (2012).

CONCLUSION

From the results, we can conclude that cultivar and bio fertilizer had a positive effect in increasing qualitative and quantitative tomato yield.

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