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Effect of inorganic and bio-fertilizers on fruit quality of tomato

R.P. Gajbhiye*, R.R. Sharma, R.N. Tewari and A.K. Sureja**
Division of Vegetable Science, Indian Agricultural Research Institute, New Delhi 110 012

ABSTRACT

The effects of biofertilizers (*Azotobacter* and *Phosphobacterium*) and inorganic fertilizers (150:60:60 kg NPK/ha) on the fruit quality of 10 tomato cultivars (Booster, Chiku, West Virginia, Pusa Gaurav, WIR-3900, Pusa Ruby, Campbell-28, P-120, Pusa Sheetal and DT-10) were studied. Application of *Azotobacter* registered highest locule number per fruit, lycopene content and vitamin-C content while, *Phosphobacterium* treatment recorded maximum pericarp thickness, total soluble solids and specific gravity. Highest total soluble solids and vitamin-C content in fruit was noted when half RD of NP and full RD of K were applied, which was statistically significant over the application of full RD of NPK. Application of recommended dose of NPK noted maximum number of locules per fruit, pericarp thickness, lycopene content and specific gravity. This might be due to better nutrient translocation to the developing fruit. The quality parameters like pericarp thickness was significantly higher with the treatment combination of full RD of NPK and *Phosphobacterium* whereas, application of half RD of NP and full RD of K along with *Azotobacter* registered highest value for total soluble solids, vitamin-C content and lycopene content.

Key words: Tomato, biofertilizer, quality, *Azotobacter*, *Phosphobacterium*.

INTRODUCTION

Tomato (*Solanum lycopersicon* L.) is one of the most important and widely consumed vegetable crops grown worldwide. In recent years, its production has increased because of adoption of high yielding varieties and high input of chemical fertilizers. Tomato being heavy feeder and exhaustive crop requires large quantities of inorganic and organic fertilizers. Excessive or indiscriminate use of nitrogenous fertilizers is not only promoting vegetative growth but also diseases and pests, and making the soil deficient of P, K and other micronutrients. Meeting the plant nutrient demand through chemical fertilizers only raises cost of cultivation and makes the system unsustainable on long term. Use of biofertilizer is helpful to sustain the production system for long term. The beneficial use of nitrogen fixing microorganisms *viz., Azotobacter* and phosphate solublizing bacteria (PSBs), as a supplementary source of plant nutrition on agricultural crops is well documented (Barakart and Gabr, 4). These non-conventional sources of fertilizers are not only cost effective but simultaneously boost up the productivity of soil and crop (Patra *et al.,* 9). Keeping in view the above scenario, an experiment was conducted to study the effect of biofertilizers on fruit quality of tomato.

**Corresponding author's E-mail: aksureja_veg@iari.res.in
*NARP (Fruits and Vegetables), Sonapur, Gadchiroli 442 605, Maharashtra

MATERIALS AND METHODS

The experiment was conducted at the Research Farm of Indian Agricultural Research Institute in two consecutive years during spring-summer season. The soil of experimental site was sandy-loam in texture and normal in reaction. Soil was low in available nitrogen, medium in available phosphorus (13.34 kg/ha) and high in available potassium (820 kg/ha). The experiment was laid out in split-split plot design with three replications. The main plot treatment comprised of ten genotypes of tomato, namely, Booster, Chiku, West Virginia, Pusa Gaurav, WIR-3900, Pusa Ruby, Campbell-28, P-120, Pusa Sheetal and DT-10. These genotypes were selected from hundred different genotypes introduced from various geographical regions. Their selection was based on economic parameters like maturity time, growth habit, shape of the fruit, number of fruits per plant and yield potential. Three levels of fertilizer application [*viz*; N_0 (no fertilizer), N_1 {1/2 recommended dose (RD) of N, P and full RD of K} and N_2 (RD of N, P, K)] constituted the sub plot treatment. The recommended dose (RD) of NPK for tomato was followed as 150 kg N ha^{-1}, 60 kg P_2O_5 ha^{-1} and 60 kg K_2O ha^{-1} as recommended by Indian Institute of Vegetable Research, Varanasi. The sub-sub plots contained three levels of biofertilizer treatments e.g. B_0 (no biofertilizer), B_1 (*Azotobacter*) and B_2 (*Phosphobacterium*). Roots of seedlings were dipped in the slurry of respective biofertilizer treatment for 30 minutes before transplanting.

RESULTS AND DISCUSSION

Pusa Sheetal recorded maximum locule number (5.07 and 4.96) per fruit. Pericarp thickness was found to be significantly higher in the variety Chiku (0.58 mm during first year and 0.56 mm during second year). However, highest total soluble solids (5.36 and 5.32 ^{0}Brix), vitamin-C content (18.29 and 17.54 mg /100g) and acidity (0.46 and 0.46g/100ml) were obtained in the variety West Virgina which was significantly superior compared to other genotypes during both the years (Table 1). DT-10 was found to be excellent for lycopene content (1.61 and 1.59mg/100g) and specific gravity (1.03 and 1.00).

Nitrogen and phosphorus nutrition played a significant role in modifying the various characters related to quality attributes of tomato. Maximum locule number per fruit (3.34 and 3.26), pericarp thickness (0.39 and 0.37 mm), lycopene content (1.54 and 1.52 mg/100g) and specific gravity (1.04 and 1.01) were obtained when full recommended dose (RD) of NPK was applied during both the years. This might be due to better nutrient translocation to the developing fruit. Highest total soluble solids (5.14 and 5.10 ^{0}Brix) and vitamin-C content (18.39 and 17.26 mg/100g) was obtained when half RD of N and P and full RD of K was applied. This was statistically significant over control, but on par with recommended dose of NPK in two years of experimentation. Similar observations were recorded by Aliyu and Yusuf (1).

Application of *Azotobacter* being on a par with *Phosphobacterium* recorded maximum locule number per fruit (3.36 and 3.28), vitamin-C content (17.74 and 16.98 mg/100g) and lycopene content (1.47 and 1.46 mg/100g), and the values were significantly higher than no biofertllizer treatment. Maximum pericarp thickness (0.38 and 0.37 mm) and specific gravity (1.02 and 0.99) were recorded by the inoculation of *Phosphobacterium*, which was significantly higher over without biofertilizer inoculation. The possible reasons for increase in these quality parameters might be attributed to better inorganic nitrogen utilization in the presence of biofertilizer, enhanced biological nitrogen fixation, better development of root system and possible synthesis of plant growth hormones. These findings are in consonance with those of Mehrotra and Lehri (7), Pandey and Kumar (8), Martinez *et al*. (6) and Antipchuk *et al*. (2).

The interaction effect of biofertilizers and chemical fertilizers was found to be significant with respect to the locule number per fruit, pericarp thickness, vitamin-C content, lycopene content and specific gravity. The highest pericarp thickness (0.40 and 0.39 mm) was noted when full RD of NPK was applied along with *Phosphobacterium* during both the years (Table 2). Application of full RD of NPK recorded the highest locule number per fruit (3.48 and 3.42 during first year and second year, respectively). The higher values of vitamin-C content (20.29 and 19.19 mg/100g) and lycopene content (1.68 and 1.68 mg /100g) were recorded when *Azotobacter* was applied with half RD of NP and full RD of K during both the years of study. *Azotobacter* with full RD of NPK noted maximum specific gravity (1.05 and 1.03) which was statistically higher than all other treatment combinations except B_0N_1, B_0N_2, B_1N_1 and B_2N_2 to which it was statistically on par. This might be because of dominance of native as well as introduced biofertilizers and their combination with macronutrients which improved the nutrient uptake. Similar results were obtained by Kotur *et al.* (5) and Thilakavathy and Ramaswamy (10). Bahadur *et al*. (3) reported significantly higher ascorbic acid content in pods of garden pea when seeds were inoculated with either *Rhizobium* or *Azotobacter* or with phosphate solubilizers.

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Table 1. Effect of bio-fertilizers on fruit quality parameters of tomato.

	Locule No. per fruit		Pericarp thickness (mm)		TSS (^{0}Brix)		Vitamin C content (mg/100g)		Lycopene content (mg/100g)		Acidity (g/100 ml)		Specific gravity	
	First year	Second year	First year	Second year	First year	Second year	First year	Second year	First year	Second year	First year	Second year	First year	Second year
Variety														
Booster	2.30	2.25	0.30	0.29	5.07	5.03	15.87	15.21	1.31	1.29	0.43	0.43	0.97	0.94
Chiku	2.27	2.22	0.58	0.56	5.03	4.10	15.99	15.32	1.40	1.38	0.44	0.43	0.99	0.96
West Virginia	2.47	2.41	0.20	0.19	5.36	5.32	18.29	17.54	1.43	1.41	0.46	0.46	0.81	0.78
Pusa Gaurav	2.38	2.32	0.40	0.39	5.08	5.04	18.17	17.41	1.29	1.28	0.43	0.43	0.95	0.92
WIR-3900	2.38	2.33	0.47	0.46	4.73	4.69	16.62	15.93	1.38	1.36	0.43	0.43	1.00	0.97
Pusa Ruby	4.42	4.32	0.33	0.32	4.82	4.79	16.74	16.04	1.38	1.36	0.44	0.43	1.00	0.98
Campbell-28	3.94	3.85	0.41	0.39	4.82	4.79	16.44	15.75	1.37	1.35	0.45	0.44	0.99	0.97
Pusa 120	4.34	4.24	0.36	0.35	4.75	4.71	16.92	16.22	1.44	1.42	0.44	0.43	0.99	0.97
Pusa Sheetal	5.07	4.96	0.31	0.30	4.94	4.90	16.61	13.10	1.43	1.41	0.44	0.44	0.99	0.97
DT-10	3.39	3.31	0.44	0.43	4.78	4.75	18.09	17.34	1.61	1.59	0.39	0.38	1.03	1.00
CD 5%	0.28	0.28	0.02	0.02	0.24	0.21	0.93	0.80	0.06	0.06	0.02	NS	0.04	0.04
Biofertilizer														
B_0	3.25	3.17	0.38	0.37	4.90	4.86	15.99	13.33	1.31	1.29	0.44	0.43	0.91	0.88
B_1	3.36	3.28	0.37	0.36	4.94	4.90	17.74	16.98	1.47	1.46	0.44	0.43	0.99	0.96
B_2	3.29	3.21	0.38	0.37	4.97	4.94	16.59	15.92	1.43	1.41	0.43	0.43	1.02	0.99
CD 5%	0.09	0.09	0.01	0.01	NS	NS	0.46	0.40	0.03	0.03	NS	NS	0.02	0.02
Fertilizer														
N_0	3.22	3.15	0.37	0.36	4.87	4.84	15.08	14.45	1.14	1.13	0.46	0.45	0.86	0.83
N_1	3.33	3.25	0.38	0.37	5.14	5.10	18.39	17.62	1.53	1.51	0.43	0.42	1.02	0.99
N_2	3.34	3.26	0.39	0.37	4.81	4.77	16.85	16.15	1.54	1.52	0.42	0.42	1.04	1.01
CD 5%	0.15	0.15	0.01	0.01	0.13	0.11	0.51	0.44	0.03	0.03	0.01	0.01	0.02	0.02

NS: Non-significant

Table 2. Interaction effect of biofertilizers and inorganic fertilizers on different fruit quality parameters of tomato.

	Locule No. per fruit		Pericarp thickness (mm)		TSS (^{0}Brix)		Vitamin C content (mg/100g)		Lycopene content (mg/100g)		Acidity (g/100 ml)		Specific gravity	
	First year	Second year	First year	Second year	First year	Second year	First year	Second year	First year	Second year	First year	Second year	First year	Second year
B x N Interaction														
B_0N_0	3.07	2.97	0.38	0.36	4.84	4.82	14.91	14.10	1.09	1.08	0.46	0.46	0.67	0.65
B_0N_1	3.19	3.12	0.39	0.38	5.09	5.03	16.66	15.89	1.38	1.36	0.44	0.42	1.01	1.00
B_0N_2	3.48	3.42	0.38	0.36	4.77	4.75	16.40	15.10	1.46	1.42	0.42	0.41	1.04	1.00
B_1N_0	3.31	3.26	0.36	0.35	4.81	4.78	15.11	14.74	1.14	1.11	0.46	0.45	0.91	0.87
B_1N_1	3.47	3.36	0.38	0.37	5.21	5.18	20.29	19.19	1.68	1.68	0.43	0.43	1.01	0.98
B_1N_2	3.28	3.21	0.38	0.37	4.80	4.74	17.82	17.01	1.60	1.58	0.42	0.41	1.05	1.03
B_2N_0	3.29	3.22	0.37	0.37	4.97	4.91	15.22	14.52	1.20	1.18	0.45	0.43	0.99	0.98
B_2N_1	3.33	3.28	0.38	0.36	5.10	5.08	18.22	17.78	1.53	1.49	0.43	0.41	1.04	1.00
B_2N_2	3.25	3.15	0.40	0.39	4.84	4.82	16.34	15.45	1.57	1.57	0.42	0.42	1.04	1.00
CD 5%	0.15	0.14	0.02	0.02	NS	NS	0.80	0.69	0.05	0.05	NS	0.01	0.04	0.04

NS: Non-significant

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