Research Article

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Influence of organic amendments on growth and yield attributes in poly-house grown tomato

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ABSTRACT

The research findings indicated that diverse combinations of biodynamic, silica and *Dashparni* have remarkable influence on the growth and yield characteristics of the tomato Ajeet variety cultivated under protected conditions. From a range of treatments and combinations of treatments, treatment T_{10} (BD 500 @7 5g/ha + BD 501 @ 2.5g/ha + Silica @ 1% + *Dashparni* @10%) produced the highest plant height at 30 DAT, 60 DAT and at final harvest (44.23, 88.56 and 244.90 cm, respectively), leaf area (254.8 cm^2), minimum day to flowering (42.66) and least day to harvest (89.00%), maximum number of branches (25). The maximum fruit length of 6.66 cm, maximum fruit diameter of 5.20 cm, maximum fruit volume of 115.33 cc, maximum fruit weight of 109.26 g, number of fruits per plant (46.46), yield per plant of 5.05 kg, yield per square metre of 11.23 kg and yield per acre of 44.94 t were attained in T_{10} (BD 500 @ 75 g/ha + BD 501 @ 2.5 g/ha + Silica @ 1% + *Dashparni* @ 10%) compared to the control.

Introduction

Tomato (*Solanum lycopersicum* L.) is the most commonly and widely grown in the world, next to potato (Bertin and Genard, 2018). It has the chromosomal number 2n=24 and belongs to the family Solanaceae, which embraces more than 3000 species, including significant food, spice and drug plants. It was domesticated from a wild ancestor of *Lycopersion esculentum* sub. species *cerasifoeme* in the Andean area of South America and in Mexico (Bai and Lindhout, 2007) and the tomato originated in Peru in South America while the name of the crop came from the Aztec word "tomato." It contains a significant amount of lycopene, minerals, essential amino acids, sugars, dietary fibres, vitamin B and C, iron and phosphorus (Agarwal and Rao, 2000); hence, due to its nutritive properties tomato is also known as a protective food. From Europe, the Portuguese introduced the tomato crop to India in the 17th century.

Production of vegetables under protected conditions involves protection of various stages of vegetables mainly from adverse environmental conditions such as temperature, high rainfall, hail storms, scorching sun light etc. In greenhouses, the management of soil fertility is of utmost importance for optimizing crop nutrition on both a short-term and a long-term basis to achieve sustainable crop production. It is related to the greenhouse climate and the complex interaction involving the many factors contributing to the biological, chemical and physical properties of the soil. Biological factors

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can be beneficial (microbial population, mycorrhizal fungi, Rhizobium bacteria) and physical properties importance for greenhouse production is soil texture and structures the soil volume that can be explored by the roots, and its water-holding capacity. Chemical factors contributing to soil fertility include nutrient status and soil organic matter, soil pH and cation exchange capacity.

The organic amendments, such as biodynamic, *Dashparni* and silicon were applied to enhance soil structure, boost fertility and act as natural pesticides and resisting both biotic and abiotic stresses. BD-500 is made by burying cow horns filled with cow dung for six months during autumn and winter in the soil. Those prepared using indigenous cow dung in indigenous cow horn are more effective. BD-500 promotes soil texture, earthworm activity, porosity, and activity of humus forming bacteria, crumb structure, nodulation and root penetration. It has been noticed that regular applications over the years provide fourfold increase in moisture-absorbing capacity that extended down the humus depth up to about 30 cm, at four-leaf stage and again at the flowering or fruit maturation stage.

BD-501 is made by filling the horns with 'mealy' silica powder and burying them in the soil during spring (March/ April) at a time when BD-500 is taken out. The preparation gets ready for use within 6 months. This aids in fungal control, nutrition, and ripening, keeping quality and drought resistance. However, by itself it can cause reduction in fruit size and burning when the weather is very dry. It is used where an extra burst of ripening is needed in the autumn or in dull seasons. Silicon is the second most abundant element in the earth's crust (Debona *et al*., 2017). Although it is not considered as an essential element for higher plants, it is beneficial for plants, especially when they are subjected to environmental stresses (Al-Aghabary *et al*., 2005; Sanglard *et al*., 2014; Adrees *et al*., 2015; Kleiber *et al*., 2015 and Debona *et al*., 2017). *Dashparni* is a natural pesticide and pest repellent which can be used on any crop, vegetable plants or fruit trees. It is made with extract of 10 leaves and Desi cow's urine. Best against insects like a mealybug, aphids, whiteflies, thrips etc.

Material and Methods

An experiment was conducted at Hi-Tech Unit, Department of Horticulture, Rajasthan College of Agriculture, MPUAT, Udaipur during June-December, 2023 to assess the influence of organic amendments on tomato [*Solanum lycopersicum* L. (Mill.)] under polyhouse condition. The ten treatments applied with three replication under completely randomized design. The treatments consisted of T_1- control, T_2- BD 500 (75g/ha), T_3- BD 501 (2.5g/ha), T_4- BD 500 (75g/ha) + BD 501 (2.5g/ha), T_5- Silica (1%), T_6- *Dashparni* (10%), T_7- Silica (1%) + *Dashparni* (10%), T_8- BD 500 (75g/ha) + Silica (1%) + *Dashparni* (10%), T_9- BD 501 (2.5g/ha) + Silica (1%) + *Dashparni* (10%), T_{10}- BD 500 (75g/ha) + BD 501 (2.5g/ha) + Silica (1%) + *Dashparni* (10%). The raised beds of 1 meter width having 1.5 ft above from ground level along with length of polyhouse were prepared the plot size was 5 m x 1 m and spacing was followed 60 cm x 45 cm. All the cultural practices including irrigation and hoeing were carried out as per the standard commercial procedures. Plants were vertically trained with nylon ropes. Observation regarding plant height at 30 DAT, 60 DAT, final harvest (cm), leaf area (cm^2), days to first anthesis, days to first harvest, fruit weight (g), fruit volume (cc), fruit length (cm), fruit diameter (cm), number of branches (at final harvest), number of fruits per plant, yield per plant (kg), yield per square meter (kg) and yield per acre (t) were recorded on selected five tagged plants of each treatment and further analysed.

The plant height was measured at 30, 60 DAT and at final harvest from the base of stem to the highest tip of the plant with the help of measuring tape and mean value was expressed in centimeter. Leaf area was measured at full maturity stage with the help of leaf area meter and then means value was expressed in cm^2. The number of days taken for anthesis and number of days taken to first picking from the date of transplanting in each tagged plant and average value was expressed in days. Total number of branches of the individual plants was counted at the time of final harvest. Fruits were harvested when they attend horticulture maturity. Number of marketable fruits were counted at each picking and summed for all the picking. Five marketable fruits were randomly selected from each replication during the picking and weight of individual fruit was measured in grams with the help of digital balance and average was computed. Fruit length was measured with the help of meter scale, fruit diameter was measured with the help of vernier caliper from the center of each fruit and average value was expressed in cm. Fruit volume was measured by water displacement method and measured in cubic centimeter. Total yield per plant was derived by multiplying average number of fruits per plants by average weight of fruit and expressed in gram. Total yield per square meter area was derived from yield per plant and respective crop geometry. The yield per acre was calculated by multiplying yield per square meter with 4000 and expressed in t. In polyhouse approx. 40 per cent area is used in path, hence calculation was done including this area not only for effective area of planting i.e. approx. 60 per cent. The recorded observations were analysed statistically as per the procedure advocated by Panse and Sukhatme (1985) for drawing inferences.

Results and Discussion

The experimental results (Tables 1 and 2) indicated that various treatments impacted different growth and yield attributes. In general, as compared to control, various

treatments enhanced tomato growth and yield. The results showed that higher plant height at 30 DAT (44.23 cm), at 60 DAT (88.56 cm), at final harvest (244.90 cm), leaf area (254.83 cm^2), number of branches (25.00), number of fruits per plant (46.46), fruit weight (109.26 g), fruit volume (115.33 cc), fruit length (6.66 cm), fruit diameter (5.20 cm), yield per plant (5.05 kg), yield per square meter (11.23 kg), yield per acre (44.94 t) and minimum days to first flowering (42.66), days to first harvest (89.00) were reported for treatment T_{10} (BD 500 @75g/ha + BD 501 @2.5g/ha + Silica @1% + *Dashparni* @10%). Best performance shown by treatment T_{10} might be due to presence of biodynamic preparations, silica and *Dashparni* as constituents of this treatment combination as BD 500 causes significant internal changes in the soil, the principal changes are a significant drop in pH, an increase in aerobic status and production of nitrate causing more plant height, similarly BD 501, enhances the photosynthesis and as such compliment the activity of the preparation BD 500, which works mostly in the root zone of the plant. It also strengthens the plants against some fungus attack, further, application of BD 500 and BD 501 also activate natural manure and humus content and *Dashparni* used for control of wide range of pests such as thrips, whiteflies, leaf folder, leafhopper, *etc*. Various bio-products as pesticides in agricultural practices and concluded that *Dashparni* ark was effective and also silicon plays a significant role in imparting both biotic and abiotic stress resistance and thereby enhances the growth of vegetables. Findings of Sharma *et al.* (2011) was in conformity with the findings of present study as they reported significantly higher plant height for the treatment having BD 500 and BD 501 while working with cumin. The findings of Soundharya *et al.* (2019) showed that maximum number of fruit per plant and maximum yield per plant in tomato is also associated due to presence of silica as silicon deposited in the walls of epidermal cells after absorption by plants which contributes considerably to stem strength. These observations were shown to be similar with that of an investigation conducted by Trivedi *et al.* (2014), Dutta *et al.* (2018), Aarya *et al*. (2023) and Nandeha *et al.* (2024).

Table 1. Effect of organic amendments on growth attributes of tomato

	Treatment details	Plant height (cm)			Days to first flowering	Days to first harvest	Leaf area (cm^2)	Number of branches per plant
		30 DAT	60 DAT	at final harvest				
T_1	Control	32.40	65.83	214.73	47.70	95.23	204.00	18.40
T_2	BD 500 (75g/ha)	35.26	73.56	218.96	46.33	93.56	215.53	19.60
T_3	BD 501 (2.5g/ha)	34.43	71.86	217.60	46.00	95.80	212.06	21.13
T_4	BD 500 (75g/ha) + BD 501 (2.5g/ha)	40.40	80.43	227.26	45.26	93.73	225.80	22.03
T_5	Silica (1%)	35.13	74.26	226.93	45.46	94.73	217.00	21.93
T_6	Dashparni (10%)	34.13	71.66	227.16	47.03	94.26	208.96	22.33
T_7	Silica (1%) + Dashparni (10%)	38.40	74.80	235.33	44.63	93.83	235.70	22.76
T_8	BD 500 (75g/ ha) +Silica (1%) + Dashparni (10 %)	41.06	83.00	244.23	44.10	90.33	245.80	24.36
T_9	BD 501 (2.5g/ha) + Silica (1%) + Dashparni (10 %)	42.76	85.70	241.46	43.06	91.93	248.46	23.93
T_{10}	BD 500 (75g/ha) + BD 501 (2.5g/ha) + Silica (1%) + Dashparni (10%)	44.23	88.56	244.90	42.66	89.00	254.83	25.00
	SEm±	0.700	0.841	2.022	0.726	0.727	2.305	0.907
	C.D. (P=0.05)	2.081	2.498	6.007	2.156	2.158	6.846	2.694

Table 2. Effect of organic amendments on yield traits and yield of tomato

	Treatment details	Fruit length (cm)	Fruit diameter (cm)	Fruit volume (cc)	Fruit weight (g)	Number of fruits per plant	Yield/ plant (kg)	Yield/ m^2 (kg)	Yield/ acre (t)
T_1	Control	5.40	4.13	95.94	90.72	38.33	3.48	7.74	30.96
T_2	BD 500 (75g/ha)	5.73	4.36	98.35	93.58	41.06	3.85	8.57	34.28
T_3	BD 501 (2.5g/ha)	5.90	4.56	100.64	95.43	42.53	4.09	9.10	36.41
T_4	BD 500 (75g/ha) + BD 501 (2.5g/ha)	6.10	4.96	108.17	102.18	43.06	4.39	9.75	39.02
T_5	Silica (1%)	5.96	4.66	102.18	96.06	42.46	4.11	9.15	36.59
T_6	Dashparni (10 %)	6.03	4.70	100.95	95.15	44.86	4.36	9.69	38.75
T_7	Silica (1%) + Dashparni (10%)	6.20	5.13	107.38	100.33	42.00	4.33	9.63	38.55
T_8	BD 500 (75g/ ha) + Silica (1%) + Dashparni (10 %)	6.43	5.13	113.33	106.70	44.96	4.65	10.33	41.33
T_9	BD 501 (2.5g/ha) + Silica (1%) + Dashparni (10 %)	6.43	5.16	112.31	105.61	46.10	4.89	10.87	43.49
T_{10}	BD 500 (75g/ha) + BD 501 (2.5g/ha) + Silica (1%) + Dashparni (10%)	6.66	5.20	115.33	109.26	46.46	5.05	11.23	44.94
	SEm±	0.139	0.083	0.922	0.991	1.197	0.126	0.280	1.119
	C.D. (P=0.05)	0.413	0.247	2.739	2.944	3.556	0.374	0.831	3.323

Conclusion

On the basis of results obtained in present investigation it is concluded that among the different treatments used, treatment T_{10} (BD 500 @ 75g/ha + BD 501 @2.5g/ha + Silica @1% + *Dashparni* @ 10%) proved the most beneficial for most of parameters studied *viz.,* plant height (at 30 DAT, 60 DAT and final harvest), days to first flowering, days to first harvest, leaf area, number of branches, fruit length, fruit diameter, fruit volume, fruit weight, number of fruits per plant, yield per plant, yield per square meter and yield per acre of tomato grown under polyhouse conditions.

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Conflict of Interest

The authors have no conflict of interest.

Data Sharing

All relevant data are within the manuscript.

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