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# Efficacy of biofertilizers on growth and development of mango plants cv. Dashehari

**Kapil Dev Poonia, Prerak Bhatnagar, MK Sharma and J Singh**

**Abstract**
A field experiment entitled "Effect of biofertilizers on growth and development of mango plants (*Mangifera indica* L.) cv. Dashehari" was conducted during the year 2017-18, at the Fruit Instructional Farm, Department of Fruit Science, College of Horticulture and Forestry, Jhalawar. The experiment consisted of different treatments of biofertilizers (Azotobacter and PSB) and Vermicompost and was laid out in Randomized Block Design. Amongst different biofertilizers treatments application, treatment $T_9$ comprising biofertilizers (Azotobacter 50 g per plant + PSB 50 g per plant) along with 3 kg Vermicompost per plant was found significantly superior over other treatments with respect to growth and development parameters such as per cent increase in plant height, rootstock girth, scion girth, number of shoots per plant, number of nodes per shoot in mango cv. Dashehari. $T_9$ treatment has also given better results in enhancing the organic carbon percentage, available N, P and K content of soil status and was found significantly superior over other treatments. Like-wise, soil pH and electrical conductivity also reduced significantly under $T_9$ treatment over other treatments. Overall, $T_9$ treatment exhibited better plant growth and development parameters and improvement in soil health of mango cv. Dashehari plants as compared to other treatments of biofertilizers.

**Keywords:** Mango, biofertilizers, Azotobacter, PSB, vermicompost, growth and development

## Introduction
Mango (*Mangifera indica* L.) is the most important and commercially grown fruit crop in India and is considered as national fruit. It belongs to the botanical family Anacardiaceae and is native of Indo-Burma region. Mango is intimately connected with folklore and religious rites in India. It has been in cultivation for over four thousand years in Eastern India and Burma. Occurrence of numerous wild and cultivated varieties, physiological, archeological, and other literary evidences suggest the existence of several ancient names, relation to climatology and geology and abundance in the garden of Bengal and Deccan favor the indo Burma origin as hot spot of biodiversity. Mango can be grown on wide range of soil variability under different agro-climatic conditions. It can grow from alluvial soil to lateritic soil and also under other soil conditions. It grows well in soil having slightly acidic pH range beyond 7.5. Mango thrives well in tropical and sub-tropical climate. It can be grown from sea level to an altitude of about 1100 meters. The favorable temperature is 24˚C to 27˚C for growth, though it can tolerate temperature as high as 48˚C if trees are given regular irrigation. Higher temperature during fruit development and maturity gives better quality fruits. Mango grows successfully in areas with wide precipitation variability ranging from 250 mm to 2500 mm annual rainfall, high humidity. Region having bright sunny days and moderate humidity during flowering are ideal for mango growing.

India ranks first among world's mango producing countries accounting for 50 per cent of world mango production, but has a poor representation in international market. The reason of poor representation of Indian mango in the international market are poor appearance and inferior quality with poor shelf life, high infection of pest, persistence of chemical residue and occurrence of post-harvest diseases. The production through biological means may help in improving the gestation period with better framework, fruit quality, shelf life and aid in boosting export of Indian mangoes. The increasing cost of chemical fertilizers and their harmful effects on the soil health is also an important consideration for the use of organic nutrients enriched with biological organism.

Jhalawar district is blessed with natural variability of mango plants with conducive environmental condition. Therefore the present studies were undertaken in newly established orchard of mango cv. Dashehari at Fruit Instructional Farm at College of Horticulture and Forestry, Jhalawar to find out the growth and development of mango under organic input of bio-resources. The optimum development of fruit plants with the use of organic inputs is need of an hour in view of degrading soil health due to excessive use of inorganic fertilizers.

**Materials and methods**

The experimental entitled "Effects of biofertilizers on growth and development of mango plants cv. Dashehari" was conducted during the year 2017-18, at the Fruit Instructional Farm, Department of Fruit Science, College of Horticulture and Forestry, Jhalawar. The application of different biofertilizers treatments were applied during first week of October, 2017 in one year old plants. The treatments combinations were:

$T_0$ = Control, $T_1$ = RDF (100 g N + 50 g P + 100 g K)/plant
$T_2$ = Azotobacter 25 g + Vermicompost 3 kg per plant
$T_3$ = Azotobacter 50 g + Vermicompost 3 kg per plant
$T_4$ = Phosphorus Solubilizing Bacteria (PSB) 25 g + Vermicompost 3 kg per plant
$T_5$ = Phosphorus Solubilizing Bacteria (PSB) 50 g + Vermicompost 3 kg per plant
$T_6$ = Azotobacter 25 g + Phosphorus Solubilizing Bacteria (PSB) 25 g + Vermicompost 3 kg per plant
$T_7$ = Azotobacter 25 g + Phosphorus Solubilizing Bacteria (PSB) 50 g + Vermicompost 3 kg per plant
$T_8$ = Azotobacter 50 g + Phosphorus Solubilizing Bacteria (PSB) 25 g + Vermicompost 3 kg per plant
$T_9$ = Azotobacter 50 g + Phosphorus Solubilizing Bacteria (PSB) 50 g + Vermicompost 3 kg per plant

The experiment was laid down in randomized block design with three replications. Soil parameters soil pH, electrical conductivity ($dSm^{-1}$), organic carbon (%) and available NPK (kg $ha^{-1}$) were recorded at initiation of experiment and termination of experiment. Soil pH was determined by glass electrode pH meter, electrical conductivity of soil by using standard precision conductivity bridge, organic carbon content by Walkley and Black's (1934) wet digestion method, available Nitrogen (kg/ha) by using alkaline Potassium Permanganate method, available Phosphorus in soil (kg/ha) by Olsen *et al*., (1954) [9], available Potassium (kg/ha) by Flame Photometer. The data obtained during the experiment were subjected to statistical analysis using Fisher's (1950) analysis of variance technique.

The present investigations were undertaken at Fruit Instructional Farm, College of Horticulture and Forestry, Jhalawar on a newly established orchard of mango cv. Dashehari spaced at 8 × 8 meter. The total number of plants included in the experiment was 30. All the selected newly mango plants uniform in growth and vigour. All the treatments were applied in first week of October 2017. No biofertilizers application was done in $T_0$ treatment (Control), in $T_1$ treatment RDF (Recommended Dose of Fertilizers) was applied and in other treatments ($T_2$ to $T_9$ treatment) dosages were given in canopy area to individual mango plants per replication. The biofertilizers AZB and PSB were procured from Department of Soil Science, RCA, Udaipur and good quality Vermicompost was procured from Krishi Vigyan Kendra, Jhalawar. Observation on growth and development parameters such as per cent increase in plant height, rootstock girth, scion girth, number of shoots per plant and number of nodes per shoot in mango cv. Dashehari plants were recorded at monthly intervals from October 2017 to March 2018. The plant growth data observations were recorded at the end of every month (Oct.-March).

**Results and Discussion**

**Plant growth:** The observations pertaining to cumulative growth progression in plant height are given in table-1. The results presented and discussed are given as under in suitable sub headings**.**

**1. Plant height** (%) The data on percentage increment in mango cv. Dashehari plants under different biofertilizers treatments application during study period are given in table 1.The maximum percentage increase (10.78 %) of plant height during March 2019 was found in $T_9$ treatment (Azotobacter 50 g + PSB 50 g + 3 kg Vermicompost) and was found significantly high as compared to other treatments. It may be attributed to the fact that Vermicompost and microorganism (Azotobacter + PSB) consortium have their role in improving the physical conditions of the soil such as increase in organic matter as well as chemical properties of the soil such as increase in the available N, P, K content. It may also be due to proliferation in beneficial microbial community which might improved soil fertility through acceleration of various soil processes viz. decomposition, mineralization and storage/release of nutrients. The fortification of PSB @ 50g/plant perhaps enhanced availability of P to plants by making available beneficial microorganisms which helped in mineralizing organic P in soil and thereby solubilizing precipitated phosphates (Chen *et al.*, 2006) [2]. The results of present findings are in accordance with those of Kumar *et al.*, (2017) [7, 11] in guava, Singh *et al.*, (2017) [11] in mango cv. Amrapali, Sharma *et al.*, (2016) [12] in mango cv. Amrapali and P. Bhatnagar and J. Singh (2015) [1] in custard apple cv. Arka Sahan.

**2. Rootstock girth and scion girth (%)**

The data on percentage increment in rootstock girth and scion girth in mango cv. Dashehari plants under different biofertilizers treatments application during study period are presented in table 2 and table 3, respectively. The maximum percentage increase in rootstock girth (11.69 %) and scion girth (12.67 %) during March 2018 was found in $T_9$ treatment (Azotobacter 50 g + PSB 50 g + 3 kg Vermicompost) in Dashehari cultivar. This might be contributed to better nitrogen fixation in soil, production of phytohormone substances and increased uptake of nutrients particularly nitrogen and phosphorus as a result of bio-organic fertilizer application comprising Azotobacter, PSB and Vermicompost under the rhizosphere of mango plants. The better scion girth might also be attributed to high rate of nitrogen mineralization with increase in the number of roots giving the plant ability to scavenge enhanced nutrients from Azotobacter, PSB and Vermicompost added soil for growth and development. The present results are in consonance to finding of increase in rootstock girth and scion girth as reported by Kundu *et al.*, (2011) [6] in mango cv. Amrapali, V. Suneetha and Ramachandrudu (2010) [13] in oil palm, P. Bhatnagar and J. Singh (2015) [1] in custard apple cv. Arka Sahan.

**3. Number of shoots per plant (%)**

The data on percentage increment in number of shoots per plant in mango cv. Dashehari under different biofertilizers

treatments application during study period are presented in table 4. The maximum per cent increase in number of shoots per plant (68.98 %) was recorded in $T_9$ treatment (Azotobacter 50 g + PSB 50 g + 3 kg Vermicompost) in Dashehari. It might be due to enhanced uptake of nutrients under combined application of Azotobacter, PSB incorporated @ 50 g each along with Vermicompost @ 3 kg per plant which might increased the available N, P, K status of the soil. There might be increase in dry matter accumulation in Azotobacter inoculated mango plants as Azotobacter stimulates development of foliage which is triggered by fixed nitrogen and plant growth regulator like substances produced. The consortium of Azotobacter + PSB and Vermicompost in $T_9$ treatment probably enriched the soil by biological nitrogen fixation and perhaps acted as a source of energy (carbon) for its growth and development. The number of shoots/plant remained constant from November 2017 to February 2018 due to specific lowering down of temperature below 10ºC and could be accounted to decrease in plant rhizosphere activities due to reduction in regulating substances like plant growth hormones. The present results are in accordance to finding of increase in number of shoots as reported by Tripathi *et al.*, (2015) [14] in strawberry cv. Chandler.

**4. Number of nodes per shoot (%)**

The data on percentage increment in number of nodes per shoot in mango cv. Dashehari under different biofertilizers treatments application during study period are exhibited in table 5.The maximum per cent increase in number of nodes per shoot (41.65 %) was recorded in $T_7$ (Azotobacter 25 g + Phosphorus Solubilizing Bacteria (PSB) 50 g + Vermicompost 3 kg) under Dashehari cultivar, it might be attributed to applied bio-organic inoculants as well as gene environment interaction. The number of nodes per shoot remained constant from November to January month during study period. It could be attributed to the slowing down of physiological metabolism concurrent with the reduction of temperature and also may be due to bud differentiation process in mango plants during this period.

**5. Soil parameters**

The main objective of biofertilizers along with Vermicompost application is to maintain the soil quality as well as promoting the plant growth and development without depleting natural resources. The data on soil physico-chemical properties in mango cv. Dashehari orchard soils are presented in table 5. An insight into soil health parameters revealed reduction in soil pH and EC under T9 treatment application as compared to other treatments and improvement of soil fertility status especially available N (341.87 kg $ha^{-1}$), P (24.92 kg $ha^{-1}$) and K (362.81 kg $ha^{-1}$) status of mango cv. Dashehari orchard soil at the end of research experimentation (March 2018).

The decrease in soil pH (7.51) and electrical conductivity (EC) (0.35 $dSm^{-1}$) under $T_9$ treatment (Azotobacter 50g + PSB 50g + 3 kg Vermicompost) in Dashehari cultivar could be attributed to improved mobilization of nutrients from bound or unavailable fractions in soil as a result of synergistic effect of biofertilizers (Azotobacter + PSB) along with Vermicompost application and similar findings were reported by Dutta *et al.*, (2016) in mango cv. Himsagar, P. Dutta and similar findings were reported by S. Kundu (2012) [4] in mango cv. Himsagar, Singh *et al.*, (2017) [11] in mango cv. Amrapali. The availability of soil organic carbon percentage (0.75 %) was found maximum in $T_9$ treatment.

The better available soil nitrogen content (341.87 kg/ha) was found in $T_9$ treatment (Azotobacter 50g + PSB 50g + 3 kg Vermicompost) under mango cv. Dashehari was found significantly higher over all other treatments. The better nitrogen content under $T_9$ treatment could be attributed to nitrogen enhancement by Azotobacter along with growth promoting effect of Phosphorus Solubilizing Bacteria (PSB) and also Vermicompost as supported by findings of Singh *et al.*, (2017) [11] in mango cv. Amrapali, P. Dutta and S. Kundu (2012) [4] in mango cv. Himsagar. The higher available soil phosphorus content (24.92 kg/ha) and was recorded in $T_9$ treatment in Dashehari cultivar. The incorporation of 50 g PSB in $T_9$ treatment perhaps benefitted the plant growth and development of mango cv. Dashehari by stimulating root development, mineral uptake and plant water relationship. In vertisols, there is higher concentration of calcium and whenever phosphatic fertilizers are applied in such soils, a large quantity gets immobilized and phosphorous becomes unavailable to the crop. Phosphorus is one of the most important mineral nutrients for plant growth and development. It is second only to nitrogen for limiting the crop growth. Plants acquire P from the soil and in majority of the soil phosphorus approximately 95-99 per cent is present in the form of insoluble phosphates. As a result, the amount available to the plant is usually a very little. This necessitates the need to apply large quantity of phosphatic fertilizers. PSB plays an important role in supplementing phosphorus to plants by improving solubilization of fixed soil phosphorus and of applied phosphates, thereby enhancing plant growth and development.

**Table 1:** Effect of biofertilizers sources on per cent increase in height (cm) of mango cv. Dashehari during growth period (October 2017 to March 2018).

| Treatment | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. |
|---|---|---|---|---|---|---|
| $T_0$ | 58.30 (1.28) | 58.80 (2.05) | 59.26 (2.86) | 59.70 (3.59) | 60.16 (4.32) | 60.93 (5.38) |
| $T_1$ | 62.13 (2.42) | 62.73 (3.23) | 62.86 (3.45) | 63.40 (4.28) | 64.00 (5.14) | 65.06 (6.71) |
| $T_2$ | 76.13 (2.05) | 76.83 (3.38) | 76.93 (3.52) | 77.53 (4.26) | 78.13 (5.11) | 79.26 (6.36) |
| $T_3$ | 49.73 (2.28) | 50.33 (3.59) | 50.43 (3.69) | 51.46 (5.70) | 51.63 (5.81) | 52.16 (6.96) |
| $T_4$ | 63.13 (2.42) | 63.76 (3.28) | 64.26 (4.04) | 64.56 (4.48) | 65.06 (5.22) | 65.93 (6.46) |
| $T_5$ | 53.53 (2.26) | 54.30 (3.62) | 54.66 (4.27) | 54.90 (4.67) | 55.60 (5.87) | 56.70 (7.69) |
| $T_6$ | 53.30 (2.18) | 53.86 (3.57) | 54.33 (4.39) | 54.60 (4.83) | 54.96 (5.48) | 56.06 (7.30) |
| $T_7$ | 73.60 (2.12) | 75.10 (4.44) | 75.66 (5.16) | 76.43 (6.13) | 76.80 (6.49) | 78.03 (8.05) |
| $T_8$ | 65.83 (2.13) | 66.73 (3.73) | 67.13 (4.32) | 67.73 (5.16) | 67.96 (5.50) | 69.40 (7.45) |
| $T_9$ | 66.10 (3.67) | 66.83 (4.47) | 67.96 (6.07) | 68.20 (6.37) | 68.90 (7.35) | 71.30 (10.78) |
| SEm (±) | 0.09 | 0.09 | 0.09 | 0.13 | 0.12 | 0.17 |
| CD (5%) | 0.27 | 0.28 | 0.29 | 0.39 | 0.37 | 0.50 |

**Table 2:** Effect of biofertilizers sources on per cent increase in rootstock girth (mm) of mango cv. Dashehari during growth period (October 2017 to March 2018).

| Treatment | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. |
|---|---|---|---|---|---|---|
| $T_0$ | 9.92 (1.17) | 9.97 (1.70) | 10.06 (2.53) | 10.19 (3.74) | 10.37 (5.42) | 10.72 (8.57) |
| $T_1$ | 10.39 (1.36) | 10.52 (2.63) | 10.62 (3.60) | 10.74 (4.62) | 10.94 (6.34) | 11.32 (9.51) |
| $T_2$ | 9.67 (1.83) | 9.74 (2.49) | 9.83 (3.44) | 9.95 (4.58) | 10.11 (6.12) | 10.50 (9.60) |
| $T_3$ | 11.94 (1.75) | 12.06 (2.70) | 12.21 (3.90) | 12.34 (4.93) | 12.58 (6.73) | 13.02 (9.87) |
| $T_4$ | 9.48 (1.44) | 9.59 (2.52) | 9.67 (3.38) | 9.76 (4.26) | 9.98 (6.38) | 10.33 (9.58) |
| $T_5$ | 9.69 (1.16) | 9.82 (2.51) | 9.93 (3.55) | 10.01 (4.34) | 10.20 (6.16) | 10.58 (9.52) |
| $T_6$ | 11.21 (1.29) | 11.33 (2.31) | 11.48 (3.52) | 11.61 (4.66) | 11.88 (6.80) | 12.23 (9.49) |
| $T_7$ | 11.20 (1.78) | 11.18 (3.89) | 11.58 (4.94) | 11.69 (5.86) | 11.90 (7.55) | 12.29 (10.44) |
| $T_8$ | 10.75 (1.32) | 10.88 (2.55) | 10.98 (3.38) | 11.09 (4.34) | 11.32 (6.36) | 11.73 (9.56) |
| $T_9$ | 12.12 (1.94) | 12.5 (4.88) | 12.62 (5.82) | 12.74 (6.73) | 12.99 (8.51) | 13.45 (11.69) |
| SEm (±) | 0.08 | 0.12 | 0.16 | 0.11 | 0.16 | 0.11 |
| CD (5%) | 0.24 | 0.32 | 0.22 | 0.35 | 0.49 | 0.34 |

**Table 3:** Effect of biofertilizers sources on per cent increase in scion girth (mm) of mango cv. Dashehari during growth period (October 2017 to March 2018).

| Treatment | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. |
|---|---|---|---|---|---|---|
| $T_0$ | 7.26 (1.14) | 7.27 (1.37) | 7.36 (2.53) | 7.42 (3.28) | 7.49 (4.22) | 7.65 (6.18) |
| $T_1$ | 6.97 (1.34) | 7.03 (2.23) | 7.12 (3.50) | 7.26 (5.28) | 7.34 (6.33) | 7.59 (9.39) |
| $T_2$ | 7.40 (1.35) | 7.49 (2.51) | 7.54 (3.20) | 7.72 (5.39) | 7.80 (6.31) | 8.05 (9.23) |
| $T_3$ | 6.89 (1.66) | 6.94 (2.35) | 7.04 (3.73) | 7.18 (5.68) | 7.28 (6.86) | 7.51 (9.80) |
| $T_4$ | 7.27 (1.55) | 7.35 (2.64) | 7.40 (3.27) | 7.57 (5.45) | 7.65 (6.36) | 7.89 (9.25) |
| $T_5$ | 7.10 (1.41) | 7.17 (2.35) | 7.28 (3.74) | 7.41 (5.45) | 7.49 (6.51) | 7.73 (9.35) |
| $T_6$ | 6.71 (1.44) | 6.78 (2.53) | 6.85 (3.44) | 7.00 (5.50) | 7.08 (6.61) | 7.31 (9.52) |
| $T_7$ | 6.62 (1.63) | 6.75 (3.61) | 6.83 (4.68) | 6.98 (6.77) | 7.06 (7.72) | 7.28 (10.53) |
| $T_8$ | 6.50 (1.63) | 6.54 (2.29) | 6.63 (3.56) | 6.74 (5.23) | 6.83 (6.42) | 7.04 (9.26) |
| $T_9$ | 7.69 (1.94) | 7.90 (4.55) | 8.06 (6.46) | 8.26 (8.62) | 8.37 (9.87) | 8.64 (12.67) |
| SEm (±) | 0.07 | 0.18 | 0.12 | 0.17 | 0.16 | 0.14 |
| CD (5%) | 0.22 | 0.54 | 0.38 | 0.50 | 0.49 | 0.43 |

**Table 4:** Effect of biofertilizers sources on per cent increase in number of shoots/plant of mango cv. Dashehari during growth period (October 2017 to March 2018).

| Treatment | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. |
|---|---|---|---|---|---|---|
| $T_0$ | 1.00 (40.50) | 2.00 (45.00) | 2.00 (45.00) | 2.00 (45.00) | 2.00 (45.00) | 2.33 (48.24) |
| $T_1$ | 2.33 (41.75) | 3.33 (51.48) | 3.33 (51.48) | 3.33 (51.48) | 3.33 (51.48) | 4.33 (56.92) |
| $T_2$ | 2.00 (45.00) | 2.33 (48.24) | 2.33 (48.24) | 2.33 (48.24) | 2.33 (48.24) | 3.33 (56.48) |
| $T_3$ | 2.33 (41.75) | 4.33 (56.92) | 4.33 (56.93) | 4.33 (56.93) | 4.33 (56.93) | 5.66 (61.51) |
| T | 2.00 (45.00) | 3.00 (54.73) | 3.00 (54.73) | 3.00 (54.73) | 3.00 (54.73) | 4.00 (60.00) |
| $T_5$ | 2.33 (41.75) | 3.33 (51.48) | 3.33 (51.48) | 3.33 (51.48) | 3.33 (51.48) | 4.33 (56.92) |
| $T_6$ | 2.66 (40.00) | 3.66 (49.56) | 3.66 (49.56) | 3.66 (49.56) | 3.66 (49.56) | 5.00 (56.36) |
| $T_7$ | 2.00 (45.00) | 5.00 (63.43) | 5.00 (63.43) | 5.00 (63.43) | 5.00 (63.43) | 7.00 (67.78) |
| $T_8$ | 2.00 (45.00) | 3.00 (54.73) | 3.00 (54.73) | 3.00 (54.73) | 3.00 (54.73) | 4.00 (60.00) |
| $T_9$ | 2.33 (41.75) | 6.33 (63.16) | 7.00 (64.55) | 7.00 (64.55) | 7.00 (64.55) | 10.00 (68.98) |
| SEm (±) | 2.33 | 2.69 | 2.62 | 2.62 | 2.62 | 2.08 |
| CD (5%) | 6.94 | 8 | 7.80 | 7.80 | 7.80 | 6.20 |

*Values in parenthesis indicate Arc Sin transformed values.

**Table 5:** Effect of biofertilizers sources on per cent increase in number of nodes/shoot of mango cv. Dashehari during growth period (October 2017 to March 2018).

| Treatment | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. |
|---|---|---|---|---|---|---|
| $T_0$ | 8.66 (11.79) | 9.66 (21.06) | 9.66 (21.06) | 9.66 (21.06) | 10.66 (28.53) | 12.33 (38.05) |
| $T_1$ | 8.66 (11.79) | 9.66 (21.06) | 9.66 (21.06) | 9.66 (21.06) | 10.66 (28.53) | 12.33 (38.05) |
| $T_2$ | 8.66 (11.95) | 9.66 (21.93) | 9.66 (21.93) | 9.66 (21.93) | 10.66 (28.80 | 12.33 (38.33) |
| $T_3$ | 10.00 (10.27) | 11.00 (18.59) | 11.00 (18.59) | 11.00 (18.59) | 12.00 (25.47) | 14.00 (36.20) |
| $T_4$ | 10.00 (10.06) | 11.00 (18.28) | 11.00 (18.28) | 11.00 (18.28) | 12.00 (25.11) | 14.00 (35.83) |
| $T_5$ | 8.66 (11.66) | 9.66 (20.87) | 9.66 (20.87) | 9.66 (20.87) | 10.66 (28.33) | 12.66 (39.67) |
| $T_6$ | 9.33 (11.12) | 10.33 (19.94) | 10.33 (19.94) | 10.33 (19.94) | 11.33 (27.13) | 13.00 (36.34) |
| $T_7$ | 10.33 (9.81) | 11.66 (19.86) | 11.66 (19.86) | 11.66 (19.86) | 13.66 (31.78) | 16.00 (41.65) |
| $T_8$ | 9.00 (11.20) | 10.00 (20.13) | 10.00 (20.13) | 10.00 (20.13) | 11.00 (27.42) | 13.00 (38.61) |
| $T_9$ | 10.33 (9.81) | 12.33 (24.56) | 12.33 (24.56) | 12.33 (24.56) | 12.66 (26.31) | 14.66 (36.48) |
| SEm (±) | 1.0 | 1.75 | 1.75 | 1.75 | 1.92 | 1.70 |
| CD (5%) | N.S | 5.21 | 5.21 | 5.21 | 5.72 | 5.05 |

**Table 6:** Effect of biofertilizers sources on soil parameters of mango plants rhizosphere cv. Dashehari during end of study period (March 2018).

| Treatments | Soil parameters | | | | | |
|---|---|---|---|---|---|---|
| | pH | EC ($dSm^{-1}$) | OC (%) | Available | | |
| | | | | N ($kgha^{-1}$) | P ($kgha^{-1}$) | K ($kgha^{-1}$) |
| Initial values | 7.75 | 0.46 | 0.57 | 317.61 | 19.76 | 280.47 |
| $T_0$ | 7.60 | 0.45 | 0.59 | 318.65 | 20.83 | 281.86 |
| $T_1$ | 7.67 | 0.42 | 0.62 | 325.92 | 21.07 | 329.59 |
| $T_2$ | 7.56 | 0.41 | 0.72 | 325.46 | 20.90 | 301.91 |
| $T_3$ | 7.58 | 0.42 | 0.68 | 325.10 | 20.75 | 282.35 |
| $T_4$ | 7.65 | 0.41 | 0.70 | 329.93 | 21.24 | 329.35 |
| $T_5$ | 7.68 | 0.39 | 0.68 | 324.63 | 20.74 | 291.24 |
| $T_6$ | 7.64 | 0.38 | 0.72 | 327.04 | 20.98 | 303.16 |
| $T_7$ | 7.55 | 0.37 | 0.73 | 338.97 | 23.61 | 327.63 |
| $T_8$ | 7.56 | 0.38 | 0.70 | 334.03 | 21.86 | 356.81 |
| $T_9$ | 7.51 | 0.35 | 0.75 | 341.87 | 24.92 | 362.81 |
| SEm (±) | 0.12 | 0.01 | 0.01 | 4.35 | 1.22 | 13.65 |
| CD (5%) | N.S | 0.03 | 0.02 | 9.15 | 2.56 | 28.67 |

*Initial values of soil health parameters were recorded at the time of initiation of experiment (Oct. 2017)

## Conclusion

The plant growth parameters study of mango cv. Dashehari under application of different biofertilizers treatments revealed that application of $T_9$ treatment (Azotobacter 50 g + Phosphorus Solubilizing Bacteria (PSB) 50 g along with Vermicompost @3 kg per plant got better results in terms of increment in plant growth parameters particularly plant height, rootstock girth, scion girth, number of shoots/plant, number of nodes/shoot and improvement in soil health particularly reduction in soil pH, EC and enhancement of soil organic carbon and available N, P, K status of mango rhizosphere soil as compared to other treatments.

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