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**Original Research Article**

# Effect of Bio-fertilizers and Inorganic Fertilizers on Growth and Yield of Sapota [*Manilkara achras* (Mill.) Forseberg]. cv. Kalipatti

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**A B S T R A C T**

The experimentation entitled, "Effect of bio-fertilizers and inorganic fertilizers on growth and yield of sapota *(Manilkara achras* (Mill.) Forseberg). cv. Kalipatti" was carried out on field of Horticulture Research Scheme (Pomology), V. N. M. K. V, Parbhani, Dist-Parbhani during mrig bahar in 2014-15 with an objective to find out influence of Azospirillum and PSB alone on growth, yield and quality of sapota fruits. The experiment was laid out in factorial randomized block design with two factors i.e. bio-fertilizers and chemical fertilizers. These factors consist of four and three levels respectively, twelve treatment combination and three replications. Among the different treatment combination the treatment T10- $N_1B_3$ (100 % NPK + Azospirillum + PSB) application of Azospirillum and PSB with full dose of chemical fertilizers reported the highest plant growth in respect to days required for sprouting of new shoots(24.30), length of shoot (12.64 cm), Girth of shoots (2.06 cm), No. of leaves per shoots(9.67), leaf area (19.48 $cm^2$), number of flowers per shoot (9.67), fruit set (44.11%), number of fruits per shoot (4.24), number of fruits per tree (635.67) and yield per tree (53.33 kg) was greatly influenced by combined application of Azospirillum and PSB with 100 percent dose of chemical fertilizer and also reduced the maturity days for harvesting of fruits. In the present experiment the treatment $N_1B_3$ with application of full dose of chemical fertilizer (100% NPK) combined with Azospirillum (200g) and PSB (200g) performs well in respect of growth and yield of Sapota which followed by treatment with (75% NPK) chemical fertilizers combined with Azospirillum(200g) and PSB (200g) with maximum economical returns.

**Keywords**

Biofertilizers, Inorganic fertilizers, Growth and yield of sapota

## Introduction

Sapota (*Manilkara achras* (Mill.) Forseberg) is one of the important tropical fruit crop belonging to family sapotaceae. It is not known when sapota first introduced in India, but sapota cultivation was taken up for the first time in Maharashtra in 1898 at village Gholwad in district Thane (Chaddha, 1993). Sapota is a best source of digestible sugar which ranges from 12 to 18 percent. Composition of ripe sapota per 100 g of

edible portion is moisture 73.7 g, Carbohydrates 21.4 g, protein 0.7 g, Fat 1.1 g, Calcium 28.0 mg, Phosphorus 27.0 mg (Shanmungavelu and Shrinivasan, 1973). The biofertilizers are the live or latent cells of efficient strain of Nitrogen fixing, Phosphate solubilizing or cellulitic micro-organism used in soil or seed treatment with the objective of augment the availability and acceses nutrients to the plant. The some biofertilizer micro-organisms are either free living or symbiotic with plant and some micro-organisms are nitrogen fixing i.e Rhizobium, Azatobactor, Azospirillium and other like Phosphate solubilizing and Phosphate mobilizing i.e PSB and VAM (Phosphate solubilizing Bacteria and Vesicular Arbascular Micorrhizae) Azospirillum and PSB are the main bio-fertilizers for horticultural crops. Bio-fertilizers helps in saving 50-70% of the requirement of inorganic nitrogen per hectare (Jitendra Singh 2011).

## Materials and Methods

Experiment was conducted on twelve years old orchard of sapota cultivar "Kalipatti" located at Horticulture Research Scheme, (Pomology) Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani district. Experiment laid out in Factorial Randomized Block design with 12 treatments and 3 replication on 12 years sapota cv. Kalipatti. Treatment details and treatment combinations are given in Tables.

## Recommended dose of fertilizers

1. Recommended dose of inorganic fertilizers @ 1000:500:500 g/ tree

2. Recommended dose of Bio-fertilizers,
a. Azospirillum @ 200 g/tree. b. PSB @ 200 g/tree.

The observations were taken of growth parameters viz. Days required for sprouting of new shoots, Length of shoots (cm), girth of shoots(cm), numbers of leaves per shoot, leaf area ($cm^2$), Days to initiate of flowering from application of treatment, Number of flowers per shoots, Percentage of fruit set %, Number of fruits per shoot, Days required for fruit maturity, Numbers of fruits per tree, Yield per tree (Kg) and Yield per hectare (q).

## Results and Discussion

The days required for sprouting of new shoots were minimum in the treatment T10 - $N_1B_3$ (100 % NPK + Azospirillum+PSB) i.e. 24.30 days followed by treatment T11 ($N_2B_3$) i.e. 25.66 days. The treatment T10 ($N_1B_3$) recorded maximum length of shoot (12.64 cm). The present findings are in agreement with the Fawazi, *et. al.* (2010) in pear and Osman and Abd El-Rhman, (2010) in fig. The maximum girth of shoot in treatment T10 ($N_1B_3$) 2.06 cm, followed by T11 ($N_2B_3$) 1.88 cm. The similar result had been reported by Manjunath *et. al*. (2001) in papaya, Samanata *et. al*. (2003) in plam, Kumar *et al.,* (2014) in aonla, Kavino *et al.,* (2010) in banana, Bankar *et. al*. (2009) in kagazi lime who reported that the stem girth after 180 day shown significant results by application of azospirillum. The treatment T10 ($N_1B_3$) recorded maximum number of leaves per shoot (9.67). The results obtained are in agreement with the findings reported by Verma and Rao (2013) and Hazarika *et al.,* (2007). The treatment T10 ($N_1B_3$) recorded the maximum leaf area i.e. 19.48 $cm^2$, followed by T4 ($N_1B_1$) 19.45 cm. The present findings are in agreement with Verma and Rao (2013). Early flower initiation was found in treatment T10 ($N_1B_3$) i.e. 80.51 days, followed by T4 ($N_1B_1$) 81.08 days. These results are in conformity with the findings of Sharma *et al*.(2009). Godage

*et al.*, (2013) in guava cv. Allahabad safeda, Verma and Rao, (2013). Application of treatment T10 ($N_1B_3$) recorded more number of flowers per shoot (9.67). Sharma *et al.*(2009), Godage *et al.*, (2013) in guava cv. Allahabad safeda, Verma and Rao, (2013) in strawberry observed same result.

## Treatment details (I)

| Factor | Sr. No. | Symbol | Treatment |
|---|---|---|---|
| **Factor:1 Bio-fertilizer** | 1 | B0 | Control |
| | 2 | B1 | Soil application of Azospirillum 200 g / plant |
| | 3 | B2 | Soil application of PSB (Phosphate Solublizing bacteria ) 200 g / plant |
| | 4 | B3 | Soil application of Azospirillum and PSB. 200g / plant each |
| **Factor:2 Inorganic fertilizer** | 1 | N1 | 100% of NPK (Whole RDF i.e. 1000:500:500 g per Plant ) |
| | 2 | N2 | 75% of NPK (RDF) |
| | 3 | N3 | 50% of NPK (RDF) |

## Treatment combinations

| Sr. No. | Treatment No. | Treatment Combination | Treatment Details |
|---|---|---|---|
| 1 | $T_1$ | $N_1$ $B_0$ | (100%RDF) 1000:500:500 g NPK / Plant. |
| 2 | $T_2$ | $N_2$ $B_0$ | (75% RDF) 750:375:375 g NPK / plant. |
| 3 | $T_3$ | $N_3$ $B_0$ | (50% RDF) 500:250:250 g NPK / plant. |
| 4 | $T_4$ | $N_1$ $B_1$ | (100% RDF ) + Azospirillum 1000:500:500 g NPK + 200 g Azospirillum /Plant. |
| 5 | $T_5$ | $N_2$ $B_1$ | (75% RDF)+ Azospirillum 750:375:375 g NPK + 200 g Azospirillum / Plant. |
| 6 | $T_6$ | $N_3$ $B_1$ | (50% RDF )+Azospirillum 500:250:250 g NPK +200 g Azospirillum / Plant |
| 7 | $T_7$ | $N_1$ $B_2$ | (100%RDF)+PSB 1000:500:500 g NPK + 200 g PSB / plant. |
| 8 | $T_8$ | $N_2$ $B_2$ | (75% RDF )+PSB 750:375:375 g NPK + 200 g PSB / Plant. |
| 9 | $T_9$ | $N_3$ $B_2$ | (50% RDF)+PSB 500:250:250 g NPK +200 g PSB / Plant. |
| 10 | $T_{10}$ | $N_1$ $B_3$ | (100% RDF ) + Azospirillum + PSB 1000: 500: 500 g NPK + 200g Azospirillum+200g PSB /Plant |
| 11 | $T_{11}$ | $N_2$ $B_3$ | (75% RDF)+ Azospirillum + PSB 750:375:375 + 200g NPK Azospirillum+200g PSB / Plant. |
| 12 | $T_{12}$ | $N_3$ $B_3$ | (50% RDF)+ Azospirillum + PSB 500:250:250+ 200g NPK Azospirillum+200g PSB / Plant. |

PSB - Phosphate solubilizing bacteria

**Result tables:** Effect of bio-fertilizers and inorganic fertilizers on Days required for sprouting of new shoots, Length of shoot, Girth of shoot, Number of leaves per shoot, Leaf area, Days to initiation of flowering from application of treatment, No. of flowers per shoot, No. of fruits per shoot, Final retention of fruits per shoot, Days required for fruit maturity, No. of fruits per tree and Yield per tree and per hectare of Sapota

| Tr. No. | Factor / Treatment | Days required for sprouting of new shoots | Length of shoot (cm) | Girth of shoot (cm) | Number of leaves per shoot | Leaf area ($cm^2$) | Days to initiation of flowering from application of treatment | No. of flowers per shoot. |
|---|---|---|---|---|---|---|---|---|
| 1 | B0-control | 29.13 | 11.39 | 1.49 | 9.30 | 19.01 | 84.63 | 9.30 |
| 2 | B1-Azospirillum | 28.50 | 11.47 | 1.64 | 9.36 | 18.89 | 83.22 | 9.32 |
| 3 | B2-PSB | 28.44 | 11.63 | 1.66 | 9.37 | 18.91 | 84.00 | 9.36 |
| 4 | B3-Azospirillum +PSB | 25.43 | 12.40 | 1.86 | 9.36 | 19.09 | 82.58 | 9.37 |
| SE± | | 0.24 | 0.081 | 0.022 | 0.015 | 0.081 | 0.31 | 0.015 |
| CD at 5% | | 0.72 | 0.23 | 0.067 | 0.46 | 0.237 | 0.90 | 0.046 |
| 1 | N1-100% NPK | 26.17 | 12.34 | 1.87 | 9.60 | 19.46 | 81.12 | 9.60 |
| 2 | N2-75% NPK | 27.87 | 11.65 | 1.67 | 9.56 | 18.94 | 84.14 | 9.56 |
| 3 | N3-50 NPK | 29.58 | 11.18 | 1.45 | 8.88 | 18.53 | 85.45 | 8.88 |
| SE± | | 0.21 | 0.07 | 0.01 | 0.013 | 0.07 | 0.26 | 0.013 |
| CD at 5% | | 0.62 | 0.20 | 0.058 | 0.040 | 0.20 | 0.78 | 0.040 |
| **Interaction Effect** | | | | | | | | |
| T1 | N1B0- 100% NPK | 26.08 | 12.16 | 1.71 | 9.56 | 19.40 | 81.16 | 9.56 |
| T2 | N2B0- 75% NPK | 30.00 | 11.34 | 1.49 | 9.51 | 18.04 | 85.17 | 9.51 |
| T3 | N3B0- 50% NPK | 31.33 | 10.68 | 1.27 | 8.85 | 18.50 | 87.58 | 8.85 |
| T4 | N1B1- 100% NPK+ Azospirillum | 26.91 | 12.31 | 1.87 | 9.59 | 19.45 | 81.08 | 9.59 |
| T5 | N2B1- 75 % NPK+ Azospirillum | 28.16 | 11.34 | 1.64 | 9.62 | 18.87 | 83.58 | 9.61 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| T6 | N3B1- 50% NPK+ Azospirillum | 30.41 | 10.76 | 1.40 | 8.88 | 18.51 | 85.00 | 8.88 |
| T7 | N1B2- 100% NPK+PSB | 27.21 | 12.25 | 1.84 | 9.60 | 19.21 | 81.75 | 9.60 |
| T8 | N2B2- 75% NPK+PSB | 27.66 | 11.47 | 1.67 | 9.62 | 19.02 | 84.91 | 9.62 |
| T9 | N3B2- 50% NPK +PSB | 30.25 | 11.18 | 1.48 | 8.88 | 18.51 | 85.33 | 8.88 |
| T10 | N1B3- 100%NPK +Azospirillum +PSB | 24.30 | 12.64 | 2.06 | 9.67 | 19.48 | 80.51 | 9.67 |
| T11 | N2B3- 75%+NPK+ Azospirillum +PSB | 25.66 | 12.45 | 1.88 | 9.49 | 19.19 | 82.91 | 9.49 |
| T12 | N3B3- 50%NPK + Azospirillum+PSB | 26.33 | 12.10 | 1.64 | 8.92 | 18.61 | 83.91 | 8.92 |
| SE+ | | 0.42 | 0.14 | 0.039 | 0.027 | 0.14 | 0.53 | 0.027 |
| CD at 5% | | 1.24 | 0.41 | 0.116 | 0.080 | 0.41 | 1.57 | 0.080 |

**Conti...**

| Tr. No. | Factor / Treatment | Fruit set (%) | No. of fruits per shoot | Final retention of fruits per shoot | Days required for fruit maturity | No. of fruits per tree | Yield per tree (kg) | Yield per ha (q) |
|---|---|---|---|---|---|---|---|---|
| 1 | B0-control | 39.34 | 3.70 | 12.85 | 251.00 | 532.44 | 39.83 | 43.17 |
| 2 | B1-Azospirillum | 41.06 | 3.81 | 13.84 | 250.67 | 563.33 | 46.25 | 46.25 |
| 3 | B2-PSB | 41.19 | 3.82 | 13.44 | 250.44 | 595.11 | 47.76 | 47.20 |
| 4 | B3-Azospirillum +PSB | 41.68 | 4.10 | 14.14 | 250.12 | 615.34 | 51.01 | 51.01 |
| SE+ | | 0.20 | 0.020 | 0.16 | 0.31 | 9.87 | 1.69 | 0.33 |
| CD at 5% | | 0.61 | 0.061 | 0.49 | NS | 28.91 | 4.90 | 0.97 |
| 1 | N1-100% NPK | 43.21 | 4.15 | 14.26 | 248.92 | 592.33 | 47.29 | 48.55 |
| 2 | N2-75% NPK | 40.85 | 3.92 | 13.20 | 250.58 | 572.75 | 46.47 | 47.29 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 3 | N3-50 NPK | 38.39 | 3.52 | 13.25 | 252.25 | 564.58 | 44.87 | 44.87 |
| SE± | | 0.18 | 0.018 | 0.14 | 0.27 | 8.54 | 1.45 | 0.28 |
| CD at 5% | | 0.53 | 0.053 | 0.42 | 0.80 | 25.03 | NS | 0.84 |
| **Interaction Effect** | | | | | | | | |
| T1 | N1B0- 100% NPK | 42.23 | 4.03 | 12.97 | 249.67 | 540.67 | 44.11 | 44.11 |
| T2 | N2B0- 75% NPK | 38.94 | 3.79 | 12.68 | 250.67 | 532.67 | 43.62 | 43.62 |
| T3 | N3B0- 50% NPK | 36.84 | 3.28 | 12.90 | 252.67 | 524.00 | 41.77 | 41.77 |
| T4 | N1B1- 100% NPK+ Azospirillum | 43.24 | 4.13 | 13.95 | 249.33 | 580.33 | 48.53 | 48.53 |
| T5 | N2B1- 75 % NPK+ Azospirillum | 41.36 | 3.84 | 13.80 | 250.33 | 558.33 | 45.85 | 45.85 |
| T6 | N3B1- 50% NPK+ Azospirillum | 38.59 | 3.47 | 13.78 | 252.33 | 551.33 | 44.36 | 44.36 |
| T7 | N1B2- 100% NPK+PSB | 43.27 | 4.16 | 13.81 | 248.67 | 602.67 | 48.55 | 48.55 |
| T8 | N2B2- 75% NPK+PSB | 41.51 | 3.85 | 13.03 | 250.67 | 591.34 | 47.77 | 47.77 |
| T9 | N3B2- 50% NPK +PSB | 38.78 | 3.47 | 13.47 | 252.00 | 581.32 | 45.28 | 45.28 |
| T10 | N1B3- 100%NPK +Azospirillum +PSB | 44.11 | 4.24 | 16.30 | 248.00 | 635.67 | 53.33 | 53.33 |
| T11 | N2B3- 75%+NPK+ Azospirillum +PSB | 41.58 | 4.20 | 13.29 | 250.67 | 608.74 | 51.92 | 51.92 |
| T12 | N3B3- 50%NPK + Azospirillum+PSB | 39.36 | 3.87 | 12.85 | 252.00 | 601.60 | 48.09 | 48.09 |
| SE± | | 0.36 | 0.036 | 0.29 | 0.54 | 17.09 | 2.90 | 0.57 |
| CD at 5% | | 1.06 | 0.106 | 0.85 | 1.60 | 50.07 | 8.70 | 1.68 |

The treatment T10 ($N_1B_3$) increased fruit set (44.11%), while in treatment T3 ($N_3B_0$) recorded minimum fruit set (36.84%). The similar result also found by Singh and Singh (2009) in strawberry, Gogai *et al.*, (2004) in banana.The treatment T10 ($N_1B_3$) recorded maximum number of fruits per shoot 4.24, followed by T11 ($N_2B_3$) 4.20. The treatment T10 ($N_1B_3$) recorded maximum number of fruits per tree 635.67 followed by T11 ($N_2B_3$) 608.74. The fruit came to harvest earlier with the application of T10 ($N_1B_3$) 248.00 days and T7 ($N_1B_2$) 247.49 days. Singh and Singh (2009) in strawberry,

Godage *et al.*, (2013) in guava and Verma and Rao, (2013) in srawberry observed similar results for hastening fruit maturity. The maximum yield per tree was recorded in treatment T10 ($N_1B_3$) 53.33 kg, followed by T11 ($N_2B_3$) 51.92 kg. Medhi *et al.*, (2007), Dalal *et al.*, (2009), Deware and Waghmare (2009) reported that 100 % NPK+ FYM+ Azospirillum and PSB increases the fruit yield. Increased yield and yield attributing characters largely may be consequences of vigorous plant growth Sah *et al.*, (2010) Meena *et al.*, (2013) in, and Sahu *et al.*, (2014) in guava.

## References


Banker, S.P., D.V. Indi and M.A. Gud, (2009). Effect of VAM fungi and Azospirillum on growth and development of kagzi lime (*Citrus arontifolia* L.) seedlings. *J. maharastra agric. Univ*., 34(2):183-185.

Chaddha, K. L. (1993). Strategy for optimization of productivity and utilization of sapota (*Manilkara achras* (Mill.) Forseberg). *Indian J. Horti* 49(1):1-17.

Dheware, R.M., and M.S. Waghmare. (2009). Influence of organic inorganic and biofertilizer and their interactions on flowering and fruit set of sweet orange (*Citrus sinensis* Osbeck L.). *The Asian J. of Hort*. 4(1): 194-197.

Fawzi, M.I.F, F.M., Shahin, F.M. Elham, A. Baood and E.A. Kandil. (2010). Effect of organic and biofertilizer and magnesium sulphate on growth, yield, chemical composition and fruit quality of "Leconte" pear trees. *Nature and Sci*., 8(12): 273-279.

Godage, S.S, N.S Parekh, D.S. Nehete and V.M.Jagtap. (2013). Influence of chemicals and biofertilizers on growth, flowering, fruit yield and quality of Guava (*Psidium guajava*) cv. Allahabad Safeda. *Bioinfolet*. 10(2A): 480- 485.

Gogoi, D, U.Kotoky and S.Hazarika. (2004). Effect of bio-fertilizers on productivity and characteristics in Banana. *Indian Journal of Horticulture* 61(4):354-356.

Hazarika, B.N, and S. Ansari. (2007). Biofertilizers in fruit crops – A review. Agric. Rev. 28(1): 69-74.

Kundu, S, P. Datta, J. Mishra, K. Rashmi and B. Ghosh. (2011). Influence of Bio-fertilizer and Inorganic fertilizer in pruned Mango orchard cv. Amrapali. *Journal of Crop and Weed*. 7(2):100-103.

Manjunath, V.G, C.P. Patil, G.S.K. Swamy, And P.B. Patil. (2001) Effect of

VAM fungi on growth parameters of papaya, cv. Sunset solo. *J. Maharashtra agric. Unvi*. 26(3):269-271.

Medhi B.K., A.J. Saikia, S.C. Bora, T.K. Hazarika and A.C. Barbora. (2007). Integrated use of concentrated organic manures, bio-fertilizers and inorganic NPK on yield, quality and nutrient content of Khasi Mandarin *(Citrus reticulata* Blanco.*). Indian J. Agric. Res*. 41(4):235-241.

Osman, S.M, and I.A. Abd El-Rehman. (2010). Effect of organic and bio-fertilization on Growth, Productivity of Fig tree (*Ficus carrica* L.). *Research Journal of Agriculture and Biological Sciences*. 6(3): 3195-328.

Panse, V.G, P.V. Sukhatme and Sable (1978). Statastical method for Agriculture workers Pub. I.C.A.R. New Delhi.

Sharma S.D., P. Kumar, S. Kumar and A.C. Bharadwaj. (2009). Symbiotic effectiveness of arbuscular mycorrhizal technology and

Azotobacterization in citrus nursery production under soil disinfestation and moisture conservation practices (Abstract). *Scientia Hort*. 132: 27-36.

Shanmugavelu, K. G. and Shrinivasan, (1973). Proximate composition of fruits of sapota (*Achras zapota* Linn.) cultivars. *South Indian Hort.* 21:107.

Singh, A, and J.N Singh. (2009) Effect of biofertillizer and biorgulators on growth, yield and nutrient status of strawberry cv. sweet charllie. *Indian j. hort*. 66(2):220-224.

Verma, J, and V.K. Rao. (2013). Impact of INM on soil propertis, plant growth and yield parameters of Strawberry cv. Chandler. *Journal of Hill Agriculture*. 4(2): 61-67.