www.ThePharmaJournal.com

The Pharma Innovation

**ISSN (E): 2277-7695**
**ISSN (P): 2349-8242**
**NAAS Rating: 5.23**
TPI 2023; 12(5): 1687-1690

www.thepharmajournal.com
Received: 15-02-2023
Accepted: 30-04-2023

**Khushboo Tandon**
Department of Horticulture and Fruit Science, College of Agriculture, I.G.K.V., Raipur, Chhattisgarh, India

**HK Panigrahi**
Department of Horticulture and Fruit Science, College of Agriculture, I.G.K.V., Raipur, Chhattisgarh, India

**Prabhakar Singh**
Department of Horticulture and Fruit Science, College of Agriculture, I.G.K.V., Raipur, Chhattisgarh, India

**Kumudani Sahu**
Department of Horticulture and Fruit Science, College of Agriculture, I.G.K.V., Raipur, Chhattisgarh, India

**Gunja Thakur**
Department of Horticulture and Fruit Science, College of Agriculture, I.G.K.V., Raipur, Chhattisgarh, India

**Corresponding Author:**
**Khushboo Tandon**
Department of Horticulture and Fruit Science, College of Agriculture, I.G.K.V., Raipur, Chhattisgarh, India

# Studies on influence of inorganic fertilizers and bio-inoculants on growth parameters of sapota [*Manilkara acharas* (Mill.) Fosberg] cv. Cricket Ball under agro-climatic condition of Chhattisgarh Plains

**Khushboo Tandon, HK Panigrahi, Prabhakar Singh, Kumudani Sahu and Gunja Thakur**

## Abstract
An experiment was conducted entitled "Studies on influence of inorganic fertilizers and bio-inoculants on growth parameters of sapota [*Manilkara acharas* (Mill.) Fosberg] cv. Cricket Ball under agro-climatic condition of Chhattisgarh Plains" was carried out during the year 2020-21 and 2021-22 at experimental field of Horticulture farm, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). The results of the experiment showed that applying 100% RDF + Azospirillum + PSB + Azotobacter + VAM ($T_{15}$) significantly increased several growth parameters, including the maximum length of new shoots (12.52 and 25.03 cm), girth of new shoots (4.32 and 8.63mm), number of leaves per shoot (18.50 and 24.17), leaf area (19.99 $cm^2$) and total chlorophyll content in leaf (48.52 mg/g). However, reduced number of days to sprouting of new shoots (26.50 days) when compared to other treatments at all stages of observation.

**Keywords:** Sapota, inorganic fertilizers, bio-inoculants, growth parameters

## Introduction
Sapota (*Manilkara acharas* (Mill.) Fosberg) is one of the important tropical fruit crop belonging to family Sapotaceae. It is commonly known as sapodilla or chikoo. Sapota fruits are also referred as 'Tropical Apples' or 'Marmalade Plums'. Sapota is a long-lived, evergreen tree native to Tropical America most probably South Mexico or Central America. It is wildly cultivated throughout tropics for its delicious fruits (Bose and Mitra, 1990) [2]. Cricket Ball is an important cultivar, which is performing very well in the area of milder climate of Haryana (Boora & Singh, 2000) [3]. It has an attractive large round fruit having crisp or gritty pulp with moderate sweetness and flavour. For proper growth and development, sapota requires warm and humid climate (70.0% relative humidity with an optimum temperature range of 12 to 36 °C). Areas having annual rainfall of 125.0 to 250.0 cm are most suitable for its cultivation so the climatic conditions of coastal regions and foothills area of Shivalik region are best suited. Alluvial, Sandy loam, Red laterite and medium black soils with good drainage are perfect for its cultivation. Application of bio-inoculants in fruit crop has been increased due to their environment friendly nature. Bio-inoculants are more appropriately a "microbial inoculants" preparations containing biologically active strain of bacteria, algae and fungi used for application to seedling or composting area with the objective of increasing the number of such micro-organism and accelerated those microbial processes, which augment the availability of nutrients that can be easily assimilated by plant. Current levels of high intensity agriculture are no longer sustainable primarily due to energy costs of N fertilizers and the decreasing supplies of P, along with a decreasing armoury of pesticides (due to legislation) and water limitation. Various studies are needed to improve our knowledge of how best to apply and use these beneficial organisms to successfully incorporate them into sustainable commercial cropping systems for fruit crops.

## Materials and Methods
The present investigation was carried out during the year 2020-21 and 2021-22 at experimental field of Horticulture farm, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.).

The experiment was designed with employing Randomized Block Design with sixteen different treatment combinations of inorganic fertilizers and bio-inoculants *viz.*, $T_0$ (Control-100% RDF), $T_1$ (60% RDF + Azospirillum), $T_2$ (60% RDF + PSB), $T_3$ (60% RDF + Azotobacter), $T_4$ (60% RDF + VAM), $T_5$ (60% RDF +Azospirillum + PSB + Azotobacter + VAM), $T_6$ (80% RDF + Azospirillum), $T_7$ (80% RDF + PSB), $T_8$ (80% RDF + Azotobacter), $T_9$ (80% RDF + VAM), $T_{10}$ (80% RDF + Azospirillum + PSB + Azotobacter + VAM), $T_{11}$ (100% RDF + Azospirillum), $T_{12}$ (100% RDF + PSB), $T_{13}$ (100% RDF + Azotobacter), $T_{14}$ (100% RDF + VAM) and $T_{15}$ (100% RDF +Azospirillum + PSB + Azotobacter + VAM), which were replicated three times. The composition of inorganic fertilizers was applied seven days before the application of bio-inoculants *i.e.* half dose of N, P and K was applied in the month of June and remaining half dose of N, P and K in the month of November in both the years.

The shoots were tagged for recording the observations for growth parameters are Days to sprouting of new shoots, Length of new shoots (cm) at 60 and 120 days, Girth of new shoots (cm) at 60 and 120 days, Number of leaves per shoot at 60 and 120 days and Leaf area ($cm^2$). The data were analysed using Gomez and Gomez's (1984) [5] approach for analysis of Randomised block design (RBD).

**Results and Discussion**

1. **Days to sprouting of new shoots:** The days to sprouting of new shoots was significantly influenced by the various bio-inoculants and increased doses of inorganic fertilizers. The minimum days to sprouting of new shoots (26.50 days) was registered under the treatment $T_{15}$ (100% RDF +Azospirillum + PSB + Azotobacter + VAM), which was found non-significant difference with the treatment $T_{10}$ having days to sprouting of new shoots (27.83 days) under the present investigation. While, the maximum days to sprouting of new shoots (32.97 days) was registered under the treatment $T_2$ (60% RDF + PSB) based on pooled mean**.** The early sprouting of new shoots might be due to brought on by the application of fertilizers in combination may have resulted from the quick uptake of nutrients through the soil**.** The above findings are in close agreements with the findings reported by Kumar *et al.* (2013) [6], Patil *et al.* (2013) in banana, Pathak *et al.* (2013) in guava, Srivastava *et al.* (2014) [13] in papaya.

   **2. Length of new shoots (cm) at 60 and 120 days:** As per the result of pooled data is concerned at 60 days of observation, the maximum length of new shoot (12.52 cm) was noticed under the superiority of treatment $T_{15}$ (100% RDF+ Azospirillum + PSB + Azotobacter + VAM), which was found significantly superior over rest of the other treatments. The minimum length of new shoots (7.95 cm) was noticed under the treatment $T_2$ (60% RDF + PSB). Similarly, at 120 days, the maximum length of new shoots (25.03cm) was noticed under the treatment $T_{15}$ (100% RDF+ Azospirillum + PSB + Azotobacter + VAM). The minimum length of new shoots (15.90 cm) was observed under $T_2$ (60% RDF + PSB). The result outcomes of the present trial were achieved due to the increased nutrient uptake and mobilization brought on by the addition of bio-fertilizer may be responsible for the improved growth. The present result corroborates with the findings reported by Patil *et al.* (2013) [9] in banana, Sharma *et al.* (2014) [12] in custard apple and Srivastava *et al.* (2014) [13] in papaya.

2. **Girth of new shoots (mm) at 60 and 120 days:** At 60 days, the maximum girth of new shoots (4.32mm) was observed under the superiority of treatment $T_{15}$ (100% RDF + Azospirillum + PSB + Azotobacter + VAM), which was found statistically at par with the treatments $T_{10}$, $T_{13}$, $T_{14}$, $T_{11}$, $T_{12}$, $T_8$, $T_0$, $T_9$, $T_6$ & $T_7$ having the respective girth of new shoots 4.15, 4.08, 3.97, 3.90, 3.85, 3.38, 3.28, 3.25, 3.18 & 3.12 mm, under the present trial. However, the minimum girth of new shoots (2.32 mm) was noticed under the treatment $T_2$ (60% RDF + PSB). Similarly, at 120 days the maximum girth of new shoot (8.63mm) was registered under the treatment $T_{15}$ (100% RDF + Azospirillum + PSB + Azotobacter + VAM), which was recorded statistically equivalent differences with the treatments $T_{10}$, $T_{13}$, $T_{14}$, $T_{11}$ & $T_{12}$ having respective girth of new shoots 8.30, 8.17, 7.93, 7.80 & 7.70 mm. The treatment $T_2$ (60% RDF + PSB) recorded minimum girth of new shoots (4.63 mm) under the present trial according to pooled data analysis. Organic manure (FYM) and bio-fertilizers primarily attributed to adequate availability of all nutrients during different vegetative growth stages of the plant. The above results are in close conformity with the findings testified by Mahendra *et al.* (2009) [8] in ber, Bhalerao *et al.* (2009) [1] in banana, Singh *et al*. (2013) [13] in papaya.
3. **Number of leaves per shoot at 60 and 120 days:** The number of leaves per shoot increased significantly with the advancement of growth of new shoots at a later stage. At 60 days, the maximum number of leaves per shoot (18.50) was recorded under the treatment $T_{15}$ (100% RDF + Azospirillum + PSB + Azotobacter + VAM), which was at par with the treatments $T_{10}$, $T_{13}$ & $T_{14}$ having respective number of leaves per shoot 17.50, 17.17 & 16.83 under the present investigation. The minimum number of leaves per shoot (10.50) was registered under the treatment $T_2$ (60% RDF + PSB). At 120 days, the maximum number of leaves per shoot (24.17) was marked under the treatment $T_{15}$ (100% RDF + Azospirillum + PSB + Azotobacter + VAM), which was found non-significant differences with the treatments $T_{10}$ & $T_{13}$ having number of leaves per shoot 22.83 & 22.17, respectively. The minimum number of leaves per shoot (15.50) was perceived under the treatment $T_2$ (60% RDF + PSB) as per documented in pooled data analysis. The data indicated that the number of leaves per shoot increased significantly with the advancement of the growth of new shoots at a later stage. It might be due to the high nutrient and mineral content present in the combination of organic and inorganic fertilizers with bio-inoculants, this might also be attributed to the improved nutrient use efficiency as a result of the use of different sources of nutrients. The present results are in closely in accordance with earlier works reported by Pathak *et al.* (2013) [10] in guava, Srivastava *et al.* (2014) [13] in papaya, Shaimaa *et al.* (2017) [15] in orange,
4. **Leaf area ($cm^2$):** The data pertaining to leaf area revealed that the effects of different combinations of inorganic fertilizers and bio-inoculants had significant impact on leaf area. The maximum leaf area (19.99 $cm^2$) was registered under the treatment $T_{15}$ (100% RDF +Azospirillum + PSB + Azotobacter + VAM), which was

found non-significant differences with the treatments $T_{10}$, $T_{14}$ & $T_{13}$ having leaf area 19.41, 19.31 & 19.09 $cm^2$, respectively. The minimum leaf area (14.90 $cm^2$) was remarked under the treatment $T_2$ (60% RDF + PSB) with respect to analysis based on pooled mean. Application of growth-promoting microorganisms such as Azospirillum, PSB, Azotobacter and VAM increased the availability of P and N, which led to better protein synthesis and improved morphological growth or increased leaf area (Singh and Singh, 2004) [16]. The microbial inoculants Azospirillum and Azotobacter, which aid in atmospheric nitrogen fixation through free-living $N_2$ fixers in the rhizosphere and produced a variety of growth compounds such indole acetic acid, gibberellins, Vitamin-B and antifungal substances, improved crop development (Dutta *et al*., 2009) [4]. The similar findings were also reported by Singh *et al.* (2004) [16] in banana, Dutta *et al.* (2009) [4] in guava cv. L-49, Kundu *et al.* (2011) [7] in mango and Patil *et al.* (2013) [9] in banana.

**Table 1:** Show the Days to Sprouting of new shoots

| Treatments | Days to Sprouting of new shoots | Length of new shoots (cm) at 60 days | Length of new shoots (cm) at 120 days | Girth of new shoots (mm) at 60 days | Girth of new shoots (mm) at 120 days | Number of leaves per shoot at 60 days | Number of leaves per shoot at 120 days | Leaf area ($cm^2$) |
|---|---|---|---|---|---|---|---|---|
| | Pooled | Pooled | Pooled | Pooled | Pooled | Pooled | Pooled | Pooled |
| $T_0$ | $30.10^{cdef}$ | $10.84^{c}$ | $21.67^{c}$ | $3.28^{abcde}$ | $6.57^{bcde}$ | $14.50^{cd}$ | $18.17^{efg}$ | $17.58^{c}$ |
| $T_1$ | $31.67^{abc}$ | $8.00^{f}$ | $16.00^{g}$ | $2.37^{e}$ | $4.73^{f}$ | $10.83^{g}$ | $16.17^{gh}$ | $14.97^{e}$ |
| $T_2$ | $32.97^{a}$ | $7.95^{f}$ | $15.90^{g}$ | $2.32^{e}$ | $4.63^{f}$ | $10.50^{g}$ | $15.50^{h}$ | $14.90^{e}$ |
| $T_3$ | $31.30^{bcd}$ | $8.17^{f}$ | $16.33^{g}$ | $2.68^{cde}$ | $5.37^{ef}$ | $12.17^{efg}$ | $16.83^{fgh}$ | $15.26^{e}$ |
| $T_4$ | $30.50^{bcde}$ | $8.23^{f}$ | $16.47^{g}$ | $2.58^{de}$ | $5.17^{ef}$ | $11.50^{fg}$ | $16.50^{fgh}$ | $15.34^{e}$ |
| $T_5$ | $29.83^{defg}$ | $9.30^{d}$ | $18.60^{def}$ | $2.92^{bcde}$ | $5.83^{ef}$ | $13.50^{def}$ | $17.50^{fgh}$ | $16.67^{d}$ |
| $T_6$ | $31.00^{bcde}$ | $8.95^{e}$ | $17.90^{f}$ | $3.18^{abcde}$ | $6.37^{cdef}$ | $15.17^{bcd}$ | $17.83^{fgh}$ | $16.72^{d}$ |
| $T_7$ | $31.70^{ab}$ | $9.23^{d}$ | $18.47^{ef}$ | $3.12^{abcde}$ | $6.23^{def}$ | $14.17^{cde}$ | $17.17^{fgh}$ | $16.27^{d}$ |
| $T_8$ | $30.28^{bcdef}$ | $9.58^{d}$ | $19.17^{de}$ | $3.38^{abcde}$ | $6.77^{bcde}$ | $15.83^{bc}$ | $18.83^{def}$ | $17.68^{c}$ |
| $T_9$ | $29.50^{efg}$ | $9.68^{d}$ | $19.37^{d}$ | $3.25^{abcde}$ | $6.50^{bcdef}$ | $15.50^{bcd}$ | $18.50^{efg}$ | $17.79^{c}$ |
| $T_{10}$ | $27.83^{hi}$ | $11.72^{b}$ | $23.43^{b}$ | $4.15^{ab}$ | $8.30^{ab}$ | $17.50^{ab}$ | $22.83^{ab}$ | $19.41^{a}$ |
| $T_{11}$ | $29.60^{efg}$ | $11.52^{b}$ | $23.03^{b}$ | $3.90^{abc}$ | $7.80^{abcd}$ | $16.17^{bc}$ | $20.83^{bcd}$ | $18.38^{bc}$ |
| $T_{12}$ | $30.50^{bcde}$ | $11.37^{b}$ | $22.73^{b}$ | $3.85^{abcd}$ | $7.70^{abcd}$ | $15.83^{bc}$ | $20.17^{cde}$ | $18.16^{c}$ |
| $T_{13}$ | $28.83^{fgh}$ | $11.60^{b}$ | $23.20^{b}$ | $4.08^{ab}$ | $8.17^{abc}$ | $17.17^{ab}$ | $22.17^{abc}$ | $19.09^{ab}$ |
| $T_{14}$ | $28.50^{gh}$ | $11.63^{b}$ | $23.27^{b}$ | $3.97^{abc}$ | $7.93^{abcd}$ | $16.83^{ab}$ | $21.50^{bc}$ | $19.31^{a}$ |
| $T_{15}$ | $26.50^{i}$ | $12.52^{a}$ | $25.03^{a}$ | $4.32^{a}$ | $8.63^{a}$ | $18.50^{a}$ | $24.17^{a}$ | $19.99^{a}$ |
| SE(m)± | 0.69 | 0.11 | 0.23 | 0.45 | 0.90 | 1.50 | 1.59 | 0.26 |
| C.D. at 5% | 1.95 | 0.32 | 0.64 | 1.28 | 2.65 | 4.25 | 4.65 | 0.74 |

## Conclusion

It is concluded that application of 100% RDF +Azospirillum + PSB + Azotobacter + VAM ($T_{15}$) was found to be significantly increased different growth attributing parameters *viz.* length of new shoots, girth of new shoots, number of leaves per shoot, leaf area and reduced number of days to sprouting of new shoots as compared to other treatments at all the stages of observation. Therefore, treatment ($T_{15}$) is considered better treatment combination for the growth parameters of sapota.

## References


1. Bhalerao VP, Patil NM, Badgujar CD, Patil DR. Studies on integrated nutrient management for tissue cultured banana cv. Grand Naine. Indian J Agric. Res. 2009;43(2):107-112.
2. Bose TK, Mitra. Fruits: Tropical and Subtropical. Naya Prakash, Calcutta. 1990;1:565-591.
3. Boora RS, Singh D. Effect of N, P, K on growth, yield and quality of sapota (*Manilkara achras* Mill.) cv. Cricket Ball. Haryana J Hort. Sci. 2000;29(3&4):188-189.
4. Dutta P, Maji SB, Das BC. Studies on the response of bio-fertilizer on growth and productivity of guava. Indian Journal Horticulture. 2009;66(1):39-42.
5. Gomez KW, Gomez AA. Statistical Procedures for Agricultural Research. 2nd edition. John Wiley and Sons, Inc., New York, USA; c1984.
6. Kumar S, Pathak KA, Kishore K, Shukla R, Solankey SS, Singh DK. Effect of bio-fertilizers on biological nitrogen fixation of banana cv. Giant Cavendish. Asian J Hort. 2013;8(2):436-439.
7. Kundu S, Datta P, Mishra J, Rashmi K, Ghosh B. Influence of bio-fertilizers and inorganic fertilizers in pruned mango orchard cv. Amrapali Journal of Crop and Weed. 2011;7(2):100-103.
8. Mahendra, Singh HK, Singh JK. Studies on integrated nutrient management on vegetative growth, fruiting behaviour and soil fertilizer status of ber (*Zizyphus mauritiana* L.) orchard cv. Banarasi Karaka; c2009.
9. Patil VK, Shinde BN. Studies on integrated nutrient management on growth and yield of banana cv. Ardhapuri (*Musa* AAA). Journal of Horticulture and Forestry. 2013;5(9):130-138.
10. Pathak DV, Singh S, Saini RS. Impact of bio-inoculants on seed germination and plant growth of guava (*Psidium guajava* L.). Journal of Horticulture and Forestry. 2013;5(10):183-185.
11. Patil VK, Shinde BN. Studies on integrated nutrient management on growth and yield of banana cv. Ardhapuri (*Musa* AAA). Journal of Horticulture and Forestry. 2013;5(9):130-138.
12. Sharma A, Bhatnagar P, Jain MC. Effect of integrated nutrient management on growth attributes in custard apple cv. Arka Sahan. Asian J Hort. 2014;9(1):43-47.
13. Srivastava A, Singh JK, Singh HK. Integrated nutrient management on growth, yield and quality of papaya (*Carica papaya* L.) cv. CO-7. Asian J Hort.

2014;9(2):390-395.
14. Singh JK, Varu DK. Effect of integrated nutrient management in papaya (*Carica papaya* L.) cv. Madhubindu. The Asian Journal of Horticulture. 2013;8(2):667-670.
15. Shaimaa MA, Massoud ON. Impact of inoculation with Mycorrhiza and Azotobacter under different N and P rates on growth, nutrient status, yield and some soil characteristics of Washington Navel Orange trees. Middle East Journal of Agriculture. 2017;6(3):617-638.
16. Singh A, Singh SP. Response of banana (*Musa* sp.) to *Vesicular arbuscular mycorrhizae* and varied levels of inorganic fertilizers. Indian Journal of Horticulture. 2004;61(2):109-113.