International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(4): 1426-1432

Received: 18-05-2018
Accepted: 20-06-2018

SL Maskar
PG Student, Department of Horticulture, College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth Parbhani, Maharashtra, India

Dr. AM Bhosale
Assistant Professor, (Horticulture), Department of Horticulture, College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. Maharashtra, India

SJ Syed
PhD Scholar, Department of Horticulture, College of Agriculture, Parbhani, Vasantrao Naik Marathwada Krishi Vidyapeeth Parbhani, Maharashtra, India

Correspondence
SL Maskar
PG Student, Department of Horticulture, College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth Parbhani, Maharashtra, India

Effect of bio-fertilizers and inorganic fertilizers on fruit set and yield of sapota (*Manilkara achras* (Mill.) Forseberg). CV. Kalipatti

SL Maskar, Dr. AM Bhosale and SJ Syed

Abstract
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. The bio-fertilizers in combination with chemical fertilizers also influenced the yield parameters and quality of fruits. The treatment combination N_1B_3 (100 per cent NPK + Azospirillum and PSB) recorded maximum number of fruits and maximum weight of fruits. The physico-chemical parameters of sapota also recorded maximum by application of 75% dose of chemical fertilizer with Azospirillum and PSB viz. T.S.S. and reducing sugar, non-reducing sugar, total sugar of fruit was observed maximum with same treatment. 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, yield and quality of Sapota which followed by treatment with (75% NPK) chemical fertilizers combined with Azospirillum(200g) and PSB (200g) with maximum economical returns.

Keywords: Sapota, Kalipatti, Azospirillum, PSB, yield, quality, FRBD, VAM

1. Introduction
Sapota (*Manilkara achras* (Mill.) Forseberg) is one of the important tropical fruit crop belonging to family Sapotaceae. It is a native of Tropical America and probably originated in Southern Mexico. 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) [6].

The Kalipatii cultivar is the main choice of the farmers and therefore 99% area under sapota is under this cultivar. Sapota crop is highly responsive to fertilizers, (Durrani *et al*. 1982) [5].

Nutrients of the soil are the most important factor affect the horticultural productivity. The beneficial micro-organism used as bio fertilizer increase growth of plant either by enhancing the availability of nutrients, releasing plant growth stimulating hormones and reducing the damage caused by the pathogens, pests or by imposing resistant to environmental stress. The release of plant growth hormone by micro-organism causes elongation of root and shoot leading to improve the growth and yield.

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 bio fertilizer 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).

Recently, application of bio-fertilizers in fruit crop has been increased due to their environment friendly nature. Bio-fertilizers are more appropriately a “microbial inoculants” are preparations containing biologically active strain of bacteria, algae and fungi used for application to seed seedling or compositing 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. In majority of developing countries nitrogen regiment in agriculture are met mainly by biological nitrogen fixation with the help of bio-fertilizers as huge amount of nitrogen present in atmosphere can be effectively used to supplement the nitrogen requirement of plant by reducing the use of chemical fertilizers. In addition, growth of bacterial population in soil is often dependent on colonization of vesicular arbuscular mycorrhizae (VAM). Application of 50% organic nitrogen and 75% organic P enhances enzyme activity is due to VAM colonization which play greater role in disease resistance, plant growth and development. (Aneesa Rani and Shathiamoorty, 1997) [1].

According to Padmashree R. S. Paroda (ICAR) "Today we need an Integrated Intensive Farming System (IIFS) which provides a pathway to achieving an evergreen revolution in Agriculture". The choice of using organic vs. conventional farming system depends upon a number of factors including the availability of land, population density and associated demand for food, fibre, feed and capability of consumers to pay higher price for farm produce and it is more sustainable and does less damage to the environment and for minimum utilization of natural resources.

2. Material and Methods

The present investigation on was carried out during the year 2014-15, at Horticulture Research Scheme, (Pomology) Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani district, experiment were laid out in Factorial Randomized Block Design Treatment details are given below.

Table 1: Treatment details

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 Solubilizing 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)

Table 2: Treatment combinations

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

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.

3. Results and Discussion

3.1 Number of fruits per tree

The data pertaining to number of fruits per tree was presented in Table 3. The bio-fertilizers and inorganic fertilizers affected the fruits per tree was significantly by different treatments. The average fruits recorded was 573.22.

3.1.1 Bio-fertilizers Effect

The bio-fertilizers were significantly influenced number of fruits per tree. The treatment B_3 (Azospirillum and PSB) produces maximum number of fruits (615.34) followed by application of treatment B_2 (PSB) it was at par with B_3. The minimum fruits per tree (532.44) were observed in without bio-fertilizer (B_0) applied.

3.1.2 Inorganic fertilizers effect

The chemical fertilizers exhibited significant influence on number of fruits per tree. The maximum number of fruits per tree (592.33) was recorded by application of full dose of chemical fertilizers (N_1) and minimum number of fruits (564.58) per tree was recorded with application of half dose of NPK (N_3).

3.1.3 Interaction effect

The interaction between bio-fertilizer and chemical fertilizers were found significantly in number of fruits per tree were presented in Table 3. The fertilizer combination N_1B_3 (100%NPK + Azospirillum + PSB) recorded maximum fruits per trees (635.67) was followed by treatment N_2B_3 (75% NPK with combination of Azospirillum and PSB (608.74). The treatment combination N_3B_0 (50% NPK) without bio-fertilizer recorded minimum fruits per tree (524.00). The treatment combination N_3B_3 was at par with N_1B_3.

Table 3: Effect of Bio-fertilizers and Inorganic fertilizers on number of fruits per tree, Yield per tree (kg) and Yield per ha (q)

Treatment No.	Factor/Treatment	No. of fruits per tree	Yield per tree (kg)	Yield per ha (q)
1	B0-control	532.44	39.83	43.17
2	B1-Azospirillum	563.33	46.25	46.25
3	B2-PSB	595.11	47.76	47.20
4	B3-Azospirillum + PSB	615.34	51.01	51.01
SE+		9.87	1.69	0.33
CD at 5%		28.91	4.90	0.97
1	N1-100% NPK	592.33	47.29	48.55
2	N2-75% NPK	572.75	46.47	47.29
3	N3-50 NPK	564.58	44.87	44.87
SE+		8.54	1.45	0.28
CD at 5%		25.03	NS	0.84
	Interaction Effect			
T1	N1B0-100% NPK	540.67	44.11	44.11
T2	N2B0-75% NPK	532.67	43.62	43.62
T3	N3B0-50% NPK	524.00	41.77	41.77
T4	N1B1-100% NPK+ Azospirillum	580.33	48.53	48.53
T5	N2B1-75% NPK + Azospirillum	558.33	45.85	45.85
T6	N3B1-50% NPK + Azospirillum	551.33	44.36	44.36
T7	N1B2-100% NPK+PSB	602.67	48.55	48.55
T8	N2B2-75% NPK+PSB	591.34	47.77	47.77
T9	N3B2-50% NPK +PSB	581.32	45.28	45.28
T10	N1B3-100% NPK + Azospirillum + PSB	635.67	53.33	53.33
T11	N2B3-75% +NPK+ Azospirillum + PSB	608.74	51.92	51.92
T12	N3B3-50% NPK + Azospirillum + PSB	601.60	48.09	48.09
SE+		17.09	2.90	0.57
CD at 5%		50.07	8.70	1.68

3.2 Yield per tree (kg)

The bio-fertilizers application (Azospirillum and PSB) alone and in combination significantly affects the yield per tree are presented in Table 3. The average yield recorded was 46.21 (kg).

3.2.1 Bio-fertilizers Effect

The bio-fertilizer Azospirillum and PSB shown significant influence on yield per tree. The treatment B_3 produced maximum yield per tree (51.01 kg) which was followed by B_2 (47.76 kg) the minimum yield was observed in treatment without bio-fertilizer (B_0) applied.

3.2.2 Inorganic fertilizers effect

The inorganic fertilizers showed the non-significant effect on yield per tree. The tree which were supplied with 100% NPK reported maximum yield (47.29 kg) followed by N_2 (46.47kg). The trees with application of 50 percent NPK (500:250:250 g NPK per plant) showed minimum yield per tree (44.87) than other treatment combination.

3.2.3 Interaction Effect

The fertilizer combination of bio-fertilizer with reduced level of inorganic fertilizers also significantly increased the yield per tree were presented in Table 3. The treatment combination (N_1B_3) recorded maximum yield per tree (53.33 kg) it was followed by N_2B_3. The treatment combination N_3B_0 recorded minimum yield per tree (41.77 kg) application of chemical fertilizers only. The treatment combination, N_1B_1 N_1B_2 and N_3B_3 were closely at par with treatment N_1B_3.

3.3 Yield per hectare (q)

The levels of bio-fertilizer application (azospirillum and PSB) alone and in combination were significantly affected the yield per tree, and data presented in table 3. The average yield /ha recorded was 46.91 (q).

3.3.1 Bio-fertilizers effect

The bio-fertilizer Azospirillum and PSB shown significant influence on yield per hectare. The treatment B_3 produced maximum yield per hectare (51.01 q) which was followed by B_2 (47.20 q) the minimum yield was observed in treatment without bio-fertilizer B_0 (43.17 q) applied.

3.3.2 Inorganic fertilizers effect

The inorganic fertilizers showed the significant effect on yield per hectare. The tree which were supplied with 100% NPK reported maximum yield (48.55 q) followed by N_2 (47.29 q). The trees with application of 50% NPK (500:250:250 g NPK per plant) showed lower yield per ha (44.87 q) than other treatment combination.

3.3.3 Interaction Effect

The fertilizer combination of bio-fertilizer with reduced level of inorganic fertilizer also significantly increases the yield per hectare were presented in Table 3. The treatment combination (N_1B_3) recorded maximum yield per hectare (53.33q) it was followed by N_2B_3. The treatment combination N_3B_0 recorded lowest yield per hectare (41.77 q) application of chemical fertilizers only. The treatment combination, N_1B_1, N_1B_2 and N_3B_3 were closely at par with treatment N_1B_3.

3.4 Weight of Fruit (g)

The average weight of fruit was significantly influenced by bio-fertilizer application with reduced levels of chemical fertilizers and data presented in Table 4. The average weight of fruits recorded was 82.70 g.

3.4.1 Bio-fertilizers Effect

The application of bio-fertilizer influenced the average weight of fruit. The treatment B_3 (Azospirillum and PSB) produced maximum weight of fruits (85.70g) and B_0 recorded the minimum weight of fruits by without bio-fertilized plant.

Table 4: Effect of Bio-fertilizers and Inorganic fertilizers on Weight of fruit (g), No. of seeds per fruit, Weight of seeds per fruit (g).

Treatment No.	Factor/Treatment	Weight of fruit (g).	No. of seeds per fruit.	Weight of seeds per fruit (g).
1	B0-control	81.07	2.87	2.04
2	B1-Azospirillium	82.08	2.78	2.04
3	B2-PSB	81.96	2.74	2.03
4	B3-Azospirilium +PSB	85.70	2.54	1.73
SE±		0.15	0.16	0.17
CD at 5%		0.45	0.49	0.50
1	N1-100% NPK	83.60	2.29	1.57
2	N2-75% NPK	83.62	2.70	1.89
3	N3-50 NPK	80.88	3.21	2.42
SE±		0.13	0.14	0.15
CD at 5%		NS	0.42	0.43
Interaction Effect				
T1	N1B0- 100% NPK	81.60	2.56	1.86
T2	N2B0- 75% NPK	81.90	2.73	1.86
T3	N3B0- 50% NPK	79.70	3.33	2.40
T4	N1B1- 100% NPK+ Azospirillum	83.63	2.37	1.66
T5	N2B1- 75 % NPK+Azospirillum	83.13	2.70	2.13
T6	N3B1- 50% NPK+ Azospirillum	80.47	3.27	2.33
T7	N1B2- 100% NPK+PSB	82.60	2.20	1.63
T8	N2B2- 75% NPK+PSB	82.64	2.89	1.96
T9	N3B2- 50% NPK +PSB	80.63	3.14	2.50
T10	N1B3- 100%NPK + Azospirillum +PSB	86.57	2.03	1.13
T11	N2B3- 75%+ NPK+ Azospirillum +PSB	87.80	2.48	1.60
T12	N3B3- 50%NPK + Azospirillum+PSB	82.73	3.12	2.46
SE±		0.26	0.29	0.30
CD at 5%		0.78	0.85	0.88

3.4.2 Inorganic Fertilizers Effect
The different levels of inorganic fertilizers affected non-significantly on the weight of fruits. The treatment N_2 produced maximum weight of fruit (83.62 g) with application of 75% NPK and N_3 recorded minimum weight of fruit (80.88 g) with application of 50% NPK per plant.

3.4.3 Interaction Effect
The interaction effect influenced the weight of fruit and data presented in Table 4. The fertilizer combination of N_2B_3 produced maximum weight of fruit (87.80 g). Treatment N_1B_3 was at par with N_2B_3 which produced 86.57g of fruits. The treatment combination having fertilizer application 50 percent NPK with azospirillum (N_3B_1) shown minimum weight of fruit (79.70g).

3.5 Number of seeds per fruit
The levels of bio-fertilizer application (Azospirillum and PSB) alone and in combination significantly affects the number of seed are presented in Table 4. The average number of seed recorded was 2.73.

3.5.1 Bio-fertilizers Effect
The application of bio-fertilizers showed impact on seeds number of fruit. The combined application of azospirillum and PSB (B_3) recorded minimum seeds number (2.54) followed by alone application of PSB (B_2) i.e. 2.74. The maximum seeds per fruit (2.87) was observed in without bio-fertilized plant (B_0).

3.5.2 Inorganic Fertilizers Effect
The reduced level of inorganic fertilizers significantly influenced the seeds number. The half dose of NPK (N3) recorded averagely maximum number of seed (3.21) per fruits and the minimum number of seed per fruits (2.29) was observed in full dose of chemical fertilizers.

3.5.3 Interaction effect
Interaction effect of bio-fertilizer with reduced level of chemical fertilizers significantly influenced the number of seeds per fruits are presented in Table 4. The treatment combination N_1B_3 (100% NPK + Azospirillum+ PSB) recorded minimum seeds per fruit (2.03) followed by N_1B_2 (100% + PSB) i.e 2.20. The maximum number of seeds (3.33) were observed in 50 percent NPK (N_3B_0).

3.6 Weight of seeds per fruit (g).
The levels of bio-fertilizer application (azospirillum and PSB) alone and in combination significantly affected the weight of seeds per fruit are presented in Table 4. The average weight of seeds per fruit recorded was 1.96 (g).

3.6.1 Bio-fertilizers Effect
The bio-fertilizers azospirillum and PSB significantly influenced weight of seeds per fruit. The treatment B_3 produced minimum weight of seeds (1.73 g) which was followed by B_2 i.e. alone application of PSB recorded (2.03), without application bio-fertilizers showed maximum weight of seeds.

3.6.2 Inorganic fertilizers effect
The inorganic fertilizers the effect on weight of seeds per fruit. The tree which were supplied with 100 percent NPK ($N_1$1000:500:500 g NPK per plant) reported minimum weight of seeds (1.57 g) followed by N_2 (1.89 g). The trees with application of 50 percent NPK (500:250:250 g NPK per plant) showed maximum weight of seeds per fruit (2.42 g) than other treatment combination.

3.6.3 Interaction Effect
The combination of bio-fertilizers with reduced level of chemical fertilizer significantly affected the weight of seeds per fruit and presented in Table 4. The treatment combination (N_1B_3) recorded minimum weight of seeds per fruit (1.13 g) it

was followed by N_2B_3, N_1B_2, N_1B_1. The treatment combination N_3B_3 recorded maximum (2.46) weight of seeds per fruit which observed by lowest application of chemical fertilizers and azospirillum and PSB.

3.7 T.S.S (%)
The data affected that the significant effect in the T.S.S. of fruit among the different treatment presented in Table 5. The average T.S.S. recorded was 17.91.

3.7.1 Bio-fertilizers Effect
The bio-fertilizer viz. azospirillum and PSB (B_3) significantly influenced on T.S.S content of fruits. The B_3 recorded maximum T.S.S (20.00%) followed by B_2 (17.44%). The minimum T.S.S (16.88%) was recorded without application of bio-fertilizer.

3.7.2 Inorganic fertilizers effect
The application of inorganic fertilizers significantly influenced on T.S.S. It was maximum in trees which were applied with 75% dose of chemical fertilizers (N_2). It was recorded 19.83 per cent followed by N_1 in 18.41 per cent and the minimum T.S.S was recorded 15.50 with application of 50% NPK per plant.

3.7.3 Interaction Effect
The interaction effect of bio-fertilizer and chemical fertilizers significantly influenced on T.S.S of fruit present in Table 5. The treatment combination N_2B_3 recorded maximum T.S.S (22.33%) followed by N_1B_3 (21.33). The minimum T.S.S observed in the treatment (14.66%) content in fruit was found in plant had applied 50% chemical fertilizers only.

Table 5: Effect of Bio-fertilizers and Inorganic fertilizers on TSS (%), Acidity (%)

Treatment No.	Factor/Treatment	TSS (%)	Acidity (%)
1	B0-control	16.88	0.060
2	B1-Azospirillium	17.33	0.055
3	B2-PSB	17.44	0.054
4	B3-Azospirilium +PSB	20.00	0.052
SE±		0.25	0.00037
CD at 5%		0.75	0.00110
1	N1-100% NPK	18.41	0.053
2	N2-75% NPK	19.83	0.054
3	N3-50 NPK	15.50	0.059
SE±		0.22	0.00032
CD at 5%		0.65	0.00095
Interaction Effect			
T1	N1B0- 100% NPK	17.00	0.061
T2	N2B0- 75% NPK	19.00	0.056
T3	N3B0- 50% NPK	14.66	0.063
T4	N1B1- 100% NPK + Azospirillum	17.66	0.052
T5	N2B1- 75% NPK + Azospirillum	19.00	0.054
T6	N3B1- 50% NPK + Azospirillum	15.33	0.059
T7	N1B2-100% NPK + PSB	17.66	0.051
T8	N2B2-75% NPK + PSB	19.00	0.053
T9	N3B2-50% NPK + PSB	15.66	0.058
T10	N1B3- 100% NPK + Azospirillum + PSB	21.33	0.049
T11	N2B3- 75% + NPK + Azospirillum + PSB	22.33	0.052
T12	N3B3- 50% NPK + Azospirillum + PSB	16.33	0.057
SE±		0.44	0.00065
CD at 5%		1.31	0.0019

3.8 Acidity (%)
The bio-fertilizer and inorganic fertilizer significantly influenced on acidity of fruit are presented in Table 5. The average acidity percentage recorded was 0.055 (%).

3.8.1 Bio-fertilizers effect
The bio-fertilizer significantly affected the acidity of sapota fruits. The combined application of Azospirillum and PSB (B_3) recorded minimum acidity percentage (0.052%) as compare to without bio-fertilizer applied trees. The (B_0) recorded maximum acidity of fruits (0.060%).

3.8.2 Inorganic fertilizers effect
The inorganic fertilizer level significantly influenced on acidity of fruit. The trees supplied full dose of NPK (N_1) reported minimum acidity percentage (0.053%) and the tree with 50 percent NPK reported maximum acidity in fruits (0.059%).

3.8.3 Interaction Effect
The interactions showed influence on acidity of fruit were presented in Table 5. The fertilizer combination of N_1B_3 (100% NPK + Azospirillum + PSB) recorded minimum acidity percentage (0.049%) followed by N_1B_2 (0.051%). The maximum acidity of fruits (0.063) was recorded with treatment combination N_3B_0 (50% NPK).

3.9 Reducing Sugar (%)
The bio-fertilizer (azospirillum and PSB) and chemical fertilizers significantly influenced on reducing sugar content are presented in Table 6. The average reducing sugar content recorded was 10.07 (%).

3.9.1 Bio-fertilizers Effect
The different levels of bio-fertilizer influenced on reducing sugar content. The combined application of Azospirillum and PSB (B_3) recorded maximum reducing sugar (12.28 %) it was followed by B_2 (9.59%). The minimum reducing sugar content was recorded in B_0 (9.02%).

3.9.2 Inorganic Fertilizers Effect
The chemical fertilizers influenced on reducing sugar. The trees which treated with 75% percent NPK (N_3) recorded maximum reducing sugar (10.8%). The minimum reducing sugar was observed in 50% NPK.

3.9.3 Interaction effect
The interaction effect produced on the reducing sugar content presented in Table 6. The treatment N_2B_3 recorded maximum reducing sugar content (14.05%). The treatment N_1B_0 reported minimum reducing sugar content (8.83%).

4.0 Non-reducing sugar (%)
The non-reducing sugar of fruit influenced by bio-fertilizer and inorganic fertilizer were presented in Table 6. The average non-reducing sugar was recorded (2.97%).

4.0.1 Bio-fertilizers effect
The different bio-fertilizers influenced on non-reducing sugar content. The combined application of Azospirillum and PSB (B_3) recorded maximum amount of non-reducing sugar (4.34) it was followed by B_2 (2.82%). The minimum non-reducing sugar content was recorded in B_0 (2.19%).

4.0.2 Inorganic fertilizers effect
The chemical fertilizers were influenced on non-reducing sugar. The trees which treated with 75% percent NPK was recorded in treatment N_3 maximum non-reducing sugar (5.53%). The minimum non-reducing sugar recorded in N_1 100% NPK i.e. (2.59%).

Table 6: Effect of Bio-fertilizers and Inorganic fertilizers on Reducing sugars (%), Non-reducing sugars (%), total sugars (%)

Treatment No.	Factor/Treatment	Reducing sugar (%)	Non-reducing sugar (%)	Total sugar (%)
1	B0-control	9.02	2.19	11.21
2	B1-Azospirillium	9.38	2.52	11.73
3	B2-PSB	9.59	2.82	12.35
4	B3-Azospirilium + PSB	12.28	4.34	16.64
SE+		0.16	0.11	0.22
CD at 5%		0.47	0.57	0.65
1	N1-100% NPK	9.67	2.59	12.22
2	N2-75% NPK	10.8	3.22	14.06
3	N3-50 NPK	9.65	3.09	12.71
SE+		0.14	0.098	0.19
CD at 5%		0.41	0.28	NS
Interaction Effect				
T1	N1B0- 100% NPK	8.76	2.03	10.79
T2	N2B0- 75% NPK	9.48	2.18	11.65
T3	N3B0- 50% NPK	8.83	2.36	11.19
T4	N1B1- 100% NPK + Azospirillum	9.17	2.34	11.38
T5	N2B1- 75% NPK + Azospirillum	9.91	2.78	12.28
T6	N3B1- 50% NPK + Azospirillum	9.07	2.46	11.53
T7	N1B2- 100% NPK + PSB	9.51	2.21	11.73
T8	N2B2- 75% NPK + PSB	10.09	2.96	13.05
T9	N3B2- 50% NPK + PSB	9.18	3.30	12.27
T10	N1B3- 100% NPK + Azospirillum + PSB	11.25	3.77	15.10
T11	N2B3- 75% + NPK + Azospirillum + PSB	14.05	4.98	19.01
T12	N3B3- 50% NPK + Azospirillum + PSB	11.54	4.27	15.81
SE+		0.28	0.19	0.38
CD at 5%		0.82	0.57	1.13

4.0.3 Interaction Effect
The interaction of the bio-fertilizer and chemical fertilizers influenced the non-reducing sugar of fruit presented in Table 6. The fertilizer combination N_2B_3 recorded maximum non-reducing sugar of fruit (4.98%) followed by N_3B_3 (50% NPK + azospirillum + PSB). The treatment N_1B_0 recorded minimum non-reducing sugar (2.03%).

4.1 Total Sugar (%)
The bio-fertilizer (Azospirillum and PSB) and chemical fertilizers significantly influenced on total sugar content are presented in Table 6. The average total sugar content recorded was (12.98%).

4.1.1 Bio-fertilizers Effect
The bio-fertilizers are influenced on total sugar content. The combined application of Azospirillum and PSB (B_3) recorded maximum amount of total sugar (16.64%) it was followed by B_2 (12.35%). The minimum total sugar content was recorded in B_0 (11.21%).

4.1.2 Inorganic Fertilizers Effect
The different level of inorganic fertilizers non-significantly influenced the total sugar of fruits.

4.1.3 Interaction Effect
The interaction effect on the total sugar content of fruit are presented in Table 6. The treatment N_2B_3 recorded maximum total sugar content (19.01%) followed by N_3B_3 and N_1B_3. The treatment N_1B_0 recorded minimum total sugar content (10.79%).

4.2 Economics of production
The cost of cultivation, gross monetary returns, net monetary returns and benefit: cost ratio of different treatments were calculated and presented in Table 7.

4.2.1 Cost of Cultivation
The data pertaining to the cost of cultivation of different treatments are presented in Table 7. The lowest cost of cultivation was observed in treatment T3 (50% NPK) (19216.00 `/ ha) which were lowest over rest of all treatments.

The treatment T10 (100% NPK + azospirillium + PSB) required highest cost of cultivation (23485.00 `/ ha.).

4.2.2 Gross monetary return

The data regarding the gross monetary return was influenced by different treatments are given in Table 7. The gross income was maximum from treatment T10 (100% NPK + Azospirillum +PSB) (133325.00 `/ ha.) was followed by treatment T11 (75% NPK+ Azospirillum +PSB). The lowest gross monetary return were recorded in treatment T5 (50% NPK) (104425.00 `/ ha.).

4.2.3 Net monetary return

The data regarding the net monetary return as influenced by bio-fertilizers and chemical fertilizers are given in Table 7. Net income was maximum from treatment T10 (100 % NPK + Azospirillum +PSB) (106640.00 `/ ha.) was followed by treatment T11 (105249.00 `/ ha.) the lowest net returns were recorded in treatment T3 (50%NPK) i.e. 85209.00 `/ ha.

Table 7: Effect of bio-fertilizers and chemical fertilizers on benefit: cost ratio

S. No	Treatment	Total cost of cultivation (`/ha)	Yield (q/ha)	Gross Monitory Return (`/ha)	Net Monitory Return (`/ha)	CBR
1	N_1B_0	23485	44.11	110275	86790	1: 4.69
2	N_2B_0	21351	43.62	109050	87699	1: 5.10
3	N_3B_0	19216	41.77	104425	85209	1: 5.43
4	N_1B_1	25485	48.53	121325	95840	1: 4.76
5	N_2B_1	23351	45.85	114625	91274	1: 4.90
6	N_3B_1	21216	44.36	110900	89684	1: 5.22
7	N_1B_2	24685	48.55	121375	96690	1: 4.91
8	N_2B_2	22551	47.77	119425	96874	1: 5.29
9	N_3B_2	20416	45.28	113200	92784	1: 5.54
10	N_1B_3	26685	53.33	133325	106640	1: 4.99
11	N_2B_3	24551	51.92	129800	105249	1: 5.28
12	N_3B_3	22416	48.09	120225	97809	1: 5.36

4.2.4 Benefit cost ratio (B: C)

The data regarding benefit: cost ratio of different treatments is presented in Table 7. The highest benefit: cost ratio was recorded in treatment T_9 (50% NPK + PSB) (1: 5.54) which was followed by treatment T_3 (50% NPK) (1: 5.43). The treatment T_{11} (75% NPK + Azospirillum + PSB) showed benefit cost ratio (1: 5.28). The lowest B: C ratio was recorded in treatment T_1 (100% NPK) i.e. (1: 4.69) and T_4 (100% NPK + azospirillum) i.e. (1:4.76).

4. References

1. Aneesa Rani MS, Sathiamoorthy S. Effect of organic and bio fertilizer on root enzyme activity nematode, total biomass and growth enhancement of papaya cv. CO-6. South Indian Hort. 1997; 45(5&6):217-223.
2. Anonymous. Fertilizer requirement for chiku tree. Recommendation Annual Research Report on fruit crops G.A.U. Navsari centre (kharif), 1984, 1-5.
3. Blane D, Gilly G, Gras R. Comparative effect of organic manures and fertilizers on soil and vegetable yield in mediteranean climate. J Organic Manure Compets Rendus De-1 Academied agricultural de, France. 1989; 75(1):36-39.
4. Chaddha KL. Strategy for optimization of productivity and utilization of sapota (*Manilkara achras* (Mill.) Forseberg). Indian J. Horti. 1993; 49(1):1-17.
5. Durrani SM, Patil VK, Kadam BA. Effect of N, P, K, on growth, yield, fruit quality and leaf composition of Sapota. Indian J Agric. Sci. 1982; 52(4):231-234.
6. Shanmugavelu KG, Shrinivasan. Proximate composition of fruits of sapota (*Achras zapota* Linn.) cultivars. South Indian Hort. 1973; 21:107.
7. Singh Jitendra. Basic Horticulture. Bio fertillizer, 2007, 135-136.