"EFFECT OF BIOSTIMULANTS ON YIELD, QUALITY AND SHELF LIFE IN SAPOTA (*Manilkara achras* L. Forsberg) cv. Kalipatti"

Anitha L.R.[1]., Santosh Barkule[2] and Anshul Lohakare[3]
[1]M.Sc. (Horticulture) Scholar, Department of Horticulture, VNMKV, Parbhani, Maharashtra
[2]Assistant Professor,Department of Horticulture,VNMKV, Parbhani, Maharashtra
srbarkule@gmail.com
[3]Assistant Professor, College of Horticulture, VNMKV, Parbhani, Maharashtra

(MS Received: 28.11.2023; MS Revised:31.12.2023; MS Accepted:01.01.2024)

MS 3146 **(RESEARCH PAPER IN HORTICULTURE)**

Abstract

An investigation entitled "Standardization of biostimulants in sapota (Manilkara achras L. Fosrberg) cv. Kalipatti" was carried out at Horticulture Research Scheme (Pomology), Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani during the year 2022-2023. The experimental treatments content application of different levels of Potassium silicate, Orthosilicic acid and Seaweed extract in sapota crop.Different biostimulants significantly influenced yield, quality and shelf life of sapota. Application of potassium silicate (0.3%) showed maximum average number of fruits per plant (1153.64), yield of fruit per plant (98.81kg),yield of fruit per hectare (9.82 tonnes), TSS (22.60 ^{0}Brix), reducing sugar (12.14%), non-reducing sugar (9.53%), total sugar (21.65%), ascorbic acid (25.35 mg/100g) shelf life (8.12 days) with minimum tritable acidity (0.049%).Economic point of view, higher net realization of Rs.167470 observed in the treatment (T_3) Potassium Silicate (0.3%). However, maximum benefit cost ratio (3.52) was obtained with treatment (T_2) Potassium Silicate 0.2%.On the basis of result, it can be concluded that precise use of Potassium Silicate (0.3%) enhanced yield, quality and shelf life of fruits in sapota.

Keyword: *Kalipatti, Orthosicic acid, Potassium silicate, Sapota, Seaweed extract.*

Introduction

Sapota (*Manilkara achras* (Mill) Forsberg) comes under Sapotaceae family and it is one of the important crops grown in India, Mexico, Gautemala and Venezuala (Kulkarni *et al.*, 2007). Its exact date of introduction to India is unknown, but in 1898, a village by the name of Gholwad in Maharashtra began cultivating it (Cheema *et al.*, 1954). Maharashtra, Gujarat, Karnataka, Tamil Nadu etc are the states where it is commonly grown. For optimum growth all year long, it prefers temperature between 25°C to 35°C , at least 6 to 8 hours of direct sunlight each day. Sapota prefers soils that drain well and have a pH between 6.0 to 8.0. Loamy or sandy soils are best for growing it. The mature fruits serve as a great supply of raw materials for the production of industrial glucose, pectin, natural fruit jellies, mixed jams. The fruit is rich in vitamins A, B_1, B_2, B_6, and C as well as minerals like Calcium, Phosphorus, Iron, and Sodium when it is fully ripe. The Kalipatti variety of sapota is a popular cultivar. It has medium-sized, round or slightly oval-shaped fruit. When ripe, the fruit flesh has a gritty texture and is sweet, juicy and aromatic. It is one of the most significant fruits in the country, due to its wide range of adaptability, low production costs, fair economic returns and low sensitivity to pests and diseases (Chaddha, 1974).The fruit is nutritious, there is also necessary to increase and maintain fruit quality, yield and shelf life. The productivity of Maharashtra is lower as compared to national productivity of sapota Therefore, there is a need to use technique. Use of biostimulants may play an important role in increasing fruit set, physical fruit qualities, yield, productivity and shelf life of sapota.

The biostimulant silicon is considered as an excellent growth promoting agent, it increases plant growth and stimulates productivity. Silicon might helped in cell division, more nutrient and water uptake and ultimately resulted in production of more number and bigger fruits. Potassium silicate also helped in synthesis of more sugar content in fruit and thus resulted in increasing maximum total solids (Stamatakis *et al.*, 2003).The seaweed extract contains most nutrients, organic compounds, enzymes, vitamins, antioxidants, amino acids. It increases yield quantitatively and qualitatively in various fruit crops (Khan *et al*., 2012).

Hence an experiment was conducted to observe effect of foliar application of different biostimulants on yield, quality and shelf life of sapota fruit.

Materials And Methods

The experiment titled "Standardization of biostimulants in sapota (*Manilkara achras* L. Forsberg) cv. Kalipatti" was conducted at Horticulture Research Scheme (Pomology), Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. during 2022-2023. The experiment designed in Randomized Block Design with 10 treatments and three replications. Three foliar applications each in the month of October, November, and December were applied with potassium silicate, orthosilicic acid and seaweed extract on15 years old 10X 10m spaced sapota plants. The treatments were as fallows : T_1: Potassium silicate (0.1%), T_2 : Potassium silicate (0.2%), T_3 : Potassium silicate (0.3%), T_4 : Orthosilicic acid (0.1%), T_5 : Orthosilicic acid (0.2%), T_6 : Orthosilicic acid (0.3%), T_7 : Seaweed extract (0.1%), T_8 : Seaweed extract (0.2%), T_9 : Seaweed extract (0.3%), T_{10} : Control. The yield, quality and shelf life of fruits were recorded and statistically analyzed by methods of Panse, V.G. and Sukhtame, P.V (1967).

Results And Discussion

The perusal of the data presented in Table 1 regarding yield, quality and shelf life of fruits as influence by different biostimulants are discussed below.

Average number of fruits per plant

The average number of fruits per plant differed significantly among different treatments. Maximum average number of fruits per plant (1153.64) was recorded in the treatment T_3 (Potassium silicate at 0.3%). However, minimum average number of fruits per plant (850.64) was recorded in T_{10} (control).Increase in average number of fruits per plant might be due to potassium silicate would have played a role in controlling the aperture of stomata, influencing both the exchange of gases and the process of photosynthesis. Enhanced photosynthesis, in turn, can result in elevated carbohydrate production, a critical factor in the development of fruits. The results obtained in the present investigation are in close conformity with those of Lalithya *et al*. (2014) in sapota, Thippeshappa *et al*. (2014) in sapotaand El-Rahman (2010) in pomegranate.

Yield of fruit per plant (kg)

The yield of fruits per plant differed significantly among different treatments. Maximum yield of fruit per plant (98.81 kg) was recorded in the treatment T_3 (Potassium silicate at 0.3%) and it is at par with treatment T_2 (Potassium silicate at 0.2%) 96.48 kg. However minimum yield of fruit per plant (65.68 kg) was recorded in T_{10} (control).Increase in yield of fruits per plant might be due to silicate could have helped in the efficient uptake and transportation of potassium within the plant. When potassium levels are optimal, it can enhance fruit formation and development, leading to increased yield. The similar results were in conformation with results of Lalithya *et al*. (2014) and Thippeshappa *et al*. (2014) in sapota, El-Rhman (2010) in pomegranate and El-Gioushy (2016) in orange.

Yield of fruit per hectare (tonnes)

The data with respect to the yield of fruit per hectare are statistically analysed and significantly influenced by different biostimulants application is presented in Table1. Maximum yield of fruit per hectare (9.88 tonnes) was recorded in the treatment T_3 (Potassium silicate at 0.3%). However, minimum yield of fruit per hectare (6.56 tonnes) was recorded in T_{10} (control).Increase in yield of fruits per hactare might be due to silicate could have helped in the efficient uptake and transportation of potassium within the plant. When potassium levels are optimal, it can enhance fruit formation and development, leading to increased yield. The results were found similar with El-Rhman (2010) in pomegranate, Soil *et al.* (2013) in mango, Lalithya *et al.* (2014) in sapota, Roshdy (2014) in banana and Thippeshappa *et al.* (2014) in sapota.

TSS (^{0}Brix)

The maximum TSS (22.70 ^{0}Brix) was recorded in the treatment T_3 (Potassium silicate at 0.3%). While, minimum TSS (19.80 ^{0}Brix) was recorded in treatment T_{10} (control).Increase in TSS might be due to silicon and potassium might have played a role in promoting the synthesis of additional sugars within the fruit, consequently leading to an elevation in the overall content of soluble solids. The results are true with the results of Soil *et al* (2013) in mango, Lalithya *et al.* (2014) in sapota, Thippeshappa *et al.* (2014) in sapota, Hanumanthaiah *et al.* (2015) in banana and El-Gioushy (2016) in orange.

Reducing Sugar (%)

The result obtained regarding the reducing sugar are statistically analysed and significantly influenced by different biostimulants application is presented in Table1.The reducing sugar differed significantly among different biostimulant treatments. Maximum reducing sugar (12.14 %) was recorded in the treatment T_3 (Potassium silicate at 0.3%) which was statistically at par with treatment T_2 (Potassium silicate at 0.2%) 12.08% and T_1 (Potassium silicate at 0.1%) 11.75%. But minimum reducing sugar (9.02%) was recorded in treatment T_{10} (control).Increase in reducing sugar might be due to potassium silicate could have served as a stress mitigator for plants.When plants face environmental stressors like drought or disease, they often reassign their resources towards sugar production as a survival strategy, thereby encouraging the plant to increase sugar production. Similar results have been reported by Soil *et al* (2013) in mango, El-Rhman (2010) in pomegranate, Hanumanthaiah *et al.* (2015) in banana and Vijayan *et al.* (2021) in banana.

Non - Reducing Sugar (%)

The maximum non reducing sugar (9.53 %) was recorded in the treatment T_3 (Potassium silicate at 0.3%) however, minimum non reducing sugar (7.23 %) was recorded in treatment T_{10} (control).Increase in non-reducing sugar might be due to potassium silicate could have triggered a mild stress reaction in plants, potentially prompting the accumulation of non-reducing sugars like sucrose. These non-reducing sugars often serve as energy reserves for plants when they experience stressful conditions. Similar results were found with Hanumanthaiah *et al.* (2015) and Vijayan *et al.* (2021) in banana

Total Sugar (%)

The data regarding to the total sugar are statistically analysed and significantly influenced by different biostimulants application is presented in Table 1. The total sugar differed significantly among different treatments. Maximum total sugar (21.65 %) was recorded in the treatment T_3 (Potassium silicate at 0.3%) which was statistically at par with treatment T_2 (Potassium silicate at 0.2%) 21.38 %. However, minimum total sugar (16.25 %) was recorded in treatment T_{10} (control). Increase in total sugar might be due to silicate could have played a crucial role in maintaining an optimal pH and nutrient balance within plant tissues, which in turn is essential for the proper functioning of enzymes involved in sugar metabolism. When these enzymes operate efficiently, it can lead to the accumulation of higher levels of sugars, including the overall total sugar content in the plant. The results are aligned with the findings of El-Rhman (2010) in pomegranate, Soil *et al* (2013) in mango, El-Gioushy *et al.* (2016) in orange and Vijayan *et al.* (2021) in banana.

Titrable Acidity (%)

The acidity differed significantly among different treatments. Minimum acidity (0.049 %) was recorded in the treatment T_3 (Potassium silicate at 0.3%) however, maximum acidity (0.063 %) was recorded in treatment T_{10} (control). Decrease in acidity might be due to potassium silicate could have improved photosynthesis, through enhanced nutrient availability, results in greater sugar production. These sugars, including sucrose, serve as natural buffers that contribute to acidity balance. The increase in sugar content functions to offset acidity, resulting in a fruit with a less pronounced acidic taste. These results were conformity with the results of Hanumanthaiah *et al.* (2015) in banana, El-Gioushy *et al.* (2016) in orange and El Kholy *et al.* (2018) in loquat.

Shelf life (Days)

Maximum shelf life (8.12 days) was recorded in the treatment T_3 (Potassium silicate at 0.3%). However, minimum shelf life (6.35 days) was recorded in T_{10} (control). Increase in shelf life might be due to potassium silicate could have effectively decelerated the ripening process, leading to an extension of the fruit's shelf life. Ethylene is a naturally occurring plant hormone with a significant role in fruit ripening and senescence. Potassium silicate has the capability to affect both the production of ethylene and the fruit's sensitivity. The similar records were also reported by Lalithya *et al.* (2014) and Thippeshappa *et al.* (2014) in sapota and Hanumanthaiah *et al.* (2015) in banana.

Ascorbic acid (mg/ 100g of pulp)

The ascorbic acid differed significantly among different treatments. Maximum ascorbic acid (25.35 mg) was recorded in the treatment T_3 (Potassium silicate at 0.3%) which was statistically at par with T_2 (Potassium silicate at 0.2%) 24.76 mg. However, minimum ascorbic acid (19.20 mg) was recorded in T_{10} (control).Increase in reducing sugar might be due to potassium silicate could have triggered the plant's natural antioxidant defense mechanisms. Ascorbic acid, known for its potent antioxidant properties, plays a crucial role in shielding plant cells from oxidative harm. When plants confront stressors or adverse environmental conditions, they often boost their production of ascorbic acid as a means of countering oxidative stress. The application of potassium silicate can potentially stimulate this antioxidant reaction, resulting in elevated levels of ascorbic acid Similar finding is noted by El-Gioushy *et al.* (2016) in orange and Aziz *et al.* (2021) in loquat.

B:C Ratio

Maximum B:C ratio (3.52) was recorded in the treatment T_2 (Potassium silicate at 0.2%). However, minimum B:C ratio (2.08) was recorded in T_{10} (control). Regarding the economic returns, the highest gross return (Rs. 217382) and highest net income (Rs. 167470) was reported in T_3 i.e., Potassium silicate at 0.3%. Lowest gross returns (Rs. 105088) and lowest net income (Rs. 70952) was found in treatment T_{10} (control).

References

1. **Aziz, M. H., Soliman, M. A. & Ennab, H. A. (2021).** Effect of potassium silicate and chelated calcium sprays on yield, quality and storage of peach fruits cv."Dessert red". *Menoufia Journal of Plant Production*. 6(3), 119-135.
2. **Cheema, G. S., Bhat, S. S., & Naik, K. C. (1954).** Commercial fruits of India. *Commercial fruits of India.*
3. **Chaddha, K.L. (1974).** Production technology of banana. *Handbook of Horticulture*. 464-474.
4. **El-Gioushy, S. F. (2016).** Productivity, fruit quality and nutritional status of Washington navel orange trees as

influenced by foliar application with salicylic acid and potassium silicate combinations. *Journal of Horticultural Science & Ornamental Plants*. 8(2), 98-107.

5. **El Kholy, M. F., Mahmoud, A. A. & Mehaisen, S. M. A. (2018).** Impact of potassium silicate sprays on fruiting, fruit quality and fruit storability of loquat trees. *Middle East Journal of Agriculture Research.* 7(1), 139-153.
6. **El-Rhman, I. E. (2010).** Physiological studies on cracking phenomena of pomegranates. *Journal of Applied Science Research*. 6(6), 696 703.
7. **Hanumanthaiah, M. R., Hipparagi, K., Renuka, D. M., Vijendrakumar, R. C., Santhosha, K. V. & Kumar, K. K. (2015).** Effect of soil and foliar application of silicon on physical character, nutrient content of soil and leaf lamina of banana cv. Neypoovan under hill zone. *Plant Arch*. 15, 447-450.
8. **Khan, A. S., Ahmad, B., Jaskani, M. J., Ahmad, R. & Malik, A. U. (2012).** Foliar application of mixture of amino acids and seaweed (*Ascophylum nodosum*) extract improve growth and physicochemical properties of grapes. *Int. J. Agric. Biol*. 14(3), 383-388.
9. **Kulkarni, A. P., Policegoudra, R. S., & Aradhya, S. M. (2007).** Chemical composition and antioxidant activity of sapota (*Achras sapota* Linn.) fruit. *Journal of Food Biochemistry*, 31(3), 399-414.
10. **Lalithya, K. A., Bhagya, H. P. & Choudhary, R. (2014).** Response of silicon and micro nutrients on fruit character and nutrient content in leaf of sapota. *Biolife*. 2(2), 593-598.
11. **Mangesh D. Daberao1*, P.S.Joshi2 And Kuntal Satkar3 2016** Effect of growth regulator on yield and yield contribution on rejuvenated sapota orchid, Vol. Vi, Issue Xvii, July 2016 Multilogic In Science ISSN 2277-7601, PP 18-20.
12. **Navneet Kumar*, S. K. Attar, S.N. 2016**, Patel Effect Of Different Irrigation Treatments on Growth And Yield of Sapota, Volume V, Issue Xv Jan 2016 Multilogic In Science ISSN 2277-7601, PP 127-129.
13. **Panse, V.G. and Sukhtame, P.V. (1967).** Statistical methods for agricultural workers, ICAR, New Delhi.
14. **Roshdy, K. A. (2014).** Effect of spraying silicon and seaweed extract on growth and fruiting of grandnaine banana. *Egyptian Journal of Agricultural Research*. 92(3), 979-991
15. **Santosh Barkule1, Anshul Lohakare2 and Sachin Chavan3, 2021**,Influence Of Different Chemical Substances On Yield And Economics Of Sapota (Manilkara achras (Mill.) CV. KALIPATTI, Vol. Xi, Issue Xxxviii, April 2021 Multilogic In Science Issn 2277-7601, pp 1882-1883.
16. **Stamatakis, A., Papadantonakis, N., Savvas, D., Lydakis-Simantiris, N. & Kefalas, P. (2003).** Effects of silicon and salinity on fruit yield and quality of tomato grown hydroponically. In *International Symposium on Managing Greenhouse Crops in Saline Environment.* 609 (02), 141-147.
17. **Soil, M. T. G. U. S. (2013).** Using silicon and salicylic acid for promoting production of Hindybisinnara. *Middle East journal.* 2(2), 51-55.
18. **Thippeshappa, G. N., Ravi, C. S. & Ramesha, Y. S. (2014).** Influence of soil and foliar application of silicon on vegetative characters, fruit yield and nutrients content of sapota leaf. *Research on Crops*. 15(3), 626-630.
19. **Vijayan, A., Sriramachandrasekharan, M. V., Manivannan, R. & Shakila, A. (2021).** Effect of silicon through potassium silicate on yield, nutrient uptake and quality of grand naine banana. *Asian Journal of Agriculture Food Science.* 9(3).

Table 1: Effect of different biostimulants on yield and quality of fruits in sapota cv. Kalipatti"

Tr. No.	Treatments	Average number of fruits per plant	Yield of fruit per plant (kg)	Yield of fruit per hectare (tonnes)	TSS (^{0}Brix)	Reducing Sugar (%)	Non Reducing Sugar (%)	Total Sugar (%)	Acidity (%)	Shelf life (Days)	Ascorbic acid (mg/ 100g of pulp)	B:C Ratio
T_1	Potassium silicate (0.1%)	1059.46	94.22	9.42	21.80	11.75	9.04	20.69	0.054	7.60	23.21	3.30
T_2	Potassium silicate (0.2%)	1085.11	96.48	9.65	22.00	12.08	9.30	21.38	0.051	7.68	24.76	3.52
T_3	Potassium silicate (0.3%)	1153.64	98.81	9.88	22.70	12.14	9.53	21.65	0.049	8.12	25.35	3.35
T_4	Orthosilicic acid (0.1%)	1039.18	87.53	8.75	20.20	11.05	8.24	19.29	0.059	7.26	22.10	2.87
T_5	Orthosilicic acid (0.2%)	1047.13	89.55	8.95	20.53	11.08	8.46	19.54	0.058	7.35	22.26	2.67
T_6	Orthosilicic acid (0.3%)	1055.34	91.17	9.12	21.60	11.11	8.72	19.83	0.057	7.51	22.56	2.68
T_7	Seaweed extract (0.1%)	980.12	80.78	8.08	20.46	9.73	7.40	17.34	0.061	6.51	20.20	2.38
T_8	Seaweed extract (0.2%)	993.34	82.77	8.28	20.80	9.65	7.70	17.35	0.060	6.60	20.90	2.46
T_9	Seaweed extract (0.3%)	1000.50	83.40	8.34	21.40	9.94	7.71	17.44	0.059	6.85	21.60	2.69
T_{10}	Control	850.64	65.68	6.57	19.80	9.02	7.23	16.25	0.063	6.35	19.20	2.08
S.Em.±		**15.31**	**1.4**	**0.17**	**0.22**	**0.14**	**0.16**	**0.27**	**0.001**	**0.07**	**0.38**	
C.D. at 5 %		**45.48**	**4.17**	**0.46**	**0.65**	**0.41**	**0.48**	**0.81**	**0.003**	**0.21**	**1.13**	