"EFFECT OF BIOSTIMULANTS ON FRUIT SET AND PHYSICAL QUALITY OF FRUITS IN SAPOTA (*Manilkara achras* L. Forsberg) cv. Kalipatti"

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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 flowering, fruit seting and physical quality of sapota. Application of potassium silicate (0.3%) showed maximum number of flowers per tree (21186.46), weight of fruit (93.70g), length of fruit (6.07 cm), diameter of fruit (5.90cm), fruit firmness (5.33 kg/cm^2), volume of fruit (91.88 cm^3), pulp weight of fruit (80.11g), peel weight (11.98g), pulp to seed ratio (63.59), fruit retention percentage (39.10%) and minimum number of days required from flower to fruit set (45.36), number of days required for fruit set to maturity (245.80) and minimum fruit drop percentage (60.10%).The outcome disclosed that precise use of potassium silicate (0.3%) gave higher fruit set percentage and better physical qualities of sapota fruis.

***Key words** : Potassium silicate, Orthosilicic acid, Seaweed extract, Biostimulants and Kalipatti*

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 flowering, fruit set and physical qualities 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 flowering, fruit set, physical characters 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 and Table 2 regarding flowering, fruit set , fruit retention and physical characters of fruits as influence by different biostimulants are discussed below.

Total number of flowers per tree

The total number of flowers per tree differed significantly among different treatments. Maximum total number of flowers per tree (21186.46) was recorded in the treatment T_3 (Potassium silicate at 0.3%) however, minimum total number of flowers per tree (18889.37) was recorded in T_{10} (control). Increase in total number of flowers per tree might be due to the increased absorption of sunlight by silicon, which subsequently elevates the chlorophyll content within the leaves. This enhanced chlorophyll content plays a pivotal role in augmenting photosynthesis, leading to a higher production of photosynthates – the organic compounds produced during photosynthesis. The surplus of photosynthates may contribute significantly to the increased production of flowers on the tree. This is because these organic compounds serve as a vital source of energy and nutrients for various plant processes, including the initiation and development of flowers. The result is supported by the findings of Lalithya *et al.* (2014) and Thippeshappa *et al*. (2014) in sapota and El-Gioushy (2016) in orange trees.

Days required from flower to fruit set

Minimum number of days required from flower to fruit set (45.36) was recorded in the treatment T_3 (Potassium silicate at 0.3%). Whereas, maximum number of days required from flower to fruit set (54.60) was recorded in T_{10} (control). The minimum number of days required from flower to fruit set in sapota might be due to potassium

silicate could have helped in increased rate of uptake of essential nutrients, including potassium which are very important for the rapid flower development. The results are in accordance with the finding of Patil and jagadeesh (2016) in banana.

Weight of fruit (g)

The maximum weight of fruit (93.70g) was obtained under T_3 (Potassium silicate at 0.3%). However, minimum weight of fruit (79.50 g) was recorded in T_{10} (control).Increase in weight of fruit might be due to, potassium silicate could have played a key role in cell enlargement and growth. Adequate potassium levels can promote cell division and expansion in fruit tissues, contributing to the development of larger fruit. The results are also confirmed with Soil *et al.* (2013) in mango, Lalithya *et al.* (2014) in sapota and El-Gioushy (2016) in orange trees.

Length of fruit (cm)

The maximum length of fruit (6.07 cm) was recorded in the treatment T_3 (Potassium silicate at 0.3%).While, minimum length of fruit (5.16 cm) was recorded in T_{10} (control).Increase in length of fruit might be due to both potassium and silicate could have increased the uptake of other essential nutrients, such as calcium, which is crucial for cell wall formation. Improved nutrient uptake can lead to better cell division and elongation, contributing to increased fruit length. The result is in conformity with Thippeshappa *et al.* (2014) in sapota, Abd El- Rahaman (2015) in mango and Badram *et al.* (2015) in datepalm.

Diameter of fruit (cm).

The diameter of fruit differed significantly among different treatments. Maximum diameter of fruit (5.90 cm) was recorded in the treatment T_3 (Potassium silicate at 0.3%). The minimum diameter of fruit (4.69 cm) was recorded in T_{10} (control).Increase in diameter of fruit might be due to both potassium and silicate could have increased the uptake of other essential nutrients such as calcium, which is crucial for cell wall formation. Improved nutrient uptake can lead to better cell division and elongation, contributing to increased fruit diameter. These perceptions are conformity with Lalithya *et al.* (2014) in sapota and Badram *et al.* (2015) in datepalm.

Fruit firmness (kg/cm^2)

The maximum fruit firmness (5.33 kg/cm^2) was recorded in the treatment T_3 (Potassium silicate at 0.3%) however, minimum fruit firmness (4.24 kg/cm^2) was recorded in T_{10} (control). Increase in fruit firmness might be due to silicon could have helped in prevent fruit softening by influencing the activities of key enzymes responsible for breaking down the cell wall. These enzymes, including cellulase, polygalacturonase and xylanase are involved in the degradation of cell wall components. Silicon application exerts an inhibitory effect on these enzymes, thereby slowing down the process of fruit softening. These perceptions are in conformity with those Kaluwa *et al*. (2009) and Tesfay *et al*. (2011) in avocado and Aziz *et al*. (2021) in loquat.

Number of seed per fruit

The data on number of seed per fruit was found lowest (2.00) in treatment T_6(Orthosilicic acid 0.3%). While highest number of seed (2.33) was found in treatment in treatment T_4(Orthosilicic acid 0.1%). But this data was non significant.

Weight of seed (g)

The data on weight of seed varies from 1.30 g to 1.63 g and it was showed that the effect of different biostimulant concentrations on weight of seed was non significant.

Volume of fruit (cm^3)

The maximum volume of fruit (91.88 cm^3) was recorded in the treatment T_3 (Potassium silicate at 0.3%). While, minimum volume of fruit (78.00 cm^3) was recorded in T_{10} (control). Increase in volume of fruit might be due to silicon would have restricted stomatal conductance, resulting in decreased flexibility of the cell wall. Which in turn increases the cell elongation and structural support for the developing fruit, allowing it to expand and grow larger. Similar, results were reported by Lalithya *et al*. (2014) and Thippeshappa *et al*. (2014) in sapota and Aziz *et al*. (2021) in loquat

Pulp weight (g)

Maximum pulp weight of fruit (80.11 g) was recorded in the treatment T_3 (Potassium silicate at 0.3%) . But, minimum pulp weight of fruit (68.95 g) was recorded in T_{10} (control).Increase in pulp weight of fruit might be due to silicon would have helped in cell division in the initial stages and later due to cell expansion associated with movement of water and other metabolites into the cell causing increase in overall pulp weight of the fruit. The results are in agreement with the findings of El-Rhman (2010) in pomegranate.

Peel weight (g)

The peel weight of fruit differed significantly among different biostimulant treatments. The maximum peel weight of fruit (11.98 g) was recorded in the treatment T_3 (Potassium silicate at 0.3%). The treatment T_{10} (control) recorded minimum peel weight (8.90 g).The increase in peel weight in sapota resulting from the foliar spray of potassium silicate can be attributed to the strengthening of the fruit's cell walls due to silica uptake, which leads to thicker and more robust peels. The result is supported by the findings of El-Rhman (2010) in pomegranate.

Pulp to seed ratio

The pulp to seed ratio differed significantly among different biostimulant treatments. Maximum pulp to seed ratio (63.59) was recorded in the treatment T_3 (Potassium silicate at 0.3%). However, minimum pulp to seed ratio (41.79) was recorded in T_{10} (control).Increase in pulp to seed ratio might be due to potassium silicate would have enhanced the water uptake efficiency in plants. If the seeds and pulp have different water absorption rates, this could lead to varying rates of growth and result in a incresed pulp to seed ratio. This is consistent with the findings of Hanumanthaiah *et al*. (2015) in banana and Vijayan *et al*. (2021) in banana.

Fruit drop (%)

The data presented in the Table 2 revealed that minimum fruit drop (60.10 %) was obtained under T_3 (Potassium silicate at 0.3%) which was statistically at par with T_2 (Potassium silicate at 0.2%) 62.03 % and T_1 (Potassium silicate at 0.1%) 62.19 %. While, maximum fruit drop (66.48 %) was recorded in T_{10} (control).Decreased fruit drop might be due to, potassium would have served as a crucial element in a plant's ability to respond to environmental stress factors such as drought or nutrient deficiencies. Supplying potassium via potassium silicate enhances the plant's resilience thereby decreased the probability of fruit drop and silicon could also have increased the uptake of other essential nutrients and reduced the fruit drop percentage. The results are in accordance with finding of Abd El-Rahaman (2015) in mango and El-Gioushy (2016) in orange.

Fruit retension (%)

The data presented in the Table 2 revealed that maximum fruit retention (39.90 %) was obtained under T_3 (Potassium silicate at 0.3 %). Minimum fruit retention (33.52 %) was recorded in T_{10} (control).Increase in fruit retention might be due to, potassium would have served as a crucial element in a plant's ability to respond to environmental stress factors such as drought or nutrient deficiencies. Supplying potassium via potassium silicate enhances the plant's resilience, thereby increasing the probability of fruit retention. These results are in accordance with the findings of Badram *et al.* (2015) in datepalm, El-Gioushy (2016) in orange trees.

Days required for fruit set to maturity

Minimum number of days required for fruit set to maturity (237.01) was recorded in the treatment T_3 (Potassium silicate at 0.3%) while maximum number of days required for fruit set to maturity (255.64) was recorded in T_{10} (control). Minimum number of days required for fruit set to maturity in sapota might be due to potassium silicate would have increased the nutrient absorption and transport, encompassing

essential minerals and water. This heightened efficiency in nutrient uptake guarantees that the fruit obtains a sufficient and consistent supply of nutrients. Similar results also been obtained by Patil *et al.* (2016) in Banana.

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Table 1: Effect of different biostimulants on flowering, fruit set and physical quality of fruits in sapota cv. Kalipatti"

Tr. No.	Treatments	Total number of flowers per tree	Days required from flower to fruit set	Weight of fruit (g)	Length of fruit (cm)	Diameter of fruit (cm)	Volume of fruit (cm^3)	Number of seed per fruit
T_1	Potassium silicate (0.1%)	20469.12	46.73	88.07	5.75	5.22	87.00	2.20
T_2	Potassium silicate (0.2%)	20970.34	46.20	90.03	5.90	5.69	88.12	2.13
T_3	Potassium silicate (0.3%)	21186.46	45.36	93.70	6.07	5.90	91.88	2.26
T_4	Orthosilicic acid (0.1%)	19600.33	51.26	85.72	5.73	5.21	84.10	2.33
T_5	Orthosilicic acid (0.2%)	19700.21	51.06	86.65	5.74	5.24	85.35	2.20
T_6	Orthosilicic acid (0.3%)	20100.32	50.13	87.51	5.78	5.29	86.90	2.00
T_7	Seaweed extract (0.1%)	19000.27	52.53	83.73	5.38	4.85	82.89	2.06
T_8	Seaweed extract (0.2%)	19350.32	52.26	84.61	5.62	5.15	83.20	2.20
T_9	Seaweed extract (0.3%)	19550.42	51.46	84.71	5.70	5.22	84.82	2.13
T_{10}	Control	18889.37	54.60	79.50	5.16	4.69	78.00	2.24
S.Em.±		**244.9**	**0.44**	**1.22**	**0.10**	**0.08**	**1.25**	**0.12**
C.D. at 5 %		**727.64**	**1.29**	**3.66**	**0.29**	**0.22**	**3.72**	**NS**

Table 2: Effect of different biostimulants on fruit retention and physical quality of fruits in sapota cv. Kalipatti"

Tr. No.	Treatments	Weight of seed (g)	Pulp weight (g)	Peel weight (g)	Pulp to seed ratio	Fruit drop (%)	Fruit retension (%)	Days required for fruit set to maturity
T_1	Potassium silicate (0.1%)	1.50	77.05	10.95	51.48	62.19	37.81	246.93
T_2	Potassium silicate (0.2%)	1.30	78.08	11.45	61.35	62.03	37.97	246.40
T_3	Potassium silicate (0.3%)	1.60	80.11	11.98	63.59	60.10	39.90	237.01
T_4	Orthosilicic acid (0.1%)	1.40	73.77	10.55	52.69	64.34	35.66	246.98
T_5	Orthosilicic acid (0.2%)	1.33	74.64	10.68	56.12	63.96	36.04	246.64
T_6	Orthosilicic acid (0.3%)	1.30	75.41	10.80	58.00	63.09	36.91	246.33
T_7	Seaweed extract (0.1%)	1.52	72.91	9.17	44.18	64.00	36.00	247.67
T_8	Seaweed extract (0.2%)	1.63	73.18	9.80	44.89	64.26	35.74	247.13
T_9	Seaweed extract (0.3%)	1.30	72.88	10.23	45.55	64.15	35.85	247.00
T_{10}	Control	1.63	68.95	8.90	41.79	66.48	33.52	255.64
S.Em.±		**0.11**	**0.99**	**0.17**	**0.75**	**0.98**	**0.31**	**3.12**
C.D. at 5 %		**NS**	**2.96**	**0.51**	**2.22**	**2.96**	**0.90**	**9.41**