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Effect of Foliar Application of Potassium Silicate on Growth Attributes of Jamun (*Syzygium cumini* (L.) Skeels.) cv. Goma Priyanka

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was carried out on the Instructional Farm, which finds its location intricately linked to the Department of Fruit Science at the esteemed College of Horticulture and Forestry in Jhalarapatan, a prominent site within the Jhalawar region. during (2021-22 and 2022-23) with the object of assessing the response of foliar humic acid on growth attributes of Jamun (*Syzygium*

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cumini (L.) Skeels) cv. Goma Priyanka. Four doses of Potassium silicate (KS) 0, 1000, 2000 and 3000 ppm were tried in 4 treatments in a factorial randomized block design. The foliar response of Potassium silicate KS_3 (3000 ppm) treatment registered relatively better plant growth parameters viz. rootstock girth, scion girth, plant height, canopy volume, canopy spread E-W, N-S, of Jamun cv. Goma Priyanka plants.

Keywords: Growth attributes; jamun; potassium silicate.

1. INTRODUCTION

Jamun holds the distinction of being an indigenous minor fruit crop in India, scientifically designated as *Syzygium cumini* Skeels. It also answers to the names *Syzygium jambolanum* and *Eugenia cumini*, all members of the Myrtaceae family. Among its diverse appellations are Jambul, Black Plum, Java Plum, Indian Blackberry, Jambulang, and Jamun. This tree's presence extends across the Asian subcontinent, Eastern Africa, South America, and Madagascar. Additionally, it has adapted to the climates of Florida and Hawaii in the United States of America (Warrier et al. 1996). The historical roots of Jamun trace back to India, but its cultivation has extended to other countries including Thailand, the Philippines, and Madagascar. Impressively, the tree has found successful establishment in regions as varied as the West Indies, California, Algeria, and Israel.

Within India, Jamun thrives predominantly in tropical and subtropical zones. Its presence is observed in the lower elevations of the Himalayas, reaching up to 1300 meters, and in the Kumaon hills up to 1600 meters. The cultivation of Jamun spans a wide geographic spectrum, encompassing the Indo-Gangetic plains in the North to Tamil Nadu in the South [1]. While approximately 75 native species reside within the Syzygium genus, only a handful possess notable commercial value. Jamun, recognized for its substantial evergreen form, bears fruits resembling dates but is distinguished by their darker hue and prominent elongated seeds.

Its extensive cultivation is a hallmark of India, with production zones stretching from the Indo-Gangetic plains in the north to Tamil Nadu in the south. Maharashtra assumes a leading role in jamun production, followed by Uttar Pradesh, Tamil Nadu, Gujarat, and other contributing states [2-5].

Jamun fruits are rich repositories of nutrients, notably boasting a high iron content.

Goma Priyanka stands as a highly promising jamun cultivar, officially released by CHES Godhra (CIAH-ICAR) Gujarat in 2009. Its potential is particularly recognized for the semi-arid regions within our country. This cultivar is characterized by its dense foliage, expansive growth habit, semi-dwarf stature, and elegantly drooping branches. A notable trait is its early flowering, commencing from the fourth year onwards, making it an early-bearing variety that holds significant value.

Potassium silicate, also known as K_2SiO_3, is a source of potassium (K), as well as highly soluble silicon, and is used in the plant industry as a biostimulant. When it comes to crop production, silicon is often regarded as one of the most important elements, particularly for its ability to mitigate the damaging effects of salt stress and oxidative stress. Si can enhance the architecture of plant roots, as well as plant development, leaf erectness, photosynthesis, and water relations. According to Hasanuzzaman et al. [6], potassium is one of the key components of the plant and plays an important role in the production of sugars and starch, the synthesis of proteins, the division of cells, the plant's development, and its seed size and quality. Potassium has been proven to boost physiological processes such as the production of chlorophyll pigments, the movement of stomata, and the plant's overall water status. Root length, vegetative development, and osmoregulation are all stimulated by potassium. Ahanger et al. [7] explored how plants encounter various environmental stresses, causing an increase in ROS production. ROS is vital for plant functions, and any concentration changes disrupt plant physiology. A well-functioning antioxidant system, composed of enzymatic and non-enzymatic elements, maintains the ROS balance. When this system is suppressed, ROS-related oxidative stress harms cellular structures and metabolic processes. Adequate mineral nutrition, including potassium (K), is crucial for growth and yield. K, a key macro-element, modulates growth, osmolyte accumulation, and antioxidant components, particularly under water and salt

stress. Potassium silicate has the potential to increase growth-related characteristics, yield-related characteristics, the quantity of fruits produced, fruit quality, and the absorption of nutrients (N, P, and K). It has been demonstrated in several studies that potassium silicate has a significant impact on the growth, output, and quality of plants [8].

2. MATERIALS AND METHODS

The conducted experiment transpired within the confines of the Instructional Farm, which finds its location intricately linked to the Department of Fruit Science at the esteemed College of Horticulture and Forestry in Jhalarapatan, a prominent site within the Jhalawar region. Jhalawar district is positioned in the South-Eastern part of Rajasthan, India, spanning from 23°4' to 24°52' N latitude and 75°29' to 76°56' E longitude. In terms of agro-climatic classification, this district falls within Zone V and is classified as the Humid South Eastern Plain. This scientific study embarked upon an exploration of considerable significance, spanning a biennial period from 2021 to 2023. The focal point of this temporal trajectory was an established orchard, poised at a pivotal juncture commonly referred to as the "gestation phase." During this period, characterized by burgeoning potential and transformative growth, the orchard became a nurturing habitat for a collection of Jamun trees, uniquely classified under the Goma Priyanka cultivar. These trees, thoughtfully placed upon raised beds, stand as a testament to the intricacies of adaptation and vigour. The experiment is laid out in a Factorial randomized block design with a factorial concept containing 4 treatment combinations (KS_0, KS_1, KS_2, KS_3,) in which KS_0: Control (Water Spray). KS_1: 1000 ppm, KS_2: 2000 ppm, KS_3: 3000ppm. Application of treatment was given in first week of August.

Chart 1. Treatments detail

S. No.	Treatment notation	Treatment content
1.	T_0	Control (Water Spray)
2.	T_1	Potassium silicate1000 ppm
3.	T_2	Potassium silicate 2000 ppm
4.	T_3	Potassium silicate 3000 ppm

2.1 Observations Recorded

The initial growth characteristics of Jamun cv. Goma Priyanka plants were meticulously documented during August 2021 and August 2022, Following, this, a consistent schedule of recording growth parameters was upheld, with measurements taken at bi-monthly intervals until the research concluded. These intervals encompassed observations in October 2021, December 2021, and March 2022. Furthermore, the second year of the investigation entailed the collection of data concerning both growth and physiological attributes. This data was gathered during specific intervals, specifically in October 2022, December 2022, leading up to the culmination of the experiment in March 2023.

2.2 Data Collected Throughout the Research Duration

1. Rootstock girth (mm)
2. Scion girth (mm)
3. Height of the plant(m)
4. Canopy volume (m^3)
5. Canopy spread (m)

a) East-West
b) North-South

2.3 Methodology used for Observations

Rootstock girth(mm): To assess the rootstock girth of the Jamun plants, a systematic procedure was adopted. A specific point on the rootstock was marked using white paint, precisely positioned at a height of 10.0 cm from the base. The initial measurement of the rootstock girth was conducted using a digital Vernier Callipers. This measurement was taken prior to the application of any treatments, within the first week of August 2021.

Subsequently, a consistent schedule of observation was established. The rootstock's girth was measured at regular intervals of every two months. These observations served to track any changes or growth in the rootstock over time. To quantify this growth, the average increase in the girth of the rootstock was determined. This calculation involved considering the cumulative increment in the initial girth value, which provided insights into the development of the rootstock at the specified time intervals.

Scion girth (mm): In order to assess the girth of the scion on the Jamun cv. Goma Priyanka plants, a systematic methodology was followed. A distinct point on the scion was designated and marked with white paint, ensuring consistency in the measurement location. The initial girth of the

scion was meticulously measured using a Vernier Calliper. This measurement was conducted before any treatments were applied, specifically within the initial week of August 2021.

Subsequent to the initial measurement, a structured routine of observation was maintained. The girth of the scion was measured at the same marked point, adhering to a consistent interval of every two months. This approach allowed for the systematic tracking of changes in the scion's girth over time. To quantify these changes, the average increase in the scion's girth was computed. This computation was based on the cumulative augmentation in the initial girth measurement, providing valuable insights into the growth progress of the scion at the designated intervals.

Plant height(m): The height of Jamun cv. Goma Priyanka plants under varying treatment combinations of KS and HA was gauged, starting from the soil base and extending to the plant's uppermost tip, using a measuring tape. Following this, consistent observations were meticulously documented at the exact same spot at bi-monthly intervals.

Canopy volume(m^3): The canopy volume measurement of Jamun cv. Goma Priyanka plants, as influenced by various treatments, was conducted using the formula proposed by Westwood in 1963. This measurement was taken in cubic meters and covered the duration of the experiment from its inception to the conclusion, spanning a total of 210 days. The process involved tracking the cumulative increase in initial values starting from August 2021, with periodic assessments carried out in October 2021, December 2021, and March 2022.

Furthermore, in the second year of the experiment, canopy volume increases were recorded based on the initial value from August 2022. These measurements were taken in October 2022, December 2022, and March 2023. To determine the percentage increase in canopy volume, the recorded values of plant height and plant spread were employed, using the provided formula:

Canopy Volume (m^3) = $4/3\pi\ a^2b$ Where,
a=Half of the plant height
b=Average of the plant spread in E-W and N-S directions
specifically, [(E-W+N-S)/4]

Canopy spread (m): The expansion of Jamun cv. Goma Priyanka plants, prompted by foliar treatments utilizing HA and KS, were documented by measuring their reach in both the East-West and North-South directions. This measurement was meticulously accomplished using a measuring tape. Subsequently, the average spread for each of these directions was computed at specified intervals, pooling the data obtained from recorded measurements.

3. RESULTS

3.1 Rootstock Girth (mm)

Individual Effect of Potassium Silicate: The outcomes related to the individual impact of potassium silicate as a foliar response in Jamun cv. Goma Priyanka plants, concerning the percentage increase in rootstock girth, during two consecutive experimental trials (2021-22 and 2022-23), are displayed in Table 1. The data for the initial experimental season (2021-22) indicated that the maximum percentage increase in rootstock girth (1.88%) in March 2022 was recorded under the treatment involving the application of KS_3 level (3000 ppm) of potassium silicate. This value was significantly greater than that of the other treatments. Conversely, the minimum percentage increase in rootstock girth (1.73%) was observed in the KS_0 (Control) treatment, demonstrating a notable decrease compared to the other treatment conditions.

The findings from the second trial (2022-23) disclosed that the total maximum percentage increase in rootstock girth (1.94%) in March 2023 was achieved through the application of the KS_3 level (3000 ppm) of potassium silicate. This measurement was significantly superior to that of the other treatments. On the other hand, the minimum percentage increase in rootstock girth (1.58%) was observed in the KS_0 (Control) treatment, exhibiting a notable reduction in comparison to the other treatment conditions.

Pooled Effect of Potassium Silicate: The provided data presents an aggregated analysis regarding the impact of potassium silicate on the cumulative percentage increase of rootstock girth in Jamun cv. Goma Priyanka plants during two successive experimental trials (2021-22 and 2022-23), as displayed in Table 2. The collective outcomes concerning the enhancement of rootstock girth demonstrated that the maximum cumulative percentage increase (1.77%) in rootstock girth during March (2022-23) was

Table 1. Effect of potassium silicate on per cent increase of Rootstock girth (mm) in Jamun cv. Goma Priyanka plants

Treatments	Initial Value (mm)	I Experimental Year			Initial Value (mm)	II Experimental Year		
		Oct. 2021	Dec. 2021	March 2022		Oct. 2022	Dec. 2022	Mar. 2023
KS_0 (Control)	216.67	217.57 (1.07%)	219.60 (1.44%)	221.58 (1.73%)	228.75	230.19 (1.06%)	231.97 (1.38%)	233.37 (1.58%)
KS_1 (1000ppm)	215.08	216.62 (1.10%)	218.62 (1.46%)	221.07 (1.81%)	228.11	229.69 (1.08%)	231.74 (1.44%)	234.16 (1.77%)
KS_2 (2000ppm)	216.00	217.51 (1.09%)	219.61 (1.47%)	222.11 (1.82%)	228.63	230.35 (1.11%)	232.57 (1.48%)	235.15 (1.83%)
KS_3 (3000ppm)	216.74	218.76 (1.20%)	221.00 (1.57%)	223.29 (1.88%)	231.32	233.80 (1.26%)	236.61 (1.66%)	238.92 (1.94%)
SEm (±)	1.31	0.01	0.01	0.01	1.28	0.01	0.01	0.01
CD (5%)	NS	0.03	0.03	0.05	3.72	0.05	0.03	0.03

**Values in parenthesis indicate square root transformed values*

Table 2. Pooled analysis representing effect of Potassium silicate on per cent increase of Rootstock girth (mm) in Jamun cv. Goma Priyanka plants

Treatments	Initial Value (mm)	Pooled Analysis (I and II Experimental year)		
		Oct. (2021-22)	Dec. (2021-22)	Mar. (2022-23)
KS_0(Control)	222.45	223.88 (1.06%)	225.79 (1.41%)	226.49 (1.52%)
KS_1(1000ppm)	221.59	223.61 (1.09%)	225.19 (1.45%)	226.39 (1.63%)
KS_2(2000ppm)	222.32	223.93 (1.10%)	226.09 (1.48%)	227.38 (1.66%)
KS_3(3000ppm)	224.01	226.33 (1.23%)	228.81 (1.62%)	229.96 (1.77%)
SEm (±)	2.51	0.009	0.009	0.006
CD (5%)	7.25	0.026	0.028	0.024

**Values in parenthesis indicate square root transformed values*

achieved through the application of the KS_3 level (3000 ppm) of potassium silicate. This value was markedly higher compared to the treatments involving KS_2, KS_1, and KS_0. Conversely, the minimum cumulative percentage increase (1.52%) in rootstock girth for Jamun cv. Goma Priyanka plants during March (2022-23) was observed in the KS_0 (Control) treatment.

3.2 Scion Girth (mm)

Individual Effect of Potassium Silicate: The data provided in Table 3 signifies the impact of foliar application of potassium silicate and humic acid on the scion girth performance of Jamun cv. Goma Priyanka plants over the course of two consecutive experimental seasons, namely (2021-22) and (2022-23). In the context of the initial season, the outcomes revealed that the most substantial percentage increase in scion girth (2.65%) for Jamun cv. Goma Priyanka plants were observed in the KS3 (2000ppm) treatment. This effect was notably and significantly greater in comparison to all other treatment options. Conversely, the minimum percentage increase in scion girth (2.12%) for Jamun cv. Goma Priyanka plants was recorded in the KS_0 (Control) treatment, exhibiting a statistically significant decrease in comparison to the remaining treatment groups.

The outcomes in the second season (2022-23) unveiled that the most substantial percentage increase in scion girth (2.63%) for Jamun cv. Goma Priyanka plants were evident in the KS_3 (3000ppm) treatment. This observation significantly surpassed the effects observed in all other treatments. Conversely, the minimum percentage increase in scion girth (2.11%) for Jamun cv. Goma Priyanka plants was documented in the KS_0 (Control) treatment, demonstrating a statistically significant lower impact compared to the other treatments. The relatively improved percentage increase in scion girth achieved with the KS_3 (2000ppm) treatment could potentially be attributed to heightened lignification and deposition in plant tissues, resulting in the development of sturdier and thicker cell walls, thus influencing scion girth.

Table 3. Effect of potassium silicate on per cent increase of Scion girth (mm) in Jamun cv. Goma Priyanka plants

Treatments	Initial Value (mm)	I Experimental Year			Initial Value (mm)	II Experimental Year		
		Oct. 2021	Dec. 2021	March 2022		Oct. 2022	Dec. 2022	Mar. 2023
KS_0 (Control)	198.97	201.87 (1.39%)	204.49 (1.81%)	206.98 (2.12%)	214.67	217.55 (1.35%)	220.46 (1.78%)	223.16 (2.11%)
KS_1 (1000ppm)	200.03	203.49 (1.49%)	206.68 (1.95%)	209.93 (2.33%)	217.46	221.13 (1.47%)	223.87 (1.85%)	227.74 (2.28%)
KS_2 (2000ppm)	198.95	202.63 (1.53%)	206.03 (2.01%)	210.23 (2.48%)	218.65	222.79 (1.54%)	226.41 (2.01%)	230.93 (2.47%)
KS_3 (3000ppm)	199.84	204.45 (1.67%)	208.62 (2.21%)	212.89 (2.65%)	221.56	226.68 (1.67%)	231.45 (2.22%)	235.81 (2.63%)
SEm(±)	2.71	0.008	0.010	0.008	2.74	0.013	0.010	0.008
CD (5%)	7.83	0.023	0.030	0.025	7.92	0.039	0.029	0.024

**Values in parenthesis indicate square root transformed values*

Table 4. Pooled analysis representing effect of potassium silicate on per cent increase of scion girth (mm) in jamun cv. goma priyanka plants

Treatments	Initial Value(mm)	Pooled Analysis (I and II Experimental year)		
		Oct. (2021-22)	Dec. (2021-22)	Mar. (2022-23)
KS_0(Control)	206.82	209.71 (1.37%)	212.48 (1.79%)	215.07 (2.11%)
KS_1(1000ppm)	208.75	212.56 (1.48%)	215.28 (1.90%)	218.84 (2.30%)
KS_2(2000ppm)	208.80	212.71 (1.54%)	216.22 (2.01%)	220.58 (2.47%)
KS_3(3000ppm)	210.70	215.57 (1.67%)	220.04 (2.21%)	224.35 (2.64%)
SEm(±)	5.34	0.007	0.006	0.006
CD (5%)	15.45	0.020	0.019	0.018

**Values in parenthesis indicate square root transformed values*

Pooled Effect of Potassium Silicate: The data is depicted in Table 4, provide a comprehensive analysis of the collective impact on the enhancement of scion girth in Jamun cv. Goma Priyanka plants resulting from the foliar application of varying levels of potassium silicate. The findings from this pooled analysis indicated that the maximum percentage increase in scion girth, reaching a value of 2.64%, was achieved with the KS_3 treatment (3000ppm). Notably, the KS_3 treatment displayed a distinct and superior performance compared to all other treatments in fostering the augmentation of scion girth. Correspondingly, the lowest percentage increase in scion girth (2.11%) was observed in the KS_0 (Control) treatment, signifying a statistically significant inferiority when compared to the other treatments.

3.3 Plant Height (m)

Individual Effect of Potassium Silicate: The data exhibited in Table 5 reveals the augmentation in plant height of Jamun cv. Goma Priyanka plants under foliar application of three levels of potassium silicate with progression of growth period on all the days of observation from October 2021 to March 2022. During first year of experimental research (2021-22) and during March 2022, the maximum per cent increase in plant height attribute (3.45%) was estimated in potassium silicate level of KS_3 (3000ppm) treatment and KS_3 treatment was found highly superior in per cent increase of plant height as compared with rest of the treatments. However, the minimum per cent increase in plant height variable (3.03%) was recorded in control.

The results were in response to effect of potassium silicate on augmentation in plant height of Jamun cv. Goma Priyanka during second experimental season (October 2022 to March 2023) revealed that during March 2023, the maximum per cent increase in plant height (3.49%) was estimated in KS_3 (3000ppm) and it was observed significant higher over rest of the treatments. However, the minimum per cent increase in plant height (2.93%) was measured inT_0 (control) treatment.

Table 5. Effect of potassium silicate on per cent increase of Plant height (m) in Jamun cv. Goma Priyanka plants

Treatments	Initial Value (m)	I Experimental Year			Initial Value (m)	II Experimental Year		
		Oct. 2021	Dec. 2021	March 2022		Oct. 2022	Dec. 2022	Mar. 2023
KS_0 (Control)	2.91	3.00 (1.82%)	3.08 (2.49%)	3.17 (3.03%)	3.33	3.42 (1.81%)	3.50 (2.40%)	3.62 (2.93%)
KS_1 (1000ppm)	2.99	3.09 (1.98%)	3.18 (2.62%)	3.27 (3.15%)	3.44	3.56 (2.01%)	3.66 (2.63%)	3.78 (3.10%)
KS_2 (2000ppm)	3.04	3.16 (2.10%)	3.25 (2.73%)	3.35 (3.28%)	3.52	3.67 (2.19%)	3.78 (2.80%)	3.92 (3.28%)
KS_3 (3000ppm)	3.14	3.28 (2.26%)	3.38 (2.85%)	3.50 (3.45%)	3.67	3.86 (2.37%)	3.99 (3.04%)	4.16 (3.49%)
SEm(±)	0.01	0.01	0.01	0.00	0.01	0.00	0.01	0.00
CD (5%)	0.03	0.03	0.03	0.02	0.03	0.02	0.03	0.02

**Values in parenthesis indicate square root transformed values*

Table 6. Pooled analysis representing effect of potassium silicate on per cent increase of Plant height (m) in Jamun cv. Goma Priyanka plants

Treatments	Initial Value (m)	Pooled Analysis (I and II Experimental year)		
		Oct. (2021-22)	Dec. (2021-22)	Mar. (2022-23)
KS_0(Control)	3.12	3.21 (1.81%)	3.29 (2.44%)	3.40 (3.04%)
KS_1(1000ppm)	3.21	3.33 (2.00%)	3.42 (2.62%)	3.53 (3.20%)
KS_2(2000ppm)	3.28	3.42 (2.14%)	3.52 (2.77%)	3.64 (3.38%)
KS_3(3000ppm)	3.41	3.58 (2.32%)	3.69 (2.95%)	3.83 (3.59%)
SEm (±)	0.01	0.00	0.00	0.00
CD (5%)	0.03	0.02	0.02	0.02

**Values in parenthesis indicate square root transformed values*

Pooled Effect of Potassium Silicate: The data represented in Table 6 exhibits pooled analysis of foliar response of varying potassium silicate levels on per cent increase in plant height of Jamun cv. Goma Priyanka leaves during two successive experimental trials (2021-23) in vertisols of Jhalawar district. The pooled results (2021-23) concerning plant height increment in Jamun cv. Goma Priyanka revealed that during March (2022-23), the maximum per cent increase in plant height (3.59%) was obtained in response to application effect of potassium silicate level inKS3 (3000ppm) treatment and it was observed significantly higher over rest of the treatments. However, during March (2022-23), the minimum per cent increase (3.04%) in plant height of Jamun was estimated in in KS0 (Control).

3.4 Canopy Volume (m^3)

Individual Effect of Potassium Silicate: The results elaborating augmentation in canopy volume of Jamun cv. Goma Priyanka plants in response to foliar effect of potassium silicate during first experimental season (Oc.2021 to March 2022) are presented in Table 7.The results revealed that during first experimental duration, maximum per cent increase in canopy volume (6.20%)of Jamun cv. Goma Priyanka plants was obtained in KS_3 (3000ppm) treatment and it was observed highly significant as compared with rest of the treatments. Likewise, minimum per cent increase in canopy volume (5.39%) of Jamun plants was obtained in KS_0 (Control) treatment and it was found significantly lower as compared with rest of the treatments.

The experimental results during second season (Oct.2022 to March 2023) revealed that maximum per cent increase in canopy volume (6.19%) of Jamun cv. Goma Priyanka plants was measured in KS_3 (3000ppm) and it was observed statistically distinct as compared with rest of the treatments. However, minimum per cent increase in canopy volume (4.98%) of Jamun cv. Goma Priyanka plants was recorded in KS_0 (Control) treatment and it was observed significantly lower as compared with rest of the treatments.

Table 7. Effect of potassium silicate on per cent increase of Canopy volume (m^3) in Jamun cv. Goma Priyanka plants

Treatments	Initial Value (m^3)	I Experimental Year			Initial Value (m^3)	II Experimental Year		
		Oct. 2021	Dec. 2021	March 2022		Oct. 2022	Dec. 2022	Mar. 2023
KS_0 (Control)	31.64	34.19 (2.91%)	37.07 (4.20%)	40.70 (5.39%)	45.71	49.12 (2.81%)	52.39 (3.88%)	56.88 (4.98%)
KS_1 (1000ppm)	33.21	36.45 (3.19%)	39.52 (4.41%)	43.40 (5.58%)	48.77	53.05 (3.13%)	57.42 (4.26%)	63.75 (5.37%)
KS_2 (2000ppm)	34.59	38.34 (3.36%)	41.71 (4.59%)	46.25 (5.85%)	51.82	57.19 (3.40%)	62.29 (4.54%)	68.65 (5.73%)
KS_3 (3000ppm)	36.37	40.96 (3.61%)	44.69 (4.83%)	50.24 (6.20%)	56.70	63.78 (3.68%)	70.35 (4.94%)	78.29 (6.19%)
SEm(±)	0.38	0.02	0.02	0.03	0.52	0.01	0.02	0.02
CD (5%)	1.11	0.06	0.06	0.11	1.51	0.05	0.07	0.07

**Values in parenthesis indicate square root transformed values*

Table 8. Pooled analysis representing effect of Potassium silicate on per cent increase of Canopy volume (m^3) in Jamun cv. Goma Priyanka plants

Treatments	Initial Value (m^3)	Pooled Analysis (I and II Experimental year)		
		Oct. (2021-22)	Dec. (2021-22)	Mar. (2022-23)
KS_0(Control)	38.67	41.65 (2.85%)	44.73 (4.03%)	48.79 (5.15%)
KS_1(1000ppm)	40.99	44.89 (3.15%)	48.47 (4.34%)	53.59 (5.44%)
KS_2(2000ppm)	43.20	47.97 (3.39%)	52.00 (4.56%)	57.45 (5.78%)
KS_3(3000ppm)	46.54	52.54 (3.65%)	57.52 (4.90%)	64.26 (6.19%)
SEm(±)	0.44	0.01	0.02	0.01
CD (5%)	1.29	0.03	0.05	0.05

**Values in parenthesis indicate square root transformed values*

Pooled Effect of Potassium Silicate: The results presented in Table 8 reflects pooled analysis of two experimental duration (2021-23) with respect to foliar effect of potassium silicate on per cent increase of canopy volume of Jamun cv. Goma Priyanka plants**.** The data revealed that maximum overall per cent increase in canopy volume (6.19%) of Jamun plants during March (2022-23) was recorded in KS_3 (3000ppm) treatment and it was observed significantly higher in augmentation of canopy volume as compared with rest of the plants.

However, a minimum per cent increase in canopy volume (5.15%) of Jamun plants was estimated in KS_0 (Control) treatment. The better augmentation in canopy volume of Jamun cv. Goma Priyanka plants obtained in KS_3 (3000 ppm) could be due to enhanced cell wall strength and deposition of Silicon might improve Jamun leaves structural integrity as well as increased nutrient uptake efficiency.

3.5 Canopy Spread E-W (m)

The presented data provides a comprehensive analysis of the individual effects of potassium silicate as a foliar response on Jamun cv. Goma Priyanka plants over two consecutive experimental trials, conducted during the periods 2021-22 and 2022-23. The summarized results are displayed in Table 9.

In the first experimental season (2021-22), the data revealed that the maximum percentage increase in the East-West spread, specifically 6.81%, was observed during March 2022. This increase was associated with the application of potassium silicate at the KS_3 level, with a concentration of 3000ppm. Interestingly, this increase was on par with the results obtained from the KS_2 treatment, which had a concentration of 2000 ppm. The KS_3 treatment showed a statistically significant increase over the KS_1 treatment (1000ppm) and the control treatment (KS_0). However, the minimum percentage increase in East-West spread, which was 5.36%, was observed in the control treatment (KS_0), and this was similar to the increases observed in the KS_1 and KS_2 treatments.

During the second experimental trial (2022-23), the results indicated that the cumulative

Table 9. Effect of potassium silicate on per cent increase in east west spread (m) of Jamun cv. Goma Priyanka plants

Treatments	Initial Value (m)	I Experimental Year			Initial Value (m)	II Experimental Year		
		Oct. 2021	Dec. 2021	March 2022		Oct. 2022	Dec. 2022	Mar. 2023
KS_0 (Control)	2.99	3.05 (1.92%)	3.11 (3.92%)	3.15 (5.36%)	3.19	3.23 (1.30%)	3.26 (2.89%)	3.33 (4.35%)
KS_1 (1000ppm)	2.97	3.03 (2.04%)	3.09 (4.05%)	3.14 (5.70%)	3.17	3.22 (1.38%)	3.27 (3.12%)	3.32 (4.61%)
KS_2 (2000ppm)	2.99	3.05 (2.06%)	3.11 (4.29%)	3.17 (6.25%)	3.20	3.25 (1.50%)	3.31 (3.24%)	3.36 (4.91%)
KS_3 (3000ppm)	2.98	3.04 (2.29%)	3.12 (4.93%)	3.17 (6.81%)	3.22	3.27 (1.44%)	3.34 (3.59%)	3.41 (5.90%)
SEm(±)	0.02	0.08	0.22	0.32	0.02	0.11	0.11	0.21
CD (5%)	0.07	0.24	0.65	0.92	0.07	0.33	0.34	0.60

**Values in parentheses indicate square root transformed values*

maximum percentage increase in the East-West spread, amounting to 5.90%, occurred in March 2023. This increase was attributed to the application of potassium silicate at the KS_3 level (3000ppm). This treatment exhibited a statistically significant increase compared to all other treatments. Similarly, the minimum percentage increase in the East-West spread, which was 4.35%, was observed in the control treatment (KS_0). This increase was comparable to the results from the KS_1 and KS_2 treatments.

These findings collectively highlight the positive effects of potassium silicate application on the East-West spread of Jamun cv. Goma Priyanka plants. The KS_3 treatment consistently demonstrated significant increases in both experimental trials, suggesting its potential to enhance plant growth and development. Conversely, the control treatment (KS_0) consistently displayed lower increases, implying the importance of potassium silicate supplementation for optimal growth of these plants.

The presented data showcases a comprehensive analysis of the effects of potassium silicate on the cumulative percentage increase in the East-West spread of jamun cv. Goma Priyanka plants across two consecutive experimental trials, conducted during the periods 2021-22 and 2022-23.

In relation to the East-West spread, the aggregated outcomes demonstrate that the highest cumulative percentage increase of 6.33% occurred in March of the 2022-23 trial. This increase was observed in response to the application of potassium silicate at the KS_3 level, specifically at a concentration of 3000ppm. This treatment exhibited a statistically significant improvement compared to the effects of the KS_2, KS_1, and KS_0 treatments. Conversely, in March of the 2022-23 trial, the lowest percentage increase of 4.84% in the East-West spread of Jamun cv. Goma Priyanka plants was recorded in the KS_0 treatment, which served as the control group without potassium silicate application.

Table 10. Pooled analysis representing effect of Potassium silicate on per cent increase in East West spread (m) of Jamun cv. Goma Priyanka plants

Treatments	Pooled Analysis (I and II experimental year)			
	Initial Value (m)	Oct. (2021-22)	Dec. (2021-22)	Mar. (2022-23)
KS_0 (Control)	3.09	3.14 (1.60%)	3.20 (3.39%)	3.24 (4.84%)
KS_1 (1000ppm)	3.08	3.13 (1.70%)	3.19 (3.57%)	3.23 (5.14%)
KS_2 (2000ppm)	3.10	3.15 (1.77%)	3.21 (3.74%)	3.27 (5.55%)
KS_3 (3000ppm)	3.10	3.16 (1.85%)	3.23 (4.23%)	3.30 (6.33%)
SEm(±)	0.02	0.07	0.13	0.19
CD (5%)	0.07	0.21	0.40	0.57

**Values in parentheses indicate square root transformed values*

4. DISCUSSION

Effect of Potassium silicate: The results clearly suggest that the application of higher concentrations of potassium silicate, particularly at KS3000 ppm, led to significantly improved growth across a majority of plant growth parameters for the Jamun plants, outperforming the other treatment levels.

This phenomenon can be rationalized by the mechanism where foliar application of potassium silicate functions to fortify the cell wall structure of plants, rendering them more resilient against potential afflictions from diseases and pests. Furthermore, this efficacy might stem from the ability of potassium silicate to facilitate the uptake of pivotal nutrients, with a notable emphasis on calcium (Ca), magnesium (Mg), and potassium (K). Notably, the incorporation of silicon from the potassium silicate compound plays a pivotal role in the photosynthetic process. By elevating the chlorophyll content within leaves, silicon intensifies the absorption of light, subsequently augmenting the conversion of energy.

The application of potassium silicate via foliar means could plausibly orchestrate enhancements in the physiological mechanisms of the Jamun plants. This, in turn, could bolster their capacity to endure stressors, navigate fluctuations in temperature, regulate osmotic conditions, and elevate the photosynthetic rate. The specific context here pertains to the Vertisols of Jhalawar.

Correspondingly, the outcomes of this study align closely with findings from previous research. For instance, Lalithiya et al. [9] observed analogous trends in sapota, Hanumanthaiah et al. [6] recorded comparable effects in bananas, Mohammed and Al Kamar (2018), reported consistent outcomes in Valencia oranges. Furthermore, Nada, M.M (2020) documented similar patterns in strawberries. The shared findings across these studies strengthen the validity of the current results and underscore the broader significance of potassium silicate in promoting plant growth and physiology [10].

5. CONCLUSION

The study revealed noteworthy improvements in various parameters. The maximum percentage increases were observed in rootstock girth (1.77%), scion girth (2.64%), plant height (3.59%), canopy volume (6.19%), and canopy spread in both East-West (6.33%) and North-South (3.38%) directions.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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