Original Research Article

Influence of Foliar Application of Plant Growth Regulators and Nutrients on Physical Fruit Characteristics of Seedless Jamun (*Syzygium cumini* L.)

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ABSTRACT

Jamun is an important minor fruit crop of tropical and subtropical countries and widely distributed throughout India. It is a versatile tree for both food and medicinal values. A local type seedless jamun trees which were located at Regional Horticultural Research and Extension Centre (RHREC), College of Horticulture, Bengaluru, evaluated to examine the influence of plant growth regulators and nutrient on physical characteristics. Significant differences were observed in physical characteristics among the various foliar application treatments. The maximum length of the inflorescence (9.79 cm) and breadth of the inflorescence (9.11 cm), lowest flower to fruit set duration (39.00 days) was recorded on foliar application of humic acid (0.2 %). The maximum fruit set per panicle (6.40) and fruit set percentage per panicle (87.16 %), fruit weight (2.31 g), fruit pulp weight (1.96 g), fruit length (19.57 mm), fruit diameter (12.99 mm), lowest number of fruits (509.66 fruits / kg) and maximum yield (25.21 kg / plant) was recorded in foliar application of GA3 at (50 ppm).

***Keywords:*** *Plant growth regulators, humic acid, inflorescence, K2* *SO4*

1. INTRODUCTION

 Jamun (*Syzygium cumini* L.) belongs to the myrtaceae family, the genus *Syzygium* consists of 75 indigenous species of which only a few have commercial importance. Jamun fruits are dark purple in color which resembles dates with elongated seeds. It is originated in India and Indonesia widely grown throughout Southern Asia and is also known as the Indian blackberry, Java plum, Black plum and Jambul (Singh *et al*.,2009). Tropical and subtropical regions of India are covered with Jamun trees including the Nilgiri and Himalayan regions, it can be grown up to about 1200 m above mean see level. It has obtained great importance in latest years not only due to its hardy nature but also because of its incomparable medicinal and nutritional properties (Devi et al., 2016).

 Jamun contains many phyto-constituents which are beneficial to health as tannins, alkaloids, steroids, flavonoids, terpenoids, fatty acids, phenols, minerals, carbohydrates, and vitamins. Clinical studies have shown that it is hypoglycemic, diuretic, analgesic, anti-inflammatory, antiplaque, antimicrobial, anti-diarrheal, antioxidant, gastro-protective, and astringent. *Syzygium cumini* L. has indicated which is to be effective in managing diabetes, in addition to being consumed fresh, fully ripe fruits can be processed into several products, including pickles, jam, jelly, squash, wine, and vinegar. The fruit has a subacid spicy flavour, squash is a highly reviving beverage for soothing thirst in the heat (Singh et al.,2009).

 Plant growth controllers or phytohormones are natural substances created normally in higher plants, controlling development or other physiological capabilities at a site remote from its place of creation and dynamic in minute sums. Phytohormones leads auxins, gibberellins, cytokinins, ethylene, development retardants and development inhibitors. Therefore, it could be beneficial to apply plant growth stimulants to the leaves of fruit crops to increase quality and quantity. Gibberellins regulate fruit growth in a variety of ways and at different phases which have a recognized effect on cell growth and division (Kumari et al., 2018).

 Humic and fulvic acids make up humic substances because they are needed for plant nourishment and soil quality. Humic and fulvic acid levels in the soil are needed for healthy plant growth and yield increment. This material also functions as soil conditioner, promoting soil structure, permeability and improving the soil's capability to store water and deliver nutrients (Pettit, 2004, Meena et al, 2024).

 Potassium is a critical nutrient, that it is the only component except for Nitrogen that plants absorb the most. Unlike N, P and most other nutrients, K is not incorporated into structures of organic compounds instead, potassium remains in ionic shape (K+) in solution in the cell and acts as an activator of many cellular enzymes. Therefore, it has many functions in nourishment for plants growth that influences both the yield and quality of the crop (Njira *et al.,* 2015). The present investigation was carried at Regional Horticultural Research and Extension Centre (RHREC), University of Horticultural Sciences Campus, Gandhi Krishi Vignana Kendra, Bengaluru, during 2021-22 to exploit the possibility of regularizing the flowering, fruit size and other physical traits by using Gibberellin (GA3), Humic acid (HA) and potassium sulphate (K2SO4).

2. material and methods

The study was conducted in the year of 2021-22 using ten years old local seedless cultivar trees of Jamun maintained at Regional Horticulture Research and Extension Centre, Bengaluru, College of Horticulture, GKVK, Bengaluru, Karnataka. The orchard was outlined with a spacing of 5 m x 5 m. The experimental design was laid out in a Randomized Complete Block Design (RCBD) with 7 treatment 3 replications. Treatments were applied as foliar application with different concentrations; GA3 @ 25 ppm and 50 ppm, HA @ 0.2 % and 0.3 %, K2SO4 @ 0.5 % and 1.0 % and control (tap water) were made by dissolving in water. Plant growth regulators and nutrients were applied two times with 15 days interval gap amongst the foliar sprays (the first spray on the third week of May and the second spray on the first week of June) during the experiment period. Observation on length of the inflorescence, breadth of the inflorescence, flowering to fruit set duration, number of fruits per panicle, fruit set percentage per panicle, fruit weight, fruit length, fruit diameter, fruit pulp weight, Fruit peel weight, Fruit pulp to peel ratio, number of days from flowering to maturity, number of fruits per kilogram and yield per plant. Length of the inflorescence and breadth of the inflorescence were measured in ten tagged inflorescences in each treated trees by a measurement scale and the mean were calculated. Flowering to fruit set duration and number of days from flowering to maturity were observed regularly and number of days for both parameters were recorded in date. The percentage of fruit set per panicle was noted when fruits were in pea nut size in tagged panicles in all four directions and the mean was calculated. The number of fruits/panicles was calculated by counting the number of fruits in 10 tagged panicles in all directions of the tree and the mean was calculated. The weight of the fruit and pulp weight (removal of fruit peel) was recorded by using electronic balance and an average of 10 fruits' weight and pulp weight was expressed in grams. The peel weight was recorded by weighing removed peels from the corresponding fruits, weighed by the electronic balance in grams. Pulp and peel were weighed individually as above by the electronic balance and evaluated as a peel to pulp ratio. Using a digital Vernier Caliper, the fruit's length and diameter was determined from top to bottom and the average was recorded in millimeters. The total fruits per one kilogram in all the treated fruits were counted and was indicated as number of fruits per kg. Harvested fruits was weighed by the electronic balance and was expressed in terms of kg per plant, this referred to yield per plant.

3. results and discussion

**3.1. Length of the inflorescence and breadth of the inflorescence**

The length of the inflorescence was impacted significantly by the use of PGR’s and nutrients in seedless jamun (Table 1). Among different levels of application, humic acid application at 0.2 % resulted in the highest inflorescence length (9.79 cm) and it was in line with the humic acid application at 0.3 % (7.62 cm) and K2So4 application at 0.5 % (7.36 cm). The lowest inflorescence length was noted in the GA3 application at 25 ppm (6.41 cm) which was in line with the GA3 application at 50 ppm (6.45 cm) and were indifferent from control (6.95 cm).

The breadth of the inflorescence was impacted significantly by the application of PGR’s and nutrients in seedless jamun (Table 1). Among different levels of application, humic acid application at 0.2 % (9.11 cm) resulted in the highest inflorescence breadth and significantly superior over all other treatments including control (6.57 cm). Though statistically non-significant, the inflorescence breadth was got reduced with GA3 application at 25 ppm (6.11 cm), GA3 application at 50 ppm (5.71 cm), K2So4 application at both 0.5 % (5.85 cm) and K2So4 application at 1.0 % (6.00 cm). Inflorescence breadth also got significantly reduced with the application of humic acid at 0.3 % compared to its lower concentration (0.2%).

The reason may be because of the increase in the absorption of macro-elements and using humic acid is appropriate for use as a way to enhance nutrients uptake instead of using high nutrients concentration (Nikbakht *et al*., 2008) and humic substances promotes not only the vegetative growth but also flowering is improved (Ahmad *et al.,* 2013). Similar work was carried out by Sanchez–Sanchez *et al*. (2002) in lemon. Ahmad *et al.* (2019) reported that humic acid increases the number of flowers and width of flowers with the presence of GA3 (plant growth regulator) in marigold.

**3.2. Flower to fruit set duration**

Flowering to fruit set duration was impacted significantly by the use of PGR’s and nutrients in seedless jamun (Table 1). Among different levels of application, humic acid at 0.2 % resulted in the lowest duration from flowering to fruit set (39.00 days) and it was in line with the application of K2So4 at 0.5 % (41.00 days), application of GA3 @ 50 ppm (41.33 days) and application of K2So4 at 1.0 % (41.66 days). The highest duration for the fruit set was noticed in control (46.00 days) which was statistically inferior to that with GA3 application at 25 ppm (43.00 days) and application of humic acid at 0.3 % (43.00 days).

Humic acid serves a crucial function in raising the cation exchange capability which makes the water and mineral absorption high and they reflect on tree productivity (Pettit, 2004).

**3.3. Number of fruits per panicle and fruit set percentage per panicle**

The number of fruits per panicle was impacted significantly by using PGR’s and nutrients in seedless jamun (Table 1). Application of GA3 @ 50 ppm resulted in highest number of fruits per panicle (6.40 fruits/panicle) and it was in line with its lower dose tested GA3 application at 25 ppm (6.10 fruits/panicle). Application of both humic acid concentrations 0.2 % and 0.3 % (4.53 & 4.56 fruits/panicle respectively) and Application of both K2SO4 0.5 % and 1.0 % (4.93 & 4.00 fruits/panicle respectively) failed to differentiate from control treatment (4.33 fruits/panicle).

The fruit set percentage per panicle was impacted significantly by use of PGRs and nutrients in seedless jamun (Table 1). Among different levels of application, GA3 @ 50 ppm resulted in the highest fruit set percent (87.16 %) and it was in line with GA3 application at 25 ppm (81.96 %) and K2So4 application at 0.5 % (75.04 %). Next to these treatments was K2So4 application at 1.0 % (66.80 %) and was statistically indifferent from control (49.13 %) as well as humic acid at both concentrations.

**Table 1.** **Effect of PGR’s and nutrients on inflorescence length, inflorescence breadth, flowering to fruit set duration, number of fruits per panicle and fruit set percentage per panicle of seedless jamun.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatments** | **Inflorescence length (cm)** | **Inflorescence breadth (cm)** | **Flowering to fruit set duration (days)** | **Number of fruits per panicle** | **Fruit set percentage per panicle (%)** |
|
| T 1- Control | 6.95 | 6.57 | 46.00 | 4.33 | 49.13 |
| T 2- Humic acid: 0.2 % | 9.79 | 9.11 | 39.00 | 4.53 | 49.37 |
| T 3- Humic acid: 0.3 % | 7.62 | 6.08 | 43.00 | 4.56 | 51.58 |
| T 4- K2So4: 0.5 % | 7.36 | 5.85 | 41.00 | 4.93 | 75.04 |
| T 5- K2So4: 1.0 % | 7.11 | 6.00 | 41.66 | 4.00 | 66.80 |
| T 6- GA3: 25 ppm | 6.41 | 6.11 | 43.00 | 6.10 | 81.96 |
| T 7- GA3: 50 ppm | 6.45 | 5.71 | 41.33 | 6.40 | 87.16 |
| **S. Em±** | 0.65 | 0.31 | 0.87 | 0.38 | 5.32 |
| **CD @ 5 %** | 2.01 | 0.97 | 2.68 | 1.19 | 16.39 |

Gibberellic acids (GAs) are known to stimulate the fruit set and growth in apples, pears (Weaver, 1972) and seedless grapes (Zabadal and Dittmer, 2000). An increase in fruit set and fruit set per panicle could be because of the successful fertilization, which was followed by mitosis and cell expansion, which led to the fruit's development. Gibberellins are known to have an impact on cell growth and division. (Adams *et al*., 1975 and Kamijima, 1981)

**3.4. Fruit weight, fruit length, fruit diameter, fruit pulp weight, fruit peel weight and fruit peel to pulp ratio**

Foliar application of PGRs and nutrients has influenced significantly on fruit weight of seedless jamun (Table 2). Amongst applications, GA3 application at 50 ppm had the heaviest fruit weight (2.31 g) which was in line with GA3 application at 25 ppm (2.16 g), K2So4 application at 1.0 % (1.95 g). Humic acid application at 0.2 % (1.72 g), Humic acid application at 0.3 % (1.73 g) and K2So4 application at 0.5 % (1.61 g), were statistically indifferent from each other as well as control (1.76 g).

Fruit length of seedless jamun was impacted significantly with the use of PGR’s and nutrients (Table 2). GA3 application at 50 ppm had the longest fruit length (19.57 mm) and was in line with GA3 application at 25 ppm (18.92 mm), K2So4 application at 1.0 % (18.12 mm) and control (17.96 mm). It was evident from the studies that, compared to control, the fruit length got reduced with the humic acid application at 0.2 % and 0.3 % (16.59 and 15.53 mm respectively) and K2So4 application at 0.5 % (16.76 mm) and was significant with humic acid application at 0.3 % (15.53 mm).

Fruit diameter in seedless jamun was impacted significantly by the use of PGRs and nutrients (Table 2). Humic acid application at 0.2 % has resulted in a wider fruit diameter (13.10 mm) and it was in line with GA3 application at 50 ppm (12.99 mm), K2So4 application at 1.0 % (12.95 mm) and GA3 application at 25 ppm (12.78 mm). The narrow fruit diameter was recorded with humic acid application at 0.3 % (10.94 mm) which was in line with K2So4 application at 0.5 % (11.65 mm) and was significantly inferior to control (12.73 mm).

The weight of the fruit pulp was significantly impacted by the various foliar application treatments of PGR’s and nutrients. But, neither the increase nor the decrease in fruit pulp weight was indifferent from control. The heaviest pulp weight was registered in the GA3 application at 50 ppm (1.96 g) which was in line with the GA3 application at 25 ppm (1.89 g), K2So4 application at 1.0 % (1.75 g) and control (1.56 g). The lightest pulp weight was noticed in the humic acid application at 0.3 % (1.12 g) which was in line with the K2So4 application at 0.5 % (1.40 g) and was statistically indifferent from control.

The fruit peel weight ranged from 0.11 to 0.18 g among the various foliar application treatments of plant growth regulators and nutrients (Table 2). Even though all the treatments reduced the peel weight compared to control but difference/reduction was statistically different.

The fruit pulp to peel ratio ranged from 7.01 (K2So4 at 0.5%) to 9.78 (GA3 @ 50 ppm) was not influenced significantly by the various foliar application of plant growth regulators and nutrients (Table 2).

The higher fruit growth with GA3 treated fruits may be because of a meditating mechanism for quicker mobilization and translocation of photosynthates from the source (Rokaya et al., 2016). Gibberellins are found to regulate fruit growth in a variety of ways and at various developmental stages. The metabolism of developing fruits is extremely active, and they serve as powerful nutritional sinks, with hormones presumably controlling the process. (Brenner and Cheikh, 1995).

**Table 2. Effect of PGR’s and nutrients on fruit weight, fruit length, fruit diameter, fruit peel weight and fruit peel to pulp ratio of seedless jamun.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Treatments** | **Fruit weight (g)** | **Fruit length (mm)** | **Fruit diameter (mm)** | **Fruit pulp weight (g)** | **Fruit peel weight (g)** | **Fruit pulp to peel ratio** |
|
| T 1- Control | 1.76 | 17.96 | 12.73 | 1.56 | 0.18 | 7.80 |
| T 2- Humic acid: 0.2 % | 1.72 | 16.59 | 13.10 | 1.59 | 0.14 | 7.61 |
| T 3- Humic acid: 0.3 % | 1.73 | 15.53 | 10.94 | 1.12 | 0.14 | 7.11 |
| T 4- K2So4: 0.5 % | 1.61 | 16.76 | 11.65 | 1.40 | 0.12 | 7.01 |
| T 5- K2So4: 1.0 % | 1.95 | 18.12 | 12.95 | 1.75 | 0.14 | 8.76 |
| T 6- GA3: 25 ppm | 2.16 | 18.92 | 12.78 | 1.89 | 0.11 | 9.46 |
| T 7- GA3: 50 ppm | 2.31 | 19.57 | 12.99 | 1.96 | 0.12 | 9.78 |
| **S. Em±** | 0.10 | 0.73 | 0.47 | 0.16 | NS | NS |
| **CD @ 5 %** | 0.33 | 2.26 | 1.45 | 0.48 | NS | NS |

**3.5. Number of days from flowering to maturity/harvesting**

The days taken to flowering to maturity/ harvesting were significantly impacted by the use of PGR’s and nutrients in seedless jamun (Table 3). Between different levels of application, GA3 @ 25 ppm (66.33 days) resulted in the lowest days took to flowering and maturity and it was in line with GA3 application at 50 ppm (66.66 days) and K2So4 application at 0.5 % (68.33 days). Reduction in the developmental duration from flowering to maturity or harvest due to GA3 application was significantly superior over the highest days taken from flowering to maturity in control (70.33 days). Application of both humic acid and K2So4 at both the concentrations tested were statistically indifferent from control with respect to the duration from flowering to harvest.

This could be because of the regulating effect of exogenous application of PGR’s that influences early floral initiation, fruit setting and duration of fruiting and helps with early maturity.

**3.6. Number of fruits per kg**

The number of fruits per kg was significantly impacted by the use of PGR’s and nutrients in seedless jamun (Table 3). Amongst the different levels of application, GA3 at 50 ppm resulted in the lowest (509.66 fruits/kg) of fruits/ kg and was in line with GA3 application at 25 ppm (513.66 fruits/kg) and K2So4 application at 1.0 % (576.33 fruits/kg). The high amount of fruits/ kg resulted in control (609.66 fruits/kg) and was par with the humic acid application at 0.2 % (607.33 fruits/kg) and humic acid application at 0.3 % (606.00 fruits/kg). Maximum number of fruits in these applications were because of having minimum fruit size which proportionally improved the amount of fruits in a kg meanwhile, the lowest number of fruits is because enhanced fruit size by the treatments. Similar observations were reported by Moneruzzaman et al. (2011) and Reddy and Prasad (2012).

**3.7. Fruit yield**

Fruit yield was impacted significantly by the use of PGR’s and nutrients in seedless jamun (Table 3). GA3 application at 50 ppm (25.21 kg/plant) resulted in the highest yield/ plant and it was in line with GA3 application at 25 ppm (24.82 kg/plant) and humic acid application at 0.2 % (22.58 kg/plant). The lower yield/ plant (18.84 kg/plant) was noticed in the humic acid application at 0.3 % which was in line with K2So4 application at 0.5 % (19.20 kg/plant) and control (20.44 kg/plant). The use of PGR’s in fruit production has become a new paradigm. There is scarce information available on the function of PGR’s on the fruit yield of jamun. Most of the PGR’s exhibit a broad spectrum and thus a single PGR may influence various aspects of fruit growth and development. Moreover, PGR’s enhance the rapid alteration in physical characteristics and improves the productivity of fruit crops. Our findings are similar to Tuan and Ruey (2013) in wax apple (*Syzygium samarangenese*), Moneruzzaman et al. (2011) in wax apple (*Syzygium samarangenese*) and Ingle et al*.* (2001) in ‘Nagpur’ mandarin.

**Table 3. Effect of PGR’s and nutrients on number of days from flowering to maturity, number of fruits per kg and yield per plant of seedless jamun.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Treatments** | **Number of days from flowering to maturity** | **Number of fruits per kg** | **Yield (kg/plant)** |
|
| T 1- Control | 70.33 | 609.66 | 20.44 |
| T 2- Humic acid: 0.2 % | 68.66 | 607.33 | 22.58 |
| T 3- Humic acid: 0.3 % | 69.00 | 606.00 | 18.84 |
| T 4- K2So4: 0.5 % | 68.33 | 602.00 | 19.20 |
| T 5- K2So4: 1.0 % | 70.00 | 576.33 | 22.14 |
| T 6- GA3: 25 ppm | 66.33 | 513.66 | 24.82 |
| T 7- GA3: 50 ppm | 66.66 | 509.66 | 25.21 |
| **S. Em±** | 0.87 | 4.75 | 0.65 |
| **CD @ 5 %** | 2.69 | 14.66 | 2.02 |

4. Conclusion

Based on the present research findings, it can be concluded that foliar application of plant growth regulators specifically GA3 at both concentrations (25 ppm and 50 ppm) and humic acid are superior to enhance physical characteristics and fruit size on seedless Jamun.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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