*Original Research Article*

**Studies on the effect of foliar application of different chemicals on yield and physical characteristics of Guava (*Psidium guajava* L.) cv. Hisar Safeda**

**Abstract -** Guava (*Psidium guajava* L.) is an important fruit crop of India. It is typically eaten fresh as a dessert fruit or processed into juice, concentrate, jam, jelly, nectarine, or syrup. Fruits are in higher demand in both domestic and foreign markets, both for fresh consumption and for processing. A field study was carried out at the Experimental Orchard, College of Agriculture, Kaul, Kaithal in the year 2023-2024 on 12 year old guava trees cv. Hisar Safeda to determine the effect of foliar application of different chemicals on yield and quality of guava. Different treatments were taken i.e. T1 : CaNO3 @ 0.5%, T2 : CaNO3 @ 1.0%, T3 : CaNO3 @ 1.5%, T4 : K2SO4 @ 0.5%, T5 : K2SO4 @ 1.0%, T6 : K2SO4 @ 1.5%, T7 : FeSO4 @ 0.2%, T8 : FeSO4 @ 0.4%, T9 : FeSO4 @ 0.6%, T10 : GA3 @ 50 ppm, T11 : GA3 @ 75 ppm, T12 : GA3 @ 100 ppm and T13: Control (water spray) with three replications under randomized block design. The results of the study revealed significant increase in yield and physical characteristics of guava fruit. However, foliar application of GA3 @ 100 ppm proved to be the best treatment in improving the fruit retention, fruit set, length of fruit, breadth of fruit, number of seeds per fruit, average seed weight, volume of fruit, firmness of fruit, number of fruits per plant, average fruit weight and yield of guava fruit over control.

**Keywords :** Guava, Hisar Safeda, Fruit set, Fruit yield, Seeds per fruit, Firmness.

**Introduction:**

The guava (*Psidium guajava* L.), a member of the Myrtaceae family. It is a tropical and subtropical fruit. Guava is also known as "Apple of the tropics" and "Poor man's apple." It is also called as the perfect fruit for nutritional security due to its extremely high nutritious properties. It is among the most affordable and high-quality sources of vitamin C. Guava fruit has 212 mg of vitamin C per 100 g and it contains roughly 1.5% pectin (Zagade *et al*., 2018). Mainly, the fruit is served as a table fruit. It is also cooked and used in chutney, shortcakes, puddings, butter, sauce, ice cream, and a lot of other items and pies. Among guava cultivars, Hisar Safeda is gaining popularity. It is the hybrid developed by cross pollination between Allahabad Safeda x Seedless. Guava is a hardy plant which can be grown in severly alkaline or poorly drained soils. It has wide adaptability with varying soil and climatic conditions. It gives fruits mainly in the two seasons *i.e.* rainy season and in winter season. The crop in the rainy season is of poor quality as there is more infestation by insects/pests and having poor storage life whereas, winter season crop is better in quality aspects having a longer storage life and helps in fetching a better price in market (Thiruppathi, 2020).

Micronutrients are the key elements in growth and development of plant. They play an important role in production and their deficiency leads in lowering the productivity. The plant growth regulators act as messengers and are needed in smaller quantities at low concentration. Plant growth regulators like GA3 play an essential role in plant growth, flower induction, fruit set, fruit growth, yield and quality (Rajput *et al.,* 2015). GA3 helps in inducing maximum fruiting and promotes the flowering. The function of GA3 is to induce the flowering and increase the fruit setting and fruit retention percentage (Suman *et al*., 2021). GA3 helps in accelerating the translocation of metabolites from plant parts to the developing fruits. Keeping in view, this experiment has been planned to study the “Studies on the effect of foliar application of different chemicals on yield and quality of Guava (*Psidium guajava* L.) Cv. Hisar Safeda”.

**Materials and Methods:**

**Experimental details**

The study was carried out at Experimental Orchard, College of Agriculture, Kaul as given below :

Fruit crop : Guava (*Psidium guajava* L.)

Variety : Hisar Safeda

Locations : Experimental Orchard, College of Agriculture, Kaul

Experimental Design : Randomized Block Design (RBD)

Spacing : 6 m × 6 m

Total no. of treatments : Thirteen (13)

Replications : Three (3)

Age of tree : 12 years

Time of application : 2nd week of October and 2nd week of November

The present investigation was conducted at Experimental Orchard, College of Agriculture, Kaul, Kaithal in the year 2023-2024, which is located at 215.2 m above the MSL with coordinates of 29°51'29.2"North latitude and 76°39'10.4" East longitudes. The climate of the Kaul, Kaithal district is tropical steppe, semiarid and humid. It is mostly dry, with scorching summers and cold winters, except during the monsoon season, when moist air from the ocean penetrates the district. The district's average annual rainfall is 511 mm, which uniformly distributes across the area. From the last week of June, the southwest monsoon arrives. The present investigation to determine the effect of foliar application of different chemicals on yield and physical characteristics of Guava (*Psidium guajava* L.) cv. Hisar Safeda The treated fruits were analyzed for Fruit set (%), Fruit retention (%), Length of fruit (cm), Breadth of fruit (cm), Number of seeds /fruit, Average seed weight (g), Volume of fruit (cc), Specific gravity (g/cc), Firmness of fruit (kg/cm2), Number of fruits per plant, Average fruit weight (g) and Yield (kg/plant).

**Treatments:**

|  |  |  |
| --- | --- | --- |
| T1 | : | CaNO3@ 0.50 % |
| T2 | : | CaNO3 @ 1.0 % |
| T3 | : | CaNO3 @ 1.5 % |
| T4 | : | K2SO4@ 0.50 % |
| T5 | : | K2SO4@ 1.0 % |
| T6 | : | K2SO4@ 1.5 % |
| T7 | : | FeSO4 @ 0.2 % |
| T8 | : | FeSO4 @ 0.4 % |
| T9 | : | FeSO4 @ 0.6 % |
| T10 | : | GA3 @ 50 ppm |
| T11 | : | GA3 @ 75 ppm |
| T12 | : | GA3 @ 100 ppm |
| T13 | : | Control – Water Spray |

**Observations for evaluation**

**Fruit set (%):** Four branches were randomly selected in each direction and tagged, then the number of flowers were counted separately on each branch and average value was taken. After that average number of flowers were multiplied with total number of branches on respective plant. Similarly, the number of fruit set was counted. The fruit setting per cent is calculated with the following formula:

 Number of fruit set

 Fruit setting (%) = –––––––––––––––––––×100

 Number of flowers

**Fruit retention (%):** The fruit retention (at maturity) is calculated with following formula:

 Number of fruits at harvest

 Fruit retention (%) = ––––––––––––––––––––––––– x100

 Initial number of fruit set

**Length of fruit (cm):** Five fruits were selected randomly from each replication and fruit length was measured with the help of digital vernier calliper. Average value of fruit length was calculated and expressed in centimetre.

**Breadth of fruit (cm):** Five fruits were selected randomly from each replication and fruit breadth was measured with the help of digital vernier calliper. Average value of fruit breadth was calculated and expressed in centimetre.

**Number of seeds /fruit:** For calculating number of seeds/fruits, the fruits were cut into four halves and the seeds were extracted from pulp and counted manually.

**Average seed weight (g):** Five fruits at mature stage for each replication were taken randomly and seeds were separated manually. Then seeds per fruit were weight by an electrical balance and expressed in gram (g). After that average value of seed weight was calculated.

**Volume of fruit (cc):** Five randomly chosen fruits from each treatment had their volume measured using the water displacement method. To do this, the fruits were dipped into a jar of water that was completely filled. The water that the fruits displaced was then collected, measured and the recorded reading was averaged.

**Specific gravity (g/cc):** Specific gravity of fruit measured by using a spacious mouth cylinder filled to the edge with water. Fruit was plunged in the cylinder and the water displaced was measured. Formula applied for deliberation of specific gravity is given below:

 Weight of fruit (g)

 Specific gravity = ––––––––––––––––––––––––––––––––––

 Volume of displaced water by fruit (cc)

**Firmness of fruit (kg/cm2):** Penetrometer was used for measuring the fruit firmness by using a cylindrical plunger probe of 4 mm. It is expressed in kg/cm2.

**Number of fruits per plant:** For estimating number of fruits per plant, four shoots were selected from each direction, then number of fruits were counted on each shoot and their average was taken. Then number of shoots were counted and multiplied with average number of fruits.

**Average fruit weight (g):** Five fruits were selected randomly from each replication and fruits were weighed on top pan electric balance. Average value of fruit weight was calculated by dividing total fruit weight with total number of fruits taken and expressed in gram.

**Yield (kg/plant):** To calculate total fruit yield, the total number of fruits per plant was multiplied with average fruit weight and the value was expressed in kilograms (kg/tree).

**Results and Discussion:**

Foliar application of GA3 significantly affected the yield and physical characteristics of guava *viz.,* Fruit set (%), Fruit retention (%), Length of fruit (cm), Breadth of fruit (cm), Number of seeds /fruit, Average seed weight (g), Volume of fruit (cc), Specific gravity (g/cc), Firmness of fruit (kg/cm2), Number of fruits per plant, Average fruit weight (g) and Yield (kg/plant).

It is evident from the data presented in Table 1, the maximum fruit set (70.15%) was recorded in T12 (GA3 @ 100 ppm) which was significantly higher than all other treatments but statistically at par with T5 K2SO4 @ 1 % (67.81 %) while, the minimum fruit set (58.76 %) was recorded in control. The fruit set is maximum in GA3 as it helps in improving the pollen germination or is responsible for assisting the growth of pollen tubes and also allows for timely fertilization before the receptivity is losed by the stigma or sometimes the style becomes non-functional. Similar results were obtained in investigation by Chavan *et al.* (2009) on sapota, Rajput *et al.* (2015) on guava and Uniyal and Mishra (2015) in bael. On the other hand, the maximum fruit retention (73.38 %) was observed from the trees sprayed with T12 (GA3 @ 100 ppm) which was statistically at par with T6 *i.e.* K2SO4 @ 1.5 % (70.68 %) and T11 *i.e.* GA3 @ 75 ppm (70.59%) while, the minimum fruit retention (59.64 %) was observed in control.The increase in fruit retention is due to the effectiveness of GA3 on several metabolic activities of plants and improving the source- sink relationship and influencing the metabolic status resulting in lesser fruit drop (Yadav *et al.,* 2021). Simultaneously, maximum length of fruit (7.37 cm) was obtained in treatment T12 (GA3 @ 100 ppm) which was followed by T11 *i.e.* GA3 @ 75 ppm (7.25 cm) and T6 *i.e.* K2SO4 @ 1.5 % (7.20 cm) whereas, the minimum length of fruit (5.93 cm) was obtained in control and maximum breadth of fruit (7.39 cm) was noted in T12 (GA3 @ 100 ppm) treatment which was followed by T11 *i.e.* GA3 @ 75 ppm (7.27 cm) and T6 *i.e.* K2SO4 @ 1.5 % (7.25 cm) whereas, the minimum breadth of fruit (5.95 cm) was noted in T13 *i.e.* control. The increase in length and breadth of fruit was due to accelerated rate of cell division and cell enlargement and more intercellular space with the application of higher concentration of GA3 (Purohit *et al*., 2019). Similar results were obtained by Lal *et al.* (2013), Rajput *et al.* (2015), Bindhyachal *et al.* (2016) and Maurya *et al.* (2018) in guava.

**Table 1. Effect of different chemicals on fruit set (%), fruit retention (%), length of fruit (cm) and breadth of fruit (cm) of guava cv. Hisar Safeda**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatments** | **Fruit set (%)** | **Fruit retention (%)** | **Length of fruit (cm)** | **Breadth of fruit (cm)** |
| T1 CaNO3@ 0.50 % | 60.17 | 61.19 | 6.36 | 6.37 |
| T2 CaNO3@ 1 % | 61.11 | 63.50 | 6.64 | 6.66 |
| T3 CaNO3@ 1.5 % | 63.90 | 67.53 | 6.95 | 6.98 |
| T4 K2SO4 @ 0.50 % | 61.73 | 63.34 | 6.86 | 6.87 |
| T5 K2SO4 @ 1 % | 64.22 | 67.90 | 7.04 | 7.06 |
| T6 K2SO4 @ 1.5 % | 67.81 | 70.68 | 7.20 | 7.27 |
| T7 FeSO4 @ 0.2 % | 59.78 | 60.67 | 6.08 | 6.09 |
| T8 FeSO4 @ 0.4 % | 59.98 | 61.96 | 6.24 | 6.26 |
| T9 FeSO4 @ 0.6 % | 60.88 | 63.11 | 6.52 | 6.55 |
| T10 GA3 @ 50 ppm | 64.92 | 65.89 | 7.09 | 7.10 |
| T11 GA3 @ 75 ppm | 68.47 | 70.59 | 7.25 | 7.27 |
| T12 GA3 @ 100 ppm | 70.15 | 73.38 | 7.37 | 7.39 |
| T13 Control – Water Spray | 58.76 | 59.64 | 5.93 | 5.95 |
| CD @ 5% | 2.58 | 2.80 | 0.27 | 0.29 |

**Fig. 1: Effect of different chemical on fruit set (%) and fruit retention (%) in guava**

 **Fig. 2 : Effect of different chemicals on yield (kg/plant) in guava**

The data presented in Table 2 depicts that the minimum number of seeds/fruit (220.7) was found in T12 *i.e.* GA3 @ 100 ppm followed by treatment T11 *i.e.* GA3 @ 75 ppm (223.1) and T6 *i.e.* K2SO4 @ 1.5 % (225.3) and the maximum number of seeds/fruit (251.6) was found in treatment T13 *i.e.* control which was statistically at par with treatments T7 *i.e.* FeSO4 @ 0.2 % (246.4) and T8 *i.e.* FeSO4 @ 0.4 % (244.1).. Similarly, the minimum seed weight (1.93 g) was exhibited in treatment T12 *i.e.* GA3 @ 100 ppm that was followed by T11 *i.e.* GA3 @ 75 ppm(1.95 g) and T6 *i.e.* K2SO4 @ 1.5 % (1.99 g). However, the maximum seed weight (2.18 g) was observed in treatment T12 *i.e.* control. The decrease in seed weight might be due to lesser number of healthy seeds as gibberellic acid helps in induction of parthenogenesis *i.e.* production of seedless fruits, so it leads to production of less number of seeds and ultimately the amount of seed weight is also reduced.Similar results were obtained by Agnihotri *et al.* (2013) and Singh *et al.* (2017) in guava. However, the maximum volume of fruit (178.2 cc) was recorded at T12 GA3 @ 100 ppm followed by T11 *i.e.* GA3 @ 75 ppm (174.8 cc) and T6 *i.e.* K2SO4 @ 1.5 % (173.5 cc) which were significantly higher over the control. However, minimum volume of fruit (151.2 cc) was recorded in control. The foliar application of GA3 is used in enhancing the sugar buildup, more pulp proportion and cell enlargement and elongation and ultimately increasing the volume of fruit. The application of different chemicals had no significant impact on the specific gravity.

**Table 2. Effect of different chemicals on number of seeds/ fruit, average seed weight (g), volume of fruit (cc) and specific gravity (g/cc) of guava cv. Hisar Safeda**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatments** | **Number of seeds/ fruit** | **Average seed weight (g)** | **Volume of fruit (cc)** | **Specific gravity (g/cc)** |
| T1 CaNO3@ 0.50 % | 239.5 | 2.14 | 159.8 | 0.99 |
| T2 CaNO3 @ 1 % | 232.9 | 2.10 | 161.9 | 1.00 |
| T3 CaNO3 @ 1.5 % | 231.7 | 2.08 | 163.2 | 1.01 |
| T4 K2SO4@ 0.50 % | 234.4 | 2.09 | 163.9 | 0.99 |
| T5 K2SO4@ 1 % | 230.9 | 2.05 | 166.7 | 1.00 |
| T6 K2SO4@ 1.5 % | 225.3 | 1.99 | 173.5 | 0.99 |
| T7 FeSO4 @ 0.2 % | 246.4 | 2.16 | 154.4 | 1.01 |
| T8 FeSO4 @ 0.4 % | 244.1 | 2.15 | 157.2 | 1.00 |
| T9 FeSO4 @ 0.6 % | 236.8 | 2.12 | 159.2 | 1.01 |
| T10 GA3 @ 50 ppm | 230.9 | 2.04 | 169.8 | 0.99 |
| T11 GA3 @ 75 ppm | 223.1 | 1.95 | 174.8 | 0.99 |
| T12 GA3 @ 100 ppm | 220.7 | 1.93 | 178.2 | 0.98 |
| T13 Control – Water Spray | 251.6 | 2.18 | 151.2 | 1.02 |
| CD @ 5% | 10.11 | 0.09 | 7.58 | NS |

 **Fig. 3 : Effect of different chemicals on volume of fruit (cc)**

The data concerning the firmness of fruit (kg/cm2), number of fruits per plant, average fruit weight (g) and yield (kg/plant) is shown in Table 3. maximum firmness (8.86 kg/cm2) was recorded in treatment T3 *i.e.* CaNO3 @ 1.5 % whereas, minimum fruit firmness (7.36 kg/cm2) was recorded in treatment T12 *i.e.* GA3 @ 100 ppm which was statistically at par with the treatment T11 GA3 @ 75 ppm (7.56 kg/cm2). This is due to application of GA3 which helps in dissolution of calcium pectate present in cell wall of fruit cells that results in softening of fruits. The results are similar with the findings of Kher *et al.* (2005), Bisen *et al.* (2014) and Rokaya *et al.* (2016) in guava and Gundogdu *et al.* (2017) in strawberry. On the other hand, the maximum number of fruits per plant (349.36) was found in T12 *i.e.* GA3 @ 100 ppm which was statistically at par with treatment T11 *i.e.* GA3 @ 75 ppm (343.12) and T6 *i.e.* K2SO4 @ 1.5 % (337.25) and minimum number of fruits per plant (172.2) was found in control. The number of fruits per plant were higher in gibberellic acid as it plays role in photosynthetic activity and better translocation of metabolites for developing fruitlets which leads to more number of fruits per plant. It also helps in retention of more fruits on plant and less fruit drop (Singh *et al*., 2017). Similarly, the maximum average fruit weight (191.4 g) was recorded in treatment T12 *i.e.* GA3 @ 100 ppm which was found statistically at par with treatments T11 *i.e.* GA3 @ 75 ppm (187.1 g) and T6 *i.e.* K2SO4 @ 1.5 % (183.8 g) whereas, the minimum average fruit weight (172.2 g) was recorded in T13 *i.e.* control. GA3 helps in cell elongation and cell enlargement, increase in cell size of the mesocarp and increased sink demand (Ramezani and Shekafandeh, 2010) resulting in maximum fruit weight. Maximum fruit yield (66.86 kg/plant) was recorded in treatment T12 GA3 @ 100 ppm which was statistically at par with treatment T11 *i.e.* GA3 at 75 ppm (64.19 kg/plant) and T6 *i.e.* K2SO4 @ 1.5 % (63.01 kg/plant). However, minimum fruit yield (50.66 kg/plant) was recorded in treatment T13 *i.e.* control. The increase in yield is associated with increasing the number of fruits, lowering the percentage of fruit drop, better fruit retention and increased size and weight of fruit by the application of gibberellic acid. Similar results were obtained by Lal *et al.* (2013), Maurya *et al.* (2018) and Suman *et al.* (2021) in guava.

**Table 3. Effect of different chemicals on firmness of fruit (kg/cm2), number of fruits per plant, average fruit weight (g) and yield (kg/plant) of guava cv. Hisar Safeda**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatments** | **Firmness of fruit (kg/cm2)** | **Number of fruits per plant** | **Average fruit weight (g)** | **Yield (kg/plant)** |
| T1 CaNO3@ 0.50 % | 8.12 | 309.98 | 174.6 | 54.12 |
| T2 CaNO3 @ 1 % | 8.51 | 314.01 | 177.9 | 55.86 |
| T3 CaNO3 @ 1.5 % | 8.86 | 320.46 | 182.8 | 58.58 |
| T4 K2SO4@ 0.50 % | 7.86 | 316.86 | 175.3 | 55.54 |
| T5 K2SO4@ 1 % | 7.91 | 324.88 | 178.1 | 57.86 |
| T6 K2SO4@ 1.5 % | 7.96 | 340.25 | 183.8 | 63.01 |
| T7 FeSO4 @ 0.2 % | 8.01 | 305.27 | 173.2 | 52.87 |
| T8 FeSO4 @ 0.4 % | 8.16 | 307.71 | 174.1 | 53.57 |
| T9 FeSO4 @ 0.6 % | 8.45 | 312.53 | 174.8 | 54.63 |
| T10 GA3 @ 50 ppm | 7.90 | 331.25 | 180.2 | 60.75 |
| T11 GA3 @ 75 ppm | 7.56 | 343.12 | 187.1 | 64.19 |
| T12 GA3 @ 100 ppm | 7.36 | 349.36 | 191.4 | 66.86 |
| T13 Control – Water Spray | 7.98 | 301.21 | 172.2 | 50.66 |
| CD @ 5% | 0.42 | 13.84 | 8.8 | 2.33 |

**Fig. 4 : Effect of different chemicals on firmness of fruit (kg/cm2)**

**Conclusion:**

The findings of the present study summarized above are indicative of beneficial effects of GA3 through foliar application. Yield and physical characteristics of guava cv. Hisar Safeda was significantly improved by foliar application of different chemicals over control. Results revealed that foliar application of GA3 @ 100 ppm was beneficial in improving the fruit retention, fruit set, length of fruit, breadth of fruit, number of seeds per fruit, average seed weight, volume of fruit, firmness of fruit, number of fruits per plant, average fruit weight and yield while, specific gravity was observed non-significant. Therefore, among all the treatments used, foliar application of GA3 @ 100 was found to be most effective for improving the yield and physical characteristics of guava fruit.

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