

## **ABSTRACT**

The investigation entitled the 'Effect of NAA and GA<sub>3</sub> on quality, yield and yield attributory traits in Phalsa (*Grewia subinaequalis* D.C.)' under central U.P. conditions. The experiment included four levels of NAA, 10, 20, 30, and 40 ppm, and four levels of GA<sub>3</sub>, 10, 20, 30, and 40 ppm, administered topically and evaluated in comparison to a control (water spray). The measurements of several parameters, such as fruit set, fruit size, fruit volume, fruit weight of 100 fruits, fruit yield per plant, and fruit yield per hectare, were made. According to the experiment, GA<sub>3</sub> at 40 ppm enhanced fruit set, size, weight, and volume of the fruits, yield. NAA+GA<sub>3</sub> used in combination was successful in enhancing the fruit set, fruit size, yield, and quality attributes of phalsa fruits. For higher returns in the agro-climatic conditions of Central Uttar Pradesh, phalsa growers may be advised to apply these growth regulators.

**Keywords** Phalsa, Sharbati, Plant Growth Regulators, NAA and GA<sub>3</sub>

## **1. INTRODUCTION**

Phalsa (*Grewia subinaequalis* D.C) is an important indigenous fruit by virtue of its adaptability to be grown right from kitchen garden to well organized orchard plantation and the cooling effect it is beneficial which plays considerable role in curing diseases. It belongs to the family Tiliaceae to also belongs the important fibre crop jute. It is very common in India. Phalsa is found in wild form all along the foothills of Himalayas. Commercially grown in Uttar Pradesh, West Bengal, Punjab, Madhya Pradesh and Bihar. Besides these states, it is also cultivated on a limited scale in the states of Maharashtra, Gujarat, Andhra Pradesh etc.

Phalsa berries contain 50 to 60 percent juice, 11 percent sugar, 2 to 2.5 percent acidity, 14.4 percent carbohydrate, 1.5 percent protein, 0.9 percent fat, 129 mg/100g of pulp, 89 mg phosphorus, 3.1mg iron, traces of vitamin C and 49IU vitamin (**Arkroyd, 1963**).

Characteristics of fruits such as length, width, pulp-stone ratio and weight of 50 fruits were increased due to foliar feeding plant growth regulators and they can also improve fruit quality, plant growth regulators improve better formation and translocation of food, hormonal signalling by gibberellins, similar results were found by **Chandra et al., 2015**.

Gibberellins decreases in acidity due to hormones application [might be due to increase translocation of carbohydrates and increase metabolism due to conversion of acids to sugar. Gibberellins improved quality of fruits supported by many researches in fruit crops such as **Byas et al., (2014)**.

Plant growth regulators can also increase the ascorbic acid content in fruits by synthesis of catalytic activity of several enzymes and co-enzymes which are essential in ascorbic acid synthesis. So that plant growth regulators may improve physico-chemical characters like as fruit length & width, weight of 50 fruits, pulp-stone ratio, ascorbic acid content, total soluble solids, sugars through better formation and translocation of carbohydrates, starch hydrolysis and early maturation phalsa fruits by ethrel **Kacha et al., (2014)**.

Hence plant growth regulators are very effective in improving physico-chemical attributes or quality of phalsa fruits. **Kumar, 2010; Garasiya et al., 2013; Karole et al., 2016**.

Plant growth regulators are signal molecules produced within the plant, and occur in extremely low concentrations. Hormones regulate cellular processes in targeted cells locally and, when moved to other locations, in other locations of the plant. Hormones also determine the formation of flowers, stems, leaves, the shedding of leaves, and the development and ripening of fruit. Plant hormones shape the plant, affecting seed growth, time of flowering, the sex of flowers, senescence of leaves,

and fruits. Plant growth regulators improved yield of fruit plants (**Chandra et al., 2015, Chundawat and Randhawa 1973, Debnath et al., 2011**).

## 2. MATERIAL AND METHOD

The experiment was conducted in the Horticulture Garden of Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (U.P.) during the year 2018-2019.

### 2.1 Experimental Design and Treatments

Sharbati Phalsa cultivar tress. That uniform, healthy and well- establishes were chosen for experiment' goal. The tress was maintained in good condition by adhering to the recommended fertilizer doses and other horticultural practices. Throughout the research, the entire orchard was kept orderly and consistently maintained. Three unique branches from each of the nine cut Ber trees were selected and utilized as a single unit (for one treatment). As a consequence, 39 units were selected on 13 Ber trees, and the experiment proceeded as planned. The experiment included thirteen treatments, each of which included foliar sprays of GA<sub>3</sub>, NAA, control. T<sub>1</sub>Control @00ppm water spray, T<sub>2</sub>(NAA@10 ppm), T<sub>3</sub>(NAA@20 ppm), T<sub>4</sub>(NAA@30ppm), T<sub>5</sub>(NAA @40ppm), T<sub>6</sub>(GA<sub>3</sub> @10 ppm), T<sub>7</sub>(GA<sub>3</sub>@20 ppm), T<sub>8</sub>(GA<sub>3</sub> @30 ppm), T<sub>9</sub> (GA<sub>3</sub> @40 ppm), T<sub>10</sub>(NAA @10 ppm + GA<sub>3</sub> @10 ppm), T<sub>11</sub>(NAA @20 ppm + GA<sub>3</sub> @20 ppm), T<sub>12</sub>(NAA @30 ppm + GA<sub>3</sub> @30 ppm), T<sub>13</sub>(NAA @40 ppm + GA<sub>3</sub> @40 ppm). In the early morning with the help of knapsack sprayer with various concentration of NAA, GA<sub>3</sub> and their combined concentration.

### 2.2 Parameters of Study

#### 2.2.1 Fruit set percentages

The number of flowers was counted on tagged shoots and percent fruit was worked out with the help of following formula:

$$\text{Fruit set (\%)} = \frac{\text{Total number of fruit set}}{\text{Total number of female flowers appeared}} \times 100$$

#### 2.2.2 Fruit diameter

A sample of 10 berries under each treatment were randomly selected and the diameter was measured with the help of a Vernier calipers and the average diameter was expressed in cm.

#### 2.2.3 Weight of 100 fruits

Fully ripened one hundred berries from each treatment were taken by random sampling and weighed on a physical balance.

#### 2.2.4 Volume of fruits (cm)<sup>3</sup>

Volume was determined by water displacement method with the help of a measuring cylinder filled with water.

#### 2.2.5 Yield per plant (Kg)

Fruits after each picking were weighed and total yield was calculated after adding up the value of all the harvest.

#### 2.2.6 Yield per hectare (q/ha)

The fruits of phalsa ripe unevenly, so harvesting is done time to time during may to June. Ripe fruits are picked in every harvesting and weight recorded every time. After last picking average data was obtained as yield and average yield per hectare was determined mathematically.

## 3. RESULT AND DISCUSSION

The observations of different parameters were recorded like Fruit set percentage, Fruit diameter, Fruit weight of 100 fruits, Fruit volume, Fruit yield per plant, and Fruit yield per hectare.

**Fruit set percentages:** The maximum fruit set percent was observed under GA<sub>3</sub> @40 ppm showed 69.39% fruit set followed by GA<sub>3</sub> @30 ppm dose (68.38%) against the minimum of 66.55% registered under control treatment.

**Fruit diameter:** The maximum fruit diameter was obtained under combined effect of NAA and GA<sub>3</sub> i.e. treatment T<sub>13</sub> (NAA @40 ppm + GA<sub>3</sub> @40 ppm) showed (0.98 cm) and the minimum fruit diameter was obtained under control treatment (T<sub>1</sub>) i.e. 0.78 cm.

**Weight of 100 fruits:** The combined effect of NAA and GA<sub>3</sub> treatment T<sub>13</sub>(NAA @40 ppm+GA<sub>3</sub> @40 ppm) showed the maximum fruit weight of 100 fruits (125.62 g) followed by the treatment T<sub>12</sub>(NAA @30 ppm+GA<sub>3</sub> @30 ppm) i.e. 120.85cm<sup>3</sup> and the minimum fruit weight of 100 fruits reported in control treatment (85.29 g).

**Volume of fruits (cm)<sup>3</sup>**: Treatment T<sub>9</sub>(GA<sub>3</sub> @40 ppm) showed the maximum fruit volume (1.27 cm<sup>3</sup>) followed by the treatment T<sub>12</sub>(NAA @30 ppm+GA<sub>3</sub> @30 ppm) 1.25cm<sup>3</sup> and the minimum fruit volume reported under control treatment (1.14cm<sup>3</sup>).

**Yield per plant (Kg)**: subjected to fruit yield per plant, the treatment T<sub>13</sub>(NAA @40 ppm+GA<sub>3</sub> @40 ppm) showed the maximum fruit yield per plant (5.89 kg/plant) followed by the treatment T<sub>12</sub>(NAA @30 ppm+GA<sub>3</sub> @30 ppm) i.e. 5.70 kg/plant and the minimum fruit yield per plant showed under the control treatment (3.16 kg/plant).

**Yield per hectare (q/ha)**: The experimental result in terms of fruit yield per hectare showed the maximum under treatment T<sub>13</sub> (NAA @40 ppm+GA<sub>3</sub> @40 ppm) 78.50 kg per hectare followed by the treatment T<sub>12</sub>(NAA @30 ppm+GA<sub>3</sub> @30 ppm) i.e. 75.98 kg/ha and the minimum fruit yield per hectare obtained under control treatment (42.10 kg/ha).

#### 4. DISCUSSION

Proper nutrition as well as adequate supply of growth regulators in the plant body plays a pivotal role in the flowering and fruiting of plants. Both excessive and deficient supply of nitrogen affects flowering and fruiting adversely under deficient conditions plants remains yellow with delayed fruiting and deformed fruit. Foliar sprays of NAA and GA<sub>3</sub> influenced the fruit set in phalsa which varied considerably. Similar results in respect of fruit set have been reported by **Prasad et al. (2005)**, **Trivedi et al. (2012)**, **Balakrishnan (2000)** in guava, **Mishra and Kriska (2008)** and **Katiyar et al. (2010)** in ber and **Seedkolai et al. (2015)** in orange. **Wei Shenglin (1997)**, however, did not find any effective result in fruit set of grapes with GA<sub>3</sub> treatment.

GA<sub>3</sub> plays an important role in fruit set percent and size of fruit being responsible for hormone movement. The above functions in the present investigation under the influence of GA<sub>3</sub> treatment might have helped improve the fruit set percent and size of fruit of phalsa. The maximum fruit set was obtained when the plants were treated with GA<sub>3</sub> at 40 ppm (69.39%) concentration but it increased when NAA 40 ppm was added to it (70.55%). Similar results have been reported by **Prasad et al. (2006)** in mango. This increase in fruit number after GA<sub>3</sub> application might be due to improve in plant health.

The size and weight of fruits in present trial increased by the plant's bio-regulators treatments. Relatively greater diameter and weight of fruits were obtained with application GA<sub>3</sub> at 40 ppm. The findings are in line with the reports of **Rajput et al. (1977)** in guava, who found increase in fruit size with increase in GA<sub>3</sub> concentration and **Biswas et al. (1988)** in guava observed increase in the weight of fruit with increase in GA<sub>3</sub> concentration. This increase in diameter and weight of fruit may be due to better supply of nutrients and photosynthates to fruits of treated plants.

The increase in fruit weight and fruit volume caused by growth regulators in the present study are in accordance with the reports of **Anawal et al. (2015)** who reported similar results in pomegranate.

The application of NAA in the present investigation has given marked increase in the yield of phalsa fruits. The maximum yield per plant was recorded in GA<sub>3</sub> 40 ppm treated plants (4.93kg). This increase in fruit yield per plant is obviously due to the increased fruit set, greater fruit size and weight. **Pandey (1999)** reported that improved yield of fruits the present findings are in accordance with the reports of **Chandra et al. (2015)** in aonla and **Debnath et al. (2011)** in phalsa. GA<sub>3</sub> 40 ppm treatment was found effective in increasing the yield/ha in phalsa (65.71 kg) followed by 30 ppm (69.76 kg). It was however, fortified under the combined application of NAA 40 ppm + GA<sub>3</sub> 40 ppm (78.50 kg). The findings agree with the reports of **Pandey (1999)**.

**Table 1. EFFECT OF FOLIAR APPLICATION OF GA<sub>3</sub> AND NAA on Fruit set (%), Fruit diameter(cm), Weight of 100 fruits(g), Fruit Volume (cm<sup>3</sup>), Fruit Yield per plant (kg) and Fruit Yield per hectare (q/ha) of Phalsa (*Grewia subinaequalis* D.C.) c.v. Sharbati**

Sr. No.	Treatments	Fruit set (%)	Fruit Diameter (cm)	Fruit Weight of 100 Fruit (g)	Fruit Volume (cm <sup>3</sup> )	Fruit Yield per plant (kg)	Fruit Yield per hectare (q/ha)
1.	T <sub>1</sub> Control @00ppm (water spray),	62.16	0.78	85.29	1.14	3.16	42.10
2.	T <sub>2</sub> (NAA@10 ppm)	63.40	0.84	88.63	1.19	3.45	45.93
3.	T <sub>3</sub> (NAA@20 ppm),	64.64	0.89	91.77	1.20	3.83	51.05
4.	T <sub>4</sub> (NAA@30ppm)	64.94	0.95	93.50	1.22	3.85	51.30
5.	T <sub>5</sub> (NAA @40ppm)	65.36	0.97	94.75	1.23	3.95	52.63
6.	T <sub>6</sub> (GA <sub>3</sub> @10 ppm)	66.55	0.86	109.61	1.18	4.25	56.64
7.	T <sub>7</sub> (GA <sub>3</sub> @20 ppm)	67.12	0.90	112.49	1.22	4.58	61.05
8.	T <sub>8</sub> (GA <sub>3</sub> @30 ppm),	68.38	0.96	116.31	1.24	4.86	64.76
9.	T <sub>9</sub> (GA <sub>3</sub> @40 ppm)	69.39	0.97	119.35	1.25	4.93	65.71
10.	T <sub>10</sub> (NAA @10 ppm + GA <sub>3</sub> @10 ppm)	67.64	0.88	110.12	1.20	5.45	72.61
11.	T <sub>11</sub> (NAA @20 ppm + GA <sub>3</sub> @20 ppm),	68.62	0.92	116.30	1.23	5.52	73.56
12.	T <sub>12</sub> (NAA @30 ppm + GA <sub>3</sub> @30 ppm)	69.31	0.94	120.85	1.24	5.70	75.98
13.	T <sub>13</sub> (NAA @40 ppm + GA <sub>3</sub> @40 ppm)	70.55	0.98	125.62	1.27	5.89	78.50
	<b>SEm (±)</b>	<b>0.183</b>	<b>0.035</b>	<b>0.130</b>	<b>0.026</b>	<b>0.070</b>	<b>0.053</b>
	<b>C.D. at 5% level</b>	<b>0.381</b>	<b>0.073</b>	<b>0.271</b>	<b>0.053</b>	<b>0.146</b>	<b>0.110</b>

## CONCLUSION

From the present investigation it can be concluded that GA<sub>3</sub> at 40 ppm increased fruit set, size, weight and volume of fruits, yield. The yield per plant as well as per hectare was recorded higher under the treatment of GA<sub>3</sub>. However, combined application of NAA+GA<sub>3</sub> proved beneficial in improving, fruit set, fruit size, yield traits of phalsa fruits. Phalsa grower may be recommended the application of these growth regulators for obtaining better return under the agro-climacteric conditions of Central Uttar Pradesh.

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