Effect of NAA And GA_3 on Fruit Yield and Yield Attributary Traits in Phalsa (*Grewia subinaequalis* D.C.) c.v. Sharbati

ABSTRACT

The experiment included four levels of NAA, 10, 20, 30, and 40 ppm, and four levels of GA_3, 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_3 at 40 ppm enhanced fruit set, size, weight, and volume of the fruits, yield. Combining NAA+GA3 proved effective in improving the fruit set, fruit size, yield, and quality characteristics 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_3*

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 Tilliaceae 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 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 **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_3, NAA, control. T_1Control (00ppm water spray), T_2(10 ppm NAA), T_3(20 ppm NAA), T_4(30ppm NAA), T_5(40ppm NAA), T_6(10 ppm GA_3), T_7(20 ppm GA_3), T_8(30 ppm GA_3), T_9 (40 ppm GA_3), T_{10}(10 ppm NAA + 10 ppm GA_3), T_{11}(20 ppm NAA + 20 ppm GA_3), T_{12}(30 ppm NAA + 30 ppm GA_3), T_{13}(40 ppm NAA + 40 ppm GA_3). In the early morning with the help of knapsack sprayer with various concentration of NAA, GA_3 and their combined concentration.

2.2 Parameters of Study

2.2.1 Fruit set (%): 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(cm): A sample of 10 berries under each treatment were randomly selected, 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(g): 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)^3: Volume was determined by 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 following measurements of several factors were made: Fruit set %, Fruit diameter, Fruit weight of 100 fruits, Fruit volume, Fruit yield per plant, and Fruit yield per hectare.

Fruit set (%): The maximum fruit set percent was observed under GA_3 @40 ppm showed 69.39% fruit set followed by GA_3 @30 ppm dose (68.38%) against the minimum of 66.55% registered under control treatment.

Fruit diameter(cm): The maximum fruit diameter was obtained under combined effect of NAA and GA_3 i.e. treatment T_{13} (NAA @40 ppm + GA_3 @40 ppm) showed (0.98 cm) and the minimum fruit diameter was obtained under control treatment (T_1) i.e. 0.78 cm.

Weight of 100 fruits(g): The combined effect of NAA and GA_3 treatment T_{13}(NAA @40 ppm+GA_3 @40 ppm) showed the maximum fruit weight of 100 fruits (125.62 g) followed by the treatment T_{12}(NAA @30 ppm+GA_3 @30 ppm) i.e. 120.85cm^3 and the minimum fruit weight of 100 fruits reported in control treatment (85.29 g).

Volume of fruits (cm)^3: Treatment T_9(GA_3 @40 ppm) showed the maximum fruit volume (1.27 cm^3) followed by the treatment T_{12}(NAA @30 ppm+GA_3 @30 ppm) 1.25cm^3 and the minimum fruit volume reported under control treatment (1.14cm^3).

Yield per plant (Kg): subjected to fruit yield per plant, the treatment T_{13}(NAA @40 ppm+GA_3 @40 ppm) showed the maximum fruit yield per plant (5.89 kg/plant) followed by the treatment T_{12}(NAA @30 ppm+GA_3 @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_{13} (NAA @40 ppm+GA_3 @40 ppm) 78.50 kg per hectare followed by the treatment T_{12}(NAA @30 ppm+GA_3 @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

The blooming and fruiting of plants are greatly influenced by the quality of nourishment as well as the quantity of growth regulators present in the plant body. Both an excessive and insufficient nitrogen supply have a negative impact on blooming and fruiting; in a deficient environment, plants remain yellow with delayed fruiting and malformed fruit.Foliar sprays of NAA and GA_3 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_3 treatment.

GA_3 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_3 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_3 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_3 application might be due to improve in plant health.

The size and weight of fruits in present trial increased by the plant growth regulators treatments. Relatively greater diameter and weight of fruits were obtained with application GA_3 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_3 concentration and **Biswas *et al.* (1988)** in guava observed increase in the weight of fruit with increase in GA_3 concentration. This increase in diameter and weight of fruit may be due to better supply of nutrients and photosynthates to fruits of treated plants.

Growth regulators increased fruit weight and volume in the current study, which is consistent with results published in pomegranates by **Anawal *et al.* (2015).**

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_3 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_3 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_3 40 ppm (78.50 kg). The findings agree with the reports of **Pandey (1999).**

Table 1. EFFECT OF FOLIAR APPLICATION OF GA_3 AND NAA on Fruit set (%), Fruit diameter(cm), Weight of 100 fruits(g), Fruit Volume (cm^3), 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^3)	Fruit Yield per plant (kg)	Fruit Yield per hectare (q/ha)
1.	T_1Control (00 ppm water spray)	62.16	0.78	85.29	1.14	3.16	42.10
2.	T_2 (10 ppm NAA)	63.40	0.84	88.63	1.19	3.45	45.93
3.	T_3 (20 ppm NAA)	64.64	0.89	91.77	1.20	3.83	51.05
4.	T_4(30ppm NAA)	64.94	0.95	93.50	1.22	3.85	51.30

5.	T_5(40ppm NAA)	65.36	0.97	94.75	1.23	3.95	52.63
6.	T_6(10 ppm GA_3)	66.55	0.86	109.61	1.18	4.25	56.64
7.	T_7(20 ppm GA_3)	67.12	0.90	112.49	1.22	4.58	61.05
8.	T_8(30 ppm GA_3),	68.38	0.96	116.31	1.24	4.86	64.76
9.	T_9 (40 ppm GA_3)	69.39	0.97	119.35	1.25	4.93	65.71
10.	T_{10}(10 ppm NAA + 10 ppm GA_3)	67.64	0.88	110.12	1.20	5.45	72.61
11.	T_{11}(20 ppm NAA + 20 ppm GA_3)	68.62	0.92	116.30	1.23	5.52	73.56
12.	T_{12}(30 ppm NAA + 30 ppm GA_3)	69.31	0.94	120.85	1.24	5.70	75.98
13.	T_{13}(40 ppm NAA + 40 ppm GA_3)	70.55	0.98	125.62	1.27	5.89	78.50
	SEm (±)	**0.183**	**0.035**	**0.130**	**0.026**	**0.070**	**0.053**
	C.D. at 5% level	**0.381**	**0.073**	**0.271**	**0.053**	**0.146**	**0.110**

CONCLUSION

According to the results of the experiment, GA_3 at a concentration of 40 ppm improved fruit set, size, weight, and volume of fruits, and yield. Under the treatment of GA_3, a higher yield was seen per plant and per hectare. The fruit set, fruit size, and yield attributes of phalsa fruits, however, were improved by the combined treatment of NAA+GA_3 for higher returns in Central Uttar Pradesh's agro-climactic settings, phalsa growers may be advised to use these growth regulators.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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