Original Research Article

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

ABSTRACT

The investigation entitled the **'Effect ofNAA and GA_3 on quality, yield and yield attributing 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_3, 10, 20, 30, and 40 ppm, administered topically and evaluated compared 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 fruit, yield.NAA+GA_3 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_3*

1. INTRODUCTION

Phalsa (*Grewia subinaequalis*D.C) isan important indigenous fruit by its adaptability to be grown from kitchen gardens to well-organized orchard plantations and itsbeneficial cooling effect, which plays a considerable role in curing diseases. It belongs to the family Tiliaceaeto also belongs to the important fibre crop jute. It is prevalent in India. Phalsa is found in wild form all along the foothills of the Himalayas and is 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.

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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 signaling by gibberellins, similar results were found by **Chandra *et al.,* 2015**.

Gibberellins decrease acidity due to hormone application [might be due to increased translocation of carbohydrates and increased metabolism due to conversion of acids to sugar. Gibberellins improved the quality of fruits, supported by many researchers in fruit crops, such as**Byase*t al.,* (2014).**

Plant growth regulators can also increase the ascorbic acid content in fruits by the synthesis of catalytic activity of several enzymes and co-enzymes, which are essential in ascorbic acid synthesis. So that plant growth regulators may improve physicochemicalcharacteristics like ~~as~~ fruit length & width, the 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 of phalsa fruits by ~~ethrel~~**Kachae*t al.,* (2014**).

Hence plant growth regulators are very effective in improving physicochemical 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 inextremely low concentrations. Hormones regulate cellular processes in targeted cells locally and then move to other locations inthe plant.Hormones alsodetermine the formation of flowers, stems, leaves, the shedding of leaves, and thedevelopment 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 the 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.),from 2018-2019.

2.1 Experimental Design and Treatments

SharbatiPhalsa cultivar trees. That uniform, healthy- establishes were chosen for the 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).Consequently, 39 units were selected on 13 Ber trees, and the experiment proceeded as planned. The experiment included thirteen treatments, including foliar sprays of GA_3, NAA, and control.T_1Control @00ppmwater spray,T_2(NAA@10ppm),T_3(NAA@20 ppm),T_4(NAA@30ppm),T_5(NAA@40ppm),T_6(GA_3@10ppm),T_7(GA_3@20 ppm),T_8(GA_3@30 ppm),T_9(GA_3@40 ppm),T_{10}(NAA@10 ppm + GA_3@10 ppm),T_{11}(NAA @20 ppm + GA_3@20 ppm),T_{12}(NAA @30 ppm + GA_3@30 ppm),T_{13}(NAA @40 ppm + GA_3@40 ppm). In the early morning,with the help of a knapsack sprayer with various concentrations of NAA, GA_3,and their combined concentration.

2.2 Parameters of Study

2.2.1 Fruit set percentages

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

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

2.2.2Fruit diameter

A sample of 10 berries under each treatment was randomly selected,~~and~~ the diameter was measured with the help of a Verniercaliper, 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 $(cm)^3$

Volume was determined by the 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 the 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 from time to time,fromMay to June. Ripe fruits are picked in every harvesting,and weight is recorded every time. After the 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: 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_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: The maximum fruit diameter was obtained under the 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: 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 the control treatment (85.29 g).

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The volume of fruits (cm)^3: Treatment T_9(GA_3 @40 ppm) showed the maximum fruit volume (1.27 cm^3) followed by 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

Proper nutrition, as well as an adequate supply of growth regulators in the plant body, plays a pivotal role in the flowering and fruiting of plants.Both excessive and deficient nitrogen supply affects flowering and fruiting adversely; plants remain yellow with delayed fruiting and deformed fruit under deficient conditions. 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, **Mishraand Kriska (2008)** and **Katiyar*et al.* (2010)** in ber and **Seedkolai*et al.* (2015)** in orange. **However, Wei Shenglin (1997)**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 improvements in plant health.

The plant's bio-regulator treatments increased the size and weight of fruits in the present trial. 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)**on guava, who found an increase in fruit size with an increase in GA_3 concentration and **Biswas *et al.* (1988)** in guava observed an increase in the weight of fruit with the increase in GA_3 concentration. This increase in diameter and weight of fruit may be due to a better supply of nutrients and photosynthates to fruits of treated plants.

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

The application of NAA in the present investigation has given a 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 the improved yield of fruits the present findings are by 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 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@00ppm (water spray),	62.16	0.78	85.29	1.14	3.16	42.10
2.	T_2(NAA@10 ppm)	63.40	0.84	88.63	1.19	3.45	45.93
3.	T_3 (NAA@20 ppm),	64.64	0.89	91.77	1.20	3.83	51.05
4.	T_4(NAA@30ppm)	64.94	0.95	93.50	1.22	3.85	51.30
5.	T_5(NAA @40ppm)	65.36	0.97	94.75	1.23	3.95	52.63
6.	T_6(GA_3@10 ppm)	66.55	0.86	109.61	1.18	4.25	56.64
7.	T_7(GA_3@20 ppm)	67.12	0.90	112.49	1.22	4.58	61.05
8.	T_8(GA_3@30 ppm),	68.38	0.96	116.31	1.24	4.86	64.76
9.	T_9 (GA_3@40 ppm)	69.39	0.97	119.35	1.25	4.93	65.71
10.	T_{10}(NAA @10 ppm + GA_3 @10 ppm)	67.64	0.88	110.12	1.20	5.45	72.61
11.	T_{11}(NAA @20 ppm + GA_3 @20 ppm),	68.62	0.92	116.30	1.23	5.52	73.56
12.	T_{12}(NAA @30 ppm + GA_3 @30 ppm)	69.31	0.94	120.85	1.24	5.70	75.98
13.	T_{13}(NAA @40 ppm + GA_3 @40 ppm)	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**

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CONCLUSION

From the present investigation, it can be concluded that GA_3 at 40 ppm increased fruit set, size, weight and volume of fruits, and yield. The yield per plant as well as per hectare was recorded higher under the treatment of GA_3. However, the combined application of NAA+GA_3 improved fruit set, size, and yield traits of phalsa fruits. Phalsa growers may be recommended to apply these growth regulators to obtain better returns under the agro-climacteric conditions of Central Uttar Pradesh.

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