

Original Research Article

Effect of foliar Spray of NAA And GA₃ Influences On Fruit Quality Traits in Phalsa (*Grewia subinaequalis* D.C.) c.v. Sharbati

Formatted: Centered

ABSTRACT

Phalsa fruits are small and abundantly produced. They don't mature within a certain period of time, which makes them difficult to grow. They have to spend more money on labour for a considerable amount of time in order to select fruit. Fruit must also be thrown out right away because it cannot be kept for more than a few hours. The study aimed to study the influences of NAA and GA₃ plant growth regulators were both applied topically in the experiment at four different concentrations-10, 20, 30, and 40 ppm each and their effects were compared to a control (water spray). The measurements of several parameters, Total soluble solids (°Brix), Ascorbic acid (mg/100g), Acidity (%), and T.S.S. Acidity ratio were measured. According to the experiment the results revealed that T₁₃ (40 ppm NAA + 40 ppm GA₃) enhances the quality attributes of phalsa. Under the control treatment, the acidity (%) showed maximum however, the application of plant growth regulators produced minimum acidity (%) content.

Keywords: NAA, GA₃, PGR, Growth, Quality, and Phalsa

1. INTRODUCTION

The phalsa (*Grewia subinaequalis* D.C.), a fruit that can be grown anywhere from a kitchen garden to a well-planned orchard plantation, is a significant indigenous fruit because of its adaptability and the cooling effect it provides, both of which are useful in the treatment of illnesses. It is a member of the major jute-producing family, which also includes other plants. In India, it's really prevalent. Along the slopes of the Himalayas, phalsa can be seen growing in wild production. Phalsa berries have a juice content of 50 to 60 percent, 11 percent sugar, 2 to 2.5 percent acidity, 14.4 percent carbohydrate, 1.5 percent protein, 0.9 percent fat, 129 mg of pulp per 100 grammes, 89 mg of phosphorus, 3.1 mg of iron, traces of vitamin C, and 49 IU of vitamin B1 (Arkroyd, 1963).

In Uttar Pradesh, West Bengal, Punjab, Madhya Pradesh, and Bihar it is cultivated commercially. Along with these, it is also minimally grown in the states of Maharashtra, Gujarat, and Andhra Pradesh. Despite the lack of exact data, it is believed that India has 0.0002 million acres of this crop under cultivation. Phalsa is a deciduous plant with a propensity of losing its leaves in the winter, which allows it to tolerate cold. In the axis of the leaves of the young stalk, Phalsa develops fruit in clusters. It mostly serves as fresh fruit and is refreshing. Auxins and gibberellins, two growth agents, have been used successfully to increase fruit set and production in numerous fruit crops, including phalsa. Similar findings were made by Chandra et al. (2015).

Foliar feeding plant growth regulators improved better formation and translocation of food, as well as hormonal signalling by gibberellins. Fruit characteristics such as length, width, pulp-stone ratio, and weight of 50 fruits were increased as a result. Gibberellins' reductions in acidity as a result of hormone administration [could be related to an increase in carbs being transported and an increase in metabolism as a result of the conversion of acids to sugar]. Numerous studies on fruit crops, like Singh et al. (2011) and Byaset al. (2014),

Attest to the improvement in fruit quality brought about by gibberellins. Bysynthesizing the catalytic activity of numerous enzymes and co-enzymes that are crucial for the manufacture of ascorbic acid, plant growth regulators may also raise the ascorbic acid concentration in fruits. In order for Kacha and colleagues' early maturation of phalsa fruits and other physio-chemical characteristics, such as fruit length and width, the weight of 50 fruits, pulp-stone ratio, ascorbic acid contents, total soluble solids, and sugars through better formation and translocation of carbohydrates, to be improved by plant growth regulators Kacha et al., (2014). Phalsa fruits are little and abundantly produced. They don't mature within a certain period of time, which makes them difficult to grow. They have to spend more money on labour for a considerable amount of time in order to select fruit. Fruit must also be thrown out right away because it cannot be kept for more than a few hours.

2. MATERIAL AND METHODS

The present investigation was carried out in the Horticulture Garden Department of Fruit Science, College of Horticulture, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur during the year 2018-2019.

2.1 Experimental Design and Treatments

Sharbati Phalsa cultivar trees that were uniform healthy, and well established were chosen for the experiment's goal, the trees, which were around 15 years old, were maintained in good condition by adhering to the recommended Fertilizer doses and other horticultural practices. As a consequence, 39 units were selected on 13 Phalsa trees, and the experiment proceeded as planned. The experiment included thirteen treatments, each of which included foliar spray of NAA, GA₃ and control. The treatments are as follows- T₁Control (00ppm-water spray), T₂(10 ppm NAA), T₃(20 ppm NAA), T₄(30ppm NAA), T₅(40ppm NAA), T₆(10 ppm GA₃), T₇(20 ppm GA₃), T₈(30 ppm GA₃), T₉(40 ppm GA₃), T₁₀(10 ppm NAA + 10 ppm GA₃), T₁₁(20 ppm NAA + 20 ppm GA₃), T₁₂(30 ppm NAA + 30 ppm GA₃), T₁₃(40 ppm NAA + 40 ppm GA₃). The spraying was done when buds were fully swollen in 2019 on randomly tagged plants and the second spraying was done at the fully fruit setting stage.

2.2 Parameters of Study

2.2.1 Total soluble solids (°Brix): Total soluble solids content of berry juice was determined with the help of a Hand Refractometer. The TSS was expressed in Brix°. The temperature was mild above or below 20°C (A.O.A.C., 1980).

2.2.2 Ascorbic acid (mg/100g): Ascorbic acid was extracted from the pulp by macerating 5g of sample with 3% metaphosphoric acid (MPA) solution. The extract was filtered and volume made to 25 ml in a volumetric flask. Two ml of the aliquot was taken and titrated against standardized blue dye till the light pink colour appeared which was taken as the endpoint (Rangana, 1986).

2.2.3 Acidity (%): It was estimated in the laboratory of Horticulture, Department of Fruit Science C.S.A.U.&T. in Kanpur terms 20 ml fruit juice solution was taken by pipette and transferred into a 100 ml flask and then distilled water was added to make up the volume up to 100 ml. It was and shaken well to dissolve. About 0.25 ml of diluted fruit juice which was taken by pipette and transferred into a 250 ml beaker, and then three drops of Phenolphthalein indicator were added in this solution. The burette was filled with N/10 NaOH solution and the juice was titrated with alkali solution, drop by drop with constant stirring till the pink endpoint developed was reached. Endpoint readings were recorded and the percentage acidity was calculated by the following formula and expressed in terms of citric acid.

Titrate acidity (%) = $x \times 100$

2.2.4 T.S.S. Acidity ratio: T.S.S. was worked out with the help of a Hand Refractometer as above and acidity obtained as above said methods gave their ratio which was calculated mathematically.

2.2.5 Statistical analysis (Add the statistical analysis with the software used, a cited reference, and the statistical model)

3. RESULT AND DISCUSSION

Fruit quality including total soluble solids, ascorbic acid, acidity, and T.S.S Acidity ratio were dramatically enhanced by foliar spray of GA₃ and NAA the biochemical components of fruit were changed over control by application of the mentioned Plant Growth Regulators.

Total soluble solid (°Brix): The foliar spray of T₁₃(40 ppm NAA + 40 ppm GA₃), showed the highest significant (P<0.05) total soluble solids (20.12°Brix), which was significant in this experiment. The plants that were left untreated (Control) showed the lowest total soluble solids (16.60°Brix) (control). Total soluble solids ranged from 16.60 to 20.12°Brix, with treatment T₁₃(40 ppm NAA + 40 ppm GA₃) being applied over control resulting in a maximum of 40.24%. This increase in total soluble solids of treated juice may be the result of a rise in plant hormone-mediated mobilization of carbohydrates from the source to sink fruit. In addition, these growth regulators stimulated enzymatic activity, converted carbohydrates into simple sugar, and released nitrogen, which strengthened the fruit juice and increased the amount of total soluble solids in the berry fruit.

Comment [es1]: Add the model and manufacturer.

Formatted: Font: (Default) Arial, 10 pt

Formatted: List Paragraph, Outline numbered + Level: 3 + Numbering Style: 1, 2, 3, ... + Start at: 4 + Alignment: Left + Aligned at: 0.04" + Indent at: 0.54"

Formatted: Font: (Default) Arial, 10 pt

Comment [es2]: Please unify the appearance of the measuring unit.

Ascorbic acid (mg/100g): The results of the experiments revealed a substantial difference in the ascorbic acid contents of the Phalsa fruit when gibberellin and naphthalene acetic acid, were applied; all of the treatments were determined to be significantly different from the control. The treatment of T₁₃(40 ppm NAA + 40 ppm GA₃)resulted in the highest ascorbic acid concentrations (29.86 mg/100g) that could be produced. The control treatment (T₁) had an impact on the lowest ascorbic acid concentration (24.67 mg/100g). The increase in ascorbic acid content has been demonstrated due to metabolic activities involving specific enzymes. The ascorbic acid content improvement may be attributable to the actual synthesis of glucose-6 phosphate during fruit growth and development, which is thought to be a precursor to ascorbic acid (vitamin C). With the use of plant growth regulators like GA₃ and NAA as well as the strengthening of the nitrogen nutrient.

Acidity (%): The data scenario showed that NAA and GA₃ reduced the acidity of Phalsa fruit. Treatment of T₅(40ppm NAA), T₁₃(40 ppm NAA + 40 ppm GA₃)andT₁Control (00 ppm water spray)displayed 1.31 and 1.87% acidity content, respectively.

T.S.S. Acidity ratio: Increasing concentrations of NAA progressively improved the T.S.S. acidity ratio irrespective of the growth regulators. Treatment T₁₃(40 ppm NAA + 40 ppm GA₃) caused significant improvement revealing 15.36. However, foliar spray of GA₃ improved the T.S.S. acidity ratio significantly. Plants under control showed a significantly (P<0.05) poorest ratio (8.88). Treatment of 10, 20, 30, and 40 ppm GA₃ expressed the ratio of 11.58, 11.95,12.70, and 13.26. The interaction of NAA and GA₃ caused further improvement in ratio and expressed 12.11, 12.74, 14.65, and 15.36 ratios.

DISCUSSION

The TSS was significantly increased (20.12^oBrix) with the treatment of T₁₃(40 ppm NAA + 40 ppm GA₃)followed by T₁₂(30 ppm NAA + 30 ppm GA₃)(19.92^oBrix). The increase in total soluble solids were expressed in ^oBrix. The present findings are in conformity with those reported by Sandhu and Bal (1990) in bear, and Biswas (1988) in guava.

NAA & GA₃ gave significantly increased Ascorbic acid (29.86mg/100g), It might be due to an increase in the synthesis of catalytic activity of several enzymes and co-enzymes which are instrumental in ascorbic acid synthesis.

Kacha (2012) in phalsa also reported increased TSS and acidity with NAA 40 ppm followed by NAA 30 ppm. Lower concentration of both i.e.10 ppm each of NAA (1.52%) and GA₃ (1.61%) caused greater acidity content. The reason for decreasing acidity might be due to hormones application (GA₃ and NAA) owing to increased translocation of carbohydrates and increased metabolism due to conversion of acids to sugar.

Table.1 Effect of Foliar Spray of NAA and GA₃ on Total soluble solid (^oBrix), Ascorbic acid (mg/100g), Acidity (%), T.S.S. Acidity ratioof Phalsa (*Grewiasubinaequalis* D.C.) cv. Sharbati

Sr. No.	Treatments	Total Soluble Solid (^o brix)	Ascorbic Acid (mg/100g)	Acidity (%),	T.S.S. Acidity Ratio
1.	T ₁ Control (00 ppm water spray)	16.60	24.67	1.87	8.88
2.	T ₂ (10 ppm NAA)	17.25	25.89	1.52	11.35
3.	T ₃ (20 ppm NAA)	18.15	26.81	1.44	12.60
4.	T ₄ (30ppm NAA)	18.65	27.63	1.36	13.71
5.	T ₅ (40ppm NAA)	18.88	28.86	1.31	14.41
6.	T ₆ (10 ppm GA ₃)	18.64	26.96	1.61	11.58
7.	T ₇ (20 ppm GA ₃)	18.77	27.83	1.57	11.95
8.	T ₈ (30 ppm GA ₃),	19.31	28.49	1.52	12.70
9.	T ₉ (40 ppm GA ₃)	19.50	29.66	1.46	13.26
10.	T ₁₀ (10 ppm NAA + 10 ppm GA ₃)	18.65	27.66	1.54	12.11
11.	T ₁₁ (20 ppm NAA + 20 ppm GA ₃)	18.86	28.89	1.48	12.74
12.	T ₁₂ (30 ppm NAA + 30 ppm GA ₃)	19.92	29.27	1.36	14.65
13.	T ₁₃ (40 ppm NAA + 40 ppm GA ₃)	20.12	29.86	1.31	15.36

Comment [es3]: The discussion has to be enhanced a little bit with higher comparisons.

SEm (±)	0.147	0.099	0.028	0.082
C.D. at 5% level	0.304	0.205	0.059	0.171

CONCLUSION

~~The From the present investigation it can be concluded that~~ T₁₃(40 ppm NAA + 40 ppm GA₃) increased Total soluble solid (°Brix), Ascorbic acid (mg/100g), T.S.S. Acidity ratio, and Acidity (%) maximum in under control treatment. The TSS acidity ratio was induced greater under the foliar application of T₁₃(40 ppm NAA + 40 ppm GA₃). Phalsa growers may be recommended the application of these plant growth regulators for obtaining better returns under the agro-climacteric conditions of Central Uttar Pradesh.

REFERENCES

1. Ahmad, M. F. Zargar, G. H. (2005) Effect of trunk girdling, flower thinning, GA₃ and ethephon application on quality characteristics in grape cv. Perlette under temperate Kashmir valley conditions. *Indian Journal of Horticulture.*, **62** (3): 285-287.
2. Agrawal, S. and Dikshit, S. N. (2010) Studies on the effect of plant growth regulators on qualitative characters of sapota cv. Cricket Ball. *Indian J. Hort.* 67 (2): 177-180.
3. Ahmed, W.; Tahir, F. M.; Rajwana, I. A.; Raza, S. A. and Asad, H. U. (2012) Comparative evaluation of plant growth regulators for preventing premature fruit drop and improving fruit quality parameters in "Dushehri" mango. *Food Science and Technology Abs. Intern. J. of Fruit Scie.*, 12(4): 372-389.
4. Aykroyd, W.R. (1963) The nutritive value of Indian foods and the planning of satisfactory diets (6th Ed.). *ICMR, New Delhi*, 101-126.
5. A.O. A.C. (1980) Official methods of analysis, Association of official analytical chemists, Washington D.C., U.S.A.
6. Balakrishnan, K. (2000) Foliar spray of zinc, iron, boron and magnesium on vegetative growth, yield and quality of guava. *Annals of plant physiology*, 14(2):151-153.
7. Byas P.N. (2014) Studies on foliar application of micronutrients and GA₃ on yield and quality of ber (*Zizyphus mauritiana* Lamk.) fruits cv. Gola. Thesis submitted to the Master of Science in Horticulture to N. D. Uni. of Agr. and Tech. Faizabad, (UP)
8. Chandra, R. Manju, Rawat, S. S. and Singh, K.K. (2015) Effect of foliar application of various growth regulators on yield and quality of aonla. cv. NA- 7. *Int. J. Tropical Agr.*, 33(3): July-September.
9. Ghosh, S. N.; Bera, B.; Roy, S. and Kundu A. (2009) Effect of plant growth regulators in yield and fruit quality in pomegranate c.v. Ruby. *Journal of Horticulture Sciences* 4: 2 158-160.
10. Goswami, J.D., Patel, N.M., Bhaduria, H.S. and Wankhade, V.R. (2013). To study the effect of plant growth regulators on quality traits of pomegranate cv. Sinduri. *The Asian J. of Hort.*, 8(1): 361-363 Kacha, H.L.; Jat, G., and Patel, S.K. (2014) Performance of various plant growth regulators on yield and quality of phalsa (*Grewia asiatica* L.). *Hort Flora Res. Spect.*, **3** (3): 292-294.
11. Rangana, S. (1986). Hand book of analysis and quality control for fruit and vegetable products. Second edition, *TaTaMc Grow Hill Publishing company*, New Delhi.
12. Sharma, A.K., Singh, K. and Mishra, S.P. (2002) Effect of foliar spray of zinc sulphate, 2,4,5-T and GA₃ on quality of Kagzilime (*Citrus aurantifolia* Swingle).
13. Sharma, A.K., Singh, K. and Mishra, S.P. (2003) Effect of foliar spray of zinc sulphate, 2,4,6-T and GA₃ on quality of kagzi lime (*Citrus aurantifolia* Swingle.) *Orissa J. Hort.*, 31(2): 29-32.
14. Sharma R R and Singh R. (2008) GA₃ influence incidence of fruit malformation, berry yield and fruit quality in strawberry (*Fragaria x ananassa* Duch.). *Acta Horticulturae*. 842: 737-740.
15. Singh, J.P., Kumar S., Katiyar P.N. and Dwivedi, A.K. (2011) Effect of calcium nitrate, GA₃ and ethephon on fruiting, ripening and chemical traits of phalsa (*Grewia subinaequalis* D.C.) *Annals Hort.*, 4(1): 72-76
16. Seedkolai, F.; Sadeghi, H. and Moradi, H. (2015) Effects of foliar applications of nitrogen, boron and zinc on auxin contents, fruit set and fruit drop in orange (*Citrus sinensis*) cv. Thompson navel. *Iranian Journal of Horticultural Science*, 46(3):367-378.

Comment [es4]: MUST BE UPDATED as only zero% (0 out of 18) of the listed references were published in the past five years. This percentage has to be improved to at least 35-40%.

17. **Young, M.; Young, E. K.; Ho Kim Chang Myung and Sangdok, K. (2003).** Effects of foliar application of GA₃ on flowering, vegetative shoots, fruit set and fruit size and fruit quality of very early-maturing Satsuma mandarin (Karan). *Korean J. of Hort. Sci. & Tech.*, 21 (2): 110-123.
18. **Yadav, B., Rana, G.A. and Bhati, S.K. (2005)** Response of NAA, urea and ZnSO₄ on fruit drop in ber (*Zizyphus mauritiana* Lamk.). *Haryana J. Hort. Sci.*, 33(3/4): 181-182.

UNDER PEER REVIEW