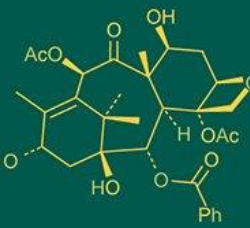
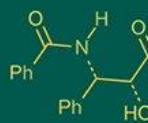


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## Influence of organic and inorganic foliar feeding applications on quality of phalsa

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### Abstract

The experiment was carried out at Regional Horticultural Research Station, ASPEE College of Horticulture, Navsari Agricultural University, Navsari, Gujarat during the year 2023. Eleven treatments T<sub>1</sub>-GA<sub>3</sub> @ 100 mg l<sup>-1</sup>, T<sub>2</sub>-GA<sub>3</sub> @ 200 mg l<sup>-1</sup>, T<sub>3</sub>-NAA @ 100 mg l<sup>-1</sup>, T<sub>4</sub>-NAA @ 200 mg l<sup>-1</sup>, T<sub>5</sub>-Ethrel @ 1 ml l<sup>-1</sup>, T<sub>6</sub>-Ethrel @ 2 ml l<sup>-1</sup>, T<sub>7</sub>-Novel Organic Liquid Nutrients @ 1%, T<sub>8</sub>-Novel Organic Liquid Nutrients @ 2%, T<sub>9</sub>-G-IV Micronutrient @ 1%, T<sub>10</sub>-G-IV Micronutrient @ 2% and T<sub>11</sub>-Control (water spray) were included in the completely randomized design of the experiment. Two applications of the foliar spray were made before the flowering stage and after the fruit set. Three iterations of the experiment were conducted. According to the findings, foliar treatment of GA<sub>3</sub> at a dose of 200 mg l<sup>-1</sup> both before and after fruit set required the least titrable acidity (2.34%) and the ethrel @ 2 ml l<sup>-1</sup> treatment had the highest TSS (22.23 °Brix), total sugar (5.47%), reducing sugar (1.98%), and non-reducing sugar (3.49%) reported. Economic point of view GA<sub>3</sub> @ 100 mg l<sup>-1</sup> was resulted in the highest net return (48520.00 Rs./ha) which, was at par with treatment GA<sub>3</sub> @ 200 mg l<sup>-1</sup> (45820.00 Rs./ha) and minimum net return in control (2443.00 Rs./ha).

**Keywords:** Phalsa, foliar application, organic & inorganic substances and quality

### Introduction

The indigenous fruit phalsa (*Grewia asiatica*) is cultivated for commercial use in various Indian states. It belongs to the family Tiliaceae. It is thought to have originated in India. Botany describes the fruit as a berry, edible, and having a desired, pleasant flavour that can be either sweet or sour. Phalsa is a fruit crop that grows in the subtropics. It is farmed for commercial use in Andhra Pradesh, Uttar Pradesh, Haryana, and Punjab. It is cultivated in areas of Ahmedabad, Vadodara, Kutch, Valsad, and Saurashtra in the state of Gujarat (Meena *et al.*, 2017) [10]. The *Vedic literature* claims that phalsa has some medicinal qualities. It may flourish in conditions like water scarcity and neglect where few other crops could. The tiny, purple to black fruit known as the Indian sherbet berry, or phalsa, is found on small trees or shrubs. It is a popular fruit in India that is used to make sherbet, jam, and jellies (Lamo *et al.*, 2017) [8]. Due to its drought resistance, the plant requires little care. The ripe fruits have a diameter of 5 to 12 mm and a colour ranging from purple to black. 50-60% juice, 10-11% sugar, 2.0-2.5% acid, and a substantial amount of vitamins A and C are all present in ripe fruits. Additionally, they are a good source of iron and phosphorus (Kacha *et al.* 2014) [5]. Because of their limited shelf life, the fruits must be processed immediately after harvesting (Salunkhe and Desai, 1984) or are suitable for the local market. The ripe phalsa fruits are consumed raw in the summer or processed into cool fruit drinks or sweets. Since phalsa yields fruit according to the growth of the current season, no initial training is required and it is allowed to grow like a shrub. Blossom control and rigorous annual pruning before spring are necessary for higher-quality fruits. The most important step in phalsa cultivation is pruning. A yearly pruning to a height of around 100 cm encourages new shoots and a higher commercial production of marketable fruits than more drastic pruning (Singh and Sharma, 1961) [14]. This practice is also practiced in Gujarat state's Kutch region (Singh and Singh, 1983) [15]. Phytohormones, commonly referred to as plant growth regulators, are naturally occurring or chemically manufactured organic chemicals that control growth or other physiological processes at a distance from the site of synthesis.

At trace levels, they are active. Exogenous administration of various plant growth agents has become an essential component of agrotechnical procedures for most cultivated plants, and especially for fruit crops.

The usage of plant growth regulators, such as GA<sub>3</sub>, has been shown to increase berry or fruit size and improve the quality of crops like grape, citrus, ber, litchi, etc., in addition to enhancing production and quality. GA<sub>3</sub> (40 ppm) has been shown to boost fruit size and overall yield in phalsa. Because phalsa fruits are perishable, they should be sold as soon as they are harvested and delivered to the market. Growers may do not receive a market price for their products that is sufficient. Therefore, it would be preferable to postpone or accelerate fruit maturity. Growth promoters, which either accelerate or postpone fruit maturation, are employed to achieve the aforementioned goals. Ethrel hastens the maturity and significantly reduces the number of pickings in phalsa (Kacha *et al.* 2014)<sup>[5]</sup>.

## Materials and Methods

**Experimental Site:** The experiment was carried out during January 2023 to May 2023 at Regional Horticultural Research Station, ASPEE College of Horticulture, Navsari Agricultural University, Navsari.

**Experimental design and treatments:** Eleven treatments and three repetitions made up the CRD experimental design. Each variable's standard error of mean (SEM±) was determined, and the treatment means were compared using the critical difference (CD) at the 5% level of probability, where the treatment effects were determined to be significant. To comprehend the variability of the experimental material for every example, the percentage coefficient of variation (CV%) was also calculated. A total of sixty-six plants were studied, with two plants chosen for

each treatment. Treatment details are as under: T<sub>1</sub>: GA<sub>3</sub> @ 100 mg l<sup>-1</sup>, T<sub>2</sub>: GA<sub>3</sub> @ 200 mg l<sup>-1</sup>, T<sub>3</sub>: NAA @ 100 mg l<sup>-1</sup>, T<sub>4</sub>: NAA @ 200 mg l<sup>-1</sup>, T<sub>5</sub>: Ethrel @ 1ml l<sup>-1</sup>, T<sub>6</sub>: Ethrel @ 2ml l<sup>-1</sup>, T<sub>7</sub>: Novel organic liquid nutrients @ 1%, T<sub>8</sub>: Novel organic liquid nutrients @ 2% , T<sub>9</sub>: G-IV Micronutrient @ 1%, T<sub>10</sub>: G-IV Micronutrient @ 2% and T<sub>11</sub>: Control (Water spray). Foliar application was given to the plants at two stages: first during the pre-blooming stage and the second during fruit set.

Using sharp secateurs, the phalsa plants were clipped during the first week of January 2023. To stop the fungal infection, Bordeaux paste was applied to the cut ends as soon as they were pruned. Chemical fertilisers, such as 100 g N: 100 g P: 50 g K/plant as a basal dose, and well-decomposed FYM @ 10 kg/plant were administered to all treatments in January 2023. A second dose of N, 100 g, was applied in February 2023. Following pruning, the first irrigation was administered right away. After that, irrigation was applied every 20 days as needed, beginning with trimming and continuing until maturity.

## Quality parameters

**TSS (°Brix):** Digital handheld refractometers (range of 0-32 °Brix) were used to measure the juice's total soluble solids (TSS).

**Total sugars (%):** Total sugar was calculated by following formula:

$$\text{Total sugars (\%)} = \frac{\text{Factor (0.05)} \times \text{Dilution}}{\text{Titre} \times \text{Weight of pulp taken}} \times 100$$

**Titrate acidity (%):** The Ranganna (1986) method was used to estimate the titrate acidity. To determine the titrate acidity (%), the following formula was used:

$$\text{Acidity (\%)} = \frac{\text{Titre} \times \text{Normality of} \times \text{Volume} \times \text{Equivalent NAOH}}{\text{made up weight of acid}} \times 100$$

$$\text{Acidity (\%)} = \frac{\text{Volume of aliquote} \times \text{Weight of sample} \times 1000}{\text{Volume of aliquote} \times \text{Weight of sample} \times 1000} \times 100$$

**Reducing sugars (%):** The titrimetric method of Lane and Eynon described by Ranganna (1986) was adopted for estimation of reducing sugar. The percentage of reducing sugar was calculated according to the following formula:

$$\text{Reducing sugars (\%)} = \frac{\text{Factor (0.05)} \times \text{Total volume made up}}{\text{Titre} \times \text{weight of the pulp}} \times 100$$

**Non-reducing sugars (%):** The reducing sugars (%) were subtracted from the total sugars (%) to determine the non-reducing sugars (%).

## Results and Discussion

It is well recognized that both organic and inorganic materials affect fruit quality parameters in addition to fruit set, yield, etc. According to a review of the literature, there are numerous examples where both organic and inorganic compounds have enhanced the amount and had a favourable impact on the physico-chemical characteristics. Without an improvement in quality, further increases in quantity are meaningless. Positive effects of both organic and inorganic compounds were observed in this research. The following summarizes the significant effects of the various treatments on the quality characteristics of phalsa, which include TSS

(°Brix), titrate acidity (%), total sugar (%), reducing sugar (%), and non-reducing sugar (%).

## TSS (°Brix)

The TSS (°Brix) ranged from 18.54 to 22.23, as can be seen from the data in Table 1. According to Table 1's results, phalsa plants treated with foliar spray of treatment T<sub>6</sub> (ethrel @ 2 ml l<sup>-1</sup>) before blooming and after fruit set recorded significantly the highest TSS (22.23 °Brix), which is comparable to T<sub>5</sub> treatment ethrel @ 1 ml l<sup>-1</sup> (22.01 °Brix). In contrast, control (T<sub>11</sub>) had the lowest TSS (18.54 °Brix). When ethrel was sprayed on the bushes before blooming and during fruit set, a noticeably greater concentration of TSS was achieved (Table 1). The rapid metabolic conversion of starch and pectin into soluble molecules and the speedy transport of sugars from the leaves to the growing fruits may be the cause of the ethrel's increased TSS (Lamo *et al.* 2021)<sup>[7]</sup>. The quick breakdown of polysaccharides into soluble sugars and the enhanced mobility of carbohydrates from the source to sink under the impact of applied growth regulators in phalsa may be the causes of the rise in TSS content (Debnath *et al.* 2011)<sup>[3]</sup>. TSS in phalsa improved more effectively with higher ethrel concentrations. Meena *et al.* (2017)<sup>[10]</sup>, Patel H. T. (2016)

<sup>[11]</sup>, and Kacha *et al.* (2014) <sup>[5]</sup> all found similar findings in Phalsa.

### Titration acidity (%)

The titration acidity (%) ranged from 2.34 to 3.03, as can be seen from the data in Table 1. Which shows that when phalsa plants were treated with foliar spray of treatment T<sub>2</sub> (GA<sub>3</sub> @ 200 mg l<sup>-1</sup>) at the pre-blooming stage and after fruit set, the titration acidity was significantly lower (2.34%), which is comparable to treatment T<sub>1</sub> treatment GA<sub>3</sub> @ 100 mg l<sup>-1</sup> (2.41%), while the control (T<sub>11</sub>) had the highest titration acidity (3.03%). GA<sub>3</sub> @ 200 mg l<sup>-1</sup> considerably decreased the titration acidity (%). This outcome is consistent with the guava findings of Sharma and Tiwari (2015) <sup>[13]</sup>. According to their research, GA<sub>3</sub> in guava was found to have a lower acidity because it quickly converts acids into sugars and their derivatives through reactions involving reverse glycolytic pathways, or it may have been utilized for respiration, or both. Majumder *et al.* (2017) <sup>[9]</sup> have found similar results in guava. When growth regulators were used, the fruit's acidity decreased because it may have quickly converted to sugar and its derivatives or because organic acids degraded more quickly.

### Total sugars (%)

Table 1 presents the data regarding the total sugar as influenced by organic and inorganic substances. It was evident from the data shown in Table 1 that the total sugar (%) was significantly impacted. Phalsa plants treated with foliar spray before blooming and after fruit set had the most total sugar (5.47%) in T<sub>6</sub> ethrel @ 2 ml l<sup>-1</sup>, which was statistically comparable to T<sub>5</sub> ethrel @ 1 ml l<sup>-1</sup> (5.43%), while T<sub>11</sub> (control) had the lowest total sugar (3.88%). Ethrel's promotion of starch hydrolysis into sugars and early fruit maturation may be the cause of the rise in total sugar (%) caused by ethrel @ 2 ml l<sup>-1</sup>. Debnath *et al.* (2011) <sup>[3]</sup>,

Lamo *et al.* (2017) <sup>[8]</sup>, Kacha *et al.* (2014) <sup>[5]</sup>, and Patel H. T. (2016) <sup>[11]</sup> have similarly acquired similar findings in Phalsa.

### Reducing sugars (%)

Table 1 presents the data regarding the reducing sugar as influenced by organic and inorganic chemicals. There was a noticeable impact on lowering sugar (%), according to the results shown in Table 1. When phalsa plants were treated with foliar spray before blooming and after fruit set, the highest reducing sugar (1.98%) was observed in T<sub>6</sub> ethrel @ 2 ml l<sup>-1</sup>, which was statistically comparable to T<sub>5</sub> ethrel @ 1 ml l<sup>-1</sup> (1.95%), while T<sub>11</sub> (control) had the lowest reducing sugar (1.44%). The ethrel induced hydrolysis of starch into sugars and the early fruit maturation may be the cause of the rise in reducing sugar (%) by ethrel @ 2 ml l<sup>-1</sup>. Debnath *et al.* (2011) <sup>[3]</sup>, Lamo *et al.* (2017) <sup>[8]</sup>, Kacha *et al.* (2014) <sup>[5]</sup>, and Patel H. T. (2016) <sup>[11]</sup> have also found similar results in Phalsa.

### Non-reducing sugars (%)

Table 1 presents the data regarding the non-reducing sugar as influenced by organic and inorganic compounds. The findings in Table 1 made it abundantly evident that the non-reducing sugar (%) was significantly impacted. When phalsa plants were treated with foliar spray at the pre-blooming stage and after fruit set, the highest non-reducing sugar (3.49%) was recorded in T<sub>6</sub> treatment ethrel @ 2 ml l<sup>-1</sup>. This was statistically comparable to T<sub>5</sub> treatment ethrel @ 1 ml l<sup>-1</sup> (3.48%), while T<sub>11</sub> (control) had the lowest non-reducing sugar (2.44%).

Ethrel's promotion of starch hydrolysis into sugars and early fruit maturity may be the cause of the rise in non-reducing sugar (%) by ethrel @ 2 ml l<sup>-1</sup>. Debnath *et al.* (2011) <sup>[3]</sup>, Lamo *et al.* (2017) <sup>[8]</sup>, Kacha *et al.* (2014) <sup>[5]</sup>, Patel H. T. (2016) <sup>[11]</sup>, Meena *et al.* (2017) <sup>[10]</sup>, and Lakra *et al.* (2022) <sup>[6]</sup> have also achieved similar findings in Phalsa.

**Table 1:** Influence of organic and inorganic substances on quality in phalsa

| Treatments                                                | TSS (°Brix) | Titration acidity (%) | Total sugars (%) | Reducing sugars (%) | Non-reducing sugars (%) |
|-----------------------------------------------------------|-------------|-----------------------|------------------|---------------------|-------------------------|
| T <sub>1</sub> : GA <sub>3</sub> @ 100 mg l <sup>-1</sup> | 20.54       | 2.41                  | 4.74             | 1.57                | 3.17                    |
| T <sub>2</sub> : GA <sub>3</sub> @ 200 mg l <sup>-1</sup> | 20.66       | 2.34                  | 4.72             | 1.62                | 3.1                     |
| T <sub>3</sub> : NAA @ 100 mg l <sup>-1</sup>             | 20.67       | 2.72                  | 4.82             | 1.69                | 3.12                    |
| T <sub>4</sub> : NAA @ 200 mg l <sup>-1</sup>             | 20.81       | 2.69                  | 4.69             | 1.77                | 2.91                    |
| T <sub>5</sub> : Ethrel @ 1 ml l <sup>-1</sup>            | 22.01       | 2.74                  | 5.43             | 1.95                | 3.48                    |
| T <sub>6</sub> : Ethrel @ 2 ml l <sup>-1</sup>            | 22.23       | 2.79                  | 5.47             | 1.98                | 3.49                    |
| T <sub>7</sub> : Novel organic liquid nutrients @ 1%      | 18.87       | 2.93                  | 4.11             | 1.62                | 2.49                    |
| T <sub>8</sub> : Novel organic liquid nutrients @ 2%      | 18.65       | 2.94                  | 4.10             | 1.59                | 2.51                    |
| T <sub>9</sub> : Grade IV micronutrient @ 1%              | 18.59       | 2.94                  | 4.16             | 1.58                | 2.57                    |
| T <sub>10</sub> : Grade IV micronutrient @ 2%             | 18.60       | 2.95                  | 4.15             | 1.58                | 2.56                    |
| T <sub>11</sub> : Control (Water spray)                   | 18.54       | 3.03                  | 3.88             | 1.44                | 2.44                    |
| SEm±                                                      | 0.31        | 0.05                  | 0.07             | 0.02                | 0.07                    |
| CD at 5%                                                  | 0.91        | 0.15                  | 0.21             | 0.07                | 0.21                    |
| CV%                                                       | 2.69        | 3.35                  | 2.81             | 2.60                | 4.44                    |

### Economics

The cost of cultivation of phalsa per hectare as influenced by the application of organic and inorganic substances is presented in Table 2. Among the organic and inorganic

substances, the highest net return (48520.00 Rs./ha) was recorded in treatment GA<sub>3</sub> @ 100 mg l<sup>-1</sup> which, was at par with treatment GA<sub>3</sub> @ 200 mg l<sup>-1</sup> (45820.00 Rs./ha) and lowest net return in control (2443.00 Rs./ha).

**Table 2:** Economics of phalsa as influenced by various treatments

| Treatments                                              | Fruit yield (Kg ha <sup>-1</sup> ) | Fixed cost (₹) | Variable cost (₹) | Total cost (₹)<br>(3 + 4) | Gross return (₹) | Net return (₹) |
|---------------------------------------------------------|------------------------------------|----------------|-------------------|---------------------------|------------------|----------------|
| 1                                                       | 2                                  | 3              | 4                 | 5                         | 6                | 7              |
| T <sub>1</sub> : GA <sub>3</sub> 100 mg l <sup>-1</sup> | 973                                | 38000          | 10780             | 48780                     | 97300            | 48520          |
| T <sub>2</sub> : GA <sub>3</sub> 200 mg l <sup>-1</sup> | 976                                | 38000          | 13780             | 51780                     | 97600            | 45820          |
| T <sub>3</sub> : NAA 100 mg l <sup>-1</sup>             | 773                                | 38000          | 8126              | 46126                     | 77300            | 31174          |
| T <sub>4</sub> : NAA 200 mg l <sup>-1</sup>             | 775                                | 38000          | 8472              | 46472                     | 77500            | 31028          |
| T <sub>5</sub> : Ethrel 1 ml l <sup>-1</sup>            | 667                                | 38000          | 5837              | 43837                     | 66700            | 22863          |
| T <sub>6</sub> : Ethrel 2 ml l <sup>-1</sup>            | 679                                | 38000          | 7395              | 45395                     | 67900            | 22505          |
| T <sub>7</sub> : Novel Organic Liquid Nutrients 1%      | 649                                | 38000          | 7035              | 45035                     | 64900            | 19865          |
| T <sub>8</sub> : Novel Organic Liquid Nutrients 1%      | 649                                | 38000          | 8235              | 46235                     | 64900            | 18665          |
| T <sub>9</sub> : G-IV Micronutrient 1%                  | 628                                | 38000          | 6225              | 44225                     | 62800            | 18575          |
| T <sub>10</sub> : G-IV Micronutrient 2%                 | 589                                | 38000          | 6615              | 44615                     | 58900            | 14285          |
| T <sub>11</sub> : Control (Water spray)                 | 455                                | 38000          | 5057              | 43057                     | 45500            | 2443           |

Selling price of phalsa = 100 Rs./kg

## Conclusion

From this investigation, it can be concluded that spraying of GA<sub>3</sub> @ 200 mg l<sup>-1</sup> twice i.e., at pre blooming stage and after fruit set is lowers titrable acidity while, ethrel @ 2 ml l<sup>-1</sup> enhancing the physico-chemical quality of phalsa like TSS °Brix, reducing sugars, non-reducing sugars and total sugars. From economic point of view GA<sub>3</sub> @ 100 mg l<sup>-1</sup> gave maximum net realization.

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