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# Effect of PGR'S and chemicals on biochemical parameters of mango cv. Banganpalli

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## Abstract
Mango (*Mangifera indica* L.) is an important fruit crop of tropical and subtropical world. An experiment was conducted during the year 2021-2022 and 2022-2023 at College of Horticulture, Anantharajupeta, to study the influence of different plant growth regulators and chemicals on biochemical parameters in mango cv. Banganpalli. The experiment was laid out in a Randomized Block Design with three replications. The PGR's and chemicals are sprayed in November first fortnight and at marble stage of fruits. The results showed that maximum Total soluble solids ($20.25^0$ Brix), lowest titrable acidity (0.27%), maximum ascorbic acid content (26.07 mg100 $g^{-1}$), total sugars (13.04%), reducing sugars (4.07%), non-reducing sugars (8.98%), maximum shelf life (12.50 days) and minimum physiological weight loss (4.83, 9.83, 12.00, 14.67, 18.83 and 21.17%) was noticed at different storage intervals *i.e.,* 3, 5, 7, 9, 12 and 14 days after harvesting with treatment NAA @ 20 ppm ($T_1$).

**Keywords:** Mango, PGR's, chemicals, bio chemical parameters, shelf life

## Introduction
Mango (*Mangifera indica* L.) holds the distinction of being the favored fruit for nearly every Indian and has earned the title of the "King of Fruits." Belonging to the Anacardiaceae family, it is native to the Indo-Burma region and possesses a chromosome number of 2n=40. The mango, known as 'Aam' in common parlance, has its English name derived from the Tamil word 'mangai' or 'manga,' as well as the Malayalam 'manga,' all originating from the Dravidian root word. This etymology made its way into English via Portuguese. Mango cultivation spans about 87 countries globally. India takes the lead in global production, contributing 40.1% to the total mango production worldwide. In India, mango cultivation covers an expansive area of 2,339 thousand hectares, resulting in a total production of 20,336 thousand tonnes as of the data from the National Horticulture Board (NHB) for the year 2021-2022.

The predominant mango growing districts in Andhra Pradesh are Chittoor, Krishna, Vizianagaram and Kadapa. Among all districts, Chittoor ranks first in area and production. In India, a diverse array of mango varieties, totaling around 1,500, are cultivated, with 1,000 of them being commercially significant. Notably, Dashehari, Langra, and Chausa are popular varieties in the northern regions, while Alphanso and Pairi gain popularity in the Deccan Plateau and Western regions. South India boasts essential varieties such as Totapuri, Neelum, and Banganpalli, as highlighted by Ravikumar *et al.* (2013) [28].

In the state of Andhra Pradesh, the predominant commercially cultivated mango variety is 'Banganpalli,' encompassing approximately 70% of the total mango cultivation area. Commonly known as 'safedi,' the Banganapalli mango derives its name from a village with the same appellation in Andhra Pradesh. Renowned for its delightful aroma, thin blemish-free skin, and fiber-free sweet yellow pulp, the Banganapalli is the preferred choice for those who appreciate a fruit without fibrous textures. Banganapalli is the earliest variety of mangoes in the market. In recent years, there has been a decline in both the production and productivity of the mango cultivar Banganpalli. Particularly in the Rayalaseema districts of Andhra Pradesh, there has been a notable deviation from the typical flowering pattern observed over the past 4-5 years. The delayed flowering leads to delay in fruits set, development and harvesting. The pre-monsoon rain may often spoils the appearance and quality of these late developing fruits. Hence it is utmost important to develop a practical solution to induce flowering at appropriate time from newly emerged vegetative flush. The present study is designed as a preliminary effort to determine the effect of different growth regulators and chemicals on flowering and fruit quality in the mango cultivar cv. 'Banganpalli'.

Plant growth regulators are employed to modify the growth patterns of plants, playing a significant role in the processes of flowering, fruit set, and the overall quality characteristics of mango fruits.

NAA, a synthetic auxin, stimulates various physiological processes, including cell division, cell elongation, shoot elongation, photosynthesis, RNA synthesis, membrane permeability, and water uptake. It plays a crucial role in processes like fruit set, delaying senescence, and increasing yield in numerous fruit crops, as highlighted by Basuchauwdary (2016) [5].

Ethylene, a gaseous phytohormone, influences several physiological activities in plants, including seed germination, seedling growth, formation of the apical hook, senescence, flowering, fruit ripening, abscission, and gravitropism. According to Nunez-Elisea *et al.* (1980) [23], the spraying of 500-1000 ppm ethephon one month before the usual flowering period increased flowering by 40-55% in ten-year-old Haden mango trees.

Salicylic acid enhances the synthesis of floral stimulus during an inductive cycle, potentially through its florigenic activity or by influencing the balance between flower-promoting and flower-inhibiting factors. As a result, it improves the sex ratio in mango, as suggested by Nehad and Abdel Gawad (2017) [21]. The application of $KH_2PO_4$ during the panicle initiation stage has been beneficial in achieving an early full bloom stage, resulting in a higher number of reproductive shoots per tree. This may further contribute to better fruit set and an increased number of fruits per tree in mango cultivar Banganpalli, as indicated by Kumar *et al.* (2005) [15].

Nitrobenzene serves as a plant energizer and flower stimulant by increasing the C: N ratio, facilitating flower induction in plants. Moreover, it enhances nutrient use efficiency, leading to improved vegetative growth, the induction of abundant flowering, and aiding in the retention of flowers and fruits, as documented by Mithila *et al.* (2012) [20].

The application of potassium nitrate ($KNO_3$) spray on mango results in an earlier appearance of panicles (17 days), an increased number of panicles and fruits per plant, maximum yield, and an earlier harvest (5 days) compared to the control, as reported by Sarker and Rahim (2013) [30]. Additionally, $KNO_3$ spray has been observed to stimulate the burst of vegetative, mixed, and total buds, contributing to the highest percentage of fruit retention in mango, as noted by Cardenas and Rojas (2003) [6].

Foliar application of IIHR mango special (Twice before flowering & twice after flowering), results in fruit quality, fruit keeping quality and taste (Sultana *et al.*, 2020) [39].

## Materials and Methods

The experiment entitled was carried out at Dr.YSRHU-College of Horticulture, Anantharajupeta, Annamayya district, Andhra Pradesh during the year 2021-2022 to 2022-2023. The details of the material and the methods adopted during the course of investigation are briefly discussed in this chapter.

The experiments were carried out at College of Horticulture, Anantharajupeta which falls under tropical zone and geographically situated at a $13^0.98^1$N latitude and $79^0.40^1$E longitude with an altitude of 162 meters (531 feet) above mean sea level (MSL). The experiment was conducted in the existing orchard (plot no - 5) in College of Horticulture, Anantharajupeta, with a spacing of 7.5 X 7.5 meters on variety Banganpalli. The experiment was carried out during 2021-2022 and 2022-2023 in Randomized Block Design (RBD) comprising of 8 treatments, replicated thrice with three plants per replication. The treatment details are $T_1$ - Napthalene acetic acid @ 20 ppm, $T_2$ – Ethephon @ 600 ppm, $T_3$ - Salicylic acid @ 200 ppm, $T_4$ - Potassium di hydrogen orthophosphate @ 1%, $T_5$ - Nitrobenzene @ 1.5 ml/lit, $T_6$ - Potassium nitrate @ 2%, $T_7$ - Arka mango special @ 5 g/lit, $T_8$ - Control.

### 1. Total soluble solids ($^0$Brix)

Total soluble solids was recorded using a digital refractometer. It was expressed in degrees of brix ($^0$Brix).

### 2. Acidity per cent (%)

Titrable acidity was determined by titration of the juice extracted after homogenization of the pulp in a mixer against 0.1N NaOH solution using Phenolphthalein as an indicator and the results were expressed in percentage of citric acid (AOAC, 1980) [2].

$$\text{Acidity (\%)} = \frac{\text{Eq. wt. of acid X Normality of alkali X titre value}}{\text{Weight of sample}} \text{X } 100$$

### 3. Ascorbic acid content (mg/100 g pulp)

Titrimetric method described by Ranganna (2004) [27] was adopted for estimation of the ascorbic acid in pulp. Ascorbic acid content was calculated adopting the following formula.

$$\text{Ascorbic acid (mg/100 g)} = \frac{\text{Titrate Value X Dye factor X Volume made up}}{\text{Aliquot of extract taken for estimation X Weight or Volume of sample taken for estimation}} \text{X } 100$$

### 4. Total sugars percent

Total sugars in each fruit were determined by the method explained by Yemm and Willis (1954) [41].

### 5. Reducing sugars percent

The di nitrosalicylic acid (DNSA) method suggested by Miller (1959) [19] was adopted for the estimation of reducing sugar content in the sample.

### 6. Non reducing sugars

The quantum of non-reducing sugars was calculated by substracting reducing sugars from total sugars as reported by Ranganna. (1986) using the following formula

Non reducing sugars (%) = Total sugars (%) – Reducing sugars (%).

**7. Shelf life (days) in bagged fruits**

Shelf life was considered ended when 30 per cent of the fruits shown over ripening or spoilage symptoms.

**8. Physiological loss in weight percent**

The physiological loss in weight was determined by using the following formula and expressed as percentage.

$$\text{PLW (\%)} = \frac{\text{Initial weight of fruit} - \text{Final weight of fruit}}{\text{Initial weight of fruit}} \times 100$$

## Results and Discussion

**1. Total Soluble Solids ($^0$ Brix)**

The foliar application of different PGR's and chemicals showed significant difference in Total Soluble Solids in mango (Table-1 and Fig 1).

During first year and in pooled mean, highest T.S.S was recorded in treatment ($T_1$) NAA @ 20 ppm (19.27 and 20.25 $^0$ Brix), which was followed by ($T_4$) $KH_2PO_4$ @ 1% (18.73 and 19.18 $^0$ Brix) and ($T_2$) Ethephon @ 600 ppm respectively with the values of 18.33 and 18.22 $^0$ Brix. During second year of study also showed highest T.S.S in treatment ($T_1$) NAA @ 20 ppm (21.23 $^0$ Brix), which was followed by ($T_4$) $KH_2PO_4$ @ 1% (19.63 $^0$ Brix). Whereas, lowest Total soluble solids was recorded in ($T_8$) control (14.23 $^0$ Brix) in pooled mean.

The improvements in TSS (Total Soluble Solids) in fruits could be attributed to the increased mobilization of carbohydrates from the source to the sink facilitated by the plant hormone NAA. Additionally, these growth regulators may have stimulated enzymatic activities, leading to the metabolism of carbohydrates into simple sugars. These findings align with the observations reported by Banker and Prasad (1990) [4] and Haidry *et al.* (1997) [11] in mango.

A positive correlation was reported between the concentrations of K application and TSS, the higher concentrations of K, the higher TSS contents in grape juice (Singh, 1968; Ganeshamurthy *et al.*, 2011) [43, 9]. The increase in T.S.S with the application of KH2PO4 spray may be attributed to the hydrolysis of polysaccharides, the conversion of organic acids into soluble sugars, and the improved solubilization of insoluble starch and pectin present in the cell wall and middle lamella. These factors collectively contribute to an increase in Total Soluble Solids (TSS), as suggested by Gupta and Brahmchari (2004) [10].

The application of Ethrel results in an elevated rate of ethylene production, leading to a significant increase in the fructose, glucose, and sucrose contents in the fruit. This increase, in turn, contributes to a rise in soluble solids, as noted by Park (1996) [24]. Similar outcomes were observed by Singh and Dhillon (1986b) [37] in mango cultivar Dashehari. The initial surge in TSS may be attributed to the rapid loss of water from the fruits and the accelerated conversion of starch into sugar, as suggested by Fernandez *et al*. (2006) [8].

**2. Acidity (%)**

The acidity per centage was recorded with the foliar application of different PGR's and chemicals and the is presented in Table -1 represented graphically Fig -1.

During both years of investigation and in its pooled mean, the data showed that ($T_1$) NAA @ 20 ppm recorded significantly lowest acidity content (0.20, 0.34 and 0.27% respectively) which was comparable with ($T_4$) $KH_2PO_4$ @ 1% (0.24, 0.43 and 0.34%) and ($T_2$) Ethephon @ 600 ppm with the values of 0.29, 0.45 and 0.37% respectively. However, highest acidity content was observed in control ($T_8$) 0.43, 0.74 and 0.58% respectively.

The decrease in fruit acidity owing to the application of NAA might be because of the conversion of acids quickly into sugars and its derivatives through the reaction of glycolytic pathway. Similar results also obtained by the Kaur and Bons (2019) [14] in sapota, Singh and Bons (2020) [33] in Sapota cv. Kalipatti.

The results align with the findings of Kumar and Reddy (2005) [15] in mango cultivar Baneshan. The neutralization of organic acids, possibly induced by elevated potassium levels, could have contributed to the reduction in acidity, as suggested by Tisdale and Nelson (1966) [40]. Similar findings are also noticed by Singh *et al*. (2019) [35] in mango cv. Bambay Green, Langra and Dashehari reduced acidity content with the foliar spray of $KH_2PO_4$.

Lowest per centage of acidity was recorded with ethephon application and the results are in accordance with the reports of Jain *et al.* (2007) [13] in Guava cv. Sardar. It is due to ethephon might have enhanced the conversion of organic acids to sugars.

**3. Ascorbic acid content (mg 100 g$^{-1}$)**

It is quite apparent from data in Table -1 that, highest ascorbic acid content (20.13 mg 100 g$^{-1}$) was recorded in the treatment $T_1$ (NAA @ 20 ppm) and lowest in ($T_8$) control (12.33 mg 100 g$^{-1}$) during first year of study.

In second year and also pooled data showed highest ascorbic acid content (32.00 and 26.07 mg 100 g$^{-1}$) was recorded in treatment $T_1$ (NAA @ 20 ppm), which was on par with ($T_4$) $KH_2PO_4$ @ 1% (30.33 and 24.25 mg 100 g$^{-1}$) and ($T_2$) Ethephon @ 600 ppm (29.33 and 22.84 mg 100 g$^{-1}$). While, lowest ascorbic acid content was noted in ($T_8$) control (18.83 and 15.58 mg 100 g$^{-1}$).

The findings demonstrated that the highest level of ascorbic acid was observed with NAA application. This could be attributed to the continuous synthesis of glucose-6-phosphate during the entire growth and development of fruits, believed to be the precursor of vitamin C. These outcomes align with the conclusions drawn by Ahmed *et al.* (2012) [1] in mango cultivar Dashehari.

The elevation in ascorbic acid content through $KH_2PO_4$ spray could be attributed to the catalytic influence of growth substances on the biosynthesis of ascorbic acid from sugar, as reported by Baiea *et al.* (2015) [3] in mango cultivar Hindi.

**4. Total sugars (%)**

Data in Table 2 and Fig 2 illustrated the percentage of total sugars significantly affected by the application of different PGR's and chemicals on mango.

During both years of investigation and in its pooled mean, the data showed that ($T_1$) NAA @ 20 ppm recorded highest total sugars (14.62, 11.46 and 13.04% respectively) which was comparable with ($T_4$) $KH_2PO_4$ @ 1% (13.77, 11.31 and 12.54% respectively). Lowest total sugars was observed in ($T_8$) control (6.65%) in pooled mean.

The breakdown of polysaccharides into simple sugars by metabolic processes, the conversion of organic acids into sugars and moisture loss are the three main causes for the rise in total sugar content in fruits reported by Manoj kumar *et al.* (2019) [17]. Possible causes of the rising fruit sweetness include photosynthesis, which increases the amount of carbohydrates in the fruit as well as their transportation. Growth regulators such as NAA cause reactions involving many glycolytic pathways, which swiftly transform sugars into their compounds. These results are in line with the reports of Haidry *et al.* (1997) [11] in mangoes cv. Langra.

The fact that potassium is involved in protein synthesis, the metabolism of carbohydrates and the neutralization of organic acids may explain the higher sugar concentration. By triggering the enzyme sucrose synthase, the foliar K treatment promotes the conversion of starch into simple sugar during ripening as reported by Singh *et al.* (2019) [35] and Das and Datta (2022) [7] in Litchi increasing the total sugars with the application of $KH_2PO_4$.

By preserving balanced electric charges, potassium is crucial for the creation of energy in the form of ATP and NADPH in chloroplast. In addition, potassium activates the enzyme starch synthase which is involved in sucrose and amino acid loading and unloading from the phloem as well as starch storage in growing fruits (Mengel and Kirkby, 1987) [18].

**5. Reducing sugars (%)**

The reducing sugars percentage among the treatments was shown in the Table -2 and Fig - 2.

It is evident from the data that there was significant difference observed in the percentage of reducing sugars in mango fruits during both the years of study.

During both years of investigation and in its pooled mean, the data showed that ($T_1$) NAA @ 20 ppm recorded highest reducing sugars (0.24, 0.43 and 0.34% respectively) which was comparable with ($T_4$) $KH_2PO_4$ @ 1% (3.10, 4.23 and 3.67%), ($T_2$) Ethephon @ 600 ppm (3.00, 3.97 and 3.48% respectively). While, lowest reducing sugars was observed in ($T_8$) control (1.48%).

The results revealed that the administration of NAA considerably increased the amount of reducing sugars. This may be due to an increase in the activity of amylases, an enzyme that hydrolyzes complex polysaccharides into simple sugars. According to several studies, auxin has the ability to quicken the transfer of metabolites from other plant sections to growing fruits. The results are conformity with findings of Prajapati *et al.* (2016) [25] in Custard apple cv. Local and Kaur and Bons (2019) [14] in mango reported highest reducing sugars with the application of NAA.

Potassium di hydrogen ortho phosphate was responsible for the greatest reducing sugar production. As potassium treatment has been associated with enhanced photosynthetic capability in leaves and a potential rise in assimilate translocation into fruit as reported by Singh *et al.* (1982) [32]. The results are hormony with the findings of Manoj kumar Singh *et al.* (2019) [17] in Mango cv. Bombay green Langra and Dashehari found highest reducing sugars with the application of $KH_2PO_4$.

**6. Non reducing sugars (%)**

Percentage of non-reducing sugars was estimated and the results are shown in the Table 2. Significant differences were observed between the treatments during first year and pooled mean and the differences during second year were found non-significant.

In first year and in pooled mean data showed highest non reducing sugars in the treatment ($T_1$) NAA @ 20 ppm (11.22 and 8.98%) which was comparable with ($T_4$) $KH_2PO_4$ @ 1% (10.67 and 8.87% respectively) and lowest non reducing sugars in the control (0.78 and 0.50%).

The results indicated that the use of NAA has led to an augmentation in the quantity of non-reducing sugars. This effect might be attributed to an increase in the activity of amylases, enzymes responsible for hydrolyzing complex polysaccharides into simpler sugars. Additionally, auxin has been demonstrated to accelerate the transfer of metabolites from other parts of the plant to the developing fruits. These findings find support in the outcomes reported by Singh *et al.* (2007) [31] in Aonla and Prajapati *et al*. (2016) [25] in Custard apple (cv. Local), where a higher concentration of non-reducing sugars was observed with the application of NAA.

The maximum production of non-reducing sugars was observed with potassium dihydrogen orthophosphate, a result that aligns with the notion that potassium treatment is associated with enhanced photosynthetic efficiency in leaves. This connection could potentially lead to increased translocation of assimilates into fruits, as reported by Singh *et al*. (1982) [32]. Similar outcomes were documented by Singh *et al.* (2019) [35] in the case of mango cultivars Bombay Green, Langar and Dashehari, where the application of $KH_2PO_4$ resulted in the highest levels of non-reducing sugars.

**7. Shelf life**

The foliar application of different PGR's and chemicals showed significant difference on shelf life of mango fruits cv. Banganpalli was furnished in the Table 3 represented graphically Fig 2.

Among all the treatments significantly highest shelf life was observed in the treatment ($T_1$) NAA @ 20 ppm (12.67, 12.33 and 12.50 days) which was closely followed by ($T_4$) $KH_2PO_4$ @ 1% with 12.00 days in each season and pooled mean. Lowest shelf life noted in ($T_8$) control (8.67, 10.00 and 9.33 days).

Fruits subjected to NAA treatment displayed decreased deterioration during storage, a finding consistent with the results reported by Youlin *et al.* (1997) [42]. Similarly, Rydahl *et al.* (2018) [29] observed improved storability of mangos through the application of potassium, which reduces crop water loss and maintains turgor, thereby extending the shelf life of the fruits. These effects may be attributed to chemical changes within the fruits, enabling them to retain more water against the force of evaporation. Additionally, these treatments might alter some proteinaceous constituents of the cells, potentially increasing their affinity for water. Notably, fruits treated with NAA and potassium exhibited a lower incidence of rotting or spoilage compared to the control group.

Potassium serves to decrease respiration, thereby preventing energy loss by maintaining turgor pressure and minimizing water loss in fruits. This attribute contributes to an enhancement in the shelf life of fruits. This finding aligns with the observations of Srivastava *et al.* (2009) [38], who noted that foliar spray of potassium fertilizers resulted in the lowest physiological weight loss and decay, ultimately improving the shelf life of Ber fruits.

**8. Physiological loss of weight (%)**

Physiological loss of weight was reduced in mango fruits by the application of different PGR's and chemicals (Table 3 and Fig 3).

The PLW was recorded at different intervals (3, 5, 7, 9, 12 and 14 days after harvest) during storage period at ambient temperature. PLW in all treatments at different intervals, NAA @ 20 ppm was found significantly lowest over the control and other treatments in the study. There is no significant differences were recorded between the other treatments. PLW recorded with NAA @ 20 ppm ($T_1$) was lowest after 3rd day (4.33, 5.33 and 4.83%), 5th day (9.33, 10.33 and 9.83%), 7th day (11.33, 12.67 and 12.00%), 9th day (13.33, 16.00 and 14.67%), 12th day (18.00, 19.67 and 18.83%) and 14th day (20.33, 22.00 and 21.17%). Maximum PLW was observed in ($T_8$) control at all intervals during both seasons and pooled mean.

The observations were consistent with the findings of Ladaniya *et al.* (2005) [16] in mandarins, when fruits treated with NAA showed lower weight loss with longer storage periods. This could be attributed to rapid moisture loss through evaporation and respiration. Similarly, Singh *et al.* (2005) [36] also reported that changes in peel stomatal density and texture may also contribute to progressive weight loss in Ber fruit at different storage intervals.

The findings suggested that storage temperature and duration are associated with variations in biochemical parameters and glycosidase activities. Hossain *et al.* (2014) [12] reported that inhibition of β-galactosidase and β-hexosaminidase activities could potentially extend the shelf life of mango fruits.

**Table 1:** Effect of PGR's and chemicals on T.S.S, Acidity and Ascorbic acid content.

| Treatments | T.S.S ($^0$ Brix) | | | Acidity (%) | | | Ascorbic acid content (mg100 g$^{-1}$) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2021-22 | 2022-23 | Pooled data | 2021-22 | 2022-23 | Pooled data | 2021-22 | 2022-23 | Pooled data |
| $T_1$ : NAA @ 20 ppm | 19.27 | 21.23 | 20.25 | 0.20 | 0.34 | 0.27 | 20.13 | 32.00 | 26.07 |
| $T_2$ : Ethephon @ 600 ppm | 18.33 | 18.10 | 18.22 | 0.29 | 0.45 | 0.37 | 16.34 | 29.33 | 22.84 |
| $T_3$ : SA @ 200 ppm | 18.07 | 17.97 | 18.02 | 0.30 | 0.47 | 0.39 | 15.24 | 27.90 | 21.57 |
| $T_4$ : $KH_2PO_4$ @ 1% | 18.73 | 19.63 | 19.18 | 0.24 | 0.43 | 0.34 | 18.17 | 30.33 | 24.25 |
| $T_5$ : NB @ 1.5 ml/ lit | 16.37 | 17.73 | 17.05 | 0.30 | 0.61 | 0.46 | 14.50 | 24.93 | 19.72 |
| $T_6$ : $KNO_3$ @ 2% | 15.97 | 17.53 | 16.75 | 0.33 | 0.62 | 0.48 | 14.10 | 23.50 | 18.80 |
| $T_7$ : AMS @ 5 g / lit | 15.67 | 16.93 | 16.30 | 0.38 | 0.65 | 0.52 | 13.97 | 21.93 | 17.95 |
| $T_8$ : control | 13.27 | 15.20 | 14.23 | 0.43 | 0.74 | 0.58 | 12.33 | 18.83 | 15.58 |
| SE (m) ± | 0.74 | 1.08 | 0.81 | 0.04 | 0.08 | 0.05 | 0.59 | 2.87 | 1.50 |
| C.D. (5%) | 2.12 | 3.08 | 2.32 | 0.11 | 0.24 | 0.13 | 1.67 | 8.19 | 4.29 |

**Table 2:** Effect of PGR's and chemicals on total sugars, reducing sugars and non-reducing sugars.

| Treatments | Total sugars (%) | | | Reducing sugars (%) | | | Non reducing sugars (%) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2021-22 | 2022-23 | Pooled data | 2021-22 | 2022-23 | Pooled data | 2021-22 | 2022-23 | Pooled data |
| $T_1$ : NAA @ 20 ppm | 14.62 | 11.46 | 13.04 | 3.40 | 4.73 | 4.07 | 11.22 | 6.73 | 8.98 |
| $T_2$ : Ethephon @ 600 ppm | 11.20 | 9.37 | 10.28 | 3.00 | 3.97 | 3.48 | 8.20 | 5.40 | 6.80 |
| $T_3$ : SA @ 200 ppm | 9.27 | 8.37 | 8.82 | 2.30 | 3.01 | 2.65 | 6.97 | 5.36 | 6.17 |
| $T_4$ : $KH_2PO_4$ @ 1% | 13.77 | 11.31 | 12.54 | 3.10 | 4.23 | 3.67 | 10.67 | 7.08 | 8.87 |
| $T_5$ : NB @ 1.5 ml/ lit | 8.24 | 7.41 | 7.82 | 2.03 | 2.57 | 2.30 | 6.20 | 4.84 | 5.52 |
| $T_6$ : $KNO_3$ @ 2% | 8.16 | 7.24 | 7.70 | 1.83 | 2.17 | 2.00 | 6.32 | 5.07 | 5.70 |
| $T_7$ : AMS @ 5 g / lit | 7.47 | 6.99 | 7.23 | 1.80 | 2.10 | 1.95 | 5.67 | 4.89 | 5.28 |
| $T_8$ : control | 7.00 | 6.30 | 6.65 | 1.53 | 1.43 | 1.48 | 5.47 | 4.87 | 5.17 |
| SE (m) ± | 0.67 | 0.76 | 0.43 | 0.24 | 0.45 | 0.24 | 0.78 | 0.87 | 0.50 |
| C.D. (5%) | 1.93 | 2.16 | 1.23 | 0.70 | 1.30 | 0.68 | 2.22 | NS | 1.42 |

**Table 3:** Effect of PGR's and chemicals on Shelf life of the mango fruits.

| Treatments | Shelf life (days) | | |
|---|---|---|---|
| | 2021-22 | 2022-23 | Pooled data |
| $T_1$ : NAA @ 20 ppm | 12.67 | 12.33 | 12.50 |
| $T_2$ : Ethephon @ 600 ppm | 12.00 | 11.67 | 11.83 |
| $T_3$ : SA @ 200 ppm | 11.67 | 12.00 | 11.83 |
| $T_4$ : $KH_2PO_4$ @ 1% | 12.00 | 12.00 | 12.00 |
| $T_5$ : NB @ 1.5 ml/ lit | 11.33 | 11.33 | 11.33 |
| $T_6$ : $KNO_3$ @ 2% | 11.33 | 10.33 | 10.83 |
| $T_7$ : AMS @ 5 g / lit | 10.33 | 11.00 | 10.67 |
| $T_8$ : control | 8.67 | 10.00 | 9.33 |
| SE (m) ± | 0.52 | 0.54 | 0.39 |
| C.D. (5%) | 1.48 | 1.55 | 1.12 |

**Table 4a:** Effect of PGR's and chemicals on Physiological loss of weight in mango fruits during 2021-2022.

| Treatments | Physiological loss of weight (%) | | | | | |
|---|---|---|---|---|---|---|
| | 3 DAH | 5 DAH | 7 DAH | 9 DAH | 12 DAH | 14 DAH |
| $T_1$ : NAA @ 20 ppm | 4.33 | 9.33 | 11.33 | 13.33 | 18.00 | 20.33 |
| $T_2$ : Ethephon @ 600 ppm | 6.00 | 12.00 | 13.67 | 15.67 | 20.33 | 22.00 |
| $T_3$ : SA @ 200 ppm | 7.33 | 12.50 | 15.67 | 18.00 | 20.33 | 22.33 |
| $T_4$ : $KH_2PO_4$ @ 1% | 5.67 | 11.33 | 12.67 | 17.00 | 19.67 | 21.33 |
| $T_5$ : NB @ 1.5 ml/ lit | 6.67 | 13.00 | 15.00 | 18.33 | 20.67 | 23.00 |
| $T_6$ : $KNO_3$ @ 2% | 7.00 | 13.67 | 17.67 | 20.00 | 22.33 | 25.33 |
| $T_7$ : AMS @ 5 g / lit | 7.67 | 14.33 | 18.33 | 21.00 | 23.00 | 24.67 |
| $T_8$ : control | 8.33 | 15.67 | 19.67 | 24.00 | 26.00 | 27.00 |
| SE (m) ± | 0.37 | 0.52 | 0.43 | 0.48 | 0.71 | 0.59 |
| C.D. (5%) | 1.05 | 1.49 | 1.22 | 1.37 | 2.03 | 1.68 |

**Table 4b** Effect of PGR's and chemicals on Physiological loss of weight in mango fruits during 2022-2023.

| Treatments | Physiological loss of weight (%) | | | | | |
|---|---|---|---|---|---|---|
| | 3 DAH | 5 DAH | 7 DAH | 9 DAH | 12 DAH | 14 DAH |
| $T_1$ : NAA @ 20 ppm | 5.33 | 10.33 | 12.67 | 16.00 | 19.67 | 22.00 |
| $T_2$ : Ethephon @ 600 ppm | 7.33 | 11.67 | 14.00 | 18.33 | 21.00 | 24.00 |
| $T_3$ : SA @ 200 ppm | 8.67 | 13.33 | 16.00 | 19.00 | 21.67 | 24.33 |
| $T_4$ : $KH_2PO_4$ @ 1% | 6.67 | 12.33 | 13.33 | 16.67 | 18.67 | 23.33 |
| $T_5$ : NB @ 1.5 ml/ lit | 7.00 | 14.33 | 16.33 | 18.67 | 21.00 | 24.00 |
| $T_6$ : $KNO_3$ @ 2% | 8.00 | 14.67 | 18.00 | 21.00 | 23.00 | 25.33 |
| $T_7$ : AMS @ 5 g / lit | 8.67 | 15.67 | 19.00 | 20.67 | 21.00 | 24.00 |
| $T_8$ : control | 9.33 | 17.00 | 21.00 | 23.00 | 24.67 | 26.33 |
| SE (m) ± | 0.49 | 0.47 | 0.50 | 0.48 | 0.55 | 0.49 |
| C.D. (5%) | 1.41 | 1.33 | 1.42 | 1.36 | 1.56 | 1.40 |

**Table 4c:** Effect of PGR's and chemicals on Physiological loss of weight in mango pooled data

| Treatments | Physiological loss of weight (%) | | | | | |
|---|---|---|---|---|---|---|
| | 3 DAH | 5 DAH | 7 DAH | 9 DAH | 12 DAH | 14 DAH |
| $T_1$ : NAA @ 20 ppm | 4.83 | 9.83 | 12.00 | 14.67 | 18.83 | 21.17 |
| $T_2$ : Ethephon @ 600 ppm | 6.67 | 11.83 | 13.83 | 17.00 | 20.67 | 23.00 |
| $T_3$ : SA @ 200 ppm | 8.00 | 12.92 | 15.83 | 18.50 | 21.00 | 23.33 |
| $T_4$ : $KH_2PO_4$ @ 1% | 6.17 | 11.83 | 13.00 | 16.83 | 19.17 | 22.33 |
| $T_5$ : NB @ 1.5 ml/ lit | 6.83 | 13.67 | 15.67 | 18.50 | 20.83 | 23.50 |
| $T_6$ : $KNO_3$ @ 2% | 7.50 | 14.17 | 17.83 | 20.50 | 22.67 | 25.33 |
| $T_7$ : AMS @ 5 g / lit | 8.17 | 15.00 | 18.67 | 20.83 | 22.00 | 24.33 |
| $T_8$ : control | 8.83 | 16.33 | 20.33 | 23.50 | 25.33 | 26.67 |
| SE (m) ± | 0.35 | 0.34 | 0.27 | 0.24 | 0.49 | 0.35 |
| C.D. (5%) | 0.99 | 0.97 | 0.76 | 0.68 | 1.40 | 1.00 |

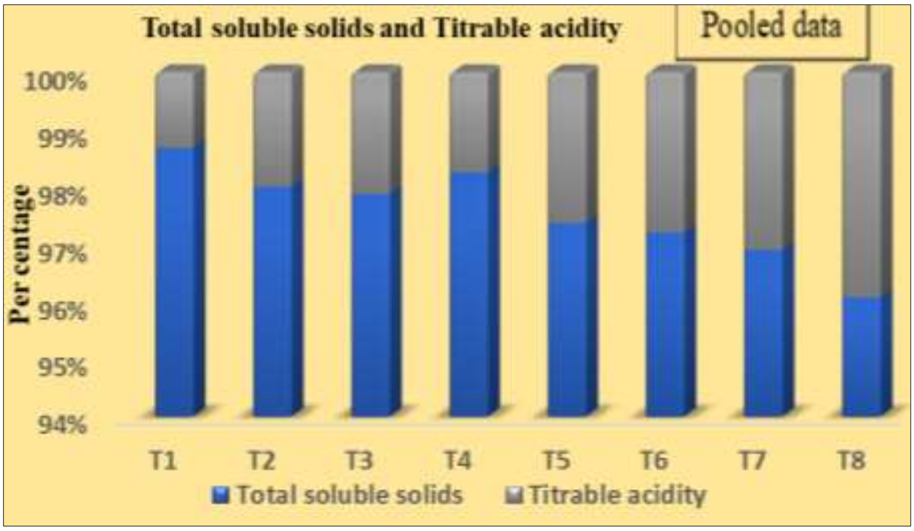


**Fig 1:** Total soluble solids and titrable acidity as influenced by different PGR's and chemicals in mango

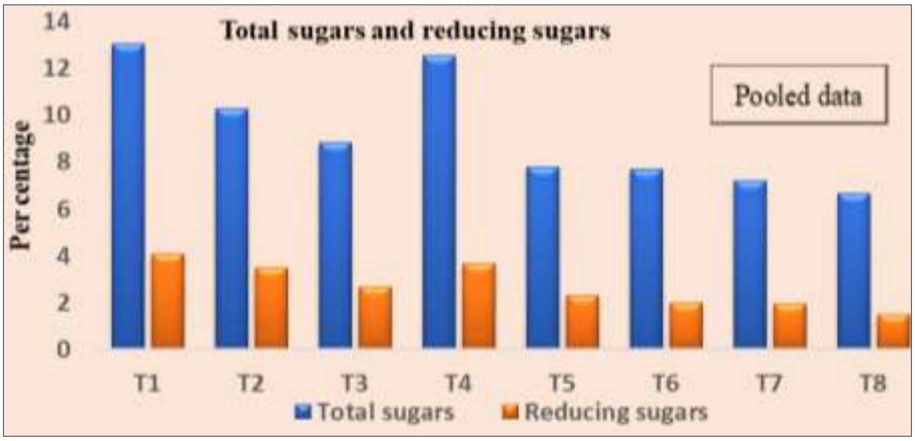


**Fig 2:** Total sugars and reducing sugars as influenced by different PGR's and chemicals in mango

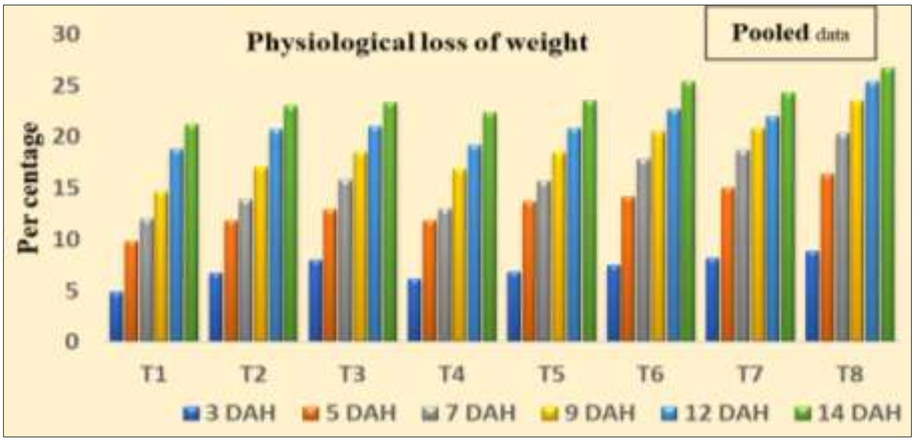


**Fig 3:** Physiological loss of weight in mango fruits as influenced by different plant growth regulators and chemicals

## Conclusion

The present study on estimation of various biochemical parameters revealed that maximum values for Total soluble solids, minimum titrable acidity, maximum ascorbic acid content, total sugars, reducing sugars, non-reducing sugars, shelf life and minimum physiological weight loss was noticed at different storage intervals *i.e.*, 3, 5, 7, 9, 12 and 14 days after harvesting with treatment NAA @ 20 ppm ($T_1$) which was closely followed by $KH_2PO_4$ @ 1% and Ethephon @ 600 ppm.

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