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Research Article

Effect of pre-flowering chemicals spray on flowering, yield and quality attributes in *Mangifera indica* L.

Magizhnan Thiruezhirselvan[1], Prakash Kasilingam[1*], Gopu Balraj[1], Nagajothi Rajasekaran[2]

[1]Department of Fruit Science, SRM College of Agricultural Sciences, SRMIST, Chengalpattu, Tamil Nadu, India.
[2]Department of Crop Physiology, SRM College of Agricultural Sciences, SRMIST, Chengalpattu, Tamil Nadu, India.

[*]Correspondence
Prakash Kasilingam
hortidoctorpks@gmail.com

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Background: The low production of the mango variety Banganapalli in India can be attributed to a number of factors. Mango varieties have a number of problems, including poor and inconsistent blooming, as well as poor or nonexistent fruit set. A significant contributor to low levels of production is the presence of Banganapalli. In order to alleviate these production issues, there is a significant requirement to make use of compounds that support the growth of flowers and improve fruit set. With this background, the present experiment was conducted to examine the suitable combination of chemicals for the flowering, yield and quality of mango.

Methods: The chosen trees were treated with sprays at two distinct phases using the following methods: Urea 1 per cent + NAA 20 ppm (T_1), Urea 1 per cent + Salicylic acid 200 ppm (T_2), Urea 2 per cent + NAA 20 ppm (T_3), Urea 2 per cent + Salicylic acid 200 ppm (T_4), KNO_3 1 per cent + NAA 20 ppm (T_5), KNO_3 1 per cent + Salicylic acid 200 ppm (T_6), KNO_3 2 per cent + NAA 20 ppm (T_7), KNO_3 2 per cent + Salicylic acid 200 ppm (T_8), Water Spray (T_9) and Control (T_{10}).

Results: The plants treated with KNO_3 at a concentration of two per cent and NAA at 20 ppm exhibited the highest levels of total number of flowers per panicle (791.82), hermaphrodite flowers (239.406), percentage of fruit set (0.48), number of fruits per tree (129.22), yield (50.04) and quality parameters *viz.*, total soluble solids (16.77°Brix), titratable acidity (0.30 per cent), ascorbic acid (20.56 mg), total sugar (19.58 per cent), reducing sugar (5.60 per cent) and non-reducing sugar (14.26 per cent) compared to other treatment combinations.

Conclusion: In a nutshell, applications of KNO_3 at a concentration of two per cent and NAA at a concentration of 20 ppm had a positive effect on the flowering, yield and quality aspects of mango cv. Banganapalli.

Keywords: *mango, pre-harvest chemicals, flowering, quality, yield*

Introduction

Mango (*Mangifera indica*) cv. banganapalli is the most favoured mango in the southern India. The crop is grown on approximately 24.01 thousand hectares in India, with an annual production of 22.42 million tonnes (Indiastat, 2024). Despite being the largest producer of mangoes, India faces significant constraints on productivity due to inadequate orchard management practices. These practices include excessive spacing, ineffective canopy management, premature fruit drop, size variability, and insufficient technological advancement (Prakash et al., 2015). According to Krishna et al., 2020, poor and uneven flowering, when combined with inadequate or non-existent fruit set, is a significant contributing factor to low production. Banganapalli is the earliest cultivar of mangoes in the market. In recent years, there has been a decline in both the production and productivity of the mango cultivar Banganapalli. The delayed flowering leads to delays in fruit setting, development and harvesting. Pre-monsoon rain may often spoil the appearance and quality of these late-developing fruits. Hence, it is important to develop a practical solution to induce flowering at an appropriate time from newly emerged vegetative flush (Lakshmi Devi et al., 2023). However, smallholder growers identified insufficient knowledge and skills, problems with disease and insect pests, low market prices, limited land and irrigation water, and insufficient grafted seedlings as the primary constraints affecting mango production (Dessalegn et al., 2014). To overcome these challenges, the application of nutrients and growth regulators before harvest can have a significant impact on the physical and biochemical transformations occurring in the developing fruit (Patel et al., 2023), as well as improve fruit set, productivity and fruit quality. 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. Foliar application is predicated on the concept that nutrients are rapidly absorbed by the stomata of the leaves and the nutrients are then transported to various parts of the plant to fulfil the plant's nutritional requirements. By increasing the concentration of these growth regulators and chemicals in the panicle through exogenous treatment, it is feasible to mitigate the adverse impact of endogenous inhibitors, resulting in less abscission and, thus, an enhancement in yield over time. Prior studies indicate that nutrients and plant growth regulators (PGRs) can enhance fruit retention and yield (Sarkar et al., 2022). According to Jain & Khurana (2009), NAA, in its capacity as a growth regulator, has an effect on plant reproduction, specifically the generation of panicles. Research has shown that NAA effectively restricts shoot growth in other crops (Arpaia et al., 2007), but there is limited research on its application to suppress vegetative growth in mango leaves. According to the research by Maurya et al., 2020, naphthalene acetic acid (NAA) effectively induces blooming, postpones the abscission of flower buds, flowers, and unripe fruits, enhances fruit size, and improves the production and quality of various fruits. According to Lokesh et al. (2020) research reveals that applying salicylic acid as a foliar spray enhances the quality characteristics of mango fruit and prolongs its shelf life during storage. In recent years, all countries that import mangoes have begun to acknowledge India as a source of mangoes of superior quality due to the country's abundance and wide variety of mangoes. Consequently, enhancing the production and quality of mangoes cultivated in India is essential to satisfy global consumer needs (Gopu et al., 2014). The objective of this research is to examine the effects of several chemicals on the flowering, yield and biochemical properties of the mango cultivar Banganapalli.

Materials and Methods

The experiment was conducted in an eight-year-old mango orchard at Karikili village near Vedandhangal, Chengalpattu District, (Latitude: 12.594430, Longitude: 79.842889, Altitude: 50 m) Tamil Nadu during the year 2023 - 2024, to investigate the impact of pre-harvest chemicals on the biochemical characteristics of mango cv. Banganapalli. The trees were planted at 5 x 5 m spacing. The experiment was replicated three times and was structured using a Randomised Complete Block Design (RCBD). The treatments *viz*., Urea 1 per cent + NAA 20 ppm (T_1), Urea 1per cent + Salicylic acid 200 ppm (T_2), Urea 2 per cent + NAA 20 ppm (T_3), Urea 2 per cent + Salicylic acid 200 ppm (T_4), KNO_3 1 per cent + NAA 20 ppm (T_5), KNO_3 1per cent + Salicylic acid 200 ppm (T_6), KNO_3 2 per cent + NAA 20 ppm (T_7), KNO_3 2 per cent + Salicylic acid 200 ppm (T_8), Water Spray (T_9), Control (T_{10}). The first spraying of Urea and KNO_3 was done at pre flowering stage (November 20, 2023), application of NAA and Salicylic acid was done at the full bloom stage (February 15, 2024). The cultural operations were carried out during the experimental period as recommended by the TNAU crop production guide (2020).

Number of flowers per panicle

The number of total flowers per panicle was obtained by taking the sum of male and hermaphrodite flowers.

Number of hermaphrodite flowers per panicle

At the time of full bloom, five panicles were randomly selected from each tree and hermaphrodite flowers were counted. Average values for these panicles were taken to represent the number of hermaphrodite flowers per panicle.

Fruit set percentage

The number of days taken from the date of panicle initiation to fruit formation of panicle at the mustard stage was recorded. Ten shoots were randomly tagged (from North, South, East and West directions) and the fruit set was recorded. The mean number of days taken for fruit set after panicle initiation was computed.

Number of fruits

The number of fruits harvested from each treated tree was counted at the time of each harvesting was summed up and the data was expressed as the number of fruits per tree.

Yield per tree (kg)

The fruit yield of each treatment was recorded with the help of weighing balance. The yield was expressed in kilograms.

Total soluble solids (TSS)

The total soluble solids (TSS) were measured by the standard method of AOAC (2012). Briefly, the TSS was determined through a hand refractometer. The refractometer prism surface was cleaned with distilled water and dried with tissue paper. A drop of juice was put on the prism, and the reading was taken by looking through the eyepiece, and the soluble sugar was expressed in °Brix.

Titratable acidity (%)

For titrable acidity estimation, 5g of crushed fruit sample or segments or 5 ml of syrup was taken and diluted with distilled water and filtered through muslin cloth and the filtrate was made up to 50 ml. To 5 ml of aliquot taken in a conical flask, a few drops of phenolphthalein indicator were added. The solution was titrated against 0.1 N NaOH until a definite pink colour, which persisted for at least 30 seconds, was obtained and the titre value was recorded.

$$\text{Total acid (\%)} = \frac{\text{Titre x normality of NaOH x Vol. Made up x Eq. Wt of acid)}}{\text{Wt. of sample x Volume taken for titration x 1000}} \text{x } 100$$

Ascorbic acid content (mg 100 -g)

The ascorbic acid was estimated by titration method using 2, 6-dichlorophenol indophenols dye as per the method reported by Ranganna (1986). With 2g of fruit sample or segment or 2ml of syrup 8 ml of metaphosphoric acid was added and filtered with the muslin cloth. Then 2 ml of the filtrate and 5 ml of metaphosphoric acid were added and titrated against the dye solution.

The amount of ascorbic acid was calculated by using the following formula:

$$\text{Ascorbic acid } \left(\frac{\text{mg}}{\text{100g}}\right) = \frac{\text{Ascorbic acid (mg)taken x Vol. of dye}}{\text{Dye used for standard x Wt. of sample x Vol. of sample taken}} x100$$

Total Sugar (%)

50 ml of the clarified solution was pipette into a 250 ml flask and added 5g of citric acid and 50 ml of water. It was boiled gently for 10 min to complete the inversion of sucrose and then cooled. Transferred it to a 250 ml flask and neutralized with 1N NaOH using phenolphthalein and make-up volume and was titrated with Fehling solution.

$$\text{Total sugar \%} = \frac{\text{Factorx Dilution x 100)}}{\text{Titre value x Weight of sample}}$$

Reducing Sugar (%)

Pipette 10 ml of mixed Fehling solution into 250 ml conical flask (5A and 5B). The burette was filled with the sample solution prepared. Then run into the flask almost the whole volume (15-50 ml) of solution required to reduce the Fehling solution so that 0.5-1.0 ml is required to later complete titration. Mixed the content was heated to boiling and boiled moderately for 2 min. Then added 3 drops of methylene blue and by not touch the sides. Titration was completed within 1 minute by adding 2-3 drops of sugar solution at 5-10 sec intervals until the indicator was completely decolourized from blue to brick red of cuprous oxide. Noted the volume of the solution required.

Note: The end point was determined within 1 drop of sugar and not interrupting the boiling for more than a few seconds as the indicator undergoes back oxidation rapidly when air has free excess into the flask.

$$\text{Total sugar \%} = \frac{\text{Factorx Dilution x 100)}}{\text{Titre value x Weight of sample}}$$

Non-reducing Sugar (%)

The difference between the estimated total and reducing sugars was computed and non-reducing sugar content was expressed in percentage.

Statistical analysis

The data underwent statistical analysis (Panse & Sukhatme 1985) using the AGRES software. Mean comparisons were conducted after computing analysis of variance (ANOVA), standard deviation (SE(d)) and least significant difference (LSD) values, with the critical difference set at a significance level of five per cent.

Results

The purpose of applied research is to attain the goal of optimising the output, which is the goal of the study. By multiplying the size of the fruit by the number of fruits that are collected from the tree, it is possible to determine the yield of any crop. Any crop may be calculated in this manner. According to Davenport and Nunez-Elisea (1990), the most significant occurrences that take place after a crop has been planted are the appearance of flowers and the development of fruit (Table 1).

Table 1. Effect of pre-harvest spray of chemicals on flowering and yield of cv. Banganapalli

Treatments	**Total number of flowers per panicle**	**Hermaphrodite flowers per panicle**	**Percentage of fruit set**	**Number of fruits**	**Fruit yield per tree (kg)**
T_1 - Urea 1 per cent + NAA 20 ppm	737.52	185.640	0.39	85.11	30.13
T_2 - Urea 1 per cent + Salicylic acid 200 ppm	726.49	174.721	0.35	81.89	27.63
T_3 - Urea 2 per cent + NAA 20 ppm	741.66	189.741	0.39	87.33	31.45
T_4 - Urea 2 per cent + Salicylic acid 200 ppm	732.29	180.468	0.37	83.78	29.18
T_5 - KNO_3 1 per cent + NAA 20 ppm	754.39	202.347	0.45	113.22	41.17
T_6 - KNO_3 1 per cent + Salicylic acid 200 ppm	748.24	196.256	0.43	92.00	33.21
T_7 - KNO_3 2 per cent + NAA 20 ppm	791.82	239.406	0.48	129.22	50.04
T_8 - KNO_3 2 per cent + Salicylic acid 200 ppm	764.38	212.235	0.46	123.33	45.88
T_9 - Water Spray	710.89	159.286	0.31	60.22	20.26
T_{10} - Control	699.27	147.773	0.31	45.33	12.48
Grand Mean	**740.69**	**188.79**	**0.39**	**90.14**	**32.14**
SE(d)	**23.24**	**12.75**	**0.02**	**6.42**	**2.32**
CD (5%)	**47.54**	**26.09**	**0.03**	**13.14**	**4.75**

Flowering parameters

Significant disparities exist between the various treatment combinations in terms of the total number of flowers produced by each panicle, as shown in Table 1. There was a significant difference in the total number of flowers per panicle among different chemical applications. Application of KNO_3 2 per cent and NAA 20 ppm had the greatest number of flowers per panicle (791.82), while treatment *i.e.*, application of KNO_3 2 per cent + SA 200 ppm had the second-highest number of flowers per panicle (764.38). The lowest number of flowers per panicle was recorded in control. Similarly, the highest number of hermaphrodite flowers was also highest in the same treatment. The chemicals showed a significant influence on the fruit set of mango cv. Banganapalli over control. Application of KNO_3 2 per cent and NAA 20 ppm recorded maximum fruit set (0.48 per cent) per panicle followed by KNO_3 2 per cent + SA 200 ppm.

Yield parameters

It was observed from the result (Table 2) that application of KNO_3 2 per cent and NAA 20 ppm recorded a significantly higher number of fruits (129.22) per tree of mango cv. Banganapalli (Table.1). While application of KNO_3 2 per cent +

SA 200 ppm produced the second highest number of fruits per tree (123.33). In regards to fruit yield (kg per tree) was also found significant maximum of 50.04 kg per tree by the effect of KNO_3 2 per cent and NAA 20 ppm. Whereas; the minimum yield was recorded in the control (12.48 kg per tree).

Table 2. Effect of chemicals on quality and shelf life of mango cv. Banganapalli

Treatment	TSS (°Brix)	Titrable acidity (%)	Ascorbic acid content (mg 100 g $^{-1}$)	Total sugar (%)	Reducing sugar (%)	Non-reducing sugar (%)
Urea 1 per cent + NAA 20 ppm	15.33	0.46	15.42	18.11	5.18	13.19
T_2 - Urea 1 per cent + Salicylic acid 200 ppm	13.42	0.49	13.12	17.55	5.02	12.79
T_3 - Urea 2 per cent + NAA 20 ppm	15.53	0.44	16.13	18.39	5.26	13.39
T_4 - Urea 2 per cent + Salicylic acid 200 ppm	14.23	0.47	13.65	17.96	5.14	13.08
T_5 - KNO_3 1 per cent + NAA 20 ppm	15.67	0.35	17.55	18.69	5.34	13.61
T_6 - KNO_3 1 per cent + Salicylic acid 200 ppm	15.62	0.42	17.19	18.48	5.29	13.46
T_7 - KNO_3 2 per cent + NAA 20 ppm	16.77	0.30	20.56	19.58	5.60	14.26
T_8 - KNO_3 2 per cent + Salicylic acid 200 ppm	15.93	0.32	18.61	19.11	5.47	13.92
T_9 - Water Spray	12.98	0.49	12.41	15.67	4.48	11.41
T_{10} - Control	12.77	0.54	12.05	14.36	4.11	10.46
Grand Mean	**14.83**	**0.43**	**15.67**	**17.79**	**5.09**	**12.96**
SE(d)	**1.01**	**0.03**	**1.08**	**1.21**	**0.35**	**0.88**
CD (5%)	**2.06**	**0.06**	**2.21**	**2.48**	**0.71**	**1.80**

Quality parameters

The foliar application of different chemicals significantly increased total soluble solids (TSS) content in comparison with the control (Table 2). Maximum total soluble solids (16.77°Brix) occurred with sprays of KNO_3 2 per cent + NAA 20 ppm which was significantly higher than with other treatments. A slight decrease in total soluble solids (15.93°Brix) was noticed with KNO_3 2 per cent + SA 200 ppm, but the treatments were higher than the control (12.77°Brix). Results in Table 1 showed that the titratable acidity (%) was significantly influenced by foliar application of pre-harvest chemicals in the present study. The highest titratable acidity (0.54 per cent) was noted in control fruits, while the lowest (0.30 per cent) was detected with application of KNO_3 2 per cent + NAA 20 ppm.

According to the findings of the observations that were recorded on the subject of "ascorbic acid content," it was revealed that each of the treatments had created a major impact on the ascorbic acid. The ascorbic acid content was found to be at its greatest, measuring 20.57 mg/100g, when the application of potassium nitrate 2 per cent and NAA 20 ppm was carried out. The ascorbic acid level of the control, on the other hand, was measured to be 12.06 mg 100 g^{-1}, which was the lowest ever recorded. Preharvest chemicals significantly affected the sugar contents of fruits in comparison to the control. Observation recorded on total sugar, reducing sugar and non-reducing sugar content, it was discovered that the application of 2 per cent potassium nitrate with 20 ppm of NAA recorded the greatest results. The highest levels of total sugar (19.58 per cent), reducing sugar (5.60 per cent), and non-reducing sugar (14.26 per cent) were found in treatment T_7 (application of 2 per cent potassium nitrate with 20 ppm of NAA).

Correlation study

All the quality parameters were highly correlated with fruit yield per tree in the current study (Table 3). The data on the correlation coefficient of quality parameters of fruits with yield reveal that yield per tree was significantly and positively correlated with TSS (0.908*), ascorbic acid (0.944) and whereas negatively correlated with titrable acidity (-0.971). Among the other chemical characters total sugar significantly and positively correlated with TSS (0.909*) and negatively correlated with acidity (-0.882). Shelf life was significantly and positively correlated with TSS (0.870*) and negatively correlated with acidity (-0.952*).

Table. 3. Correlation matrix for quality parameters of mango cv. Banganapalli

	TSS	Titrable acidity (%)	Ascorbic acid content	Total sugar (%)	Reducing sugar (%)	Non-reducing sugar (%)	Shelf life (days)	Number of fruits	Fruit yield per tree (kg)
TSS	1								
Titrable acidity (%)	-0.882**	1							
Ascorbic acid content	0.963**	-0.955**	1						
Total sugar (%)	0.909**	-0.829**	0.857**	1					
Reducing sugar (%)	0.909**	-0.828**	0.857**	0.999**	1				
Non-reducing sugar (%)	0.908**	-0.828**	0.857**	0.999**	0.999**	1			
Shelf life (days)	0.870**	-0.952**	0.937**	0.811**	0.812**	0.811**	1		
Number of fruits	0.896**	-0.966**	0.933**	0.926**	0.926**	0.926**	0.930**	1	
Fruit yield per tree (kg)	0.908**	-0.971**	0.944**	0.927**	0.926**	0.927**	0.945**	0.997**	1

Discussion

In the current investigation, the application of 2 per cent potassium nitrate and 20 ppm NAA had a significant impact on the maximum number of hermaphrodite flowers per inflorescence. The results may come from the presence of floral stimuli in stems when buds are induced by KNO_3, suggesting that KNO_3 might enhance bud sensitivity to the floral stimulus. The aforementioned results align with the findings presented by Phyu (2016) in mango and Mitali et al. (2019) in litchi. The NAA treatment, on the other hand, shows the capacity to increase the number of hermaphrodite flowers that are produced by each inflorescence. The findings were in agreement with those of Chung et al., (2023) found that NAA increased the proportion of perfect flowers to staminate flowers in mango. Application of potassium nitrate coupled with 20 ppm NAA resulted in the highest percentage of fruit set and fruit retention. The potential cause could be the reduction of osmotic potential by potassium, which in turn decreases water stress. Additionally, potassium is a key component in the synthesis of carbohydrates. Conversely, the application of KNO_3 increased the nitrogen levels in the experimental plants, leading to improved carbohydrate reserves and ultimately resulting in a greater fruit set. These metabolites and water stress are reduced by competition among fruits, fruit sets and subsequent development. Auxin, in turn, plays a crucial function in promoting fruit set and fruit retention by inhibiting the formation of the abscission layer in the fruit stalk. Potassium nitrate has shown a beneficial interaction with fruits, promoting their desirable traits and enhancing fruit set and retention (Barun, 2006). Similar findings were found by Singh et al. (2005) Nahar et al. (2010) and Sudha et al. (2012), in mango; Srivastava et al. (2013) in ber, which are in agreement with the present investigation.

In the present investigation, the maximum number of fruits per tree was recorded with, the application of potassium nitrate coupled with 20 ppm NAA. Patoliya et al. (2017) reported that 2 per cent KNO_3 gave a maximum number of fruits per tree in Dashehari mango. Similar results were registered by Sarker & Rahim (2013) in mango. The necessity of potassium also gets increased at the time of flowering and plays a crucial role in the retention of fruit through various stages of fruit development (Patel et al., 2018). The above demand in the shoots was being compensated through the foliar application of potassium nitrate which has positively impacted the all-over yield from the Kesar mango tree. The application of two per cent potassium nitrate in combination with 20 ppm NAA recorded the maximum TSS. Potassium, which is essential for the translocation of sugars, photoassimilates, hydrolysis of polysaccharides, conversion of organic acids into soluble sugars and other soluble solids, and for enhancing the solubilization of insoluble starch and pectin found in the cell wall and middle lamella, may be responsible for the increased TSS resulting from the treatment. Khayyat et al. (2012), Sarker & Rahim (2013), Yadav et al. (2014), and Baiea et al. (2015) corroborated the augmentation of TSS concentration by potassium nitrate in mango. The rise in TSS may result from the hydrolysis of polysaccharides, the transformation of organic acids into soluble sugars, and the augmented solubilization of insoluble starch and pectin found in the cell wall and middle lamella (Gupta & Brahmchari, 2004a). Gharge et al. (2014) confirmed an increase in total soluble solids in mango plants treated with potassium nitrate.In the same way, the application of NAA markedly enhanced the TSS content in the current study. Maurya et al. (1973) noted enhanced TSS levels in mango fruit as a result of NAA treatment. However, Haidry et al. (1997) found that applying NAA to the leaves of "Langra" mango in ppm amounts increased the total soluble solids. The augmented mobilisation of carbohydrates in these treatments may lead to an elevation in TSS due to increased solutes (Ahmed et al., 2012). Acidity is a significant quality criterion in fruit crops. In sugary fruits such as mangoes, acidity plays a crucial role in balancing the excessive sweetness, as extremely sugary fruits are often unpalatable. High-quality fruit consistently favours a superior combination of acids and sugars. This study examines several therapy combinations. Among the treatment combinations, the combination of two per cent potassium nitrate and 20 ppm NAA produced the lowest acidity. An elevated application of potassium leads to a decrease in the acid content of fruits. Low potassium levels may redirect phosphoenol pyruvate (PEP) into other pathways, resulting in a deficiency of acetyl co-A (Pattee and Teel, 1967). Therefore, plants with low potassium levels appeared to preferentially synthesize oxaloacetate from PEP, leading to the accumulation of these organic acid derivatives. Elevated potassium levels in tissues may have neutralized organic acid, leading to a decrease in acidity (Tisdale & Nelson, 1966a). Dutta (2011) and Bibi et al. (2019) have observed an enhancement in total soluble solids (TSS) content in fruit resulting from potassium application. Since mango is a climacteric fruit, the rapid absorption of organic acids during respiration at maturity is responsible for the decrease in acidity percentage. We may attribute the reduction in acidity percentage to the elevated total soluble solids (TSS) and sugars in the fruits from the treated trees, possibly due to auxin production in the plants, which boosts physiological activities and subsequently increases TSS in the fruits. The current research confirms the findings of Gupta & Brahmachari (2004b) on mango. The rapid conversion of acids into sugars and their derivatives via the glycolytic pathway may account for the reduction in fruit acidity resulting from NAA treatment. Kaur & Bons (2019) and Singh & Bons (2020) reported similar findings in the sapota cultivar, Killadi et al. (2007) focused on guava fruits. The combination of potassium nitrate and 20 ppm NAA yielded the highest ascorbic acid level in the current study. Potassium's influence on the generation and accumulation rates of sugars contributes to the enhancement of fruit's chemical characteristics. Stino et al. (2009), Ebeed et al. (2005), and Abd El-Razek et al. (2013) obtained a comparable result. Potassium enhanced the chemical attributes of mango fruits, including total soluble solids (TSS), total acidity, and vitamin C content. Kumar et al. (2006) discovered that potassium significantly affects the chemical characteristics of fruit by influencing soluble solids, acidity, and vitamin C concentration. The results align with those of Bansode et al. (2012). The administration of NAA recorded the maximum concentration of ascorbic acid, according to the results. We can attribute this to the continuous synthesis of glucose-6-phosphate during fruit growth and development, believed to be the precursor of vitamin C. These results correspond with the findings of Ahmed et al. (2012) regarding the mango cultivar Dashehari. These findings corroborate the reports of Lal et al. (2015) on Kinnow Mandarin. The treatment with 2 per cent KNO_3 and 20 ppm NAA showed the highest levels of total sugar, reducing sugar, and non-reducing sugar. The maximum total sugar may result from potassium's role in carbohydrate synthesis, degradation, translocation, protein synthesis, and the neutralization of physiologically significant organic acids (Tisdale & Nelson, 1966b). K also helps with sucrose and amino acid loading and unloading in the phloem and stores starch in fruits that are still growing by turning on starch synthesis enzymes (Nahar et al., 2010). Singh & Varma (2011) and Singh et al. (2005) have also documented similar findings. The current results align with those of Kaur et al. (2012) regarding peach fruits and Prasad et al. (2015) concerning pear fruits. The results on total sugars, reducing sugars, and non-reducing sugars indicate that the administration of NAA greatly enhanced the sugar content. The degradation of polysaccharides into monosaccharides through metabolic processes, the transformation of organic acids into sugars, and moisture loss are the three primary factors contributing to the increase in total sugar content in fruits, as stated by Manoj Kumar et al. (2019). Potential factors contributing to the increased sweetness of fruit encompass photosynthesis, which enhances carbohydrate accumulation and their translocation inside the fruit. Growth regulators like NAA initiate reactions that engage many glycolytic pathways, rapidly converting carbohydrates into their derivatives. The application of 2 per cent KNO_3 and 20 ppm NAA demonstrated the highest fruit firmness in this study. Potassium governs the opening and closing of stomata in leaves, enhancing the water absorption capacity of plants and hence increasing fruit firmness. The use of potassium enhances the osmoregulation of cell vacuoles and sustains equilibrium, leading to firmer fruits (Sajid et al., 2022).The current experiment found that the combination of KNO_3 at a concentration of 2 per cent and NAA had the longest shelf life under ambient conditions when compared to the other treatment combinations. Potassium reduces respiration, preserving turgor pressure and reducing water retention in fruits, thereby preventing energy loss. This characteristic contributes to an increase in the shelf life of fruits. This result is consistent with the observations made by Srivastava et al. (2013), who found that foliar spraying with potassium fertilizers led to the least amount of physiological weight loss and decay, which eventually led to an increase in the shelf life of ber fruits. Potassium reduces water loss from the crop and maintains its turgor, thereby extending the fruits' shelf life. These effects may be due to chemical changes that occur within the fruits, which result in them being able to retain more water despite the force of evaporation. Moreover, these therapies may modify certain protein components of the cells, thereby enhancing their hydrophilicity. Compared to the control group, the fruits treated with NAA and potassium exhibited a significantly lower incidence of rotting or spoilage. The correlation study also carried out to decipher the correlation among the important characters. Notably, Krishna et al. (2020) reported that significant positive correlation of yield per tree with TSS and negative correlation with acidity. Saha (2004) findings also inline with our study and reported that self life was significantly correlated with TSS and negatively correlated with acidity.

Conclusion

In a nutshell, based on the findings of the current investigation into the estimation of various flowering and yield parameters, it was observed that the 2 per cent KNO_3 with 20 ppm NAA produced the highest values for total number of flowers per tree, hermaphrodite flowers per tree, fruit set, number of fruits and yield per tree. The quality parameters *viz*., total soluble solids, minimum titrable acidity, maximum ascorbic acid content, total sugars, reducing sugars, non-reducing sugars and shelf life were also highest in the same treatment and this may be recommended to get superior quality of fruits mango cv. Banganapalli. Among plant quality parameters dependent variable (yield) was significantly and positively correlated with TSS, ascorbic acid, total sugar and shelf life of mango.

Author contributions

Magizhnan Thiruezhirselvan conducted Research trial, collection, analysis of data, and Thesis writing. Prakash Kasilingam has contribution as Research guide, guided to conduct trial, observations, analysis & thesis writing. Gopu Balraj contributed to the final version of the article. Nagajothi Rajasekaran provided critical feedback and helped to shape the article.

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Competing Interests

The author declares no conflict of interest. The manuscript has not been submitted for publication in other journal.

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