Original Research Article

Interaction Effect of Mango Varieties and Chemical Spray Applications on Post-Harvest Quality Parameters

ABSTRACT

Aim: To study the effect of mango varieties and chemicals and their interaction effect on post-harvest parameters.

Design: Randomized Block Design with Factorial Concept

Place of study: The present experiment was conducted during the years of 2021 and 2023 at the Regional Horticultural Research Station, ASPEE College of Horticulture, Navsari Agricultural University, Navsari, with the objective to know the impact of chemical spray application on post-harvest parameters of mango. The study was not conducted in 2022 due to no flowering.

Results: The highest total soluble solids (TSS 20.60 °Brix) was observed in variety V_2 (Sonpari), while variety V_3 (Amrapali) exhibited the highest levels of non-reducing sugars (11.00 %), total sugars (16.22 %) and lowest titrable acidity (0.217%). Variety V_1 (Kesar) recorded the highest ascorbic acid (40.5 mg/100g) and reducing sugars (5.6 %). Among the chemical treatments, (GA_3 30 mg/l + $ZnSO_4$ 0.25% + Boron 0.1%) resulted in the highest TSS (19.69°Brix) and C_3 (Novel 1% + $ZnSO_4$ 0.25% + Boron 0.1%) resulted in the lowest titratable acidity (0.228%). The highest values for reducing sugars (5.69%), non-reducing sugars (9.81%), total sugars (15.51%), and ascorbic acid content (39.66 mg/100g)were recorded with chemical treatment C_1 (NAA 20 mg/l + $ZnSO_4$ 0.25% + Boron 0.1%). The combination of variety V_2 and chemical treatment C_2 (Sonpari + GA_3 30 mg/l + $ZnSO_4$ 0.25% + Boron 0.1%) resulted in the significantly highest TSS (21.61 °Brix), while the highest ascorbic acid (44.64 mg/100g) and reducing sugars (5.91%) were observed with V_1C_1 (Kesar + NAA 20 mg/l + $ZnSO_4$ 0.25% + Boron 0.1%). The highest non-reducing sugars (12.94%) and total sugars (18.67%) were recorded with the treatment combination V_3C_3 (Amrapali + Novel 1% + $ZnSO_4$ 0.25% + Boron 0.1%).

Conclusion: In conclusion, the study highlights the significant influence of both mango variety and chemical treatments on various quality parameters. Optimal combinations, such as V2 with C2 and V1 with C1, were found to enhance TSS (^{0} Brix), ascorbic acid (mg/100g), reducing sugars (%), and other important attributes, suggesting potential strategies for improving mango fruit quality.

Keywords: *Mango, Titrable acidity, Reducing sugars, Asorbic Acid*

INTRODUCTION

Mango belongs to the genus *Mangifera* of the family Anacardiaceae and is widely regarded as the 'King of Fruits' in the Indian sub-continent (Tharanatahn *et al.,* 2006). Mango has become naturalized and adapted across the tropics and sub-tropics. Today, mangoes are recognized and consumed throughout the world and are regarded as one of the most popular and esteemed tropical fruits. The genus *Mangifera* originated in tropical Asia, with maximum number of species found in Borneo, Java, Sumatra and the Malay Peninsula. The most-cultivated *Mangifera* species, *M. indica*, has its origin in India and Myanmar (Bally 2006). When ripe, this delicious dessert fruit is particularly high in vitamin A.

The total annual production of mango in India is estimated to be 22,548,000 MT and 24, 06,000 ha cultivated area (Anon., 2024). Major mango producing states in India are Andhra Pradesh, Uttar Pradesh, Bihar, Karnataka, Tamil Nadu, Gujarat and Telangana. Uttar Pradesh is the leading state in mango production (5807.19 MT) followed by Andhra Pradesh (4985.28 MT). In Gujarat, mango covers 177.62 thousand hectares of area with a production of 1089.16 thousand MT (Anon., 2024). Some commercially grown mango cultivars in Gujarat are Kesar, Alphonso, Sonpari, Rajapuri, Totapuri, Dashehari, Langra and Amrapali

Several factors influence the yield and quality of mangoes, including total soluble solids (TSS), acidity, sugar content, ascorbic acid levels, pulp percentage, and shelf life. These attributes are significantly affected by various pre-harvest practices, among which the application of plant growth regulators plays a crucial role (Manoj *et al.,* 2019). Considering these challenges, it is essential to evaluate the impact of pre-harvest applications of plant growth regulators and chemicals on the quality of Kesar, Sonpari and Amrapali mango.

MATERIALS AND METHODS

The experiment was carried out at Regional Horticultural Research Station, ASPEE College of Horticulture, Navsari Agricultural University, Navsari during the year 2020-21 and 2022-23. The experiment was not carried during 2022 due to no flowering. The experiment was conducted in Randomized Block Design with factorial concept which comprised of two factors; first factor consisted of three varieties V_1- Kesar, V_2 – Sonpari and V_3 – Amrapali and the second factor consisted of Chemicals *viz.,* C_1- NAA 20 mg/l + $ZnSO_4$ 0.3% + Boron 0.1%, C_2 - GA_3 30 mg/l + $ZnSO_4$ 0.3% + Boron 0.1%, C_3 - Novel 1% + $ZnSO_4$ 0.3% + Boron 0.1%, C_4 – Ca $(NO_3)_2$ + $ZnSO_4$ 0.3% + Boron 0.1% and C_5 – Control (No spray).Total Soluble Solids (TSS) of the mango pulp were recorded by using digital hand refractometer (Range of 0 to 32 °Brix). The average value was calculated and expressed in ºBrix. The method described by Ranganna (1986) was adopted for estimation of titratable acidity. The vitamin C *i.e.* ascorbic acid content was determined by Dye method as detailed by Ranganna (1986). Lane and Eynon (1923) titration method described by Ranganna (1986) was taken on for the estimation of reducing sugars. For total sugars estimation, the filtrate obtained in the above estimation was used. Non-reducing sugar percentage was calculated by subtracting the reducing sugars (%) from the total sugars (%).The simple technique of analysis of variance may not be valid under two different seasonal conditions as the error variances in the season and the treatment and season interaction may be significant. Hence, pooled analysis of two years was worked out as per the procedure suggested by Cochran and Cox (1957). Bartlett’s test was applied to examine the homogeneity of variance of the error. The variance obtained due to season x treatment component were tested against joint estimate of error variance with an objective to find out whether season x treatment interaction exist or not.

3. RESULTS AND DISCUSSION

The data presented in the tables represents pooled data from the two seasonal years, 2021 and 2023.

3.1 Total Soluble Solids (TSS)

The Total Soluble Solids (TSS) content exhibited significant variation across different treatments and mango varieties. Among the varieties, Sonpari (V_2) recorded the highest TSS value of 20.60° Brix, followed closely by Amrapali (V_3) at 20.58° Brix. Among the chemical treatments, the application of GA_3 (30 mg/L) + $ZnSO_4$ (0.25%) + Boron (0.1%) (C_2) resulted in the highest TSS content of 19.66° Brix (Table.1). The interaction between variety and treatment, V_2C_2 (Sonpari + GA_3 (30 mg/L) + $ZnSO_4$ (0.25%) + Boron (0.1%)), exhibited the maximum TSS value (21.61^0 Brix) (Table.1). Increase in TSS may be due to the hydrolysis of the polysaccharides, conversion of organic acids into soluble sugars and enhanced solubilisation of insoluble starch and pectin present in cell wall and middle lamella (Gupta and Brahmchari, 2004). Gharge *et al.,* (2014)) in mango confirmed Increase in TSS. Similar results were obtained in relation to fruit quality by Anon. (2014) in banana and Anon. (2013) in papaya.

3.2 Titratable Acidity

Titratable acidity demonstrated a decreasing trend with the application of growth regulators and micronutrients. Among the varieties, Amrapali (V_3) exhibited the lowest acidity (0.217%), whereas Kesar (V_1) recorded the highest value (0.312%). Among the chemical treatments, NOVEL @ 1% + $ZnSO_4$ (0.25%) + Boron (0.1%) (C_3) resulted in the lowest acidity (0.228%) (Table.1). The interaction effect was most pronounced in V_3C_3 (Amrapali + NOVEL @ 1% + $ZnSO_4$ (0.25%) + Boron (0.1%)), which recorded the lowest titratable acidity (0.175%) (Table.1). The findings are in the line of earlier reports of Dutta *et al.,* (2011), Baiea *et al.,* (2015), Elkhishen (2015), Patolia *et al.,* (2017b) and Singh and Kaur (2018) in mango fruits itself. The decrease in acidity of fruits might have been attributed to their conversion in sugars and their derivatives by the reactions involving reversal of glycolytic pathway and also might be used in respiration (Singh and Maurya, 2004).

3.3 Ascorbic Acid Content

The ascorbic acid content varied significantly across varieties and treatments. Among the varieties, Kesar (V_1) exhibited the highest ascorbic acid content (40.50 mg/100g). Among the chemical treatments, NAA (20 mg/L) + $ZnSO_4$ (0.25%) + Boron (0.1%) (C_1) resulted in the highest ascorbic acid content (44.64 mg/100g) (Table.1). The interaction effect was most prominent in V_1C_1

(Kesar + NAA (20 mg/L) + $ZnSO_4$ (0.25%) + Boron (0.1%)), where the ascorbic acid content reached 44.04 mg/100g (Table.1). This might be due to catalytic influence of growth regulators on its bio-synthesis from its precursor glucose-6-phosphates throughout the development of fruit which is precursor of vitamin C. Similar trend were found by Chovatiya *et al.* (2015). The findings emphasize the positive impact of growth regulators and micronutrients on increasing the vitamin C content in mango fruits. The elevated levels of ascorbic acid observed in fruits treated with NAA (Naphthalene Acetic Acid) may result from higher sugar concentrations, as ascorbic acid is synthesized from sugars (Singh *et al.,* 2017). Similar outcomes were reported by Sankar *et al.* (2013) regarding mangoes. These results are consistent with earlier studies by Shrivastava and Jain (2006) on mango and Shukla *et al.* (2011) on aonla.

3.4 Reducing Sugars

The reducing sugar content ranged from 4.65% to 5.91% across different treatments. The highest reducing sugar content was observed in Kesar (V_1) under C_1 treatment (5.91%), followed by Amrapali (V_3) under the same treatment (5.73%) (Table 2). Among the varieties, Kesar recorded a reducing sugar content of 5.6% (Table 1). Among the chemical treatments, NAA (20 mg/L) + $ZnSO_4$ (0.25%) + Boron (0.1%) resulted in the highest reducing sugar content (5.69%) (Table 1).

3.5 Non-Reducing Sugars

Non-reducing sugars varied across treatments, with Amrapali (V_3) exhibiting the highest non-reducing sugar content (12.94%) under C_1 treatment (Table.2). Among the varieties, Amrapali recorded the highest non-reducing sugar content (11%). Among the chemical treatments, NAA (20 mg/L) + $ZnSO_4$ (0.25%) + Boron (0.1%) resulted in the highest non-reducing sugar content (9.81%) (Table 1). These findings suggest that micronutrient supplementation and growth regulator applications play a crucial role in sugar metabolism, enhancing fruit sweetness and consumer acceptability.

3.6 Total Sugars

The total sugar content was highest in Amrapali (V_3) treated with NAA (20 mg/L) + $ZnSO_4$ (0.25%) + Boron (0.1%) (C_1), reaching 18.67%, followed by Amrapali under NOVEL (1%) + $ZnSO_4$ (0.25%) + Boron (0.1%) (C_3) at 16.21% (Table 2). Among the varieties, Amrapali recorded the highest total sugar content (16.2%) (Table.1). Among the chemical treatments, NAA (20 mg/L) + $ZnSO_4$ (0.25%) + Boron (0.1%) exhibited the highest total sugar content (15.51%). The lowest total sugar content was recorded in Sonpari (V_2) under control conditions (11.78%). Among the chemical treatments, NAA (20 mg/L) + $ZnSO_4$ (0.25%) + Boron (0.1%) exhibited the highest reducing sugar content (5.9%). The application of growth regulators, particularly NAA and GA_3, significantly enhanced reducing sugar levels across all varieties. This improvement suggests a positive influence on sweetness development, fruit quality, and commercial value. This might be due to synthesis of auxin in plants, which increase the physiological activities and in turn helps in increasing sugar contents. The results are also in accordance with the findings of Sharma *et al.* (1990), Patel (1991), Patel

(1992), Haidry *et al.* (1997), Shinde *et al.* (2006) in mango, Bhatt *et al.* (2012) and Singh *et al.* (2013)

Treatments	Post Harvest Parameters					
	TSS (^{0} Brix)	**Titrable Acidity (%)**	**Ascorbic acid (mg/100g)**	**Reducing sugars (%)**	**Non reducing sugars (%)**	**Total sugars (%)**
V: 1	16.59	0.312	40.5	5.6	7.98	13.59
V: 2	20.60	0.252	32.91	4.95	7.58	12.52
V: 3	20.58	0.217	37.3	5.21	11	16.22
SEm±	**0.09**	**0.001**	**0.15**	**0.02**	**0.04**	**0.06**
CD@5%	**0.26**	**0.003**	**0.43**	**0.06**	**0.12**	**0.18**
C: 1	19.14	0.241	39.66	5.69	9.81	15.51
C: 2	19.69	0.249	36.64	5.29	8.56	13.85
C: 3	19.44	0.228	37.31	5.32	8.81	14.14
C: 4	19.23	0.259	37.5	5.11	8.99	14.1
C: 5	18.63	0.328	33.41	4.87	8.06	12.94
SEm±	**0.12**	**0.001**	**0.19**	**0.03**	**0.05**	**0.08**
CD@5%	**0.34**	**0.004**	**0.56**	**0.08**	**0.16**	**0.23**
Interaction (V X C)						
SEm±	**0.21**	**0.21**	**0.34**	**0.05**	**0.09**	**0.14**
CD@5%	**0.59**	**0.60**	**0.97**	**0.15**	**0.28**	**0.41**
Interaction (V X C X Y)						
SEm±	0.13	0.004	0.48	0.07	0.13	0.2

in mango and Venu *et al.* (2014) in acid lime.

Table 1. Effect of varieties and chemicals on post-harvest parameters in mango (Pooled data of 2021 and 2023)

CD@5%	NS	NS	NS	NS	NS	NS

Note: **V_1** – Kesar, **V_2** – Sonpari, **V_3** – Amrapali, **C_1** – NAA (20 mg/l) + $ZNSO_4$ (0.25%) + Boron (0.1%), **C_2** – GA3 (30 mg/l) + $ZNSO_4$ (0.25%) + Boron (0.1%), **C_3** – NOVEL (1%) + $ZNSO_4$ (0.25%) + Boron (0.1%), **C_4** – Ca $(NO_3)_2$(0.3%) + $ZNSO_4$ (0.25%) + Boron (0.1%) and **C_5** - Control (No spray).

Table 2. Interaction effect of Varieties and Chemicals on post-harvest parameters of Mango (Pooled 2021 and 2023)

4. CONCLUSION

This study result clearly underlines the potential use of growth regulators and micronutrients for enhancement of biochemical contents of mango fruits. For example, TSS in Sonpari was reported highest with 30 mg/L of GA3 when used with ZnSO4 (0.25%) and Boron at a concentration of 0.1%. The Amrapali variety, however, received the highest total sugar content under the treatment of NAA (20 mg/L), ZnSO4 (0.25%), and Boron (0.1%). Furthermore, the Kesar variety received the maximum ascorbic acid level with the same NAA, ZnSO4, and Boron treatment. These results would represent the use of specific growth regulators and micronutrients, enhancing fruit sweetness, vitamin C content, and general quality; such improvements should lead to increasing commercial viability and consumer appeal among several mango cultivars.

Disclaimer (Artificial intelligence)

Option 1:

Treatment combinations	Post-harvest parameters					
	TSS (^{0}Brix)	Titrable acidity (%)	Ascorbic acid (mg/100g)	Reducing sugars (%)	Non reducing sugars (%)	Total sugars (%)
V_1C_1	16.38	0.288	44.04	5.91	8.59	14.5
V_1C_2	16	0.318	41.5	5.85	7.92	13.78
V_1C_3	17.55	0.287	40.64	5.75	7.94	13.69
V_1C_4	16.58	0.285	39.68	5.27	7.81	13.09
V_1C_5	15.98	0.394	36.64	5.25	7.62	12.87
V_2C_1	20.71	0.266	34.28	5.44	7.95	13.35
V_2C_2	21.61	0.192	32.83	4.96	7.58	12.54
V_2C_3	20.04	0.193	33.88	4.93	7.57	12.51
V_2C_4	20.94	0.28	33.46	4.76	7.66	12.44
V_2C_5	19.7	0.337	30.11	4.65	7.12	11.78
V_3C_1	20.33	0.207	40.67	5.73	12.94	18.67
V_3C_2	20.72	0.238	35.58	5.05	10.19	15.25
V_3C_3	21.48	0.175	37.4	5.28	10.93	16.21
V_3C_4	20.17	0.218	39.36	5.28	11.48	16.77
V_3C_5	20.21	0.257	33.49	4.72	9.44	14.17
SEm±	**0.21**	**0.002**	**0.34**	**0.05**	**0.09**	**0.14**
CD@5%	**0.59**	**0.007**	**0.97**	**0.15**	**0.28**	**0.41**

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