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MP Ramoliya
Department of Horticulture, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, India

Mani N Chaudhari
Department of Horticulture, B.A. College of Agriculture, Anand Agricultural University, Anand, Gujarat, India

AM Butani
Department of Horticulture, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, India

Corresponding Author:
Mani N Chaudhari
Department of Horticulture, B.A. College of Agriculture, Anand Agricultural University, Anand, Gujarat, India

Effect of various organic and inorganic formulations on fruit quality in mango cv. Kesar

MP Ramoliya, Mani N Chaudhari and AM Butani

Abstract
The present experiment entitled "Effect of various organic and inorganic formulations on fruit setting, yield and quality in mango cv. Kesar" was carried out at Fruit Research Station, Sakkarbaugh, Department of Horticulture, College of Agriculture, Junagadh Agricultural University, Junagadh (Gujarat). The results of the study indicated that the spraying of KNO_3 2% + NAA 50 ppm + *Jeevamrut* 5% exhibited the maximum fruit weight (208.83 g), maximum length (10.52 cm), maximum fruit breadth (6.33 cm), maximum pulp weight (143.47 g), maximum pulp: stone ratio (4.08), maximum TSS (26.44 ^{0}B), maximum fruit firmness (6.46 kg/cm^2), maximum period of shelf life (14.13 days) and highest mean score (7.13). While, the spraying of MPP 2% + *Jeevamrut* 5% + *Novel* 4% exhibited the maximum total sugar (12.14%).

Keywords: Mango cv. Kesar, KNO_3, NAA and *Jeevamrut*

Introduction
Mango (*Mangifera indica* L.) belongs to the family Anacardiaceae and the genus is believed to be originated in the Indo-Burma region. The fruit is having excellent adaptability and regarded as "King of Fruits" (Radha and Mathew, 2007) [20]. Mango is one of the major fruit crop of Asia and has developed its own importance all over the world (Bose *et al.* 2001) [6]. Mango is a national fruit of India because of its excellent flavour, delicious taste, delicate fragrance and attractive colour. In mango, heavy fruit drop is an important factor contributing to low fruit yield and sometimes only 0.1% of fruits reached up to maturity. The maintenance of fruit quality is critical while, employing any new technology for increasing production and shelf life. Thus, fruit set in mango is crucial event which greatly influence the ultimate fruit yield.

Materials and Methods
The present investigation was carried out at Fruit Research Station, Sakkarbaugh, Department of Horticulture, College of Agriculture, Junagadh Agricultural University, Junagadh (Gujarat) during 2020. Junagadh is situated at 21.5° N latitude and 70.5 ° E longitude with an altitude of 60 meters above the mean sea level on the western side at the foot hills of mountain Girnar sierra. The experiment was laid out with various organic and inorganic formulations in Randomized Block Design with three replications. The experiment comprising of eight treatments including: T_1: Control, T_2: MPP 2% + NAA 50 ppm + *Novel* 4%, T_3: KNO_3 2% + CPPU 10 ppm + Cow urine 25%, T_4: KNO_3 2% + NAA 50 ppm + *Jeevamrut* 5%, T_5: MPP 2% + Boron 0.8% + *Panchgavya* 3%, T_6: MPP 2% + *Jeevamrut* 5% + *Novel* 4%, T_7: Boron 0.8% + *Jeevamrut* 5% + *Panchgavya* 3% and T_8: KNO_3 2% + Boron 0.8% + *Jeevamrut* 3%+ *Panchgavya* 3% + *Novel* 4% with three replications. The foliar application of various organic and inorganic formulations applied once during the investigation at pea stage in 'Kesar' mango orchard.

Results
Physical parameters
The data on the effect of various organic and inorganic formulations on fruit weight (g), fruit length, fruit breadth, pulp weight, peel weight, stone weight, pulp: Stone ratio and fruit firmness were recorded during experiment trial and was presented in Table 1.

Fruit weight (g)
The maximum fruit weight (208.83 g) was obtained in treatment T_4 (KNO_3 2% + NAA 50 ppm + *Jeevamrut* 5%). The minimum fruit weight (121.07 g) was noted in T_1 (Control).

Pulp weight (g)
The maximum pulp weight (143.47 g) was noted in treatment T_4 (KNO_3 2% + NAA 50 ppm + *Jeevamrut* 5%). The minimum pulp weight (73.93 g) was resulted in T_1 (Control).

Peel weight (g)
The minimum peel weight (22.03 g) was noticed in T_1 (Control), which was statistically at par with treatment T_5 (MPP 2% + Boron 0.8%+ *Panchgavya* 3%) (25.07 g). The maximum peel weight (31.90 g) was noted in treatment T_4 treatment (KNO_3 2% + NAA 50 ppm + *Jeevamrut* 5%).

Stone weight (g)
The minimum stone weight (25.10 g) was exhibited in treatment T_1 treatment (Control). The maximum stone weight (33.47 g) was obtained in T_4 (KNO_3 2% + NAA 50 ppm + *Jeevamrut* 5%).

Fruit length (cm)
The maximum length (10.52 cm) was noticed in treatment T_4 (KNO_3 2% + NAA 50 ppm + *Jeevamrut* 5%). Where as the minimum length (8.16 cm) was noted in treatment T_1 (Control).

Fruit breadth (cm)
The maximum fruit breadth (6.33 cm) was recorded in treatment T_4 (KNO_3 2% + NAA 50 ppm + *Jeevamrut* 5%), which was statistically at par with treatments T_3 (KNO_3 2%+ CPPU 10 ppm + Cow urine 25%) (6.06 cm) and T_8 (KNO_3 2% + Boron 0.8% + *Jeevamrut* 3%+ *Panchgavya* 3% + *Novel* 4%) (6.09 cm). The minimum fruit breadth (5.18 cm) was noted in T_1 (Control).

Pulp: Stone ratio
The maximum pulp: stone ratio (4.29) was observed in treatment T_4 treatment (KNO_3 2% + NAA 50 ppm + *Jeevamrut* 5%). The minimum pulp: stone ratio (2.94) was observed in T_1 (Control).

Fruit firmness (kg/cm^2)
The maximum fruit firmness (6.46 kg/cm^2) was recorded in treatment T_4 (KNO_3 2% + NAA 50 ppm + *Jeevamrut* 5%), which was statistically at par with treatments T_6 (MPP 2% + *Jeevamrut* 5% + *Novel* 4%) (6.13 kg/cm^2). The minimum fruit firmness (3.23 kg/cm^2) was noticed in T_8 (KNO_3 2% + Boron 0.8% + *Jeevamrut* 3%+ *Panchgavya* 3% + *Novel* 4%).

Biochemical parameters
The data on the effect of various organic and inorganic formulations on TSS, acidity, total sugar, reducing sugar, non-reducing sugar and ascorbic acid were recorded during experiment trial and are presented in Table 2.

Total soluble solids (^{0}Brix)
The maximum TSS (^{0}B) (26.44 ^{0}B) was recorded in treatment T_4 (KNO_3 2% + NAA 50 ppm + *Jeevamrut* 5%), which was statistically at par with treatments T_6 (MPP 2% + *Jeevamrut* 5% + *Novel* 4%) (24.71 ^{0}B). The minimum TSS (^{0}B) (20.46 ^{0}B) was noted in T_5 (MPP 2% + Boron 0.8% + *Panchgavya* 3%).

Acidity (%)
The data presented on acidity (%) in Table 2. The result was found non-significant with various organic and inorganic formulations.

Ascorbic acid (mg/100 g pulp)
The data presented on ascorbic acid (mg/100 g pulp) in Table 2. The result was found non-significant with various organic and inorganic formulations.

Total sugar (%)
The maximum total sugar (12.14%) was noted in treatment T_6 treatment (MPP 2% + *Jeevamrut* 5% + *Novel* 4%), which was statistically at par with treatments T_3 (KNO_3 2% + CPPU 10 ppm + Cow urine 25%) (11.00%) and T_8 (KNO_3 2% + Boron 0.8% + *Jeevamrut* 3% + *Panchgavya* 3% + *Novel* 4%) (11.21%). The minimum total sugar (8.98%) was noted in T_2 (MPP 2% + NAA 50 ppm + *Novel* 4%).

Reducing sugar (%)
The maximum reducing sugar (4.38%) was noted in treatment T_1 treatment (Control), which was statistically at par with treatments T_3 (KNO_3 2%+ CPPU 10 ppm + Cow urine 25%) (3.83%), T_5 (MPP 2% + Boron 0.8% + *Panchgavya* 3%) and T_6 (MPP 2% +*Jeevamrut* 5% + *Novel* 4%) (3.67%). The minimum reducing sugar (2.75%) was noted in T_7 (Boron 0.8% +*Jeevamrut* 5%+ *Panchgavya* 3%).

Non-reducing sugar (%)
The data presented on non-reducing sugar (%) in Table 2 clearly revealed the non-significant effect of various organic and inorganic formulations in non-reducing sugar (%).

Shelf-life (Days)
The data presented on shelf-life (days) in Table 2 clearly indicated that the significant differences due to various organic and inorganic formulations in shelf life (days) of 'Kesar' mango fruits stored at ambient temperature were increased by all the treatments. The maximum period of shelf life (14.20 days) was observed in treatment T_4 (KNO_3 2% + NAA 50 ppm + *Jeevamrut* 5%). The minimum shelf life of mango fruits (12.60 days) was observed in treatment T_1 (Control).

Organoleptic evaluation
The data presented on organoleptic evaluation in Table 2 clearly revealed that significant differences due to various organic and inorganic formulations in organoleptic evaluation. The organoleptic score on fruit colour, flavour, taste, texture and over all acceptability of ripened 'Kesar' mango fruits. It is evident from the data that various organic and inorganic formulations have an influence on the organoleptic evaluation of fruits. The highest mean score (7.13) was observed in treatment T_4 (KNO_3 2% + NAA 50 ppm + *Jeevamrut* 5%). The minimum mean score for organoleptic evaluation (6.20) was noted in treatment T_1 treatment (Control).

Discussion
Physical parameters
The physical characteristics *viz*., fruit weight, fruit length and fruit breadth, pulp weight, peel weight, stone weight and pulp: stone ratio fruit firmness were significantly influenced by the various organic and inorganic formulations application during the experiment. The data analysis indicated that mango plants

applied with KNO_3 2%, NAA 50 ppm and *Jeevamrut* 5% yielded fruits with maximum weight, length, breadth, pulp weight, peel weight, stone weight and pulp: stone ratio.

According to Nijjar (2000) [18] potassium might have acted as an activator for a number of complex enzyme systems and these enzymes catalyze metabolic reactions related to the carbohydrate, nucleic acid, amino acid, protein and folic acid. These results show parallelism to the findings of Nahar *et al.* (2010) [16] and Reddy (2006) [22] in mango and Gill and Bal (2009) [10] in ber.

Increase in fruit size in the present study was probably due to accelerated rate of cell enlargement, the size of fruit may be correlated with cell size and number of cells (Bain and Robertson, 1951) [4] in apple. The results were supported by Nahar *et al*. (2010) [16] in mango and Srivastava *et al.* (2013) [30] in ber.

Abdrabboh (2013) [2] found that spraying Manzanillo olive trees with GA_3 and NAA at concentrations fluctuated from 50 to 100 ppm improved the physical fruit properties than untreated plants (control). Stern *et al.* (2007) [31] reported that treatments of NAA encourage cell expansion in the fruit mesocarp, which in turn, causes an increase in fruit volume and yield in Japanese Plum.

The present results are in agreement with that reported by Ghazzawy (2013) [9] found that foliar application of Barhee date palm cultivar with NAA at 90 ppm at hababouk stage increased fruit dimensions in comparison to that of control. The increase in fruit dimensions (length and diameter) might be due to NAA ability in the division and elongation of the fruit cells.

Increase in the pulp weight of fruit, all treatments affected differently and showed significant difference for fruit pulp weight, it is due to increase of fruit weight. Significantly response of KNO_3 2% + NAA 50 ppm + *Jeevamrut* 5% on pulp weight and maximum pulp weight were recorded. Increased sink demand by induced application of auxin is closely related to the activation of in vertase cell wall-bound in the core and invertase neutral and dependent sorbitol dehydrogenase in the pulp during rapid fruit growth. These findings are in agreement with the findings of Hammam *et al.* (2001) [12], Ruby and Brahmachari (2004) [24], Saxena (2004) [27], Singh and Banik (2011) [29] and Yadav *et al.* (2011) [33] in mango, Malik *et al.* (2000) [14] in kinnow and Ram and Bose (2000) [21] in mandarin.

Naidu *et al.* (2000) [17] who reported a significant increase in fruit length of okra by the application of organic manures. *Jeevamrut* at 5% also increase fruit weight. This might have been due to increase in the photosynthetic are and translocation of photosynthates in plants which subsequently accelerated the formation of more number of large sized fruits.

The pulp: stone ratio was significantly affected by the various chemicals during the present study. The highest value of pulp: stone ratio was found through the foliar application of KNO_3 2.0% + NAA 50 ppm + *Jeevamrut* 5%. Arvind *et al.* (2012) [3] revealed that maximum pulp: stone ratio with 2% KNO_3 in sub-tropical peach.

The fruit firmness was found the highest in foliar treatment of KNO_3 2% + NAA 50 ppm + *Jeevamrut* 5% during the present study. Abd El-Fatah *et al*. (2008) [1] stated that trees sprayed with KNO_3 showed the higher fruit firmness value in 'Costata' Persimmon. Robertson *et al.* (1990) [23] mention that fruits from trees sprayed with K was more firmness and better quality than the control in peach cv. Cresthaven. Cohen (1976) [7] observed that application of potassium improved the rind thickness in citrus fruit.

Biochemical parameters

The findings of the present investigation show that foliar feeding of mineral nutrients effectively enhanced chemical characteristics namely total soluble solids, sugars (total, reducing and non-reducing), ascorbic acid, acidity of 'Kesar' mango. However, the application of KNO2.0% + NAA 50 ppm + *Jeevamrut* 5% was most effective and resulted in significantly highest TSS, total sugar.

The higher fruit chemical characteristics, especially higher sugar content, can be explained by the role of K in carbohydrate synthesis, breakdown and translocation and synthesis of protein, and neutralization of physiologically important organic acids (Tisdale and Nelson, 1966) [32]. The present result is in corroboration with the observations made by Reddy (2006) [22] in mangoand Arvind *et al.* (2012) [3] in sub-tropical peach in pomegranate.

Application of NAA 50 ppm increase the TSS. The increase in TSS of treated fruit juice might be due to the increase in mobilization of carbohydrates from the source to sink (fruits) by auxin and gibberellins treatments. These results are agreement with the findings of Masalkar and Wavhal (1991) [15], Grewal *et al.* (1993) [11], Kale *et al.* (1999) [13] and Bhati and Yadav (2003) [5] in ber.

The increase in total sugar may be because of transformation of organic acids into sugars as well as maybe due to balanced absorption of nutrients and optimum PGR's status in the plant which may have exerted regulatory role as an important constituent of endogenous factors of feeling the quantity of fruits. Results are in agreement with the finding reported by Hammam *et al.* (2001) [12], Dutta and Dhua (2002) [8], Singh and Maurya (2003) [28], Patel and Valia (2004) [19], Sarkar and Ghosh (2004) [26] in mango.

The increase in reducing sugar may bebecause of transformation of organic acids into sugars. These findings are inagreement with the findings of Hammam *et al.* (2001) [12], Singh and Maurya (2003) [28], Patel and Valia (2004) [19], Sarkar and Ghosh (2004) [26], Singh and Banik (2011) [29] and Yadav *et al.* (2011) [33] in mango.

The acidity, non-reducing sugar and ascorbic acid were not influenced by the different treatment. The remarkable difference was not observed among all the treatments included under this investigation for this attribute. Hence, the treatments were found statistically non-significant at this stage. Similar results found by Saha *et al.* (2017) [25] in mango.

The maximum period of shelf life was noted in fruits harvested from the trees treated with KNO_3 2% + NAA 50 ppm + *Jeevamrut* 5%. Potassium reduces respiration, preventing energy losses through maintaining turgor pressure and reduces water loss in fruits which helps in improving the shelf life of fruits. The results confirm with the Srivastava *et al.* (2013) [30] concluded that lowest physiological weight loss and decay loss with improved shelf-life of fruits with foliar spray of KNO_3 2% in ber.

Table 1: Effect of various organic and inorganic formulations on physical parameters of mango cv. Kesar

Sr. no.	Treatment	Physical parameters							
		Fruit weight (g)	Pulp weight (g)	Peel weight (g)	Stone weight (g)	Fruit length (cm)	Fruit breadth (cm)	Pulp: Stone ratio	Fruit firmness (kg/cm^2)
1.	T_1	121.07	73.93	22.03	25.10	8.16	5.18	2.94	3.91
2.	T_2	167.33	108.70	26.20	32.43	9.29	5.71	3.35	4.62
3.	T_3	180.40	115.97	31.50	32.93	9.76	6.06	3.52	5.00
4.	T_4	208.83	143.47	31.90	33.47	10.52	6.33	4.29	6.46
5.	T_5	152.13	95.87	25.07	31.20	9.43	5.75	3.07	3.54
6.	T_6	152.87	96.73	26.33	29.80	8.88	5.58	3.25	6.13
7.	T_7	153.20	94.07	28.93	30.20	8.94	5.63	3.11	5.14
8.	T_8	151.20	94.67	26.33	30.87	8.82	6.09	3.07	3.23
	S.Em	7.236	5.892	1.352	1.114	0.224	0.172	0.200	0.121
	C. D. at 5%	20.59	16.77	3.85	3.17	0.64	0.49	0.57	0.35
	C. V. %	7.79	9.92	8.58	6.28	4.21	5.16	10.51	4.41

Table 2: Effect of various organic and inorganic formulations on biochemical parameters of mango cv. Kesar

Sr. no.	Treatment	Biochemical parameters							
		TSS (^{0} B)	Acidity (%)	Ascorbic acid (mg/100 g pulp)	Total sugar (%)	Reducing sugar (%)	Non-reducing sugar (%)	Shelf-life (Days)	Organoleptic Evaluation (mean score)
1.	T_1	22.62	0.24	70.83	10.12	4.38	5.74	12.60	6.20
2.	T_2	23.10	0.22	75.00	8.98	2.96	6.03	13.20	6.33
3.	T_3	23.27	0.23	72.92	11.00	3.83	7.17	13.40	6.53
4.	T_4	26.44	0.23	75.83	9.95	2.99	6.96	14.20	7.13
5.	T_5	20.46	0.24	75.00	9.68	4.20	5.48	13.53	6.60
6.	T_6	24.71	0.25	72.00	12.14	3.67	8.47	13.27	6.33
7.	T_7	23.44	0.23	72.92	9.92	2.75	7.17	12.67	6.43
8.	T_8	23.81	0.23	82.58	11.21	3.52	7.69	13.33	6.67
	S.Em	0.673	0.009	3.318	0.407	0.262	0.616	0.172	0.118
	C. D. at 5%	1.91	NS	NS	1.16	0.75	NS	0.49	0.36
	C. V. %	4.96	6.31	7.70	6.79	12.85	15.60	2.24	3.1

Conclusion

The observations recorded from the present investigation revealed that the in mango at pea stage, spraying of MPP 2% + Boron 0.8% + *Panchgavya* 3% was found effective with respect to reducing sugar, while spraying of KNO_3 2% + NAA 50 ppm + *Jeevamrut* 5% was found better for physical and biochemical parameters like fruit weight, pulp weight, pulp: stone ratio, fruit firmness, TSS, shelf life and organoleptic evaluation (mean score). While the maximum total sugar (12.14%) was observed in spraying of MPP 2% + *Jeevamrut* 5% + Novel 4%. Hence, spray of KNO_3 2% + NAA 50 ppm + *Jeevamrut* 5% at pea stage for obtaining better fruit setting and yield of mango cv. Kesar.

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