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Effect of pre-harvest spray of chemicals on shelf-life and quality of mango cv. KESAR

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ABSTRACT : A trial was conducted to study the effect of pre-harvest spray of chemicals on shelf-life and quality of mango cv. KESHAR. The experiment involved pre-harvest spray of nutrients combined with chemicals and plant growth regulators. The treatments included GA_3 25 ppm + KNO_3 2 per cent (T_1), GA_3 25 ppm + $ZnSO_4$ 0.05 per cent (T_2), GA_3 25 ppm + borex 1 per cent (T_3), GA_3 25 ppm + $CaCl_2$ 2 per cent (T_4), 2, 4-D 20 ppm + KNO_3 2 per cent (T_5), 2, 4-D 20 ppm + $ZnSO_4$ 0.05 per cent (T_6), 2, 4-D 20 ppm + borex 1 per cent (T_7) and 2, 4-D 20 ppm + $CaCl_2$ 2 per cent (T_8). The results obtained indicated that the tree sprayed with 2, 4-D 20 ppm + $ZnSO_4$ 0.05 per cent showed good results in fruit yield and yield attributing characters as well as shelf-life of mango. Whereas physical parameters like highest marketable fruit, minimum spoiled friut, minimum riped fruit as well as lowest days of ripening were recored in pre harvest spray of GA_3 25 ppm + borex 1 per cent. The quality parameters like TSS, acidity, ascorbic acid, vitamin-'A', colour, flavour, texture, taste and overall acceptability etc. were performed better in pre harvest spray of GA_3 25 ppm + $ZnSO_4$ 0.05 per cent (T_2) and GA_3 25 ppm + $CaCl_2$ 2 per cent(T_4).

KEY WORDS : Mango, GA_3, 2,4-D, KNO_3, $ZnSO_4$, Borex, $CaCl_2$

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The mango (*Mangifera indica* L.) belongs to family Anacardiaceae and is an important fruit crop of India, as well as tropical and subtropical countries of the world. Besides fine taste, it's high palatability, sweet fragrance, attractive colour and nutritional value, it is known as "king of fruits". The fruit contains a high concentration of sugars (16-18 % w/v) and acids with organoleptic properties and also contains antioxidants like carotene. Pre harvest application of different growth regulators and chemicals improve the post harvest quality of fruit. There is great role of gibberallic acid and 2, 4-Dichlorophenoxyacetic acid growth regulators not only on shelf-life of fruit but also improves the post harvest quality of fruits. Major elements/ macronutrients are quickly taken up and utilized by the tissues of the plants by the catalyzing effect of micronutrients/minor elements. Pre harvest spray of micronutrients is the common practice to overcome the micronutrients deficiencies in order to improve the fruit quality. Nutrients are generally quickly available to the plants by the foliar application than the soil application. Calcium chloride is also known to play an important role in the quality retention of fruit in maintaining the firmness, reducing respiration rate and ethylene evolution and decreasing rot. Similarly, potassium nitrate, zinc sulphate and borex enhanced the growth and yield of mango when applied either alone or in combinations.There is great role of pre-harvest treatment of some chemicals on shelf life and post harvest quality of fruits. Very scarce research work has been done on this concept. The mango constitutes more than 21 per cent of the fruit production in the country and stands first in the world in terms of production followed by China. In India, more than 1000 varieties of mango are available and about 20 of them

are in commercial production. The most popular varieties for processing are Alphanso and Kesar for the production of mango slice. In India, mango cultivated area is 24.80 lakh ha and production is 176.9 lakh MT, as productivity 7.13 MT/ha in the year of 2012-13. While, in Gujarat state; mango cultivated area 1.41 lakh ha, production is 10.03 lakh MT with productivity of 7.1 MT/ha (Anonymous, 2013).

RESEARCH METHODS

The present investigation on effect of pre-harvest spray of chemicals on shelf-life and quality of mango was conducted on seven years old mango plants cultivar 'Kesar'. All the plants selected were uniform in growth and size which were planted at the distance 6 m × 6 m at Sakkar baug, Department of Horticulture, Collage of Agriculture, Junagadh Agricultural University, Junagadh, (Gujarat) during 2014-15. The experiment was conducted in Randomized Block Design with three replications with total eight treatments. Mango plants were sprayed with different micronutrients combined chemicals with plant growth regulators. *viz.*, GA_3 25 ppm + KNO_3 2 per cent (T_1), GA_3 25 ppm + $ZnSO_4$ 0.05 per cent (T_2), GA_3 25 ppm + borex 1 per cent (T_3), GA_3 25 ppm + $CaCl_2$ 2 per cent (T_4), 2, 4-D 20 ppm + KNO_3 2 per cent (T_5), 2, 4-D 20 ppm + $ZnSO_4$ 0.05 per cent (T_6), 2, 4-D 20 ppm + borex 1 per cent (T_7) and 2, 4-D 20 ppm + $CaCl_2$ 2 per cent (T_8). The different chemicals were sprayed at marble stage and 30 days before harvest.Observations of various fruit attribute characters and fruit yield were recorded. Results thus, obtained were subjected to statistical analysis.

RESEARCH FINDINGS AND DISCUSSION

The findings of the present study as well as relevant discussion have been presented under following heads :

Yield and yield attributes :

Spraying of micro nutrients with combination of plant growth regulators like 2, 4-D 20 ppm + $ZnSO_4$ 0.05 per cent had significantly effect on fruit yield and yield attribute characteristics like weight, length and girth of the fruit of mango.

Yield attributes like weight, length and girth of fruit were also affected significantly due to spraying of micro nutrients showed in Table 1. The maximum fruit weight and fruit girth was found with an application of 2, 4-D 20 ppm + $ZnSO_4$ 0.05 per cent followed by 2, 4-D 20 ppm + $CaCl_2$ 2 per cent. In terms of weight and girth of fruit was probably due to an increased in the volume of mesocarp cells. Further, the size of fruit was increased not due to excessive cell division in mesocarp, but due to increase in volume of mesocarp cells. Similar results were found by Suresh *et al.* (2013) and Vejendla *et al.* (2008).

In case of fruit length, the maximum fruit length was recorded with an application of 2, 4-D 20 ppm + $CaCl_2$ 2 per cent. The improvement observed in the fruit length due to calcium chloride could be attributed to its effects in influcing formation and changes of carbohydrates and carbohydrate enzyme. Other reasons might be the reduction of abscission and the calcium influence in the maintaining the middle lamella cells. The findings obtained in the present investigation can be compared to those obtained by Wahdan *et al*. (2011) and Singh *et al.* (2012) who indicated that pre harvest application of $CaCl_2$ at 2 per cent is the effective for improving the marketability.

It was observed that the effect of different plant growth regulators with combination of micronutrients significantly increased the yield per tree. Among the different treatments, the maximum fruit yield recorded with an application of 2, 4-D 20 ppm + $ZnSO_4$ 0.05 per cent. This may be due the fact that 2, 4-D and $ZnSO_4$ increased the number of fruits and promoted the more fruit retention, thereby increased number of fruits and ultimately produced more yield. Further, increase in fruit yield in treated plant may be attributed to reason that plants remain physiologically more active to build up sufficient food stock for developing fruits ultimately leading the higher yield. Vejendla *et al.* (2008) evaluate the spraying of $ZnSO_4$ at 0.75 per cent, give higher result in fruit weight and yield in mango.

Physical characteristics :

The observation on present study indicated that, the physiological loss in weight was increased with increase in duration of storage mention in Table 2. Lowest physiologiacal loss of weight were recorded in treatment 2, 4-D 20 ppm + borax 1 per cent during 2, 4 and 8 days of storage, respectively. But at 6, 10 and 12 days, it recorded lowest in 2, 4-D 20 ppm + $CaCl_2$ 2 per cent.The reason attributed is that 2, 4-D might have slowed down the process of ripening by retarding the pre climacteric respiration rate and subsequently on ethylene production. Reduction in physiologiacal loss of weight by pre harvest 2, 4-D treatment was also observed by Khader *et al.*

(1988).

Maximum per cent of marketable fruits were retained under GA_3 25 ppm + borex 1 per cent during 4 and 6 days of storage indicated in Table 3. Whereas, during 8 days of storage, it was recorded in GA_3 25 ppm + $CaCl_2$ 2 per cent. It may be due to reduction in the rate of water loss and lesser ripening of fruits turns to higher shelf-life. However, the percentage of marketable fruit was decreased with increasing the storage period. Hence, marketable fruit is reduced. Similar results have also been

Table 1 : Effect of pre-harvest spray of chemicals on fruit weight, length, girth and yield of mango cv. KESAR

Sr. No.	Treatments	Fruit weight (g)	Fruit length(cm)	Fruit girth (cm)	Fruit yield (kg/tree)
1.	$GA_3$25 ppm + KNO_3 2%	179.10	9.45	6.19	93.44
2.	$GA_3$25 ppm + $ZnSO_4$ 0.05%	160.45	8.78	6.06	81.11
3.	$GA_3$25 ppm + Borex 1%	173.65	9.02	6.17	124.48
4.	$GA_3$25 ppm + $CaCl_2$ 2%	179.50	9.44	6.28	124.26
5.	2, 4-D 20 ppm + KNO_3 2%	171.95	9.23	6.19	101.29
6.	2, 4-D 20 ppm + $ZnSO_4$ 0.05%	194.10	9.56	6.50	129.89
7.	2, 4-D 20 ppm + Borex 1%	187.05	9.39	6.20	92.39
8.	2, 4-D 20 ppm + $CaCl_2$ 2%	187.30	9.75	6.42	79.75
	S.E. ±	2.401	0.100	0.089	1.925
	C.D. (P=0.05)	7.07	0.30	0.22	5.64
	C.V %	6.51	5.46	5.79	18.92

Table 2 : Effect of pre-harvest spray of chemicals on physiological loss of weight (%) of mango cv. KESAR

Sr. No.	Treatments	Physiological loss of weight (%)					
		Day 2	Day 4	Day 6	Day 8	Day 10	Day 12
1.	$GA_3$25 ppm + KNO_3 2%	0.93	3.06	6.94	11.09	16.55	57.64
2.	$GA_3$25 ppm + $ZnSO_4$ 0.05%	1.00	3.24	7.68	13.06	20.60	79.99
3.	$GA_3$25 ppm + Borex 1%	1.18	3.37	7.58	13.28	20.08	67.50
4.	$GA_3$25 ppm + $CaCl_2$ 2%	0.90	2.98	6.83	12.61	20.01	62.87
5.	2, 4-D 20 ppm + KNO_3 2%	1.01	3.09	5.95	9.68	15.34	79.87
6.	2, 4-D 20 ppm + $ZnSO_4$ 0.05%	0.83	2.57	5.16	8.93	13.83	57.44
7.	2, 4-D 20 ppm + Borex 1%	0.82	2.21	5.26	8.11	15.67	80.34
8.	2, 4-D 20 ppm + $CaCl_2$ 2%	1.06	2.48	4.93	9.62	15.32	40.46
	S.E. ±	0.04	0.11	0.28	0.42	0.68	5.06
	C.D. (P=0.05)	0.10	0.34	0.85	1.23	1.99	15.57
	C.V %	9.85	8.18	9.21	7.78	8.83	9.51

Table 3 : Effect of pre-harvest spray of chemicals on percentage of marketable fruit of mango cv. KESAR

Sr. No.	Treatments	Marketable fruit (%)			
		Day 2	Day 4	Day 6	Day 8
1.	$GA_3$25 ppm + KNO_3 2%	100.00	90.00	55.00	30.00
2.	$GA_3$25 ppm + $ZnSO_4$ 0.05%	100.00	90.00	55.00	30.00
3.	$GA_3$25 ppm + Borex 1%	100.00	95.00	60.00	30.00
4.	$GA_3$25 ppm + $CaCl_2$ 2%	100.00	80.00	55.00	35.00
5.	2, 4-D 20 ppm + KNO_3 2%	100.00	80.00	60.00	30.00
6.	2, 4-D 20 ppm + $ZnSO_4$ 0.05%	100.00	75.00	45.00	20.00
7.	2, 4-D 20 ppm + Borex 1%	100.00	80.00	50.00	25.00
8.	2, 4-D 20 ppm + $CaCl_2$ 2%	100.00	75.00	55.00	25.00
	S.E. ±	-	1.705	1.704	1.703
	C.D. (P=0.05)	-	5.01	5.01	5.01
	C.V %	-	9.95	11.48	14.39

reported by Singh *et al*. (2012). The minimum rotting per cent recorded in fruits treated with GA_3 and borex might be due to the chemical fungicides which check the fungal growth (Table 4). This may be due to treatment effect with retarded ripening and reduced weight loss through controlled transpiration and respiration rates and delayed the disintegration of ripening. The similar findings were reported by Karmera and Habimana (2014).

Table 4 : Effect of pre-harvest spray of chemicals on spoiled fruit of mango cv. KESAR

Sr. No.	Treatments	Spoiled fruit (%)						
		Day 2	Day 4	Day 6	Day 8	Day 10	Day 12	Day 14
1.	$GA_3$25 ppm + KNO_3 2%	0.00	0.00	0.00	15.00	45.00	75.00	95.00
2.	$GA_3$25 ppm + $ZnSO_4$ 0.05%	0.00	0.00	0.00	15.00	45.00	70.00	90.00
3.	$GA_3$25 ppm + Borex 1%	0.00	0.00	0.00	5.00	35.00	65.00	85.00
4.	$GA_3$25 ppm + $CaCl_2$ 2%	0.00	0.00	0.00	0.00	35.00	65.00	85.00
5.	2, 4-D 20 ppm + KNO_3 2%	0.00	0.00	0.00	5.00	30.00	75.00	95.00
6.	2, 4-D 20 ppm + $ZnSO_4$ 0.05%	0.00	0.00	0.00	10.00	35.00	70.00	90.00
7.	2, 4-D 20 ppm + Borex 1%	0.00	0.00	0.00	10.00	50.00	75.00	95.00
8.	2, 4-D 20 ppm + $CaCl_2$ 2%	0.00	0.00	0.00	5.00	40.00	65.00	85.00
	S.E. ±	-	-	-	1.70	1.71	1.20	1.43
	C.D. (P=0.04)	-	-	-	5.05	5.09	3.52	4.20
	C.V %	-	-	-	9.94	9.76	9.64	5.95

Table 5 : Effect of pre-harvest spray of chemicals on percentage of ripened fruit of mango cv. KESAR

Sr. No.	Treatments	Ripened fruit (%)			
		Day 2	Day 4	Day 6	Day 8
1.	$GA_3$25 ppm + KNO_3 2%	0.00	0.00	25.00	90.00
2.	$GA_3$25 ppm + $ZnSO_4$ 0.05%	0.00	0.00	35.00	90.00
3.	$GA_3$25 ppm + Borex 1%	0.00	0.00	25.00	95.00
4.	$GA_3$25 ppm + $CaCl_2$ 2%	0.00	0.00	25.00	80.00
5.	2, 4-D 20 ppm + KNO_3 2%	0.00	0.00	25.00	80.00
6.	2, 4-D 20 ppm + $ZnSO_4$ 0.05%	0.00	0.00	35.00	75.00
7.	2, 4-D 20 ppm + Borex 1%	0.00	0.00	30.00	80.00
8.	2, 4-D 20 ppm + $CaCl_2$ 2%	0.00	0.00	25.00	75.00
	S.E. ±	-	-	1.703	1.704
	C.D. (P=0.05)	-	-	5.01	5.01
	C.V %	-	-	11.14	11.18

Table 6 : Effect of pre-harvest spray of chemicals on days to ripening, shelf-life, peel weight/ fruit, pulp weight/ fruit, stone weight and days to ripening of fruits on mango cv. KESAR

Sr. No.	Treatments	Days to ripening (days)	Shelf-life of fruits (days)	Peel weight/ fruit (g)	Pulp weight/ fruit(g)	Stone weight (g)	Days to ripening (days)
1.	$GA_3$25 ppm + KNO_3 2%	9.50	13.75	27.00	106.5	53.50	9.50
2.	$GA_3$25 ppm + $ZnSO_4$ 0.05%	10.75	14.25	24.25	80.75	49.25	10.75
3.	$GA_3$25 ppm + Borex 1%	10.75	13.75	23.50	80.00	48.25	10.75
4.	$GA_3$25 ppm + $CaCl_2$ 2%	8.75	14.00	25.75	85.25	51.75	8.75
5.	2, 4-D 20 ppm + KNO_3 2%	8.50	13.75	26.5	89.00	55.25	8.50
6.	2, 4-D 20 ppm + $ZnSO_4$ 0.05%	11.00	14.50	29.00	94.00	59.50	11.00
7.	2, 4-D 20 ppm + Borex 1%	10.00	14.00	26.25	84.00	54.50	10.00
8.	2, 4-D 20 ppm + $CaCl_2$ 2%	8.50	11.75	29.75	98.75	57.75	8.50
	S.E. ±	0.364	0.170	0.779	4.264	1.198	0.364
	C.D. (P=0.05)	0.65	0.50	2.26	12.53	3.51	0.65
	C.V %	7.50	7.01	8.27	9.38	8.44	7.50

The ripening process was started at 6 days of storage and the percentage of ripened fruits was increased with increasing the storage period up to 8 days of storage (Table 5). Minimum per cent of ripened fruits was observed in majority of treatments during 6 days and T_6 and T_8 at 8 days of storage. Delay in ripening by use of GA_3 as pre harvest spray may be due to inhibition of other enzyme activities during ripening and it had antagonistic effects on the biogenesis of endogenous ethylene. The result is in confirmation with that of Karmera and Habimana (2014).

Data indicated the lowest peel weight, stone weight as well as pulp peel and pulp stone ratio was found in treatment with GA_3 25 ppm + borex 1 per cent (Table 6).The highest pulp weight per fruit was recorded in GA_3 25 ppm + KNO_3 2 per cent. It is because while GA_3 stimulated the functioning of a number of enzymes in the physiological process which probably caused an increase in pulp percentage.Thinning effect is due to GA_3 induced ethylene synthesis. Which minimize the peel weight of fruit. The increase in pulp weight, stone weight and pulp to stone ratio could be attributed to the fact that fruit thinning increased fruit size which resulted in higher proportionate pulp weight and marginal increase in stone weight. It is in conformity with the observations of Sanker and Rahim (2013) and Burondkar *et al.* (2009) in Mango. Minimum days to ripening (8.50 days) was noted in 2, 4-D 20 ppm + KNO_3 2 per cent and 2, 4-D 20 ppm + $CaCl_2$ 2 per cent. 2, 4-D is the growth promoter which suppresses the concentration of ethylene and has the ripening is delayed.The delay in ripening was due to increase in endogenous levels of auxins and cytokinins and reduction in inhibitor content influenced by exogenous application of 2, 4-D. The similar finding was reported

Table 7 : Effect of pre-harvest spray of chemicals on shelf-life of fruits, peel weight/ fruit, pulp weight/ fruit, stone weight, pulp-peel ratio, pulp-stone ratio and specific gravity of fruits on mango cv. KESAR

Sr. No.	Treatments	Shelf-life of fruits (days)	Peel weight/ fruit (g)	Pulp weight/ fruit(g)	Stone weight (g)	Pulp-peel ratio (g)	Pulp-stone ratio (g)	Specific gravity
1.	$GA_3$25 ppm + KNO_3 2%	13.75	27.00	106.5	53.50	3.86	1.97	1.01
2.	$GA_3$25 ppm + $ZnSO_4$ 0.05%	14.25	24.25	80.75	49.25	3.33	1.64	1.02
3.	$GA_3$25 ppm + Borex 1%	13.75	23.50	80.00	48.25	3.42	1.67	1.01
4.	$GA_3$25 ppm + $CaCl_2$ 2%	14.00	25.75	85.25	51.75	3.28	1.65	1.02
5.	2, 4-D 20 ppm + KNO_3 2%	13.75	26.5	89.00	55.25	3.12	1.60	1.02
6.	2, 4-D 20 ppm + $ZnSO_4$ 0.05%	14.50	29.00	94.00	59.50	3.20	1.72	1.02
7.	2, 4-D 20 ppm + Borex 1%	14.00	26.25	84.00	54.50	3.20	1.73	1.02
8.	2, 4-D 20 ppm + $CaCl_2$ 2%	11.75	29.75	98.75	57.75	3.30	1.70	1.01
	S.E. ±	0.170	0.779	4.264	1.198	0.191	0.071	0.010
	C.D. (P=0.05)	0.50	2.26	12.53	3.51	0.53	0.21	NS
	C.V %	7.01	8.27	9.38	8.44	6.92	8.38	0.47

NS=Non-significant

Table 8 : Effect of pre-harvest spray of chemicals on TSS, acidity, ascorbic acid, reducing sugar, non-reducing sugar, total sugar and vitamin 'A' in fruit of mango cv. KESAR

Sr. No.	Treatments	TSS (^{0}Brix)	Acidity (%)	Ascorbic acid (mg/100 g)	Reducing sugar (%)	Non-reducing sugar (%)	Total sugar (%)	Vitamin 'A' (IU/100g)
1.	$GA_3$25 ppm + KNO_3 2%	20.51	0.25	21.41	2.46	8.83	11.30	917.05
2.	$GA_3$25 ppm + $ZnSO_4$ 0.05%	21.53	0.22	20.91	3.21	8.74	11.95	856.15
3.	$GA_3$25 ppm + Borex 1%	21.01	0.24	20.97	3.32	8.83	11.40	645.05
4.	$GA_3$25 ppm + $CaCl_2$ 2%	20.04	0.27	22.61	2.51	9.22	11.72	955.83
5.	2, 4-D 20 ppm + KNO_3 2%	19.80	0.25	20.48	3.18	8.47	11.64	829.45
6.	2, 4-D 20 ppm + $ZnSO_4$ 0.05%	21.08	0.22	21.8	2.58	8.40	10.98	982.55
7.	2, 4-D 20 ppm + Borex 1%	20.07	0.25	21.67	2.79	7.27	10.06	1026.85
8.	2, 4-D 20 ppm + $CaCl_2$ 2%	18.86	0.28	21.34	2.82	7.86	10.68	991.15
	S.E. ±	0.181	0.010	0.321	0.050	0.130	0.111	15.090
	C.D. (P=0.05)	0.52	0.03	0.94	0.14	0.39	0.31	44.40
	C.V %	5.22	9.92	7.9	8.53	6.38	5.55	4.04

by Karmera and Habimana (2014) in mango. The shelf life (days) was significantly influenced due to different treatments and highest shelf-life was recorded in 2, 4-D 20 ppm + $ZnSO_4$ 0.05 per cent (Table 7). The increase of shelf life in 2, 4-D 20 ppm + $ZnSO_4$ 0.05 per cent can be attributed to the action of 2, 4-D in counteracting the senescence that could be initiated by ethylene and abscissic acid. Similar findings were noticed by Suresh *et al*. (2013) in mango. In case of pulp weight, Similar results have been reported by Singh *et al.* (2004) and Burondkar *et al*. (2009) in Mango.

Bio-chemical characteristics :

The foliar sprays of nutrients with the combination with plant growth regulators had significantly effect on different bio-chemical characteristics for different treatments. The maximum TSS, total sugar and organolaptic rating whereas, minimum acidity was recorded in GA_3 25 ppm + $ZnSO_4$ 0.05 per cent (Table 8). This might be due to its converting complex substances into simple sugars, which enhances the metabolic activity in fruits and might be due to its action on converting complex substances into simple ones, which enhances the metabolic activity in fruits and it results in increased total sugars of fruit. Similar results were cited by Singh *et al*. (2004); Singh *et al*. (2003) and Sharkawy (2006) in mango.

The data indicated the maximum ascorbic acid and non reducing sugar content in treatment with GA_3 25 ppm + $CaCl_2$ 2 per cent. This is due to either speedily converted into sugars and their derivatives by reactions involving reverse glycolytic pathways or might have been used in respiration. The similar results were reported by Jayachandran *et al*. (2005) in mango. Whereas, maximum reducing sugar was found with GA_3 25 ppm + borex 1 per cent. It might be due to consequence of release of sugars by the hydrolysis of starch reserve during the post harvest stage. The result was also supported by Bhatt *et al.* (2012) in mango. Maximum vitamin "A" was found with 2, 4-D 20 ppm + borex 1 per cent. The result may be due to more synthesis of pigments or secondly metabolites responsible for higher vitamin 'A'. The finding was also given by Singh *et al.* (2012) in mango.

Conclusion:

From the foregoing discussion, it can be concluded that the fruit yield and yield attribute characters as well as shelf life were performed good in pre harvest spray of 2, 4-D 20 ppm + $ZnSO_4$ 0.05 per cent (T_6). Majority of physical parameters like highest marketable fruit, minimum spoiled friut, minimum riped fruit as well as lowest days of ripening were recored in pre harvest spray of $GA_3$25 ppm + borex 1 per cent (T_3). The quality parameters like TSS, acidity, ascorbic acid, vitamin- 'A', colour, flavour, texture, taste and overall acceptability etc. were performed better in pre harvest spray of $GA_3$25 ppm + $ZnSO_4$ 0.05 per cent (T_2) and GA_3 25 ppm + $CaCl_2$ 2 per cent (T_4). Hence, $GA_3$25 ppm + $ZnSO_4$ 0.05 per cent was found better for post harvest qualitative characters.

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