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Evaluation of physico-chemical attributes and postharvest qualities of Himsagar mango with the exogenous application of growth regulators, anti-oxidant and geotextile mulch

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ABSTRACT

Eighteen years old mango plant cv. Himsagar with uniform size and vigour were given seven treatments with 3 replications comprising of growth regulators, antioxidant and organic mulching at the Horticultural Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, West Bengal to study their effect on shelf life, marketability and physico-chemical properties. This study was laid on RBD consists of -NAA @20ppm + geotextile mulch (T_1), GA_3 @20ppm + geotextile mulch (T_2), Citric acid @200ppm + geotextile mulch (T_3), NAA @20ppm + citric acid @200ppm (T_4), GA_3 @20ppm + citric acid @200ppm + geotextile mulch (T_5), Geotextile mulch (400 GSM) (T_6), Control- Water spray (T_7). Result revealed that T_5 significantly affected physical and bio-chemical properties of mango.Respiration rate and physiological loss in weight was found lowest with the recommended treatment. Marketability percentage was also recorded highest (73%)underT_5. Finally the treatment T_5can be suggested to farmers which showed better results on the fruit retention and marketability of mango cv. Himsagar.

***Keywords*:** Antioxidant, growth regulator, marketability, mango, mulching

The most scrumptious fruit crop in Asia's tropical and subtropical regions is the mango (*Mangifera indica* L.), which belongs to the Anacardiaceae family.The fruit gains immense popularity due to its wide adaptability, nutritional importance, luscious taste, rich flavor and charismatic appearance. Himsagar becomes a commercial cultivar and it is admired due to its thin skinned, fiber free nature, good keeping quality, unparalleled sweetness and mouth-watering taste. In contrast to other mango-growing nations, Himsagar's productivity in India is quite low,due to a lack of environmental factors for flowering, which is a barrier to achieving reliable mango output in the tropics. Despite possessing all the qualities to compete with other well-known mango varieties like Alphonso, Himsagar is not grown in all parts of India for two main reasons: first, there is no effective post-harvest care and second, there is no proper marketing strategy.That is why proper knowledge of using right amount of growth regulators is needed to control some major drawback of this fruit production i.e., fruit drop.Foliar application of the growth regulators like NAA and GA_3 at mango's pea stage of development aids in controlling pre-harvest fruit drop, resulting in an improvement in fruit quality and quantity (Bhowmick and Banik, 2011).

Utilizing plant growth regulators, mulching, and irrigation at the beginning of fruit development can greatly reduce the amount of fruit drop. According to reports, mulching extends the shelf life as well as quality of fruits (Kumar *et al.*, 2008). The final retention rate and marketable yield of mango is remarkably poor, mostly due to excessive fruit drop, despite the fact that there is generally abundant flowering and very high fruit set (Ghosh, 2016). While GA_3 application is more impactful in keeping the highest fruit percentage per panicle with an increase in fruit size as well as weight in mango, NAA aids in the flower induction, prevention of shedding of buds and unripe fruits, enlargement of fruit size and increase in quality and yield of several fruits. Plant growth regulators potentially increase productivity of fruits by changing the plant's hormonal and nutritional status (Tripathi and Shukla, 2006). Dry periods during flowering and the first phases of fruit development negatively impact on fruit yield (Suresh *et al*., 2009). That is why application of organic mulching on soil surface is feasible option for better soil health. Moreover, mulches have a great impact on soil health properties, specifically organic mulching slowly decompose and release nutrients into the soil while improving the soil structure. Mulching increases fruit quality and yield while reducing water loss through evaporation, regulating temperature of soil, preventing weed growth, and maintaining stability of the entire planting system (Pande *et al*., 2005). Other than plant growth regulators and mulching, citric acid

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has been used in the above experiment. Citric acid is one of the organic acids which produce naturally in the fruit itself. But additional use of this acid improves not only shelf life of the fruit but also the flavor, aroma and taste. Citric acid's most significant function is to prevent the growth of pathogenic microorganisms and food rotting organisms. The main objective of this current study was to determine the impact of pre-harvest treatments employing growth regulators and antioxidants in conjunction with geotextile mulch on the physico-chemical characteristics, growth, yield and marketability of Himsagar mango.

MATERIALS AND METHODS

This investigation was carried out during 2019-2021 at Horticultural Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, West Bengal in a commercial mango cultivar Himsagar. The 18 years old trees were uniform in height and vigour. The experiment was triple replicated and set up using a Randomized Block Design. The varied combination of growth regulators, antioxidant as well as mulching were used in this experiment, i.e., NAA, GA_3, citric acid and geotextile mulch (Table 1), they were used at the fruit's pea stage of development. Recommended package of practices including implementation of 1000 g N, 500 g P_2O_5, 1000 g K_2O per plant, plant protection measures and weed control were followed accordingly. Physico-chemical properties were studied after proper ripening of fruits. The method given by Ranganna (2002) was used to estimate total soluble solids, acidity and total sugars. Through the approach outlined by Panse and Sukhatme (1954), statistical analysis was carried out. Mango fruits that had just been harvested and were still raw were gathered, measured and then left to ripen at room temperature in order to measure physiological loss in weight (PLW). The initial fruit weight and the weight loss observed at the time of periodic sample during storage were used to calculate PLW, which was estimated as cumulative percentage loss in weight. Mature fruits were kept at room temperature and 84-89% relative humidity to record the rate of respiration and storage life was examined every three days up to the ninth day. Total soluble solids, CO_2 evolution and the proportion of marketable fruits were all measured during storage. According to Mitra *et al*.(1971), residual $Ba(OH)_2$ titration in the solution with standardized N/10 HCl was used to evaluate the CO_2 evolution of mango fruits. By analyzing surface morphology traits such as smoothness or shininess, shrinking or dryness and the amount of visible fungal growth the qualitative quality criteria were evaluated. Shiny mango fruits without black stains, shrinking or other signs of rot were regarded as marketable mangoes. The percentage of marketability was calculated as follows:

$$\text{Percentage marketability} = \text{Total number of fruits} \times \frac{\text{Number of marketable fruits}}{\text{Total number of fruits}} \times 100$$

RESULTS AND DISCUSSION

Table 2 shows that during the flowering and fruiting stages, plants treated with GA_3 @20 ppm, citric acid @200 ppm, and geotextile mulch (T_5) had considerably higher fruit weight (268.50g). Fruit width was maximum in treatment T_5 and was followed by trees sprayed with NAA @20 ppm + citric acid @200 ppm(T_4). Length of the fruit was determined to be non-significant regardless of the various treatments given to the trees with no particular pattern. The maximum yield (246 fruits $tree^{-1}$) was noticed from the treatment T_5 and the value was at par with the trees treated with T_4. The result is similar to the experiment conducted by Sarkar and Ghosh (2005) where they obtained increased yield with the application of GA_3 in mango.Vejendla *et al*.(2008),observed that NAA application was influential in minimizing flower drop and increasing high flower retention and yield in mango. Das and Dutta (2018) also implied that the effect of mulching helps with greater yield of mango. This implies the combined treatment of T_5 is better than T_4 as per the results obtained in the investigation although they were at par with each other. These results are very similar to those of Vejendla *et al.* (2008) and Nkansah *et al.* (2012).The acquired results of citric acid in terms of its beneficial impact on fruit retention, number of fruits per tree and marketability are in conformity with the inventions of Ahmed and Abdelaal (2007), Mansour *et al*. (2010) on Anna apple and 4 mango cultivars respectively. They claimed that treating the aforementioned fruit species with citric acid successfully increased fruit set and production.Citric acid partially helped in increasing yield and fruit retention capacity of mango. Additionally, NAA spraying raised productivity and improved mango fruit quality while reducing floral drop and increasing flower retention (Vejendla *et al*., 2008). Numerous experts have discovered via experimentation that mulching with the right materials significantly increases plant yields.

TSS and total sugar content in Table 3 were not observed to differ significantly between treatments, despite the fact that T_5 was the treatment with the maximum TSS and total sugar content and T_7 was the treatment with the minimum and that T_5-treated fruits had the lowest acidity. The acidity of the fruits of the trees treated with T_2 and T_3 was at par with the T_4. Osama

Table 1: Treatment details

Sr. No.	Treatment specification
T_1	NAA @20ppm + geotextile mulch
T_2	GA_3 @20ppm + geotextile mulch
T_3	Citric acid @200ppm + geotextile mulch
T_4	NAA @20ppm + citric acid @200ppm
T_5	GA_3 @20ppm + citric acid @200ppm + geotextile mulch
T_6	Geotextile mulch (400 GSM)
T_7	Control

Table 2: Fruit physical parameters influenced by different treatments of growth regulators, antioxidant and mulching

Treatment	Fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Yield (no. tree^{-1})
T_1	252.000	7.77	6.92	217.00
T_2	253.333	7.79	6.91	219.50
T_3	250.500	7.42	6.87	206.00
T_4	255.500	7.83	6.97	244.00
T_5	268.500	7.87	6.99	246.00
T_6	250.000	7.14	6.73	215.00
T_7	249.250	7.10	6.45	197.50
SEm(±)	**3.77**	**0.32**	**0.12**	**3.02**
LSD(0.05)	**11.00**	**NS**	**0.34**	**8.82**

Table 3: Effect of growth regulators, antioxidant and mulching on fruit chemical parameters

Treatment	TSS(°brix)	Total sugars(%)	Acidity (%)
T_1	18.60	15.28	0.17
T_2	18.65	15.37	0.18
T_3	18.50	14.11	0.18
T_4	18.70	15.11	0.15
T_5	19.40	15.64	0.14
T_6	18.60	14.91	0.20
T_7	18.15	14.76	0.23
SEm(±)	**0.28**	**0.36**	**0.01**
LSD(0.05)	**NS**	**NS**	**0.04**

Table 4: Respiration rate at an interval of 3 days upto 9 DAS

Treatment	Respiration rate (mg kg^{-1}h^{-1})			
	0 DAS	**3 DAS**	**6 DAS**	**9 DAS**
T_1	119.22	127.14	149.32	37.27
T_2	110.10	124.32	143.11	34.11
T_3	100.22	131.00	141.23	33.12
T_4	90.11	112.44	131.25	31.42
T_5	91.22	110.22	128.77	28.12
T_6	90.00	127.44	141.22	61.32
T_7	120.00	131.25	172.15	121.00
SEm(±)	**3.21**	**0.34**	**0.29**	**0.51**
LSD(0.05)	**9.89**	**1.06**	**0.90**	**1.58**

Table 5: Percentage of fruit physiological loss and marketable fruits at various storage days

Treatment	Fruit physiological loss (%)		Marketability at 9 DAS (%)	
	3 DAS	6 DAS	9 DAS	(%)
T_1	4.47	5.39	10.12	70.00
T_2	4.77	5.92	10.00	69.00
T_3	4.11	5.37	10.99	49.00
T_4	3.93	4.72	9.37	70.00
T_5	3.77	5.07	10.11	73.00
T_6	4.91	5.71	13.37	65.00
T_7	5.82	9.44	23.27	25.00
SEm(±)	**0.29**	**0.06**	**0.35**	**1.02**
LSD(0.05)	**0.89**	**0.17**	**1.07**	**3.15**

et al.(2015), experimented similar observation in mango cv. Keitt.

The information in Table 4 showed that fruits treated with GA_3 @20 ppm along with citric acid @200 ppm and geotextile mulch (T_5) showed less evolution of CO_2 on the 9th day of storage compared to other treatments. In control fruits(T_7), CO_2 evolution was found to be at its peak. Singh *et al*. (2004) noted a comparable finding with mango.Chiumarelli *et al.*(2010) suggested that citric acid along with GA_3 have a great effectiveness for reducing the respiration rate in mango.

Data from Table 5 showed that the control fruit (T_7) experienced greater physiological loss in weight (PLW) after 3 days of storage than did other fruits, although less PLW was seen over a 3-day period which was found to be the lowest with the application of the treatment T_5. In the current study, growth regulators, antioxidant as well as mulching, all had a substantial impact on how marketable fruits were. Citric acid helped in improving the marketability percentage as it successfully imparts flavor and aroma to the fruits and also helps in inhibiting the microbial growth which kept the fruits fresh and pathogen free. Highest amount of marketable fruit was noted 73% with TSS value of 19.40°Brix on 9th day of storage was acquired from T_5 resulting in as the best treatment for storage and transportation with intact quality and values of the fruits and low rates of respiration during fruit preservation may also contribute to this, while negligible amount (25%) was obtained from control fruits (T_7).

Similarly, mulching also helped to overcome water stress during panicle development and retention of the fruit, by reducing the competition between the crop and the weed for nutrient there by the nutrient availability was increased to the crop. This is in confirmatory with the results of Dutta and Majumdar (2009). This may also be due to the beneficial effect of mulching which suppresses weed growth, reducing evaporation of soil moisture and minimizing the variation in soil temperature, which seems to stimulate growth and productivity of mango (Vivekanathan *et al.,* 2006). According to Prasad *et al.* (2006), NAA @20 ppm produced the maximumlevels of Total soluble solid (22.5°Brix), ascorbic acid, reducing sugar and non-reducing sugar, as well as the highest levels of both total sugar content and sugar:acid ratio.

CONCLUSION

From the above experiment it can be concluded that out of seven treatments the combined effect of geotextile mulch along with GA_3 and citric acid was found promising in respect to physiological as well as biochemical parameters of mango cv. Himsagar. According to this analysis, application of GA_3 at 20 ppm twice throughout the pod stage of fruit growth, along with 200 ppm citric acid and geotextile mulch, was advantageous for increasing fruit yield, weight of the fruit and for storage and transportation with intact quality of mango cv. Himsagar. As a result mango producers can be encouraged to use this specific treatment for commercial mango adoption, and it should take their customer's and business's demands into consideration.

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