www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(8): 473-477

www.thepharmajournal.com
Received: 03-06-2023
Accepted: 08-07-2023

Susmita Dey
Department of Fruit Science, Faculty of Horticulture, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, India

Soustav Datta
Department of Fruit Science, Faculty of Horticulture, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, India

Gouri Mandi
Department of Fruit Science, Faculty of Horticulture, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, India

Chinmoy Mandal
Department of Pomology and Post Harvest Technology, Faculty of Horticulture, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal, India

Sarthak Bhattacharya
Department of Horticulture, School of Agriculture and Allied Sciences, The Neotia University, South 24 Parganas, West Bengal, India

Corresponding Author:
Soustav Datta
Department of Fruit Science, Faculty of Horticulture, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, India

Impact of pre-harvest foliar application of Jasmonic acid and soil cover of different organic mulching on physico-chemical attributes and post-harvest qualities of mango cv. Himsagar

Susmita Dey, Soustav Datta, Gouri Mandi, Chinmoy Mandal and Sarthak Bhattacharya

Abstract
An investigation was carried out to research the influence of jasmonic acid along with different organic mulching materials on fruit quality parameters of mango cv. Himsagar in West Bengal's new alluvial zone. The experiment was set up by using Randomized Block Design with four replications along with five treatments *viz*. T_1 (Jasmonic acid @ 0.5 µM+ Geotextile mulch @ 500 GSM), T_2 (Jasmonic acid @ 1.0 µM + Paddy straw mulch), T_3 (Jasmonic acid @ 1.5 µM + Banana leaf mulch), T_4 (Jasmonic acid @ 2.0 µM + Black polythene mulch), T_5 (Control-Water spray). Experimental findings revealed that JA is effective in increasing physico-chemical qualities of mango and reduces disease infestation on storage. Among different treatments, T_2 was proved most effective in improving physico-chemical characteristics as well as post-harvest qualities of mango. This treatment also exhibited minimum disease infestation on storage with maximum shelf life at ambient temperature. Finally, it was concluded that Jasmonic acid @ 1.0 µM along with Paddy straw mulch applied at flowering stage can be applied for quality fruit production of mango to achieve a noble goal.

Keywords: Foliar spray, Growth regulators, Jasmonic acid, Mango, Marketability, Shelf life

Introduction
Jasmonic acid (JA), a chemical constituent, is present in a wide variety of plants. The substance belongs to the class of plant hormones called jasmonates. The octadecanoid pathway is used to produce it from linolenic acid. The interactions that occur between plants and microbes in defence and symbiosis, as well as reactions to biotic and abiotic stress, are all influenced by them. One volatile derivative that enables long-distance plant communication is methyl jasmonate. The chemical structures of the jasmonic acid and its methyl derivative (MeJA), which were initially identified as odorous substance components in the jasmine essential oil (Moreno *et al*., 2010) [15], have now been determined. An abundantly distributed phytohormone is methyl jasmonate (MeJA), which is a methyl ester of jasmonic acid. This plant hormone is generally believed to regulate a variety of physiological events in higher plants, including defensive reactions, flowering as well as senescence (Cheong & Choi, 2003) [7]. These findings suggest that jasmonates may represent a distinct class of anti-cancer drugs because they decrease both proliferation of cells and apoptosis in cultures of many human cell types (Balbi & Devoto, 2008) [3]. Methyl jasmonate (MeJA) is extensively used in industrial and experimental settings for a variety of fruits. Spraying jasmonate on plants before and after harvest may therefore act as a route of communication. It has been shown that jasmonate-induced volatiles attract advantageous arachnids, a reaction that may be useful in the production of horticultural crops. Numerous pieces of literature have been written about the analysis of jasmonate-mediated reactions that were discovered through altered gene expression.
The accumulation of organic matter in the soil was significantly aided by organic mulching. Mulches have numerous positive effects, including stabilising soil temperature, reducing water loss through evaporation, increasing soil moisture storage and that is utilised by crop plants, particularly during dry season (Kaur and Kaundal, 2009) [11], inhibiting weed growth (Shirgure *et al*., 2003) [23] and enhancing production and development (Pande *et al*., 2005) [17]. In many regions of the world, it has long been common practise to cover the soil's surface with a layer

of crop waste mulch, such as straw mulch. It is well known that mulching materials with an organic origin provide the plant with essential nutrients. As they decompose, a variety of plant-derived materials, such as straw, leaves and crop leftovers, improve the soil's tilth and moisture-holding capacity while also adding nutrients and humus (Borthakur and Bhattacharyya, 1999) [5].

Mango has significant promise in West Bengal's many agroclimatic zones, but more research is needed to determine how to enhance both the interior and outer qualities of a mango variety. Jasmonic acid alters the physico-chemical composition of mangoes in addition to enhancing colour development. On this subject, very little work has been done in West Bengal, especially in the new alluvial zone. Before beginning any planned programme for commercial exploitation in the mango sector, a comprehensive investigation and in-depth research on the impact of jasmonic acid in combination with different organic mulching materials on the physico-chemical properties of a specific mango variety such as Himsagar is necessary. The major goal of this study was to assess the effects of jasmonic acid foliar spraying before harvest along with different organic mulches treatments on physical, bio-chemical attributes and post-harvest qualities of mango cv. Himsagar.

Material and Methods

Location of the research site and treatment specifications

This present investigation was conducted at Horticultural Research Station, Mondouri during the period of 2018-2019. The experimental field was situated at 22.95 °N latitude and 88.49 °E longitude with an elevation of 9.75 m above MSL. This investigation was conducted with 30 years old mango plants cv. Himsagar of uniform vigour and size. Throughout the experiment, all of the trees were maintained using the same cultural practises. The experiment was replicated thrice with the setup of Randomized block design. The investigation is consisted of five treatments with a view to interpret, standardize and inculcate the varied combination of jasmonic acid along with different weightage of geotextile mulch, paddy straw, banana leaves and Black polythene mulch (Table I). T_1 (Jasmonic acid @ 0.5 μM+ Geotextile mulch @ 500 GSM, T_2 (Jasmonic acid @ 1.0 μM + Paddy straw mulch), T_3 (Jasmonic acid @ 1.5 μM + Banana leaf mulch), T_4 (Jasmonic acid @ 2.0 μM + Black polythene mulch), T_5 (Control-Water spray).

Timing and technique of application of Jasmonic acid and organic mulching

Each of the organic mulching materials was applied as soil cover @ 1.00 kg m^2 during both the year of study. Every treated tree of mango was uniformly supplemented with 75g N, 110 g P_2O_5, 55g K_2O during the month of June-July. With the aid of a hand sprayer, the plants were once sprayed with varying concentrations of jasmonic acid till the leaves as well as fruits were wet and droplets of solutions started trickling down. The spray was done at flowering stage i.e., end of February.

Measurement of plant growth parameters

Fruit weight was calculated with the help of an electronic balance, the length as well as breadth of the fruits were determined with the help of a slide calipers.

Calculation of fruit bio-chemical parameters

Hand Refractometer was utilized to evaluate TSS. Titratable acidity, total sugar as well as reducing sugar were measured by the technique described in A.O.A.C. 2000 [1]. The method described by Ranganna (2002) was used to calculate the β-carotene content of fruits.

$$\beta\text{-carotene} = \frac{\text{Concentration of carotene solution from standard curve} \times \text{Final volume} \times \text{Dilution factor}}{\text{Weight of the sample}} \times 100$$

Shelf life of fruits

Fruits becoming rotten signalled the end of their shelf life.

Pest and disease incidence

On alternate days, each fruit was carefully scrutinised for any obvious signs of deterioration brought on by the presence of pests or diseases while being stored at room temperature.

Statistical analysis

According to Panse and Sukhatme (1985) [18], the obtained data was statistically analysed using the analysis of variance method, and the significance of various causes of variation was assessed using the Error Mean Sum of Squares by Fischer "F" test of probability level of 0.05%.

Results and Discussion

Results depicted in Table 1 showed that different treatments of Jasmonic acid (JA) did not significantly influence the fruit weight. However, maximum weight of fruit (281.43 g) was measured in T_2 (Jasmonic acid @ 1.0 μM + Paddy straw mulch) followed by T_3 (Jasmonic acid @ 1.5 μM + Banana leaf mulch) while Control fruit recorded minimum weight (270.12 g). Fruit length and breadth was also affected by several treatments of Jasmonic acid as well as organic mulching materials. Fruit length varied from 7.92 to 8.82 cm due to different treatments of Jasmonic acid with organic mulching materials. T_2 recorded maximum length (8.91 cm) and breadth (7.87 cm) of fruit followed by T_3 (Jasmonic acid @ 1.5 μM + Banana leaf mulch) while Control recorded minimum.

Data presented in Table 1 showed that yield of fruit varied significantly among different treatments of Jasmonic acid. Yield varied from 44.92 to 59.10 kg/plant due to application of several concentrations of Jasmonic acid. Maximum yield (59.10 kg/plant.) was recorded from T_2 (Jasmonic acid @ 1.0 μM + Paddy straw mulch) followed by T_3 (Jasmonic acid @ 1.5 μM + Banana leaf mulch) while control recorded minimum (44.92 kg/plant). The present observation on fruit weight and yield was similar to the previous findings as obtained by Martinez-Espla *et al*. (2014) [13] in plum cultivars. The data was supported with research findings of Ahmed (2001) [2] on mango on pomegranate.

Just like physical parameters, the bio-chemical composition was affected due to different treatments of Jasmonic acid and organic mulching materials. Table 2 revealed that TSS content of fruits varied between 18.8 to 21.8 °Brix. Maximum TSS (21.8 °Brix) content of fruit was measured from T_2 (Jasmonic acid @ 1.0 μM + Paddy straw mulch) followed by T_3 (Jasmonic acid @ 1.5 μM + Banana leaf mulch) while minimum was recorded from T_5 (Control). Fruits treated with

Jasmonic acid @ 1.0 µM + Paddy straw mulch (T_2) showed maximum (15.11%) total sugar followed by T_3 while Control fruit recorded minimum (13.98%) total sugar content. Highest reducing sugar (3.08%) and non-reducing sugar (12.11%) were noted from T_3 (Jasmonic acid @1.5 µM + Banana leaf mulch) and T_2 (Jasmonic acid@ 1.0 µM + Paddy straw mulch) respectively while Control received minimum reducing sugar (2.60%) and non-reducing sugar (11.32%) content. T_3 and T_4 recorded minimum (0.18%) acidity while T_5 (Control fruit) recorded the maximum value (0.30%). Similar findings were also obtained by Lolaei *et al*. (2013) [12] in strawberry. They reported that Methyl jasmonate treated strawberry fruit had higher total soluble solid content. Gonzalez-Aguilar *et al*. (2003) [10] also found increased TSS content of guava fruit due to application of methyl jasmonate. Other quality parameters were also influenced by application of jasmonic acid. Rohwer and Erwin (2008) [21] also showed the positive effect of jasmonic acid on fruit quality characteristics in many fruits.

Table 1: Effect of Jasmonic acid along with organic mulching on physical characters and yield of mango cv. Himsagar at harvest

Treatment	Fruit Physical Characters				
	Fruit weight (g)	Fruit length (cm)	Fruit breadth (cm)	Pulp weight (g)	Yield (kg/plant)
T_1	272.47	8.82	7.32	181.44	52.41
T_2	281.43	8.91	7.87	189.11	59.10
T_3	280.72	8.90	7.84	186.47	57.27
T_4	280.47	8.89	7.80	187.13	56.31
T_5	270.12	7.92	7.21	179.12	44.92
SEm±	3.791	0.120	0.104	2.529	0.761
CD (p≤0.05)	NS	0.397	0.345	NS	2.521

Table 2: Effect of Jasmonic acid along with organic mulching on bio-chemical composition of Mango cv. Himsagar at harvest

Treatment	Bio-Chemical Parameters					
	TSS (°Brix)	Total sugar (%)	Reducing sugar (%)	Non-reducing Sugar (%)	Titratable Acidity (%)	β-Carotene (µg/100 g)
T_1	20.4	14.37	3.00	11.37	0.23	7478
T_2	21.8	15.11	3.00	12.11	0.19	7912
T_3	20.8	15.10	3.08	12.02	0.18	7377
T_4	20.6	14.97	2.97	12.06	0.18	7241
T_5	18.8	13.98	2.66	11.32	0.30	6741
SEm±	0.282	0.227	0.041	0.161	0.003	100.501
CD (p≤0.05)	0.932	0.752	0.135	0.534	0.010	332.836

Table 3: Effect of Jasmonic acid along with organic mulching on disease infestation at room temperature

Treatment	Disease infestation (%)	
	Stem end rot	Anthracnose
T_1	37.00	31.00
T_2	32.42	37.00
T_3	34.14	37.92
T_4	39.12	41.00
Control (Water spray)	47.42	47.32
SEm±	0.510	0.522
CD (p≤0.05)	1.689	1.728

Table 4: Effect of jasmonic acid along with organic mulching on shelf life of fruits

Treatment	Shelf-life at room temperature (days)
Jasmonic acid @ 0.5 µM+ Geotextile mulch @ 500 GSM	6.0
Jasmonic acid @ 1.0 µM + Jasmonic acid @ 1.0 µM + Paddy straw mulch	8.0
Jasmonic acid @ 1.5 µM + Jasmonic acid @ 1.5 Mm + Banana leaf mulch	6.0
Jasmonic acid @ 2.0 µM + Black polythene mulch	7.0
Control (Water spray)	4.0
SEm±	0.094
CD(p≤0.05)	0.310

Fruit's β-carotene content was also affected by application of several concentrations of Jasmonic acid. Maximum (7912 mg/100 g) β-carotene content of fruit was measured from fruit treated with Jasmonic acid @ 1.0 @ µM+ Paddy straw mulch followed by T_1 (Jasmonic acid @ 0.5 µM+ Geotextile mulch @ 500 GSM) while Control recorded the minimum value (6741 mg/100 g). A similar research finding was observed by Oliva *et al*. (1988) [16] on fruit species. Different conclusions of jasmonic acid significantly enhanced the β-carotene content of fruit. Similar result was obtained by Boonyaritthongachai *et al*. (2017) [4] in mango. Perez *et al*. (1993) [19] also reported that exogenous jasmonic acid stimulated carotene synthesis in tomato.

Table 3 revealed that different treatment of Jasmonic acid significantly influenced the post-harvest disease infestation at ambient room temperature. Results showed that different

treatment of Jasmonic acid significantly reduced this post-harvest disease infestation. T_2 recorded minimum (32.42%) infestation of stem-end-rot while T_1 (Jasmonic acid @ 0.5 µM+ Geotextile mulch @ 500 GSM) showed minimum (31.00%) infestation of anthracnose at 6 days of storage in ambient room temperature. Maximum infestation of both this disease was recorded in Control fruit. Lower infestation of post-harvest disease was observed on jasmonic acid treated fruits as compared to Control fruits. Similar observation was also noted by Boonyaritthongchai *et al.* (2017) [4] in mango. In a number of horticultural crops, methyl jasmonate has been found to prevent post-harvest diseases, which may be due to a direct inhibitory effect on pathogen development or the induction of natural disease resistance (Droby *et al*. 1999).
Table 4 revealed that Shelf life of fruit in ambient temperature was also affected due to application of Jasmonic acid. JA @ 1.0 µM+ Paddy straw mulch recorded maximum (8.00 days) shelf life at ambient temperature followed by T_1 and T_3 while minimum (4.00 days) shelf life of fruit was noted in Control fruits. At this present study, jasmonic acid along with paddy straw mulch increased the shelf life of fruit at ambient room temperature. Jasmonic acid @ 1.0 µM+ Paddy straw mulch proved most effective, this is might be due to the fact that jasmonate induce defences against pathogens and insects (Saniewski *et al*. 2010) [22]. Jasmonic acid increased the shelf life and decreased microbiological contamination of freshly cut celery and peppers, according to Buta and Moline (1998) [6]. The current results are in close conformity with the other workers like Moline *et al*. (1997) [14] and Wang (2003) [10, 24].

Conclusion
In the present experiment different concentration of jasmonic acid were sprayed at the flowering stage of mango plant and several organic mulches were applied in every treatment. Based on the results of the above experiment, spraying of jasmonic acid @ 1.0 µM along with the cover spreading of paddy straw mulch followed by Jasmonic acid @ 1.5 µM + banana leaf mulch recorded maximum fruit weight, length & breadth, pulp weight and yield. Like physical characters, bio-chemical composition of fruit was also influenced by the same application. Finally, it can be concluded that Jasmonic acid @ 1.0 µM along with the cover spreading of paddy straw mulch is effective in increasing physico-chemical qualities and shelf life of fruits with reduction in post-harvest diseases. This particular treatment combination can therefore be distributed to mango producers for commercial application.

References

1. A.O.A.C. Official Methods of Analysis. Association of the Official Analytical Chemists, Washington D.C. 13th Edn; c2000.
2. Ahmed MA. Studies for controlling malformation and improving yield and fruit quality of Hindy Bissinara mangoes by using active dry yeast, ascorbic acid and sulphur. Minia J Agric. Res. Dev. 2001;21(2):219-233.
3. Balbi V, Devoto A. Jasmonate signaling network in *Arabidopsis thaliana:* Crucial regulatory nodes and new physiological scienarios. New phytol. 2008;177:301-318.
4. Boonyaritthongchai P, Supapvanich S. Effects of Methyl Jasmonate on Physicochemical Qualities and Internal Browning of 'Queen' Pineapple Fruit during Cold Storage. Hortic. Environ. Biotechnol. 2017;58(5):479-487.
5. Borthakur PK, Bhattacharyya RK. Response of mulching on yield and mineral composition of guava (*Psidium guajava* L). Hariyana J Hort. Sci. 1999;28:35-37.
6. Buta JG, Moline HE. Methyl jasmonate extends shelf life and reduces microbial contamination of fresh cut celery and peppers. J Agric. Food chem. 1998;46:1253-1256.
7. Cheong JJ, Choi YD. Methyl jasmonate as a vital substance in plants. Trends Genet. 2003;19:409-413.
8. Droby S, Porat R, Cohen L, Weiss B, Shapiro B, Philosoph-Hadas S, *et al*. Suppressing green mold decay in grapefruit with postharvest jasmonate application. Journal of the American Society for Horticultural Science. 2003;124:184-188.
9. Fayed TA. Effect of compost tea and some antioxidant application on leaf chemical constituents, yield and fruit quality of Pomegranate. World. Journal of Agricultural. Science. 2001;6(4):402-411.
10. Gonzalez-Aguilar GA, Buta JG, Wang CY. Methyl jasmonate and Jasmonate on the composition of yield and growth of strawberry (Selva and Queen Elisa). International Journal of Agriculture and Crop Sciences. 2003;5(3):200-206.
11. Kaur K, Kaundal G. Efficacy of herbicides, mulching and sod cover on control of weeds in plum orchards. Indian Journal of. Weed Science. 2009;104:110-112.
12. Lolalei A, Zanavi S, Ahmadian E, Mobashevi S. Effect of Methyl Jasmonate on the composition of yield and growth of strawberry (Selva and Queen Elisa). International Journal of Agriculture and Crop Sciences, 2013;5(3):200-206.
13. Martinez-Espla A, Zapata PJ, Castillo S, Guiller F, Martinez-Romero D, Valero D, *et al*. Preharvest application of methyl jasmonate (MeJA) in two plum cultivars. 1. Fruit growth and quality attributes at harvest. Postharvest Biology and Technology. 2014;98:98-105.
14. Moline HE, Buta J, Safther RA. Comparison of three volatile natural products for the reduction of postharvest decay in strawberries. Advances in Strawberry Research. 1997;6:13-18.
15. Moreno FD, Blanch GP, Flores G, Del Castillo MLR. Development of a method based on on-line reversed phase liquid chromatography and gas chromatography coupled by means of an adsorption–adsorption interface for the analysis of selected chiral volatile compounds in methyl jasmonate treated strawberries. Journal of Chromatography A. 2010;1217:1083-1088.
16. Oliva H, Perez M, Del C, Mierch O, Ehriquez G. A. The use of jasmonic acid and methyl jasmonate in fruit crops. Citricos Y Otras Frutases. 1998;11(3):7-23.
17. Pande KK, Dimri DC, Prashant K. Effect of various mulches on growth, yield and quality of Apple. Indian Journal of Horticulture. 2005;62:145-47.
18. Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research, New Delhi. 1985;145-152.
19. Perez AG, Sanz C, Richardson DG, Olias JM. Methyl jasmonate vapor promotes β-carotene synthesis and chlorophyll degradation in Golden Delicious apple peel. Journal of Plant Growth regulator. 1993;12(3):163-167.
20. Rangana S. Manual for Analysis of Fruit and Vegetable Products. Tata McGraw Co. Pvt. Ltd., New Delhi; c1977.
21. Rohwer CL, Erwin JE. Horticultural applications of jasmonates: A review. The Journal of Horticultural

Science and Biotechnology. 2008;83:283-304.
22. Saniewski M, Horbowicz M, Kanlayanarat S. Possibilities of fruits and vegetables. Acta Horticulture. 2010;875:37-47.
23. Shirgure PS, Sonkar AK, Singh S, Panighrah P. Effect of different mulches on soil moisture conservation, weed reduction, growth and yield of drip irrigated Nagpur mandarin (*Citrus reticulata*). Indian Journal of Agricultural Sciences. 2003;73:148-52
24. Wang CY. Maintaining postharvest quality of raspberries with natural volatile compounds. International Journal of Scientific & Technology Research. 2003;38:869-875