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Research Article

IMPROVED FRUIT RETENTION, YIELD AND FRUIT QUALITY IN MANGO CV. HIMSAGAR WITH EXOGENOUS APPLICATION OF POLYAMINES

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Abstract- Aqueous solutions (0.5, 1.0, 1.5 mM) of putrescine and spermidine containing a surfactant 'Tween 20' were sprayed onto panicles of mango (Mangifera indica L.) cv. Himsagar at 10-15% opening of panicle and 15 days before harvest to study the effect of preharvest application of polyamines on fruit retention, yield, quality and shelf life of fruit during 2014-2016. The result revealed that putrescine (0.5mM) recorded the highest fruit retention (1.61 % respectively), maximum number of fruits/tree (168.00 fruits/tree), fruit weight (250.22 g) and yield (42.03 kg/tree). As regards the biochemical attributes, highest TSS (20.00 °Brix), total sugars (16.24 %) and reducing sugar (3.62 %) with lowest acidity (0.12 %) were obtained in control trees. Similarly, exogenous application of polyamines improved the shelf life of fruits with maximum shelf life (9 days) recorded in putrescine (0.5mM) followed by (7.5 days) in spermidine (1.5mM) whereas control recorded the minimum shelf life (5 days). Finally, it can be concluded that putrescine (0.5mM) was effective in improving fruit retention, yield, quality attributes and shelf life of mango cv. Himsagar at ambient room temperature.

Keywords- *Mangifera indica*, polyamines, putrescine, spermidine, shelf life

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Introduction

Mango (*Mangifera indica* L.) is most important fruit of India. It has been rightly termed as 'King of fruits' because of its wide adaptability, delicious taste, high nutritive value, cultural and religious importance. It is grown in India since ancient time and shares about 45.10 % of total mango production in the world [3]. Heavy fruit drop is an important factor contributing to low fruit yield in mango orchards and sometime only 0.1% of set fruit reach maturity [8]. Research work implicates the role of phytohormones [5] and endogenous polyamines [15] in fruit drop of mango. Exogenous application of various plant growth regulators has been reported to have variable success in reducing fruit drop [9, 1], possibly due to environmental variation and the limited understanding of the complex nature of the abscission phenomenon. On the basis that ethylene biosynthesis increases fruitlet abscission [14], there is substantial evidence to support that ethylene is the main trigger in abscission process [7]. Polyamines are considered as anti-ethylene substances [2], being the likely competitors of precursors of ethylene (S-adenosylmethionine: SAMdc). Exogenous application of polyamines has been reported to improve fruit retention and yield in apple [11], olive [22], litchi [28] and mango [26, 27, 16]. Although a number of studies demonstrated the significance of polyamines in reducing fruit drop and improving yield in various fruit crops, information on their effects on fruit quality and shelf life is scant. In mango, the effects of exogenous application of polyamines on fruit quality and shelf life have not been investigated in detail. The present study reports the effects of polyamines on fruit retention, quality and shelf life of mango cv. Himsagar.

Materials and Methods

The experiment was conducted at Bidhan Chandra Krishi Viswavidyalaya, Regional Research Station, Gayeshpur, West Bengal during 2014-15 and 2015-16. Twelve years old trees of mango cv. Himsagar of uniform vigor and size, planted at 10 M × 10 M distance and maintained under uniform cultural practices were selected for study. The treatments comprised of spermidine 0.5Mm, spermidine 1mM, spermidine 1.5mM, putrescine 0.5mM, putrescine 1mM, putrescine 1.5mM and control. Different concentrations of polyamines were sprayed once at 10-15% opening of panicle and again at 15 days before normal harvest with wetting agent Tween20 at 0.01%. Control trees were sprayed with water and wetting agent at the same time. The treatments were laid out in a Randomized Block Design with three replications. Observations were made for fruit retention, fruit weight (g), number of fruits/tree, fruit yield (kg/ha), TSS, titratable acidity, total sugars, reducing sugar, ascorbic acid and shelf-life of fruits at room temperature. Fruit retention was recorded by tagging ten uniform and healthy panicles per tree from all directions at fruit set stage and total number of fruit on tagged panicles of each tree was counted at pin head stage and then at commercial harvest stage. The fruit retention was calculated at the time of harvest as follows and expressed as percentage.

$$\text{Fruit retention percentage} = \frac{\text{Number of fruits retained}}{\text{Total Number of Fruit Formed at Intial Stage}} \times 100$$

At commercial harvest stage, the weight of each fruit was recorded and multiplied by the average numbers of fruits counted to record the yield. The T.S.S was recorded by using a hand refractrometer and expressed as ° Brix. The per cent acidity and ascorbic acid content (mg 100 ml-1) were estimated using A.O.A.C. [4] method. Total and reducing sugar contents were estimated as per the method suggested by Ranganna [21]. Shelf-life of fruit was recorded by keeping ten mature fruits per treatment in three replicates for each treatment at room temperature for ripening without deterioration of fruits. Data collected on fruit retention, yield, quality attributes and shelf life were statistically analyzed as per the methods suggested by Panse and Sukhatme [19].

Result and Discussion

Fruit retention

Exogenous application of PAs stage did not significantly improve fruit retention (Table 1). However, mean fruit retention was increased with PAs treatments compared to control with putrescine (0.5mM) recorded highest fruit retention (1.61 %) followed by (1.48 %) in putrescine (1mM) and lowest (0.87 %) in control. The increased in fruit retention with exogenous application of polyamines may be ascribed to the increase level of endogenous polyamines in the fruitlets and pedicels, which were less prone to abscine, especially during initial 4-6 weeks of heavy fruitlets abscission [15]. It may also be argued that the exogenous application of PAs improved fruit retention, possibly by inhibiting endogenous ethylene biosynthesis, which is the known trigger in abscission [7]. Present investigation also conforms the finding of earlier workers like Rugini, *et al*. [23] in olive, Mitra and Sanyal, [17] in litchi, Singh and Singh [26] in mango and Movahed, *et al*. [18] in Strawberry.

Table-1 *Effect of polyamines on fruit retention and yield attributes of mango cv. Himsagar*

Treatments	Fruit retention (%)	Numbers of fruits per tree	Fruit weight (g)	Fruit yield (kg/tree)
Water spray	0. 87	134.65	214.50	28.882
Spermidine				
0.5mM	1.34	167.2	244.42	40.867
1mM	1.00	156.4	234.64	36.698
1.5mM	0.93	151.0	227.88	34.410
Putrescine				
0.5mM	1.61	168.0	250.22	42.037
1mM	1.48	163.1	242.63	39.573
1.5mM	1.32	158.4	222.56	35.254
C.D. (p=0.05)	0.03	2.00	2.40	0.52

Table-2 *Effect of polyamines on quality attributes of mango cv. Himsagar*

Treatments	Total soluble solids (°Brix)	Titratable acidity (%)	Total sugars (%)	Reducing sugar (%)	Shelf life (nos. of days at ambient room temperature)
Control	20.00	0.12	16.24	3.62	5
Spermidine					
0.5mM	18.52	0.16	15.12	3.18	7
1mM	19.10	0.15	15.62	3.24	7
1.5mM	18.76	0.16	15.31	3.20	7.5
Putrescine					
0.5mM	19.60	0.14	16.08	3.48	9
1mM	19.52	0.15	15.84	3.36	7
1.5mM	19.84	0.13	16.14	3.50	6
C.D. (p= 0.05)	0.39	0.02	0.20	0.04	0.50

Yield attributes

Results indicated that number of fruits/tree, fruit weight and yield varied significantly among the different treatments. Table 1 showed that the highest number of fruits/tree (168.00 fruits/tree), fruit weight (250.22 g) and yield (42.03 kg/tree) was recorded with putrescine (0.5mM) followed by spermidine (1.5mM) whereas, the lowest number of fruits/tree (134.65 fruits/tree), fruit weight (214.50 g) and yield (28.88 kg/tree) was observed in control. The improvement in numbers of fruits and yield by the application of polyamines might be due to inhibiting endogenous ethylene biosynthesis, which is the known trigger in abscission [7]. Exogenous applications of different polyamines at full bloom have earlier been reported to increase fruit set and total yield in apple [10, 6], olive [22], litchi [17] and mango [15]. Similarly, Costa, *et al.*, [11] pointed out that improvement in fruit weight by putrescine application might be due to the role in cell division leading to improved weight of fruits. Present study also conformed the previous finding of increased fruit set, fruit weight and yield by the application of polyamines.

Quality attributes

All the fruit quality parameters such as TSS, titratable acidity, total sugars, reducing sugar and ascorbic acid were found significantly affected by exogenous polyamines application (table 2). Experimental data showed that highest TSS (20.00 °Brix), total sugars (16.24 %), reducing sugar (3.62 %) with minimum acidity (0.12 %) was recorded in control trees. The lower total soluble solids and sugars content in polyamines treated fruits compared to control at harvesting stage may be due to the slower conversion of starch to sugars. Since the predominant sugar in mango has been sucrose [25], polyamines may have suppressed the activities of certain enzymes such as sucrose phosphate synthase (SPS) involved in sucrose metabolism. Similar results were also obtained by Malik, *et al*., [14] in mango, Costa, *et al*., [11] in apple and Saleem, *et al*., [24] in sweet orange.

Shel life

Exogenous application of polyamines increased the shelf life of mango at ambient room temperature. Table 2 indicated that putrescine (0.5mM) was most effective in extending the shelf life of mango (9 days) as compared to control (5 days). Similar results were also obtained by Krammer, *et al*., [13] in apple, Ponappe, *et al*., [20] in strawberry and Malik, *et al*., [17] in mango. Increased in fruit firmness and reduced colour development with the application of putrescine may be attributed to lower ethylene production and retardation of ripening process [12]. Valero, *et al*., [29] also observed that polyamines in their free forms act as anti-senescence agents, from both endogenous and exogenous applications, the main effect in fruits being retarded colour changes, increased fruit firmness, delayed ethylene and respiration rate emission which collectively exhibit the greater storage life.

Conclusion

From the result of the experiment, it can be concluded that polyamines played an important role in improving fruit set, fruit retention, yield, quality and shelf life of mango cv. Himsagar. Among the different treatments, putrescine (0.5mM) was most effective in improving fruit set, fruit retention, yield, physico-chemical qualities and shelf life of mango cv. Himsagar at ambient room temperature.

Application of research

Polyamines played an important role in improving fruit set, fruit retention, yield, quality and shelf life of mango *cv*. Himsagar with putrescine (0.5mM) being the most effective treatment.

Research Category: Applied research

Abbreviations:
TSS - Total Soluble Solids
A.O.A.C. Official Method of Analysis
G – gram
Kg – kilogram
Ha – Hectar
mM – mili molar

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