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Influence of fruit bagging on chemical composition of mango (*Mangifera indica* L.) Under high density planting

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Abstract
Field Experiment was carried out at Regional Horticultural Research Station, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari from January 2018 to July 2018 in Sonpari variety of mango. The experiment was laid out in Randomized Block Design with factorial concept and repeated thrice with twenty one treatment combination. The experiment consisted of three planting distance (D) *viz*., 5 m × 5 m (D_1), 3 m × 3 m (D_2) and 3 m × 2 m (D_3) and seven fruit bagging materials (B) *viz*., control (B_1) newspaper bag (B_2), brown paper bag (B_3), transparent PP bag (B_4), butter paper bag (B_5), muslin cloth bag (B_6) and non woven bag (B_7). The fruits were bagged at egg stage (55-60 days after fruit set). Results showed that chemical parameters such as TSS, reducing sugars, total sugars, non-reducing sugars and titrable acidity were significantly affected by planting distance. TSS, reducing sugar and total sugars were significantly higher and titrable acidity was significantly lower in the planting distance 5m × 5m (D_1). Non-reducing sugar was found higher under 3 m × 3 m distance (D_2). While, ascorbic acid content and β carotene (µg 100 g^{-1}) were not significantly affected by planting distance. Regarding effect of different bagging material, TSS, reducing sugar, total sugar, non-reducing, titrable acidity and ascorbic acid were significantly improved by newspaper bag followed by muslin cloth bag while β-carotene content of fruit was significantly higher in brown paper bag followed by muslin cloth bag. No significant effect was found for the chemical properties of mango fruits between planting distance and different bagging material.

Keywords: Mango, planting distance, bagging materials, chemical properties

Introduction

Mango (*Mangifera indica* L.) belongs to family Anacardiaceae has been grown in India since long and is considered as "King of Fruits". It is one of the choicest and most ancient fruits known to mankind. India is the major producer and exporter of mangoes in the world. The productivity of mango in India is comparatively less than other mango producing countries. The low productivity of mango is mainly due to low plant population per hectare, improper orchard management practices, pests and diseases problems *etc*. Therefore, high density plantation and management are necessary to deal with this unfavorable situation of low productivity which gives higher yield at low cost with more resilience to climatic stresses along with maintains export quality of fruits. High density planting (HDP) is one of the technology for mango cultivation worldwide to increase productivity without affecting the quality of fruits. It has the potential to yield 200 per cent more produce than that of the traditional method (Singh, 2017) [21].

Climatic abbreviation such as sudden rise in temperature, humidity and unseasonal rain are the main problems in recent years. Such adverse climate not only affects the external appearance of the fruit but also aggravate the pest and diseases incidence. Thus, to prevent the losses caused by biotic and abiotic factors several good agricultural practices (GAP) are becoming popular throughout the world (Sharma, 2009) [16]. Among them, pre-harvest fruit bagging emerged as an effective method. It was known to originate in Japan and Korea. Countries such as Mexico, Chile and Argentina do not import fruits unless they were bagged (Sharma *et al.*, 2014) [17]. Bagging not only improves the visual quality of fruits but also improves the internal quality of fruits by promoting skin colouration and reducing blemishes by change micro-environment. Hence an experiment was undertaken to study the influence on fruit bagging on quality of fruits.

Materials and Methods

The experiment was carried out at Regional Horticultural Research Station, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari during the year 2018. The experiment was laid out in Randomized Block Design with factorial concept and repeated thrice with twenty one treatment combinations. The experiment consisted of three planting distance (D) *viz*., 5 m × 5 m (D_1), 3 m × 3 m (D_2) and 3 m × 2 m (D_3) and seven fruit bagging materials (B) *viz*., control (B_1) newspaper bag (B_2), brown paper bag (B_3), transparent PP bag (B_4), butter paper bag (B_5), muslin cloth bag (B_6) and non woven bag (B_7). All fruits at egg stage (55-60 days after fruit set) were bagged and tied with the help of plastic thread to the fruit stalk. Six perforations of 4 mm diameter were made at the bottom of all the bags except muslin cloth and non woven bags for proper ventilation. Observations of chemical parameters were taken at ripe stage. For that study, three fruits were randomly selected per replication from six fruits and analyzed to determine the fruit chemical composition (TSS, reducing, non-reducing and total sugars, acidity, ascorbic acid and β carotene) at ripe stages. TSS was recorded by using digital hand refractometer (Range of 0 to 32 °Brix). Reducing sugars, total sugars and non-reducing sugars were determined by method suggested by Lane and Eylon (1923) [8] as described by Ranganna (1986) [14]. Titrable acidity was estimated by titrating known amount of pulp against 0.1 N NaOH using phenolphthalein as indicator Ranganna (1986) [14]. Ascorbic acid content of fruits was determined by Dye method given by Ranganna (1986) [14]. β-carotene content of mango fruits was estimated by spectrophotometric method as detailed by Raj *et al.* (2016) [13]. The statistical analysis of data was carried out as per the method prescribed by Panse and Sukhatme (1985) [12]. The standard error of mean (S. Em.) was worked out and the critical difference (C. D.) at 5 per cent was calculated whenever the results were found significant.

Results and Discussion

Effect of planting distance

Table 1 showed the significant effect of planting distance and bagging materials on chemical parameters of mango fruit. In case of planting distance, the maximum TSS (19.90 ºBrix), reducing sugars (5.15%), total sugars (12.12%) and minimum titrable acidity (0.16%) were obtained in the planting distance of 5 m × 5 m. Significantly highest non-reducing sugar content of fruit (7.07%) was noted in D_2 (3 m × 3 m), which was at par with D_1 (5 m × 5 m) being 6.98%. It might be due to lesser competition among plants for nutrients and better penetration of sunshine for photosynthesis (Pal *et al.*, 2017) [11]. The results are in agreement with the findings of Singh (2003) [19], Brar *et al.* (2013) [2], Kumar *et al.* (2017) [7] and Singh *et al.* (2007) [20] in guava; Sarrwy *et al.* (2012) [15] in banana; Gaikwad *et al.* (2017) [3] in mango. While, Ascorbic acid content and β carotene (µg 100 g^{-1}) were not significantly affected by planting distance.

Table 1: Effect of planting distance and bagging materials on chemical composition of mango fruit cv. Sonpari at ripe stage

Treatments	TSS (ºBrix)	Reducing sugar (%)	Total sugars (%)	Non-reducing sugars (%)	Titrable acidity (%)	Ascorbic acid (mg 100 g^{-1})	β-carotene content (µg 100 g^{-1})
Planting distance (D)							
D_1 (5 m × 5 m)	19.90	5.15	12.12	6.98	0.16	32.99	721.64
D_2 (3 m × 3 m)	18.63	4.21	11.28	7.07	0.17	32.32	693.70
D_3 (3 m × 2 m)	18.42	4.36	10.82	6.46	0.18	32.00	681.20
S.Em.±	0.21	0.12	0.13	0.17	0.003	0.63	14.18
C.D. at 5%	0.61	0.34	0.38	0.49	0.01	NS	NS
Bagging materials (B)							
B_1: Control	17.84	4.05	9.66	5.61	0.20	29.33	422.88
B_2: Newspaper bag	20.55	5.33	13.15	7.82	0.14	36.26	779.72
B_3: Brown paper bag	19.02	4.69	12.10	7.41	0.15	32.82	1290.10
B_4: Transparent PP bag	18.34	3.99	10.01	6.02	0.19	30.78	478.64
B_5: Butter paper bag	19.01	4.51	10.95	6.43	0.16	32.82	592.72
B_6: Muslin cloth bag	19.52	4.92	12.36	7.44	0.15	35.59	916.11
B_7: Non woven bag	18.59	4.52	11.64	7.12	0.18	29.47	411.73
S.Em.±	0.32	0.18	0.20	0.26	0.004	0.96	21.67
C.D. at 5%	0.93	0.52	0.57	0.75	0.01	2.73	61.92
Interaction effect (D × B)							
S.Em.±	0.56	0.32	0.35	0.45	0.007	1.66	37.53
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS
C.V. %	5.13	12.02	5.28	11.52	7.75	8.84	9.30

Effect of bagging materials

In case of different bagging materials, the maximum TSS (20.55 ºBrix), reducing sugars (5.3%), total sugars (13.15%), non-reducing sugars (7.82%), ascorbic acid content of fruit (36.26 mg 100 g^{-1}) and minimum titrable acidity content of fruit (0.14%) was noticed in fruits bagged with newspaper bag. It was at par with brown paper and muslin cloth bag. These findings are in agreement with those of Mingire *et al.* (2017) [9], Haldankar *et al.* (2015) [4] and Mohapatra (2016) [10] in mango. Abbasi *et al*. (2014) [1] also noted that the fruits bagged using newspaper bag improve the TSS content of fruits. β-carotene content was found maximum (1290.10 µg 100 g^{-1}) in fruits bagged with brown paper bag, which was at par with muslin cloth bag (916.11 µg 100 g^{-1}). It might be due to bagging of fruits change the micro-environment favorably around the fruits with respect to light, humidity and temperature and ultimately improve the quality of fruits (Shinde *et al.*, 2015) [18]. The results are in conformity with Mingire *et al.*, (2017) [9], Haldankar *et al.* (2015) [4], Mohapatra, 2016 [10], Islam *et al.* (2017[a]) [5] and Islam *et al.* (2017[b]) [6] in mango.

Combined effect of planting distance and bagging materials on chemical properties of mango fruit were remained non-significant.

Conclusion

Owing to the results obtained during this study, it is inferred that fruits bagged with newspaper bag with planting distance of 5 m × 5 m was found better for enhancing the chemical properties of mango fruit cv. Sonpari.

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