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EFFECT OF CONTAINERS AND FUNGICIDAL APPLICATION ON THE STORAGE OF KHASI MANDARINS

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ABSTRACT

The fruits of Khasi mandarins were packed in three types of containers viz. Gunny bags, corrugated carton boxes and polythene bags with and without cushioning material (paddy straw). These were stored in two conditions viz., low temperature (5± 1°C) and room temperature (12–19° C). Maximum loss in fruit weight was recorded in polythene bags along with cushioning (4.09% at room temperature and 2.85% at low temperature). The percent fruit rotting was also low in polythene bags at room temp. (5.48 and 8.33% without and with paddy straw cushioning respectively). Post harvest fungicidal application with carbendazim (500,1000,1500 ppm) had significantly reduced the percent fruit rot and weight loss as compared to the control in both with and without cushioning. Green mould (*Penicillium digitatum),* sour rot *(Geotrichum candidum),* anthracnose *(Colletotrichum gloeosporiodes)* and stem end rot *(Botryodiplodia theobromae* and *Alternaria citri)* were observed with varying intensities during the storage. Out of these, the frequency of *Penicillium* incidence was higher from 1st to 4th week of the storage followed by *Colletotrichum gloeosporiodes.* Maximum reduction in fruit rot was exhibited by post harvest treatment with 1500 ppm carbendazim followed by 1000 and 500 ppm.

INTRODUCTION

Khasi mandarin (*Citrus reticulata* Blanco) is the major fruit crop in Meghalaya and is grown in about 7024 ha area with 40885 tonnes production per annum. Lack of adequate protection measures against the post harvest diseases, traditional orchard management and improper post harvest handling of fruits from the area of production to the consumer results in heavy losses. In North Eastern India, the prevalence of high inoculum of pathogens in the orchards due to poor plant protection measures, non adoption of scientific harvesting, handling, transit, storage and anti microbial treatments are considered to be various factors leading to heavy losses of fruits after harvest. Therefore, studies were undertaken to evaluate the effect of containers, cushioning material, storage temperature and post harvest fungicidal dip treatment on the control of fruit rot, weight loss and frequency of pathogens associated during storage.

MATERIAL AND METHODS

The fully matured Khasi mandarins were harvested from the orchard of Division of Plant Pathology, ICAR Research Complex, Barapani. The fruits were washed, dried and packed in various containers viz. gunny bag (GB), carton box (CB) and polythene bag (PB) perforated with 8–10 pin holes and stored at room temperature (12–19°C) and low temperatures (5± 1°C). Paddy straw was used as a cushioning material. Freshly harvested fruits were washed and dipped in carbendazim (2-methoxy carbammoyl-Benzimidazole). Three concentrations viz. 500,1000 and 1500 ppm were tested and the treated fruits were dried in the shade and packed in carton boxes and stored at room temperature (12–19°C and 58–90% RH). Fruit weight before packing and at weekly interval was recorded to work out weight loss. In each treatment three replications were maintained with five fruits in each. Fruit spoilage and rotting fungi were recorded at weekly intervals.

RESULTS AND DISCUSSION

The minimum loss of fruit weight was recorded when fruits were packed in polythene bag (8.1%) as compared to the carton (15.9%) and gunny bag (29.9%) at room temperature (Table 1). Jain *et al.* (1997) reported that minimum loss in weight was recorded with the fruits packed in corrugated fiber box than other containers and fruits packed in gunny bag recorded less price in market because of scratches and dull colour of the fruit skin. Fruits stored at low temperature recorded minimum weight loss (Table 1) in all the three types of containers as compared to room temperature. Similar trend was reported by Wasker *et al.* (1997) that fruits stored at low temperature were found fresh, firm and attractive.

The percent spoilage of fruits was more in gunny bags both at room and low temperatures followed by carton, however it was minimum in polythene bags at room temperature (Table 2). The corrugated carton boxes exhibited lowest spoilage of fruits (4.8%) at low temperature. Storage at low temperature showed less spoilage and minimum weight loss than at room temperature (Tables 1 & 2). Low temperature had been shown to slow down the fungus growth which helps in increasing the physiological post harvest life of stored fruits (Sommer, 1982). The effect of cushioning with paddy straw on fruit spoilage was studied in all the three containers. Results (Fig.1) showed that percent fruit spoilage was low with cushioning in all the containers, however its effect was maximum in polythene bags followed by CB and GB.

Comparison of carbendazim dip treatment at various concentrations showed that there was no spoilage of fruits (Table 3) at 1500 ppm. The rotting of fruits was maximum (20.45%) in untreated fruits. Stem rot *(A. Citri* and *B. theobromae),* sour rot, green mould and anthracnose were observed with severe intensity on untreated fruits. However, these diseases were also found on the treated fruits at 500 and 1000 ppm but with low intensity. Sidhu *et al.* (1997) found that Kinnow mandarins sealed in HDPE film after fungicidal treatment (0.03% carbendazim + 0.05% sportak) secured minimum rotting during storage.

Combination of fungicide dip treatment with cushioning material showed reduction in fruit spoilage in all the concentrations, however, maximum control was recorded at 1500 ppm (Fig. 2). Post harvest treatment of mandarins with carbendazim (1500 ppm) showed no spoilage of fruits even at room temperature and had higher score of acceptability. Wasker *et al.* (1997) reported that post harvest fungicidal application of bavistin with polythene packing extended the shelf life of sweet oranges up to 47 days when stored in cool chamber as against 20 days

in control at room temperature. Tak *et al.* (1985) found that Rovral was the best followed by Bavistin, Bayton and Vitavax in controlling the post harvest diseases of apple.

Different fungi recorded during study were *Penicillium digitatum Geotrichum candidum, Colletotrichum gloeosporioides, Botriodiplodia theobromae, Alternaria, citri, Elsinoe fawcettii, Diaporthe citri, Guingnardia* sp., *Fusarium* sp., *Aspergillus niger* and *Rhizopus sp.* The intensity of the fruit rot fungi were higher at room temperature in comparison to low temperature. The distribution of fungi in different packing containers revealed that the intensity of these fungi was higher in gunny bag followed by CB and least in PB. A similar trend with lower intensity was observed with cushioning material in all the three containers. Dip treatment with different concentrations of carbendazim reduced the occurrence of different storage fungi as compared to untreated check, however, maximum reduction was recorded in 1500 ppm followed by 1000 and 500 ppm. The frequency of storage fungi was lower in case of cushioning as compared to non-cushioning in all the concentrations.

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Table 1. Effect of packing containers on the percent weight loss of khasi mandarins during storage

Packing containers	Room temperature (12 – 20° C) Weeks						Low temperature (5° C) Weeks					
	Initial Weight (g)	1	2	3	4	mean	Initial Weight (g)	1	2	3	4	Mean
Gunny bag	104.7	11.4 (19.7)	5.8 (13.9)	11.7 (20.0)	25.7 (30.1)	21.0	102.7	1.87 (7.8)	3.4 (10.7)	9.4 (17.8)	9.1 (17.5)	13.4
Corrugated carton box	104.7	6.7 (14.9)	2.8 (9.6)	9.7 (18.1)	12.7 (20.8)	15.9	97.0	2.3 (8.8)	2.7 (9.4)	13.6 (21.6)	7.2 (15.5)	13.8
Polythene bag	97.3	0.7 (4.6)	1.0 (5.8)	3.2 (10.3)	4.1 (11.6)	8.1	91.7	0.0 (0.5)	0.0 (0.5)	2.1 (8.5)	2.8 (9.7)	4.8
Mean		13.1	9.8	16.1	20.9			5.7	6.8	15.9	14.3	

Figure in the parenthesis are arc sin transformed values,

CD at 5% containers (A) = 2.7, Period of storage (B) = 1.3, temperature (C) = 2.2

AxBxC = 7.6

Table 2. Effect of packing containers on the spoilage of khasi mandarins during storage.

Packing containers	Room temperature (12 – 20° C) Weeks					Low temperature (5° C) Weeks				
	1	2	3	4	mean	1	2	3	4	Mean
Gunny bag	2.5 (9.2)	0.0 (0.5)	56.7 (48.8)	50.3 (45.2)	25.9	0.0 (0.5)	0.0 (0.5)	26.2 (30.8)	7.0 (15.3)	11.8
Corrugated carton box	9.4 (17.8)	3.2 (10.3)	75.0 (60.0)	7.0 (15.3)	25.9	0.0 (0.5)	0.0 (0.5)	9.4 (17.8)	0.0 (0.5)	4.8
Polythene bag	14.1 (22.1)	0.0 (0.5)	0.0 (0.5)	5.4 (13.4)	9.1	0.0 (0.5)	0.0 (0.5)	5.4 (13.4)	17.8 (24.9)	9.8
Mean	16.4	3.7	36.4	24.6		0.5	0.5	20.7	13.6	

Figures in the parenthesis are arc sin transformed values,

CD at 5% containers (A) = 9.9, Period of storage (B) = 11.4, temperature (C) = 8.1

AxBxC = 28.0

Table 3. Effect of fungicide (carbendazim) on spoilage (%) of khasi mandarin during storage

Treatment Carbendazim (ppm)	Fruit spoilage (%) Weeks				Mean
	1	2	3	4	
500	5.4 (13.4)	3.2 (10.3)	41.0 (39.8)	0.0 (0.5)	16.0
1000	2.5 (9.2)	2.5 (9.2)	10.6 (19.0)	20.5 (26.9)	16.1
1500	0.0 (0.5)	0.0 (.05)	0.0 (0.5)	0.0 (0.5)	0.5
Check	9.4 (17.8)	0.0 (0.5)	41.0 (51.3)	4.4 (12.1)	20.4
Mean	10.2)	5.1	27.7	9.9	

Figures in parenthesis are arc sin transformed values,
CD at 5% = Treatments (T) = 11.1, weeks (W) = 11.1; TxW = 22.1

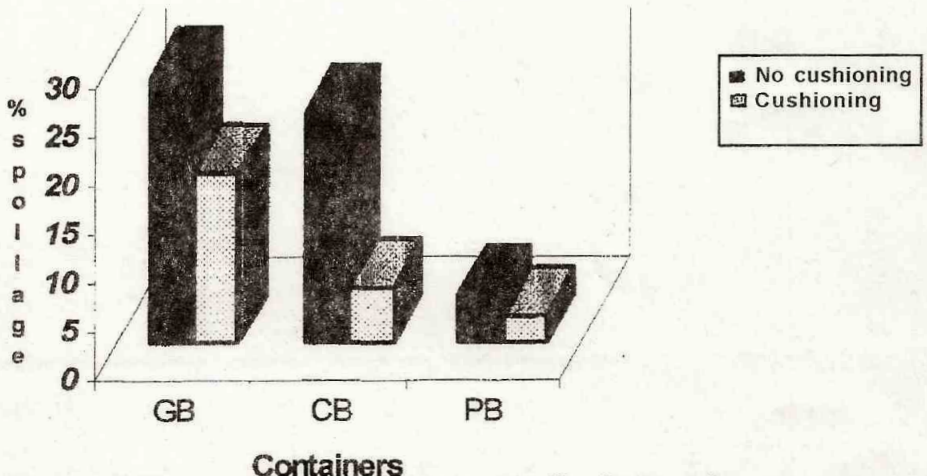

Fig.1 Effect of containers on fruit spoilage

Fig 2. Effect of carbendazim on fruit spoilage