

Post harvest fungal spoilage in mango at different levels marketing

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Abstract: A systematic study was conducted during the year 2000 to assess the extent of loss due to post harvest diseases in mango in Coimbatore at field, wholesale, retail and consumer levels. The magnitude of loss due to post harvest diseases on mango varied at different stages of storage and marketing. Fungal spoilage of mango was higher at retail (40.79 per cent) and consumer level (24.62 per cent) and was minimum at wholesale (3.01 per cent) and the least at field level (1.13 per cent) since the symptoms of the disease of unripe mango manifested only upon ripening. It was observed that the extent of post harvest loss was higher in the months of July (47.90 per cent) and August (51.70 per cent) when compared to other months. Among the post harvest diseases anthracnose caused by *Colletotrichum gloeosporioides* and stem end rot caused by *Botryodiplodia theobromae* caused the major damage.

Key words : Survey - Mango - Post harvest diseases - Retail level - Consumer level - Wholesale level - Farm level - Anthracnose - Stem end rot.

Introduction

Fruits constitute an important item of our food and they play a significant role in the human diet through the supply of vitamins and minerals. The recommended quantity of fruits to be consumed by a normal healthy adult is 230 g/day while the present per capita consumption of fruits is reported to be below 160 g/ day (Veeraragavathatham *et al.* 1996). Among the various fruits grown in India, mango is one of the most important tropical fruits and is called as the king of fruits. India ranks first in the world production of mango with a share of 54.3 per cent.. Post harvest losses in fruits are due to many factors, among which post harvest disease is considered to be a principal cause. Dasgupta and Mandal (1989) described more than 300 parasitic diseases of fruits and vegetables after harvest. Mango is the worst sufferer based on the percentage loss over the marketable period (Mandal and Dasgupta, 1981). The estimated post harvest losses during 1987-88 varied from 17.1 to 36.7 per cent

(Anon., 1990). Studies on post harvest losses of perishables are limited and fragmentary. The surveys mostly confined to retail level of marketing and the estimate of losses has not reflected the real loss due to post harvest diseases. Hence, a study was conducted to assess the post harvest losses at different stages of marketing *viz.*, field, wholesale, retail and consumer levels.

Materials and Methods

A systematic survey was conducted to assess the extent of loss due to post harvest disease in mango fruits in Coimbatore at field, wholesale, retail and consumer levels. The information about the place of origin, variety, duration of transport and distance traveled were also collected. The temperature and relative humidity of the storage godown were also recorded.

The loss due to fungal spoilage was assessed at weekly intervals for four months

Table 1. Post harvest fungal spoilage in mango at consumer level

Month	Variety	Percent Disease Index (PDI)				Total
		Anthracnose	Stem end rot	Mixed infection	Others*	
May, 2000	Shenduram	7.00	12.50	4.00	0.50	23.00
	Salem kundu	10.30	7.50	3.00	0.30	21.30
	Nadusalai	10.00	6.00	2.50	0.30	18.80
	Gudadad	10.50	7.00	3.00	0.30	20.80
	Mulgoa	13.00	5.50	3.50	0.30	22.30
	Banganapalli	12.50	6.80	3.50	0.50	22.30
	Kalepad	8.00	4.00	2.50	0.30	14.80
	Alphonso	9.80	4.50	2.00	0.30	16.60
	Mean	10.14	6.73	3.00	0.35	20.22
June, 2000	Shenduram	9.00	14.15	4.00	0.30	27.80
	Salem kundu	10.00	8.00	3.30	0.50	22.60
	Nadusalai	10.80	7.50	3.50	0.30	21.10
	Mulgoa	13.30	6.50	4.00	0.30	24.10
	Banganapalli	14.00	6.80	4.30	0.80	25.90
	Bangalora	3.00	10.8	3.30	0.80	17.90
	Rumani	9.30	5.80	2.50	0.30	18.10
	Mean	10.03	9.13	3.56	0.44	23.16
July, 2000	Mulgoa	17.50	8.00	5.00	0.30	30.80
	Bangalora	4.00	12.00	4.30	0.80	21.10
	Panchavarnam	7.30	4.00	2.30	0.50	14.10
	Neelum	21.00	5.50	6.00	0.30	32.80
	Mean	12.45	7.38	4.40	0.48	24.71
August, 2000	Neelum	17.30	6.50	5.80	0.80	30.40
	Mean	17.30	6.50	5.80	0.80	30.40
	Grand mean	12.48	7.44	4.19	0.52	24.62

* Others include *A.niger* and *R. arrhizus*

(May to August, 2000) at different levels of handling after harvest, from three samples each having 20 fruits selected at random. At consumer level, loss due to post harvest diseases was assessed either by holding samples under conditions that stimulate those in home kitchens or surveying house hold regularly.

The intensity of the disease was assessed using a special score chart based on the area of infection.

Description	Category
No infection	0
< 1 per cent fruit surface infection	1
1 - 5 per cent fruit surface infection	2
6 - 25 per cent fruit surface infection	3
26 - 50 per cent fruit surface infection	4
> 50 per cent fruit surface infection	5

The loss due to post harvest diseases was expressed in Per cent Disease Index (PDI) (Rose, 1974).

Table 2. Post harvest fungal spoilage in mango at retail market

Month	Variety	Percent Disease Index (PDI)				Total
		Anthraco-nose	Stem end rot	Mixed infection	Others*	
May, 2000	Shendnram	11.30	19.60	5.80	0.80	37.50
	Salem kundu	18.30	11.20	3.00	1.00	33.50
	Naclusalai	16.50	8.80	3.50	0.50	29.30
	Gudadad	18.40	12.10	4.30	0.50	25.30
	Mulgoa	20.80	11.30	3.30	0.30	35.70
	Banganapalli	23.00	13.80	4.50	0.80	42.10
	Kalepad	14.30	5.60	3.50	0.30	23.70
	Imampasand	19.00	11.80	4.00	0.80	35.60
	Rumani	15.60	8.00	3.00	0.00	26.60
	Alphonso	13.60	6.30	2.50	0.80	23.20
	Mean	17.08	10.85	3.74	0.64	31.25
June, 2000	Shenduram	12.00	27.30	6.50	1.00	46.80
	Nadusalai	21.30	10.00	4.30	0.80	36.40
	Gudabad	21.60	18.60	4.50	0.80	45.50
	Mulgoa	22.60	13.00	4.00	0.50	40.10
	Banganapalli	24.00	14.00	5.30	1.30	44.60
	Bangalora	6.40	13.60	3.00	1.00	24.00
	Alphonso	16.50	11.00	3.30	1.00	31.80
	Neelum	34.60	8.00	6.00	0.50	49.10
	Dashchari	24.60	10.00	3.00	0.50	38.10
	Mean	21.06	14.38	4.43	0.82	38.71
July, 2000	Mulgoa	26.30	16.00	8.30	0.80	51.40
	Bangalora	7.30	17.50	5.50	1.50	31.80
	Neelum	40.30	10.40	9.00	0.80	60.50
	Dashehari	20.30	12.60	4.00	1.00	37.90
	Panchavarnam	13.60	9.30	2.50	0.50	25.90
	Mean	21.56	13.16	5.86	0.92	41.50
August, 2000	Neelum	31.80	11.10	8.00	0.80	51.70
	Mean	31.80	11.10	8.00	0.80	51.70
	Grand mean	22.88	12.38	5.51	0.80	40.79

* Others include *A.niger* and *R.arrhizus*

$$\text{PDI} = \frac{\text{Sum of all individual ratings}}{\text{Total number of fruits graded}} \times \frac{100}{\text{maximum grade}}$$

During survey, the infected fruits were collected in sterile polythene bags for isolation and Koch's postulate was proved for each pathogen.

Results and Discussion

The pathogens that caused post harvest spoilage were isolated and their extent of loss on mango was assessed by systematic survey at Coimbatore from field to consumer level. Mango fruits were predominantly affected by *Colletotrichum gloeosporioides* (anthracnose), *Botryodiplodia theobromae* (Stem end rot), mixed infections of both anthracnose and stem end rot, *Aspergillus niger* and *Rhizopus arrhizus* at different stages of marketing and storage.

The magnitude of loss due to post harvest diseases on mango varied at different stages of storage and marketing. The fungal spoilage of mango was higher at retail and consumer level and was minimum at wholesale and field levels, since the symptoms of the disease of unripe mango manifested only upon ripening.

Consumer level

The extent of loss due to different diseases at consumer level is presented in the Table 1. The loss was lesser at consumer level (20.20 to 30.40 per cent) than retail stage but more than at wholesale and field level of marketing. It was evident from the table that anthracnose alone was responsible for 10.00 to 17.30 per cent loss, while stem end rot, mixed infections of both anthracnose and stem end rot and others (*A.niger* and *R. arrhizus*) were responsible for 6.70 to 9.10, 3.00 to 5.80 and 0.30 to 0.80 per cent respectively.

Retail level

Mango at this stage was more vulnerable for development of disease. The post harvest fungal spoilage was higher in retail market than other stages of marketing. The total loss in mango by different pathogens at retail market was 31.20 to 51.70 per cent. Of these, anthracnose accounted for 17.10 to 31.80 per cent, stem end rot 10.80 to 13.10 per cent, mixed infection 3.70 to 8.00 per cent and *Aspergillus* and *Rhizopus* rot together accounted for 0.60 to 0.90 per cent loss (Table 2).

Wholesale level

Fruits after harvest are received at wholesale market or mandies within a short period. Hence, the extent of post harvest loss in mango at wholesale market was less compared to retail and consumer levels (Table 3). At wholesale market the total loss was recorded as 2.30 to 3.60 per cent in which anthracnose contributed to 0.30 to 1.00 per cent, stem end rot 0.90 to 1.50 per cent, mixed infection 0.30 to 0.50 per cent and *A.niger* and *R.arrhizus* together accounted for 0.70 to 0.80 per cent loss.

Field Level

In the field after harvest, the fungal spoilage was still lower (1.10 per cent) when compared to other levels. It was observed that wound fungi such as *A.niger* and *R.arrhizus* (0.90 per cent) recorded higher incidence at field level than other diseases (0.00 to 0.30 per cent). Since, mechanical injury during harvest mostly predisposed the incidence of wound pathogen (Table 4).

The post harvest spoilage was higher in the months of July (47.90 and 41.50 per cent) and August (30.40 and 51.70 per cent) than May and June both in the consumer and retail markets. This was attributed to favourable post harvest environment and availability of susceptible varieties during July and August.

Table 3. Post harvest fungal spoilage in mango at wholesale market

Month	Variety	Percent Disease Index (PDI)				Total
		Anthracnose	Stem end rot	Mixed infection	Others*	
May, 2000	Shenduram	0.50	1.50	0.80	0.50	3.30
	Salem kundu	0.80	1.30	0.50	0.80	3.40
	Nadusalai	0.30	1.00	0.00	0.30	1.60
	Gudadad	1.00	1.80	0.50	1.50	4.80
	Mulgoa	0.60	1.50	0.00	0.30	2.40
	Banganapalli	2.30	2.60	0.80	1.80	7.50
	Kalepad	0.80	1.00	0.00	0.50	2.30
	Imampasand	1.50	1.00	0.00	0.80	3.30
	Mean	0.90	1.46	0.32	0.81	3.57
June, 2000	Shenduram	0.30	1.80	0.80	0.50	3.40
	Nadusalai	0.30	1.30	0.30	0.80	2.70
	Gudadad	1.00	2.00	0.80	1.30	5.10
	Mulgoa	0.80	1.50	0.50	0.30	3.10
	Bangalora	0.00	1.50	0.30	0.50	2.30
	Neelum	1.00	0.50	0.50	0.30	2.30
	Alphonso	1.00	1.50	0.00	1.50	4.00
	Dashehari	1.30	1.00	0.50	0.50	3.30
	Mean	0.71	1.38	0.46	0.71	3.33
July, 2000	Neelum	0.30	0.80	0.50	0.50	2.10
	Bangalora	0.30	1.00	0.30	0.80	2.40
	Mean	0.30	0.90	0.40	0.65	2.25
August, 2000	Neelum	0.80	1.00	0.30	0.80	2.90
	Mean	0.80	1.00	0.30	0.80	2.90
	Grand mean	0.70	1.19	0.37	0.75	3.01

* Others include *A.niger* and *R.arrhizus*

Among 13 varieties surveyed, Neelum showed higher decay due to anthracnose in the consumer and retail market and the disease incidence was noted to the extent of 17.3 to 21.0 per cent in consumer level and 31.8 to 41.3 per cent in retail level and the incidence of anthracnose at wholesale and field level was very meagre. In respect of stem end rot, Shenduram

variety recorded 12.5 to 14.5 per cent at consumer level and 19.6 to 27.3 per cent at retail market. The varieties susceptible to both anthracnose and stem end rot showed higher mixed infection. The extent of loss due to mixed infection in retail market varied from 6.0 to 9.0 per cent in Neelum, 5.8 to 6.5 per cent in Shenduram and 3.3 to 8.3 per cent in Mulgoa.

Anthracnose has been reported to cause heavy losses in mango to the extent of 15 per cent in India (Tandon, 1967), 29 per cent in Bangalore (Sohi *et al.*, 1973), 11 per cent in West Bengal (Mandal, 1981), 24 per cent in Lucknow (Omprakash and Raoof, 1988) and 29.6 per cent in Himachal Pradesh (Sharma *et al.*, 1993). Stem end rot incited by *Botrydiplodia theobromae* was reported to cause decay to the maximum extent of 20 per cent in India (Tandon, 1967), 50 per cent in Coimbatore (Palaniswami, 1978), 30 per cent in Lucknow (Omprakash and Raoof, 1988), 12.5 per cent in Bangladesh (Quroshi and Meah, 1991) and 26.7 per cent in Himachal Pradesh (Sharma *et al.*, 1993).

At retail and consumer levels, the mango fruits were in the stage of ripening or fully ripe, since, the symptoms of the diseases on unripe mango manifested only upon ripening. Diseases such as anthracnose caused by *C.gloeosporioides* (Daquioug and Quimo, 1979; Sangchote and Chayasombat, 1986; Chandra and Pathak, 1992) and stem end rot caused by *B.theobromae* (Pathak and Srivastava, 1967; Palaniswami, 1978; Chandra and Pathak, 1989) showed latent infections. This might be the reason for heavy loss in mango at retail and consumer levels as compared to other stages.

Mango season in Tamil Nadu starts from April and ends in August. It was observed that the extent of post harvest loss was higher in the months of July and August compared to other months. The stem end rot was generally severe during June and July (Palaniswami, 1978) and at the termination of the season owing to high temperature and relative humidity (Chandra and Pathak, 1989). According to Chandra and Pathak (1992), the maximum incidence of anthracnose was in the month of April in 12 varieties of mango surveyed. The incidence of diseases varied in different varieties as the varietal reactions to any disease can be expected

to affect the development of disease. Similar results were obtained by several workers (Pathak and Srivastava, 1967; Patel, 1972; Sohi *et al.*, 1973; Palaniswami, 1978; Quroshi and Meah, 1991).

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Table 4. Post harvest fungal spoilage in mango at farm level

Variety	Percent Disease Index (PDI)				
	Anthracnose	Stem end rot	Mixed infection	Others*	Total
Bangalora	0.00	0.50	0.00	1.30	1.80
Neelum	0.00	0.30	0.00	0.80	1.10
Panchavarnam	0.00	0.00	0.00	0.50	0.50
Nadusalai	0.00	0.30	0.00	0.80	1.10
Mean	0.00	0.26	0.00	0.85	1.13

* Others include *A.niger* and *R.arrhizus*

black rot, stem end rot and anthracnose diseases. *Int. J. Tropical Plant Diseases*, 6: 99-105.

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