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EFFECT OF DIFFERENT TEMPERATURES ON POST-HARVEST ROTS OF BANANA

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ABSTRACT

The fungi viz. *Fusarium pallidoroseum, Lasiodiplodiat heobromae, Colletotrichum musae and Vetricillium theobromae* were isolated and identified from diseased banana tissues Temperature management is critical for the reduction of post-harvest losses in banana. Storage of banana at 18ºC showed significant reduction in disease severity and grade of all post-harvest rots *viz.* crown rot, anthracnose and cigar end rot on both 5th and 7th day of storage. The disease severity (%) was found highest at 35ºC.

Keywords: Banana, crown rot, anthracnose, cigar end rot, post-harvest losses, temperature

INTRODUCTION

Banana is the common name for the members of the genus *Musa* belonging to the family *Musaceae*. It is a climacteric fruit and gives off large amounts of ethylene during ripening phase. It is the second most important horticultural crop of Sindh, cultivated on almost 66,000 acres with an average yield of 5-6 tons per acre (Qureshi, 2011). Around 126,000 metric tons of bananas are produced in Sindh annually and represents 85% of country's total banana production (SDF, 2009).

Post-harvest losses are of significant importance for overall agribusiness activity and can result in to rise in consumer prices and low returns to grower, processors and traders (SBP, 2008). About 50% production losses among the supply chains of fruits and vegetables are reported in South East Asia (FAO, 2011). Post-harvest diseases are reported to destroy 10-30% of the total yield of crops especially in developing countries (Agrios, 2000; Ilyas *et al.*, 2007; Kader, 2002). In Pakistan post-harvest losses are up to 35-40% of the total production (SDF, 2009).

Different post-harvest diseases reduce the quality and post-harvest life of banana. The most important of these include anthracnose (*Colletotrichum musae*), cigar-end rot (*Trachysphaeria fructigena* and *Verticilliumt heobromae*), crown rot (*Ceratocystis paradoxa, C. musae, Fusarium pallidoroseum, Lasiodiplodia theobromae* and *V. theobromae*), finger rot (*L. theobromae*), Johnson spot (*Magnaport hegrisea*) and squirter disease (*Nigrospora sphaerica*) (Sholberg and Conway, 2004). Rot producing fungi *viz.Lasiodiplodia theobromae, Colletotrichum musae, Fusarium moniliformae* and *Verticilliumt heobromae* are reported from banana during transport and storage in Pakistan (Ilyas *et al.*, 2007).

During the present studies, an emphasis was laid on the banana post-harvest disease assessment along with improvement of quality and was screened for the isolation of rot producing organisms. The effect of temperature on post-harvest rots of banana was investigated by artificial expensive of green mature banana to different temperature regimes.

MATERIALS AND METHODS

Survey of markets and storage godowns in Karachi was carried out to study the extent of different post-harvest rots affecting the banana fruit. Samples of diseased fruit were collected, diseased tissues were cut into 2-3 cm long pieces, surface sterilized with 2% NaOCl and placed in Petri plates containing Potato Dextrose Agar (PDA). The Petri plates were incubated at 28°C for 5-7 days and fungi growing on diseased tissue were isolated in pure culture. The fungi were identified after reference to Barnett and Hunter (1998), Domsch *et al*. (1980), Ellis (1971), Kulwant (1991), Nelson *et al*., (1983), Raper and Fennel (1965) and Watanabe (2002)**.**

The effect of temperature was assessed by surface sterilizing banana hands with 2% NaOCl solution for 2 minutes, washed with sterile distilled water and dried on sterilized blotter paper. With the help of a 5mm sterile cork borer wounds were created in each hand. To plug the wounds a 5mm diameter culture discs of fungi *viz*. *Fusarium pallidoroseum, Lasiodiplodia theobromae, Colletotrichum musae* and *Vetricillium theobromae* were cut from an actually growing culture. Intact banana hands with the application of plug of simple agar were set as controls. The

three replicated banana hands each carrying 8 fingers were stored at different recommended storage temperatures *viz*. 18^{0}C in cool incubator, 25-30^{0}C in ambient conditions and 30-35^{0}C at warm market conditions.

Disease severity (%) and grade were calculated by using two disease indices. For Crown rot a disease index based on a scale of 0-5 disease grades was used where, 0= apparently healthy fruits, 1= Slight infection, 2= 25% of the crown/fruit infected, 3= 50% of the crown/fruit infected, 4= 100% of the crown/fruit infected, 5= Entire crown/fruit infected and the infection is progressing towards the pedicels (Frossard and Laville, 1973). Whereas, for Anthracnose and Cigar end rot a disease index carrying 1-5 disease grades was used where, 1= 0% of fruit rotten, 2= 1-25% of fruit rotten, 3=26-50% of fruit rotten, 4= 51-75% of fruit rotten and 5= 76-100% of fruit rotten (Maqbool *et al*., 2010).The results were analyzed by Factorial Analysis of Variance and the means were separated by Duncan's Multiple Range Test (DMRT) (P≤0.05) by using Statistical Package for the Social Sciences (SPSS) Version 19 (SPSS Inc., USA).

RESULTS

The fungi viz. *F. pallidoroseum*, *L. theobromae*, *C. musae* and *V. theobromae* were isolated and identified from diseased banana tissues. The data on effect of temperature on crown rot, anthracnose and cigar end rot was as follows:

a. Crown rot

The significant main effect of temperature and time was observed The banana fruit stored at 18^{0}C showed lowest disease severity (%) and grade (M = 14.73, 19.73, SD = 1.4, 1.2, P ≤0.05) both on 5th and 7th day (Table 1). An increase in severity (%) and grade was observed with the increase in temperatures.

b. Anthracnose

The disease severity (%) and grade were significantly low in bananas stored at 18^{0}C (M = 18.9, 25.33, SD =1.67, 3.05, P ≤ 0.05) on both 5th and 7th day of storage showcasing the significant main effect of time and temperatures (Table 2).Whereas, the disease severity (%) and grade were highest at 35^{0}C.

c. Cigar end rot

Significant increase in disease severity (%) and grade was observed with the increasing temperatures and were highest at 35^{0}C (M = 41.3, 62.20, SD = 1.5, 2.1, P ≤ 0.05) on both 5th and 7th day of storage (Table 3). However, the disease severity (%) was lowest at 18^{0}C.

Table 1. Mean values and Standard Deviation of the effect of different temperatures on crown rot disease severity (%) and grade.

Temperatures	Time	Mean	Std. Deviation	N
18°C	5th Day	14.73	1.419	3
	7th day	19.73	1.250	3
	Total	17.23	2.988	6
25-30°C	5th Day	22.53	1.286	3
	7th day	35.70	2.893	3
	Total	29.12	7.484	6
35°C	5th Day	41.33	1.528	3
	7th day	54.67	2.082	3
	Total	48.00	7.483	6
Control	5th Day	64.67	1.528	3
	7th day	86.00	2.646	3
	Total	75.33	11.843	6

Table 2. Mean values and Standard Deviation of the effect of different temperatures on anthracnose disease severity (%) and grade.

Temperatures	Time	Mean	Std. Deviation	N
18°C	5th Day	18.93	1.677	3
	7th day	25.33	3.055	3
	Total	22.13	4.141	6
25-30°C	5th Day	33.33	3.055	3
	7th day	42.67	2.082	3
	Total	38.00	5.621	6
35°C	5th Day	43.00	2.000	3
	7th day	56.33	1.528	3
	Total	49.67	7.474	6
Control	5th Day	51.33	2.082	3
	7th day	75.67	3.512	3
	Total	63.50	13.576	6

Table 3. Mean values and Standard Deviation of the effect of different temperatures on cigar end rot disease severity (%) and grade.

Temperatures	Time	Mean	Std. Deviation	N
18°C	5th Day	13.33	1.528	3
	7th day	15.10	0.458	3
	Total	14.22	1.398	6
25-30°C	5th Day	37.00	2.646	3
	7th day	41.20	1.709	3
	Total	39.10	3.043	6
35°C	5th Day	41.33	1.528	3
	7th day	62.20	2.163	3
	Total	51.77	11.551	6
Control	5th Day	55.00	1.000	3
	7th day	78.33	2.082	3
	Total	66.67	12.863	6
	5th Day	36.67	15.761	12

DISCUSSION

Temperature management is the critical most factor for maintaining post-harvest quality and disease control in fruits and vegetables (Bachman and Earle, 2000; Sommer, 1989). Modification of temperature, relative humidity and atmospheric conditions during pre-storage, storage and transportation are significantly important to control post-harvest rots (Kader, 2002; Spotts, 1984). In the present studies, exposure and storage of banana handsto low temperature i.e. 18^0C significantly reduced the development of all post-harvest rots viz. crown rot, anthracnose and cigar end rot. However, at higher temperatures the fruit became subjected to higher disease severity (%) and grade. Thangamani *et al*. (2003) and Ramma *et al*. (1999) reported the similar results of least rot development and increased shelf life of banana at lower temperature. Average market life of 1-10 days stored at ambient temperature is reported by Chia and Huggins (2003). However, at higher temperatures i.e. 35^0C significant increase in rot

development was observed which confirmed the findings of Gowen (1995) and Slabaugh and Grove (1982) proposing higher rot development and alteration in the quality due to the modification of metabolism of banana fruits. It was revealed during present study that optimum growth of all rot producing fungi *viz*. *Lasiodiplodia theobromae*, *Colletotrichum musae*, *Fusarium pallidoroseum* and *Verticillium theobromae* was at 25-30^{0}C. Similar results were reported by Masudi and Bonjor (2012) and Nandini devi (2008). Ratule *et al*. (2006) reported the loss of marketability in terms of weight loss and change in peel color of banana fruit when stored at temperature equals to or below 5^{0}C. However, temperature beyond 35^{0}C is reported to be inhibitory and the growth of fungi ceases at higher temperatures (Prabakar, 1997; Prabakar *et al*., 2003). Cheng *et al*. (1998) also reported that fresh produce like fruits and vegetables when exposed to higher temperatures become subject to damage in terms to disease development and weight loss.

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