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Studies on the status of fungal fruit rot of tomato (*Lycopersicon esculentum*)

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ABSTRACT

Tomato (Lycopersicon esculentum) being an economically high value crop and cultivated both in greenhouses and in open field has been in great attention for its protection from pathogens. World losses in the tomato yield can be greatly referred to soil and air borne pathogens. Fungal pathogens are considered to be one of the highly damaging agents that cause the reduction of tomato production and after harvest losses. From the survey of incidence of post harvest fruit rot of tomato in various markets of district Srinagar conducted during 2012-13 it was observed that the fruit rot of tomato is prevalent in every location during the period of the survey with varied incidence at different locations and during different months. Lowest average percent disease incidence was recorded in the month of January and highest in the month of July. Among various locations surveyed, highest average annual percent disease incidence was recorded at Hazratbal and the lowest at Batmaloo. The pathogens isolated from infected fruit samples were identified as Rhizopus stolonifer, Aspergillus niger,Alternaria alternata, Fusarium oxysporum f. sp. lycopersici and *Phytophthora nicotianae.*

Key words: Status, Fungal, Fruit Rot, Tomato

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I INTRODUCTION

Tomato (*Lycopersicon esculentum*) originated from South America belongs to Solanaceae family is a widely grown vegetable in the world. The leading producer of tomato in the world is USA followed by China, Italy, Turkey, Egypt, Spain, Romania, Brazil and Greece. In Kashmir Valley (India), the crop is grown over an area of 1200 hectares with an average yield of 250-300 quintal per hectare (Anonymous, 2002). In Kashmir, tomato is attacked by variety of pathogens; predominant being the fungal fruit rots (Taskeen-un-Nisa *et al*.,2011). These fungal rots are responsible for causing serious production problems and become menace for successful cultivation of tomatoes in the valley. Fungal rots are world-wide in occurrence and have been reported almost in all parts of the world. Vegetables coming from the field may be already infected although they may not yet show visible symptoms at harvest which later on may cause severe damage at high temperature and humidity. The problem gets aggravated due to respiration of the living cells and poor transport technology. Present investigation was carried as no efforts till date have been carried out to explore the status of the tomato fruit rot in the district Srinagar.

II MATERIALS AND METHODS

For recording incidence of fruit rot, regular survey of the main vegetable markets (*viz*.,Hazratbal, Nowhatta, Batmaloo and Bemina) of district Srinagar was conducted in a systematic manner from September 2012 to August 2013. The disease incidence was recorded by counting number of fruits showing rotting symptoms and worked out by formula:

$$\text{Percent disease incidence} = \frac{\text{No. of infected fruits}}{\text{Total No. of fruits observed}} \times 100$$

Moreover tomato fruits showing typical fruit rot symptoms were collected once from the markets and also from Shalimar Campusfor the purpose of isolation of the pathogens.

ISOLATION OF FUNGAL PATHOGENS

Isolation of fungi was made in Laminar Air Flow Chamber (Narang Scientific Works, NSW Pvt. Ltd. GI-111, Mayapuri, New Delhi) by following the standard tissue bit method (Mamatha and Rai, 2004).The infected portion of the tomato fruits were cut into small bits measuring about mm and surface sterilized with 0.1% mercuric chloride for one minute. The bits were then rinsed thrice in a sterilized distilled water and then aseptically transferred to the plates containing Potato Dextrose Agar (PDA) media, incubated in BOD incubator (Narang Scientific Works, NSW Pvt. Ltd. GI-111, Mayapuri, New Delhi) at 28±1 °C and observed periodically for fungal growth.

PURIFICATION OF FUNGAL PATHOGENS

The culture obtained was purified in Laminar Air Flow Chamber (Narang Scientific Works, NSW Pvt. Ltd. GI-111,

Mayapuri, New Delhi) by single spore and hyphal tip isolation methods. Hyphal tip isolation was done on water agar plates. Ten ml of clear, two per cent water agar was poured into sterile petriplates and allowed to solidify. Dilute spore suspension (8-10 spores/ml) was prepared in sterile distilled water. One ml of such suspension was spread uniformly on two per cent water agar plates. Single spore was then marked under the microscope (Leica Hiplan 1359500, China) with ink on the glass surface of the plate and it was allowed to germinate. Such plates were incubated in BOD incubator (Narang Scientific Works, NSW Pvt. Ltd. GI-111, Mayapuri, New Delhi) at 27±1 °C and periodically observed for germination of spores under the microscope. Hyphae coming from each end cell of the single spore was traced and marked with the ink. Then tip of hypha was cut and transferred to PDA slants under aseptic conditions and incubated at temperature of 27±1 °C for 5 days. Later, mycelial bits of the fungus were placed in the center of petriplates containing PDA medium and incubated at 27±1 °C for 5 days. No saltation or sectoring was observed in the culture and it was concluded that, it was a pure culture of the fungus.

IDENTIFICATION OF THE PATHOGENS

The culture thus obtained was observed under the microscope (Leica Hiplan 1359500, China) for various cultural and morphological characters.

III RESULTS AND DISCUSSION

During the course of survey it was found that fruit rot of tomato is prevalent in all the markets of the district Srinagar with varied incidence at different locations (Table 1) and during different months of the year (Table 1). From the periodic surveys and upon comparison of the weather parameters of temperature and humidity over the year 2012 and 2013 it is clear from Fig.1 that the disease is severe in hot summer months and comparatively less severe in cooler months of the year (Fig-1).Among various locations surveyed, highest average annual disease incidence was recorded at Hazratbal (18.29%) followed by Nowhatta (17.17%) and Bemina (15.82%). Lowest average disease incidence of 14.6 per cent was recorded at Batmaloo. Among different months surveyed, highest average disease incidence (35.61%) was recorded in the month of July followed by the incidence of 30.32 and 28.81 per cent in the month of June and August, respectively. The disease incidence of 27.27, 21.97, 12.50, 11.82, 10.87, 8.32, 4.37 and 3.13 per cent was examined in September, May, October, April, March, November, February and December respectively. Lowest average disease incidence of 2.56 per cent was recorded in the month of January. Decreasing trend of fruit rot incidence was apparently found from month of September to January but it was increased from the month of February to July in all the vegetable markets of district Srinagar with changes in temperature and relative humidity as shown in Fig. 1. As the temperature increases the disease also increases reaching its peak during July and. Temperature and relative humidity are the important components of environment which affect sporulation and respiration of fungal microbes and have therefore a strong bearing on the development of an ailment caused by fungal microorganisms. Less rotting in winter is seen, as low temperature reduces respiration, sporulation and enzymatic degradation capacity of microbes. Similar trend was also reported by

Bhat *et al*. (2010). Among various locations surveyed, incidence of disease was highest in Hazratbal followed by Nowhatta and Bemina whereas least disease incidence was recorded in Batmaloo. It is worthwhile to mention that the tomatoes are supplied to different markets of district Srinagar from wholesale vegetable market of Batmaloo which receives the freshly harvested tomatoes sooner after harvest. The tomatoes are dispatched to other locations after some time gap from this main market. Due to this reason, least fruit rot incidence was recorded at Batmaloo.

On the basis of cultural and morphological characteristics the pathogens were identified as *Rhizopus stolonifer* (Ehrenberg ex. Fr.) Lind, *Aspergillus niger* Van Teighem, *Alternaria alternata* (Fr.) Keissler, *Fusarium oxysporum* f. sp. *lycopersici* (Sacc.) W.C. Snyder and H.N. Hans, and *Phytophthora nicotianae* Breda de Haan.(Fig. 2). The identity of the pathogens was confirmed from the Division of Plant Pathology, SKUAST Kashmir, Shalimar.

The pathogens *viz.Rhizopus stolonifer*, *Aspergillus niger*, *Alternaria alternata*, *Fusarium oxysporum* f. sp. *lycopersici* were isolated from the tomato samples brought from local markets,where as the pathogen *Phytophthora nicotianae* was isolated from the tomato samples brought from Shalimar campus. The cultural and morphological observations also agreed with the description for *Alternaria alternata* Abeer *et al*. (2014), *Phytophthora nicotianae* Mounde *et al*. (2012), *Fusarium oxysporum* f. sp. *Lycopersici* Nirmaladevi and Srinivas (2012) and Chopada *et al*. (2015), *Rhizopus stolonifer* Kwon *et al*. (2001), *Aspergillus niger* Diba *et al*. (2007).

Table 1: Per cent disease incidences of fruit rot of tomato (*Lycopersicon esculentum*) in the markets of district Srinagar during 2012-2013

District	Location	Month												Mean±S.E
		Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June	July	Aug.	
Srinagar	Hazratbal	29.20	13.80	10.50	3.60	3.00	5.80	12.80	14.54	24.50	32.50	37.17	32.00	**18.29±3.51**
	Nowhatta	28.40	12.70	8.90	3.40	3.10	4.40	11.30	13.33	22.00	31.70	36.58	30.20	**17.17±3.47**
	Batmaloo	25.00	11.20	6.40	2.35	1.42	3.30	9.20	9.09	20.00	27.00	33.90	25.93	**14.6±3.23**
	Bemina	26.50	12.30	7.50	3.20	2.53	4.00	10.20	10.34	21.40	30.10	34.80	27.14	**15.82±3.32**
Mean ±S.E		**27.27 (±0.94)**	**12.50 (±0.53)**	**8.32 (±0.88)**	**3.13 (±0.27)**	**2.56 (±0.40)**	**4.37 (±0.52)**	**10.87 (±0.77)**	**11.82 (±1.28)**	**21.97 (±0.94)**	**30.32 (±1.21)**	**35.61 (±0.76)**	**28.81 (±1.39)**	

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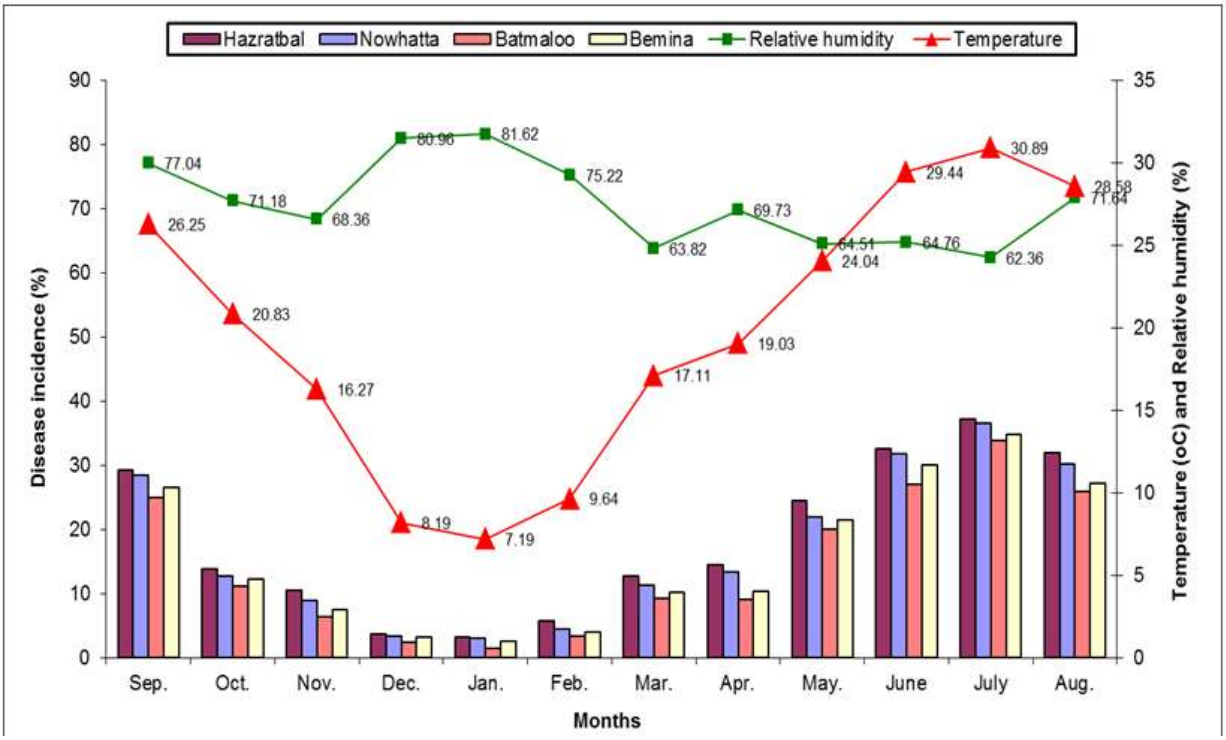
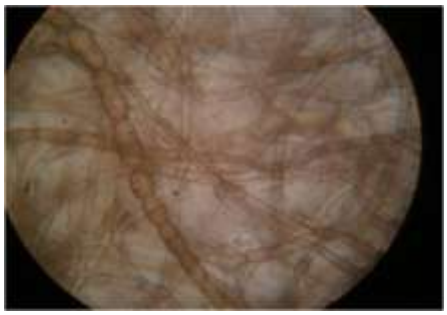
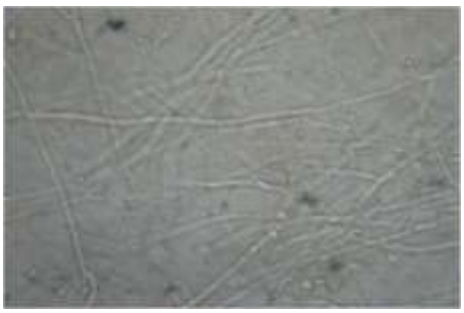
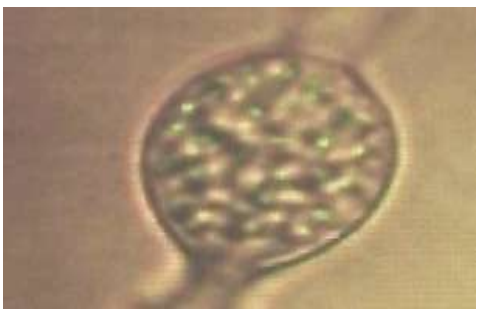


Fig. 1: Per cent disease incidences of fruit rot of tomato (*Lycopersicon esculentum*) in the markets of district Srinagar during 2012-2013







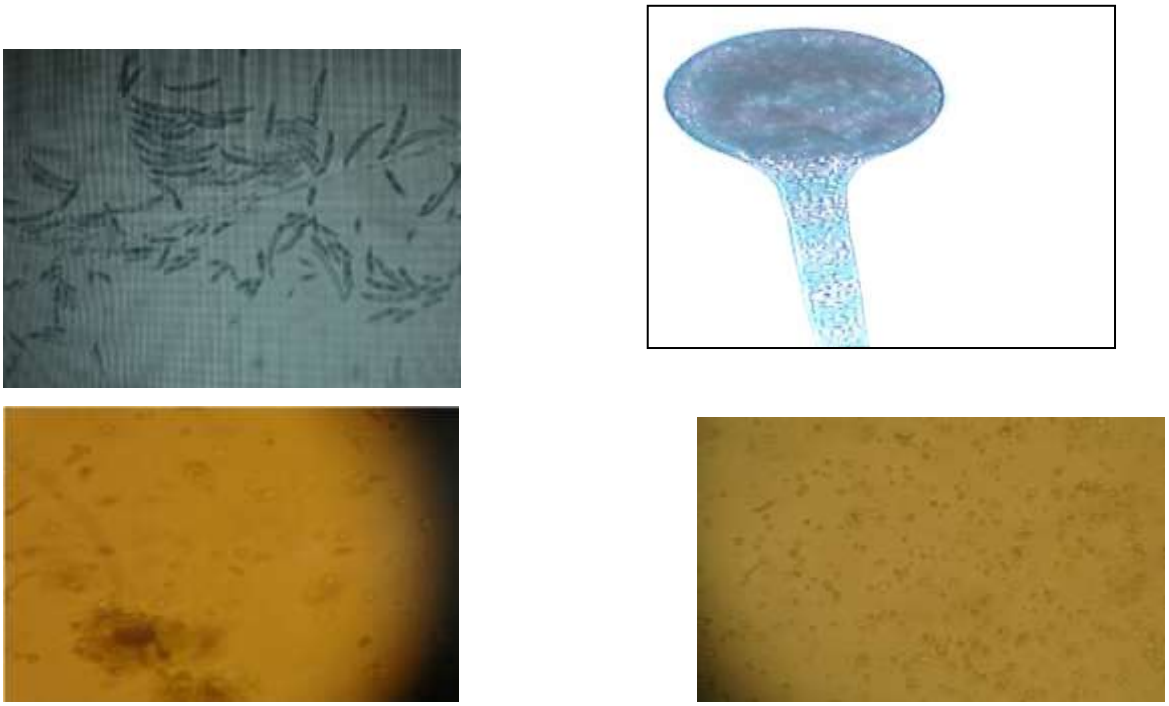


Fig. 2: Microscopic observations of Conidia of *Alternaria alternata,* Brownish septate conidiophores with simple olive-brown septate of *Alternaria alternata,* Hyphae of *Phytophthora nicotianae,* Sporangia of *Phytophthora nicotianae and* Conidia of *Fusarium oxysporum* f. sp. Lycopersici, Sporangia and sporangiophores of *Rhizopus stolonifer,* Conidia of *Aspergillus niger,* Conidiophore of *Aspergillus niger*

IV CONCLUSION

It can be thus concluded that since the incidence of fruit rot in tomato is highest during summer months in comparision to winter months, they can be prevented from spoilage by treating them at low temperature as low temperature reduces respiration, sporulation and enzymatic degradation capacity of microbes.

Among various locations surveyed,as the incidence of disease was highest in Hazratbal followed by Nowhatta and Bemina whereas least disease incidence was recorded in Batmaloo. It is worthwhile to mention that the tomatoes are supplied to different markets of district Srinagar from wholesale vegetable market of Batmaloo which receives the freshly harvested tomatoes sooner after harvest. The tomatoes are dispatched to other locations after some time gap from this main market. Due to this reason, least fruit rot incidence was recorded at Batmaloo.

In view of the above it is recommended that:

1) Tomato vendors should be given intensive training related to post harvest handling of the produce at government level. Such training should cover improved technologies including grading, packaging, pre-cooling, storage and transportation. This will help in avoiding post harvest losses in tomato leading to an increase in their the income.

2) Organized regular markets should be developed in the area to provide opportunities to vendors for getting better market price to increase their returns.

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