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Incidence of Post-harvest Blue Mould Rot Disease of Indian Gooseberry (*Emblica officinalis* Goerth.) Incited by *Penicillium islandicum* Sopp.

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ABSTRACT

Background: Aonla or Indian gooseberry (*Emblica officinalis* Goerth. Syn. *Phyllanthus emblica* L.) is one of the most important indigenous fruit of Indian sub-continent and cultivated since time immemorial. Amongst post-harvest diseases of aonla, blue mould rot caused by *Penicillium islandicum* Sopp. is most important as it affects the fruit yield and quality pertaining to the market value.

Methods: A survey was conducted during November to January 2015-16 to assess the post-harvest practices and losses of Indian gooseberry in four locations of Hisar and Rewari districts of Haryana *viz*., CCS HAU Hisar orchard, terminal market of Hisar, Regional Research Station, Bawal orchard and terminal market of Rewari.

Result: The survey carried out from first fortnight of November to last fortnight of January, 2015-16 revealed that the maximum per cent disease incidence (6 and 7.50%) due to blue mould rot was observed in terminal markets of Rewari and Hisar districts, respectively. The disease incidence was 7.0 and 6.25 per cent in fruits collected from orchards of CCS HAU, Hisar and RRS, Bawal respectively after 10 days of storage in laboratory. Some indigenous postharvest practices were observed being practiced in all the growing areas mostly by the growers and /or traders involved in harvesting.

Key words: Blue mould rot, Disease incidence, Indian gooseberry, *Penicillium islandicum,* Survey.

INTRODUCTION

Aonla or Indian gooseberry (*Emblica officinalis* Goerth. Syn. *Phyllanthus emblica* L.) is one of the most important indigenous fruit of Indian sub-continent and cultivated since time immemorial. It is said to be the very first tree that originated on earth, as claimed by age-old Indian mythology. Almost all parts of the tree *i.e.,* root, bark, leaf, flower, fruit and seed are utilized in Ayurvedic and Unani medicinal formulations to improve the overall digestive process, decrease fever, act as a blood purifier, relieve asthma and cough and improves heart health (Gantait *et al.,* 2021). Aonla fruit contains different essential nutrients *i.e.* carbohydrates, proteins, phenol, calcium, phosphorus, zinc and vitamin B. It is a rich source of vitamin C ranging from 400-1300 mg/100 g pulp and vitamin B content 300 mg/ 100 g pulp (Srivasuki, 2012). It grows in tropical and subtropical parts of India, China, Indonesia and the Malay Peninsula (Golechha *et al.,* 2012). In India, nearly 20-35 per cent of perishable fruits and vegetables are deteriorated due to post harvest diseases (Rawal and Saxena, 2005). Infection by fungi and bacteria may occur during the growing season, at harvest time, during handling, storage, transport and marketing, or even after purchase by the consumer (Dennis, 1988). Sengupta *et al.* (2020) described numerous post-harvest diseases of aonla that occurred during various stages. The losses to a particular disease vary from place to place because of the existence of different races, biotypes or strains of the pathogen. The fruits are injured during picking, packaging and transportation also, which make major avenues for infection by the various pathogens (Yadav *et al.*, 2012). Aonla is prone to various diseases causing losses from 5-21% (Jat and Goyal, 2003). Amongst post-harvest diseases of aonla, blue mould rot caused by *Penicillium islandicum* Sopp. Is most important as it affects the fruit yield and quality pertaining to the market value. Morton and Miami (1987) reported that in the market, fruits have been found contaminated with yeast, molds and bacteria during storage that were subjected to blue mould and rotting caused by *Penicillium islandicum*. Among post-harvest diseases in aonla, fruit rot caused by *Penicillium islandicum* Sopp. can cause significant losses (Radha and Mathew, 2007; Akhund *et al.*, 2010). *Penicillium* rot has been observed as a common disease of aonla (Rathod, 2010). The losses to the extent of 58.33 per cent have been observed due to Blue mould rot disease of Aonla (Akhund *et al.* 2010). Survey of diseases carried out at various locations could help in devising remedial measures to

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manage post-harvest diseases. The present study was carried out to assess post-harvest practices/losses of aonla at two different locations of Haryana.

MATERIALS AND METHODS

Periodical survey of orchards in Chaudhary Charan Singh Haryana Agricultural University, Hisar (Haryana) and its Regional Research Station, Bawal District Rewari along with fruit collection centres were carried out at fortnightly interval during November 2015 to January 2016. Aonla fruits were collected from each location and stored under laboratory conditions for disease development. Five samples were collected randomly amongst 100 fruits each brought to the laboratory. Fruits showing blue mould rot symptoms were counted at 0 day (day of collection), after 5 and 10 days of storage.

The per cent disease incidence was calculated by following standard formula:

$$\text{Disease incidence (\%)} = \frac{\text{Number of infected fruits}}{\text{Total number of fruits examined}} \times 100$$

RESULTS AND DISCUSSION

In present study, periodic survey of aonla orchards at CCS HAU, Hisar and Regional Research Station, Bawal along with Hisar and Rewari markets was conducted to record the incidence of blue mould rot. The data presented in Table 1 revealed that blue mould rot was prevalent in fruits of aonla collected from orchard of Chaudhary Charan Singh Haryana Agricultural University, Hisar including markets. The highest disease incidence of blue mould rot was recorded during month of January. Disease incidence on 1st and 15th January was observed to the tune of 7.50 per cent in Hisar terminal market and disease incidence was 7.00 per cent in fruits collected from CCS HAU orchard on 15th January at 10 days of storage. The per cent disease incidence in fruits collected on 1st and 15th January from Hisar market was 3.50 and 5.50 respectively at 5 days of storage. The disease incidence was 3.00 and 5.00 per cent in fruits collected from CCS HAU orchard on 1st and 15th January, respectively at 5 days of storage. The minimum disease incidence was observed in the month of November. The disease incidence in fruits collected from terminal market of Hisar on 1st and 15th November was 1.25 per cent at zero day whereas the incidence was 1.0 and 1.5 per cent in fruits of CCS HAU orchard at zero day of storage. The incidence increased to 2.00 and 2.75 per cent after five and ten days of collection respectively in fruits collected from Hisar terminal market while the corresponding disease incidence in fruits collected from CCSHAU, Hisar orchard was 2 and 2.5%, respectively.

The data depicted in Table 2 revealed that fruits collected from terminal market of Rewari and Regional Research Station, Bawal Orchard increased with increase in duration of storage of fruits. Maximum per cent disease incidence of 6.00 and 6.25 per cent respectively was observed in fruits collected on 20th January from terminal market of Rewari and Regional Research Station, Bawal Orchard after ten days of storage. Minimum disease incidence (1.00 per cent and 0.75 per cent) was observed in the fruits collected from Regional Research Station Bawal orchard in the month of November. The disease incidence upsurged to 1.25 and 2.25 per cent after 5 days and 2.25 and 2.50 per cent after 10 days in the fruits collected from RRS Bawal orchard and terminal market of Rewari on 5th November, respectively. The per cent disease incidence in fruits collected from Rewari terminal market was 2.25 and 3.50 per cent on zero day of collection of fruits on 5th January and 20th January, respectively.

Various researchers have reported the occurrence of blue mould rot of aonla at various locations during survey. Arya and Arya (2004) recorded 20 per cent fruit rot in aonla due to *Aspergillus terreus* from Vadodara market. Kaiser and Saha (2005) recorded 15 to 20 per cent fruit spoilage in aonla due to brown rot (*Penicillium* spp.) from Bolapur, Suri and Jhargram markets of West Bengal. Meena (2006) revealed the incidence of *Penicillium* rot of aonla

Table 1: Incidence of blue mould rot in aonla fruits collected from CCS HAU, Hisar orchard and terminal market of Hisar.

Date of collection	Per cent disease incidence*					
	0-Day		5-Days		10-Days	
	CCS HAU, Hisar orchard	Hisar terminal market	CCS HAU, Hisar orchard	Hisar terminal market	CCS HAU, Hisar orchard	Hisar terminal market
Nov. 01	1.00 (5.04)**	1.25 (6.33)	2.00 (7.99)	2.00 (7.53)	2.50 (9.05)	2.75 (9.51)
Nov. 15	1.50 (6.93)	1.25 (6.93)	1.75 (7.53)	2.50 (9.05)	3.50 (10.75)	3.75 (11.14)
Dec. 01	1.50 (6.93)	2.00 (7.99)	2.75 (9.51)	3.00 (9.90)	4.50 (12.22)	5.00 (12.88)
Dec. 15	1.75 (7.53)	2.25 (8.59)	2.75 (9.44)	3.00 (11.49)	5.75 (13.84)	6.25 (14.46)
Jan. 01	2.25 (8.59)	2.25 (8.59)	3.00 (9.90)	3.50 (12.22)	6.75 (15.03)	7.50 (15.32)
Jan. 15	2.25 (8.59)	2.50 (10.75)	5.00 (12.88)	5.50 (13.54)	7.00 (16.41)	7.50 (17.19)
CD (P=0.05) Market × Orchard (Main treatment)				0.40		
Days (Sub treatment)				0.49		
Interaction				0.70		

*Average of four replications; **Figures in parentheses are angular transformed values.

Table 2: Incidence of blue mould rot in aonla fruits collected from Regional Research Station, Bawal orchard and terminal market of Rewari district.

Date of collection	Per cent disease incidence*					
	0- Day		5- Days		10- Days	
	RRS, Bawal orchard	Rewari terminal market	RRS, Bawal orchard	Rewari terminal market	RRS, Bawal orchard	Rewari terminal market
Nov. 05	1.00 (5.74)**	1.50 (6.93)	1.25 (6.33)	2.25(8.45)	2.25 (8.59)	2.50 (9.05)
Nov. 20	0.75 (4.45)	2.50 (8.59)	2.50 (9.05)	1.50 (6.80)	3.50 (10.75)	2.50 (9.05)
Dec. 05	1.50 (6.93)	2.25 (8.45)	2.00 (7.99)	2.50 (9.05)	3.00 (9.90)	4.00 (11.49)
Dec. 20	1.75 (7.53)	3.25 (10.36)	3.00 (9.90)	2.25 (8.45)	4.50 (12.22)	5.25 (13.49)
Jan. 05	2.75 (9.44)	2.25 (8.45)	4.50 (12.22)	5.50 (13.49)	5.00 (12.88)	5.75 (13.80)
Jan. 20	2.25 (8.45)	3.50 (10.75)	4.50 (12.22)	5.25 (13.23)	6.25 (14.44)	6.00 (14.15)
CD (P=0.05) Market × Orchard (Main treatment)				0.44		
Days (Sub treatment)				0.54		
Interaction				0.77		

* Average of four replications; **Figures in parentheses are angular transformed values.

predominant in all the months in fruits collected from Chomu and Jobner markets, however that was maximum during month of April. Waghunde (2008) noted the presence of various fruit rots of aonla *i.e. Penicillium*, *Colletotrichum*, *Alternaria*, *Phomopsis*, *Aspergillus*, Internal necrosis and others, during two years of study. Yadav *et al.* (2013) reported blue mould rot incidence of aonla due to *Penicillium funiculosum* in the transit and storage phase and recorded maximum disease incidence of *Penicillium* rot of aonla to the tune of 4.93 per cent at vegetable market Anand (Gujarat).

However, in present study the highest disease incidence of blue mould rot was recorded in the month of January. The minimum disease incidence was observed in November month in the fruits from different orchards and markets. These variations could be due various climatic conditions prevailing in particular region and occurrence of different mycoflora.

CONCLUSION

In present study, it was observed that blue mould rot caused by *P. islandicum* was found prevalent in the fruits collected from orchards and markets. Fortnightly survey carried out from first week of November to 3rd week of January, 2015-16 revealed that the maximum per cent disease incidence of blue mould rot (6 and 7.50%) was observed in terminal markets of Hisar and Rewari districts. The disease incidence in the fruits of CCS HAU, Hisar orchard and Regional Research Station, Bawal orchard was 7.0 and 6.25 per cent respectively.

Conflict of interest

All authors declare that they have no conflict of interest.

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