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POST-HARVEST ECO-FRIENDLY MANAGEMENT OF *PENICILLIUM EXPANSUM* CAUSING BLUE MOLD OF ONION

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A B S T R A C T

Onion is one of the most important salad and vegetable plants in all parts of Pakistan. Onions in storage are being affected by different types of diseases, but Blue Mold of Onions is one of the most important detrimental post-harvest diseases of onions. The research was conducted in the Plant Pathology Laboratory at Sindh Agriculture University, Tando Jam, to manage *Penicillium expansum* by applying different Botanical extracts, Viz., Caramon, Garlic and Neem. The efficacy of all three botanicals was tested on storage onion with three replications and data was collected at four days' intervals. After statistical analysis, it was observed that all three botanicals cause significant reductions in the rot severity of onion in storage: among the three botanicals, Neem was found most effective in reducing rot severity, followed by garlic and caramon.

Keywords: Onion, *Penicillium expansum*, Botanicals, Blue mold

INTRODUCTION

Onion (*allium cepa* L.) was originally native to Central Asia, Later, onion spread to other parts of the world, and found their way to the Egyptian trade, becoming a crucial food plants. Pakistan has been on the list of the leading onion producers in the world. China ranks first in the world concerning onion production, followed by India, the USA, Turkey, Pakistan, Iran, Indonesia, Vietnam and Myanmar. In Pakistan, onion is grown on an area of 135.1 thousand hectares with an annual production of 1,763.0 thousand tonnes, and is also an important vegetable in the country (FAO, 2019). In Pakistan, the onion was cultivated on an area of 141.0 thousand hectares with a production of 2,108.8 thousand tons,, showing an 8.5 percent reduction in production over the preceding year, 2019-2020, when the onion was cultivated on an area of 153.8thousand hectares with a production of 2,305.7 thousand tons (GOP, 2020-21). Many *Penicillium* species are responsible for post-harvest illness. *Penicillium expansum* is a major post-harvest pathogen that causes blue mold rot in onions and blue mold in various horticultural vegetables (Khokhar and Rukhsana, 2014). Some species and subsidiaries have an inhibitory action on microbial poison. They could be utilized as helpful antimicrobial mixes for guaranteed stable food (Souza *et al.,* 2005; Ali *et al*., 2023). Species of *Penicillium* were universal soil parasites preferring cool and direct atmospheres, and normally showed where biological matter was accessible. Saprophytic types of *Penicillium* and *Aspergillus* were among the finest identified agents of the Eurotiales and survived primarily on natural decomposable matters. Generally referred to as molds, they were among the primary drivers of nourishment waste, particularly types of subgenus *Penicillium* (Samson *et al.,* 2004).

The present studies used different botanical extracts against post-harvest blue mold rot of onion. It is hoped that the research may provide sufficient control measures against blue mold rot of onion.

MATERIAL AND METHODS

The experiment was conducted in the Plant Pathology

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Labouratory of Sindh Agriculture University, Tando Jam, to evaluate different plant extracts against blue rot of onion under storage conditions. A sample of onion bulbs was collected from different markets of Quetta and then stored at room temperature for observation of different pathological aspects in the Plant pathology lab. When the pathogen appeared on stored onion, it took one and a half weeks. Rinsed infected bulbs with 70% ethyl alcohol solution for 1 minute and with distilled water as no other material was left on the onion. Disinfected bulbs were cut into pieces plated on Potato Dextrose Agar medium, and incubated at 28 ºC for seven days. When germination started, the culture was purified by transferring it to other petri plates. When pure culture was received, these were re-isolated in agar slants containing Potato Dextrose Agar media.

Table 1. Plant Extracts used against *Penicillium expansum*

S.No.	Plant Extract	Botanical Name
1	Caramon	*Elettaria cardamomum.*
2	Garlic	*Allium sativum*
3	Neem	*Azadirachta indica*

Application of Plant Extracts on Stored Onion: Fresh samples of onion bulbs were dipped distinctly in plant extract for 5 minutes. Onion bulbs were left dry in a cardboard tray under a shade. After drying, these bulbs were marked with permanent marker and then these marked areas were injured using a pinprick strategy to identify their ability to withstand the post-harvest diseases under storage. After the injury, the inoculum was swabbed with moist cotton on the healthy onion bulbs (Naik and Rawal, 2002; Nawaz *et al*., 2022; Alhadidy, 2023). After inoculation, these onions were stored at 28°C under 80% relative humidity (Erdogan and Mustafa, 2021).

Effect of plant extracts on rot severity: The effect of Plant Extract was checked on onion in storage. The Severity rot was calculated by following the formula and grade scale adopted by McKinney, 1923 and Wani and Nisa, 2011.

$$\text{Disease severity\%} = \frac{\text{The sum of all numerical rotting}}{\text{No. of plants examined} \times \text{maximum grade value}} \times 100$$

Table 2. Disease rating scale for calculation of severity rot

Grade	Extent of rotting	Numerical score (%)
0	No rotting	0
1	Pin head to 10mm	10
2	Up to 1/4th of the onion bulb	25
3	Up to ½ of onion bulb	50
4	Up to 3/4th of the onion bulb	75
5	More than 3/4th of onion bulb	100

(Mckinney, 1923; Wani and Nisa, 2011)

Calculation of mycelial growth: The following formula computed the mycelial growth percentage:

$$\text{Mycelial growth inhibition (\%)} = \frac{(\text{dc} * - \text{dt} **)}{dc} \times 100\%$$

*average diameter of the fungal colony in control ** average diameter of the fungal colony in the treatment group.

STATISTICAL ANALYSIS

The composed data was evaluated statistically by using a Factorial Design and treatment averages were equated by using the Significant Difference (LSD) test at a 5% level of significance.

RESULTS

Effect of Plant Extracts on Severity of Rot: Table 3 disclosed that all the plant extracts gave an assured effect in reducing the severity of rot of onion in storage caused by *Penicillium expansum* when compared with control. After statistical analysis of data, results showed that Neem provided the most effective control (33.0) against *Penicillium expansum,* followed by garlic (50.0), Caramon (91.33), respectively and on control onion disease was at a high level with (91.67) and rotten the onions after 20 days of inoculation.

Table 3. Effect of Plant Extracts on Severity of Rot

T	Treatment	Rot Severity After					Mean	Disease severity %	Severity reduction %
		4 days	8 days	12 days	16 days	20 days			
T_1	Caramon	7.33	10.00	25.00	33.00	91.33	33.33	51.28	48.72
T_2	Garlic	0.00	6.67	20.00	41.67	50.00	23.67	36.41	63.59
T_3	Neem	6.67	10.00	25.00	33.00	33.67	21.67	33.33	66.67
T_4	Control	10.00	10.00	25.00	58.33	91.67	39.00	60.00	40.00

Pairwise comparisons test of severity rot for botanicals: Table 4 disclosed that all the plant extracts gave an assured effect in reducing the severity of rot of onion in storage caused by *Penicillium expansum* compared with the control. After statistical, data analysis, results showed that Neem provided the most effective control (33.33) against the pathogen, followed by garlic (36.41). Caramon (51.28) and while on control (60.00), rotting was observed against *Penicillium expansum.*

Table 4. Pairwise comparisons test of severity rot for botanicals

Disease Severity % Botanicals				
T	Treatment	Disease Severity %	Homogeneous Groups	
T_2	Garlic	36.41	B	
T_3	Neem	33.33	D	
T_4	Control	60.00	A	
Alpha		0.05	Standard Error for Comparison	1.722
Critical T Value		2.306	Critical Value for Comparison	3.9709
Error term used:		Error, 8 DF		

All 4 means are with significant results.

DISCUSSION

Penicillium species, causing blue mold rot, show similar symptoms as stated by earlier scientists. The result revealed that blue mold rot of symptoms on onions appeared as whitish lesions, which were further changed to bluish lesions or blue. Bulb shows blue mold covered with yellow lesions when the disease is severe. The bulb becomes soft to the touch and the surface is easily detachable. As demonstrated (Oh *et al.,* 2015).

The present study revealed that Aerosol (Thiophanate Methyl) was found effective against the mycelial growth of *Penicillium species,* followed by Acetic acid and Puslan (Matalaxyl+ Mancozeb), as reported by earlier Carbendazim followed by Thiophanate-methyl found most effective fungicides against *Fusarium oxysporum* f. sp. *Vasinfectum* (Rajput *et al.,* 2006; Toka *et al*., 2023) and Benlate followed by Thiophanate Methyl and Thiram afford the best fungal check at the rate of 3 and 3.5 g kg-1. Against *Aspergillus flavus, A. niger and Fusarium moniliform.* Mancozeb, Fosetyl aluminium and Metalaxyl plus mancozeb interrupt all the fungi at 3.5 g kg-1. Dimethomorph was almost non-effective to exclude the fungi (Saleem *et al.,* 2012; Ateeq *et al.,* 2023; Ambreen *et al.*, 2022).

Treatment of different genera Aspergillus, Fusarium,, and Penicillium, that affect Maize were observed with different fungicides Antracol (propineb), Milraz (combination of propineb and Cymoxanil), Mistress (Mixture of Cymoxanil and Mancozeb) and Victory (mixture of Metalaxyl and Mancozeb) mistress and victory show 0% infestation while.Milraz and antracol revealed 10% and 14% infestation, respectively (Ajmal *et al*., 2023; Tonui *et al.*, 2014).

The present study showed that in storage, Coriander gave an effective result. This result was due to the fungicidal effect of plant extract. It is outstanding for its utilization in food because of various medical advantages and its defensive impact saving the for more periods (Bhat *et al.,* 2014; Hanif *et al*., 2023; Mehmood *et al*., 2022).

CONCLUSION

It was concluded that Neem and Garlic had significant results in controlling the Blue mold disease of onion in storage conditions, which farmers can practice for minimizing the storage losses of onion as per conducted research.

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Muhammad Waris	:	Conceived idea and wrote original manuscript.
Manzoor A. Abro	:	Editing of manuscript.
Jamal-U.D. Hajano	:	Conduct research and contributed in manuscript write up.
Arfan A. Gilal	:	Data analysis