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Variability of *Stemphylium vesicarium* on Onion (*Allium cepa* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The onion (*Allium cepa* L.) crop is affected by a number of diseases in the field as well as in storage which cause a significant reduction in yield leading to heavy losses each year depending on weather conditions. Leaf blight and leaf spot caused by *Stemphylium vesicarium* is one such disease that affects onion plants in field causing purple coloured spots and blighting of leaves, particularly in seed production plots. During investigations of the pathogen, it was found that there was a considerable variation in the conidial characteristics of *Stemphylium* species compared to the available literature. *Stemphylium vesicarium* was invariably found associated with typically blighted onion leaves throughout the growing period (82.75 per cent in January to 77.40 per cent in February), though its relative occurrence declined slightly in March (49.15 per cent) and April (37.75

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per cent). The average conidial dimensions of *Stemphylium vesicarium* recorded were 43.54 ± 0.44 µm X 25.57 ± 0.36 µm with l/w ratio ranging from 1.40-2.13. It can be concluded that there are significant variations in the conidial dimensions of *S. vesicarium* obtained from host and grown under *in vitro* conditions. Differences also exist in the conidial dimensions of isolates from different geographical regions which indicates that further studies are required at molecular level to decipher the reasons and implications.

Keywords: Stemphylium; leaf blight; variation; onion; commercial varieties; Stemphylium species; economical yields.

1. INTRODUCTION

Stemphylium vesicarium is an important pathogen of onion which causes considerable losses in the economical yields, particularly when the conditions of disease development are favourable. The pathogen was first recorded on onion by Rao and Pavgi [1] in the months of December and January from India. It was reported to cause significant damage during 1976, both alone and in combination with *Alternaria porri* [2]. It has become a serious threat among the pathogenic foes of onion crop, as almost all the commercial varieties are found susceptible to this disease. It has been reported to cause up to 80–85 per cent losses [3]. Shishkoff and Lorbeer [4] isolated *S. vesicarium* from lesions on leaves of onion plants grown commercially on organic soil in New York, whereas, Cedeno et al*.* [5] reported that *S. vesicarium* was responsible for causing severe foliar blight on garlic in Venezuela. Recently *S. vesicarium* has been reported from Slovakia Kadasi et al*.,* [6] Robert et al. [7] and Mauritius Vally et al*.,* [8] Anucha et al, [9]. Brar et al*.,* [10] have reported that *S. botryosum,* can invade downy mildew (*Perenospora destructor*) lesions, causing severe damage on the umbel stalks. A recent study suggested that onion thrips play a significant role in the infection and spread of disease and that management of thrips may prove helpful in the management of disease [11-13].

Stemphylium leaf blight is characterized by elongated spindle-like lesions on leaves, initially small and white, which later become sunken with a purple colour surrounded by a whitish margin [14]. Lesions caused by *Stemphylium vesicarium* are non-delineated, light yellow to brown, water soaked and from 1 cm in length to the entire leaf, compared with purple lesions of *A. porri* and the flecking of tip blight caused by *Sclerotinia squamosa* [2]. Early infection of the foliage leads to secondary infection on the seed stalks and inflorescence resulting in the production of shrivelled, non-viable and diseased seeds [15,16] reported that plants of all ages (10-120 d) were almost equally susceptible. Medina-Melchor et al*.,* [17] reported changes in metabolic profiling of *S. vesicarium* infected onion plants with energy producing processes being reduced and pyruvic acid and its amino acid derivatives being increased.

During investigations of the pathogen it was found that there was a considerable variation in the conidial characteristics of *Stemphylium* species compared to the available literature. Hence a detailed study was undertaken to ascertain the true conidial features of the pathogen.

2. MATERIALS AND METHODS

Disease samples with typical blight symptoms were collected in perforated polyethylene bags at monthly intervals. Samples collected from various locations at different stages of crop growth were brought to laboratory for disease assessment. Purification of the cultures was done by hyphal tip method and the cultures were maintained on PDA slants for further studies. The identification of the purified cultures was done with the help of standard texts and manuals [18-21]. Frequency of the pathogens associated with the foliar blight of onion was calculated by assessing the recovery of pathogen from the total number of isolations made. Conidia of *Stemphylium vesicarium* were collected from disease samples brought from different locations. Surface sporulation was encouraged by keeping the specimen in a moist chamber overnight. The conidia of the fungi sporulating on the surface of typical symptomatic leaves were examined in a drop of lactophenol placed on clean glass slides, covered with cover slips. Observations were taken for 500 conidia collected from each location.

3. RESULTS AND DISCUSSION

Stemphylium vesicarium was invariably found associated with typically blighted onion leaves

throughout the growing period (82.75 per cent in January to 77.40 per cent in February), though its relative occurrence declined slightly in March (49.15 per cent) and April (37.75 per cent) (Table 1). The results of the present study are in conformity with Jakhar et al. [16] who reported that the disease caused by *Stemphylium* first increased gradually, and then decreased late in the season. Hay et al. [22] also reported that the symptoms declined with the increasing temperatures, probably due to reduction in the production of spores. The results of the present study revealed that the symptoms of *A. porri* and *S. vesicarium* were indistinguishable in the field, which is in conformity with the results of Suheri and Price (2000) who reported that typical purple blotch lesions in the field were often colonized by both the pathogens. Aveling et al. [23] showed that *S. vesicarium*, in conjunction with *A. porri*, was a destructive foliar and seed stalk pathogen of onion under warm, moist conditions.

The average conidial dimensions of *Stemphylium vesicarium* recorded were 43.54 ± 0.44 µm X 25.57 ± 0.36 µm with l/w ratio ranging from 1.40-2.13 (Table 2). The average length of conidia was maximum in onion leaf isolate of Kathua 1 (50.58 µm), followed by onion and garlic leaf isolate of Gharkhal 1 and Reasi 2, respectively (47.77 µm), whereas, minimum conidial

Table 1. Frequency of *Stemphylium vesicarium* associated with the onion crop

Month	1st Year	2nd Year	Average
January	85.50	80.00	82.75
February	79.30	75.50	77.40
March	55.00	43.30	49.15
April	40.50	35.00	37.75

Table 2. Variation in the conidial dimensions among different isolates of *Stemphylium vesicarium*

Isolate	Isolated from (Plant part)	Average length (µm)	Average width (µm)	l/w
Kathua 1	Onion leaf	50.58	28.10	1.80
Kathua 2	Garlic leaf	39.34	28.10	1.40
Chatha 1	Onion leaf	42.15	25.29	1.67
Chatha 2	Garlic leaf	44.86	30.91	1.45
Gharkhal 1	Onion leaf	47.77	22.48	2.13
Gharkhal 2	Garlic leaf	39.34	28.10	1.40
R. S. Pura 1	Onion leaf	44.86	22.48	2.00
R. S. Pura 2	Garlic leaf	42.15	22.48	1.88
Reasi 1	Onion leaf	36.53	19.67	1.86
Reasi 2	Garlic leaf	47.77	28.10	1.70
Mean ± S. E. (m)		43.54 ± 0.44	25.57 ± 0.36	1.40 – 2.13

** Average of 500 readings*

Table 3. Comparative conidial dimensions of *Stemphylium* sp. as reported on *Allium* sp.

Isolate	Average conidial dimensions(µm)			
	Culture		Host	
	Size	l/w ratio	Size	l/w ratio
S. vesicarium Simmons, [19]	45 X 18	2.5-3.0	33.4 X 17.7	1.9
S. botryosum Simmons, [19]	33 X 23	1.5	34 X 25	1.0-1.5
S. vesicarium Rao and Pavgi, [1]	22-42 X 12-25	1.7-1.8	-	-
S.vesicarium Shishkoff and Lorbeer, [4]	33 ± 4 X 14 ± 2	2.4 ± 0.4	32 ± 4 X 12 ± 2	2.7 ± 0.5
Stemphylium vesicarium (present observations)*	28.94 ± 4.40 X 20.33 ± 3.45	1.0-1.29	43.54 ± 0.44 X 25.5 ± 0.36	1.4- 2.1

** Mean of 500 observations*

length (36.53 µm) was recorded in conidia obtained from onion leaf sample of Reasi 1 isolate. The average width ranged from 19.67 µm (Reasi 1 isolate) to 30.91 µm (Chatha 2 isolate).

There is considerable variation in the average conidial dimensions of different *Stemphylium* species and there are differences in the conidial dimensions on host and under cultural conditions (Table 3). In the present studies, the average conidial dimensions of 28.94 X 20.33 µm were recorded under cultural conditions. However, the conidial size was larger under *in vivo* conditions (43.54 X 25.5 µm) with l/w ratio ranging from 1.4-2.1. Similar findings have been reported by other workers also. The average conidial size of 45 X 18 µm and 33 X 23 with l/w ratio ranging from 2.5-3.0 and 1.5, in culture was recorded for *S. vesicarium* and *S. botryosum*, respectively whereas in host the conidial size varied from 33.4 X 17.7 µm and 34 X 25 with l/w ration of 1.9 and 1.0-1.5, respectively [19].

4. CONCLUSION

The present study revealed that considerable variation exists in the conidial dimensions of *S. vesicarium,* both under *in vitro* conditions and *in vivo* conditions. Variation also exists between different isolates obtained from different regions of Jammu & Kashmir. Cultural, morphological and pathological variations have been reported to occur among different isolates of *S. vesicarium* [24]. Prasad et al*.,* 2024 and Heck et al*.* [25]. Further studies are required using molecular markers to decipher the nature, extent and type of variations in different isolates of *S. vesicarium* for better understanding of the pathogen and management of the disease under field conditions.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

The authors hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-t-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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