



STEMPHYLIUM LEAF BLIGHT OF ONION: DISTRIBUTION, SPECIES COMPOSITION OF PATHOGENS, AND BIOLOGICAL CHARACTERISTICS (REVIEW)

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ABSTRACT

This review analyzes current scientific information on the distribution, symptoms, and harmful effects of *Stemphylium* leaf blight of onion (*Allium cepa* L.), as well as the species composition, identification, cultural-morphological, and biological characteristics of its causal agents. Analysis of the literature indicates that *Stemphylium* leaf blight is widespread in onion-growing regions worldwide and is becoming increasingly important economically in certain areas. Although the disease is primarily associated with *Stemphylium vesicarium*, the detection of other species, including *S. eturmiunum*, *S. solani*, and *S. lycopersici*, on *Allium* crops demonstrates the diversity of the pathogen species complex. Considerable variability among *Stemphylium* isolates in colony characteristics and the morphological features of conidia and conidiophores limits the reliability of identification based solely on morphology. Therefore, integrating morphological characterization with molecular phylogenetic analyses is essential for accurate species identification. Temperature and the duration of leaf wetness have also been identified as important environmental factors influencing pathogen development and the infection process. The findings of this review highlight the need to determine the species composition of *Stemphylium* leaf blight pathogens and comprehensively evaluate their biological characteristics under local conditions.

KEYWORDS: onion, *Allium cepa*, *Stemphylium* leaf blight, *Stemphylium vesicarium*, *Stemphylium* spp., identification, morphological characteristics, molecular analysis, temperature, leaf wetness.

INTRODUCTION

Onion (*Allium cepa* L.) is one of the most widely cultivated vegetable crops worldwide and plays an important role in the human diet. According to FAOSTAT data, India and China were the leading producers of dry onions and shallots in 2024, producing 24.27 and 24.22 million tonnes, respectively, with each country accounting for approximately 22.4% of global production¹.

Fungal diseases are among the major factors adversely affecting onion yield and product quality. Among them, *Stemphylium* leaf blight has emerged as an important phytopathological problem in several onion-growing regions worldwide in recent years. The disease primarily affects the leaves, and the resulting reduction in photosynthetically active leaf area adversely affects bulb development and quality (Hay et al., 2021).

Current studies identify *Stemphylium vesicarium* (Wallr.) E.G. Simmons as the species most commonly associated with *Stemphylium* leaf blight of onion. However, the morphological similarity among *Stemphylium* species, variability in certain diagnostic characteristics, and the detection of several *Stemphylium* species on *Allium* crops indicate the need to investigate the species composition of the pathogens using a combination of morphological and molecular phylogenetic approaches (Woudenberg et al., 2017; Back et al., 2022; Islam et al., 2025). Therefore, the aim of this review is to analyze and synthesize the available scientific information on the distribution and harmful effects of *Stemphylium* leaf blight of onion, the species composition of its causal agents, methods used for their identification, and their major biological characteristics.

Distribution, Symptoms, and Damage of *Stemphylium* Leaf Blight of Onion.

Stemphylium leaf blight is a foliar disease widely distributed across various onion-growing regions of the world, and its phytopathological importance has increased considerably in some areas in recent years. In particular, *Stemphylium* leaf blight caused by *S. vesicarium* has been recognized as an important re-emerging disease in the northeastern United States and the province of Ontario, Canada (Hay et al., 2021). In New York, it has been reported as the predominant foliar disease of onion grown on a large scale (Hay et al., 2022).

The initial symptoms of the disease appear on onion leaves as small, light brown to brown lesions. As the disease progresses, the lesions enlarge, resulting in necrosis of leaf tissues and premature leaf senescence (Hay et al., 2021). In Italy, Cortiello et al. (2023) observed yellowish to light-brown, oval lesions on diseased onion leaves. These lesions subsequently coalesced to form large

¹ <https://terra-cultiva.com/en/rankings/onions-and-shallots-dry-excluding-dehydrated/production>

necrotic areas, the leaf tips became darkened, and severely affected plants underwent premature senescence. The formation of conidia of the pathogen was also observed on necrotic leaves (Cortiello et al., 2023).

The reduction in photosynthetically active leaf area caused by *Stemphylium* leaf blight adversely affects bulb growth, resulting in reduced bulb size and market quality. Premature leaf necrosis may also indirectly affect the storability of harvested bulbs, as the retention of green leaf tissue is important for the translocation of preharvest-applied growth inhibitors to the bulbs (Hay et al., 2021). In an onion field surveyed in Italy in 2019, disease incidence was approximately 70%, and yield losses were estimated to exceed 30% (Cortiello et al., 2023).

Recent geographic reports further confirm the occurrence of the disease under diverse agroclimatic conditions. Cortiello et al. (2023) reported *Stemphylium* leaf blight caused by *S. vesicarium* for the first time in Italy, while Vally et al. (2024) recorded the disease in three onion-growing regions of Mauritius. In the surveyed fields in Mauritius, disease incidence ranged from 53 to 93%, while disease severity ranged from 9 to 28% (Cortiello et al., 2023; Vally et al., 2024).

Typical symptoms of *Stemphylium* leaf blight on onion leaves and the morphological structures of *S. vesicarium* are presented in Fig. 1.

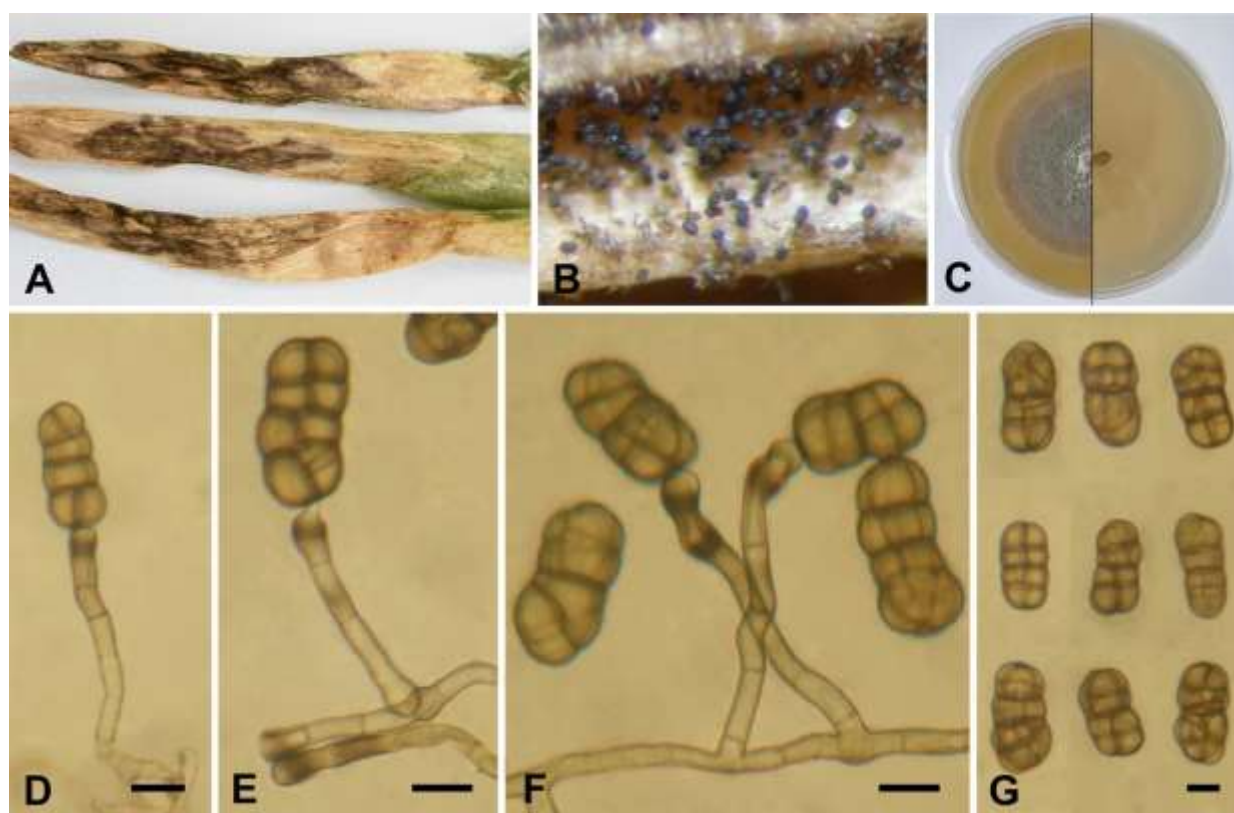


Fig. 1. Symptoms of *Stemphylium* leaf blight of onion caused by *Stemphylium vesicarium* and morphological characteristics of the pathogen: A – disease symptoms on onion leaves; B – sporulation of the pathogen on necrotic tissue; C – colonies grown on PDA (left) and water agar (right) after 2 weeks at room temperature; D–F – conidiophores bearing conidia obtained from cultures grown on water agar; G – conidia obtained from cultures grown on water agar. Scale bars = 10 µm.

Source: Kádasi Horáková et al. (2024).

Species Composition and Identification of Pathogens Causing *Stemphylium* Leaf Blight of Onion.

The genus *Stemphylium* belongs to the family Pleosporaceae, order Pleosporales, and has been characterized as a well-supported monophyletic genus based on molecular phylogenetic analyses. Traditionally, *Stemphylium* species have been identified using morphological characteristics such as the shape, size, color, and septation of conidia and conidiophores. However, the morphological similarity among certain species and the variability of these characteristics limit the reliable identification of species based solely on morphology and host association (Woudenberg et al., 2017).

Stemphylium vesicarium is the species most commonly associated with *Stemphylium* leaf blight of onion and other *Allium* crops. However, molecular studies have demonstrated that the species diversity of *Stemphylium* associated with *Allium* crops is broader. In South Korea, Back et al. (2022) analyzed isolates obtained from onion, garlic, and Welsh onion using the ITS region and the calmodulin (*cmdA*) gene and identified *S. vesicarium*, *S. eturmiunum* and *S. solani*. Among these, *S. vesicarium* was the most



frequently detected species in onion and garlic, while *S. eturmiunum* was reported for the first time as a pathogen of onion and garlic, and *S. solani* was identified from Welsh onion (Back et al., 2022).

In Bangladesh, Islam et al. (2025) analyzed 20 *Stemphylium* isolates collected from onion and garlic in different regions based on their cultural, morphological, molecular, and pathogenic characteristics. Phylogenetic analysis identified 18 isolates as *S. vesicarium* and two isolates as *S. lycopersici*. These findings indicate the predominance of *S. vesicarium* in the population studied, while also demonstrating that the species composition of *Stemphylium* is not uniform (Islam et al., 2025).

The ITS marker alone is insufficient for reliable discrimination among all closely related *Stemphylium* species. Woudenberg et al. (2017) conducted a multilocus phylogenetic analysis based on the ITS, *gapdh*, and *cmdA* gene regions, resolving 28 species clades within the genus and placing 22 names in synonymy. The authors demonstrated that ITS sequences could identify 22 species at the species level; however, an additional gene locus alongside the standard ITS barcode is required to distinguish certain closely related species. Therefore, reliable identification of *Stemphylium* species should integrate morphological characteristics with molecular data (Woudenberg et al., 2017).

Cultural-Morphological and Biological Characteristics of the Pathogen.

Stemphylium isolates obtained from onion exhibit considerable variability in their cultural and morphological characteristics. Chandel et al. (2024) examined 22 *S. vesicarium* isolates collected from different onion-growing regions and found significant differences in colony diameter, radial growth rate, and sporulation. On PDA, the colonies exhibited velvety, cottony, or fluffy textures, with colors ranging from whitish to dark gray; some isolates also showed greenish-olive or brownish pigmentation (Chandel et al., 2024).

Considerable variation was also observed in the morphological characteristics of the isolates. According to Chandel et al. (2024), the mean length of conidiophores ranged from 36.81 to 66.44 μm and their width from 3.05 to 6.96 μm , while the mean length of conidia ranged from 23.31 to 43.18 μm and their width from 12.84 to 23.13 μm . Differences among isolates were also observed in conidial shape, color, and septation. These findings demonstrate that morphological characteristics may vary considerably even among isolates belonging to the same species (Chandel et al., 2024).

Similar cultural variability has also been reported in Bangladesh. Islam et al. (2025) observed considerable diversity in the cultural, morphological, and pathogenic characteristics of 20 *Stemphylium* isolates obtained from onion and garlic. At the end of the experiment, radial mycelial growth of the isolates ranged from 37.13 to 43.00 mm (Islam et al., 2025).

Temperature and the duration of leaf wetness are important environmental factors influencing the infection process of the pathogen. Subsequent epidemiological studies referring to Suheri and Price (2000) reported that germination of *S. vesicarium* conidia and infection of onion leaves occurred at temperatures ranging from 10 to 25°C when leaf wetness persisted for more than 8 h (Suheri and Price, 2000).

This interaction between temperature and moisture has also been confirmed under field conditions. Gossen et al. (2021) compared airborne ascospores and conidia of *S. vesicarium* with meteorological variables over two growing seasons in Ontario, Canada, and found that the first disease symptoms coincided with increased conidial concentrations, rainfall, at least 8 h of leaf wetness, and days with a mean daily temperature of 18°C or higher. In addition, airborne spore concentrations increased within 24-72 h following rainfall. Because ascospore concentrations were very low during the period when disease symptoms appeared, the authors considered conidia to be an important source of inoculum in the development of *Stemphylium* leaf blight epidemics in onion (Gossen et al., 2021).

Thus, variability in the cultural and morphological characteristics of *Stemphylium* isolates limits their reliable identification based solely on phenotypic traits. Furthermore, the dependence of the infection activity of *S. vesicarium* on the interaction between temperature and the duration of leaf wetness highlights the importance of considering environmental factors when evaluating the biological characteristics of the pathogen.

CONCLUSION

The reviewed literature indicates that *Stemphylium* leaf blight is a widespread foliar disease of onion in various onion-growing regions worldwide and is becoming increasingly important economically in some areas. Although the disease is primarily associated with *S. vesicarium*, recent molecular studies have also identified other species, including *S. eturmiunum*, *S. solani* and *S. lycopersici*, on *Allium* crops, demonstrating that the species composition of *Stemphylium* leaf blight pathogens is not uniform (Back et al., 2022; Islam et al., 2025).

Considerable variability in the cultural and morphological characteristics of *Stemphylium* isolates limits their reliable identification at the species level based solely on these traits. Therefore, integrating morphological characterization with molecular phylogenetic data provides a more reliable approach for pathogen identification (Woudenberg et al., 2017; Chandel et al., 2024). The infection



process of the pathogen is also closely associated with temperature and the duration of leaf wetness, and the interaction between these factors plays an important role in disease development (Gossen et al., 2021).

Overall, the available evidence demonstrates considerable diversity in the species composition and cultural-morphological and biological characteristics of *Stemphylium* isolates obtained from different geographical regions. These findings highlight the need to determine the species composition of *Stemphylium* leaf blight pathogens and comprehensively evaluate their major biological characteristics under local conditions.

REFERENCES

1. Back C.-G., Han Y.-K., Dumin W.B., Park J.-H., Han J.-W., Bae Y.-S. Phylogenetic analysis and biological characterization of *Stemphylium* species isolated from *Allium* crops // *Korean Journal of Agricultural Science*. – 2022. – Vol. 49, No. 1. – P. 113–120.
2. Chandel R., Kamil D., Kumar A., Taak Y., Khar A. Morpho-cultural and molecular variability of *Stemphylium vesicarium* causing *Stemphylium* leaf blight in tropical onions // *Heliyon*. – 2024. – Vol. 10, No. 20. – Art. e39107. – DOI: 10.1016/j.heliyon.2024.e39107.
3. Cortiello M., Prodi A., Stefani E., Giovanardi D. First report of *Stemphylium* leaf blight of onion (*Allium cepa*) caused by *Stemphylium vesicarium* in Italy // *Plant Disease*. – 2023. – Vol. 107, No. 9. – P. 2878. – DOI: 10.1094/PDIS-10-22-2398-PDN.
4. Gossen B.D., Tayviah C.S., McDonald M.R. The role of ascospores and conidia, in relation to weather variables, in the epidemiology of *Stemphylium* leaf blight of onion // *Plant Disease*. – 2021. – Vol. 105, No. 7. – P. 1912–1918. – DOI: 10.1094/PDIS-06-20-1283-RE.
5. Hay F., Heck D.W., Klein A., Sharma S., Hoepting C., Pethybridge S.J. Spatiotemporal dynamics of *Stemphylium* leaf blight and potential inoculum sources in New York onion fields // *Plant Disease*. – 2022. – Vol. 106, No. 5. – P. 1381–1391. – DOI: 10.1094/PDIS-07-21-1587-RE.
6. Hay F., Stricker S., Gossen B.D., McDonald M.R., Heck D., Hoepting C., Sharma S., Pethybridge S. *Stemphylium* leaf blight: A re-emerging threat to onion production in Eastern North America // *Plant Disease*. – 2021. – Vol. 105, No. 12. – P. 3780–3794. – DOI: 10.1094/PDIS-05-21-0903-FE.
7. Islam M.M., Siloi S.S., Chakraborty S., Khokon M.A.R. Diversity of *Stemphylium* spp. of onion and garlic revealed the differential pathogenicity and in vitro efficacy of different growth suppressors // *Heliyon*. – 2025. – Vol. 11, No. 3. – Art. e42342. – DOI: 10.1016/j.heliyon.2025.e42342.
8. Kádasi Horáková M., Barta M., Tancik J., Pastirčák M., Pastirčáková K. First report of *Stemphylium vesicarium* causing leaf blight of onion in Slovakia // *Journal of Plant Diseases and Protection*. – 2024. – Vol. 131. – P. 1721–1730. – DOI: 10.1007/s41348-024-00927-9.
9. Suheri H., Price T.V. Infection of onion leaves by *Alternaria porri* and *Stemphylium vesicarium* and disease development in controlled environments // *Plant Pathology*. – 2000. – Vol. 49, No. 3. – P. 375–382. – DOI: 10.1046/j.1365-3059.2000.00458.x.
10. Vally V., Jouen E., Maudarbaccus F., Seenevassen-Pillay M., Ganeshan S., Gungadurdoss M., Gopall K., Bulajić A., Ranghoo-Sanmukhiya V.M. First report of *Stemphylium vesicarium* causing onion *Stemphylium* leaf blight in Mauritius // *Plant Disease*. – 2024. – Vol. 108, No. 3. – P. 816. – DOI: 10.1094/PDIS-11-23-2431-PDN.
11. Woudenberg J.H.C., Hanse B., van Leeuwen G.C.M., Groenewald J.Z., Crous P.W. *Stemphylium* revisited // *Studies in Mycology*. – 2017. – Vol. 87. – P. 77–103. – DOI: 10.1016/j.simyco.2017.06.001.