



## Checklist of genus *Septoria* (*Mycosphaerellaceae*) in Uzbekistan

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### Abstract

Uzbekistan is blessed with a rich ecosystem diversity, however, only a small fraction of the diverse flora and fauna in the country is known. Recently, there has been a growing demand for a systematic database based on the latest data that completely covers the mycobiota of Uzbekistan. This study provides an update on the available data on *Septoria* species throughout Uzbekistan. This study is based on the literature published between 1926 and 2021 and the latest research in the country on herbarium specimens held in the Tashkent Mycological Herbarium. The current checklist contains information on 117 species of *Septoria* in the region from 163 host species belonging to 40 families and 104 host genera, among which they are distributed.

**Keywords** – Ascomycetous – biodiversity – fungi – host plant – mycobiota – *Mycosphaerellales*

### Introduction

Although many scientists estimate that there are about 1.5 million species of fungi, about 130,000 species have been identified so far around the world (Hawksworth & Lucking 2017; Cheek et al. 2020; Hyde et al. 2020). However, in countries with high biodiversity, it can be considered that knowledge about fungi is not enough, or fungal species have not been studied in depth. As a result, we are still unable to make a list of species due to the lack of information about them (Gafforov et al. 2020). Uzbekistan is one of the countries where the number of such fungal species has not yet been studied sufficiently.

Uzbekistan is located in Central Asia, east of the Caspian Sea, directly south of Kazakhstan, north of Turkmenistan, and on the western borders of Tajikistan and Kyrgyzstan (Fig. 1). The area of Uzbekistan is 447,400 square kilometers, of which 425,400 square kilometers is the land surface. The territory of Uzbekistan is a desert zone with the western ends of the Tien Shan and Pamir-Alai mountain systems, including the foothill plains, entering the territory of the republic, forming an altitudinal zone. Within this area, moisture content increases with height, which is associated with an increase in humus content and soil leaching. Mountainous areas occupy 15% of the territory of Uzbekistan, and forests cover 0.8% (Gafforov et al. 2020). Uzbekistan is a region rich in animals, plants and fungi. More than 4500 species of higher plants have been identified, of which 334 are endemic (Turginov et al. 2019). Despite the high biodiversity in the region, the number of species in need of protection is also increasing. For example, 314 species of higher plants and three species of fungi (*Polyporus frondosus* (Dicks), *Geastrum fimbriatum* Fr., *Tuber aestivum* Vittad.) are listed in the Red Book of Uzbekistan.

*Septoria* is a large genus of asexual morphs of *Ascomycota*, causing leaf spot and blight diseases in field crops, vegetables, ornamentals and wild plants. Host specificity has long been a

decisive criterium in species delimitation in *Septoria*, mainly because of the paucity of useful morphological characters and the high level of variation therein (Shin & Sameva 2002; Verkley et al. 2013; Quaedylied et al. 2013). Many scientific research was carried out on the diversity of fungi, and data were collected on the species of *Septoria* (*Mycosphaerellales*, *Ascomycota*) (Zaprometov 1926, 1928; Golovin 1947, 1949a, b, 1950; Kleyner 1958; Lebedeva 1958; Gaponenko 1965; Baymuratova 1963; Panfilova & Gaponenko 1963; Usmonov 1965; Axmedova 1966; Kuchmi 1970; Kirgizbaeva 1972, Soliyeva 1989; Kamilov 1991; Kirgizbaeva et al. 1997; Nuraliyev, 1998, Gafforov 2005; Sherqulova et al. 2019; Mustafaev 2018).

Several checklists on fungi in some regions of Uzbekistan were provided by Gafforov (2017), Gafforov et al. (2017, 2020), Mustafaev et al. (2019) and Abdurazakov et al. (2021). However, there are no generalized data on the diversity and the number of fungi in Uzbekistan. Information on the taxonomy of fungi is updated year by year, and after studying many types of fungi based on modern mycological methods, it becomes clear that they are synonymous with other types of fungi. Therefore, carrying out mycological studies in unexplored regions of Uzbekistan and compiling a generalized list of mycobiota is one of the urgent tasks. This study is the first taxonomy-based checklist of *Septoria* species in Uzbekistan. In this research, we have compiled a list of *Septoria* species in Uzbekistan. This list serves as one of the main resources for fungi in the Republic of Uzbekistan.



**Fig. 1** – Study area. Regional division of Uzbekistan.

## Materials & Methods

This checklist includes the results of field surveys carried out in the Botanical-Geographical Region of Northern Turkestan in 2018-2020, as well as all published literature on fungi found in Uzbekistan from 1926 to March 2021. Furthermore, a thorough examination of the herbaria stored at the Tashkent Mycological Herbarium Fund (TASM) was also conducted. The unpublished data and fungi identified up to the genus level have not been included in this checklist. Some species

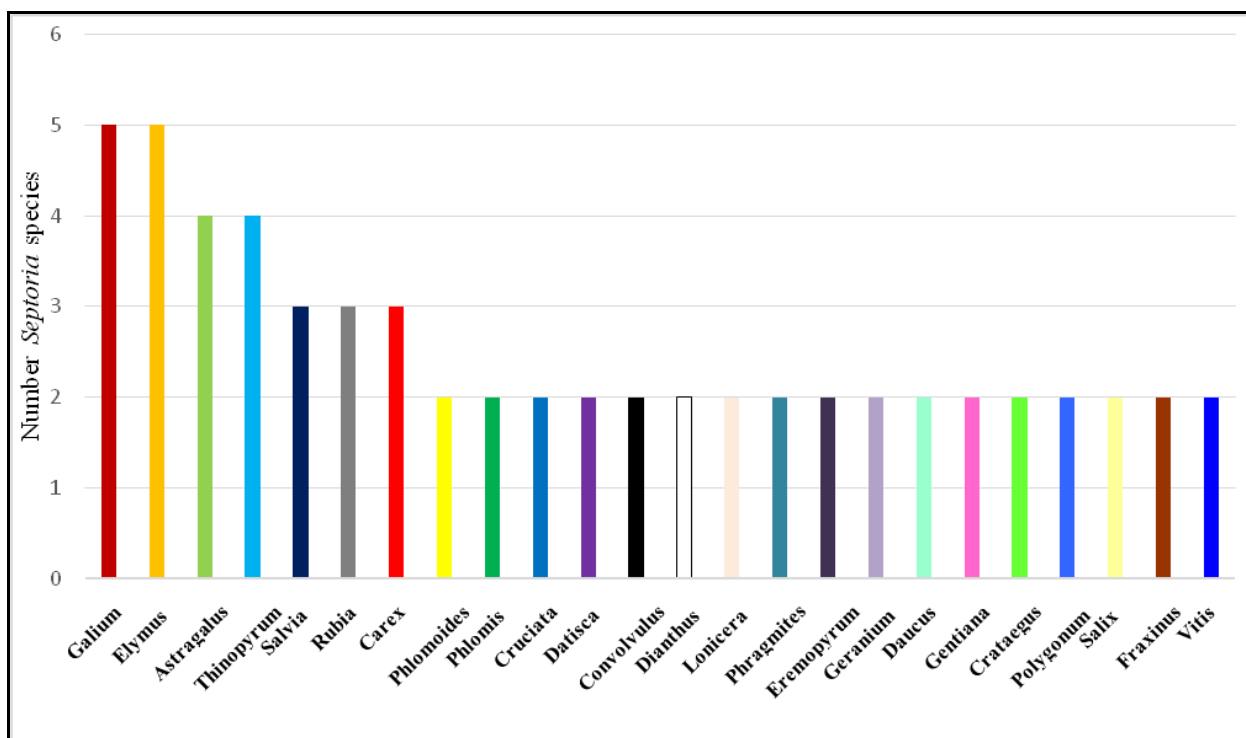
names reported in their cited publications have been replaced with their currently accepted name according to Index Fungorum (2021) and Wijayawardene et al. (2020). The name of the host species given in the original citation is sometimes changed to be consistent with the current taxonomy based on Plants of the world online ([www.powo.science.kew.org](http://www.powo.science.kew.org)).

Many samples of *Septoria* were collected from 1926 to 2021 in different habitats of Uzbekistan, which are designated in the checklist by the following abbreviations: ADR – Andijan region, BR- Bukhara region, FR – Fergana region, JZR – Jizzakh region, KK – Karakalpakstan, NMR – Namangan region, NVR – Navoi region, QDR – Qashqadaryo region, SDR –Surxondaryo region, SMR – Samarqand region, SRR – Syrdarya region, TSR – Tashkent region, XR – Khorezm region.

## Results

A checklist of 117 *Septoria* species is arranged alphabetically by *Septoria* species, host plants, distribution places, and references (Table 1). There are 163 host plants belonging to 40 families from 104 genera. The majority of the *Septoria* species distributed in the region reported from the *Poaceae* family (on 28 host plants, 19 fungal species) as pathogens, followed by members of the families *Lamiaceae* (on 12 host plants, 12 fungal species), *Fabaceae* and *Rubiaceae* (on 11 host plant, 8 fungal species each), and *Asteraceae* (on 8 host plant, 7 fungal species). Collectively, these families host about 46% of *Septoria* species present in the study area, while other plant families host one to six *Septoria* species (Table 3).

The highest number of *Septoria* species was reported in the following host genera: *Galium* and *Elymus* (five species each, 4.3% of the total species number), *Astragalus*, *Thinopyrum* (four species each, 3.4% of the total species number), *Salvia*, *Rubia* and *Carex* (three species each, 2.3% of the total species number), *Phlomis*, *Cruciata*, *Datisca*, *Convolvulus*, *Dianthus*, *Lonicera*, *Phragmites*, *Eremopyrum*, *Geranium*, *Daucus*, *Gentiana*, *Crataegus*, *Polygonum*, *Salix*, *Fraxinus* and *Vitis* (two species each, 1.7% of the total species number), while other plant genera host one *Septoria* species per genus (Fig. 2).



**Fig. 2** – Occurrence numbers of genus *Septoria* species on most representative host genera.

**Table 1** Checklist of the genus *Septoria* and host plants from Uzbekistan.

No.	Species reported	Host plant	Distribution	Reference/s
1.	<i>Septoria acerella</i> Sacc.	<i>Acer pentapomicum</i> J.L.Stewart <i>Acer platanoides</i> subsp. <i>Turkestanicum</i> (Pax) P.C.de Jong <i>Acer regelii</i> Pax.	SDR, June 1986 Unknown	Soliyeva (1989) Kleyner (1958)
2.	<i>Septoria acetosae</i> Oudem.	<i>Rumex aquaticus</i> L.	SDR, July 1986 QDR, May 1995	Gafforov (2017) Nuraliyev (1998)
3.	<i>Septoria aegopodii</i> Desm.	<i>Aegopodium alpestre</i> Ledeb.	TSR, July 1961	Kirgizbaeva et al. (1997)
4.	<i>Septoria agrestis</i> Sacc.	<i>Triticum vulgare</i> L. <i>Elymus repens</i> (L.) Gould	TSR, 1924 TSR, Aug. 1954	Zaprometov (1926) Pashenko et al. (1978)
5.	<i>Septoria agriophylli</i> Gapon.	<i>Agriophyllum minus</i> Fisch. & C.A.Mey. ex Fenzl <i>Thinopyrum intermedium</i> (Host) Barkworth & D.R.Dewey	XR, June 1952 QDR, July 1997	Kirgizbaeva et al. (1997) Nuraliyev (1998)
6.	<i>Septoria agropyri</i> Ellis & Everh.	<i>Elymus repens</i> (L.) Gould <i>Eremopyrum orientale</i> (L.) Jaub. & Spach <i>Thinopyrum intermedium</i> (Host) Barkworth & D.R.Dewey	TSR, Aug. 1975 QDR, May 1996 BR* Unknown	Kamilov (1991) Nuraliyev (1998) Gaponenko (1965) Pashenko et al. (1978)
7.	<i>Septoria alhagi</i> Szemb.	<i>Alhagi maurorum</i> Medik. <i>Alhagi canescens</i> (Regel) Shap.	TSR, June 1936 NMR, May 2000 BR, April 1956 QDR, Sep. 1994	Kirgizbaeva et al. (1997) Gafforov (2005) Kirgizbaeva et al. (1997) Nuraliyev (1998)
8.	<i>Septoria alliicola</i> Bäumler	<i>Allium cepa</i> L.	SRR, June 1958	Baymuratova (1963)
9.	<i>Septoria ampelina</i> Berkeley & M.A. Curtis	<i>Ampelopsis vitifolia</i> (Boiss.) Planch.	SDR, July 1986	Soliyeva (1989)
10.	<i>Septoria apocyni</i> Khokhr.	<i>Apocynum</i> sp.	SDR, June 1987	Soliyeva (1989)
11.	<i>Septoria artemisiae</i> Pass.	<i>Artemisia vulgaris</i> L.	NMR, April 2001, May 2002	Gafforov (2005)
12.	<i>Septoria asperulae</i> Bäumler.	<i>Galium humifusum</i> M.Bieb. <i>Asperula pauciflora</i> Tschern.	TSR, Sep. 1954 SDR, July 1986	Kirgizbaeva et al. (1997) Soliyeva (1989)
13.	<i>Septoria asteris-alpini</i> Nann.	<i>Aster</i> sp.	TSR, June 1950	Kirgizbaeva et al. (1997)
14.	<i>Septoria astragali</i> Desm.	<i>Astragalus platyphyllus</i> Kar. & Kir. <i>Astragalus</i> sp.	Unknown BR, Sep. 1936 SDR, July 1986 JZR, May 2019	Pashenko et al. (1978) Kirgizbaeva et al. (1997) Soliyeva (1989) This study
15.	<i>Septoria betulina</i> Pass.	<i>Betula pendula</i> Roth	TSR, Aug. 1955 TSR, July 1982	Panfilova & Gaponenko (1963) Kamilov (1991)

**Table 1** Continued.

No.	Species reported	Host plant	Distribution	Reference/s
16.	<i>Septoria bromi</i> Sacc.	<i>Bromus danthoniae</i> Trin. <i>Bromus japonicas</i> Houtt. <i>Bromus lanceolatus</i> Roth <i>Bromus oxyodon</i> Schrenk <i>Bromus tectorum</i> L. <i>Bromus sterilis</i> L. <i>Bromus</i> sp.	JZR, April 1957 QDR, July 1997 SDR, July 1987 JZR, April 1957 JZR, April 1958 TSR, June 1977 TSR, June 1950	Kirgizbaeva et al. (1997) Nuraliyev (1998) Soliyeva (1989) Kirgizbaeva et al. (1997) Kirgizbaeva et al. (1997) Kamilov (1991) Kirgizbaeva et al. (1997)
17.	<i>Septoria cannabis</i> (Lasch) Sacc.	<i>Cannabis sativa</i> L.  <i>Carex physodes</i> M.Bieb. <i>Datisca cannabina</i> L.	ADR, NMR, TSR* FR, May 1949 NMR, July 2002 BR* TSR, June 1949, Sep. 1950.	Zaprometov (1928) Kirgizbaeva et al. (1997) Gafforov (2005) Gaponenko (1965) Kirgizbaeva et al. (1997)
18.	<i>Septoria caricis</i> Pass.	<i>Carex asturica</i> Boiss. <i>Carex melanostachya</i> M.Bieb. ex Willd. <i>Carex pachystylis</i> J.Gay <i>Carex physodes</i> M.Bieb.  <i>Carex</i> sp.	TSR, July 1954 TSR, June 1950 SRR, April 1954 TSR, June 1986 QDR, May 1996 TSR, July 1955, NVR, June 1956	Kirgizbaeva et al. (1997) Kirgizbaeva et al. (1997) Kirgizbaeva et al. (1997) Baymuratova (1963) Kirgizbaeva et al. (1997) Nuraliyev (1998) Kirgizbaeva et al. (1997)
19.	<i>Septoria carotae</i> Nagorny	<i>Daucus carota</i> L.	SRR, Aug. 1957	Baymuratova (1963)
20.	<i>Septoria chenopodii</i> Westend.	<i>Chenopodium album</i> L.	TSR, 1925	Zaprometov (1928)
21.	<i>Septoria cerasi</i> Pass.	<i>Prunus mahaleb</i> L.	NMR, June 2001	Gafforov (2005)
22.	<i>Septoria cirsii</i> Niessl.	<i>Cirsium</i> sp.	TSR, May 1953	Kirgizbaeva et al. (1997)
23.	<i>Septoria codonopsidis</i> Ziling	<i>Codonopsis clematidea</i> (Schrenk) C.B. Clarke	SDR, May 1987	Soliyeva (1989)
24.	<i>Septoria convolvuli</i> Desm.	<i>Convolvulus arvensis</i> L.  <i>Convolvulus hamadae</i> (Vved.) Petrov <i>Convolvulus</i> sp.	TSR, 1919 TSR, July 1949, 1950, 1953 TSR, Aug. 1969 QDR, July 1995 NMR, May 2000 BR, Oct. 1957, June 1958 JZR, May 2010  JZR, May 2019	Zaprometov (1928) Kirgizbaeva et al. (1997) Kamilov (1991) Nuraliyev (1998) Gafforov (2005) Kirgizbaeva et al. (1997) Mustafaev (2018), Mustafaev et al (2019) This study
25.	<i>Septoria cortusae</i> Solkina.	<i>Primula matthioli</i> (L.) V.A. Richt.	FR, 1925	Zaprometov (1928)
26.	<i>Septoria crataegi</i> J. Kickx f.	<i>Crataegus pontica</i> K. Koch <i>Crataegus turkestanica</i> Pojark.	JZR, July 2017 QDR, May 1995	Mustafaev et al. (2019) Nuraliyev (1998)

**Table 1** Continued.

No.	Species reported	Host plant	Distribution	Reference/s
27.	<i>Septoria crataegicola</i> Bondartsev & Tranzschel	<i>Crataegus pontica</i> K. Koch <i>Crataegus turkestanica</i> Pojark. <i>Crataegus</i> sp.	Unknown Unknown TSR, 1918	Kleyner (1958) Kleyner (1958) Zaprometov (1926)
28.	<i>Septoria crepidis</i> Vestergr.	<i>Crepis pulchra</i> L. <i>Crepis tectorum</i> L	Unknown TSR, Aug. 1955	Pashenko et al. (1978) Kirgizbaeva et al. (1997)
29.	<i>Septoria cruciatae</i> Roberge ex Desm.	<i>Cruciata pedemontana</i> (Bellardi) Ehrend. <i>Galium verum</i> L <i>Galium verrucosum</i> Huds.	TSR, May 1953 TSR, July 1955 Unknown	Kirgizbaeva et al. (1997) Kirgizbaeva et al. (1997) Pashenko et al. (1978)
30.	<i>Septoria curva</i> P. Karst	<i>Phragmites australis</i> (Cav.) Trin. ex Steud.	Unknown	Pashenko et al. (1978)
31.	<i>Septoria cynodontis</i> Fuckel	<i>Cynodon dactylon</i> (L.) Pers.	SDR, May 1984, July 1986 TSR, June 1971	Soliyeva (1989) Kamilov (1991)
32.	<i>Septoria cyperi</i> Ellis & Everh.	<i>Cyperus</i> sp.	JZR, Aug. 2009	Mustafaev (2018)
33.	<i>Septoria datiscae</i> Bondartsev	<i>Datisca cannabina</i> L.	TSR, 1915, 1921 TSR, Aug. 1953	Zaprometov (1926), (1928) Kirgizbaeva et al. (1997)
34.	<i>Septoria dauci</i> Nicolas & Agg�ery	<i>Daucus carota</i> L.	JZR, June 2012, July 2017	Mustafaev (2018), Mustafaev et al. (2019)
35.	<i>Septoria delphinella</i> Sacc.	<i>Delphinium brunonianum</i> Royle	QDR, June 1996	Nuraliyev (1998)
36.	<i>Septoria dianthicola</i> Sacc.	<i>Dianthus recticaulis</i> Ledeb.	TSR, June 1954	Kirgizbaeva et al. (1997)
37.	<i>Septoria didymospora</i> Golovin	<i>Carex physodes</i> M.Bieb.	BR, May 1914	Kirgizbaeva et al. (1997)
38.	<i>Septoria didyma</i> Fuckel	<i>Salix niedzwieckii</i> Goerz <i>Salix triandra</i> L.	SMR, July 1948 TSR, 1912	Kirgizbaeva et al. (1997) Zaprometov (1926)
39.	<i>Septoria dipsaci</i> Westend.	<i>Dipsacus azureus</i> Schrenk  <i>Dipsacus fullonum</i> L.	TSR, July 1954 TSR, July 1972 TSR, July 1976	Kirgizbaeva et al. (1997) Kamilov (1991) Kamilov (1991)
40.	<i>Septoria distachya</i> Brunaud	<i>Ephedra</i> sp.	JZR, May 1936	Golovin (1941)
41.	<i>Septoria elymi</i> Ellis & Everh.	<i>Elymus repens</i> (L.) Gould  <i>Eremopyrum orientale</i> (L.) Jaub. & Spach <i>Kengyilia pulcherrima</i> (Grossh.) C.Yen <i>Thinopyrum intermedium</i> (Host) Barkworth & D.R.Dewey	TSR, Aug. 1955, SMR, July 1945 BR, May 1915 SMR, June 1956 TSR, July 1945	Kirgizbaeva et al. (1997) Kirgizbaeva et al. (1997) Kirgizbaeva et al. (1997)
42.	<i>Septoria eremostachydis</i> M.N. Kusnezowa & Byzova	<i>Phlomoides</i> sp.	SDR, May 1987	Soliyeva (1989)

**Table 1** Continued.

No.	Species reported	Host plant	Distribution	Reference/s
43.	<i>Septoria eremuri</i> Pisareva	<i>Eremurus anisopterus</i> (Kar. & Kir.) Regel <i>Eremurus fuscus</i> (O.Fedtsch.) Vved. <i>Eremurus soogdianus</i> (Regel) Benth. & Hook.f.  <i>Eremurus tianschanicus</i> Pazij & Vved. ex Pavlov <i>Eremurus</i> sp.	BR, May 1956 BR, May 1956 BR, June 1957, TSR, June 1962  BR, May 1958 TSR, July 1954	Kirgizbaeva et al. (1997) Kirgizbaeva et al. (1997) Kirgizbaeva et al. (1997)  Kirgizbaeva et al. (1997) Kirgizbaeva et al. (1997)
44.	<i>Septoria erianthi</i> Zaprom.	<i>Tripidium ravennae</i> (L.)	BR, 1926	Zaprometov (1928)
45.	<i>Septoria exotica</i> Speg.	<i>Veronica biloba</i> Schreb. ex L.	Unknown	Pashenko et al., (1978)
46.	<i>Septoria expansa</i> Niessl	<i>Geranium</i> sp.	TSR, July 1955	Kirgizbaeva et al. (1997)
47.	<i>Septoria ferulicola</i> Melnik	<i>Ferula assa-foetida</i> L. <i>Ferula kirialovii</i> Pimenov <i>Ferula kuhistanica</i> Korovin  <i>Ferula moschata</i> (H.Reinsch) Koso-Pol. <i>Ferula penninervis</i> Regel & Schmalh.  <i>Ferula</i> sp.	BR, April 1956 TSR, July 1949 SDR, July 1986 QDR, May 1995 JZR, May 2010 NMR, Sep. 2001 JZR, June 2012 TSR, May 1953	Kirgizbaeva et al. (1997) Kirgizbaeva et al. (1997) Soliyeva (1989) Nuraliyev (1998) Mustafaev et al. (2019) Gafforov (2005) Mustafaev (2018) Kirgizbaeva et al. (1997)
48.	<i>Septoria fraxini</i> Desm.	<i>Fraxinus excelsior</i> L.  <i>Fraxinus raibocarpa</i> Regel  <i>Fraxinus sogdiana</i> Bunge <i>Fraxinus</i> sp.	SDR, July 1987 NMR, June 2001 FR, Nov. 2000 QDR, June 2013 JZR, Oct. 2019 TSR, 1916	Soliyeva (1989) Gafforov (2005) Gafforov (2005) Sherqulova (2018) This work Zaprometov (1928)
49.	<i>Septoria fusispora</i> Died.	<i>Thinopyrum intermedium</i> (Host) Barkworth & D.R.Dewey	Unknown	Pashenko et al. (1978)
50.	<i>Septoria galiorum</i> Ellis	<i>Cruciata pedemontana</i> (Bellardi) Ehrend. <i>Galium canescens</i> Kunth <i>Galium parisiense</i> L.  <i>Galium verrucosum</i> Huds.	Unknown TSR, May 1955 JZR, July 2010	Kirgizbaeva et al. (1997) Mustafaev (2018), Mustafaev et al. (2019) Pashenko et al. (1978)
51.	<i>Septoria gentianae</i> Thüm.	<i>Gentiana olivieri</i> Griseb.	Unknown TSR, April 1958, May 1954 JZR, May 2012, 2015, 2017 JZR, May 2018	Kirgizbaeva et al. (1997) Mustafaev (2018) This study
52.	<i>Septoria geranii</i> Roberge ex Desm.	<i>Geranium collinum</i> Stephan ex Willd. <i>Geranium rectum</i> Trautv	JZR, June 1945 FR, May 1963	Kirgizbaeva et al. (1997) Kuchmi (1970)
53.	<i>Septoria glomerata</i> Jørst.	<i>Dactylis glomerata</i> L.	QDR, Aug. 1995	Nuraliyev (1998)

**Table 1** Continued.

No.	Species reported	Host plant	Distribution	Reference/s
54.	<i>Septoria glycyrrhizae</i> Ellis & Kellerm.	<i>Glycyrrhiza glabra</i> L.	SDR, June 1987	Soliyeva (1989)
55.	<i>Septoria hordei</i> Jacz.	<i>Hordeum bulbosum</i> L.	QDR, June 1995, 1997	Nuraliyev (1998)
56.	<i>Septoria lactucae</i> Pass.	<i>Lactuca tatarica</i> (L.) C.A.Mey.	SRR, June 1958	Baymuratova (1963)
57.	<i>Septoria lamiicola</i> Sacc.	<i>Lamium album</i> L. <i>Lamium flexuosum</i> Ten.	Unknown TSR, July 1955 QDR, May 1995	Pashenko et al. (1978) Kirgizbaeva et al. (1997) Nuraliyev (1998)
58.	<i>Septoria lasiagrostis</i> Melnik	<i>Stipa conferta</i> Poir. <i>Lasiagrostis caragana</i> (Trin.)	TSR, May 1948 TSR, 1950	Kirgizbaeva et al. (1997) Axmedova (1966)
59.	<i>Septoria lepidii</i> Desm.	<i>Lepidium chalepense</i> L. <i>Lepidium draba</i> L.  <i>Lepidium latifolium</i> L. <i>Lepidium obtusum</i> Basiner <i>Lepidium perfoliatum</i> L.	SRR, June 1957. TSR, May 1955, FR, July 1950 SDR, June 1986 NMR, 1926 SMR, Oct. 1957 TSR, May 1949, JZR, April 1958, SRR, April 1957 NMR, July 2000	Baymuratova (1963) Kirgizbaeva et al. (1997) Soliyeva (1989) Zaprometov (1928) Kirgizbaeva et al. (1997) Kirgizbaeva et al. (1997)
60.	<i>Septoria leucostoma</i> Ell.	<i>Fraxinus</i> sp.	TSR, July 1945	Gafforov (2005) Axmedova (1966)
61.	<i>Septoria ligulariae</i> Murashk.	<i>Ligularia heterophylla</i> Rupr. <i>Ligularia thomsonii</i> (C.B.Clarke) Pojark. <i>Ligularia</i> sp.	TSR, July 1953-54 Unknown TSR, July 1955	Kirgizbaeva et al. (1997) Pashenko et al. (1978) Kirgizbaeva et al. (1997)
62.	<i>Septoria ligustici</i> Guba	<i>Paraligusticum discolor</i> (Ledeb.) V.N.Tikhom.	TSR, July 1953	Panfilova & Gaponenko (1963)
63.	<i>Septoria limnanthemii</i> Thüm.	<i>Nymphoides peltata</i> (S.G.Gmel.) Kuntze	KK, June 1951	Kirgizbaeva et al. (1997)
64.	<i>Septoria lycocotoni</i> var. <i>sibirica</i> Sacc.	<i>Aconitum</i> sp.	KK, 1923	Zaprometov (1928)
65.	<i>Septoria lycopersici</i> Speg	<i>Solanum lycopersicum</i> L.	TSR, 1912	Zaprometov (1926)
66.	<i>Septoria martianoffiana</i> Thüm.	<i>Convolvulus arvensis</i> L. <i>Paeonia anomala</i> L.	Unknown SDR, July 1948	Pashenko et al. (1978) Kirgizbaeva et al. (1997)
67.	<i>Septoria maydis</i> Schulzer & Sacc.	<i>Zea mays</i> L.	QDR, June 1995	Nuraliyev (1998)
68.	<i>Septoria melissae</i> Desm.	<i>Melissa officinalis</i> L.	TSR, June 1953 QDR, Aug. 1997	Kirgizbaeva et al. (1997) Nuraliyev (1998)
69.	<i>Septoria menthae</i> (Thum.)	<i>Mentha asiatica</i> Boriss.	TSR, July 1948	Axmedova (1966)
70.	<i>Septoria microspora</i> Ellis	<i>Gentiana olivieri</i> Griseb.	SDR, July 1985	Soliyeva (1989)



**Table 1** Continued.

No.	Species reported	Host plant	Distribution	Reference/s
71.	<i>Septoria nepetae</i> Ellis & Everh.	<i>Nepeta mariae</i> Regel	TSR, Aug. 1955	Panfilova & Gaponenko (1963)
72.	<i>Septoria origanicola</i> Allesch.	<i>Origanum vulgare</i> L.	TSR, Aug. 1953 SDR, June 1987	Kirgizbaeva et al. (1997) Soliyeva (1989)
73.	<i>Septoria pastinacina</i> Peck	<i>Pastinaca sativa</i> L.	JZR, Sep. 1958	Kirgizbaeva et al. (1997)
74.	<i>Septoria phlomidis</i> Bondartsev & Lebedeva	<i>Phlomis thapsoides</i> Bunge	BR, 1926	Zaprometov (1928)
75.	<i>Septoria phragmitis</i> Sacc.	<i>Phragmites australis</i> (Cav.) Trin. ex Steud.	QDR, July 1995	Nuraliyev (1998)
76.	<i>Septoria pistaciae</i> Desm.	<i>Pistacea vera</i> L.	Unknown	Kleyner (1958)
77.	<i>Septoria plantaginea</i> Pass.	<i>Plantago major</i> L.	TSR, July 1973	Kamilov (1991)
78.	<i>Septoria poae-trivialis</i> Cocc.,	<i>Poa bulbosa</i> L. <i>Poa trivialis</i> L.	SRR, May 1959 SRR, April 1957	Baymuratova (1963) Baymuratova (1963)
79.	<i>Septoria polygonorum</i> Desm.	<i>Koenigia coriaria</i> (Grig.) T.M.Schust. & Reveal  <i>Persicaria hydropiper</i> (L.) Delarbre <i>Persicaria maculosa</i> Gray <i>Polygonum</i> sp.	SMR, July 1959 QDR, June 1995 TSR, June 1953-54 NMR, April 2001 NMR, April 2002	Kirgizbaeva et al. (1997) Nuraliyev (1998) Kirgizbaeva et al. (1997) Gafforov (2005) Gafforov (2005)
80.	<i>Septoria polygonicola</i> (Lasch) Sacc.	<i>Polygonum</i> sp.	Unknown	Pashenko et al. (1978)
81.	<i>Septoria potentillica</i> Thüm.	<i>Potentilla reptans</i> L. Sibbaldianthe bifurca (L.) Kurtto & T.Erikss.	NMR, May 2001 TSR, June 1954 TSR, July 1976	Gafforov (2005) Kirgizbaeva et al. (1997) Kamilov (1991)
82.	<i>Septoria quevillensis</i> Sacc.	<i>Potentilla</i> sp. <i>Lonicera humilis</i> Kar. & Kir. <i>Lonicera tatarica</i> L. <i>Spiraea hypericifolia</i> L. <i>Spiraea italica</i> Raf.	SDR, May 1987 NMR, Oct. 2002 TSR, 1986 JZR, May 2019 TSR, July 1949-50	Soliyeva (1989) Gafforov (2005) Kamilov (1991) This study Panfilova & Gaponenko (1963)
83.	<i>Septoria ranunculacearum</i> Lév.	<i>Ranunculus arvensis</i> L. <i>Ranunculus</i> sp.	JZR, June.2012 JZR, June 1936	Mustafaev (2018) Golovin (1941)
84.	<i>Septoria relictia</i> Bubák	<i>Galium turkestanicum</i> Pobed.	JZR, April 1958	Kirgizbaeva et al. (1997)
85.	<i>Septoria roegneriae</i> Melnik	<i>Dianthus recticaulis</i> Ledeb.	TSR, May 1949	Panfilova & Gaponenko (1963)
86.	<i>Septoria rubiae</i> (Pat.) Bubák & Ranoj	<i>Elymus dentatus</i> (Hook.f.) Tzvelev <i>Rubia tinctorum</i> L.	TSR* NMR, 1925	Kirgizbaeva et al. (1997) Zaprometov (1928)

**Table 1** Continued.

No.	Species reported	Host plant	Distribution	Reference/s
87.	<i>Septoria rubiae-tinctorum</i> Unamuno	<i>Rubia tinctorum</i> L.	TSR, June 1949	Panfilova & Gaponenko (1963)
88.	<i>Septoria salicis</i> Westend.	<i>Salix songarica</i> Andersson	SRR, Sep. 1957	Baymuratova (1963)
89.	<i>Septoria salsolae</i> Kalymb.	<i>Caroxylon scleranthum</i> (C.A.Mey.)	BR, 1958	Gaponenko (1965)
90.	<i>Septoria salviae</i> Pass.	<i>Salvia lilacinocoerulea</i> Nevski	TSR, June 1949	Panfilova & Gaponenko (1963)
		<i>Salvia schmalbausenii</i> Regel	TSR, June 1953	Kirgizbaeva et al. (1997)
91.	<i>Septoria salviae-pratensis</i> Pass.	<i>Salvia nemorosa</i> L.	TSR, 1925	Zaprometov (1928)
92.	<i>Septoria scabiosicola</i> Desm.	<i>Salvia lilacinocoerulea</i> Nevski	QDR, April 1997	Nuraliyev (1998)
		<i>Scabiosa songarica</i> Schrenk	TSR, July 1954-55	Kirgizbaeva et al. (1997)
			QDR, April 1997	Nuraliyev (1998)
93.	<i>Septoria secalis</i> Prill. & Delacr.	<i>Secale cereale</i> L.	QDR, July 1996	Nuraliyev (1998)
94.	<i>Septoria serebrianiowii</i> Sacc.	<i>Astracantha bactriana</i> F.G.L.Fisch.	QDR, May 1997	Nuraliyev (1998)
		<i>Astragalus maveranagri</i> Popov	SRR, June 1956	Baymuratova (1963)
		<i>Astragalus villosissimus</i> Bunge	BR, June 1958	Kirgizbaeva et al. (1997)
		<i>Astragalus</i> sp.	TSR, July 1949	Kirgizbaeva et al. (1997)
95.	<i>Septoria simplex</i> (J. Schröt.) Sacc.	<i>Elymus repens</i> (L.) Gould	TSR, July 1955	Panfilova & Gaponenko (1963)
		<i>Melica altissima</i> L.	Unknown	Pashenko et al. (1978)
		<i>Oryzopsis vicaria</i> Grig.	TSR, July 1955	Axmedova (1966)
		<i>Piptatherum microcarpum</i> (Pilg.) Tzvelev	TSR, July 1955	Panfilova & Gaponenko (1963)
96.	<i>Septoria sisymbrii</i> Niessl	<i>Sisymbrium brassiciforme</i> C.A.Mey.	NMR, May 2002,	Gafforov (2005)
		<i>Sisymbrium loeselii</i> L.	NMR, June 2001, May 2002	Gafforov (2005)
97.	<i>Septoria sonchifolia</i> Cooke	<i>Sonchus asper</i> (L.) Hill	BR, May 1958	Panfilova & Gaponenko (1963)
		<i>Sonchus oleraceus</i> L.	Unknown	Pashenko et al. (1978)
98.	<i>Septoria stachydis</i> Roberge ex Desm.	<i>Phlomis</i> sp.	TSR, July 1953	Kirgizbaeva et al. (1997)
			TSR, July 1988	Kamilov (1991)
99.	<i>Septoria taraxaci</i> Hollós	<i>Taraxacum campylodes</i> G.E.Haglund	TSR, Aug. 1982	Kamilov (1991)
100.	<i>Septoria thermopsisidis</i> Muraschk.	<i>Thermopsis</i> sp.	TSR, June 1948	Axmedova (1966)
101.	<i>Septoria tianschanica</i> Golovin	<i>Astragalus masenderanus</i> Bunge	Unknown	Kirgizbaeva et al. (1997)
102.	<i>Septoria tinctoriae</i> Brunaud	<i>Rubia tinctorum</i> L.	TSR, June 1949	Kirgizbaeva et al. (1997)
103.	<i>Septoria tiliae</i> Westend.	<i>Tilia rubra</i> (Weston) DC.	TSR, Sep. 1988	Kamilov (1991)

**Table 1** Continued.

No.	Species reported	Host plant	Distribution	Reference/s
104.	<i>Septoria trachelii</i> Allesch	<i>Campanula</i> sp.	TSR, 1924	Zaprometov (1926)
105.	<i>Septoria trifolii</i> Ellis	<i>Trifolium repens</i> L.	JZR, July 2012	Mustafaev (2018), Mustafaev et al. (2019)
106.	<i>Septoria tussilaginis</i> West.	<i>Tussilago farfara</i> L.	TSR, 1938	Axmedova (1966)
107.	<i>Septoria ugamica</i> Golov.	<i>Elytrigia trichophora</i> (Link.) Nevski	TSR, 1950	Axmedova (1966)
108.	<i>Septoria urticae</i> Roberge ex Desm.	<i>Urtica dioica</i> L.	JZR, June 1956 NMR, May 2002	Kirgizbaeva et al. (1997) Gafforov (2005)
109.	<i>Septoria vassiljevskii</i> Melnik	<i>Phlomis salicifolia</i> Regel <i>Phlomis</i> sp.	SDR, May 1987 TSR, July 1953-1954	Soliyeva (1989) Kirgizbaeva et al. (1997)
110.	<i>Septoria verbenae</i> Roberge ex Desm.	<i>Verbena officinalis</i> L.	TSR, 1924	Zaprometov (1928)
111.	<i>Septoria viticola</i> Brunaud	<i>Vitis</i> sp.	July 1997	Pashenko et al. (1978)
112.	<i>Septoria vitis</i> Lév	<i>Vitis vinifera</i> L.	TSR, June 1994	Pashenko et al. (1978)
113.	<i>Septoria wisconsina</i> Greens.	<i>Astragalus skorniakowii</i> B.Fedtsch.	TSR, June 1940	Axmedova (1966)
114.	<i>Septoria xanthii</i> Desm	<i>Xanthium strumarium</i> L.	TSR, 1924	Zaprometov (1928)
115.	<i>Septoria xylostei</i> Sacc.	<i>Lonicera nummulariifolia</i> J. et Sp.	TSR, June 1961	Axmedova (1966)
116.	<i>Septoria zilingiae</i> Melnik	<i>Galium fimbriigerum</i> Boiss.	TSR, July 1951	Axmedova (1966)
117.	<i>Septoria zygophylli</i> P. Syd.	<i>Zygophyllum bucharicum</i> B.Fedtsch.	SDR, June 1987	Soliyeva (1989)

\*- date collection unknown

**Table 2** Distribution of *Septoria* species by regions of Uzbekistan.

No.	Regions	<i>Septoria</i> species	Host plants	No.	Regions	<i>Septoria</i> species	Host plants
1	Andijan Region	1	1	8	Navoi Region	1	1
2	Bukhara Region	14	16	9	Qashqadaryo Region	21	22
3	Fergana Region	5	5	10	Samarqand Region	4	5
4	Jizzakh Region	19	21	11	Surxondaryo Region	19	21
5	Karakalpakstan	2	2	12	Syrdarya Region	9	10
6	Khorezm Region	1	1	13	Tashkent Region	66	78
7	Namangan Region	14	17				

Among the *Septoria* species, 20 were associated with a wide range of plant hosts. For example, *Septoria ferulicola*, *S. bromi* isolated from six host species each; *Septoria lepidii*, *S. eremuri*, *S. caricis* isolated from five host species each; *Septoria simplex*, *S. serebriankowii*, *S. quevillensis*, *S. polygonorum*, *S. galiorum*, *S. fraxini*, *S. elymi* isolated from four host species each; *Septoria potentillica*, *S. ligulariae*, *S. cruciatae*, *S. crataegicola*, *S. convolvuli*, *S. cannabis*, *S. agropyri* and *S. acerella* isolated from three host species each. The other 97 *Septoria* species were isolated from one to two host species each.

**Table 3** The number of the host families, genera, and species and number of *Septoria* species on the host family in the study area.

Host family	No. of host genera	No. of host species	No. of <i>Septoria</i> species	Host family	No. of host genera	No. of host species	No. of <i>Septoria</i> species
<i>Poaceae</i>	20	28	19	<i>Plantaginaceae</i>	2	2	2
<i>Lamiaceae</i>	8	12	12	<i>Caryophyllaceae</i>	1	1	2
<i>Fabaceae</i>	6	11	8	<i>Datisceae</i>	1	1	2
<i>Rubiaceae</i>	4	11	8	<i>Oleaceae</i>	1	1	2
<i>Asteraceae</i>	7	8	7	<i>Asphodelaceae</i>	1	5	1
<i>Apiaceae</i>	5	10	6	<i>Amaryllidaceae</i>	1	1	1
<i>Rosaceae</i>	5	9	5	<i>Sapindaceae</i>	1	3	1
<i>Caprifoliaceae</i>	3	6	4	<i>Anacardiaceae</i>	1	1	1
<i>Cyperaceae</i>	2	5	4	<i>Apocynaceae</i>	1	1	1
<i>Polygonaceae</i>	4	4	3	<i>Betulaceae</i>	1	1	1
<i>Ranunculaceae</i>	3	4	3	<i>Cannabaceae</i>	1	1	1
<i>Amaranthaceae</i>	3	3	3	<i>Ephedraceae</i>	1	1	1
<i>Compositae</i>	3	6	3	<i>Malvaceae</i>	1	1	1
<i>Vitaceae</i>	2	2	3	<i>Menyanthaceae</i>	1	1	1
<i>Brassicaceae</i>	2	6	2	<i>Paeoniaceae</i>	1	1	1
<i>Convolvulaceae</i>	1	3	2	<i>Primulaceae</i>	1	1	1
<i>Gentianaceae</i>	1	1	2	<i>Solanaceae</i>	1	1	1
<i>Geraniaceae</i>	1	3	2	<i>Urticaceae</i>	1	1	1
<i>Salicaceae</i>	1	3	2	<i>Verbenaceae</i>	1	1	1
<i>Campanulaceae</i>	2	2	2	<i>Zygophyllaceae</i>	1	1	1

The distribution of *Septoria* species in host plants is given based on the regions of Uzbekistan in which they are distributed (Table 2). The largest number of *Septoria* species and host plants were found in the Tashkent region, followed by the Kashkadarya region (on 22 host species, 21 *Septoria* species), Surkhandarya region (on 21 host species, 19 *Septoria* species), Jizzakh region (on 21 host species, 19 *Septoria* species), Namangan region (on 17 host species, 14 *Septoria* species), Bukhara region (on 16 host species, 14 *Septoria* species), and Syrdarya region (on 10 host species, 9 *Septoria* species). In other regions, such as Andijan, Fergana, Karakalpakstan, Khorezm, Navoi and Samarkand, 1 to 5 *Septoria* species have been identified on their host plants.

## Discussion

The checklist gives an overview of *Septoria* species in Uzbekistan from different sources of data. Mycological research in Central Asia, including Uzbekistan, began in the second half of the 19<sup>th</sup> century (Borshchov 1865). As a result of studies carried out in 1926–1997, 120 species of *Septoria* were found in Uzbekistan (Kirgizbaeva et al. 1997). Later, 18 new *Septoria* species were identified from 22 host plants as novel records in Uzbekistan during 1997–2021 (Nuraliyev 1998; Gafforov 2005; Mustafaev 2018; Sherqulova et al. 2019). When all 138 identified *Septoria* names were re-examined according to the current nomenclature of fungi, 24 *Septoria* species (*Septoria aceris*, *S. apallens*, *S. atriplicis*, *S. berberidis*, *S. bubakii*, *S. calamagrostidis*, *S. exotica*, *S. ferulae*, *S. fraxini*, *S. fuckelii*, *S. fuispora*, *S. hyperici*, *S. longispora*, *S. meliloti*, *S. phlomidis*, *S. podagrariae*, *S. populi*, *S. rosae*, *S. rubi*, *S. silenes*, *S. stellariae*, *S. stipae*, *S. salicicola*, *S. tritici*) were transferred to other genera (Index Fungorum 2021; Wijayawardene et al. 2020). The fungal

diversity reported here for Uzbekistan is much lower than that in other regions where the diversity of *Septoria* species is well explored. For example, 223 *Septoria* species were reported in Kazakhstan (Bizova et al. 1970). The low species number in Uzbekistan is partly due to the relatively small area, but also due to the lack of systematic field surveys and thorough identification with the aid of molecular sequencing.

Since 1926, fungi have been studied in the regions or separate territories of Uzbekistan (Table 2). For example, fungi of the Bukhara region were studied by Gaponenko. Of the 396 species found, 17 belonged to *Septoria* (Gaponenko 1965). As a result of mycological studies conducted in the mountainous regions of Uzbekistan (Jizzakh, Namangan, Kashkadarya and Surkhandarya), 17 to 22 *Septoria* species have been identified on vascular plants. In addition, the mycobiota of Surkhandarya (Soliyeva 1989, Gafforov 2017), Kashkadarya (Nuraliyev 1998; Sherqulova et al. 2019), Namangan (Gafforov 2005), Jizzakh (Mustafaev 2018) regions were studied. Baymuratova (1963) identified nine *Septoria* species on 10 vascular plants distributed in the Syrdarya region during the study of hungry steppe regions of Uzbekistan. The largest number of *Septoria* species were found in the Tashkent region, which is located in the north-eastern part of Uzbekistan, between the Syrdarya and Western Tianshan Mountains. Therefore, the diversity of vascular plants in the region is high (Tojibaev et al. 2020). This may ensure an increase in the diversity of the *Septoria* species. Therefore much more research may have been done in the Tashkent region compared to other regions (Panfilova & Gaponenko 1963; Axmedova 1966; Kamilov 1991; Kirgizbaeva et al. 1997). As a result, 66 *Septoria* species were identified on 76 vascular plants in the Tashkent region (Table 2). It was found that no systematic studies of the fungal biota were carried out in the Andijan, Fergana, Karakalpakstan, Khorezm, Navoi and Samarkand regions of Uzbekistan (Table 2).

During our survey in the Jizzakh region, ten *Septoria* species were found. Even though previous studies found *S. distachya* on *Ephedra* sp. (Golovin 1941), *S. pastinacina* on *Pastinaca sativa*, and *S. relictata* on *Galium turkestanicum* (Kirgizbaeva 1997) in the same area, we did not find these species in the study area during our three years of the survey. We also identified *Septoria* sp. on the *Heracleum lehmannianum* Bunge from the Jizzakh region. According to our microscopic examination, this species could be *Septoria heraclei* Desm. This species is a new species for the mycobiota of Uzbekistan. According to Index fungorum, *Septoria heraclei* was changed to *Phloeospora heraclei* (Lib.) Petr.. This species is a new record for the mycobiota of Uzbekistan. According to Index fungorum, *Septoria heraclei* was changed to *Phloeospora heraclei* (Verkley et al. 2013). This requires that we re-conduct extensive molecular studies on this species of *Septoria*.

Our results confirm that most species of *Septoria* have narrow host ranges, being limited to a single genus or a few genera of the same plant family. For example, *Septoria astragali* is found only on the genus *Astragalus* (*Fabaceae*), *S. bromine* on the genus *Bromus* (*Poaceae*), and *S. convolvuli* on the genus *Convolvulus* (*Convolvulaceae*). However, there were a few notable exceptions. Verkeley et al. (2013) demonstrated that the supposed single-family host ranges of *Septoria paridis* (*Liliaceae*) and *S. urticae* (*Urticaceae*) each included one additional family (*Violaceae* and *Lamiaceae*, respectively). Previously *Septoria protearum* was only associated with *Proteaceae* (*Protea*), was now found to be also associated with *Araceae* (*Zanthedeschia*), *Aspleniaceae* (*Asplenium*), *Rutaceae* (*Boronia*), *Boraginaceae* (*Myosotis*), *Oleandraceae* (*Nephrolepis*), and *Rosaceae* (*Geum*) (Crous & Braun 2003).

*Septoria* species in Uzbekistan were found on 163 host plant species of 104 genera, and 40 families. The largest number of *Septoria* species was recorded in seven families: *Poaceae*, *Lamiaceae*, *Fabaceae*, *Rubiaceae*, *Asteraceae*, *Apiaceae* and *Rosaceae*. It is most common among the members of the family *Poaceae*. This may be due to the fact that species in these families are widespread in Uzbekistan. *Septoria* species are also common in members of the *Poaceae* family, similar to other countries (Seifbarghi et al. 2009; Assylbek et al. 2021).

Data on *Mycosphaerellales* fungi in Uzbekistan are still scarce. Molecular and morphological studies are very important to revise and reevaluate existing *Septoria* species and also to determine

their taxonomic position. The knowledge generated by the work is of immense importance as it is a key to revealing the diversity and ecology of the genus *Septoria* from Uzbekistan.

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