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The genus *Septoria* Sacc. in Turkey

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Abstract

Seventynine *Septoria* species from 72 host plants have been identified in Turkey so far. There can be distinguished different interrelations between *Septoria* species and their host plants. So there are indifferent relationships between *Cercis siliquastrum* and *S. cercidis*, *Petroselinum sativum* and *S. petroselini, Apium graveolens* and *S. apiicola, Cannabis sativa* and *S. cannabis* presented negative consortium relationship. On *Lycopersicum esculentum* in high degree develop *S. lycopersici*. Between components of association they made antagonistic relationship, when infected plants perish. Some species of *Septoria* take part on the same substratum with other fungi species. In mycological association of *S. tritici* and *Puccinia recondita* and *P. striiformis, S. tritici* suppresses development of these rust fungi. The species *S. convolvuli* can be the example for mycological association with successive development of parasitic and saprobic components.
The geographical elements of *Septoria* are represented by Holarctic (34.1%), Paleoarctic (16.5%), European–caucasian (11.4%), Mediterranean (10.1%), Holarctic with irradiation to South Hemisphere (6.3%), European with irradiation to West Asia (5.1%), European–caucasian–middle asiatic (3.8%), Mediterranean–paleoarctic (5.1%), Cosmopolitan (5.1%) and Caucasian (2.5%). *S. valerianae* Sacc. & Fautr. on *Valeriana alliarifolia* Adams. is a new record for Turkey.
Key words: Geographical elements, micromycetes, new record.

Introduction

The concept of the genus *Septoria* has evolved since its description by Saccardo (1884). Initially, all the species are parasitic, typically causing leaf spots, having multicellular narrowly elongate to filiform conidia being produced in pycnidial conidiomata on the leaves, were reffered to this taxon. These features weakly distinguished *Septoria* species from representatives of the genus *Rhabdospora*: the only indicator of the last was development of the pycnidia on stems and parasitic or saprobic (Barnett and Hunter, 1999). The current features determining the genus *Septoria* are more distinct and explicit. The taxon comprises *Coelomycetes* with pycnidial conidiomata, holoblastic conidiogenesis and multiseptate, hyaline, filiform, straight or flexuous, often curved or worm-like, smooth, continuous or constricted at the septa conidia (Sutton, 2004). The teleomorph state belongs to *Mycosphaerella* Johanson pro parte (*Mycosphaerellaceae*).

Septoria may by confused with *Cylindrosporium* in which has conidia are produced in acervuli but instead of pycnidia with irregular dehiscence but often pushing up a flap of host tissue. The genera *Phloeospora* and *Stagonospora* also look like *Septoria*. *Phloeospora* has good clear, but not closed tissue on lower part of acervulus while *Stagonospora* has thick-walled pycnidia with hyaline, rather thickened and short conidia.

Septoria species are wide spread in the World. The data on these fungi are represented in classical florae and in a number of critical revisions from different regions. According to Markevičius (1996) genus *Septoria* while includes more than 2000 species distributed all over the World, Kirk *et al*. (2001) believe that the genus has 1000 species. Investigations on *Septoria* fungi diversity were not special but rather accidental in Turkey. Some brief notes on occurrence of these fungi may be found in publications devoted to general distribution of micromycetes. The first fragmentary data on *Septoria* fungi are scattered in mycological papers of Bremer and his colleaques (Bremer 1948, Bremer *et al.,* 1952). Petrak, (1953) reported two species in *Septoria* from Turkey: viz. *S. adanensis* and *S. falcariicola.* In the preliminary list of plant diseases in Turkey, Karel, (1958), 30 species of the genus *Septoria* are given as agents of diseases of forest-trees, fruit-trees, cereals vegetables, industrial and ornamental plants. More species of the genus *Septoria* have been reported by Göbelez (1967), Uçar and Öner (1977), Tamer *et al*. (1987, 1990), Demirci *et al.* (1998), Selçuk and Hüseyinov (2001), Hüseyin and Selçuk (2002), Kurt (2003), Selçuk *et al*. (2003), Kırbağ (2004), Bahcecioğlu and Yıldız (2005) and Hüseyin and Yıldızbaş (2005).

Intensive study of leaf-inhabiting anamorphic fungi was started toward the end of 20th century in Turkey. As a result more *Septoria* species taxa were detected from different forest regions. *S. oleandriicola* was described as a new species by Hüseyin and Selçuk (2002). The modern idea on the range of *Septoria* species in Turkey was formed and completed by new data as a result of our expeditions, identification and revision of herbarium specimens of *Septoria* species collected from Turkey which have been critically reviewed.

Materials and Methods

The total number of 50 publications were examined for the records of *Septoria* sensu lato. In 30 of them there were listed species belonging to this genus collected from Turkey (Bremer *et al.,* 1948, 1952; Petrak, 1953; Karel, 1958; Göbelez, 1967; Uçar and Öner, 1977; Tamer *et al*., 1987, 1990; Selçuk and Hüseyinov, 2001; Hüseyin and Selçuk, 2002; Kurt, 2003; Selçuk *et al.,* 2003; Hüseyin and Yıldızbaş; 2005). These papers, (including short communications and monographic studies), have been analysed paying special attention to the ecological data on occurence of *Septoria* species.

In the last stage the prepared list of species has been compared with the taxonomical status assigned to them in the revision (Teterevnikova-Babayan 1987; Vanev *et al.,* 1997; Andrianova 1999).

Results and Discussion

Septoria species are represented on the territory of Turkey by 79 taxa up to now. We think that these species are more numerously in fact, because the host-plants are very diverse and the climate is very good for the growth and development of *Septoria* fungi. Seventynine noted species were registered on 72 species of high plants from 64 genera of 40 families (Table 1). Most of them were found on members of Asteraceae (6), Caryophyllaceae (5), Lamiaceae (5), Apiaceae (4), Fagaceae (4) and Rosaceae (4). On the other plants of 34 families 1-3 species of *Septoria* were noted only (Table 2). These plant families have rather high species diversity and are basic in flora of Turkey.

The same tendencies of host plants preferences were demonstrated for *Septoria* species from other previously investigated area of holarctic region (Marland, 1948; Brezhnev, 1955; Teterevnikova-Babayan, 1962; Nikolaeva and Alferova, 1971; Pantidou, 1973; Radulescu *et al.,* 1973, Ershad 1977, Bakalova 1980, Vanev *et al*., 1997, Andrianova 1999). It may be accounted for high species diversity of these plant families in floras. Synonym species of *Septoria* and their hosts are listed in Table 3.

Today *Septoria* fungi are associated with a unimportant part of known plants of Turkey only, as these fungi infect representatives of 64 genera out of 1223 genera of plants. Nevertheless, *Septoria* fungi are collected on all main genera of Turkish flora, such as *Anchusa, Anemone, Apium, Arbutus, Berberis, Bromus, Clematis, Cornus, Elaeagnus, Hordeum, Polygonum, Populus, Pyrus, Quercus, Rubus, Urtica* and other genera.

The distribution of *Septoria* species living hosts is very interesting because it is very closely connected with biology and ecology of their hosts, with their method of overwintering, spring renewal and so on. The number of *Septoria* species on kind of host plants are given below:

On grass plants fiftyfour species, on scrubs fifteen and on trees ten.

In the whole territory of Turkey *S. bromi*, *S. berberidis, S. cannabis, S. cirsii, S. clematidis, S. convolvuli, S. cornicola, S. lepidii, S. scabiosicola, S. tritici* are most widespread while *S. cyclaminis, S. ebuli, S. intybi, S. karelli, S. mahoniae, S. oleandriicola, S. silenes* are rare species in natural phytocenoses and *S. oleandriicola* was described as a new species on *Nerium oleander* by Hüseyin and Selçuk (2002).

Septoria species are represented by different ecological groups. The first group includes species which are reported from all parth of the country. They possess wide adaptability and develope in different ecological conditions. This group includes 30 species. These are *S. didyma, S. cornicola, S. lamii, S. septulata* and others on leaves of woody plants while *S. cirsii, S. lepidii, S. passerinii, S. polygonicola, S. polygonorum, S. urticae, S. convolvuli* etc. are parasites of widespread herbaceous plants.

Some species distributed only in more mesophilous mountain forests, and high humidity regions of country. This group represented by 47 species which include a lot of parasites of trees and shrubs, herbaceous plants and floral cultures. For example: *S. querceti, S. quercicola* on species of *Quercus*, *S. gilletiana* on *Castanea sativa, S. unedonis* on species of *Arbutus, S. cyclaminis* on *Cyclamen hederifolium*, six species on meadow grasses etc. In central Anatolia, where climate is arid and hot are spread 43 *Septoria* species. These include *S. berberidis* on *Berberis crataegina, S. carthami* on *Carthamus tinctorius, S. catariae* on *Nepeta cataria* and *Septoria* ssp. on *Poaceae*. In

South-east of the country also with arid and hot climate are found nine species including *S. euphorbia, S. stellariae* and *S. xanthii*. In mediterranean region are found *S. cercidis, S. clematidis, S. intybi, S. lapadensis, S. longispora, S. adanensis, S. scabiosicola.* These are parasites on woody plants and on members of mixed fodder plants.

Most of *Septoria* species are parasites, damaging different plants. They cause diseases of cereals, damage, forage, ornamental plants, fruit-trees, forest-trees, vegetables, berry-likes and wild plants (Eskalen *et al.,* 2009). *Septoria* blight of parsley is caused by *S. petroselini* while *S. apiicola* causes leaf blight of cultivated and wild celery. *S. cannabis* causes ellipsoidal or polygonal, yellowish to greyish leaf spots and leaf fall of hemp. *S. carthami* occurs on safflower causing leaf spots and leaf fall. *S. lycopersici* on tomato and on eggplant caused *Septoria* spot, which very severe disease levels infection spreads to the younger leaves, lesions coalesce, leaves dry out and the resulting defolation ends by leaving only a few leaves at the top of the stem. In some years fungi of this genus damage 80-100% of plants.

You can distinguish different relationships between *Septoria* species and their host plants. So there are indifferent relationships between *Cercis siliquastrum* and *S. cercidis*. Between species of *Petroselinum sativum* and *S. petroselini; Apium graveolens* and *S. apiicola; Cannabis sativa* and *S. cannabis* presented negative relationships. On *Lycopersicum esculentum* in high degree develop *S. lycopersici*. Between component of association made antagonistic relationship, when infected plants perish.

Some species of *Septoria* were recorded growing together on the same substratum with other fungi species. In mycological association of *S. tritici* and *Puccinia recondita* and *P. striiformis, S. tritici* suppresses development of these rust fungi. The species *S. convolvuli* can be an example for mycological association with successive development of parasitic and saprobic components. *S. convolvuli* infects the plants and then *Cladosporium herbarum* and *Alternaria alternata* developed on the same spots. *S. oleandriicola* and *S. oleandrina* infects the leaf of *Nerium oleander* and causes spots and then *Cladosporium microsporum* develops on these spots.

The geographical analysis of *Septoria* species in Turkey shows the prevalence of Holarctic (34.1% of total number of species), and Paleoarctic (16.5%) elements, with the smaller part of Europaen-caucasian (11.4%), Mediterranean (10.1%), Holarctic with irradiation to South Hemisphere (6.3%), European with irradiation to West Asia (5.1%), European-caucasian-middle Asiatic (3.8%), Mediterranean-paleoarctic (5.1%), Cosmopolitan (5.1%) and Caucasian (2.5%) ones (Table 4).

Holarctic elements: *S. aciculosa, S. apiicola, S. ampilina, S. anemones, S. bromi, S. cannabis, S. chelidonii, S. cirsii, S. clematidis, S. cornicola, S. cornicola* var. *cornicola, S. cucurbitacearum, S. didyma, S. digitalis, S. fragariae, S. lactuca, S. lamii, S. lamiicola, S. lepidii, S. menthae, S. polygonicola, S. polygonorum, S. passerinii, S. rosarum, S. querceti, S. quercicola, S. xanthii;* Holarctic elements with irradiation to South Hemisphere: *S. dianthi, S. dulcamarae, S. petroselini, S. stellariae, S. verbenae;* Paleoarctic elements: *S. alhaginis, S. anchusae, S. carthami, S. catariae, S. cyclaminis, S. clematidis-flammulae, S. dimera, S. fragariaecola, S. ebuli, S. gladioli, S. linariae, S. scabiosicola, S. valerianae;* European-caucasian elements: *S. castaneicola, S. guepini, S. hederae, S. hedericola, S. longispora, S. mahoniae, S. phytolaccae, S. silenes, S.tritici;* European-caucasian-middle Asiatic elements: *S. berberidis, S. elaeagni, S. intybi*; European elements with irradiation to front Asia: *S. euphorbia, S. gypsophilae, S. lapadensis, S. melissae;* Mediterranean elements: *S. adanensis, S. cercidis, S. karelli, S. oleandrina, S. oleandriicola, S. styracis, S. ulicis, S. unedonis;* Mediterranean-paleoarctic elements: *S. falcariinicola, S. gilletiana, S. hibisci, S. rhois;* Caucasian elements: *S. alliicola, S. melongenae;* Cosmopalitan: *S. convolvuli, S. lycopersici, S. septulata, S. urticae.*

S. valerianae Sacc. & Fautr. on *Valeriana alliarifolia* Adams. (*Valerianaceae*) is new record for Turkey. Küre Mountain National Park, Pınarbaşı district, Ilıca, 41°39’50’’N, 33°08’31’’ E, 680 m., 30 August 2005, Co. Hüseyin E and Erdoğdu M (MK 1514).

(This study was presented at IV Balkan Botanical Congress, Sofia, 2006 and at International Symposium, 7th Plant Life of South West Asia, Eskisehir, 2007).

Table 1: The species of *Septoria* genus and their host plants.

Fungus	Host plants
Septoria aciculosa Ellis & Everh.	*Fragaria* sp.
S. adanensis Petr.	*Chrysanthemum indicum* L.
S. alliicola Bäumler	*Allium scorodoprasum* L. subsp. *rotundum* (L.) Stearn.
S. alhaginis Szemb.	*Alhagi camelorum* Fisch.
S. ampelina Berk. & M.A. Curtis	*Vitis vinifera* L.
S. anchusae Syd.	*Anchusa arvensis* (L.) Bieb., *A. azurea* Miller
S. anemones Desm.	*Anemone narcissiflora* L.
S. apiicola Speg.	*Apium graveolens* L.
S. berberidis Niessl	*Berberis crataegina* DC., *B. vulgaris* L.
S. bromi Sacc.	*Bromus racemosus* L.
S. cannabis (Lasch) Sacc.	*Cannabis sativa* L.
S. carthami Murashk.	*Carthamus tinctorius* L.
S. castaneicola Desm.	*Castanea sativa* Miller
S. catariae Bubák	*Nepeta cataria* L.
S. cercidis Fr.	*Cercis siliquastrum* L.
S. chelidonii Desm.	*Chelidonium majus* L.
S. cirsii Niessl	*Cirsium arvense* (L.) Scop.
S. clematidis Roberge ex Desm.	*Clematis cirrhosa* L.
S. clematidis-flammulae Roum.	*Clematis flammula* L.
S. convolvuli Desm.	*Convolvulus arvensis* L.
S. cornicola Desm.	*Cornus australis* C.A. Meyer, *C. sanguinea* L.
S. cornicola var. *cornicola* Desm.	*Cornus sanguinea* L.
S. cucurbitacearum Sacc.	*Cucurbita* sp.
S. cyclaminis Durieu & Mont.	*Cyclamen hederifolium* Aiton
S. dianthi Desm.	*Dianthus* sp.
S. didyma Fuckel	*Salix alba* L.
S. digitalis Pass.	*Digitalis ferruginea* L. subsp. *ferruginea, D. lamarckii* Ivan.
S. dimera Sacc.	*Silene dichotoma* Ehrh.
S. dulcamarae Desm.	*Solanum dulcamara* L.
S. ebuli Roberge ex Desm.	*Sambucus ebulus* L.
S. elaeagni (Chevall.) Desm.	*Elaeagnus angustifolia* L.
S. euphorbiae Kalchbr.	*Euphorbia macroclada* Boiss.
S. falcariincola Petr.	*Falcaria rivinii* Host
S. fragariae Desm.	*Fragaria* sp.
S. fragariaecola Lobik	*Fragaria* sp.
S. gilletiana Sacc.	*Castanea sativa* Miller
S. gladioli Pass.	*Gladiolus* sp.
S. guepini Moesz	*Euphorbia* sp.
S. gypsophilae Died. var. *macrospora* Padwick & Merh	*Gypsophila porrigens* (Gouan ex L.) Boiss.
S. hederae Desm.	*Hedera helix* L.
S. hedericola (Fr.) Jørst.	*Hedera helix* L.
S. hibisci Sacc.	*Hibiscus syriacus* L.
S. intybi Pass.	*Cichorium intybus* L.
S. lactucae Pass.	*Lactuca serriola* L.
S. lamii Pass.	*Lamium amplexicaule* L.
S. lamiicola Sacc.	*Lamium amplexicaule* L.
S. lapadensis Jaap	*Linaria lanigera* Desf.
S. lepidii Desm.	*Lepidium latifolium* L., *L. draba* L., *Cardaria draba* (L.) Desv.
S. linariae H. C. Greene	*Linaria* sp
S. longispora Bondartsev	*Convolvulus arvensis* L.

S. lycopersici Speg.	*Lycopersicum esculentum* Miller
S. mahoniae Pass.	*Mahonia aquifolium* (Pursh) Nutt.
S. melissae Desm.	*Melissa officinalis* L.
S. melongenae Lobik	*Solanum melongena* L.
S. menthae (Thüm.) Oudem.	*Mentha pulegium* L.
S. oleandrina Sacc.	*Nerium oleander* L.
S. oleandriicola Hüseyin & Selçuk	*Nerium oleander* L.
S. passerinii Sacc.	*Hordeum sativum* Pers., *H. murinum* L.
S. petroselini Desm.	*Petroselinum sativum* Hoffm.
S. phytolaccae Cavara	*Phytolacca americana* L.
S. polygonicola (Lasch) Sacc.	*Polygonum hydropiper* L.
S. polygonorum Desm.	*Polygonum hydropiper* L., *P. lapathifolium* L.
S. querceti Thüm.	*Quercus pontica* C. Koch
S. quercicola Sacc.	*Q. vulcanica* Boiss. & Heldr. ex Kotschy
S. rhois Lév.	*Rhus coriaria* L.
S. rosarum Westend.	*Rosa* sp.
S. scabiosicola Desm.	*Scabiosa palestina* L.
S. septulata Beach	*Convolvulus* sp.
S. silenes Westend.	*Silene dichotoma* Ehrh., *S. capitellata* Boiss.
S. stellariae Roberge ex Desm.	*Stellaria media* (L.)Vill. subsp. *media*
S. styracis Göbelez	*Styrax officinalis* L.
S. tritici Desm.	*Triticum sativum* Lam.
S. ulicis Göbelez	*Ulex* sp.
S. unedonis Roberge ex Desm.	*Arbutus andrachne* L., *A. unedo* L.
S. urticae Roberge ex Desm.	*Urtica urens* L., *U. dioica* L.
S. valerianae Sacc. & Fautrey	*Valeriana alliarifolia* Adams.
S. verbenae Roberge ex Desm.	*Verbena officinalis* L.
S. xanthii Desm.	*Xanthium strumarium* L.

Table 2: The number of *Septoria* species on families, genera and species of host plants in Turkey.

Host Family	**The number of *Septoria* species**	**The number of host plants**	
		Genera	**Species**
Anacardiaceae	1	1	1
Apiaceae	4	4	4
Apocynaceae	2	1	1
Araliaceae	2	1	1
Asteraceae	6	6	6
Brassicaceae	1	2	3
Boraginaceae	1	1	2
Caesalpiniaceae	1	1	1
Cannabaceae	1	1	1
Caprifoliaceae	1	1	1
Caryophyllaceae	5	4	4
Convolvulaceae	3	1	1
Cornaceae	2	1	2
Cucurbitaceae	1	1	-
Dipsacaceae	1	1	1
Elaeagnaceae	1	1	1
Ericaceae	1	1	2
Euphorbiaceae	2	1	1
Fabaceae	2	2	1
Fagaceae	4	2	3
Iridaceae	1	1	1
Liliaceae	1	1	1
Lamiaceae	5	4	4

Malvaceae	1	1	1
Phytolaccaceae	1	1	1
Poaceae	3	3	4
Polygonaceae	2	1	2
Primulaceae	1	1	1
Ranunculaceae	3	2	3
Rosaceae	4	2	-
Salicaeae	1	1	1
Scrophulariaceae	3	2	3
Solanaceae	3	2	3
Styracaceae	1	1	1
Urticaceae	1	1	2
Valerianaceae	1	1	1
Vitaceae	1	1	1
Total	**79**	**64**	**72**

Table 3: The Synonyms of *Septoria* species and their host plants reported from Turkey

Fungus	**Host**
Septoria calystegiae Westend.= ***Stagonospora calystegiae*** Koshk*	*Convolvulus arvensis* L.
S. donacis Pass.= ***Pseudoseptoria donacis*** (Pass.)B. Sutton*	*Arundo donax* L.
S. graminum Desm.= ***Mycosphaerella graminicola*** (Fuckel)J. Schröt.*	*Avena sativa* L.
S. linicola (Speg.) Garass.= ***Mycosphaerella linicola*** Naumov*	*Linum usitatissimum* L.
S. oxyacanthae Kunze & J. C. Schmidt= ***Phleospora oxyacanthae*** (Kunze & J. C. Schmidt)Wallr.*	*Crataegus oxyacantha* L.
S. pistacina Allesch.= ***Mycosphaerella pistacina*** Chitzan.*	*Pistacia vera* L.
S. pistaciarum Caracc.= ***Mycosphaerella pistaciarum*** Chitzan.*	*Pistacia vera* L.
S. populi Desm.= ***Mycosphaerella populi*** (Auersw.)J.Schröt.*	*Populus nigra* L.
S. pseudoplatani Roberge ex Desm.= ***Cylindrosporium pseudoplatani*** (Roberge ex Desm.)Died.*	*Acer platanoides* L.
S. pyricola Desm.= ***Mycosphaerella pyri*** (Auersw.)Boerema*	*Pyrus communis* L., *P. syriaca* Boiss. var. *microphylla*
S. ribis (Lib.) Desm.= ***Mycosphaerella ribis*** (Fuckel) Lindau*	*Ribes biebersteinii* Berl. & DC.
S. rosae Desm.= ***Sphaerulina rehmiana*** Jaap*	*Rosa* sp.
S. rubi Westend= ***Coryneopsis rubi*** (Westend.)Grove*	*Rubus caecius* L.
S. ulmi Fr.= ***Mycosphaerella ulmi*** Kleb.*	*Ulmus minor* Miller subsp. *minor*, *U. campestris* L.

* Teliamorphs of *Septoria* species

Table 4: The Ecological distribution of *Septoria* species in Turkey.

Areas				
Type	**Class**	**Group**	**Number of Species**	**% of total species**
Boreal	Holarctic	Holarctic	27	34.1
		Holarctic with irradiation to South Hemisphere	5	6.3
	Paleoarctic	Paleoarctic	13	16.5
	European	European-caucasian	9	11.4
		European-caucasian-middle asiatic	3	3.8
		European with irradiation to West Asia	4	5.1
Xerophile	Mediterranean	Mediterranean	8	10.1
		Mediterranean- paleoarctic	4	5.1

Caucasian	Caucasian	Caucasian	2	2.5
Cosmopolitan	Cosmopolitan	Cosmopolitan	4	5.1
Total			**79**	**100**

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