

## **Weed Hosts of Field Dodder (*Cuscuta campestris* Yunck.) in Northwestern Marmara Region of Turkey**

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**ABSTRACT:** Dodder (*Cuscuta* spp.) is a parasitic weed damaging several crop plants. A weed survey covering vegetable fields, orchards and vineyards was conducted from 2015 to 2018 in Northwestern Turkey. During surveys parasitic weed *Cuscuta campestris* Yunck was found attached to 23 weed species from 15 families. Higher frequency of parasitism of dodder was determined in *Polygonum aviculare* L., *Amaranthus retroflexus* L., *Chenopodium album* L., *Ecballium elaterium* (L.) A. Rich., *Lactuca serriola* L., *Portulaca oleracea* L. and *Cichorium intybus* L. weed species. The infection intensity was the highest in *Lactuca serriola* L., *Convolvulus arvensis* L., *Portulaca oleracea* L., *Tribulus terrestris* L., *Ecballium elaterium* (L.) A. Rich., *Rumex crispus* L. and *Polygonum aviculare* L.

**Keywords:** *Cuscuta campestris* Yunck, field dodder, weeds, host, Turkey.

### **Kuzeybatı Marmara Bölgesinde Tarla Küskütü (*Cuscuta campestris* Yunck)'nün Yabancı Ot Konukçuları**

**ÖZ:** Küsküt (*Cuscuta* spp.) birçok kültür bitkisinde zararlı olan parazitik bitkidir. 2015-2018 yılları arasında Kuzeybatı Marmara Bölgesinde sebze, meyve ve bağ alanlarını kapsayan yabancı ot sürveyine çıkmıştır. Sürveyler sırasında *Cuscuta campestris* Yunck 15 familyaya ait 23 yabancı otta parazit bulunmuştur. *Polygonum aviculare* L., *Amaranthus retroflexus* L., *Chenopodium album* L., *Ecballium elaterium* (L.) A. Rich., *Lactuca serriola* L., *Portulaca oleracea* L. ve *Cichorium intybus* L. yabancı otlarında parazitlenme sıklığı yüksek bulunmuştur. *Lactuca serriola* L., *Convolvulus arvensis* L., *Portulaca oleracea* L., *Tribulus terrestris* L., *Ecballium elaterium* (L.) A. Rich., *Rumex crispus* L. ve *Polygonum aviculare* L. 'de ise parazitlenme yoğunluğu yüksek olarak belirlenmiştir.

**Anahtar Kelimeler:** *Cuscuta campestris* Yunck, tarla küskütü, yabancı otlar, konukçu, Türkiye.

## INTRODUCTION

Weeds are unwanted plants comprising 8,000 of 250,000 plant species present in the world (Holm *et al.*, 1979). These plants can cause significant crop losses under heavy infestations, host many pests and diseases; inhibit plant growth with secreting many allelopathic compounds. Furthermore, some weeds contain toxic compounds such as nitrates, resinous, glycosides, alkaloids, oxalates which affect the heart and nervous system of feeding livestock's (Allred, 1982).

Among all plants 4200 plants belonging to 274 genera and 20 families were confirmed as parasitic in the world (Sarić-Krsmanović and Vrbničanin, 2015). Within parasitic plants *Cuscuta*, *Arceuthobium*, *Orobanchae*, and *Striga* genera reported to be most damaging and economically most important (Nickrent, 2002).

The genus *Cuscuta* consists of 3 subgenera, *Monogyna*, *Cuscuta*, and *Grammica* (Engelmann, 1859). The primarily subgenera is *Cuscuta* which include up to 200 annual and perennial parasitic species found attached to several, ornamentals, weeds, crop plants and trees (Kadioğlu, 1992; Garcia *et al.*, 2014).

Prominent families attacked by dodder were reported as dicotyledons including Rosaceae, Asteraceae, Solanaceae due to their suitable morphology for haustoria attachment (Sarma *et al.*, 2008). *C. europea* has been reported from 237 plant species, *C. campestris* has been observed on 69 plants, *Cuscuta epithimum* was found on 147 plants; *Cuscuta gronovii* was observed on 175 plant species across the world (Holm *et al.* 1997; Quasem, 2008; Smith *et al.*, 2016). But parasite was observed in some monocotyledons such as *Eleusine indica* (L.) Gaertn and *Echinochloa crus-galli* (L.) P. Beauv (Şin *et al.*, 2018).

There are several reports on the occurrence of *Cuscuta* species in Turkey. Studies dated back to 1978 clarified the presence of almost 21 dodder species. These were reported mostly in Anatolian part of the country. *C. campestris* were identified on several field crops and vegetables, *C. paniflora* collected from pastures while *Cuscuta approximata* found frequently on clover (*Trifolium repens* L.), *C. europea* and *C. epithimum* on sugar beet

(Davis, 1978; Gürsoy, 2001; Ayan and Töngel 2004; Yıldırım and Tepe, 2014; Arat, 2015; Kadioğlu *et al.*, 2015; Nemli *et al.*, 2015).

*Cuscuta* species (dodder) are plants that are unable to assimilate carbon and inorganic nitrogen and are dependent to host plant for food and water (Heide-Jørgensen, 2008; Westwood *et al.*, 2010). These parasites have no roots, generally no leaves and chlorophyll except some species like *Cuscuta europaea* and *Cuscuta campestris* (Dawson *et al.*, 1994; Hibberd *et al.*, 1998). These plants obtain carbon, water and nutrients by attaching to host plants with their haustoria. Water and food uptake from host of these plants results in poor growth and even plant death under severe infestations. Damage to host plants varies from 26 to 100 % depending on *Cuscuta* varieties and host susceptibility (Nemli and Öngen, 1982; Bewick *et al.*, 1988; Konieczka *et al.*, 2009).

Following attachment parasite has the ability to grow rapidly and can reach to 8 cm length at the end of the day. Upon maturation flowers bear and produce capsule containing many seeds which germinate easily without any stimulation (Dawson *et al.*, 1994). Germinated seedlings have short life and need immediate penetration to host plant for survival in eight days (Nwokocha and Aigbokhan, 2013). Only one host from any family is sufficient for the life completion and seed production. In this point susceptible weeds play significant role by serving as an alternate host when crop plant is not in the area. The dodder can invade weed, grow and produce 3000 to 25.000 seeds which can stay viable in the soil up to 20 years. The present seeds may initiate new invasions in the following growing season (Dawson *et al.*, 1994).

Meanwhile *Cuscuta* species are able to transmit several viruses and mycoplasma like organisms from infected to healthy plants. These parasites may also retain some viruses which were introduced to plants by insect vectors. In both ways host weeds of dodder are playing role as a virus maintaining source (Toth *et al.*, 2006).

Despite the published results of occurrence of 21 dodder species related to different crop host plants in Turkey the information about other hosts has not been documented clearly. Therefore, a study was

carried in Northwestern Marmara Region in order to reveal current weed hosts.

## MATERIAL and METHODS

### Survey area information and survey

The survey area comprises Edirne, Kırklareli and Tekirdağ Provinces located in Northwestern Turkey. In order to evaluate *Cuscuta* species in the region regular field visits was conducted from May to mid-September between 2015 and 2018. In surveys randomly selected cherry, apple, olive, almond, walnut, quince, pear, peach orchards, vegetable gardens, sunflower fields, flower gardens, weedy roadsides, fallow fields and pastures were visited and investigated for the presence of dodder species (Figure 1). A total of 217 different plantations (79 vineyard, 91 orchards, 15 sunflower fields, 34 others) in three provinces were visited. Sampling numbers were determined based on production area statistics of TURKSTAT (Anonymous, 2014). Field study was done according to partial sampling method of Bora and Karaca (1970) and at least 1% of survey area was sampled. Attachment of field dodder on host plant stem is given in Figure 2.

During visits weed species attached with parasite were recorded, photographed and samples were collected for identification. Weed identification was carried out after preparing the herbarium of each species by slow drying of plant samples at room temperature. After complete drying each weed sample were stuck on to cardboard, covered by nylon and labelled. Data's on collection site, province, and collection date were recorded on each label. Weeds were identified by comparing plant morphology with published literatures published literatures of Dickson and Royer (2015). The results were confirmed by after re-examination at Weed Science Laboratory at Gaziosmanpaşa University in Tokat, Turkey. The weed images were taken with Nikon Coolpix P900 digital camera.

Flowering dodder samples were collected for species determination. *Cuscuta* spp. was identified by examining plant morphology at 10-40X magnification with Leica DM 1000 microscope. The anther, sepal and petal images were taken with Leica ICC50 W camera and whole dodder stem

was photographed with Nikon Coolpix P900 digital camera (Figure 3). The plants were compared with published descriptor of *Cuscuta* by Yunker (1932).

The degree of parasitic infection on the host plant and the prevalence was determined by a modification of the methods of Quasem (2008). The prevalence was determined based on the incidence of the same parasitic dodder on the same host in different infested locations. Prevalence of dodder was scaled rare, common and very common when the result was between 0-30%, 31-70%, 71-100% respectively. The severity of infection was rated as low, high and moderate depending on the intensity of parasite shoots on host plant and related plant damage (Quasem, 2008).



Figure 1. Field dodder (*Cuscuta campestris*) invasion on the weeds in apple (left) and cherry (right) orchard.

Şekil 1. Elma ve kiraz bahçelerinde bulunan yabancı otlar üzerindeki tarla küskütü (*Cuscuta campestris*).

## RESULTS

The dodder species in our sampled area in Northwestern Marmara was identified as *Cuscuta campestris* Yunker. This parasitic weed was found in several locations in Edirne, Kırklareli and Tekirdağ provinces.

*C. campestris* is dicotyledon annual parasitic plant with thin yellow to orange branched herbaceous stem which wrap around the host plant and attach with haustoria. Prior to attachment parasite seedling has yellow color but after penetrating some nutrients the color turns to orange.

*C. campestris* has bisexual, self-fertile, sessile or short-pedicellate, white flowers with bell-shaped corolla about 2 mm long calyx. Calyx lobes are ovate-triangular, broad and overlapping. Styles are filiform; stamens are slightly exerted; anthers are elliptic, filaments slightly longer than anthers. Corolla tube is campanulate, corolla lobes are triangular-lanceolate, and stigmas are capitate. Inflorescence is 5-25 stalked flowers in clusters. Fruit is a capsule, indehiscent or irregularly dehiscent, depressed-globose to depressed, light-brown in color containing 2-4 seeds and seeds are oval, light-brown or brownish, to 1.2-2.0 mm long, 1-1.5 mm wide (Costea and Tardiff, 2006).



Figure 2. Attachment of field dodder (*Cuscuta campestris*) on host plant stem.

Şekil 2. Tarla küskütü (*Cuscuta campestris*)'nün konukçu bitki gövdesine bağlanması.



Figure 3. Field dodder (*Cuscuta campestris*): A) Wrapped stem; B) Flower; C) Petal + sepal; D) Stem + flower; E) Anther.

Şekil 3. Tarla küskütü (*Cuscuta campestris*): A) Sarılcı gövde; B) Çiçek; C) Petal ve sepal; D) Gövde ve çiçek; E) Anter.

*C. campestris* was determined on 23 dicotyledonous weed species from 15 families. Family Asteraceae was leading family with six species followed by Brassicaceae, Plantaginaceae and Polygonaceae with two species in each family.

Within these families Plantaginaceae members were considered as most susceptible to *C. campestris*. *Polygonum aviculare* and *Rumex crispus* were very common to common distributed species and the intension of attack of parasite was high. Although the parasite prevalence was very common in *P. aviculare* plants, the symptoms of parasite damage were not visible. In contrast wilted and dried several *R. crispus* plants were observed under heavy infections. In contrast *Plantago major* and *P. lanceolata* from Plantaginaceae had lower prevalence rate and infection degree. The infection intensity was found higher in *Lactuca serriola* L., *Convolvulus arvensis* L., *Portulaca oleracea* L., *Tribulus terrestris* L., *Ecballium elaterium* (L.) A. Rich., *Rumex crispus* L., and *Polygonum aviculare* L. (Table 1).

All the infected weeds had different life spans including annual, biannual, perennial and annual/perennial. Within 31 species 21 were annual plants while 7 species were perennials. Meanwhile *Artemisia absinthium* show biannual characteristics and two species including *P. major* were perennial.

Higher frequency of parasitism of dodder was determined in *Polygonum aviculare* L., *Amaranthus retroflexus* L., *Chenopodium album* L., *Ecballium elaterium* (L.) A. Rich., *Portulaca oleracea* L., *Lactuca serriola* L., and *Cichorium intybus* L. weed species. The majority of parasitism of dodder on weeds was observed in roadside and pasture grown weeds (Table 1).

Field dodder (*Cuscuta campestris*) invasion on some weed hosts is given in Figure 4. Weed hosts, prevalence and infection degree of *C. campestris* were given in Table 1. Common names and families of species were included.





Figure 4. Field dodder (*Cuscuta campestris*) invasion on some weed hosts: A) *Artemisia absinthium* L.; B) *Chenopodium album* L.; C) *Portulaca oleracea* L.; D) *Xanthium strumarium* L.

Şekil 4. Tarla küskütü (*Cuscuta campestris*)' nün bazı konukçu yabancı otları: A) *Artemisia absinthium* L.; B) *Chenopodium album* L.; C) *Portulaca oleracea* L.; D) *Xanthium strumarium* L.

Table 1. Weed hosts of *Cuscuta campestris*, prevalence and infection degrees.

Çizelge 1. *Cuscuta campestris*'in, yabancı ot konukçuları, bulunma sıklığı ve bulaşıklık derecesi.

Common name Genel adı	Host weed Konukçu yabancı ot	Family Familya	Prevalence Yaygınlık*	Infection degree Bulaşıklık düzeyi**
Pigweed/Kırmızı kuyruklu tilki kuyruğu	<i>Amaranthus retroflexus</i> L.	Amaranthaceae	Very common	Moderate
Lambsquarters / Kazayağı	<i>Chenopodium album</i> L.		Very common	Moderate
Wild carrot / Yabani havuç	<i>Daucus carota</i> L.	Apiceae	Rare	Low
Absint wormwood / Pelin otu	<i>Artemisia absinthium</i> L.	Asteraceae	Common	Moderate
Common coclebur / Domuz pıtrağı	<i>Xanthium strumarium</i> L.		Common	Moderate
Field sow thistle / Eşek marulu	<i>Sonchus arvensis</i> L.		Common	Moderate
Common cichory / Yabani hindiba	<i>Cichorium intybus</i> L.		Very common	Low
Common dandelion / Aslan dişi	<i>Taraxacum officinale</i> F.H.Wigg		Common	Low
Canadian horseweed / Pire otu	<i>Conyza canadensis</i> (L.) Cronq.	Polygonaceae	Rare	Moderate
Prickly lettuce / Dikenli yabani marul	<i>Lactuca serriola</i> L.		Very common	High
Wild radish / Yabani turp	<i>Raphanus raphanistrum</i> L.	Brassicaceae	Rare	Moderate
Bindweed / Tarla sarmaşığı	<i>Convolvulus arvensis</i> L.	Convolvulaceae	Common	High
Squirting cucumber / Eşek hıyarı	<i>Echallium elaterium</i> (L.) A. Rich.	Cucurbitaceae	Very common	High
Black horehound / Köpek otu	<i>Ballota nigra</i> L.	Lamiaceae	Common	Moderate
Common mallow / Ebegümeçi	<i>Malva sylvestris</i> L.	Malvaceae	Common	Low
Broad leaved plantain / İri sinir otu	<i>Plantago major</i> L.	Plantaginaceae	Rare	Low
Ribwort plantain/ Dar yapraklı sinir otu	<i>Plantago lanceolata</i> L.		Rare	Low
Prostrate knotweed / Çoban değneği	<i>Polygonum aviculare</i> L.	Polygonaceae	Very common	High
Curly dock / Kıvrık labada	<i>Rumex crispus</i> L.		Common	High
Common purslane / Semizotu	<i>Portulaca oleracea</i> L.	Portulacaceae	Very common	High
Stickwilly / Dil kanatan	<i>Galium aparine</i> L.	Rubiaceae	Rare	Moderate
Black nightshade / Köpek üzümü	<i>Solanum nigrum</i> L.	Solanaceae	Common	Moderate
Puncture vine / Demir diken	<i>Tribulus terrestris</i> L.	Zygophyllaceae	Rare	High

\*: Rare / Nadir (0-30%); Common / Yaygın (31-70%); Very common / Çok yaygın (71-100%).

\*\* : Low / Düşük (1-30%); Moderate / Orta (31-60%); High / Yüksek (61-100%).

## DISCUSSION

*Cuscuta campestris* can parasitize over 100 plant species including many vegetables, legumes, horticultural crops, dicotyledon weeds (Dawson *et al.*, 1994; Kaiser, 2015). In Turkey *C. campestris* was identified on 55 different plants species. Among all 27 species including pepper (*Capsicum*

*annuum* L.), alfa alfa (*Medicago sativa* L.), clover (*Trifolium* spp.), faba bean (*Vicia faba* L.), tomato (*Solanum lycopersicum* L.), melon (*Cucumis melo* L.), sugar beet (*Beta vulgaris* L.), eggplant (*Solanum melongena* L.), cumin (*Carum carvi* L.), tobacco (*Nicotiana tabacum* L.) onion (*Allium cepa* L.), potato (*Solanum tuberosum* L.), anise

(*Pimpinella anisum* L.), melon (*Cucumis melo* L.), grapevine (*Vitis vinifera* L.) and chickpea (*Cicer arietinum* L.) were crop plants (Nemli, 1978).

*Cuscuta* genus were reported to infect several weed species such as *Polygonum aviculare*, *P. persicaria*, *Amaranthus retroflexus*, *Urtica dioica*, *Chenopodium album*, *Cirsium arvense*, *Convolvulus arvensis*, *Ambrosia artemisiifolia*, *Xanthium strumarium* all around the world (Rančić and Božić, 2004). Our field study in Northwestern Marmara Region showed the invasion of Amaranthaceae, Apiceae, Asteraceae, Brassicaceae, Convolvulaceae, Cucurbitaceae, Lamiaceae, Malvaceae, Plantaginaceae, Polygonaceae, Portulacaceae, Rubiaceae, Solanaceae, Zygophyllaceae family member weeds by *Cuscuta campestris*. The majority of weeds were annuals (67%). Six species *Portulaca oleracea*, *Lactuca serriola* L. *Rumex crispus* L., *Tribulus terrestris* L., *Convolvulus arvensis* L., *Echallium elaterium* (L.) A. Rich. represent the higher results in the point of occurrence and intensity studies.

Field dodder is not only food parasite also a vector of virus diseases and phytoplasmas which affect crop growth. More than 20 viruses including Peach Rosette Mosaic Virus (PRMV), Apple Mosaic Virus (AMV), Arabis mosaic virus (ArMV), Cucumber mosaic virus (CMV), Tomato Spotted Wilt Virus (TSWV) were transmitted to healthy plants by means of *Cuscuta campestris* (Hosford, 1967; Demirkan *et al.*, 2014). There are several reports on the presence of these viruses in Northwestern Marmara. Yılmaz (2014) detected CMV and TSWV in tomato, pepper, cabbage and cucumber fields in Edirne while ArMV was found in grapevines (Öztürk *et al.*, 2017).

*C. campestris* has wide distribution in Northwestern Marmara and seeds easily invade to new areas. This weed requires 10-30 °C for proper growth while the climate and soil conditions in our study area are appropriate for seed germination. Thus the seeds lay in the soil always carry risk for initiation of new invasions.

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