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., Echallium 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., Echallium elaterium (L.) A. Rich., Rumex crispus L. and Polygonum aviculare L.

Keywords: Cuscuta campestris Yunck, field dodder, weeds, host, Turkey.
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 allolpathic 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, Orobanche, 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 perennal parasitic species found attached to several, ornamentals, weeds, crop plants and trees (Kadoğlu, 1992; Garcia et al., 2014).

Prominent families attached by dodder were reported as dicotyledons including Rosaceae, Asteraceae, Solanaceae due to their suitable morphology for haustoria attachment (Sarma et al., 2008). C. europaea has been reported from 237 plant species, C. campestris has been observed on 69 plants, Cuscuta epithymum 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. europaea and C. epithymum on sugar beet (Davis, 1978; Gürsoy, 2001; Ayan and Töngel 2004; Yıldırım and Tepe, 2014; Arat, 2015; Kadoğlu 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; Koniecza et al., 2009).

Following attachment parazite 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 Nicon 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 Nicon 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 Yunck. 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).

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 intensity 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., *Echallium 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., *Echallium 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.
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 plant species. Among all 27 species including pepper (Capsicum annuum L.), alfalfa (Medicago savita 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

**DISCUSSION**

Cuscuta campestris invasion on some weed hosts: 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.

| Common name                          | Genel adı | Host weed                | Family | Prevalence | Infection degree | Bulaşıklık düzeyi** |
|--------------------------------------|-----------|--------------------------|--------|------------|-----------------|-------------------|
| Wild carrot / Yabanı havuç           | C. campestris | Amaranthus retroflexus L. | Amaranthaceae | Very common | Moderate         | Low               |
| Absint wormwood / Pelin otu          | L.; C) | Chenopodium album L. | Amaranthaceae | Very common | Moderate | Low               |
| Common cichory / Yabanı hindiba      | L. | Xanthium strumarium L. | Asteraceae | Common | Moderate | Low               |
| Common dandelion / Aslan dişi        | L.; D) | Echinacea officinal L. | Asteraceae | Very common | Low | Low               |
| Canadian horseweed / Pire otu        | L.; D) | Conyza canadensis (L.) Cronq. | Asteraceae | Rare | Moderate | Low               |
| Pricky lettuce / Dikenli yabanı marul | L.; D) | Lactuca serriola L. | Asteraceae | Very common | High | Low               |
| Wild raddish / Yabanı turp           | L.; D) | Raphanus raphanistrum L. | Brassicaceae | Rare | Moderate | High               |
| Squirtling cucumber / Ekek hayvari    | L.; D) | Echinacea officinal L. | Cucurbitaceae | Very common | High | Low               |
| Black horehound / Köpek otu          | L.; D) | Ballota nigra L. | Lamiaceae | Common | Moderate | Low               |
| Broad leaved plantain / Irı sirin otu | L. | Plantago major L. | Plantaginaceae | Rare | Low | Low               |
| Ribwort plantain / Dar yapraklı sirin otu | L. | Plantago lanceolata L. | Plantaginaceae | Rare | Low | Low               |
| Prostrate knotweed / Çoban değişi     | L.; D) | Polygonum aviculare L. | Polygonaceae | Very common | High | Low               |
| Curly dock / Kivrak labada           | L.; D) | Rumex crispus L. | Polygonaceae | Very common | High | Low               |
| Common purslane / Semizotu           | L.; D) | Portulaca oleracea L. | Portulaceae | Very common | High | Low               |
| Stickwilly / Dil kanatan             | L.; D) | Galium aparine L. | Rubiaceae | Rare | Moderate | Low               |
| Black nightshade / Köpek üzümü       | L.; D) | Solanum nigrum L. | Solanaceae | Common | Moderate | Low               |
| Puncture vine / Demir diken         | L.; D) | Tribulus terrestris L. | Zygophyllaceae | Rare | High | Low               |

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

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