We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

6,300

Open access books available

172,000

International authors and editors

190M

Downloads

Our authors are among the

154

Countries delivered to

TOP 1%

most cited scientists

12.2%

Contributors from top 500 universities

WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index
in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?
Contact book.department@intechopen.com

Numbers displayed above are based on latest data collected.
For more information visit www.intechopen.com

Parasitic Plants in Forage Legumes – *Medicago sativa* L.

Rozafa Fetahaj, Besarta Kabashi
and Arben Mehmeti

Abstract

Medicago sativa L. is one of the main forage crops widely grown throughout the world. The yield quality and quantity of the alfalfa crop are influenced by many factors. Weeds, as the most problematic pests in agriculture, compete with crops obtaining water, nutrients, light, and space, and parasitic weeds are becoming a threat to food production. Weed species, such as *Cuscuta* spp., are particularly noxious since they also directly extract valuable water and nutrients from the host plant, and in some cases can also be difficult to eradicate.

Keywords: parasitic plants, forage legume, weeds, *Cuscuta* spp., *Medicago sativa*

1. Introduction

Alfalfa (*M. sativa* L.)— as a forage species, is the more important cultivated forage in the world since at least ancient Greek and Roman times [1], as a perennial legume cultivated to provide high-quality forage in the form of hay, silage, and to a lesser extent as a grazing crop, as well as for improving soil fertility [2]. According to Putnam et al. [3], *M. sativa* L. is regarded as the most important forage crop in the world with a global hay market in 2017 of 8.3 million metric tons [4]. It is one of the world's most important forage species, due to its high nutritional quality, yields, and adaptability [1].

As a major forage protein source for livestock, alfalfa is cultivated in over 80 countries with coverage exceeding 30 million hectares [1, 5]. Besides forage quality, alfalfa shows adaptability to different environments, abundant biomass yield, drought tolerance, and more important, capacity to fix nitrogen through symbiosis with rhizobia [1, 3, 6, 7]. After harvesting in late summer or early autumn, different alfalfa varieties show diverse growth speeds, leading to differences in shoot growth height in autumn [8]. Forage quality is also dependent on various factors such as palatability, digestibility, and the final animal performance [9].

Currently, based on food production requirements globally to meet the needs of an increasing population and climate change, the decrease of agricultural lands is crucial to maximizing the yield and nutritive value of forage crops, including alfalfa production [10, 11].

Regarding irrigation and water demand, alfalfa requires significant water annually due to its high yield and long growing season (including border trips, furrows, and corrugations), but it is among the most water-use efficient crops grown under irrigation [12]. Water use by the crop to its production is high when compared to

other forage crops such as forage maize, and when economic conditions permit, alfalfa is replaced by maize as a forage crop [13].

One of the current agronomic goals is to improve the performance of alfalfa plants grown at high densities, either as pure stands or as a companion crop with grasses, as this would represent an increase in production resulting from an increase in the number of shoots per unit of the area [14–16].

Given the significant yield decline by weeds in different crops, numerous studies have been carried out on various aspects of weed biology and control. Weeds affect alfalfa stands in different ways during the various stages of alfalfa production: before establishment, in the seedling stage, and established stands. Weeds reduce alfalfa production during establishment by competing with and choking out young alfalfa seedlings. Weeds also invade established alfalfa fields and reduce forage quality and alfalfa yield. *Cuscuta* spp. as a member of Convolvulaceae, plant family, are widespread weeds of parasitic plants, agronomically and economically important in terms of harvest devastation.

2. Weeds as a major problem in agriculture

No matter which definition is used, weeds are plants that under certain conditions cause economic and social harm to the farmers. Human activities create weed problems since no plant is a weed in nature. In the agro-ecological context, weeds are a product of the inter-specific selection brought about by humans since they began cropping, which affected the soil and the whole habitat. Weeds are classically defined as plants that spontaneously grow on a land modified by humans [17], while arable weeds are those specifically occurring in regularly cultivated fields.

Weeds are naturally strong competitors for water, space, light, and nutrients, and those weeds that can best compete always tend to dominate. Weeds can produce tens or hundreds of thousands of seeds per plant, while most crop plants only produce several hundred seeds per plant. Most weeds can germinate and become established relatively quickly. They also produce viable seeds even under environmental and soil conditions that are not favorable for most crop plants. In a general aspect, weeds, as a major problem in agriculture, compete with native plants for resources such as moisture, light, and nutrients contributing to reductions in the populations of native species and, in some cases, increasing the risk of species extinctions [18–21]. Weedy plants are considered troublesome because they are prolific and highly adaptable and often persist in large numbers in areas where they are not wanted [22, 23].

Parasitic weeds are becoming a major problem in agriculture, respectively in forage crops. Parasitism among plants is a fascinating phenomenon in which one plant establishes no mutual dependence on another. Parasitic plants have evolved at least 11 times among the angiosperms [24] and are distributed among 17 families [25]. Dodder is an agriculturally destructive weed that causes serious damage by suppressing the growth of its host, in some cases leading to host death [26]. In a general aspect, weeds compete directly and indirectly with crops for the space, water, nutrients, and light, compared to parasitic weeds, particularly noxious since they also directly extract valuable water and nutrients from the host plant. In order to extract nutrients from the host plants, parasitic weeds have evolved a unique multicellular structure termed the haustorium that invades the host, forms connections with the host vascular system, and withdraws its needed water and nutrients [27, 28].

The impact of parasitic weeds species in forage crops is noted in the early stages of germination. *Striga* species, also known as witchweeds, are widely distributed in sub-Saharan Africa, India, and Southeast Asia [29], affecting cereal crops such as

maize, rice, millets, sorghum, and the legume cowpea. *Striga* causes yield losses up to 80%, often resulting in field abandonment by local farmers.

The *Phelipanche* and *Orobanche* species are widely distributed, and their hosts are not limited to cereals and legumes, but also comprise *Solanaceae* (e.g., tomato, tobacco), *Asteraceae* (e.g., sunflower), and *Cucurbitaceae* (e.g., watermelon). Geographically distributed, they affect crop production in Western Africa, the Mediterranean area but also occur in Australia, America, and Asia. For *Orobanche crenata*, legume crop losses of up to 100% have been reported in Morocco, Portugal, Spain, and Syria [30].

Weed species, such as *Cuscuta* spp. are particularly noxious since they also directly extract valuable water and nutrients from the host plant, and in some cases can also be difficult to eradicate. In addition, parasitic plants that attack host roots can inflict serious damage to crop plants before the latter emerge from the soil, making it difficult to diagnose infestations before economic losses occur. *Cuscuta* is one of the most economically detrimental groups of parasitic plants worldwide as infestation by some of its species can result in major yield losses in numerous crops [25, 26, 31–33] (Figures 1 and 2) (Table 1).

Figure 1.
Alfalfa (Medicago sativa L.)—A perennial legume [34].

Figure 2.
Alfalfa (Medicago sativa L.) (host plant) and dodder (Cuscuta spp.) (parasitic plant) [35].

No.	Weed species	Short description
1	<i>Striga</i> spp.	<p><i>Striga</i> species belongs to the family Scrophulariaceae [36]. The genus is now classified in the family of Orobanchaceae although earlier authors placed it in Scrophulariaceae [37].</p> <p>Most <i>Striga</i>-infested areas are characterized by agricultural production systems exhibiting low productivity. <i>Striga</i> germinates close to its hosts in response to specific chemical signals from the root exudates of the host or certain non-hosts plants [38].</p> <p>The major agricultural <i>Striga</i> species are <i>Striga hermonthica</i> (Del.) Benth and <i>S. asiatica</i> (L.), <i>Saxifraga forbesii</i> (Benth.), and <i>S. aspera</i> (Willd.) Benth been reported to have sporadic effects on cereal crops in their limited locations [39].</p>
2	<i>Orobanche</i> spp.	<p>Belonging to the closely related family Orobanchaceae, have no chlorophyll or leaves and are therefore totally dependent on their hosts for all nutrients.</p> <p><i>Orobanche</i> species, considered serious pests, have the widest host ranges and heavily damage a variety of crops, including tomato, potato, eggplant, faba bean, lentil, peanut, chickpea, cucumber, cabbage, and sunflower [40].</p> <p>Out of the 140 known species of <i>Orobanche</i> [41].</p>
3	<i>Cuscuta</i> spp.	<p>They are obligate holo-parasites, typically exhibiting broad host ranges, and inflict serious damage to many crops [26].</p> <p>As <i>Cuscuta</i> is the only parasitic genus in the Convolvulaceae family, there is a high similarity among the species within this genus [42].</p> <p>Parasitic plants of the genus <i>Cuscuta</i> have no chlorophyll, or only a reduced amount, and are not usually photosynthetically active.</p> <p>Agriculturally, the most important <i>Cuscuta</i> species are <i>C. pentagona</i> and <i>C. campestris</i>, which show an almost worldwide distribution and have a wide host spectrum.</p>

Table 1.
The major parasitic plants in agriculture.

2.1 *Cuscuta* spp. as a parasitic plant: Plant description

Genus: *Cuscuta*
Tribe: *Cuscutaceae*
Family: *Convolvulaceae*
Clade: *Asterids*

Figure 3.
Cuscuta spp. [50].

Clade: *Eudicots*
 Clade: *Angiosperms*
 Clade: *Tracheophytes*
 Kingdom: *Plantae*.

Cuscuta L. (dodder) is a parasitic weed species belonging to the family Convolvulaceae [43, 44]. The genus *Cuscuta* is distinguished from other Convolvulaceae genera based on the absence of leaves, the presence of haustoria and acotyledonous embryo, arrangement of flowers in clusters, or short racemes and the presence of five-fimbriate scales within the corolla [13]. Although some dodders (15–20 species) cause economic or ecological damage to crop production worldwide as agricultural, horticultural, or exotic pests [26, 32, 45], more species are endangered or even threatened, requiring conservation efforts [46].

Regarding environmental conditions, *Cuscuta* spp. can grow in a wide variety of climates and ecosystems [47]; therefore, are considered as the third-most detrimental group of parasitic plants worldwide following *Striga* and *Orobancha* [47]. *C. chinensis* is a typical native holoparasitic plant that belonged to the *Cuscuta* genus in China, which is also known as the Chinese Dodder [48] or Tu-Si-Zi in Chinese (**Figure 3**) [49].

Dodder is prolific at seed setting and the seeds can remain dormant for 5 years or more, thus making more complex the integrated management as a weed. The seed lacks enough reserves for sustained seedling growth. The seedling contains little chlorophyll and for survival is completely dependent on finding a host within a few days of germination [51]. The germination process of *Cuscuta* is independent of the presence of chemical compounds released by host plants [52].

3. Management options

Successful and sustainable weed management of *Cuscuta* spp. requires an integrated approach that includes multiple strategies. There are four general weed management strategies used in alfalfa: preventive, mechanical, cultural, and chemical. To prevent and mitigate the threat of *Cuscuta* as invasive plants and agricultural weeds, quarantine legislation has been enacted worldwide (**Table 2**) [32, 46].

Weed control type strategy	Short description
Preventive	Preventive measures such as crop rotation with non-host plants, delaying planting until fall, use of resistant varieties, and use of herbicides are effective only to an extent [53].
Mechanical	Mechanical weed management offers little help in managing weeds in established alfalfa: Prematurely cut to eliminate the weeds; Plowing or disking before planting alfalfa; Equipment should always be checked and cleaned.
Cultural	Planting certified seed and varieties suited for the area; Maintaining proper field fertility and managing any disease or insect problems; Proper irrigation timing strategy; Proper harvest management.
Chemical	When using herbicides, pay attention to information such as the timing of application, rates of application, and types of weeds controlled. A shortlist of applied herbicides [54]. For weed management in alfalfa may include the following: <ul style="list-style-type: none">• Metribuzin,• Quizalofop-p-ethyl,• Diquat dibromide• Fluazifop-p-butyl

Table 2.
The integrated weed management of Cuscuta spp. strategies.

4. Conclusions

- According to Putnam et al. [3], *M. sativa* L. is regarded as the most important forage crop in the world with a global hay market in 2017 of 8.3 million metric tons (ITC,2018). It is one of the world’s most important forage species, due to its high nutritional quality, yields, and adaptability [1].
- Alfalfa (*M. sativa* L.)—as a forage species is the more important cultivated forage in the world, as a perennial legume cultivated to provide high-quality forage in the form of hay, silage, and to a lesser extent as a grazing crop, as well as for improving soil fertility.
- Parasitic weeds are becoming a major problem in agriculture, respectively in forage crops. Weed species, such as *Cuscuta* spp., are particularly noxious since they also directly extract valuable water and nutrients from the host plant, and in some cases can also be difficult to eradicate.
- Nowadays, in light of the need to increase food production globally to meet the needs of an increasing population and climate change, the decrease of agricultural lands is crucial to maximizing the yield and nutritive value of forage crops, including alfalfa production [10, 11].
- Successful and sustainable weed management of *Cuscuta* spp. requires an integrated approach that includes multiple strategies, including quarantine legislation [32, 46], as a preventive measure.

Conflict of interest

The authors declare no conflict of interest.

IntechOpen

IntechOpen

Author details

Rozafa Fetahaj*, Besarta Kabashi and Arben Mehmeti
Faculty of Agriculture and Veterinary, Department of Plant Protection, Germany
and University of Prishtina, Hasan Prishtina, Prishtinë, Republic of Kosovo

*Address all correspondence to: fetahajrozafa@gmail.com

IntechOpen

© 2021 The Author(s). Licensee IntechOpen. This chapter is distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/3.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

References

- [1] Radović J, Sokolović D, Marković JJBAH. Alfalfa-most important perennial forage legume in animal husbandry. *Biotechnology in Animal Husbandry*. 2009;25:465-475. DOI: 10.2298/BAH0906465R
- [2] Sedaghati E, Hokmabadi H. Safety of Food and Beverages: Oilseeds and Legumes, *Encyclopedia of Food Safety*. Academic Press; 2014. pp. 331-339. ISBN 9780123786135. DOI: 10.1016/B978-0-12-378612-8.00443-1
- [3] Putnam D, Ruselle M, Orloff S, Kuhn J, Fitzhugh L, Godfrey L, et al. Alfalfa Wildlife and the Environment. The Importance and Benefits of Alfalfa in the 21st Century. Novato, CA: The California Alfalfa and Forage Association; 2001. p. 24. [Google Scholar]
- [4] ITC (2018) International Trade Center. <http://www.intracen.org/itc/market-info-tools/trade-statistics/>
- [5] Mielmann A. The utilisation of lucerne (*Medicago sativa*): a review. *British Food Journal*. 2013;115:590-600. DOI: 10.1108/00070701311317865
- [6] Lei Y, Hannoufa A, Yu P. The use of gene modification and advanced molecular structure analyses towards improving alfalfa forage. *International Journal of Molecular Sciences*. 2017;18. [PMC free article] [PubMed] [Google Scholar]
- [7] Singer SD, Hannoufa A, Acharya S. Molecular improvement of alfalfa for enhanced productivity and adaptability in a changing environment. *Plant, Cell & Environment*. 2018;41(9):1955-1971. [PubMed] [Google Scholar]
- [8] Barnes DK, Smith DM, Stucker RE, Elling LJ. Fall dormancy in alfalfa: A valuable predictive tool. In: *Proc.26th N. Am. Alfalfa Imp. Conf. South Dakota*. 1978
- [9] Ball DM, Collins M, Lacefield GD, Martin NP, Mertens DA. *Understanding Forage Quality*. 2001. pp. 1-01
- [10] Ranganathan J, Waite R, Searchinger T, Hanson C. How to Sustainably Feed 10 Billion People by 2050, in 21 Charts. Washington, DC, USA: World Resources Institute; 2018. Available online: <https://www.wri.org/blog/2018/12/how-sustainably-feed-10-billion-people-2050-21-charts> (accessed on 29 September 2020)
- [11] Silva S. Feeding the World in 2050 and Beyond—Part 1: Productivity Challenges. In *MSU Extension Agriculture*. East Lansing, MI, USA: Michigan State University Extension; 2018 Available online: <https://www.canr.msu.edu/news/feeding-the-world-in-2050-and-beyond-part-1> (accessed on 29 September 2020)
- [12] Putnam DH, Orloff SB. Forage Crops, *Encyclopedia of Agriculture and Food Systems*. Academic Press; 2014. pp. 381-405. ISBN 9780080931395. DOI: 10.1016/B978-0-444-52512-3.00142-X
- [13] FAO – Food and Agriculture Organization of the United Nations, *Aflalfa, Land and Water 2021*, <http://www.fao.org/land-water/databases-and-software/crop-information/alfalfa/en/>
- [14] Lin CH, McGraw RL, George MF, Garrett HE. Shade effects on forage crops with potential in temperate agroforestry practices. *Agroforestry Systems*. 1999;44:109-119
- [15] Varella AC. Modelling lucerne (*Medicago sativa* L.) crop response to light regimes in an agroforestry system [thesis]. Lincoln, New Zealand: Lincoln University; 2002
- [16] Varella AC, Moot DJ, Pollock KM, Peri PL, Lucas RJ. Do light and alfalfa

responses to cloth and slatted shade represent those measured under an agroforestry system? Agroforestry Systems. 2010;**81**(2):157-173

[17] Godinho I. Les definitions d' 'adventice' et de 'mauvaise herbe'. Weed Research. 1984;**24**:121-125

[18] Groves RH, Lonsdale M, Boden R. Jumping the Garden Fence: Invasive Garden Plants in Australia and Their Environmental and Agricultural Impacts SYDNEY: CSIRO Report Prepared for WWF-Australia; 2005

[19] Vilà M, Espinar JL, Hejda M, Hulme PE, Jarošík V, Maron JL, et al. Ecological impacts of invasive alien plants: A meta-analysis of their effects on species, communities and ecosystems. Ecology Letters. 2011;**14**:702-708. DOI: 10.1111/j.1461-0248.2011.01628.x. [PubMed] [CrossRef] [Google Scholar]

[20] Foxcroft LC, Pyšek P, Richardson DM, Genovesi P. Plant Invasions in Protected Areas: Patterns, Problems and Challenges. Dordrecht: Springer; 2013. [Google Scholar]

[21] Csurhes S, Edwards R. Potential Environmental Weeds in Australia: Candidate Species for Preventative Control Canberra: Environment Australia; 1998. [Google Scholar]

[22] Quammen D. Planet of weeds. Harper's Magazine. 1998:57-70. [Google Scholar]

[23] Radosevich SR, Holt JS, Ghersa CM. Ecology of Weeds and Invasive Plants: Relationship to Agriculture and Natural Resource Management. 3rd ed. New York, NY, USA: Wiley Publishing; 2007 [Google Scholar]

[24] Barkman T, McNeal J, Lim S-H, Coat G, Croom H, Young N, et al. Mitochondrial DNA suggests at least 11 origins of parasitism in angiosperms

and reveals genomic chimerism in parasitic plants. BMC Evolutionary Biology. 2007;**7**:248

[25] Parker C, Richard CR. Parasitic Weeds of the World: Biology and Control. Wallingford, UK: CAB International; 1993

[26] Dawson JH, Musselman LJ, Wolswinkel P, Dörr I. Biology and control of Cuscuta. Review Weed Science. 1994;**6**:265-317. [Google Scholar]

[27] Riopel JL, Timko MP. Haustorial initiation and differentiation. In: Press MC, Graves JD, editors. Parasitic Plants. London, UK: Chapman & Hall; 1995. pp. 39-79

[28] Joel DM. Functional structure of the mature haustorium. In: Joel DM, Gressel J, Musselman LJ, editors. Parasitic Orobanchaceae. Germany: Springer; Berlin/Heidelberg; 2013. pp. 25-60

[29] Spallek T, Mutuku M, Shirasu K. The genus Striga: A witch profile. Molecular Plant Pathology. 2013;**14**:861-869

[30] Vurro M, Boari A, Thiombiano B, Bouwmeester H. Strigolactones and parasitic plants. In: Koltai H, Prandi C, editors. Strigolactones - Biology and Applications. Springer International Publishing; 2019. pp. 89-120

[31] Holm L, Doll J, Holm E, Pancho JV, Herberger JP. World Weeds: Natural Histories and Distribution. John Wiley & Sons; 1997. [Google Scholar]

[32] Costea M, Tardif FJ. The biology of Canadian weeds. 133. Cuscuta campestris Yunck., C. gronovii Willd. ex Schult., C. umbrosa Beyr. ex Hook., C. epithymum (L.) L. and C. epilinum Weihe. Canadian Journal of Plant Science. 2006;**86**:293-316. [Google Scholar]

- [33] Sandler HA. Managing *Cuscuta gronovii* (swamp dodder) in cranberry requires an integrated approach. *Sustainability*. 2010;**2**:660-683. [Google Scholar]
- [34] Rozafa Fetahaj, 2020, *Medicago sativa* L., University of Prishtina, Faculty of Agriculture and Veterinary, Prishtine. Image type: Field
- [35] Gerald Holmes, Strawberry Center, Cal Poly San Luis Obispo, Bugwood.org Dodder parasitizing alfalfa. 1995 Image type: Field
- [36] Reymond P, Farmer EE. Jasmonate and salicylate as global signals for defense gene expression. *Current Opinion in Plant Biology*. 1998;**1**: 404-411
- [37] Gethi JG, Smith ME, Mitchell SE, Kresovich S. Genetic diversity of *Striga hermonthica* and *Striga asiatica* populations in Kenya. *Weed Research*. 2005;**45**:64-73
- [38] Hooper AM, Hassanali A, Chamberlain K, Khan ZR, Pickett JA. New genetic opportunities from legume intercrops for controlling *Striga* spp. parasitic weeds. *Pest Management Science*. 2009;**65**:546-552
- [39] Parker C. Observations on the current status of *Orobanche* and *Striga* problems worldwide. *Pest Management Science*. 2009;**65**:453-459
- [40] Parker C, Riches CR. *Parasitic Weeds of the World: Biology and Control*. Wallingford, UK: CAB International; 1993
- [41] Kroschel, J. and O. Klein (2002). Biological control of *Orobanche* spp. in the Near East and North Africa by inundative releases of the herbivore *Phytomyza orobanchia*
- [42] Garcia MA, Costea M, Kuzmina M, Stefanovic S. Phylogeny, character revolution, and biogeography of *Cuscuta* (dodders; Convolvulaceae) inferred from coding plastid and nuclear sequences. *American Journal of Botany*. 2014;**101**:670-690. DOI: 10.3732/ajb.1300449
- [43] Costea M, García MA, Stefanović S. A phylogenetically based infrageneric classification of the parasitic plant genus *Cuscuta* (dodders, Convolvulaceae). *Systematic Botany*. 2015;**40**:269-285. DOI: 10.1600/036364415X686567. [CrossRef] [Google Scholar]
- [44] Fang R.-C., Musselman L.J., Plitmann U. *Cuscuta* Linnaeus. In: Wu Z.Y., Raven P.H., editors. *Flora of China, Gentianaceae Through Boraginaceae*. Volume 16. Science Press; Beijing, China: Missouri Botanical Garden Press; St. Louis, MO, USA: 1995. pp. 322-325. [Google Scholar]
- [45] Hwang S, Kil J, Lee C-W, Kim Y. Distribution and host plants of parasitic weed *Cuscuta pentagona* Engelm. *Hangug Jawon Sigmul Haghoeji*. 2013;**26**:289-302. DOI: 10.7732/kjpr.2013.26.2.289. [CrossRef] [Google Scholar]
- [46] Costea M, Stefanović S. *Cuscuta jepsonii* (Convolvulaceae): An invasive weed or an extinct endemic? *American Journal of Botany*. 2009;**96**:1744-1750. DOI: 10.3732/ajb.0800425. [PubMed] [CrossRef] [Google Scholar]
- [47] Costea M, Spence I, Stefanoviæ S. Systematics of *Cuscuta chinensis* species complex (subgenus *Grammica*, Convolvulaceae): evidence for long-distance dispersal and one new species. *Organisms, Diversity and Evolution*. 2011;**11**:373-386. DOI: 10.1007/s13127-011-0061-3
- [48] Lei JC, Xu HG. MaxEnt-based prediction of potential distribution of *Solidago canadensis* in China. *Journal of Ecology and Rural Environment*. 2010;**26**(2):137-141. [Google Scholar]

[49] Wang GY, Wen JF, Chen GH, Dong ZF, Dong ZT, Ye DN. Biological characteristics observation and control measures of *Cuscuta chinensis*. Plant Quarantine. 2007;**21**(6):351-352.
[Google Scholar]

[50] Copyright 2021, Lillooet Regional Invasive Species Society • Website by Atef Design

[51] Hibberd JM, Bungard RA, Press MC, Jeschke WD, Scholes JD, Quick WP. Localization of photosynthetic metabolism in the parasitic angiosperm *Cuscuta reflexa*. Planta. 1998;**205**: 506-513

[52] Dawson JH. *Cuscuta* (Convolvulaceae) and its control. In: Weber HC, Forstreuter W, editors. Parasitic Flowering Plants. Marburg: Philipps-Universität; 1987. pp. 137-149.
Google Scholar

[53] Parker C. Protection of crops against parasitic weeds. Crop Protection. 1991;**10**:6-22. DOI: 10.1016/0261-2194(91)90019-N

[54] Mehmeti A, Demaj A. Manuali i produkteve për Mbrojtjen e Bimëve në Kosovë. Artini: Shtëpia botuese; 2016