

DISTRIBUTION AND BIODIVERSITY OF BROOMRAPE (*Orobanche* L.) WORLDWIDE AND IN SERBIA

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SUMMARY

The broomrape genus (*Orobanche* L.) is characterized by pronounced biodiversity. Of its 99 species identified so far throughout the world, 26 have been found in Serbia. The species of the *Orobanche* genus are highly variable and include 56 varieties, 226 forms (a total of 308 taxons), and a number of physiological races adjusted to specific crops. Despite such high biodiversity, 8 species alone are important parasite species in cultivated crops (*Orobanche cumana* Wallr., *O. ramosa* L., *O. nana* Noë, *O. muteli* Sch., *O. minor* Sutt., *O. lutea* Baumg., *O. aegyptiaca* Pers. and *O. crenata* Forsk.). *Orobanche cumana* Wallr. (*O. cernua* Loefl.) is especially important as a parasite species in sunflower but it is also frequently found growing on the root of tomato, tobacco and some weed plants.

Key words: broomrape, *Orobanche* L., biodiversity, distribution

INTRODUCTION

The genus *Orobanche* L. (broomrape) comprises some one hundred parasite species associated with various host plants and growing throughout the world, including Serbia. So far, the flowering species of this genus have been insufficiently discussed from chorological and biodiversity aspects. Based on detailed analyses and a study of relevant literature, we have attempted to show the distribution of the genus *Orobanche* L. worldwide, in Europe and in Serbia, particularly regarding the diversity of its species and infraspecies. Effects of broomrape in agriculture, particularly on sunflower, were an underlying consideration. Data on broomrape's most frequent host plants are also included.

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Recent research of broomrape has mostly focused on its physiological and biochemical aspects, as well as on plant resistance (especially of the concerned cultivated species) and control methods (Aćimović, 1980; Wegmann, 1998; Jorriin *et al.*, 1998; Ivanov *et al.*, 1998; Alonso, 1998; Kleifeld, 1998; Maširević, 1999). In contrast, chorological and biodiversity approaches to this issue have so far been scarce. This analysis was therefore aimed to shed more light on such aspects and thus to contribute to our better understanding of that widely distributed group of parasite flowering plants.

Taxonomic relations within the *Orobanche* L. genus and global distribution of its species

The genus *Orobanche* L. belongs to the family *Orobanchaceae* Juss., the order *Scrophulariales*, the class *Magnoliatae* (dicotyledones), the sub-division *Magnoliophytina* (angiosperms) and the division *Spermatophyta* (flowering seed plants).

The *Orobanchaceae* family includes a total of 157 species (Hayek, 1929; Hegi, 1931; Beck-Mannagetta, 1966; Parabućski in Josifović (ed.), 1974; Mihaljčević, 1994; Kojić and Vrbničanin, 2000) classified into 14 genera (including *Orobanche*) and characterized by global distribution. Following is the list of the genera:

1. *Orobanche* L. (includes 99 species)
2. *Aeginetia* L. (5 species)
3. *Conopholis* Wallr. (2 species)
4. *Epiphegus* Nutt. (1 species)
5. *Cistanche* Hoffm. and Link. (16 species)
6. *Phelyraea* (Tourn.) Desf. (2 species)
7. *Kopsiopsis* Beck (2 species)
8. *Gleadovia* Gamb. and Prain. (1 species)
9. *Christisonia* Gardn. (17 species)
10. *Lathraea* L. (6 species)
11. *Boschniakia* C.A.Mey. (2 species)
12. *Xylanche* Beck (2 species)
13. *Platypholius* Max. (1 species)
14. *Phacellanthus* Sieb. and Zucc. (1 species)

The 99 species falling into the genus *Orobanche* (Tourn.) L. have global distribution and are part of four sections, namely: 1: Sect. *Gymnocaulis* Nutt., 2. Sect. *Myzorrhiza* (Philippi) Beck, 3. Sect. *Trionychon* Wallr., and 4. Sect. *Osproleon* Wallr. (Hayek, 1929; Hegi, 1931; Beck-Mannagetta, 1927, 1966; Parabućski in Josifović (ed.) 1974).

The section *Gymnocaulis* Nutt. includes three species (*Orobanche uniflora* L., *O. porphyrantha* Beck and *O. fasciculata* Nutt.), all of them common to North and South America but not native to the European continent.

The section *Myzorrhiza* (Philippi) Beck includes ten species (*O. californica* Cham. and Schl., *O. grayana* Beck, *O. ludoviciana* Nutt., *O. weberbaueri* Matt., *O. pinorum* Gay., *O. chilensis* Beck, *O. bulbosa* Beck, *O. tarapacana* Phil.,

O. tacnaensis Matt. and *O. xanthochroa* Nels. and Cock), which are common in North and South America but cannot be found anywhere in Europe.

The species falling into the sections *Trionychon* Wellr. (23 species) and *Osproleon* Wellr. (63 species) are characterized by wide distribution across Europe, including Serbia.

The section *Trionychon* Wellr. includes 23 species listed below. Beck-Manna-getta (1966) in his study of the family *Orobanchaceae* cites the following species and their distribution worldwide:

1. *Orobanche ramosa* L. (distributed across Europe, Asia and Africa)
2. *O. nana* Noë (throughout the Mediterranean region)
3. *O. schweinfurthii* Beck (Africa)
4. *O. rosmarina* (Welw.) Beck (Mediterranean)
5. *O. muteli* Schultz. (throughout the Mediterranean)
6. *O. aegyptiaca* Pers. (Mediterranean and Eastern India)
7. *O. serratocalyx* Beck (Syria and Armenia)
8. *O. lavandulacea* Reich. (Mediterranean)
9. *O. trichocalyx* (Webb. and Berth.) Beck (Africa, Canary Islands, Lusitania)
10. *O. oxyloba* (Reut.) Beck (Mediterranean)
11. *O. orientalis* Beck (Afghanistan, Himalayas)
12. *O. schultzii* Mutel. (Mediterranean)
13. *O. heldreichii* (Reut.) Beck (Asia Minor)
14. *O. coelestis* Boiss. and Reut. (Asia and Western Mediterranean)
15. *O. mongolica* Beck (China)
16. *O. tunetana* Beck (Africa)
17. *O. cilicica* Beck (Asia Minor)
18. *O. bungeana* Beck (Eastern Mediterranean)
19. *O. caesia* Reich. (Lower Austria, Hungary and Russian steppes)
20. *O. caucasica* Beck (Caucasus)
21. *O. arenaria* Borkh. (Europe and Asia)
22. *O. purpurea* Jacq. (Europe and Asia)
23. *O. uralensis* Beck (Siberian parts near the Ural)

Beck-Manna-getta (1966) lists the following 63 species as belonging to the *Osproleon* Wallr. section:

1. *O. pycnostachia* Hance (Eastern Asia)
2. *O. coerulescens* Steph. (Central Europe and Central Asia)
3. *O. cernua* Loefl. (Southern Europe, Africa and Asia)
4. *O. solmsii* Clarke (Western Himalayas)
5. *O. cathae* Defl. (Southern Arabia)
6. *O. kotschyi* Reut. (Iran, Turkestan)
7. *O. amoena* C.A. Mey. (Central Asia)
8. *O. sintenisii* Beck (Armenia)
9. *O. clarkei* Hook. (Tibet)
10. *O. cistanchoides* Beck (Iran and Afghanistan)
11. *O. stocksii* Boiss. (Afghanistan)
12. *O. crenata* Forsk. (Southern Europe, Northern Africa, Orient and Caucasus)

13. *O. owerini* Beck (Caucasus)
14. *O. alba* Steph. (Ireland, Scotland, Spain, Italy, Switzerland and Liechtenstein)
15. *O. reticulata* Wallr. (England, Denmark, Scandinavian countries, Switzerland, Germany, Austria, Slovakia, Italy, Banat, Romania, Croatia, Herzegovina, Dalmatia, Greece)
16. *O. pancicii* Beck (Balkan countries - Serbia, Bulgaria, Northern Albania)
17. *O. serbica* Beck and Petrović (Serbia and Bulgaria)
18. *O. cyrenaica* Beck (Northern Africa)
19. *O. haenseleri* Reut. (Spain only)
20. *O. hymenocalyx* Reut. (Transcaucasia)
21. *O. amethystea* Thuill. (Western Europe, Mediterranean)
22. *O. castellana* Reut. (Southern France and Pyrenean Peninsula)
23. *O. canescens* J. and C. Presl. (Mediterranean)
24. *O. esulae* Pančić (Serbia)
25. *O. versicolor* Schultz. (Eastern Mediterranean)
26. *O. mauretunica* Beck (Southeastern Mediterranean)
27. *O. aethiopica* Beck (Eritrea, Nubia)
28. *O. densiflora* Salzm. (Southeastern Mediterranean, Malta)
29. *O. hadroantha* Beck (Asia Minor)
30. *O. grisebachii* Reut. (Eastern Mediterranean)
31. *O. loricata* Reich. (Eastern Mediterranean and Central Europe)
32. *O. picridis* Schultz. (Mediterranean and warmer parts of Europe)
33. *O. ozanonis* Schultz. (Southern France)
34. *O. minor* Sutt. (Mediterranean)
35. *O. palaestina* Reut. (Palestine)
36. *O. fuliginosa* Reut. (Mediterranean)
37. *O. boissieri* Reich. (Algeria)
38. *O. clausonis* Pom. (Southwestern Mediterranean)
39. *O. hederiae* Duby (Mediterranean)
40. *O. macrolepis* (Coss.) Beck (Spain, boreal Africa)
41. *O. gamosepala* Reut. (Caucasian lands)
42. *O. caryophyllacea* Smith. (Europe as far as the Caucasus and Iran)
43. *O. teucritii* Hol. (Europe)
44. *O. lutea* Baumg. (Europe and Western Asia)
45. *O. major* L. (Europe and Asia)
46. *O. borbasiana* Beck (Croatia and Dalmatia)
47. *O. cypria* Reut. (Cyprus, Iran and Kurdistan)
48. *O. singarensis* Beck (Mesopotamia)
49. *O. chironii* Lo Jac. (Sicily)
50. *O. laserpitii-sileris* Reut. (Alps and Illyrian mountains)
51. *O. alsatica* Kirsch. (Europe and Siberia)
52. *O. kurdica* Boiss. (Asia Minor)
53. *O. denudata* Beck (Sardinia)
54. *O. flava* Mart. (Alps, Carpathian Mountains, Bosnia)
55. *O. lucorum* Braun (Alps)
56. *O. salviae* Schultz. (Alps and Illyrian countries)

57. *O. rapum-genistae* Thuill. (Western Europe, France, Pyrenean Peninsula, Italy, Northern Algeria)
58. *O. rigens* Lois. (Corsica and Sardinia)
59. *O. anatoloca* Boiss. (Caucasian countries, Afghanistan, Syria, Kurdistan, Iran)
60. *O. gracilis* Smith. (Europe)
61. *O. variegata* Wallr. (Mediterranean)
62. *O. foetida* Poir. (Lusitania, Spain, Africa)
63. *O. sanguinea* Presl. (Mediterranean)

Survey of *Orobanche* L. species found in Europe

A number of authors, primarily Hayek (1929), Hegi (1931), Beck-Mannagetta (1966), Parabućski (1956, 1974), Josifović (ed.) (1974), Wegmann (1998), Kojić and Vrbničanin (2000) have provided some important data on broomrape distribution in different regions, including Europe. Based on their findings, we have established a total of 59 broomrape species growing on the European continent, which account for nearly 60% of the world's overall fund of species included in the *Orobanche* L. genus. Chorological analyses of European broomrape species show that over half of them (56%) grow in the Mediterranean region.

In view of their distribution, European broomrape species may be classified into the following two categories:

- 1 Mediterranean broomrape species, and
- 2 Broomrape species widely distributed throughout Europe but frequently found on other continents as well, primarily in Asia and Africa.

The following is the list of broomrape species growing in Europe:

1. Mediterranean species

1. *Orobanche nana* Noë
2. *O. rosmarina* (Welw.) Beck
3. *O. muteli* Schultz.
4. *O. lavandulacea* Reich.
5. *O. oxyloba* (Reut.) Beck
6. *O. schultzii* Mutel.
7. *O. bungeana* Beck
8. *O. haenseleri* Reut.
9. *O. castellana* Reut.
10. *O. canescens* J. and C. Presl.
11. *O. versicolor* Shultz.
12. *O. mauretanica* Beck
13. *O. densiflora* Salzm.
14. *O. grisebachii* Reut.
15. *O. ozanonsis* Schultz.
16. *O. minor* Sutt.
17. *O. fuliginosa* Reut.
18. *O. clausonis* Pom.

19. *O. hederæ* Duby
20. *O. macrolepis* (Coss.) Beck
21. *O. denudata* Beck
22. *O. rapum-genistæ* Thuill.
23. *O. rigens* Lois.
24. *O. variegata* Wallr.
25. *O. foetida* Poir.
26. *O. sanguinea* Presl.

Predominantly Mediterranean species

27. *O. aegyptiaca* Pers.
28. *O. coelestis* Boiss. and Reut.
29. *O. cernua* Loefl.
30. *O. crenata* Forsk.
31. *O. loricata* Reich.
32. *O. picridis* Schultz.
33. *O. cypria* Reut.
34. *O. chizonii* Lo Jac.

2. Species widely distributed throughout Europe but frequently found on other continents as well, primarily in Asia and Africa

1. *Orobanchë ramosa* L.
2. *O. caesia* Reich.
3. *O. caucasica* Beck
4. *O. arenaria* Borkh.
5. *O. purpurea* Jacq.
6. *O. coerulescens* Steph.
7. *O. overini* Beck
8. *O. alba* Steph.
9. *O. reticulata* Wallr.
10. *O. pancicii* Beck
11. *O. serbica* Beck and Petrović
12. *O. amethystea* Thuill.
13. *O. esulae* Pančić
14. *O. gamosepala* Reut.
15. *O. caryophyllacea* Smith.
16. *O. teucrii* Hol.
17. *O. lutea* Baumg.
18. *O. major* L.
19. *O. borbasiana* Beck
20. *O. laserpiti-sileris* Reut.
21. *O. alsatica* Kirsch.
22. *O. flava* Mart.
23. *O. lucorum* Braun.
24. *O. salviae* Schultz.
25. *O. gracilis* Smith.

Species and infraspecies biodiversity of *Orobanche* L. genus in Serbia

Broomrape (*Orobanche* L.) embraces a large number of parasite weed species but despite their considerable distribution relevant studies of their biodiversity are scarce in Serbia. Some important data in this respect have been provided by the following authors: Pančić (1884), Adamović (1908), Hayek (1929), Josifović, ed. (1974), Mijatović (1960, 1961), Parabućski (1956, 1974), Obradović (1965), Maširević (1999), Kojić and Vrbničanin (2000), etc. A detailed analysis of relevant literature and the actual plant material found throughout Serbia suggest pronounced broomrape diversity.

Analyses have shown that broomrape's species and infraspecies diversity is fairly high, which is obvious from a mere survey of taxons found in the Serbian territory. The number of broomrape species, their varieties and forms have been established as follows:

Species	26
Varieties	56
Forms	226
Total	308 taxons

Apart from these strictly taxonomic categories (species, varieties, forms), physiological races have also been found for many broomrape species or infraspecies taxons as being specially adjusted to develop as parasites on specific cultivated plants. Maširević (1999) has found a new broomrape race (E) in sunflower. Maširević (1999) also reports that six broomrape races (A, B, C, D, E and F) have been identified in Romania, and five in Bulgaria and Turkey. Alonso (1998) has listed five broomrape races in Spain. The data suggest that besides taxonomic diversity there are also physiological races of broomrape within its individual species, which further adds to the biodiversity of this parasite group of flowering plants.

Broomrape (*Orobanche* L.) species and infraspecies structure in Serbia

1. *Orobanche ramosa* L. (Syn.: *O. cannabis* Vauch.; *Kopsia ramosa* Dum.; *Phelipaea ramosa* Mey.)

- f. *ramosa*
- f. *polyclonos* Wallr.
- f. *monoclonos* Wallr.
- f. *cyanea* Beck
- f. *albiflora* (Godr. and Gren.) Beck
- f. *gracillima* Beck
- f. *proboscistyla* (Bianca) Beck

2. *Orobanche nana* Noë (Syn.: *Phelipaea nana* Rchb.)

- f. *nana*
- f. *manostachys* Beck

- f. *instabilis* Guim.
- f. *melitensis* Beck
- f. *aragonensis* Beck
- f. *intercedens* Beck

3. *Orobanche muteli* Schultz.

var. *muteli*

- f. *muteli*
- f. *coeruleo-violacea* Beck
- f. *panormitana* Beck
- f. *ochroleuca* Beck
- f. *emarginata* (Reut.) Beck
- f. *malloantha* Beck

var. *spissa* (Rony) Beck

- f. *spissa*
- f. *decipiens* Beck

var. *sinaica* Beck

var. *angustiflora* Beck

var. *interjecta* Beck

var. *interrupta* Beck

4. *Orobanche arenaria* Borkh. (Syn.: *O. comosa* Wallr.; *O. laevis* L.; *Kopsia borkhauseni* Car.; *Phelipaea arenaria* Wallr.)

- f. *arenaria*
- f. *robusta* (Diet.) Beck
- f. *gigantiflora* Borb.
- f. *ionatha* (Kern.) Beck
- f. *lamprantha* Beck
- f. *prominens* Beck
- f. *leptocaulon* Beck
- f. *stenosepala* Beck
- f. *personata* Beck
- f. *sareptana* Beck

5. *Orobanche purpurea* Jacq. (Syn.: *O. coerulea* Vill.; *O. purpurascens* Gmel.; *Phelipaea coerulea* Mey.)

var. *purpurea*

- f. *purpurea*
- f. *millefolii* (Reich.) Beck
- f. *ciliaris* (Gris.) Beck
- f. *acutiloba* Beck
- f. *achroantha* Beck
- f. *longirhachis* Beck

var. *tapeina* Beck

var. *ischnosiphon* Beck

var. *bohémica* (Čel.) Beck

var. *spitzelii* Beck

var. *hirsuta* Beck

var. *garhwalensis* Beck

var. *iberica* Beck

var. *pareysi* Beck

var. *simulans* Beck

6. *Orobanche coerulescens* Steph.

- f. *coerulescens*
- f. *pekinensis* Beck
- f. *occidentalis* Beck
- f. *ombrochares* Beck
- f. *cristata* Beck
- f. *lehmannii* Beck

7. *Orobanche cernua* Loefl. (Syn.: *O. cumana* Wallr.)

- var. *cernua*
- var. *latebracteata* Beck
 - f. *latebracteata*
 - f. *nanantha* Beck
 - f. *cryptantha* Beck
- var. *desertorum* Beck
- var. *hansii* Beck
 - f. *hansii*
 - f. *subgrandis* Beck
 - f. *camptolepis* (Poiss. and Reut.) Beck
- var. *cumana* (Wallr.) Beck
 - f. *cumana*
 - f. *tenuisepala* Beck
 - f. *holoseptala* Beck
 - f. *taurica* Beck
 - f. *densior* Beck
- var. *australiana* (Muell.) Beck
 - f. *australiana*
 - f. *valens* Beck

8. *Orobanche alba* Steph. (Syn.: *O. epithymum* DC)

- var. *alba*
 - f. *alba*
 - f. *capitata* Beck
 - f. *communis* Beck
 - f. *campanulata* Beck
 - f. *leptocalamus* Beck
 - f. *rubra* (Hook) Beck
 - f. *hololeuca* (Borb.) Beck
 - f. *dasytrix* Beck
 - f. *ankylantha* Beck
 - f. *subalpina* Beck
 - f. *maxima* Beck
- var. *raddeana* Beck
 - f. *raddeana*
 - f. *minutiflora* Beck
 - f. *viscidula* Beck
 - f. *ampla* Beck
 - f. *longebracteata* Beck
 - f. *stenophyllon* Beck

- f. *mikrosepala* Beck
- f. *hellebori* (Mieg.) Beck
- f. *lutescens* (Bor.) Beck
- f. *cuprea* Beck
- var. *wiedemannii* (Boiss.) Beck
- var. *glabrata* (Mey.) Beck
 - f. *glabrata*
 - f. *ingens* Beck
 - f. *areschensis* Beck
- var. *bidentata* Beck
- var. *nissana* Beck
 - f. *nissana*
 - f. *rubiginosa* (Diet.) Beck

9. *Orobanche reticulata* Wallr.

- var. *reticulata*
 - f. *reticulata*
 - f. *atrata* (Sauf.) Beck
 - f. *lophofera* Beck
 - f. *exiguior* Beck
 - f. *deucalion* (Reich.) Beck
 - f. *viscosa* Beck
- var. *pallidiflora* (Wimm. and Grab.) Beck
 - f. *pallidiflora*
 - f. *imminuta* Beck
 - f. *cephalariae* Beck
- var. *procera* (Koch.) Beck
 - f. *procera*
 - f. *kirantha* Beck

10. *Orobanche pancicii* Beck

- var. *pancicii*
 - f. *pancicii*
 - f. *intumescens* Beck
 - f. *spaniantha* Beck
 - f. *melanochroa* Beck
 - f. *curta* Beck
 - f. *kerochroa* Beck
 - f. *longebracteata* Beck
- var. *adusta* (Panč.) Beck

11. *Orobanche serbica* Beck and Petroviæ

12. *Orobanche amethystea* Thuill. (Syn.: *O. eryngii* Duby)

- var. *amethystea*
- var. *coartata* Beck
- var. *carphita* Guim.
 - f. *carphita*
 - f. *campylantha* Guim.
 - f. *transiliens* Guim.
 - f. *eucarphita* Beck
 - f. *paulini* (Guim.) Beck

- var. *attica* (Reut.) Beck
var. *evonymi* (Petrović) Beck
var. *hyrcana* Beck
- 13. *Orobanche esulae* Panèia**
- 14. *Orobanche loricata* Reich. (Syn.: *O. artemisiae* Vauch.;
O. subamethystea Borb.)**
f. *loricata*
f. *pumilio* Beck
f. *nouletii* Beck
f. *synomora* (Guim.) Beck
f. *balsensis* Guim.
f. *ossonobensis* Guim.
- 15. *Orobanche picridis-hieracioides* Schultz. (Syn.: *O. picridis* Schultz.)**
var. *picridis-hieracioides*
f. *picridis-hieracioides*
f. *albo-bracteata* Beck
f. *parviflora* Beck
var. *carotae* (Moul.) Beck
- 16. *Orobanche minor* Sutt. (Syn.: *O. apiculata* Wallr.; *O. multiflora* Wallr.;
O. trifolii-pratensis Schultz.)**
var. *minor*
f. *minor*
f. *minima* Beck
f. *conchiliata* Beck
f. *albata* Beck
f. *brevicalyx* Beck
f. *procerior* Reich.
f. *barbata* Beck
f. *angustissima* Beck
f. *crithmi maritimi* Beck
f. *ambigua* Beck
f. *neglecta* Beck
f. *hydrocotylei* Beck
f. *pumila* Beck
var. *concolor* (Duby) Beck
f. *concolor*
f. *albus* Beck
- 17. *Orobanche hederæ* Duby (Syn.: *O. medicaginis* Gris.)**
f. *hederæ*
f. *minuscula* Beck
f. *stenantha* (Loj.) Beck
f. *megaphyllon* Beck
f. *inmaniflora* Beck
f. *monochroa* Beck
f. *gyroflexa* Beck
f. *trichodea* Guim.
f. *godroni* Rouy
- 18. *Orobanche caryophyllacea* Smith. (Syn.: *O. galii* Duby; *O. vulgaris* Poir)**
var. *caryophyllacea*

- f. *caryophyllacea*
- f. *macrantha* (Diet.) Beck
- f. *macroglossa* (Wallr.) Beck
- f. *vulgaris* Beck
- f. *tubiflora* (Diet.) Beck
- f. *besseri* Beck
- f. *megalepis* Beck
- f. *subfissa* Beck
- var. *incurvata* Beck
 - f. *incurvata*
 - f. *torquata* (Reich.) Beck
 - f. *curva* Beck
 - f. *citrina* (Diet.) Beck
 - f. *strobiligena* (Reich.) Beck
 - f. *subgilva* Beck
 - f. *gilva* (Diet.) Beck
 - f. *krausei* (Diet.) Beck
 - f. *ligustri* (Suard.) Beck
 - f. *albiflora* Baguet
- var. *buhsei* (Reut.) Beck
- var. *gymnantha* Beck
- 19. *Orobanche teucrii* Hol. (Syn.: *O. atropurpurea* Schultz.)**
 - f. *teucrii*
 - f. *aurea* Teyb.
 - f. *elata* Rouy
 - f. *variisepala* Beck
- 20. *Orobanche lutea* Baumg. (Syn.: *O. bueckii* Dietr.; *O. medicaginis* Duby)**
 - var. *lutea*
 - f. *lutea*
 - f. *rubens* (Wallr.) Beck
 - f. *collecta* Beck
 - f. *porphyrea* Beck
 - f. *pallens* (A. Braun) A. and G.
 - f. *lilacea* Beck
 - f. *hypoleuca* Beck
 - f. *evanida* Beck
 - f. *lopholepis* Beck
 - f. *concreta* Beck
 - f. *podantha* Borb.
 - var. *buekiana* Koch
 - f. *buekiana*
 - f. *liburnica* Beck
- 21. *Orobanche major* L. (Syn.: *O. amethystea* Maly; *O. confusa* Schur.; *O. comosa* Schultz.; *O. echinopsis* Panè.; *O. fragrans* Koch; *O. elatior* Sutt.; *O. stigmatodes* Wimm.)**
 - f. *major*
 - f. *exigua* Beck
 - f. *oreites* Beck

- f. *trichocheilon* Beck
- f. *remotiflora* Beck
- f. *moravica* Beck
- f. *karelini* Beck
- f. *ritro* (Gred. and Godr.) Beck
- f. *hypochoeridis* (Druce) Beck
- f. *krylowi* Beck
- 22. *Orobanche laserpitii-sileris* Reut.**
 - f. *laserpitii-sileris*
 - f. *habrocaulon* Beck
- 23. *Orobanche alsatica* Kirsch.**
 - var. *alsatica*
 - f. *alsatica*
 - f. *macrosepala* (Schultz.) Beck
 - f. *haplodois* Beck
 - var. *libanotidis* (Rupr.) Beck
- 24. *Orobanche flava* Martius (Syn.: *O. petasites* Borb.; *O. tussilaginis* Mut.)**
 - f. *flava*
 - f. *petasitidis* Beck
 - f. *communis* Beck
 - f. *adenostylidis* Beck
- 25. *Orobanche salviae* Schultz.**
 - var. *salviae*
 - f. *salviae*
 - f. *eminens* Beck
 - f. *dimota* Beck
 - f. *neottioides* (Saut.) Beck
 - f. *bosniaca* Beck
 - var. *pedemontana* Beck
- 26. *Orobanche gracilis* Smith. (Syn.: *O. cruenta* Bertol.)**
 - var. *gracilis*
 - f. *gracilis*
 - f. *ingens* Beck
 - f. *megista* Guim.
 - f. *hackelii* Beck
 - f. *orgeia* Beck
 - f. *latiloba* Beck
 - f. *communis* Beck
 - f. *conica* Beck
 - f. *polyantha* Beck
 - f. *humilis* Beck
 - f. *exandra* Guim.
 - f. *hians* Beck
 - f. *elachista* Beck
 - f. *brevissima* Beck
 - f. *ampla* Beck
 - f. *atrantha* Beck
 - f. *psilantha* Beck

- f. *trichota* Beck
- f. *dentiloba* Beck
- f. *longesquamata* Beck
- f. *filiformis* Beck
- f. *unidentata* Beck
- f. *panxantha* Beck
- f. *albo-violacea* Beck
- f. *breviflora* Beck
- f. *pellita* Beck
- f. *strobilacea* Guim.
- var. *spruneri* (Schultz.) Beck
- var. *wagneri* Beck

Species of the *Orobanche* L. genus growing on agricultural plants

In contrast with the fact that about one hundred broomrape species exist worldwide, over one quarter of which have been detected in the Serbian territory, there is only a small number of species that grow as parasites on the root of agricultural plants. Eight species alone deserve to be briefly discussed here as they cause considerable problems.

Severe problems in agriculture are caused by the following species: *Orobanche cernua* Loef. (= *O. cumana* Wallr.); *O. ramosa* L.; *O. nana* Noë; *O. muteli* Schultz.; *O. minor* Sutt.; *O. lutea* Baumg.; and two more species undetected so far in Serbia: *O. aegyptiaca* Pers. and *O. crenata* Forsk. (Beck, 1966; Maširević, 1999).

1. *Orobanche cernua* Loefl. (= *O. cumana* Wallr.)

This species has been found growing on the root of the following agricultural plants: sunflower (*Helianthus*), tomato (*Solanum lycopersicum*) and tobacco (*Nicotiana tabacum*, *Nicotiana rustica*).

It can also be found as a parasite species on *Xanthium strumarium* and *Sonchus oleraceus*.

In Yugoslavia, especially in Vojvodina, *Orobanche cernua* is frequent, particularly in sunflower. According to Maširević (1999) "broomrape growing on sunflower causes problems mostly in Bačka; the focus of the new race has been located on the stretch between Bačka Topola and Subotica where it also tends to spread toward Senta via Čantavir, while another branch spreads toward Čonoplja and Aleksa Šantić... In 1998, a total of about 5000 ha of sunflower fields came under immediate threat in the region of Ljutova near Subotica; somewhat lower intensity of occurrence has also been observed in the Banat region, around Padej and Itebej". About 7 million hectares of sunflower fields are believed to face the threat of *Orobanche cernua* every year (Maširević, 1999).

2. *Orobanche ramosa* L.

The species has been found growing as parasite on several agricultural species, namely: hemp (*Cannabis sativa*), tobacco (*Nicotiana tabacum*), tomato (*Solanum lycopersicum*), potato (*Solanum tuberosum*), hop (*Humulus lupulus*) and carrot (*Daucus carota*).

It may also occur on some other species: *Xanthium strumarium*, *Lamium maculatum*, *Geranium pusillum*, *Melilotus officinalis*.

3. *Orobanche nana* Noë

It grows on all clover (*Trifolium*), vetch (*Vicia*) and bird's foot trefoil (*Lotus corniculatus*, *Lotus uliginosus*) species.

Other host plants include species of the genera *Capsella* (*Capsella bursa-pastoris*, etc.) and *Glechoma* (*Glechoma hederacea*, etc.)

4. *Orobanche muteli* Schultz.

The parasite can be found on a large number of species belonging to the families *Asteraceae* and *Fabaceae* (including some cultivated species).

5. *Orobanche minor* Sutt.

The species is found growing on all clover (*Trifolium*) and alfalfa (*Medicago*) species and on other species of the *Fabaceae* family, as well as species of the *Asteraceae* and *Apiaceae* families.

6. *Orobanche lutea* Baumg.

It is frequently found on species of the *Fabaceae* family, particularly alfalfa (*Medicago*), clover (*Trifolium*), fabales (*Melilotus*) and bird's foot trefoil (*Lotus*).

Besides these six species, additional two have also been established as relevant to agricultural purposes though not observed in Serbia. Those are:

7. *Orobanche aegyptiaca* Pers.

Its host plants are: eggplant (*Solanum melongena*), cucumber (*Cucumis sativus*), cotton (*Gossypium herbaceum*), cabbage (*Brassica oleracea*) and other species of the *Brassica* genus.

8. *Orobanche crenata* Forsk. (= *O. speciosa* DC)

The host plants to it include: broad-bean (*Vicia faba*), garden peas (*Pisum sativum*) and vetch (*Vicia lens* and *Vicia ervillia*).

Broomrape species growing as parasites on non-agricultural plants (ruderal, weed, forest and other species)

1. *Orobanche purpurea* Jacq.

Its host plants are species of the following genera: *Achillea*, *Artemisia*, *Anthemis*, *Chrysanthemum*, all of which fall into the *Asteraceae* family.

2. *Orobanche armeria* Borkh.

It is found growing exclusively on the ruderal species *Artemisia campestris*.

3. *Orobanche coerulescens* Steph.

The only host plant to this species is *Artemisia campestris*.

4. *Orobanche alba* Steph.

The host plants are many species of the family *Lamiaceae*, most prominently the species of the following genera: *Thymus*, *Satureia*, *Origanum*, *Salvia*, *Mellisa* and *Teucrium*.

5. *Orobanche reticulata* Wallr.

It is associated with species of the genera *Carduus*, *Cirsium*, *Centaurea* (all of the family *Asteraceae*), and *Knautia* (family *Dipsacaceae*).

6. *Orobanche serbica* Beck and Petroviæ

Its main host is the species *Artemisia campestris* but it can also be found growing on some other dry meadow species.

7. *Orobanche pancicii* Beck

It is found only on species of the genera *Ligustrum* and *Scabiosa*.

8. *Orobanche caryophyllacea* Sm.

Its host plants include species of the genera *Galium*, *Sherardia* and *Asperula*, all of the family *Rubiaceae*.

9. *Orobanche teucrii* Hol.

It is found growing on the root of different species of the genera *Teucrium*, *Thymus* and *Satureia*.

10. *Orobanche loricata* Rchb.

Its host plants are the species *Artemisia campestris* and some species of the genus *Achillea* (family *Asteraceae*).

11. *Orobanche picridis-hieracioides* Schultz.

It is frequently found growing on species of the *Asteraceae* family (*Picris hieracioides*, *Leontodon hispidus*), and somewhat less frequently on species of the family *Apiaceae* (*Orlaya grandiflora*, *Daucus carota*).

12. *Orobanche gracilis* Sm.

Its hosts are various species of the following genera: *Cytisus*, *Dorcnium*, *Genista*, *Lotus*, *Lathyrus*, *Melilotus*, *Onobrychis*, *Trifolium*, *Ononis* and *Coronilla*.

13. *Orobanche amethystina* Thuill.

It grows on the root of sea holly (*Eryngium campestre*) and some species of the genus *Evonymus*.

14. *Orobanche esulae* Panèia

The species grows on the root of spurge (*Euphorbia esula*).

15. *Orobanche hederæ* Duby

It can only be found growing on the root of English ivy (*Hedera helix*).

16. *Orobanche major* L.

Its hosts include several species of the family *Asteraceae*: *Centaurea scabiosa*, *Centaurea variegata*, *Carduus acanthoides*, *Carduus nutans* and *Echinops ruthenicus*.

17. *Orobanche laserpitii-sileris* Reut.

The exclusive host plant to this species is the species *Laserpitium siler*.

18. *Orobanche flava* Mart.

It grows on species of the genera *Petasites* and *Tussilago* (family *Asteraceae*).

CONCLUSION

The 99 species of the globally represented genus *Orobanche* L. are part of four sections, namely 1. Sect. *Gymnocaulis* Nutt. (3 species), 2. Sect. *Myzorrhiza* (Phil.) Beck (10 species), 3. Sect. *Trionychon* Wallr. (23 species), and 4. Sect. *Osproleon* Wallr. (63 species).

The *Orobanche* species which belong to the sections *Gymnocaulis* and *Myzorrhiza* are not native to Europe but are quite common in North and South America.

The greatest number of *Orobanche* species fall into the *Trionychon* and *Osproleon* sections, and grow almost in all parts of the world, primarily in the Mediterranean region. Twenty-six of them are common in Serbia.

Broomrape species growing in Serbia show a remarkable biodiversity (species and infraspecies). So far, 26 *Orobanche* species have been found in Serbia, including 56 varieties and 226 forms. The total number of taxons of the *Orobanche* genus found in Serbia thus reaches as many as 308. Besides, some species (and some infraspecies taxons) form physiological races especially adjusted to specific crops, which further adds to their diversity.

Although nearly a hundred broomrape species have been identified worldwide, only 8 of them deserve to be considered as parasites that draw sustenance from cultivated crops. Those are:

1. *Orobanche cernua* Loefl. (= *O. cumana* Wallr.),
2. *O. ramosa* L.,
3. *O. nana* Noë,
4. *O. muteli* Schultz.,
5. *O. minor* Sutt.,
6. *O. lutea* Baumg.,
7. *O. aegyptiaca* Pers., and
8. *O. crenata* Forsk. (= *O. speciosa* DC).

The last two (*Orobanche aegyptiaca* and *O. crenata*) have not been detected in Serbia so far. Of the other broomrape species, *Orobanche cernua* is especially widespread, primarily in sunflower fields. It also grows as a parasite species on tomato, tobacco and some weeds (*Sonchus oleraceus*, *Xanthium strumarium*, *Artemisia austriaca*, etc.).

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EXTENSION Y BIODIVERSIDAD DE OROBANCA (*Orobancha* L.) EN EL MUNDO Y EN SERBIA

RESUMEN

El genero de orobanca (*Orobancha* L.) es caracterizado por la biodiversidad mareada. De 99 especies de orobanca identificadas en todo el mundo, 26 pueden hallarse en Serbia. Las especies del genero de orobanca son muy variables. Ellas incluyen 56 variedades (o en 308 taxones en total), asi como un grande numero de razas fisiologicas adaptadas a ciertos cultivos. A pesar de la grande diversidad, solo en ocho especies se hallan los parasitos graves de las plantas cultivadas (*Orobancha cumana* Wallr., *O. ramosa* L., *O. nana* Noë, *O. muteli* Sch., *O. minor* Sutt., *O. lutea* Baumg., *O. aegyptiaca* Pers. y *O. crenata* Forsk.). *Orobancha cumana* Wallr. (*O. cernua* Loefl.) es especialmente importante como el parasito de girasol, pero esa se halla a menudo en tomates, tabaco y unas plantas adventicias.

DISTRIBUTION ET BIODIVERSITÉ DE L'OROBANCHE (*Orobancha* L.) DANS LE MONDE ET EN SERBIE

RÉSUMÉ

La famille de l'orobanche (*Orobancha* L.) est caractérisée par une biodiversité prononcée. Des 99 espèces d'orobanches identifiées dans le monde, 26 ont été répertoriées en Serbie. Les espèces de la famille de l'orobanche sont caractérisées par une grande variabilité. Elles comprennent 56 variétés, 226 formes (ou un total de 308 taxons) ainsi qu'un grand nombre de races physiologiques adaptées à certaines cultures. Malgré cette grande diversité, seules

huit espèces sont d'importants parasites des plantes cultivées (*Orobanche cumana* Wallr., *O. ramosa* L., *O. nana* Noë, *O. muteli* Sch., *O. minor* Sutt., *O. lutea* Baumg., *O. aegyptiaca* Pers. et *O. crenata* Forsk.). L'*Orobanche cumana* Wall. (*O. cernua* Loebl.) est particulièrement importante en tant que parasite du tournesol, mais elle se trouve aussi souvent dans la tomate, le tabac et certaines mauvaises herbes.

