

Three *Orobanche* Species Newly Found on Crops in Israel

Daniel M. Joel^{*,1} and Hanan Eisenberg¹

Orobanche amethystea Thuill., *O. loricata* Reichenb. and *O. pubescens* D'Urv. were found to parasitize the roots of cultivated plants in Israel. *Orobanche pubescens* is known from the local flora, and was now found to cause damage in parsley fields and to *Tropaeolum majus* L. (nasturtium) in ornamental gardens. *Orobanche amethystea* and *O. loricata* are known as occasional weeds in Europe and were recently found for the first time in Israel. *Orobanche amethystea* densely populated vetch fields in Israel, and *O. loricata* was found in ornamental gardens. A key for the identification of *Orobanche* species in cultivated areas in Israel is given, based on morphological features.

KEY WORDS: *Orobanche amethystea*; *O. loricata*; *O. pubescens*; weeds.

INTRODUCTION

Orobanche spp. are root parasites that attach to dicotyledonous host plants, deriving water and nutrients from them. All species are holoparasitic, devoid of leaves and totally dependent on their hosts for most of their life cycle. Only a few of the many *Orobanche* species are known to be weedy, i.e., to infest agricultural fields and to specialize on crops in cultivated areas. The most important species that are known as serious pests in many countries are *O. crenata* Forssk., *O. cumana* Wallr., *O. cernua* Loeffl., *O. ramosa* L., *O. aegyptiaca* Pers. and *O. minor* Sm. Ten *Orobanche* species have been recorded for Israel and neighboring countries (2,3,4), of which five are known as weeds while the others have never been reported to infest agricultural fields. *O. cumana* was introduced into the country in the 1970s and gradually became a major pest in sunflower fields in large parts of the country (5). *O. coerulescens* Stephan ex Willd. was found in tomato fields in the Arava Valley (3) in the 1980s, but disappeared after the application of an eradication program. Quarantine measures concerning *Orobanche* spp. are difficult to impose, due to the small dimensions of the dust-like seeds.

In the following we describe three *Orobanche* species that have recently been found in agricultural fields and gardens in Israel, and present a key for their identification.

MATERIALS AND METHODS

Orobanche plants were collected in the field and identified using Flora Palaestina (2) and Flora Europaea (1). Voucher specimens were deposited at the Neve Ya'ar Weed Herbarium. Geographical terms follow Feinbrun-Dothan (2).

Received Aug. 10, 2001; received in final form Nov. 5, 2001; <http://www.phytoparasitica.org> posting Jan. 13, 2002.

¹Dept. of Weed Research, ARO, Neve Ya'ar Research Center, Ramat Yishay 30095, Israel [*Fax: +972-4-9836936; e-mail: dmjoel@netvision.net.il].

RESULTS AND DISCUSSION

Orobanche amethystea Thuill. parasitized vetch (*Vicia sativa* L.) in two agricultural areas in Israel, viz., in the 'Akko Plain and the southern Coastal Plain. Species description: Bracteoles absent, bracts 12–21 mm. Bracts, calyx and corolla subglabrous. Calyx segments free, with filiform teeth. Corolla tubular to campanulate, not inflated and not constricted. Corolla white or pale cream outside, at least towards the base tinged with violet. Corolla hairs colorless. Corolla lips small, 17–23 mm, sparsely glandular. Lower lip and lower corolla tube not ciliate. Filaments inserted 2–3 mm above the base of the corolla tube, sparsely hairy below, glabrous above. Stigma purple.

Orobanche loricata Reichenb. parasitized *Gazania longiscapa* DC. and other perennial ornamental Asteraceae, as well as ornamental *Pelargonium* species, in flower gardens mainly in the Tel Aviv area. Species description: Flowering stem up to 1 m, purple. Bracteoles absent, bracts lanceolate, 12–16 mm, subglabrous. Calyx puberulent or glandular-pubescent. Calyx segments 10–15 mm, free, unequally bifid. Corolla 18–20 mm, glandular-pubescent to subglabrous, tubular, not inflated and not constricted. Corolla white or pale cream outside, tinged and veined with violet. Corolla lips small, outer side of upper lip glandular-pubescent, lower lip and inner side of upper lip glabrous. Middle lobe of lower lip larger than lateral lobes. Filaments inserted 3–5 mm above the base of the corolla tube, glabrous. Stigma purple.

Orobanche pubescens D'Urv. This has already been described as a native plant in Israel but was now found to parasitize cultivated plants, causing damage to parsley in agricultural fields in the Bet She'an Valley and to *Tropaeolum majus* L. in ornamental gardens in the Lower Galilee. Species description: Spike 10–40 cm, lax or dense, yellowish to purplish, pubescent with glandular hairs. Bracteoles absent, bracts lanceolate, as long as corolla or slightly longer, pubescent. Calyx about the same length as corolla. Segments free, two-lobed, filiform. Corolla 10–16 mm, tubular-campanulate, curved outwards, whitish, violet above, often with purplish veins, pubescent with glandular hairs like stem and calyx. Filaments inserted 1–2 mm above the base of the corolla tube, their bases woolly (not glandular). Anthers glabrous. Flowering in February–April. Rather small (10–20 cm) on parsley, much larger (20–40 cm) on *Tropaeolum* sp.

Whereas *O. amethystea* and *O. loricata* have not been found before in Israel, *O. pubescens* is known in the native flora (2) in areas adjacent to the cultivated fields and gardens in which it was recently found. It is therefore speculated that seeds of this species that remained in the soil from before it had been cultivated, germinated and attacked cultivated plants as soon as suitable hosts were planted. It is interesting to note that *T. majus* is a very 'successful' host in urban areas, hosting various species of *Orobanche*, like *O. ramosa*, *O. minor*, *O. crenata* and *O. aegyptiaca*, not only in Israel but in other countries as well, including Western Australia (S. Lloyd and R. Randall, pers. comm., 1998).

Orobanche amethystea was found in many legume fields in the country (mainly vetch). Being very similar to *O. crenata* in size and general appearance, this species has been wrongly identified as *O. crenata* for many years. A significant difference that enables rapid distinction between these two species is the characteristic fragrance that is present only in *O. crenata*; *O. amethystea* is non-fragrant (and see the key below).

Orobanche amethystea and *O. loricata* seem to have been introduced into Israel, presumably from Europe. The latter was probably brought into Israel on imported

ornamentals. It spreads rapidly in ornamental gardens, mainly in public areas. While *O. amethystea* causes damage in agriculture, *O. loricata* does not seem to cause any damage to garden plants, in spite of the fact that it may grow to a large size (up to 1 m in height).

Distinguishing among the broomrape species is often difficult, because of the rarity of morphological differences in various groups of species. Using molecular markers of both the nuclear and the plastid genomes, we have been able to distinguish clearly between the agriculturally important species (6,7), and confirmed key morphological characteristics (6). In the following we present a key for species identification that is based on the main morphological differences among the important species.

Key to *Orobanche* species in cultivated areas in Israel

1a Bracteoles present	-2
1b Bracteoles absent	-4
2a Corolla villose	= <i>O. pubescens</i>
2b Corolla glabrous or short-hairy	-3
3a Corolla 20–35 mm long, stamen connective pubescent	= <i>O. aegyptiaca</i>
3b Corolla 10–22 mm long, stamen glabrous	= <i>O. ramosa</i>
4a Upper stem and flowers arachnoid-woolly	= <i>O. coerulescens</i>
4b Upper stem and flowers not arachnoid-woolly	-5
5a Filaments hairy, inserted in the lower part of the corolla tube	-6
5b Filaments glabrous, inserted about the middle of the corolla tube	-7
6a Corolla up to 20 mm long with small lips, filaments hairy below	-8
6b Corolla >20 mm long with large divergent lips, filaments hairy throughout, stem glandular and fragrant	= <i>O. crenata</i>
7a Corolla tubular, often bent downwards, seeds longish, testa pits small	= <i>O. cumana</i>
7b Corolla upright, constricted above its middle, seeds pear-shaped, testa pits larger than bars between them	= <i>O. cernua</i>
8a Filaments purple on top, white or yellow at base	= <i>O. amethystea</i>
8b filaments white, stem purple	= <i>O. loricata</i>

REFERENCES

1. Chater, A.O. and Webb, D.A. (1972) *Orobanche*. in: Tutin, T.G., Heywood, V.H., Burgess, N.A., Walters, S.M. and Webb, D.A. [Eds.] *Flora Europaea*. Cambridge University Press, Cambridge, UK. Vol. 3, pp. 286-293.
2. Feinbrun-Dothan, N. (1978) *Flora Palaestina*. The Israel Academy of Sciences and Humanities, Jerusalem, Israel. Vol. 3, pp. 210-215.
3. Feinbrun-Dothan, N. (1986) *Flora Palaestina*. The Israel Academy of Sciences and Humanities, Jerusalem, Israel. Vol. 4, p. 403.
4. Joel, D.M. (1987) Identification of *Orobanche* seeds. *Proc. 4th Int. Symp. Parasitic Flowering Plants* (Marburg, Germany), pp. 437-444.

5. Joel, D.M. (1988) *Orobanche cumana* - a new adventive weed in Israel. *Phytoparasitica* 16:375 (abstr.).
6. Joel, D.M., Benharrat, H., Portnoy, H. and Thalouarn, P. (1998) Molecular markers for *Orobanche* species – new approaches and their potential uses. *Proc. 4th Int. Workshop on Orobanche* (Albena, Bulgaria), pp. 115-124.
7. Katzir, N., Portnoy, V., Tzuri, G., Castejon-Muñoz, M. and Joel, D.M. (1996) Use of random amplified polymorphic DNA (RAPD) markers for the study of the parasitic weed *Orobanche*. *Theor. Appl. Genet.* 93:367-372.