

First record of *Ficus microcarpa* L. f. (Moraceae) in Algeria

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Key words: Alien flora, new record, North Africa, syconia.

Ključne besede: Tujerodna flora, novi podatki, Severna Afrika, sikonija.

Abstract

The escape from cultivation of *Ficus microcarpa* (Moraceae, Magnoliopsida) in Algeria is here reported. Several localities where the species reproduces from seeds have been discovered recently in northeastern Algeria. A map of its current distribution in the study area is provided. The species colonizes mainly urban habitats (walls, balconies and sidewalks) but its propagation in the natural environment is being facilitated by birds that disseminate the seeds over long distances. *Ficus microcarpa* can be considered as in the process of naturalization in Algeria. An updated key to species of the genus *Ficus* in Algeria is provided.

Izveček

V članku poročamo o pobegu gojene vrste *Ficus microcarpa* (Moraceae, Magnoliopsida) v Alžiriji. V zadnjem času smo v severovzhodni Alžiriji odkrili številne lokacije, kjer se vrsta razširja s semeni. Prikazali smo karto razširjenosti v obravnavanem območju. Vrsta naseljuje predvsem urbana rastišča (zidove, balkone in pločnike), njeno razmnoževanje v naravnem okolju pa pospešujejo ptiči z razširjanjem semen na dolge razdalje. Vrsto *Ficus microcarpa* lahko v Alžiriji obravnavamo kot vrsto v procesu naturalizacije. Podali smo tudi posodobljen določevalni ključ rodu *Ficus* v Alžiriji.

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Introduction

The family Moraceae is represented in Algeria by only three genera, namely *Ficus* Tourn. ex L., *Maclura* Nutt. and *Morus* L., and accommodates only woody species (Dobignard & Chatelain, 2012). The genus *Ficus* is the only one that includes native taxa such as *F. cordata* Thunb. subsp. *salicifolia* (Vahl) C.C. Berg (syn.: *F. salicifolia* Vahl) or *F. ingens* (Miq.) Miq., both found exclusively in the desert areas (Maire, 1961; Quézel & Santa, 1962). Several other species of the same genus, originating from tropical areas, have been introduced in Algeria for a very long time, mainly by the Hamma acclimatization garden during the colonial period. A total of 38 species have been progressively introduced, among which *Ficus benjamina* L., *F. elastica* Roxb. ex Hornem., *F. lyrata* Warb., *F. macrophylla* Pers., *F. microcarpa* L. f., *F. racemosa* L., *F. religiosa* L., *F. rubiginosa* Desf. ex Vent., *F. scabra* G. Forst., *F. sur* Forssk. and *F. sycomorus* L. (Hardy, 1863). Among these species, several are evergreen and very decorative while others are good rubber producers such as *F. variegata* Blume from Sumatra. The successful acclimatization of several of them allowed their subsequent distribution by all the nurseries that were set up at that time in the different regions of the country (Carra & Gueit, 1952).

Currently, *Ficus benjamina*, *F. elastica*, *F. lyrata*, *F. macrophylla* and *F. microcarpa* are among the most applied taxa of the genus in Algeria. The first three species are mainly used as indoor plants and are rarely cultivated in gardens, while the last two are mainly cultivated in public green spaces, the considerable size that they can reach at maturity probably having hampered their use in private gardens that, most of the time, are limited in surface.

Apart from *Ficus carica* L., a species with edible fruits that is reported as naturalized in Algeria (Dobignard & Chatelain, 2012) but assumed to be native to the Maghreb and North Africa in general (Maire, 1961; Quézel & Santa, 1962) and *F. pumila* L., a liana native to China and Japan, reported as cultivated/subspontaneous in our country (Dobignard & Chatelain, 2012), no other species of the genus has been recorded so far outside of cultivation.

In the context of the monitoring of population dynamics of potentially invasive species recorded in our previous work (Sakhraoui et al., 2019a, 2019b, 2019c), carried out mainly in northeastern Algeria, more precisely in the wilaya of Skikda and the wilaya of El-Tarf, allowed us to record the escape of *Ficus microcarpa*. This species has already been reported as escaped from cultivation in some countries of North Africa (Dobignard & Chatelain, 2012) but never before in Algeria. In this paper, we assess the species degree of naturalization and the nature of the colonized habitats and we provide information rela-

tive to its reproduction mode and dispersion. This newly gathered information allows us to better understand the success of its escape and to predict the evolution of its propagation in the area under study.

Materials and methods

During botanical surveys carried out between 2015 and 2021 in two wilayas of northeastern Algeria, namely the wilaya of Skikda and the wilaya of El-Tarf, several localities with growing *Ficus microcarpa* were discovered. These field surveys were mainly carried out in urban areas, particularly cities and villages, but natural or semi-natural areas were also occasionally surveyed; in the latter case, obvious tracks through easily accessible areas were followed.

The identification and description of the species was facilitated to the consultation of the Flora of North Africa (Maire, 1961), the Flora of North America (retrieved from http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=112770) and the Flora of China (retrieved from http://www.efloras.org/florataxon.aspx?flora_id=2&taxon_id=200006364). Synonymy was checked at the level of WFO (2021), and the degree of naturalization was assessed according to Pyšek et al. (2004). To confirm the originality of our records, international databases focusing on plant biodiversity were consulted, notably the Global Biodiversity Information Facility (GBIF, 2021) and the African Plant Database (APD, 2021).

Data relating to the biological characteristics of *Ficus microcarpa*, in particular the fructification and the production of seeds or the diseases which can affect the species, were recorded by the first author (N.S.) following personal observations made *in situ*, mainly in the gardens of the University campus of the region of Skikda, which was recently integrated into the common research service 'pôle de vulgarisation botanique'.

Results and discussion

A total of 16 individuals of various sizes were observed, distributed over ten localities, eight of which were in the Skikda region and only two in the El-Tarf region (Figure 1). The different observations, including the date of recording, size of individuals, geographical coordinates, physical description and photographs of the various recorded localities are presented further down.

Morphological description

Ficus microcarpa L. f., Suppl. Pl. 442. 1782 ≡ *Urostigma microcarpum* (L. f.) Miq., = *F. retusa* L. var. *crassifolia* W. C. Shieh, = *Ficus rubra* Roth

A moderate to large, evergreen, up to 15–20 m tall tree, with a dense rounded crown, dark gray bark, aerial roots when old, glabrous shiny leaves and paired; sessile, purple or black, obovoid, pyriform, or nearly globose, 9–11 × 5–6 mm syconia. Male, gall, and female flowers within same fig. Male flowers: scattered, sessile or pedicellate; filament as long as anther. Gall and female flowers: sepals 3, broadly ovate; style ± lateral; stigma short, clavate. Achenes ovoid.

Phenology: in studied region, the production of syconia bearing male and female flowers starts from July and the mature fruits bearing fertile seeds (Figure 2) appear from the end of August.

Native range and general distribution

Native from Sri Lanka, India, southern China, Singapore, Taiwan, Japan, the Ryukyu Islands, northern Australia, New Caledonia and many Pacific Islands (Berg & Corner, 2005), *Ficus microcarpa* is widely cultivated as ornamental tree in different regions of the world and easily escapes from cultivation, notably in Central and South America, Florida, Puerto Rico, Hawaiian Islands (Wunderlin, 1997), southern California (Riefner, 2016), Bermuda, New Zealand, and some Mediterranean countries like Italy, Spain, Tunisia and Palestine where it is sometimes considered as invasive (see e.g. Galasso et al., 2017; El Mokni, 2019).

Growing localities in Algeria, habitat and degree of naturalization

The species was first observed in the village of Hamadi Krouma (wilaya of Skikda), where an individual of about 1 m growing on the wall of an old building was spotted on 15 March 2021 (Table 1, locality n°1), then three others, smaller individuals of 20 to 30 cm tall were found on 19 March 2021 in the same village, emerging from a crack at the edge of a sidewalk in the center of the city (Table 1, locality n°2), where adult trees are cultivated at only 2 to 3 m from the recorded individuals, the latter probably being the origin of this appearance (Figure 3). We initially thought that the young specimens were issued from the suckering of the roots of the old trees, however the pulling up of one of them revealed the erroneousness of this idea: to our great astonishment, they originated from the germination of seeds which had, until now, never been reported in Algeria.

This observation encouraged us to look for the species in other places, especially urban habitats. Thus, on April 12, 2021, it was found in the common service of the research pole of botanical popularization located in the University Campus of the wilaya of Skikda, where three individuals grew on the walls of old buildings, varying in size and ranging in length from 40 to 80 cm (Table 1, locality n° 3). Old trees are also grown here, bearing fruit regularly and often reproducing through aerial layering.

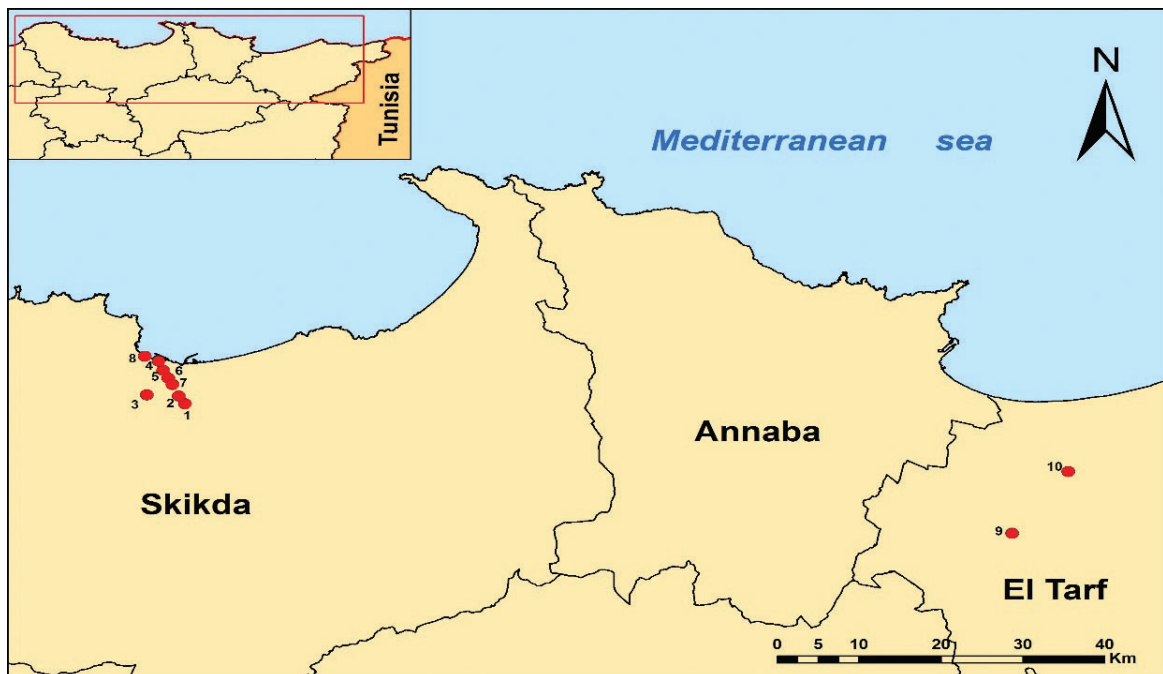


Figure 1: Localities where *Ficus microcarpa* was recorded in northeastern Algeria. The numbers of localities correspond to Table 1.

Slika 1: Kraji, kjer so zabeležili *Ficus microcarpa* v severovzhodni Alžiriji. Številke lokacij so enako kot v Tabeli 1.

From 19 to 21 May 2021, five other individuals of variable sizes ranging from 30 cm to 2 m, growing on walls and balconies of old buildings, were observed in different cities of the old town of Skikda (Table 1, locality n°4, 5, 6, 7), each time in the vicinity of old trees of considerable size that are planted at the edges of the avenues.

On 31 May 2021, a young individual of about 50 cm tall was found clinging to the rocks of a sea cliff exposed to salt spray at the edge of the road leading to the port of Stora (wilaya of Skikda) (Table 1, locality n°8, Figure 3D). In this locality, old trees are also cultivated in private gardens but no mature trees are located near the escaped individual.

The enlargement of the survey area allowed us to discover other individuals in the wilaya of El-Tarf, located about 150 km east of the wilaya of Skikda. Two individuals of about 1 m each were observed on 1 June 2021 growing on an old building in the center of the village of El-Besbes (Table 1, locality n°9), then in the village of Ben M'Hidi where an individual of about 90 cm tall was observed on the wall of a local bank (Table 1, locality n°10). In this wilaya, *F. microcarpa* is also widely cultivated in public gardens as an ornamental plant or at the edges of avenues as a line tree.

Although the species maintained in the observation stations has begun to establish itself in the natural environment, in particular on the sea cliffs of Stora, where we suspect the presence of other individuals, the status of naturalized plant cannot be attributed to it, because its appearance in the region remains recent, from where it is considered here as in the process of naturalization (according to Pyšek et al., 2004).

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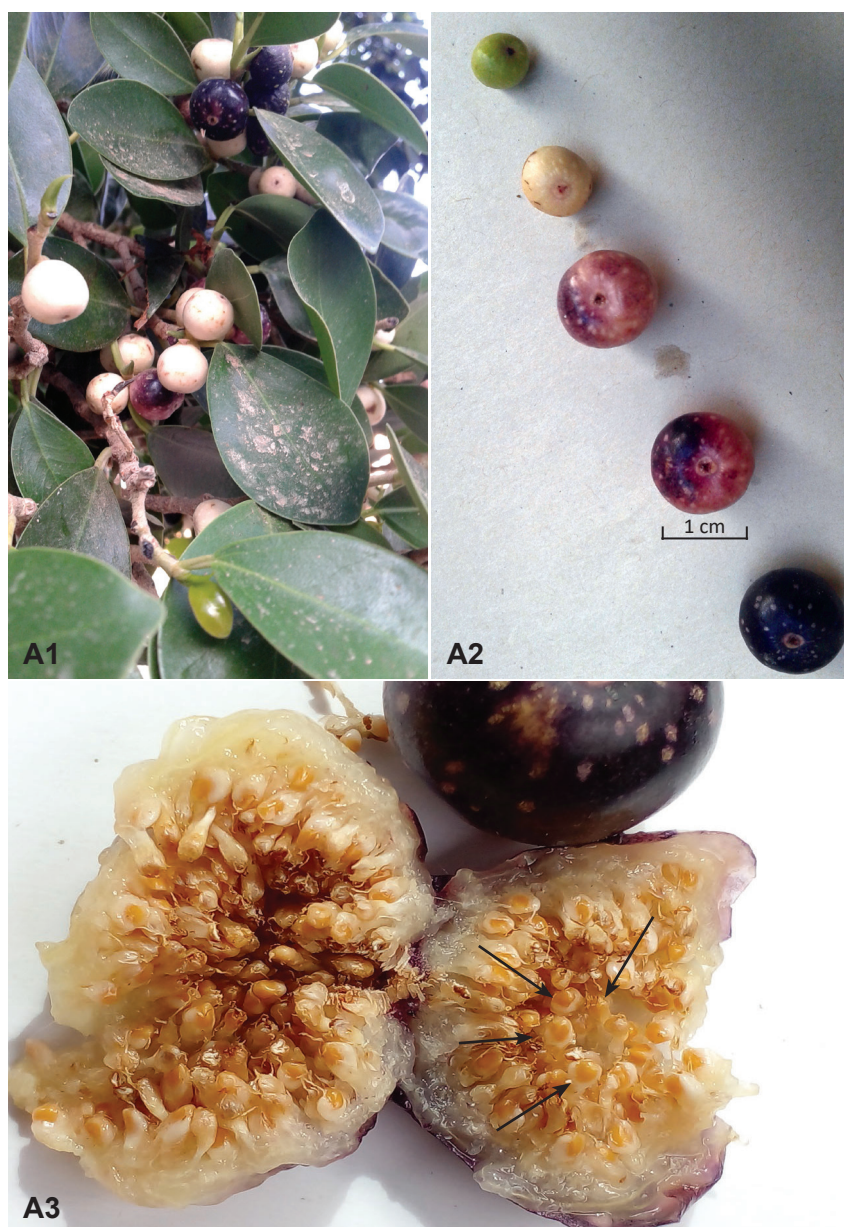


Figure 2: Fruits of *Ficus microcarpa* observed in the Skikda region (northeastern Algeria). A1: fruits on the tree; A2: different stages of maturation of syconia; A3: seeds. Photos by Nora Sakhraoui (29.08.2021).

Slika 2: Plodovi vrste *Ficus microcarpa* opaženi v regiji Skikda region (severovzhodna Alžirija). A1: plodovi na drevesu; A2: različne stopnje zrelosti socvetja sikonija; A3: semena. Fotografije Nora Sakhraoui (29.08.2021).



Figure 3: Different habitats occupied by *Ficus microcarpa* in the Skikda region (northeastern Algeria). A: individual hanging on a wall at the joint research service, botanical popularization pole; B: individual at the edge of the sidewalk in the capital of the commune of Hamadi Krouma; C: individual clinging to a building in the town of Skikda; D: individual clinging to the rocks of a sea cliff at the side of the road leading to the port of Stora. Photos by N. Sakhraoui (01.09.2021).

Slika 3: Različni habitati, kjer se pojavlja vrsta *Ficus microcarpa* v regiji Skikda (severovzhodna Alžirija). A: primerek na zidu raziskovalne postaje; B: primerek na robu pločnika v glavnem mestu območja Hamadi Krouma; C: primerek na zidu zgradbe v mestu Skikda; D: primerek na skalovju obmorskega klifa ob cesti do pristanišča Stora. Fotografije N. Sakhraoui (01.09.2021).

This is the first time that *Ficus microcarpa* has been officially reported in Algeria as in the process of naturalization. However, an observation of the species dating from 2019 exists on the iNaturalist platform (<https://www.inaturalist.org/>) which was taken over by GBIF (2021). Careful examination of the images and information published in this site, allow us to say that the observation seems to represent a tree in a bus station in the city of Algiers, but no details on the exact status of the species were given, requiring a verification in the field if it is an escaping or cultivating origin.

In North Africa, the species is reported occasionally in Egypt (El Beheiry et al., 2020) and cultivated/escaped in Morocco and Libya (Dobignard & Chatelain, 2012). In Tunisia, *Ficus microcarpa* is reported as a casual alien where it occurs as an epiphyte colonizing preferentially trees such as *Jacaranda mimosifolia* D. Don., *Melia azedarach* L. and *Phoenix canariensis* Chabaud (El Mokni, 2019). In Algeria, however, the species probably prefers rocky habitats like the original substrate in the native range which makes it particularly threatening to the native flora of sea cliffs, especially those of Stora where it

Table 1: Geographic coordinates of recorded localities of *Ficus microcarpa* in Algeria.

Tabela 1: Geografske koordinate zabeleženih nahajališč vrste *Ficus microcarpa* v Alžiriji.

Id	Locality	Wilaya	Number of individuals	Habitat	Latitude	Longitude	Altitude (m)
1	City of Hamadi krouma	Skikda	1	Wall	36°50'36"	006°55'50"	20
2	City of Hamadi krouma	Skikda	3	Sidewalk	36°50'43"	006°56'34"	20
3	University of 20 August 1955	Skikda	3	Wall	36°50'57"	006°53'30"	20
4	City of Skikda	Skikda	2	Wall	36°52'53"	006°54'23»	29
5	City of Skikda	Skikda	1	Balconies	36°52'55"	006°54'24"	30
6	City of Skikda	Skikda	1	Old building	36°52'46"	006°54'29"	52
7	City of Skikda	Skikda	1	Balconies	36°52'37"	006°54'33"	46
8	Stora	Skikda	1	Sea cliff	36°53'24"	006°53'22"	39
9	Village of El-Besbes	El-Tarf	2	Old building	36°42'10"	007°50'27"	24
10	Village of Ben M'Hidi	El-Tarf	1	Wall	36°46'05"	007°54'10"	11



Figure 4: Cottony secretions of *Macrohomotoma gladiata* on leaves of *Ficus microcarpa* (Skikda, northeastern Algeria). Photo by N. Sakhraoui (31. 09. 2021).

Slika 4: Bombažni izločki vrste *Macrohomotoma gladiata* na listih *Ficus microcarpa* (Skikda, severovzhodna Alžirija). Fotografija N. Sakhraoui (31. 09. 2021).

is at the beginning of establishment. The cliffs of Stora harbor an important area of plant diversity, with some rare and endemic taxa (Sakhraoui et al., 2020) but they are under increasing anthropic pressure which has largely facilitated the spread of some exotic plants with a strong invasive character notably *Arundo donax* L., *Opuntia*

ficus-indica (L.) Mill. and *O. stricta* (Haw.) Haw. *Ficus microcarpa* could also be found in this region, exposed to sea spray, the conditions favorable to its propagation that could lead to the explosive proliferation of its populations. Species is salt tolerant ; it has been identified as a halophyte (Yensen, 2015). It is also renowned for its ability to adapt to dry and harsh conditions in its native range and where it has been introduced (Riefner, 2016) which also makes it a threat to the other types of environments in Algeria.

The other negative effect that can be caused by the lithophytic aspect of *F. microcarpa* is most likely the destructive action of its roots on urban structures (foundations, streets, sidewalks and water systems, among others), as was demonstrated for *F. benjamina* (Vargas-Garzón & Molina-Prieto, 2012).

The local authorities, including those responsible for the development of urban green spaces, participate considerably in the propagation of this species by planting it on a large scale at the edges of most of the roads of the country, especially in its northern part, where the climatic conditions influenced by the Mediterranean Sea are favorable to the development of this species (Riefner, 2016). In the northeast of Algeria, it is one of the most planted trees in recent years in the urban and peri-urban environment, along with e.g. *Acacia saligna* (Labill.) H. Wendl., *Myoporum laetum* G. Forst., *Washingtonia filifera* (Rafarin) H. Wendl. ex de Bary and *W. robusta* H. Wendl (Sakhraoui, 2021). Its more or less rapid growth, its tolerance of hot summers, its indifference to the nature of the soil and the well supplied shade offered by the old trees (Weber, 2003), have apparently encouraged its selection among dozens of other exotic species for a wide use in Algeria. For all these reasons, we foresee its potential escape from cultivation in other coastal cities of the country.

In the study area, the species is always present in isolated individuals growing mostly on the walls of old

buildings at heights that can, sometimes, be important (the highest subject was observed in the city of Skikda at a height of about 15 m), indicating the involvement of birds and probably also ants in the dissemination of seeds (Simberloff, 2013). However, birds also seem to facilitate their germination (Traveset, 1998).

The production and fertility of the seeds raise questions about the pollinating agent of the flowers. The fruits of *Ficus microcarpa* are specifically pollinated by *Eupristina verticillata* Waterston (Wang et al., 2015a), a wasp that has not yet been confirmed in Algeria, nor have we observed it inside the figs examined. In 1961, Maire wrote about *F. microcarpa* cultivated in North African countries: “Cette espèce fleurit abondamment chez nous, mais ne donne pas de graines” [translated: This species flowers abundantly in our country, but does not give seeds]. This means that, at that time, the pollinator did not exist yet in Algeria, but it was probably introduced accidentally afterwards. This would explain the escape of the species which cannot reproduce sexually unless this specific fig wasp pollinator is present, since they are linked by a very intimate mutualistic relationship (Wang et al., 2015a). The presence of the wasp has been reported in some Mediterranean countries where the escape of *Ficus microcarpa* has also been observed including Turkey (Doğanlar, 2012; Uludağ et al., 2017) and Italy (Lo Verde et al., 1991; Galasso et al., 2018). In North Africa, it is reportedly known from Tunisia and the Canary Islands (see Van Noort et al., 2013). However, other non-pollinating wasps that can be found in *Ficus microcarpa* figs were also reported in the Mediterranean region such as *Meselatus bicolor* Chen, *Odontofroggattia galili* Wiebes and *Walkerella microcarpae* Bouček (Lo Verde & Porcelli, 2010; Doğanlar, 2012), the first two of which have a very marked negative impact on seed and pollinator development (Wang et al., 2015b). The entire wasp fauna associated with figs of this species is to be researched in Algeria.

Our field surveys allowed us to record 30 cultivated individuals attacked by the psyllid *Macrohormotoma gladiata* Kuwayama (Figure 4) whose presence in Algeria has already been reported in Mostaganem (northwestern Algeria) (Guenaoui & Ouvrard, 2016). The whitish cotton-wool like secretions produced by this bio-pest, which seems to spread on the national territory, cause the deformation of leaves and young shoots, as they can stop their development and even cause their death (Roberti et al., 2016). In the event of an invasion, this and other pests could potentially be used as biological control agents to curb the spread of *F. microcarpa*, as it has a negative impact on the growth of the species, however, the non-pollinating wasps cited above, in particular *Meselatus*

bicolor, seems to be a valuable biological control agent as it prevents seeds and pollinators from developing in the figs it occupies.

Key to species of the genus *Ficus* L. in Algeria

- Leaves deciduous, palmately lobed, scabrous above, whitish-villous below, fruits 3–8 cm long, bulky, pear-shaped *F. carica*
- Leaves lanceolate or linear-lanceolate (5–20 × 1–4 cm), very rough, fruits 6–10 mm long, pink, fleshy and sweet when ripe, finely pubescent.....
- *F. cordata* subsp. *salicifolia*
- Leaves oval more or less cordiform at the base, large (8–15 × 4–10 cm), fruits 8–15 mm long, glabrous, small, dry
- *F. ingens*
- Leaves glabrous, shiny, paired, fruits sessile, dark purple or black, obovoid or nearly globose, small
- *F. microcarpa*
- Liana with lower leaves ovate-cordiform very shortly petiolate, upper leaves ovate-oblong rather long petiolate, coriaceous, big fruits 5–6 cm long..... *F. pumila*

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