SYSTEMATICS OF EURASIAN AND NORTH AFRICAN DORONICUM (ASTERACEAE: SENECIONEAE) 1

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ABSTRACT

The genus Doronicum (Asteraceae: Senecioneae) comprises perennial herbs distributed in Europe, North Africa, and Asia. A worldwide revision of the genus recognizing 26 species and 4 subspecies is presented. In the present taxonomic treatment no infrageneric groups are recognized. Seven names are newly lectotypified herein: Arnica doronicum Jacq., Doronicum caucasicum M. Bieb., Doronicum portae Chabert, Doronicum scrophoides Lam., Doronicum soulei Cavill., Doronicum thibetanum Cavill., and Doronicum turkestanicum Cavill. A new chromosome count is provided for D. carpetanum subsp. diazii.

Key words: Asia, Asteraceae, Doronicum, Europe, North Africa, Senecioneae.

The genus Doronicum L. (Asteraceae: Senecioneae) includes rhizomatous herbs with yellow or green-tinted radiate capitula. All phyllaries are similar, generally herbaceous and arranged in two or three rows. Cypselae are cylindric to obovate-cylindric with 10 longitudinal ribs and bear a pappus of white-tinted minutely scabrous capillary bristles. The pappus can be absent in ray flowers of some heterocarpic species.

This genus belongs in the Senecioneae, one of the largest and most complex tribes in the Asteraceae with 123 genera and around 3200 species (Cassini, 1819; Bentham & Hooker, 1873b; Hoffmann, 1892; Nordenstam, 1977; Bremer, 1994). Its 26 species constitute a presumably natural group (Bremer, 1994; involucre without shorter supplementary bracts, phyllaries herbaceous arranged in two or three rows, and cypselae cylindric to ob-

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ovate-cylindric with 10 longitudinal ribs). Its geographical area extends from Europe and North Africa to Asia, growing in mesic woods and open rocky places with moist soil, and near watercourses, from sea level to 5000 m of elevation.

Although there are several regional studies of the genus (Turkey, Edmondson, 1973, 1975, 1978; Armenia, Avetisyan, 1980; Iberian peninsula, Chacón, 1987; Belgium, Duvigneaud, 1992), there is only one previous worldwide revision of *Doronicum* (Cavillier, 1907, 1911). Fifteen new species (Diels, 1922; Widder, 1925; Sergievskaja, 1949; Widder & Rechinger, 1950; Edmondson, 1973, 1978; Chacón, 1987; Pérez & Penas, 1990; Pérez et al., 1994; Chen, 1998) and six hybrids (Bornmüller & Koch, 1930; Widder, 1934, 1948; Stace, 1991) were subsequently described. Two species included in Cavillier’s monograph have since been transferred to other genera (i.e., *D. hookeri* C. B. Clarke ex Hook. to *Nannoglottis* (Kitamura, 1980), and *D. thibetanum* Cavill. to *Aster* (Álvarez Fernández & Nieto Feliner, 2000)). Cavillier (1907, 1911) studied the morphology of the genus in great detail, especially the indumentum, but his proposed infrageneric classification is of rather limited value since these groups are obscurely defined based mainly on non-exclusive characters. As a result, classifying newly described taxa in any infrageneric framework is problematic.

The need to evaluate the newly described species and to assess the infrageneric taxonomy provides justification for this work. The objectives were to study as many morphological characters (qualitative and quantitative) as possible so that (1) only entities that could be consistently diagnosed were recognized in the taxonomic treatment, and (2) speculative and quantitative) as possible so that (1) only exclusive characters. As a result, classifying newly described taxa in any infrageneric framework is problematic.

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**Material and Methods**

More than 50 qualitative and quantitative morphological characters were studied in ca. 4300 dried specimens from the following herbaria: B, BC, BCF, BM, BR, BRNM, COI-WILLK, E, FI, G, GAZI, GH, GZU, HBR, IRAN, JACA, JE, K, LAU, LE, LINN, LY, MA, MACB, MAF, MO, NY, RO, S, SANT, UPS, W, WU, ZA, and the Sánchez-Pedraja personal herbarium. From other institutions, only photographs and photocopies of specimens, or additional information, were available: AV, B-W, BOLO, BP, C, CL, G-BOIS, G-DC, GE, GRM, LD, NAP, P-HA, P-LA, LEB, PAL, and SZB. A list of species and subspecies and an index to exsiccatae are presented in Appendices 1 and 2, respectively.

Observations were made directly or with the aid of binocular lenses. Microcharacters of indumentum and cypselae were studied by SEM. Quantitative characters were recorded using a Brown & Shape Plus digital caliper (model 599-571-3). Measurements were made on herbarium specimens, after flattening and drying.

Distribution maps for each taxon are based on the specimens studied. Note that geographical areas and countries follow Hollis and Brummitt (1992), and major political divisions for countries were included when that information was available.

**Taxonomic History**

The name *Doronicum* is apparently derived from the Arabic word “darawany,” used for at least two different plants (Dozy, 1877). The pre-Linnaean botanists (Dioscorides, 1554, 1557; Dodoens, 1574) and other Greek authors referred to species of *Doronicum* as *Aconitum paratardianches*, and the plant was probably introduced in Western culture by Avicenna (Dodoens, 1574; Dalenchamps, 1587).

The genus *Doronicum* was described by Linnaeus (1753) to include four species, only two of which are currently accepted in the genus: *D. paratardianches* and *D. plantagineum*. The remaining species correspond to *Senecio* and *Aster*, respectively. Further, one species of *Arnica* described by Linnaeus (1753), *A. scorpioides* L., also belongs in *Doronicum* as recognized by Lamarck (1786). Several pre-Linnaean authors also confused species of *Senecio*, *Aster*, and *Arnica* with *Doronicum* (Dalenchamps, 1587; Clusius, 1601; Bauhin, 1623; Tournefort, 1700). In particular, the overall morphological similarity between *Arnica* and *Doronicum* suggested their close affiliation until the 1970s. However, Nordenstam’s (1977) micromorphological study of style, anthers, and pollen definitively has excluded *Arnica* from the Senecioneae.

The cypselae dimorphism that occurs in some species has been a relevant feature in the taxonomic history of the genus. Lamarck (1786) referred to the heterocarpic and homocarpic species as “arénes” and “doronics,” respectively. Necker (1790) even proposed the different genus *Aronicum* for the homocarpic species, and his classification had wide acceptance in the 19th century (de Candolle, 1838; Koch, 1843; Hausmann, 1851; Reichenschach, 1854; Schur, 1866; Ardoiño, 1867; Simonkai, 1886), although some authors only recognized *Aronicum* as a section of *Doronicum*...
Cavillier (1817) established the genus Grammatheron with two species, G. biligulatum and G. scorpioides, now subsumed within Doronicum (Jacquin, 1773; Lamarck, 1786); de Candolle (1836) described the monotypic genus Fullartonia (F. kammenensis), now D. kammenense (DC.) Álv. Fern. (Álvarez Fernández, 2001). In 1838, de Candolle proposed two sections within Doronicum: section Eudoronicum, including some species of Senecio, and the monotypic section Chromochaeta, with Doronicum linifolium (Wall.) DC., now also in Senecio (Maguire, 1943).

Webb in Webb and Berthelot (1846) treated the genus Pericallis D. Don (in Sweet, 1833–1835: tab. 229) including five species as a section of Doronicum (D. cruentum, D. echinatum, D. papryraceum, D. tussilaginis, and D. webbi), but it is now treated at its original rank (Nordenstam, 1978).

Cavillier (1907, 1911) divided his study of the genus Doronicum, the first devoted to the study of the homocarpic species (1907), and the second to the heterocarpic ones (1911). However, he later concluded (1911) that this character was not useful to delimit natural groups. Cavillier proposed a new classification (1911) that included 3 sections, 7 subsections, and 34 species within Doronicum: section Doronicastrum (subsect. Corsica, subsect. Austriaca, subsect. Cardiophylla, subsect. Macrophylla, subsect. Pardalianchia, subsect. Plantaginea, and subsect. Grandiflora), section Soulleastrum (D. stenoglossum Maxim.), and section Hookerastrum (D. hookeri C. B. Clarke ex Hook.). However, this sectional treatment is not satisfactory, since section Hookerastrum was described on the basis of a species from another tribe (Nannaglotis hookeri, Asteraceae) and the phylogenetic position (Álvarez Fernández et al., 2001) of section Soulleastrum's only taxon precludes recognition at the sectional level without artificially splitting the bulk of the genus. The subsections in Doronicum were defined (Cavillier, 1911) mainly from the shape of basal leaves, the size of leaves, and the presence of cypsela dimorphism. Phylogenetic study of the genus (Álvarez Fernández et al., 2001) concluded that these are not synapomorphic characters, and therefore Cavillier's classification does not recognize natural groups.

Even after Cavillier's work the relevance of heterocarpy was claimed again (Gorschкова, 1961). In the Flora of the U.S.S.R., the classification proposed by Willkomm and Lange (1870) was merged with that of Cavillier (1911) to distinguish two sections in Doronicum (Gorschкова, 1961): section Aronicum (ser. Altaica, ser. Carpatica), and section Pardalianches (ser. Austriaca, ser. Cardiophylla, ser. Macrophylla, ser. Pardalianches, and ser. Plantaginea). More recently, Edmondson (1978) followed Cavillier's classification (1911) instead of Gorschкова's (1961), but described the monotypic subsection Isaurica (D. cacalifolium Boiss. & Heldr.) within section Doronicum, which corresponded to Cavillier's section Doronicastrum (1911).

The phylogenetic analysis herein confirms what a preliminary morphological study suggested: the morphological characters used are too labile to provide a sound classification at the infrageneric level (Álvarez Fernández et al., 2001). The molecular data from nuclear ribosomal and chloroplast DNA suggest some groups but without enough support to recommend formal taxonomic groupings. One exception is a Mediterranean group of species (D. plantagineum group), which receives good support from both molecular and morphological data. To avoid adding to the already complex taxonomic history of the genus, a formal infrageneric treatment is not proposed here, but is deferred against new evidence.

As already mentioned in the introduction, after Cavillier's revision and until the present work, a large number of taxonomic actions were taken within Doronicum. These include the description of new species (Sergievskaja, 1949; Edmondson, 1973, 1978; Chen, 1998, among others) and one subsection (Edmondson, 1973), and a few lectotypifications (Chacón, 1967; Pérez et al., 1997; Jarvis & Turland, 1996). Despite all of these actions the genus was still lacking nomenclatural stability. Thus, during this study and immediately preceding this work, several nomenclatural and taxonomic clarifications were done (Álvarez Fernández & Nieto Feliner, 1997, 1999, 2000; Álvarez Fernández, 2001). The lectotypification of 16 names of Doronicum in current use (Álvarez Fernández & Nieto Feliner, 1999) gave the genus nomenclatural stability leading up to this revision. In this work, additional lectotypification of seven names belonging in Doronicum, although not in current use, is also presented to consolidate and clarify as far as possible the nomenclature of the genus. Despite the efforts made to locate type material for all the names in current use, 4 out of 30 names (i.e., D. carpaticum, D. clusii, D. corsicum, and D. orientale)
still required further investigations for lectotype designation. Because at present these names clearly represent different recognized taxonomic entities, they are cited herein as names in current use, although their formal identity is not conclusive until lectotypes are designated.

**Geographical Distribution**

Half of the 26 recognized species of *Doronicum* are distributed in Europe and North Africa. Seven of the remainder are from southwestern Asia (Iran, Iraq, Caucasus, and Turkey), and 6 species are distributed in central Asia (Turkistan, Altay, Tibet, Yunnan, and the Himalayas).

With the exception of *Doronicum orientale*, each species is restricted to one of the three well-delimited areas: Europe, southwestern Asia, central Asia. *Doronicum orientale* is distributed in Europe and southwestern Asia, abundantly in the eastern Mediterranean (Greece, western Turkey, southern Italy, and Lebanon–Syria), and scattered in central Europe, where its proximity to inhabited places suggests possibly having escaped from gardens. Delimiting the natural areas of distribution is also difficult in the case of two other European species: *D. plantagineum* and *D. pardalianches*. Both were used as ornamental plants in previous centuries (Pena, 1571; Miller, 1787) and now are considered alien plants in the United Kingdom (Harron, 1986; Clement & Foster, 1994).

The species discussed above (*D. orientale*, *D. plantagineum*, and *D. pardalianches*) occur in similar mesic habitats from sea level up to subalpine regions, but not in high mountain habitats (the upper tree-line). *Doronicum hungaricum*, occupying similar habitats in Eastern Europe, can be considered vicariant with *D. plantagineum* in this region. *Doronicum austriacum* is widely distributed in Europe, most abundantly in the Austrian Alps, Macedon, and Ukraine, always in subalpine regions, and in the Iberian peninsula it occurs only in a few localities in the eastern Pyrenees.

The strictly alpine species of the genus in Europe are represented by *Doronicum grandiflorum*, *D. clusii*, and *D. glacieale*. The first of these species is the most widely distributed of them. It is abundant in the Alps, the Pyrenees, and in the Cantabrian range (northern Spain). In addition, there are two specimens from Corsica dated 1878 and 1917, suggesting its extinction on this Mediterranean island, which has well known floristic affinities with the Alps (Briquet, 1901). *Doronicum clusii* is present in the Alps and Carpathians, while *D. glacieale* is restricted to the Alps (mainly the Austrian Alps), where it can coexist with *D. clusii*. The alpine and subalpine habitats of the central and northern half of the Iberian peninsula (except the Pyrenees) are occupied by *D. carpaticum*, under which four subspecies are recognized.

Other alpine to subalpine species in central and eastern Europe are *Doronicum columnae* and *D. carpaticum*. The first is widely distributed from Italy to Romania, and *D. carpaticum* is restricted to the Carpathians.

The remaining two European species are endemics, *D. cataractarum* in the Austrian Alps and *D. corsicum* in Corsica, and both occur in subalpine habitats.

The genus *Doronicum* in southwestern Asia is represented by seven species. Only one, *D. oblonsatifolium* (from the Caucasus), is morphologically quite different from the others. Three of them are widely distributed: *D. macrophyllum* (Caucasus and northern Turkey), *D. dolichotrichum* (Caucasus and south of the Caspian Sea), and *D. maximum* (eastern Turkey, and south of the Caspian Sea). Of the three remaining species a limited number of specimens are known, and this results in a scattered distribution.

All of the central Asian species (*D. altaicum*, *D. briquetii*, *D. falconeri*, *D. gansuense*, *D. kamaonense*, *D. stenoglossum)* overlap at least in one point of their distributions.

**Morphology**

**Rhizomes**

All representatives of *Doronicum* are perennial rhizomatous herbs. The shape and structure of the rhizome are constant within each species, but are not exclusive to any one. These characters are useful, sometimes indispensable, to discriminate between species. There are fleshy or woody (or somewhat woody) rhizomes in *Doronicum*. This character was described by Cavillier (1911: 199), who provided histological diagrams, as “tubéreux” and “non tubéreux,” respectively. To distinguish between these, observations on fresh material are required, although when pressed, fleshy rhizomes flatten easily while the woody ones retain their original more or less terete shape. When fresh, fleshy rhizomes are succulent and brittle, while woody ones are fibrous and tough. Fleshy rhizomes are easily recognized in some European species (e.g., *D. plantagineum*, *D. pardalianches*, *D. hungaricum*), while woody rhizomes are well represented in Asian species (e.g., *D. macrophyllum*, *D. maximum*, *D. stenoglossum*). In a few cases, rhizomes are fleshy to somewhat woody and cannot be as-
signed to either type (e.g., D. grandiflorum, D. cataractarum).

Within a species, rhizome internodes may have roughly constant length and width (e.g., D. altaiicum, Fig. 1G), or may vary in length and width, resulting in stolon-like structures. Most species have the former condition, and only D. orientale (Fig. 1A), D. plantagineum, D. pardalianches, and sometimes D. hungaricum have clearly irregular internodes.

Sometimes rhizome nodes have brown-tinted scales remaining from the sheath of basal leaves from previous years (e.g., D. carpetanum, Fig. 1F).

The persistent remains of basal fibers from old petioles occur, for example, in Doronicum oblongifolium, but they are frequently absent (e.g., D. austriacum, Fig. 1C).

Hyaline, shiny, and smooth trichomes are sometimes present on the younger nodes of rhizomes and also in the axils of basal leaves. Sometimes these trichomes are long, abundant, entangled, and white to yellow, and they can cover a large part of the rhizome (e.g., D. orientale). Such rhizomes were referred to as “ériopode” by Cavillier (1911: 199) in contrast to “gymnopode” rhizomes, which lack this indumentum (e.g., D. columnae). In many cases it is difficult to see trichomes on rhizomes, because they are short and scarce and can be covered with leaf remains (e.g., D. carpetanum, D. clusii, D. glaciale, and D. grandiflorum).

Buds are evident on some fleshy rhizomes (e.g., D. hungaricum, Fig. 1B). These stem buds can be seen in plants two years or older, but these must be collected carefully. Sometimes the scales that cover young buds can also be observed.

Two species each have unique rhizomes. Doronicum cacalifolium has moniliform rhizomes with uniform, spherical, swollen internodes, alternating with nodal constrictions, sometimes covered by a fibrous net. In the second type, seen in most D. stenoglossum, the main stem is inserted on a convex swollen woody surface. Sometimes, pieces of a woody organ perpendicular to the stem were also collected. Although the whole structure has not been seen, it is presumed to be a kind of distinct woody rhizome, but further study of the subterranean organ is needed.

Adventitious roots are present in Doronicum stenoglossum and sometimes in D. kamaonense a few centimeters above the subterranean woody organ, suggesting that the lowest vertical part of the stem was buried.

**STEMS**

The stems in Doronicum are always erect, fistulose, cylindric, and slightly ribbed, green when fresh, and pale yellow to brown when dry. Generally stems are straight, but zigzag stems occur in some species (e.g., D. austriacum). The stems are often simple and end in a single capitulum. When bearing several capitula, the stem is branched only in the upper part. Exceptions are seen in D. stenoglossum and D. kamaonense, which sometimes have branches on the lower part of the stem.

The main stem terminates in a capitulum, which matures first. Further capitula, if any, are on terminal lateral branches, which for the most part overtop the main head. Each species generally has a characteristic number of capitula, e.g., one in D. falconeri, up to 5 in D. pardalianches, and more than 5 (up to 20) in D. corsicum.

**LEAVES**

Leaves are simple and alternate. Leaf characters have been traditionally used in the taxonomy of the genus (Cavillier, 1911), but their usefulness is limited to the specific level. The shape and size of leaves are variable even within a single specimen for some species. For this reason, basal leaves (those inserted on the rhizome nodes) and cauline leaves are necessary for descriptive purposes. Similarly, cauline leaves are distinguished by position as lower, middle, and upper, i.e., inserted in the basal, middle, and upper third of the stem, respectively. In some species, basal and lower cauline leaves are usually absent at flowering time.

Basal leaves are petiolate, the petiole being short and wide (e.g., D. briquetii), or much longer than the leaf blade (e.g., D. columnae). In species with large basal leaves, sheaths are conspicuous (e.g., D. macrophyllum, D. maximum, and D. dolichotrichum). Acropetally, along the stem, the petiole gradually shortens, often leading to fiddle-shaped leaves. The upper cauline leaves are reduced, sessile, and ovate to bract-like. This leaf transition is marked in D. austriacum, D. carpetanum, D. macrophyllum, and D. pardalianches.

Leaves may be orbicular, ovate, elliptic, and obovate, as well as fiddle-shaped or bract-like. The base of leaves can be cordate (Fig. 2A), subcordate, truncate, or attenuate (Fig. 3A, C, F, I). Leaf margins are generally entire to subentire, sometimes markedly dentate (e.g., D. cacalifolium, D. columnae, D. corsicum, and D. grandiflorum).

Number and arrangement of cauline leaves determine to a large extent the architecture of the plant. In some species the number of cauline leaves is low (2 to 4, e.g., D. orientale) and they are confined to the basal third of the stem. In other leafy species (D. austriacum, D. corsicum, or D. altai-
cum) leaves are arranged along the stem. The largest leaves are usually seen at the middle or basal parts of stems.

Leaf venation is a good taxonomic character, easily observed in dry specimens and preferably from basal leaves. For its description and categorization the terms proposed by the Leaf Architecture Working Group (1999) are used. Most species have an actinodromous venation for first vein category (e.g., D. grandiflorum, D. carpetanum, D. reticulatum) in which all secondary and tertiary veins are more or less equally evident. Pinnate venation for the first vein category occurs in central Asian species. In this type, the tertiary veins are not well marked, and both the secondary veins and the main vein are equally prominent and thick (e.g., D. altaicum, D. gansuense, D. kamaonense, D. stenoglossum). The acrodromous type of venation for the first vein category is restricted to a European group of species (D. columnae, D. orientale, D. plantagineum, and D. columnae). Intermediate cases between the latter and the actinodromous type occur in D. columnae, D. carpaticum, and D. pardalianchies, and between pinnate and actinodromous venation in D. clusii and D. glacieale.

HABIT

Four main habit classes can be distinguished:

(1) An “orientale” type: solitary capitulum with a scapose stem, sometimes bearing bract-like leaves; a few cauline leaves (2 to 4) inserted in the basal third of the stem. It is displayed by some European species (e.g., D. orientale, D. columnae, D. plantagineum).

(2) An “altaicum” type: generally a single capitulum; a mostly leafy stem and a variable number of leafy leaves (4+) along the stem length, or at least in its lower half. This is present in some central Asian as well as European species (e.g., D. altaicum, D. falconeri, D. grandiflorum).

(3) A “macrophyllum” type: several capitula; stem branched in the upper third; large cauline leaves (3 to 5) mainly in the lower half of the stem, and bract-like leaves on the upper stem. This is restricted to the southwestern Asian species.

(4) A “corsicum” type: several capitula; a variable number of ≤ uniform leaves (5+) ≤ evenly inserted along the stem. This is characteristic of D. corsicum and D. austriacum.

In some species the habit does not correspond to these patterns (e.g., D. kamaonense and D. stenoglossum, which are sometimes branched from the base), and sometimes intermediate patterns occur (e.g., D. pardalianchies, D. cacaliifolium).

CAPITULA

All Doronicum species have radiate, hemispheric to widely campanulate, homochromous capitula (Fig. 5A, E) with yellow or green-yellow corollas. Capitulum diameter ranges from 8 to 15 mm (e.g., D. cacaliifolium and D. kamaonense) and 7 to 8 cm (e.g., D. falconeri and D. cataractarum). The receptacle is convex to hemispheric, glabrous or pubescent. In fruit, the base of the capitulum is sometimes widely turbinate.

Ray flowers are female with strap-like or narrowly elliptic to slightly obovate rays, generally ending in three or two teeth, sometimes entire (e.g., D. altaicum). Disk flowers are hermaphrodite, actinomorphic, and narrowly funnel-shaped.

Phyllaries are herbaceous to slightly papery at the base in some species (e.g., D. austriacum) and arranged in 2 or 3 rows, the outer being wider than the inner. In most species the phyllaries are clearly shorter than the ray flowers, but they can be almost equal or even longer than them (e.g., D. stenoglossum, D. pardalianchies). Phyllaries are ovate-triangular, ovate-elliptic, or ovate-lanceolate to linear. The phylary apex is usually acute, except in D. gansuense where it bears a sessile gland (Fig. 4A–C). Phylary margins are entire, except in D. hausshnechtii where they are slightly fimbriate. A group of species (D. orientale, D. plantagineum, D. hungaricum, D. carpaticum, and D. columnae) have phyllaries with ciliate margins, bearing thin, stiff, acute, and equidistant trichomes (0.2–1.5 mm) (Fig. 5E–G).

FRUITS

Some species of the genus have dimorphic cypsela (heterocarpy), evident primarily by the absence of a pappus in ray flowers. Cypsela without pappuses are also generally larger than those with a pappus in the same specimen (Fig. 6A, B). Heterocarpy occurs in other genera of Asteraceae such as Senecio, Crepis, Erigeron, Leontodon, and Heterotheca, as well as in other families, Caryophyllaceae, Apiaceae, Poaceae (Zohary, 1950). These morphologic differences serve different functions. In Heterotheca latifolia, in which the type of dimorphism is similar to Doronicum. Venable and Levin (1985) suggested that the pappose cypsela are dispersed away by wind, while epappose cypsela fall near the mother plant. This double dispersal strategy implies the potential to colonize different habitats (Venable & Levin, 1985; Tanowitz et al., 1987; Imbert et al., 1996). Although plants with incompletely developed pappuses on ray florets are found in some species (e.g., D. carpaticum,
Figure 6.  A, B. *Doronicum plantagineum* (from Álvarez et al. 954, MA). —A. Cypsela from a ray flower. —B. Cypsela from a disk flower. —C. Cypsela of *Doronicum carpetanum* subsp. diazii (from Álvarez et al. 924, MA). —D. Base of caducous pappus in *Doronicum stenoglossum* (from Bartholomew & Gilbert 1205, E).
D. carpetanum), dimorphism is generally either present or not in Doronicum. Such intermediate situations were considered hybrids by Cavillier (1911). In the present taxonomic treatment, since hybrids were not confirmed, intermediates are included with the closest species.

Cypselae are cylindric to obovate, have 10 longitudinal ribs, and are black, brown, brown-red, or olive-green. When an indumentum is present, this occurs mainly on the ribs, except for D. stenoglossum, where trichomes are spread across the cypsela surface. In most species, the pappus consists of 2 or 3 rows of minutely scabrous, white or yellow-tinted capillary bristles. A single row of bristles is present in some southwestern Asian species (e.g., D. macrophyllum, D. maximum) as well as in D. stenoglossum. This latter species is functionally heterocarpic since the pappus in ray flowers is caducous. A thick base, or “crown,” remains when the pappus falls (Fig. 6D).

Surfaces of cypselae are warty to slightly warty (Fig. 7A), reticulate-grooved (Fig. 7B), grooved to longitudinal ribs, and wider than the stalk. This latter type is characteristic of leaves and phyllaries in D. glacie and D. clusii (Fig. 3C–H).

(2) Uniseriate trichomes with blunt apices that are formed by a single row of rectangular or square cells, these trichomes are 0.1–0.4 mm long. This is the most common pubescence, occurring on stems, leaves, and phyllaries in almost all species. In D. cacalifolium (Fig. 5A–C) they cover the abaxial phyllary surface and differ from others by their enlarged basal part and curved apex (Fig. 3B). This type of trichome also occurs in D. clusii, in which the cells are clearly rectangular, but the trichome length is up to 5 mm, and they may form an entangled covering on the leaf margins.

(3) Multiseriate trichomes with acute apices. These consist of at least two rows of fusiform cells ending in one or two cells with an acute apex. Four subtypes occur:

(3a) Stiff trichomes (0.5–2.5 mm long), consisting generally of more than two rows of cells, characteristic of leaves and phyllaries in D. glacie and D. clusii (Fig. 3C–H).

(3b) Somewhat stiff trichomes (0.2–1.5 mm long), sometimes crooked (cilia). They are only present on the margins of phyllaries of D. orientale (Fig. 5E–G), D. plantagineum, D. hungaricum, D. carpaticum, and D. columnae.

(3c) Trichomes (ca. 0.3 mm long), formed by two or three cells. They occur on the cypselae of almost all Doronicum species (Fig. 8A).

(3d) Trichomes (0.5–5 mm long) that end in two acute cells, and are present only on leaves and petioles of D. pardalianches.

**Glandular trichomes**

The following types of glandular trichomes are recognized in this work:

(1) Short-stalked glandular trichomes. These consist of 4 to 8 cells, 0.05–0.3 mm long, and are present on the stems, leaves, phyllaries, cypselae, and flowers of all the species. Two subtypes are distinguished:

(1a) Trichomes with acies (of 2 cells) of the same diameter as the cells of the trichome stalk (Fig. 8C).

(1b) Trichomes with capitate acies (of 3 or 4 cells) and wider than the stalk.

(2) Long-stalked glandular trichomes. These consist of more than 6 cells, 0.3–5 mm long, and are present on the stems, leaves, and phyllaries in many Doronicum species. Two subtypes are distinguished:

(2a) Trichomes with acies of 3 or 4 cells of the same diameter as stalk cells.

(2b) Trichomes with acies (of more than 4 cells) exceeding stalk cells (Fig. 3D). This latter type is present in a few species (D. macrophyllum, D. hun-
Figure 7. Cypselae surfaces in *Doronicum*. —A. *Doronicum pardalianches* (from Almaraz et al. 1015, MA). —B. *Doronicum reticulatum* (from Baytop & Baytop 20972, E, as *D. bithynicum*). —C. *Doronicum cacaliifolium* (from Davis 14551, K). —D. *Doronicum dolichotrichum* (from Davis & Polunin 24383, E).
Figure 8. —A. Uniseriate eglandular trichomes with acute apices on a cypsela of *Doronicum maximum* (from Davis & Polunin 24113, E). —B. Uniseriate eglandular trichomes with blunt apices on a phyllary of *Doronicum cacaliifolium* (from Davis 14551, K). —C. Uniseriate glandular trichomes on the margins of a phyllary of *Doronicum cataractarum* (from Fest 571, B). —D. Apex of a multiseriate glandular trichome from the base of the capitulum in *Doronicum kamaonense* (from Polunin et al. 401, G, as *D. roylei*).
Several chemical analyses on *Doronicum macrophyllum* (Bohlmann & Grenz, 1979), *D. pardalianches* (Bohlmann & Abraham, 1979), *D. hungaricum* (Bohlmann et al., 1980), and *D. grandiflorum* (Reynaud & Raynaud, 1984, 1986; Reynaud et al., 1985) have resulted in the isolation of 52 different compounds. Two of them are pyrrolizidine alkaloids, a few are aromatic compounds: 10 benzofurane-derivatives, 4 phenols, and 2 flavonoids. Twenty-one monoterpenes, mainly thymol-deriva-tives, were also isolated. The remaining compounds are 5 diterpenes with kaurane structure, 2 triterpenes (one of them a lupane-derivative and other oleane-derivative), and 6 sesquiterpenes, most of these germacradiene-derivative.

Since only four species were analyzed, the taxonomic usefulness of these chemical characters at the specific level cannot be assessed. However, the presence of alkaloids of the pyrrolizidine group (Bohlmann & Grenz, 1979) is consistent with the inclusion of the genus within the tribe Senecioneae, which is characterized by these alkaloids (Robins, 1977).

**Chemistry**

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**Chromosome Numbers**

Chromosome numbers in *Doronicum* are rather constant. Most reports included herein were obtained from the literature (Lindeqvist, 1950; Skalinska, 1950; Baksay, 1956; Contandriopoulos, 1957; Favarger & Huynh, 1964; Polatschek, 1966; Favarger & Kupfer, 1966; Lovka et al., 1972; Kuzmanov & Ancev, 1973; Lose & Kjellqvist, 1974; Garbari et al., 1980; Van Loom, 1980; Belaeva & Sipilivinsky, 1981; Van Loom & Oudemans, 1982; Kuzmanov & Georgieva, 1983; Strid & Frantzen, 1983; Davladianidze, 1985; Strid & Anderson, 1985; Chacon, 1987; Lippert & Heubl, 1988; Tasnekevitch et al., 1989; Vir Jee & Kachroo, 1989; Baltisberger, 1991; Ruiz de Clavijo, 1993). Only when no original sources were available (i.e., *D. cataractarum*, *D. macrophyllum*, among other counts), data from indexes of plant chromosome numbers (Fedorov, 1969; Moore, 1982; Goldblatt, 1985, 1988; Goldblatt & Johnson, 1994, 1996, 1998) were cited, and they are indicated by an asterisk after the number. However, chromosome counts were made here for *D. carptanum* subsp. diazii (2n = 60) and *D. carptanum* subsp. kuepferi (2n = 60). Material was cultivated from fresh rhizomes or seeds. Aripes of secondary roots as well as immature disk flowers were used for counting. Both were fixed in 3:1 ethanol: acetic acid for 48 hours and then kept in 70% ethanol at −20°C. Chromosomes were stained with acetic orcein.

The basic chromosome number x = 30, characteristic of the “cacalioid” group in Senecioneae, is also considered to be the basic number in *Doronicum* (Bremer, 1994), although previous authors suggested x = 10 (Fernandes & Queiros, 1971; Majovsky & Murin, 1987). Chromosome numbers, known for 19 taxa, are consistent with both hypotheses, although the fact that most of them are multiples of 30 (2n = 60) may support the basic number x = 30. Only *D. carptanum* subsp. carptanum, *D. carptanum* subsp. pubescens, *D. plantagineum*, and several populations of *D. clusii* and *D. pardalianches* had higher counts, at 2n = 120. Other species show both ploidy levels (e.g., *D. altaicum* 2n = 30*, 60; *D. macrophyllum*, n = 30*, 60; and *D. oblongifolium*, 2n = 60, 40), suggesting that polyploidy is common in the genus. *Doronicum oblongifolium* (2n = 40) is the only count that is inconsistent with x = 30, and it should be recounted.

**Phylogeny**


Cavillier (1911) mentioned that his three sections (sect. *Doronicastrum*, sect. *Soulieastrum*, and sect. *Hookerastrum*) were not closely related, and thus the genus so circumscribed is polyphyletic.

Cavillier considered the *Doronicum* subsections included in section *Doronicastrum* to be natural groups, and his classification was developed accordingly. He thought that subsection *Plantaginea* (*D. plantagineum*, *D. longifolium* (= *D. hungaricum* herein), *D. oblongifolium*, and *D. falconeri*) was monophyletic and the most ancient group in the genus. *Doronicum* subsect. *Pardalianchia* (*D. pardalianches*, *D. roylei* (= *D. kamaonense* herein), *D. reticulatum*, and *D. atlanticum* (= *D. plantagineum* herein)) was a grouping derived from subsec-
tion Plantaginea. Doronicum subsects. Cardiophylla (D. carpetanum, B. orientale, D. carpathicum, and D. cordatum (= D. columnae herein)) and Macrophylla (D. macrophyllum, D. dolichotrichum, D. haussknechtii, D. maximum, and D. cacalifolium) were derived from subsection Pardalianchia and were also natural groups. In contrast, Cavillier placed the probable origin of subsection Grandiflora (D. altaicum, D. briquetii, D. grandiflorum, D. glaciale, and D. clusii) among several members of subsection Plantaginea. The monotypic subsections Corsica and Austriaca would be derived from different members of subsection Pardalianchia. Morphologically, Cavillier (1911) noted a trend from ancient plants bearing one capitulum and basal leaves with a truncate or attenuate base to evolved plants with several capitula and basal leaves with cordate bases. Biogeographically this is not easy to reconcile since these groups include members from different continents.

The phylogenetic analysis of Álvarez Fernández et al. (2001) was based on morphological evidence as well as molecular data (nuclear ribosomal ITS and chloroplast trnL-F sequences).

When morphological characters were mapped onto the most parsimonious topologies, only three were free from homoplasy (scapiform habit, acrodromous basal leaf venation, and ciliate involucral bracts). All of these characters are synapomorphic for the D. plantagineum clade, and the strict consensus can be seen in Figure 9.

There are only two clades with bootstrap support above 90%, both basal. The Doronicum clade had 100% bootstrap support in all analyses, using Ligularia and Tussilago as outgroups. Although the use of only two outgroups does not provide stringent conditions for testing the monophyly of the ingroup, other evidence also indicates the monophyly of Doronicum. In particular, sequences aligned well onto the most parsimonious topologies, only three outgroups does not provide stringent conditions for testing the monophyly of the ingroup, other evidence also indicates the monophyly of Doronicum. In particular, sequences aligned well onto the most parsimonious topologies, only three outgroups does not provide stringent conditions for testing the monophyly of the ingroup, other evidence also indicates the monophyly of Doronicum. In particular, sequences aligned well onto the most parsimonious topologies, only three outgroups does not provide stringent conditions for testing the monophyly of the ingroup, other evidence also indicates the monophyly of Doronicum. In particular, sequences aligned well onto the most parsimonious topologies, only three outgroups does not provide stringent conditions for testing the monophyly of the ingroup, other evidence also indicates the monophyly of Doronicum. In particular, sequences aligned well onto the most parsimonious topologies, only three outgroups does not provide stringent conditions for testing the monophyly of the ingroup, other evidence also indicates the monophyly of Doronicum. In particular, sequences aligned well onto the most parsimonious topologies, only three outgroups does not provide stringent conditions for testing the monophyly of the ingroup, other evidence also indicates the monophyly of Doronicum. In particular, sequences aligned well onto the most parsimonious topologies, only three outgroups does not provide stringent conditions for testing the monophyly of the ingroup, other evidence also indicates the monophyly of Doronicum. In particular, sequences aligned well onto the most parsimonious topologies, only three outgroups does not provide stringent conditions for testing the monophyly of the ingroup, other evidence also indicates the monophyly of Doronicum. In particular, sequences aligned well onto the most parsimonious topologies, only three outgroups does not provide stringent conditions for testing the monophyly of the ingroup, other evidence also indicates the monophyly of Doronicum. In particular, sequences aligned well onto the most parsimonious topologies, only three outgroups does not provide stringent conditions for testing the monophyly of the ingroup, other evidence also indicates the monophyly of Doronicum. In particular, sequences aligned well onto the most parsimonious topologies, only three outgroups does not provide stringent conditions for testing the monophyly of the ingroup, other evidence also indicates the monophyly of D. plantagineum, a member from different continents.

Towards the species data, the 20 species were free from homoplasy (scapiform habit, acrodromous basal leaf venation, and ciliate involucral bracts). All of these characters are synapomorphic for the D. plantagineum clade, and the strict consensus can be seen in Figure 9.

The next taxon that is a derivative of this Corsican endemic is D. pardalianches, followed by the D. plantagineum group, which has 85% of bootstrap support. All these species are European, mostly Mediterranean, suggesting that early diversification took place on the European continent, specifically within the Mediterranean Basin.

**Taxonomy**


Figure 9. Strict consensus from 228 most parsimonious trees resulting from the combined analysis of three data sets in *Doronicum* (morphology, nrITS, cpDNA *trn*L-F sequence data, see Álvarez Fernández et al., 2001). Bootstrap values above 50% are shown above the branches. Outgroups: *Tussilago farfara* L. and *Ligularia sibirica* (L.) Cass. Geographical distribution of taxa: central and central-eastern Asia (crosses), southwestern Asia (circles), and Europe and northern Africa (squares).
Perennial herbs, 10–150(+v) cm tall. Rhizomes fleshy or woody, glabrous to pubescent, sometimes with buds. Stems terete, fistulose, slightly ribbed, erect, branched or not, scape-like to leafy, sometimes with persistent leaf remains forming dark scales or fibers at the base, yellow to brown-tinted when dry. Indumentum variable, eglandular or glandular, abundant near the capitulum to very scarce at the base of the plant, sometimes absent.

Leaves alternate, simple, entire to dentate, pubescent or glabrous, with actinodromous or pinnate-actinodromous venation, sometimes somewhat acrodromous. Basal leaves sometimes reduced to cataphylls or absent at flowering time, petiolate, with orbicular, ovate, elliptic or obovate blades, generally with a blunt apex; base of blade truncate, attenuate or cordate; petiole generally as long as the blade or longer, sometimes shorter. Lower cauline leaves similar to basal leaves, sometimes sessile. Middle cauline leaves sessile, ovate, elliptic, obovate, or fiddle-shaped, semi-amplexicaul, with blunt or acute apex. Upper cauline leaves similar, sometimes bract-like. Capitula 1 to 20(+v), heterogamous, arranged in cymose synflorescences, terminal when solitary, radiate, 0.0–3 cm diam. including rays. Involucre much shorter than rays or sometimes with white-tinted eglandular trichomes (up to 2 mm long), sometimes sparse. 

KEY TO SPECIES OF DORONICUM

1. Ray flowers without pappus (heterocarpic plant) .......................................................... 2

1'. Ray flowers with pappus, although sometimes poorly developed (homocarpic plant) .......... 20

2(1). Base of blade of basal leaves truncate or attenuate; plants usually bearing a single capitulum ................................................................. 3

2'. Base of blade of basal leaves cordate or subcordate; plants bearing one to several capitula .................................................................................. 6

3(2). Basal leaves with acrodromous venation ................................................................. 4

3'. Basal leaves with pinnate-actinodromous, or actinodromous venation .............................. 5

4(3). Basal leaves oblong-elliptic; indumentum of the adaxial surface of basal leaves generally consisting of eglandular trichomes (2–3 mm long), sometimes sparse. 

4'. Basal leaves ovate to ovate-elliptic; indumentum of the adaxial surface of basal leaves mainly glandular, sometimes with eglandular trichomes (up to 2 mm) .

5(3). Outer phyllaries 2.5–3.5 mm wide; petiole of basal leaves with well-marked veins, and sometimes persisting fibers at the base of the stem; margins of leaf blades slightly swollen, sometimes with white-tinted eglandular trichomes (up to 1 mm) .... 21. D. oblongifolium

5'. Outer phyllaries 1–3.5 mm wide; petiole of basal leaves without well-marked veins; margins of leaf blades flat, glabrous, glabrate or glandular ........................................................................ 12. D. falconeri

6(2). At least ray cypselae black, with warty surface; plant branched in the upper part, usually with more than 2 capitula; basal leaves eglandular pubescent, with base of blade clearly cordate and margins entire to subentire .... 23. D. pardalianches

Doronicum (Asteraceae)
6'. All cypsela brown, red-brown, or olive-green; plants branched or not; basal leaves eglandular or glandular pubescent or glabrous, with base of blade cordate, subcordate, or truncate and margins entire or dentate

7(6). Outer phyllaries ciliate (cilia not glandular) ................................................. 7
8(7). Rhizome woody to somewhat woody, glabrous ................................. 9, D. columnae
9'. Rhizome fleshy, with pubescent nodes ...................................................... 9
9(8). Basal leaves with ovate blades, subcordate to truncate at base .................. 24, D. plantagineum
10(7). Rhizome fleshy with short trichomes on nodes, sometimes scarce and absent on the oldest nodes ................................................................. 11
10'. Rhizome woody to somewhat woody, glabrous ........................................... 12
11(10). Upper part of stem and phyllaries glabrous or with short-stalked glandular trichomes (up to 0.3 mm), sometimes also with scattered eglandular trichomes (up to 0.4 mm); plants bearing more than 2 capitula; receptacle glabrous ........................................ 7, D. cataractarum
11'. Upper part of stem with long-stalked glandular trichomes (up to 5 mm), sometimes also with eglandular trichomes and short-stalked glandular trichomes; plants bearing 1 to 6 capitula; receptacle glabrous or pubescent ........................................ 6, D. carpetanum
12(10). Leaves with pinnate-actinodromous venation; upper part of stem and base of phyllaries generally with long-stalked glandular trichomes, the gland markedly obconical; sometimes with adventitious roots and sometimes branched near the base ........................................ 18, D. kamaonense
12'. Leaves with actinodromous venation; upper part of stem and phyllaries glabrous, with eglandular or glandular trichomes, but if glandular, the gland not obconical; plants without adventitious roots and branched in the upper part of stem ........................................ 13
13(12). Stem leafy (more than 6 cauline leaves); middle and upper cauline leaves generally longer than the adjacent internodes; basal leaves and lower cauline leaves generally absent at flowering time; receptacle generally pubescent ........................................ 2, D. austriacum
13'. Stem not leafy (less than 6 cauline leaves); middle and upper cauline leaves generally shorter than the adjacent internodes; basal leaves and lower cauline leaves sometimes present at flowering time; receptacle glabrous to glabrate ........................................ 14
14(13). Plants with a single capitulum (exceptionally 2 to 3); basal leaves dentate; petiole of basal leaves 0.5–2 mm wide ........................................ 9, D. columnae
14'. Plants with two to several capitula; basal leaves dentate to entire; petiole of basal leaves more than 2 mm wide, sometimes with a sheath more than 3 cm long ........................................ 15
15(14). Basal leaves with a reniform base and dentate margins; phyllaries covered with sericeous uniseriate eglandular trichomes (0.2–0.4 mm); rhizome moniliform, covered with scarious remains or fibers ........................................ 4, D. cacaliifolium
15'. Basal leaves ovate to widely ovate with cordate to subcordate base or reniform, margins dentate to entire; phyllaries glabrous, pubescent (eglandular or glandular), but not sericeous; rhizome not moniliform ________________________________ 16
16(15). Upper part of stem with long-stalked glandular trichomes or pubescent ________________________________ 17
16'. Upper part of stem glabrous to glabrate or with very short white eglandular trichomes restricted to the base of capitula ........................................ 19
17(16). Phyllaries with subulate apex and dark-colored longitudinal veins ........... 25, D. reticulatum
17'. Phyllaries with acute but not subulate apex, veins not dark-colored ............. 18
18(17). Upper part of stem and upper cauline leaves with white multisierate glabrous and/or eglandular trichomes (0.5–3 mm), sometimes scattered, sometimes also glandular ________________________________ 11, D. dolichotrichum
18'. Upper part of stem generally glabrous and without white multisierate eglandular trichomes ____________________________ 19, D. macrophyllum
19(16). Base of capitula with short white eglandular trichomes (ca. 0.2 mm); margins of phyllaries sometimes slightly finobrate or glandular ........................................ 16, D. hausknechtii
19'. Base of capitula glabrous; margins of phyllaries entire ____________________________ 20, D. maximum
20(1). Corollas with pale yellow to green tints; rays linear (0.5–1.5 mm wide); phyllaries erect, triangular-subulate, generally longer than rays; pappus consisting of one row of thin capillary bristles, caducous (at least in ray flowers); lower stems sometimes with adventitious roots ........................................ 26, D. stenoglossum
20'. Corollas yellow; rays elliptic to obovate-elliptic (1.2–4.5 mm wide); phyllaries erect to patent or patent, generally shorter than rays; pappus with more than one row of trichomes, not caducous (sometimes poorly developed in ray flowers); lower stems without adventitious roots ........................................ 21
21(20). All cauline leaves sessile; plants bearing several capitula ......................... 10, D. corsicum
21'. At least lower cauline leaves petiolate; plants bearing one to several capitula .......... 22
22(21). Rhizomes with very short trichomes on nodes, generally covered by scarious remains of basal leaves, these sometimes scarce ........................................ 23
22'. Rhizomes glabrous ........................................ 27
23(22). Stems generally more than 50 cm; basal leaves with cordate to subcordate base; plants bearing several capitula; base of capitula glabrous or with short-stalked glands, generally scattered .......... 7, D. cataractarum
23'. Stems generally less than 50 cm; basal leaves with subcordate, truncate or attenuate base; plants bearing one to several capitula; base of capitula with eglandular or long-stalked glandular trichomes ........................................ 24
24(23). Leaf margins mainly glabrous, sometimes also with scattered eglandular trichomes .......... 25
24'. Leaf margins with eglandular trichomes, these sometimes scarce ........................................... 26

25(24). Pappus of ray flowers well developed, similar to pappus of disk flowers; cypselae of disk flowers pubescent, sometimes with glands .......................... 25

26'. Pappus of ray flowers poorly developed; cypselae of disk flowers mainly glandular .................................................. 6. D. carpitanum

27(26). Leaf margins scarcely hirsute (acute, stiff, multiseriate eglandular trichomes 0.5–2.5 mm), sometimes also with short-stalked glands, scattered (Fig. 3B–E) .... 14. D. glaciale

28(27). Phyllaries with acute apex, without a sessile gland ................................................................................. 27

29(27). Phyllaries with blunt apex that bears a sessile gland ................................................................................. 28

29(28). Base of capitula with long-stalked glandular trichomes (1–5 mm); plants bearing one capitulum ................................................................. 3. D. briquetii

29'. Base of capitula glabrous or with short-stalked glandular trichomes (up to 1.5 mm), scattered; plants bearing 1 to 4 capitula ..................................................................... 1. D. altaicum


Plant up to 80 cm tall. Rhizomes somewhat woody, glabrous, generally with scaly leaf remains. Stems simple, sometimes branched at the upper part, leafy, with leaves all along the stem, internodes generally shorter than adjacent leaves. Indumentum of short-stalked glandular trichomes and eglandular trichomes (up to 1 mm), more abundant near the capitula, sometimes glabrate to glabrous. Leaves entire to slightly dentate. Basal leaves generally absent at flowering time; blade 5–6(10) × 2.5–3 cm, ovate, elliptic or obovate, with attenuate base, and blunt or subacute apex, with actinodromous to pinnate-actinodromous venation; petiole (2.7)–10(27) cm long, 3–(4) cm wide. Lower and middle cauline leaves (2.5)3–8(11.2) × (1)3–5(6) cm, similar to basal leaves or sessile, elliptic to obovate, sometimes widely ovate to suborbiculate, semi-amplexicaul, with blunt apex. Upper cauline leaves 2.5–7(8.5) × (0.5)2–4(3.5) cm, similar to middle cauline leaves or ovate-lanceolate and with subacute apex. Indumentum similar to the adjacent part of stem, sometimes glabrous. Capitula 1 to 4; (2.5)4–5 cm diam. including rays; involucre shorter than rays, (3)3.5–4.5 cm diam. Phyllaries herbaceous, (0.7)1–1.2(1.7) cm long, 1.2–2 mm wide, ovate-lanceolate to subulate. Indumentum similar to the upper part of stem, sometimes glabrate. Receptacles glabrous. Flowers with yellow corollas. Ray flower corollas 1.2–2.1 cm long, (1.5)2–3.5 mm wide, obovate-elliptic, apex with 2 or 3 teeth, sometimes toothless, acute or blunt. Disk flower corollas 4–5.5 × 2–2.5 mm. Cypselae dark brown, with smooth or slightly grooved surface, homomorphic, ca. 2.8 × 1 mm, generally glabrous, sometimes with scattered eglandular trichomes or glands. Pappus up to 5 mm, white to brown yellow-tinted. Chromosome number, 2n = 30*, 60 (Belaeva & Splivinsky, 1981, as D. bargusense Serg.; *Goldblatt & Johnson, 1998, see comments below).

Illustrations. Pallas (1779: tab. 16); Figures 1G, 2G, H, 10A, B.

Distribution. Central Asia (Turkistan and Altai region to lake Baikal), Woods, meadows, and near watercourses, altitude 1300–3400 m (Fig. 11).

In central Asia there are some species morphologically similar to Doronicum altaicum (i.e., D. briquetii, D. falconeri, and D. gansuense). All of them have the same habit (solitary capitulum and mostly leafy stems with uniform leaves), but only one of these, D. falconeri, overlaps its area of distribution with D. altaicum. The character used to distinguish between these two species is the presence of a pappus in the ray flowers of D. altaicum versus its absence in D. falconeri. The remaining similar species are differentiated based on the indumentum (long trichomes on the base of capitulum in D. briquetii vs. short trichomes in D. altaicum (Fig. 10)), and on the apex shape of phyllaries, which is blunt (due to a sessile gland) in D. gansuense (Fig. 4B, C) and acute (lacking the sessile gland) in D. altaicum.

The citation of the chromosome number 2n = 30 for Doronicum altaicum was found in Goldblatt and Johnson’s (1998) index, but the original source for this data was not seen.


Plant up to 150(+) cm tall. Rhizomes woody to somewhat woody, glabrous, and generally without scaly or fibrous leaf remains. Stems generally branched in the upper part, leafy, internodes generally shorter than the adjacent leaves. Indumentum of glandular trichomes, uniseriate and multisieriate eglandular trichomes (up to 2 mm), sometimes only eglandular trichomes, sometimes glabrate, more abundant near the capitula. Leaves entire to slightly dentate. Basal leaves absent at flowering time, petiolate, ovate to orbicular, with cordate to subcordate base and blunt apex, with actinodromous venation. Lower and middle cauline leaves 6.5–19 × 4.5–12.5 cm, similar to basal leaves or sessile, fiddle-shaped, semi-amplexicaul. Upper cauline leaves 2.5–13 × 0.7–5 cm, ovate-lanceolate, generally with acute apex. Indumentum similar to the adjacent part of the stem. Capitula (1)2 to 16; 3–7 cm diam. including rays; involucres generally shorter than rays, involucres generally shorter than rays, 1.5–3.5 cm diam.; peduncles 1.5–16 cm long, 0.5–2 mm diam. Phyllaries herbaceous, sometimes slightly papery at the base or at the margins, ovate-subulate, generally with acute apex; the outer 0.5–1.8 cm long, 1.2–4 mm wide; the inner 0.6–1.4 cm long, 0.7–3 mm wide. Indumentum of glandular and eglandular trichomes, sometimes glabrous. Receptacles pubescent, rarely glabrate. Flowers with yellow corollas. Ray flower corollas (1.2)1.5–3.5 cm long, (1)2–4...
mm wide, oblong-elliptic to obovate-elliptic; apex generally with 3 teeth. Disk flower corollas 4.5–5.5 × 1–1.5 mm. Cypselae brown-tinted to olive-green, with grooved-reticulate surface, dimorphic. Cypselae of ray flowers 2–3.5 × 0.7–1.3 mm, glabrous or glabrate, without pappus. Cypselae of disk flowers 1.5–3 × 0.7–1 mm, pubescent, with white pappus 3–6 mm. Chromosome number 2n = 60 (Skalinska, 1950; Baksay, 1956; Kuzmanov & Anchev, 1973; Strid & Franzén, 1983).

Illustrations. Jacquin (1774: tab. 130); Hegi (1926: 713, fig. 421); Săvulescu (1964: pl. 159, fig. 2); Bolbos & Vigo (1995: 839); Figures 1C, 12A–D.

Distribution. Europe (Carpathians, Balkans, Alps, Apennines, and eastern Pyrenees). Cultivated and naturalized at least in Great Britain. Growing in forest, meadows, near watercourses, and in moist rocky places, altitude 300–2200 m (Fig. 13).

*Doronicum austricum* is a variable species with regard to phyllary shape, number of capitula and, in particular, type and abundance of indumentum. Based on the protologue, where there is no mention of the presence of glandular trichomes, Pérez et al. (1997) characterized it as a non-glandulose species, and accordingly, they chose a lectotype with no glandular trichomes. Although both glandular populations might be included in *Doronicum carpatanum*, a different species as recognized here.


Plant up to 80 cm tall. *Rhizomes* somewhat woody, glabrous, generally with scaly leaf remains. **Stems** not branched, leafy completely up entire stem, internodes generally shorter than adjacent leaves. **Indumentum** of short- and long-stalked glandular trichomes (1–5 mm), more abundant near the capitula, rarely only eglandular trichomes. **Leaves** entire to slightly dentate. Basal leaves generally absent at flowering time; blade (1.2)2–4 × (0.9)1–2(3) cm wide, ovate, elliptic or obovate, with
attenuate base, and blunt or subacute apex, with actinodromous to pinnate-actinodromous venation; petiole (0.9)1.5–3(5) cm long, (1.2)–3(5) mm wide. Lower and middle cauline leaves (3)–9(12.3) × (0.5)1.5–3.5(6.2) cm, sessile, ovate-elliptic to ovate-elliptic, semi-amplexicaul. Upper cauline leaves 2–4(5.5) × (0.3)–1(2.3) cm, similar to middle cauline leaves or ovate. Indumentum similar to the adjacent part of stem, sometimes with glandular margins. Capitula solitary, (4)–5–7(8) cm diam. including rays; involucre shorter than rays, rarely equaling them, (3)–3.5–4.5(6.2) cm diam. Phyllaries herbaceous; the outer (1)–1.5–2(2.5) cm long, 1.5–2.5(3) mm wide; the inner 1–2 cm long, 1–2(3.5) mm wide, ovate-lanceolate to subulate. Indumentum similar to the upper part of stem, more abundant at the base. Receptacles glabrous, rarely with scattered short-stalked glandular trichomes. Flowers with yellow corollas. Ray flower corollas (1.8)–2–3 cm long, 2–3(3.5) mm wide, obovate-elliptic, apex generally with 2 or 3 teeth. Disk flower corollas 3.5–5 × 1.5–2 mm. Cypselae dark brown, homomorphic, 1.5–3 × 1 mm, glabrous, sometimes with scattered eglandular trichomes or glands. Pappus up to 6 mm, white to yellow-tinted. Chromosome number unknown.

Illustrations. Figures 2E, F, 10C, D.

Distribution. Central and southern China (provinces of Sichuan, Tibet-Qinghai, and Yunnan), and the Himalayas. Open moist rocky places and woods, altitude 3000–5000 m (Fig. 11).

As already discussed (see comments for D. altaicum), there is a group of central Asian species morphologically very similar to each other. Doronicum briquetii is included in this group, but its distribution may only overlap that of D. falconeri. The character used to distinguish between them is the heterocarpy in D. falconeri versus the homocarpy in D. briquetii. There are other species outside this morphological group, D. kamaonense and D. stenoglossum, that also overlap part of their area of distribution with D. briquetii. But D. stenoglossum is quite different from D. briquetii in noticeable characters (i.e., number of capitula, color, shape and size of ray flowers, and shape and size of phyllaries) as well as D. kamaonense (i.e., number and size of capitula and type of indumentum). (See also comments under D. gansuense.)

Selected specimens examined. CHINA. Sichuan: Mt. Konka, Risonquembha, Konkaling, Rock 16834 (E, K, GH, MO, NY, W); Donggrego, Smith 3270 (S, UPS); Sikang, Kangting, Tachienu, Tapaoshan, Smith 11473 (S, UPS). Tibet-Qinghai: Mekong–Salween divide behind Tzekou, Forrest 666 (E); Bei-lua Shan, Mekong–Yangtze divide, Forrest 13164 (E); Oika-gur-pu, Mekong–Salween divide, Sarong, Forrest 14526 (BM, E, K, W); Dü Chu valley, Pashö, Kham, Hanbury-Tracy 22 (BM); Doshong La, Kingdom Ward 5366 (E); Sōbā La, Kingdom Ward 12125 (BM); Tha Chu valley, Kingdom Ward 19592 (BM, E, UPS); Kongbo, Tsangpo valley, Lushia Chu, Ludlow et al. 4752 (BM, E, UPS); Kongbo, Tsangpo valley, Lushia Chu, Ludlow et al. 5205 (BM, E, UPS); Kongbo, Tsangpo valley, Dolshong La, Ludlow et al. 5258 (BM, E, UPS); Tsang La, near Paka, Ludlow et al. 5670 (BM, E, UPS); above Showa Dzong, Pome, Ludlow et al. 13148 (BM, E, UPS); Ba La, Pasum Chu, Kongbo, Ludlow et al. 13955 (BM, E, G, UPS); Budi Tsepo La, Kongbo, Ludlow et al. 15261 (BM, E, UPS); Kongbo, Nyoto Sama, Ludlow et al. 15604 (BM, E, UPS);

Plant up to 50(+) cm tall. Rhizomes woody to somewhat woody, glabrous, moniliform, sometimes with fibrous leaf remains. Stems branched in the upper part, leaves mainly distributed in the lower middle, upper internodes longer than the adjacent leaves. Indumentum of uniseriate eglandular trichomes (0.2–0.4 mm), sometimes with short-stalked glandular trichomes and a few multisieriate eglandular trichomes, more abundant near the caputula and sometimes glabrous at the base. Leaves dentate. Basal leaves generally present at flowering time; blade 5.5–8 × 5–9 cm, orbicular to suborbicular, with cordate base and blunt apex, with actinodromous venation; petiole 8–19.5 cm long, 2–2.3 cm wide. Lower cauline leaves with blade ca. 6 × 8 cm; petiole ca. 6.5 cm long, 1.5 mm wide, similar to basal leaves. Middle and upper cauline leaves 3–4 × 1.2–5.5 cm, sessile, fiddle-shaped, semi-amplexicaul, the upper leaves ovate to bract-like. Indumentum similar to the adjacent part of the stem or glabrate. **Capitula** 2 to 13; ca. 3.5 cm diam. including rays; involucre shorter than rays, 1–2 cm diam. **Phyllaries** herbaceous, 6–7 × 2.5 mm, ovate-elliptic to ovate-subulate, generally with acute apex. Indumentum of uniseriate eglandular trichomes (0.2–0.4 mm), sericeous, abundant. **Receptacles** glabrous or glabrate. Flowers with yellow corollas. Ray flower corollas ca. 1.7 cm long, 2 mm wide, oblong-elliptic, apex generally with 3 teeth. Disk flower corollas ca. 5 mm long. **Cypselae** brown-tinted, with slightly reticulate surface, dimorphic. Cypselae from ray flowers 2–3 × 0.9–1.2 mm, glabrous or glabrate, without pappus. Cypselae from disk flowers 2.7 × 0.9–1 mm, pubescent (eglandular trichomes), with pappus white-tinted, 3–4 mm. Chromosome number unknown.

**Illustrations.** Figures 5A–D, 7C, 8B.

**Distribution.** Southern Turkey (Antalya and Konya provinces). Growing in shady rocky places, elevation 1800–2300 m (Fig. 14).

Most of the *Doronicum* species from Turkey are similar morphologically (rhizomes woody to somewhat woody and glabrous, several heterocarpic capitula, and a few but very large leaves). These species have a few diagnostic characters; sometimes only one of these is consistent, making species
identification difficult. *Doronicum cacaliifolium* is one of the best delimited species within this morphological group, and is also the one that has the most restricted area of distribution. The distinctive characters are its exclusive type of rhizome (moniliform) and the shape, size, and type of indumentum of phyllaries (Figs. 5A–C, 8B). Geographically, the closest species within its morphological group is *D. reticulatum* from western Turkey (Figs. 14, 26), but this one has different shape, size, and type of indumentum, and color of phyllaries (Fig. 26E–G).

Outside this morphological group, only *D. orientale* may overlap its area of distribution with *D. cacaliifolium* (Figs. 14, 27), but there are noticeable characters to distinguish between them. In addition to the difference in their phyllary characters (Fig. 5A–C, E–G), rhizomes from both species are quite different (fleshy and pubescent in *D. orientale* vs. woody to somewhat woody, glabrous, and moniliform in *D. cacaliifolium*). *Doronicum orientale* is the closest species within its morphological group, and is also the one that has the most restricted area of distribution. The distinctive characters are its exclusive type of rhizome (moniliform) and the shape, size, and type of indumentum (Fig. 14, 27), but this one has different shape, size, and type of indumentum, and color of phyllaries (Fig. 26E–G). outside this morphological group, only *D. orientale* may overlap its area of distribution with *D. cacaliifolium* (Figs. 14, 27), but there are noticeable characters to distinguish between them. In addition to the difference in their phyllary characters (Fig. 5A–C, E–G), rhizomes from both species are quite different (fleshy and pubescent in *D. orientale* vs. woody to somewhat woody, glabrous, and moniliform in *D. cacaliifolium*).

Selected specimens examined. TURKEY. Antalya: Akdag, Davis 14381 (E, G, K, MO, W); Akdagl, Davis 14551 (K). 


Plant up to 50 cm tall. *Rhizomes* woody to somewhat woody, glabrous, sometimes with leaf remains forming dark scales on nodes. *Stems* not branched, generally scape-like. *Indumentum* of uniseriate, multiseriate, and glandular trichomes, scattered, glabrous in the lower part. *Leaves* dentate to slightly dentate. Basal leaves generally present at flowering time; blade 2–4 × 2–4 cm, orbicular to broadly ovate with cordate base and with blunt or subacute apex, with an actinodromous venation that sometimes tends to be acrodomous; petiole 4–11 cm long, 0.5–1 mm wide. Lower and middle cauline leaves 3–6 × 1.4–3.5 mm, similar to basal leaves or sessile, fiddle-shaped, semi-amplexicaul. Upper cauline leaves 1.5–3 × 0.9–2.5 cm, ovate-elliptic to ovate-lanceolate, sometimes bract-like. *Indumentum* of white-tinted scattered multiseriate eglandular trichomes (up to 1.5 mm), uniseriate eglandular trichomes mainly on the edge of the blade, and scarce short-stalked glandular trichomes. *Capitula* solitary, 3.5–5 cm diam. including rays; involucre shorter than rays, 2.5–3 cm diam. *Phyllaries* herbaceous, 0.9–1.2 cm long, 1.5–4 mm wide, ovate-subsulate; margins sometimes ciliate, with acute, stiff and equidistant multiseriate eglandular trichomes (up to 0.6 mm long). *Indumentum* mainly glandular, and sometimes with uniseriate eglandular trichomes. *Receptacles* glabrous or almost glabrous. *Flowers* with yellow corollas. Ray flower corollas 1.4–2.2 cm long, 2.2–8 mm wide, oblong-elliptic, apex generally with 3 teeth. Disk flower corollas up to 4 mm long. *Cypselae* (not seen at maturity), brown-tinted, homomorphic, 1.5 × 0.8 mm, scarcely pubescent (eglandular trichomes) to glabrate. *Cypselae* from ray flowers sometimes with a poorly developed pappus. Pappus up to 3.5 mm, white-tinted. Chromosome number 2n = 60 (Taskevitch et al., 1989).

**Illustrations.** Săvulescu (1964: pl. 98, fig. 3).

**Distribution.** Europe (Carpathians). Meadows, shady rocky places, and near watercourses, altitude 1200–2200 m (Fig. 15).

The type material of *Aronicum scorpioides* DC. var. *carpathicum* Griseb. & A. Schenk could not be found, and although the protologue matches the diagnostic features of this taxa, its identity here is tentative and the formal synonymy needs to wait until clarification.

*Doronicum carpathicum* and *D. columnae* are closely related species, which differ only by their heteromorphic versus homomorphic fruits, respectively, Simonkai (1886) described a new species, including specimens without well-developed pappus: *Aronicum barcense*. Later, this name was considered by Cavillier (1911) to be a hybrid species (*D. carpaticum × D. columnae*). I cannot confirm the hybrid origin for this taxon and therefore include it as a synonym of *D. carpaticum* due to the presence of pappus, although poorly developed.

Figure 15. Distribution map for: Doronicum carpathicum (○); Doronicum cataractarum (△); Doronicum columnae (●).


Plant up to 120 cm tall. **Rhizomes** fleshy, with shining white-tinted short trichomes on nodes, sometimes with buds, and generally with leaf remains. **Stems** branched in the upper part or simple. Indumentum of multiseriate eglandular trichomes (up to 1.5 mm) and short-stalked glandular trichomes at the middle part of stem, and also long-stalked glandular trichomes (up to 5 mm) at the upper part of the stem, sometimes glabrous at the base, sometimes mainly glandular, more abundant near the capitula. **Leaves** entire to slightly dentate. Basal leaves generally absent at flowering time; blade 2.5–9 × 2–7 cm, ovate to orbicular, with subcordate to truncate base and blunt or subacute apex, with actinodromous venation; petiole (1.5)3.5–13.5 cm long, (0.5)1–3 mm wide. Lower and middle cauline leaves 3–11(15) × 1.5–7.5(10) cm, similar to basal leaves or sessile, fiddle-shaped, sometimes ovate, semi-amplexicaul. Upper cauline leaves 1–7.5(9) × 0.2–4 cm, ovate-lanceolate, sometimes bract-like. Indumentum similar to the adjacent part of the stem. **Capitula** 1 to 6, 2.5–6(7) cm diam. including rays; involucre shorter than rays, 1.5–4 cm diam.; peduncles (0.7)1–16(21) cm long, 0.5–2.5 mm wide. **Phyllaries** herbaceous, ovate-subulate to narrowly elliptic; the outer 0.8–2.2 cm long, 1–3(3.5) mm wide; the inner 0.7–2.1 cm long, 0.5–2.5 mm wide. Indumentum of long-stalked glandular trichomes and sometimes also with eglandular trichomes. **Receptacles** pubescent or glabrous. **Flowers** with yellow corollas. Ray flower corollas (1.2)1.5–3 cm long, 1.7–5 mm wide, obturate-elliptic, apex generally with 3 teeth. Disk flower corollas 4–7(8) × 1–2.5 mm. **Cypselae** brown-tinted to olive-green, with grooved-reticulate to somewhat warty surface, dimorphic or homomorphic. Cypselae from ray flowers (1.5)3–4.3 × 0.7–1.5 mm, glabrous or glabrate, with or without pappus. Cypselae from disk flowers (1.5)2–4 × 0.2–
1.3 mm, with eglandular or glandular trichomes, with pappus. Pappus (2.5)4–5.5 mm, white. Chromosome number 2n = 60, 120 (Fernandes & Queiroz, 1971, as D. pardalianches).

Illustrations. Figures 1F, 6C, 16.

Distribution. North of the Iberian peninsula and mountains in central Spain and eastern Portugal. Open moist rocky places, cliffs, screes, woods, and near watercourses, from sea level to 2500 m elevation (Figs. 17, 18).

This taxon can be confused with Doronicum austriacum due to their similarities (e.g., habit, leaves, capitula, habitat; see comments under this species), but the presence of this latter species in the Iberian peninsula is only based on a few gatherings more than 50 years old from Andorra and Cerdagne in the Pyrenees. This species must be searched for in these areas in the Pyrenees.

Doronicum carpetanum is variable with regard to quantity of indumentum, size, ploidy level, and presence of pappus in the ray flowers. Variation in these characters follows geographical patterns, and in most cases these populations can be distinguished morphologically. Hybridization events both contemporary and in the origin of one of the subspecies here recognized (subsp. diazii) cannot be discarded in this group. However, further investigation is needed, and at present, taxonomic recognition at the subspecific level is preferred to handling the intraspecific variability (see also comments for D. grandiflorum). In the present taxonomic treatment the following subspecies are recognized:

KEY TO SUBSPECIES OF DORONICUM CARPETANUM

1. Receptacle glabrous or glabrate; plants generally bearing one capitulum

1’. Receptacle pubescent; plants bearing one to several capitula

2(1). Cypselae of disk flowers with mostly glandular trichomes

3(1). Lower and middle cauline leaves with eglandular trichomes, sometimes also with glandular trichomes

5. Doronicum carpetanum subsp. pubescens

6a. Doronicum carpetanum subsp. carpetanum

Plants glabrous or glabrate, generally glandular in the upper part, sometimes also with scattered eglandular trichomes. Receptacle pubescent. Cypselae dimorphic, the inner with eglandular trichomes. Chromosome number 2n = 120 (Chacón, 1967).

Illustrations. Figures 1F, 16A–D.

Distribution. Massifs in the center of the Iberian peninsula in Spain, plus some scattered populations in the north. Open moist rocky places and near watercourses, altitude 900–2300 m (Fig. 17).

Selected specimens examined. SPAIN. Castilla–La Mancha: Guadalajara, Cantalojas, Tejera Negra, 20 June 1965, Burgos & Caniel, s.n. (MACB); Castilla y León: Ávila, Solana de Ávila, laguna del Duque, arroyo Malillo, Álvarez & Yague 931 (MA); Salamanca, Candelerio, sierra de Bejar, 28 June 1979, Amich et al. s.n. (MA); Burgos, Pineda de la Sierra, pico Mancillas, 14 July 1984, Benedict et al. s.n. (MA, MAF); Ávila, sierra de Majarreina ad desus de Tornavacas près Plasencia, Bourgeois 2508 (COI-WILLK, K, MA, NY); Ávila, El Calvitero, 16 July 1979, Carrasco et al. s.n. (MACB); Zamora, Puebla de Sanabria, sierra Calva de Porto, 19 July 1973, Casaseca s.n. (MA); Burgos, pico Trigana, Castroviejo & Fernández Quirós 3568 (MA); Ávila, El Barco de Ávila, sierra del Barco, Castroviejo et al. 7133 (MA); Segovia, Cerezo de Arriba, pico del Lobo, Castroviejo et al. 10709 (MA); Burgos, valle de Valdelaguna, sierra de Neila, Mt. Haedillo, Gil Zúñiga & Alejandro 225–88 (MA); Ávila, Hoyos del Espino, Las Chorreras, Leñero & Vargas 290 (MA); Soria, sierra Cebojera, rio Racioncillo, 5 July 1979, Mendiola s.n. (MACB); Soria, sierra Carbonera, 6 July 1979, Mendiola s.n. (MACB); Soria, El Bercolar, sierra Cebollera, 17 July 1980, Mendiola s.n. (MACB); Soria, Laguna Negra de Urbién, 15 July 1985, Navarro s.n. (MA); Ávila, Cepeda de la Mora, La Serreta, El Nevoro, 5 July 1982, Rivas Martínez et al. s.n. (MAF); Zamora, San Martín de Cañasheda, El Cabezó, 22 June 1987, Rou s.n. (MA); Ávila, sierra de Gredos oriental, puerto de Mijares, July 1984, Sánchez-Mata s.n. (MACB); Ávila, Navalguido, garganta de los Caballeros, 3 June 1990, Sardínion s.n. (MAF); Soria, Santa Inés, Majadarrubia, Segura Zuziarreta 12525 (MA); Ávila, San Martín del Pimpollar, Segura Zuziarreta 22654 (MA). Comunidad de Madrid: Sierra de Guadarrama, laguna de Peñalara, Almaraz et al. 892 (MA). La Rioja: Ezcaray, cerro de San Lorenzo, Almaraz et al. 805 (MA); puerto de Piqueras, Sandukh 5684 (K); Zafelma, sierra de la Demanda, pico Torocuervo, 14 July 1992, Urrutia s.n. (MA); País Vasco: Álava, La Leze, sierra de Alzarría, 1 July 1965, Uribe-echesturillo s.n. (MA). Principado de Asturias: lagos de Saliencia, Leñero & Vargas 2569’ (MA).

6b. Doronicum carpetanum subsp. diazii


Plant up to 70 cm tall, glabrous or glabrate in the lower part, glandular at the middle and upper part, sometimes also with scarce eglandular trichomes. Stems generally simple. Basal leaves
Figure 17. Distribution map for *Doronicum carpetanum* subsp. *carpetanum*.

Figure 18. Distribution map for: *Doronicum carpetanum* subsp. *diazii* (▲); *Doronicum carpetanum* subsp. *kuepferi* (●); *Doronicum carpetanum* subsp. *pubescens* (○).
sometimes present at flowering time; blade 4–6 × 3–4 cm; petiole 6.5–10 cm long, 1–2 mm wide. Lower and middle cauline leaves 3.5–8.5 × 2–6 cm. Upper cauline leaves 1.2–5.5 × 0.5–2 cm. Capitula 1 to 2(4), 3–4 cm diam. including rays; involucre 2–2.5 cm diam. Phyllaries 0.9–1.4 cm long, 1.5–3 mm wide. Receptacles glabrous to glabrate. Ray flower corollas 1.3–1.9 cm long, 3±3.5 mm wide. Cypselae generally dimorphic, ray flowers sometimes with pappus poorly developed. The inner cypselae mainly with eglandular trichomes. Chromosome number 2n = 60 (Chacón, 1967; re-counted and confirmed here: Spain. Ávila, Portilla de Talamanca, Álvarez & Yagüe 933 (MA 611196)).

Illustrations. Pérez & Penas (1990: 156, fig. 2); Figure 6C.

Distribution. Northern Iberian peninsula (Cantabrian range) and central-eastern ranges (Picos de Urbión) in Spain. Open moist rocky places and screes, altitude 1700–2100 m (Fig. 18).

Although type material was not available, plants collected at the type locality and also several specimens identified by Pérez (one of the authors) as "Doronicum diazii" were studied.

Selected specimens examined. SPAIN. Castilla y León: Ávila, Solana de Ávila, Portilla de Talamanca, Alvarez & Yagüe 933 (MA); Ávila, El Calvetero, 16 July 1979, Carrasco et al. s.n. (MA); Salamanca, sierra de Béjar, El Trampl, 4 Aug. 1977, Casaseca et al. s.n. (MA); Ávila, laguna de Gredos, sierra de Gredos, Dresser 846 (E); Salamanca, sierra de Béjar, El Trampl, Nieto Feliñer et al. 2736 (MA); Ávila, Villatoro, La Serrota, 5 July 1997, Palacio et al. s.n. (MA); Salamanca, Trampl, 27 July 1900, Pau s.n. (LY); Salamanca, sierra de Béjar, Hoyomoro, 22 Aug. 1983, Rico s.n. (MACB); Ávila, Sierra de Gredos, El Morezón, 26 July 1958, Rivas Goday s.n. (MAF); Ávila, sierra de Béjar, La Ceja, 26 July 1989, Rivas Martínez et al. s.n. (MAF); Ávila, puerto de Villatoro-Villanueva del Campillo, 20 May 1962, Sánchez-Mata et al. s.n. (MAF); Salamanca, sierra de Béjar, La Hoya, círculo de la Peña Negra, 14 July 1990, Sardíñero s.n. (MAF); Ávila, sierra de Tomantos, Puerto Castillo, círculo de El Barco, 23 Aug. 1990, Sardíñero s.n. (MAF); Salamanca, Candelario, Calvitero, Valdés Bermejo et al. 5812 (MA). Extremadura: Cáceres, sierra Majarreina, cerca del Pico del Telégrafo, 7 Aug. 1946, Rivas Goday s.n. (MA, MAF).

Illustrations. Figure 16E–H.

Distribution. Central-western of the Iberian peninsula (Sierra de Gredos). Open moist rocky places, screes, and near watercourses, altitude 1800–2500 m (Fig. 18).

Selected specimens examined. SPAIN. Castilla y León: Ávila, Solana de Ávila, Portilla de Talamanca, Alvarez & Yagüe 933 (MA); Ávila, El Calvetero, 16 July 1979, Carrasco et al. s.n. (MA); Salamanca, sierra de Béjar, El Trampl, 4 Aug. 1977, Casaseca et al. s.n. (MA); Ávila, laguna de Gredos, sierra de Gredos, Dresser 846 (E); Salamanca, sierra de Béjar, El Trampl, Nieto Feliñer et al. 2736 (MA); Ávila, Villatoro, La Serrota, 5 July 1997, Palacio et al. s.n. (MA); Salamanca, Trampl, 27 July 1900, Pau s.n. (LY); Salamanca, sierra de Béjar, Hoyomoro, 22 Aug. 1983, Rico s.n. (MACB); Ávila, Sierra de Gredos, El Morezón, 26 July 1958, Rivas Goday s.n. (MAF); Ávila, sierra de Béjar, La Ceja, 26 July 1989, Rivas Martínez et al. s.n. (MAF); Ávila, puerto de Villatoro-Villanueva del Campillo, 20 May 1962, Sánchez-Mata et al. s.n. (MAF); Salamanca, sierra de Béjar, La Hoya, círculo de la Peña Negra, 14 July 1990, Sardíñero s.n. (MAF); Ávila, sierra de Tomantos, Puerto Castillo, círculo de El Barco, 23 Aug. 1990, Sardíñero s.n. (MAF); Salamanca, Candelario, Calvitero, Valdés Bermejo et al. 5812 (MA). Extremadura: Cáceres, sierra Majarreina, cerca del Pico del Telégrafo, 7 Aug. 1946, Rivas Goday s.n. (MA, MAF).


Plants mainly with eglandular trichomes at least in the middle part, also glandular in the upper part. Blade of basal leaves 4–6.5 × 3.5–5.5 cm; petiole 7–9 cm long. Capitula 4.5–5(7) cm diam. including rays. Receptacles pubescent. Cypselae dimorphic, the inner with eglandular trichomes. Chromosome number 2n = 120 (Chacón, 1987, as D. carpetanum).

Distribution. Northern Iberian peninsula in Spain and central Portugal (Serra da Estrela). Open moist rocky places, cliffs, woods, and near watercourses, altitude 50–2200 m (Fig. 18).

Although type material of **Doronicum pubescens**...
was not seen, plants collected at the type locality as well as several specimens identified by Pérez (one of the original authors) as Doronicum pubescens, were studied.

Selected specimens examined. PORTUGAL. Beira Alta: Manteigas, Serra da Estrela, Mondeguinho, Álvarez et al. 1296 (MA). SPAIN. Cantabria: picu Tresmares, 25 July 1982, Aedo s.n. (MA); Mt. Galatrapa, Mazandreño, 2 July 1983, Aedo s.n. (MA); puerto de Piedrasluengas, Álvarez 923 (MA); Vega de Liébana, Ledantes, puertos de Pineda, Álvarez & Yague 941 (MA); Fuente Dé, Harold & McBeath 158 (F); Vega de Pas, puerto de Estacas de Trueba, Pardo de Santayana & Morales 1690 (MA); Soba, puerto de La Stia, 27 May 1990, Patino et al. s.n. (MA); El Henar, 13 July 1977, Rivas Martínez et al. s.n. (MAF); Curavacas, Valdés Bermejo et al. 4223 (MA); Castilla y León: Palencia, Cardano de Arriba, Aedo et al. 3631b (MA); León, Encincedo, Laguna de La Baña, Álvarez 927 (MA); León, Oseja de Sajambre, puerto del Pontón, Álvarez & Yague 936 (MA); León, Boca de Huergano, Cisasco, arroyo Lauriana, Álvarez & Yague 937 (MA); León, Puerta de Lillo, 18 July 1974, Andrés s.n. (MAF); León, Nacedo, Cueto Ancino, 18 July 1951, Borja s.n. (MAF); León, circo Cebollero, puerto de San Isidro, 16 July 1974, Casaseca & Fernández Díaz s.n. (MA); León, puerto de las Señales, 27 July 1979, Casaseca et al. s.n. (MA); León, entre el col de Pandermedas et Posada de Valdelos, Charpin 15017 (B); León, Palacios del Sil, pico Catoute, 15 Aug. 1997, Martín Blanco s.n. (MACB); León, puerto de Pandetrave, 16 June 1981, Rivas Martínez et al. s.n. (MAF); Zamora, Portilla del Pardornelo, 24 July 1972, Valdés Bermejo s.n. (MA); Galicia: Lugo, Cervantes, monte Camporredondo, Degrada, pico Tres Obispos, Álvarez et al. 926 (MA); La Coruña, Casaveiro, 25 Apr. 1981, Anach et al. s.n. (MA); La Conúa, Puente Carreira, 29 May 1953, Bellot s.n. (MA, MACB, MAF); Orense, sierra do Invernadeiro, Cabeza de Val do Calheiro, 10 July 1973, Castroviejo s.n. (MA); Orense, Viana del Bollo, montaña de Ramilo, Merino 18 (MA); La Conúa, Maljúca, As Portelas, 19 June 1994, Soñora s.n. (SANT), Principado de Asturias: supra Pajares, 14 July 1992, Lonas s.n. (MA); Cangas de Narcea, vega de Renfos, Muniellos, Silva Pando et al. 1394 (MA, MACB, MAF).


Plant up to 100(+) cm tall. Rhizomes woody to somewhat woody, scarcely pubescent to pubescent, and generally with leaf remains forming dark scales on nodes. Stem branched in the upper part, leafy, internodes generally shorter than the adjacent leaves. Indumentum of uniseriate eglandular trichomes (up to 0.4 mm), also with short-stalked or subsessile glandular trichomes near the capitula, sometimes glabrate. Leaves slightly dentate to dentate. Basal leaves sometimes present at flowering; blade 8–20 × 8.5–19.5 cm, ovate to orbicular, with cordate to subcordate base and generally blunt apex, with actinodromous venation; petiole 21–26 cm long, 2.5–4.5 mm wide. Lower and middle cauline leaves 7–19 × 6–15 cm, similar to basal leaves or sessile, fiddle-shaped, semi-amplexicaul. Upper cauline leaves 2.5–4.5 × 0.8–2 cm, ovate to ovate-lanceolate, sometimes bract-like. Indumentum similar to the adjacent part of the stem, sometimes with uniseriate and multiseriate eglandular trichomes (up to 2 mm). Capitula 2 to 14, 4–8 cm diam. including rays; involucres shorter than rays, 2.5–5 mm diam.; peduncles 3–16 cm long, 0.7–1.5 mm wide, sometimes with turbinate base during fruit (up to 12 mm width). Phyllaries herbaceous, 1.2–1.8 cm long, 1.5–3.5 mm wide, ovate-lanceolate to elliptic, generally with acute apex. Indumentum of short-stalked glandular trichomes and uniseriate eglandular trichomes, sometimes glabrate. Receptacles glabrous. Flowers with yellow corollas. Ray flower corollas 2.5–3.5 cm long, 1.7–3 mm wide, oblong-elliptic to obovate-elliptic, apex generally with 3 teeth. Disk flower corollas 4–5 × 2–3 mm. Cypselae brown-tinted, with grooved-reticulate surface, dimorphic. Cypselae from ray flowers ca. 3.5 × 1 mm, glabrous or glabrate, without pappus or sometimes with a poorly developed pappus. Cypselae from disk flowers 2.5–3 × 0.6–0.8 mm; pappus 4–5.5 mm, white. Chromosome number 2n = 60 (data obtained from several indexes of plant chromosome numbers: Fedorov, 1969; Goldblatt, 1985; Goldblatt & Johnson, 1994, 1996; original sources not seen).

Illustrations. Widder (1925: Taf. 25–27); Hegi (1928: 716, fig. 424); Figures 1D, 3C, 12E, 12F.

Distribution. Europe (Austrian Alps). In gullies and rocky places near watercourses, altitude 1600–1900 m (Fig. 15).

Morphologically, the closest species to Doronicum cataractarum is D. austriacum (see comments above), and there are only slight and few differences between them. Doronicum cataractarum is an endemic from the Austrian Alps, which is included within the area of distribution of D. austriacum. The characters used to distinguish them are the scarcely pubescent to pubescent rhizomes of D. cataractarum versus glabrous rhizomes of D. austriacum; base of capitula glabrous to glabrate with short-stalked or subsessile glandular trichomes in D. cataractarum versus base of capitula glabrate to pubescent or with long-stalked glandular trichomes in D. austriacum. In addition, although these two species have dimorphic cypselae (ray flowers without pappus and disk flowers with pappus), this is not a very
stable character in *D. cataractarum* and sometimes the ray flowers in this species have a poorly developed pappus, which is never present in *D. austriacum*.

*Selected specimens examined.* AUSTRIA. Kärnten: Koralpe, am Bach im Himmelreichen, 22 Aug. 1934, Drobný s.n. (B); Koralpe bei Deutschlandberg, Fest 571 (B); Koralpe, Bachufer unterhalb der Grillschütte, 30 July 1950, Boyiglenger s.n. (BM, G); Koralpe,Crosses Kaar, Sep. 1953, Patzak s.n. (k); Weiβwassergraben, Waldgrenze, 20 Aug. 1923, Widder s.n. (GZU); Weiβwassergraben, Grillschütte, Surzbach, 19 Aug. 1928, Widder s.n. (MAF).

**Steiermark:** Runde des Seelaches, Seekar der Koralpe, 24 Aug. 1936, Widder s.n. (G); Seebach der Koralpe, Seekar, 26 Aug. 1939, Widder s.n. (B).


Plant up to 40 cm tall. **Rhizomes** fleshy to somewhat woody, with shining white-tinted short trichomes on nodes, generally with leaf remains. **Stems** generally not branched, with leaves mainly at the base or in the middle basal part of stem. **Indumentum** of eglandular and glandular trichomes, more abundant near the capitula. **Leaves** entire to dentate. **Basal leaves** generally present at flowering time; blade 7(8.5)–(1.5) × 1–2.5 cm, elliptic to ovate-elliptic, truncate or attenuate at the base, blunt to acute apex, with actinodromous to pinnate-actinodromous venation; petiole (0.8)–2–10 cm long, 1–3(4) cm wide. Lower and middle cauline leaves 2.5–10 × 0.7–2.5(3.5) cm, similar to basal leaves or sessile, ovate-elliptic to narrowly elliptic, semi-amplexicaul. Upper cauline leaves 1.5–5.5 × 0.5–3 cm, similar to middle cauline leaves, or ovate-lanceolate. **Indumentum** of stiff, acute, and shiny multiseriate eglandular trichomes (up to 2.5 mm), and thin, tangled uniseriate eglandular trichomes (up to 2 mm), mainly on leaf margins, also short-stalked glandular trichomes on leaf blade. **Capitula** (to 4), 4–7.5 cm diam. including rays; involucre shorter than rays, 2.5–5 cm diam. **Phyllaries** herbaraceous; the outer 1.2–2 cm long, 1.5–3.3 mm wide; the inner 1–2 cm long, 1.2–2.3 mm wide, ovate-lanceolate to widely subulate. **Indumentum** similar to the upper part of stem. **Receptacles** glabrous. **Flowers** with yellow corollas. Ray flower corollas 1.8–2.5 cm long, 2.5–4.5 mm wide, obovate-elliptic, apex generally with 3 teeth. Disk flower corollas 4–5 × 1.5–2 mm long. **Cypselae** brown, with grooved-reticulate surface, homomorphic, 1.5–2.5 × 0.7–1 mm, with eglandular trichomes or glabrate. Pappus up to 5.5 mm, white. Chromosome number 2n = 60*, 120 (Skalinska, 1950), as *Aronicum clusii*; Tasenkevitch et al., 1989; *Goldblatt & Johnson, 1996, see comments below.*

**Illustrations.** Reichenbach (1854: tab. 63, fig. 2); Hegi (1928: fig. 432); Săvulescu (1964: pl. 99, fig. 1), Resmeriţă & Moravetz (1956: fig. 1); Figure 3F–H.

**Distribution.** Europe (Alps and Carpathians). Open moist rocky places and screes, altitude 1500–3000 m (Fig. 19).

The type material of *Arnica elusii* could not be found, and although the protologue matches the diagnostic features of this taxon, its identity here is tentative and the formal synonyms need to wait until clarification.

There are three European species, *Doronicum clusii*, *D. glaciale*, and *D. grandiflorum*, that are morphologically similar, and whose areas of distribution overlap in some places in the Alps occupying the same habitats. All of them have homomorphic fruits (all cypselae with pappus), ovate to elliptic basal leaves with truncate or attenuate bases, and rhizomes fleshy to somewhat woody with short trichomes on nodes, generally with a single capitulum or sometimes a few (2 to 4). All of them grow in open moist rocky places in the mountains, preferably the upper tree line to 3000 m in elevation. Although they only differ in the type of indumentum, it is a very constant character (more noticeable on the leaf margins). In *D. clusii* and *D. glaciale*, stalked glandular trichomes are absent or scarce, while they are common in *D. grandiflorum* (Fig. 3B). In contrast, long (up to 2.5 mm) non-glandular trichomes are present in both *D. clusii* and *D. glaciale* (Fig. 3F, H). Differences between *D. clusii* and *D. glaciale* are slight, and it is difficult to delimit them. Typical individuals from *D. clusii* and from *D. glaciale* present the indumentum as it is represented (Fig. 3H and E, respectively), but some individuals have a very few scattered thin and tangled uniseriate trichomes, which are abundant in typical *D. clusii* and absent in typical *D. glaciale*. Because of this, the present taxonomic treatment includes those exceptional individuals within *D. clusii*, although the existence of hybrids between these two species is not rejected.

The citation of the chromosome number 2n = 60 for *D. clusii* was found in Goldblatt and Johnson’s (1996) index, but the original source for this data was not seen.

*Selected specimens examined.* AUSTRIA. **Steiermark:** Grafenalpe, Krakaudorf, July 1902, Fest s.n. (B); Rottenmanner Tauern, Haute Styrie, 21 July 1868, Ober-
leitner s.n. (B, LE). **Tirol:** Paznaun, Fladner Massio, 2 Aug. 1932, Bornmüller s.n. (B); Ferwallgruppe, Fassultal, 2 Aug. 1942, Freiberg s.n. (MA); Alztalher Alpen, Oberimtal, Gocklärriegelb Felsblock in der Radschelalm, 25 Aug. 1939, Günther s.n. (B); Alpbach bei Brixlegg am Gallenberg, Schiefer, 10 Aug. 1933, Reiter s.n. (B); Gschmit, Mt. Muttenjoch, 16 Aug. 1890, Schafferer s.n. (B). **Vorarlberg:** Schruns, Sulzlhütte, 27 July 1895, Bornmüller s.n. (B). **CZECHOSLOVAKIA.** Vysoke Tatry in valley montana Mlynica, 6 Aug. 1933, Dostál s.n. (BM, MA, NY); Felka pod Gerlachovský Sitt, July 1895, Fíkko s.n. (B); Magas Tatyr, lacum Kősmárki Zöld-tó, Künmerle & Timkó 790 (B, E, MO); Brezno, Mt. Dumbier, 3 Aug. 1898, Kapčák s.n. (E). **FRANCE.** Alpes-Maritimes: Mt. Bissa, col de Tende, Bourgeois 139 (COI-WILLK, G, K). **ITALY.** Lombardia: Bormio, passo dello Stelvio, Álvarez et al. 1355 (MA); Sondrio, Bormio, Mt. Levernore, 31 July 1911, Longa s.n. (BM). **Piemonte:** passo del Domignone, Alpes Bergamasques, 31 July 1910, Chenevard s.n. (G). **Trentino-Alto Adige:** Trento, Canazei, col del Cuc, Álvarez et al. 1353 (MA); Sondrio, Bormio, Mt. Leverone, 31 July 1911, Longa s.n. (BM). **Tessin:** San Bernardino, 28 July 1920, Valentine s.n. (NY). **Valais:** près Zermatt, 14 Aug. 1888, Bernoülli s.n. (MA); Ferpecle-Baracolla, Bonnier 163 (MO); Weisimilshütte, Quellflur, Damboldi 679/70 (B); Saas-Tal, Graschibi Spielbadalm, Saas-Fee, Damboldi 714/70 (B); près des alpes de Taesch, 5 June 1906, Palibin s.n. (LE). **SWITZERLAND.** Graubünden: Alp i’scholás, Engadine, Biz 405 (MO); Pontresina, Murtersatsch, pas de Bernina, Lejner, Castroviño et al. 11615 (MA). **Tessin:** San Bernardino, 28 July 1920, Valentine s.n. (NY). **Valais:** près Zermatt, 14 Aug. 1888, Bernoülli s.n. (MA); Ferpecle-Baracolla, Bonnier 163 (MO); Weisimilshütte, Quellflur, Damboldi 679/70 (B); Saas-Tal, Graschibi Spielbadalm, Saas-Fee, Damboldi 714/70 (B); près des alpes de Taesch, 5 June 1906, Palibin s.n. (LE). **YUGOSLAVIA.** Visoki Vehr, Liptau, July 1894, Ullepitsch s.n. (B).


Plant up to 70 cm tall. **Rhizomes** woody to somewhat woody, glabrous, generally with leaf remains forming dark fibers or scales on nodes. **Stems** not branched, generally scape-like. **Indumentum** of uniseriate, multiseriate eglandular trichomes, short-stalked and long-stalked glandular trichomes, scarce at the base, more abundant near the capitula. **Leaves** dentate to slightly dentate. Basal leaves generally present at flowering time; blade 1.5–7 × 2–6.5 cm, orbicular to broadly ovate with cordate to subcordate base, with blunt or subacute apex, with actinodromous venation that sometimes tends to be acrodromous; petiole thin and stiff, 4–15(24) cm long, 0.5(–2) mm wide. Lower and middle cauline leaves 1.9–8(10.4) × 1.2–6(7) cm, similar to basal leaves or sessile, fiddle-shaped, semi-amplexicaul. **Upper cauline leaves** 1.5–4.5(7.1) × 0.8–3 cm, ovate-elliptic to ovate-lanceolate, sometimes bract-like. **Indumentum** of uniseriate eglandular trichomes (up to 0.5 mm), conspicuously on the blade edge. **Capitula** 1(2 to 3), 2.5–7 cm diam. including rays; involucre shorter than rays, rarely equaling them, 1.8–4 cm diam. **Phyllaries** herba-
Doronicum columnae is a polymorphic species morphologically similar to D. carpaticum and D. orientale. These species share the habit (scape-like stem with a few caulinar leaves bearing a single capitulum), the shape of basal leaves (orbicular to lanceolate margins of phyllaries (Fig. 5E, F), although this latter character is not constant in D. columnae and D. carpaticum. The most distinctive character between D. orientale and both D. columnae and D. carpaticum is the type of rhizome, which is fleshy with pubescent nodes in D. orientale versus woody to somewhat woody and glabrous in D. columnae and D. carpaticum. There is only one character to distinguish D. columnae and D. carpaticum: the dimorphic cypselae (ray flowers without pappus) in D. columnae versus the homomorphic cypselae (all flowers with pappus) in D. carpaticum. Some specimens that have poorly developed pappus in the ray flowers are included in D. carpaticum, although the hybrid nature of them is not rejected. In addition, there are some exceptional specimens of D. columnae that have a few capitula instead of a single one and that can be confused with another sympatric species, D. pardalianches. It is easy to distinguish between them by comparing their rhizomes, which are woody and glabrous in D. columnae while fleshy with pubescent nodes in D. pardalianches. Besides, cypselae in D. pardalianches turn black at maturity, which is a unique character in the genus.

The type designation for Doronicum columnae was difficult (Álvarez Fernández & Nieto Feliner, 1999). Since there is no collection date, doubt remains concerning this issue. Based on historical records, Tenore visited the type locality himself describing several new species in his Prodomus in 1811. Taking into account this fact, and without other suitable type material, this was the best choice as lectotype.

Plant up to 100(+) cm tall. *Rhizomes* woody to somewhat woody, glabrous. *Stems* branched in the upper part, leafy, internodes generally shorter than the adjacent leaves. Indumentum glandular and also with uniseriate and multisieriate eglanular trichomes, abundant near the capitulum, sometimes glabrous in the lower part. *Leaves* dentate to slightly dentate. Basal leaves absent at flowering time, similar to cauline leaves. Cauline leaves oblong-elliptic, sessile, slightly auriculate, semi-amplexicaul, acute apex, pinnate-actinodromous venation. Middle cauline leaves 7–16 × 2–5.5 cm. Upper cauline leaves 3.5–10 × 1–2.5 cm. Indumentum scarce, with uniseriate and multisieriate eglanular trichomes, and short-stalked glands. *Capitula* several, 5(+), ca. 5 cm diam. including rays; involucre much shorter than rays, 2–2.5 cm diam.; peduncles 3.5–7 cm long, 1 mm wide. *Phyllaries* herbaceous, ovate to ovate-lanceolate, generally with acute apex, sometimes slightly papery at the base or at the margins; the outer 0.6–0.8 cm long, 1.7–2.5 mm wide; the inner 0.7–1 cm long, 0.7–1.6 mm wide. Indumentum mainly of uniseriate eglandular trichomes, sometimes also with multisieriate eglanular trichomes and glandular trichomes. *Receptacles* glabrous or pubescent. *Flowers* with yellow corollas. Ray flower corollas ca. 2.5 × 0.4 cm, oblong-elliptic to obovate-elliptic, apex generally with 3 teeth. Disc flower corollas up to 0.7 cm long. *Cypsela* brown and with a smooth to grooved surface, homomorphic, ca. 3 × 1 mm, glabrous or glabrate; pappus ca. 5.5 mm, white. Chromosome number 2n = 60 (Contandriopoulos, 1957).

**Illustrations.** Loiseleur-Deslongchamps (1807: tab. 20).

**Distribution.** Corsica. In forests and gullies and on rocky slopes that are sometimes inundated, altitude 700–1750 m (Fig. 19).

The type material cited in the protologue of *Arnica corsica* refers to one sheet from the D. Richard herbarium. This collection should be in P, but no material was found there. Unfortunately, the protologue includes only a crude and incomplete illustration that is not appropriate as a lectotype. Although the protologue and the illustration included both match the diagnostic features of this taxon, its formal identity needs further investigation in the search of an appropriate lectotype or a neotype.

Currently, this is the only species of *Doronicum* growing in Corsica (see comments under *D. grandiflorum*). Although *D. corsicum* is morphologically similar to *D. austriacum*, they differ basically in the homomorphic cypselae in *D. corsicum* versus dicromorphic in *D. austriacum*. In addition, *D. corsicum* has uniform, elliptic, sessile caulinar leaves with dentate margins, while *D. austriacum* presents different types of caulinar leaves in the same specimen (acropetally, petiolate to fiddle-shaped and ovate), with entire to slightly dentate margins.

**Selected specimens examined.** FRANCE. *Corse:* forêt d’Aitone bei Evisa, 20 July 1932, Aellen s.n. (MA); Calacuccia, Gol Gondo, 12 July 1912, Costurier s.n. (NY); Mt. d’Oro, 12 July 1916, Forsyth-Major s.n. (K); vallée de Mangamulou, près Virario, 18 July 1906, Gygerger s.n. (B); Calvi, Mt. Sollieu, 1822, Jacquesmont s.n. (NY); Tavignano, Corte, Kralik, 538 (E, K); Fiumorbe, Puzzi du Mt. Renoso, Kralik, 633a (E, K); l’Incudine, Lambitoton 86/C0/264 (MA); Lit de la Restonica, près de Corte, Malbile 142 (BM, K); Mt. Niolo, Requien 250 (BM, K); Bastelica, 18 July 1878, Reverchon s.n. (COI-WILK, E, K, N1); forêt d’Aitone, 1895, Reverchon s.n. (B, E, NY).


Plant up to 100(+) cm tall. *Rhizomes* woody, glabrous, generally without leaf remains. *Stems* branched in the upper part, leaves distributed along the stem, upper internodes generally longer than the adjacent leaves. Indumentum of triangular, white-tinted, multisieriate eglanular trichomes (1–5 mm), sometimes scattered, long-stalked glandular trichomes (0.5–3 mm), sometimes abundant near the capitula, and occasionally uniseriate eglanular trichomes and short-stalked glandular trichomes, sometimes glabrous at the base. *Leaves* entire to dentate. Basal leaves sometimes present at flowering time; blade 6–15 × 3.5–18.5 cm, orbicular or ovate, with cordate base and blunt or acute apex, with actinodromous venation; pappos 4.7–23 cm long, 3–3.5(6) mm wide, with sheathing base, sheath ca. 5 cm long. Lower and middle cauline leaves with blade 10–26 × 5–21.5 cm, similar to basal leaves or sessile, fiddle-shaped, semi-amplexicaul; pappos 12–20 cm long, 3.5–5.5 mm.
wide. Upper cauline leaves 4–9 × 1.6–7.5 cm, sessile, ovate to obovate, or bract-like. Indumentum similar to the adjacent part of the stem, sometimes also with uniseriate eglandular trichomes on margins and on veins in the abaxial surface of leaves. *Capitula* 2 to 8, 4–5.5 cm diam. including rays; involucre shorter than rays, 2.5–3.5 cm diam.; peduncles 2–9 cm long, 1.5–2.3 mm wide, sometimes turbinate at the base of capitula (4–7 mm wide) in fruit. *Phyllaries* herbaceous, ovate-lanceolate to obovate-lanceolate with acute apex; the outer 1.1–1.7 cm long, 2–5.5 mm wide; the inner 1.2–1.5 cm long, 1.5–2.3 mm wide. Indumentum similar to the upper part of stem. *Receptacles* glabrous. *Flowers* with yellow corollas. Ray flower corollas 1.5–2.5 cm long, 2–3.8 mm wide, obovate-elliptic to oblong-elliptic, apex generally with 3 teeth. Disk flower corollas 4–5 mm long. *Cypsela* brown, with smooth or slightly reticulate surface, dimorphic. Cypsela from ray flowers 2.8–4.3 cm long, 2–1.5 mm wide; the inner 1.2–1.7 cm long, 0.8–1.5 mm wide. Chromosome number unknown.

Illustrations. Figures 2C, D, 7D, 20A–D.

Distribution. Northeastern Turkey, Caucasus, and south of the Caspian Sea. Growing in woods, open moist rocky places, meadows, gullies, and near watercourses, altitude 800–3300 m (Fig. 14).

The type of indumentum is critical for distinguishing among species of *Doronicum* in southwestern Asia. The variability of this character both in type and abundance in *D. dolichotrichum* (Fig. 2C, D) sometimes makes it difficult to identify material conclusively. Plants with intermediate characters between *D. maximum* (Fig. 23B, C) and *D. macrophyllum* (Fig. 26B, C) have been found.

The diagnostic characters used to separate *Doronicum braecatum* (Edmondson, 1973), *D. hakkaricum* (Edmondson, 1973), and *D. hircicum* (Widler & Rechinger, 1950) overlap substantially with those of *D. dolichotrichum*. The patterns of indumentum variability also match those of *D. dolichotrichum*. Accordingly, these names are considered synonyms.

Selected specimens examined. **CAUCASUS**: North Caucasus: Daghestan, Schalbur dagh, Backir 183 (LE). Transcaucasia: Castrhalina, Tabischkuri, A. H. & V. F. Brothers 3506 (BM, G); Kachetia, Mt. Chozcal-dagh, 12 July 1898, Fumix s.n. (LE); Armenia, Migrj Gjunej, inter m. Gjeljedzhik et m. Ketschmas, 20 Aug. 1932, Karygjin & Groshein s.n. (K); Tilisskaja, Gorjiskij, Gora Tschinn-Tschar, 7 July 1916, Krylov & Scheitgen s.n. (LE); Batumskaia, Artvinskij, Arsijanskij, 16 June 1910, Nesterow s.n. (LE); Nachitschevan, Mt. Ketschal-dagh, 4 Aug. 1934, Prilipho & Isaw s.n. (K); Nor-Bajazet, Gri-zor, 16 Aug. 1929, Schelkonnikov & Kara-Murza s.n. (LE); Mt. Alagöz, Kacafar, 31 July 1931, Tumenshian & Maleer s.n. (E); Chokhatauri, Bakhmaro, Meshetskii, Mt. Gdzel-vake, 22 July 1979, Vizik & Zravshchian s.n. (G, W). IRAN: Azerbaidjan, Maku to Khoy, Kélisakandi, Assadi & Mazaffarian 30306 (E); Zanjan, Vansar mountains, 20 June 1983, Moussavi et al. s.n. (IRAN); Ostan 2, Dinelo, Schmid 5989 (G, W); Gorgan, Ketul, Sharif 224 (W); Azerbaidjan, Ahar, Hassano, 3 Aug. 1968, Termeh s.n. (IRAN); Azerbaidjan, Kalidar, Nahidjan, Koucha-ye Doghroum, 26 June 1978, Termeh et al. s.n. (IRAN). IRAQ: Helgord range, Rawi & Serhong 24553 (K); Qandil mountain, Qala Diza, Thesiger 1154 (BM). TURKEY. **Artvin**: Yalnizcan Sillesi, Sivasat, Alby et al. 3159 (K); Ardanuç, Kordevan dag, Yalnizcan Daglari, at Kütül yayla, Davis & Hedges 30342 (BM, E, K, W); Yalnizcan-Dergehi bei Karaköy, Savsat, Raus 4864 (B). **Erzurum**: Bingöz Köyü yaylas, Yıldız Dagi, Tatlı 5171 (E). **Hakkari**: Kara dag, Davis & Polunin 24383 (BM, E, K). **Kars**: Yagmurlu dag between Sarikamis and Karuargan, Davis & Hedges 30819 (E, K); Arpogay, Kaya Diplei, Ocalverdi 2340 (GAZI).


Plant up to 90 cm tall. *Rhizomes* woody to somewhat woody, glabrous, generally with leaf remains forming dark scales. *Stems* not branched, leaves generally arranged all along the stem, internodes generally shorter than adjacent leaves, indumentum of glandular trichomes (up to 2 mm), more abundant near the capitula, sometimes only very scarce eglandular trichomes or glabrate. *Leaves* entire. Basal leaves sometimes absent at flowering time; blade 2–7(9) × (0.2)1–2.5(3.2) cm, elliptic to obovate, with attenuate base and generally blunt apex, with actinodromous to pinnate-actinodromous venation; petiole 1–4.5 cm long, 2–5 mm wide. Lower and middle cauline leaves (3)5–12.5 × (0.3)1.5–4.5(5.5) cm, similar to basal leaves or sessile, obovate, ovate, elliptic, or almost fiddle-shaped, semi-amplexicaul, with blunt apex. Upper cauline leaves 2.5–6(7.5) × (0.4)0.5–1.5(3.6) cm, similar to middle cauline leaves or obovate-lanceolate. Indumentum similar to the adjacent part of stem, sometimes also with uniseriate eglandular trichomes and glands on margins. *Capitula* solitary, (4)5–7.5 cm diam. including rays; involucres shorter than rays, rarely equaling them, 3–5 cm diam. *Phyllaries* herbaceous, obovate-lanceolate to subulate; the outer 1.2–2(3) cm long, (1)1.5–2.5(3.5) mm wide. upper cauline leaves 4–9 × 1.6–7.5 cm, sessile, ovate to obovate, or bract-like. Indumentum similar to the adjacent part of the stem, sometimes also with uniseriate eglandular trichomes on margins and on veins in the abaxial surface of leaves. *Capitula* 2 to 8, 4–5.5 cm diam. including rays; involucre shorter than rays, 2.5–3.5 cm diam.; peduncles 2–9 cm long, 1.5–2.3 mm wide, sometimes turbinate at the base of capitula (4–7 mm wide) in fruit. *Phyllaries* herbaceous, ovo...
Figure 21. Distribution map for: Doronicum gansuense (●); Doronicum falconeri (▲); Doronicum stenoglossum (○).

wide; the inner 1–2 cm long, 0.7–2 mm wide. Indumentum similar to the upper part of stem, very scarce at the apex. Receptacles glabrous. Flowers with yellow corollas. Ray flower corollas 2–3 cm long, 1–2.5(3) mm wide, obovate-elliptic, apex with 2 or 3 teeth, sometimes without teeth, acute. Disk flower corollas 4.3–5.3 × 1.3 mm. Cypselae brown, with smooth surface, dimorphic, generally glabrous, sometimes with scattered eglandular or glandular trichomes. Cypselae from ray flowers without pappus. Pappus up to 5 mm, white. (Mature cypselae not seen.) Chromosome number unknown.

Distribution. Central-western China (provinces of Tibet-Qinghai and Xinjiang), Mongolia, Turkestan, Pamir, and Himalayas. Woods, open rocky places, gullies, and near watercourses, altitude 1800–5000 m (Fig. 21).

Caviller (1911) recognized two sympatric species, Doronicum falconeri and D. turkestanicum. The character claimed to distinguish them (shape of leaves) is vague and quite polymorphic, and based on it the differentiation into two groups of species is not easy to make. Some specimens determined by Caviller as D. falconeri and D. turkestanicum were included in a multivariate morphometric study (Álvarez Fernández & Nieto Feliner, 2001) resulting in no discrimination at all. Because of the lack of consistency in the delimitation between these two species, D. turkestanicum, which was described later, is here treated as synonym of D. falconeri.

Despite the recognition of Caviller's species Doronicum turkestanicum in a local floristic study (Gorschkova, 1961), this name was still lacking a type designation. Thus, in this work the best preserved specimen chosen among Caviller's citations as D. turkestanicum is designated as its lectotype (see synonym above).

The morphological similarities of Doronicum falconeri with other central Asian species is discussed above (see comments for D. altaicum and D. briquetii).

Selected specimens examined. CHINA. Tibet-Qinghai: Ata Kang La, Nagong, Kingdom Ward 10876 (BM, E). Xinjiang: Thianschan, Rigil-tasch, l’Ak-son, Brocherel 39 (G); Sairam, 18 July 1878, Frisow s.n. (LE, S); Tien Shan, Ununqi river, Liston 818-1 (MO); Mts. Bogdo-ola et Urumtschi, Merzbacher 1275 (LE, W); Pamir, Kashgar, Bostan Terek, 5 Aug. 1934, Persson s.n. (S); Tian-Shan, Karagajte, Sari-dzhasa, 30 June 1902, Saposhnikov s.n. (LE). INDIA. Uttar Pradesh: Bhowaini, Duthie 4127 (LE). Punjab: Rotang, Kalu Lahaul, Drummond 22598 (K); Rupin pass, Dhaula Dhar, Simla Hill, Sherriff 7405 (BM, E). JAMMU-KASHMIR. Kagan valley between Balakot and Babusar pass, Abel 94 (BM); Astor, Alamji Li, Duthie 12164 (BM, E, K); Burzil, Koelz 9429 (GH, NY); Srinagar, Vishenar, Lancaster 160 (BM); Haramukh, Lodlow & Sherriff 7850 (BM, E, UPS); Karakoram, Ghara glacier, Nagar, Polunin 6238 (B, BM, E); Karakoram, Hispar glacier, Turmum-Makerum, Russell 1235 (BM); Nafran, Lidder, Stewart 12638 (NY). KAZAKHSTAN. Talgarske,


Plant up to 30 cm tall. **Rhizomes** somewhat woody, glabrous, generally with leaf remains. **Stems** not branched, with leaves all along the stems, internodes generally shorter than adjacent leaves. Indumentum of glandular trichomes (up to 2 mm), more abundant near the capitula, sometimes glabrous at the base. **Leaves** entire. Basal leaves sometimes absent at flowering time; blade 1.4–3.5 × 1.5–3 cm, orbicular, suborbicular, or elliptic, with truncate or attenuate base and blunt apex, with axenodromous to pinnate-axenodromous venation; petiole 3–6.5 cm long, 0.6–1.5 mm wide. Lower and middle cauline leaves 3–5 × 1–3 mm, sessile, ovate-elliptic to widely elliptic, semi-amplexicaul. Upper cauline leaves 1.5–4 × 0.7–2 cm, similar to middle cauline leaves. Indumentum of uniseriate glandular trichomes (up to 0.5 mm), short-stalked glandular trichomes, and sometimes also long-stalked glandular trichomes, mainly on leaf margins, scarce, sometimes glabrous. **Capitula** solitary, 3–5.5 cm diam. including rays; involucres shorter than rays, 2–3 cm diam. **Phyllaries** herbaecous, 1.2–1.4 cm long, 1.5–2.5 mm wide, ovate-lanceolate to widely subulate, with blunt apex (bearing a sessile gland). Indumentum similar to the upper part of stem, more abundant at the base. **Receptacles** glabrous. **Flowers** with yellow corollas. Ray flower corollas 2–2.5 cm long, 2–3 mm wide, obovate-elliptic, apex generally with 2 or 3 teeth. Disk flower corollas ca. 5 × 2 mm. **Cypselae** brown, homomorphie, ca. 3 × 1 mm, with eglandular trichomes or glabrate, sometimes glandular. Pappus up to 4 mm, white. (Mature cypselae not seen.) Chromosome number unknown.

**Illustrations.** Chen (1998: 36, fig. 1); Álvarez Fernández & Nieto Feliner (2000: 251, fig. 1); Figure 4A–D.

**Distribution.** Central China (provinces of Gansu and Sichuan). Woods, rocky places, and grassy slopes, altitude 3000–3700 m (Fig. 21).

After the name *Doronicum cavillieri* (Álvarez Fernández & Nieto Feliner, 2000) was published, the authors realized that a previously published name of which they were not aware corresponded to the same species. Although the type material of *Doronicum gansuense* was not available for the present study, plants from the type locality, as well as from other localities cited in protologue were examined. Morphological relationships of *D. gansuense* with other central Asian species is discussed above (see comments for *D. altaicum* and *D. briquetii*).


Plant up to 30 cm tall. **Rhizomes** fleshy to somewhat woody, with shining white-tinted short trichomes on nodes, generally with leaf remains. **Stems** not branched, with leaves mainly at the base.
or on the middle lower part of stem. Indumentum of short-stalked glandular trichomes, also with eglandular trichomes more abundant near the capitula. Leaves entire to slightly dentate. Basal leaves generally present at flowering time; blade 1.5–4.5 × 1–2 cm, elliptic to ovate-elliptic, with truncate or attenuate base, blunt to subacute apex, with actinodromous to pinnate-actinodromous venation; petiole 2–6 cm long, 1–2.5 mm wide. Lower and middle cauline leaves 3–7.5 × 1–4 cm, similar to basal leaves or sessile, ovate-elliptic to narrowly elliptic, semi-amplexicaul. Upper cauline leaves 1.5–3.5 × 0.3–2 cm, similar to middle cauline leaves, or ovate-lanceolate. Indumentum of stiff, acute, and shiny eglandular trichomes (up to 2.5 mm), mainly on leaf margins, and also short-stalked glandular trichomes. Capitula solitary, 4–5.5 cm diam. including rays; involucre shorter than rays, generally with 3 teeth. Disk flowers up to 4 cm long, 2.5–3 mm wide, obovate-elliptic, apex with yellow corollas. Ray flowers 2–2.2 mm long, 2.5–3 mm wide, obovate-elliptic, apex generally with 3 teeth. Disk flower corollas up to 4 mm long, Cypselae brown, with grooved-reticulate surface, homomorphic, up to 2 mm long, with eglandular trichomes or glabrate. Pappus up to 4 mm, white. Chromosome number 2n = 60 (Polatschek, 1966, as D. calceatum; Lovka et al., 1972).

Illustrations. Jacquin (1773: tab. 92, 1789: tab. 586); Sturm (1814: tab. 19.2); Reichenbach (1854: tab. 62, tab. 63 figs. 1, 3); Hegi (1928: fig. 431); Figure 3C–E.

Distribution. Europe (central-eastern Alps). Open moist rocky places and screes, altitude 1000–2000 m (Fig. 19).

In 1773 Jacquin described Arnica doronicum. This species corresponds to Doronicum and although Jacquin named it first, the ICBN (Greuter et al., 2000) does not allow the use of the same epithet for both genus and species; thus the correct epithet is “glacieale” given by Wulfen in Jacquin (1786). Part of Jacquin’s collection is kept at LINN. When this herbarium was studied, one sheet of Jacquin’s material labeled as “Arnica doronicum” was found. To clarify as far as possible the identity of Jacquin’s name, its lectotype is designated here (see D. glaciale synonyms).

Doronicum glaciale is a species very similar to D. clusii and to a lesser extent to D. grandiflorum. Similarities and differences among these species are discussed above (see comments for D. clusii).


Plant up to ca. 70 cm tall. Rhizomes fleshy to somewhat woody, with shining white-tinted short trichomes on nodes, generally with leaf remains. Stems generally simple. Indumentum of short- and long-stalked glandular trichomes, also with multi-seriate eglandular trichomes more abundant near the capitula. Leaves slightly dentate to dentate; basal leaves sometimes present at flowering time; blade 3–6(7) × (1)2–5 cm, ovate-elliptic, ovate or sub-oblanceolate, with subcordate, truncate or attenuate base, blunt apex, actinodromous venation; petiole 10(20)–1.5 cm long, 1–4(6) mm wide. Lower and middle cauline leaves (1)4–9(13.2) × (1)1.5–6(7) cm, similar to basal leaves or sessile, ovate-elliptic, sometimes almost fiddle-shaped, semi-amplexicaul. Upper cauline leaves 1.2–5.5 × 0.5–2 cm, similar to middle cauline leaves, ovate to lanceolate.

Selected specimens examined. AUSTRIA. Kärnten: Gartnerkofel zur Kühnveter Alp., 15 July 1928, Bothe s.n. (B); Wolayer-Alpe, Bierbaum, Lesachtal, 25 July 1907, Engelhardt s.n. (B); Steinhütte, Bärenthal, Karawanken, Hodgkin 168 (K); Wolayer See, Quital, Hodgkin 220 (K); Gloknerhaus am Steige zur Pasterze, 27 July 1899, Schulz s.n. (B). Südtirol: Rabstädter Tauern, Pfl Menispitze, Jacquemourn 3888 (G); Auf den Thanern bei Wildbad Sastein, July 1892, Pickler s.n. (G); Pinzgau, Salzburger, Sauter 971 (K); Gamskar Kogel, Wyatt 28 (K); Sulzkar, Ennrother Alps, Wyatt 89 (K). Steiermark: Graftenalpe prope Kraukaudorf, July 1902, Fest s.n. (K); Mt. Hochschwab, Aug. 1887, Steininger s.n. (G, LY). Tirolo: Virgen in valle Isolae, 10 Aug. 1873, Ausserdorfer s.n. (E, K); Kleiner Ispeital, Johannishütte, July 1929, Beger s.n. (B); Gröden, Dolomiten, Hochjoch, Geislen gruppe, 27 July 1907, Bornmüller s.n. (B); montem Weisspitz pr. Herzing, Aug. 1883, Hauer s.n. (K); Pflumenseetauern, Bavaria, 25 July 1955, Lauenert s.n. (BM); Lienz, auf der Zoche, Henschhammer Alpe, 31 July 1999, Schulz s.n. (B); Steinhaus, June 1878, Treffer s.n. (B); Tristen in Weissenbach, 24 July 1890, Treffer s.n. (G); Bendelstein, Wippthal, Wyatt 56 (K). GERMANY. Bayern: Steineige zehhatte Triften in Hasenthal Prettan, Aug. 1882, Treffer s.n. (B). ITALY. Trentino-Alto Adige: Trento, Campitiello di Fassa, col Rodella, Álvarez et al. 1350 (MA). SWITZERLAND. Furrpass, Röhngletscher, 24 July 1886, Bornmüller s.n. (B).
Indumentum mainly of glandular trichomes, sometimes also with eglandular trichomes. Capitula 1(to 4), 3.5–5.5 cm diam. including rays; involucres shorter than rays, 2–4 cm diam. Phyllaries herbaceous, ovate-lanceolate to widely subulate; the outer 1–2(2.5) cm long, 1.5–4 mm wide; the inner 1–2 cm long, 1–2.8 mm wide. Indumentum of glandular trichomes, sometimes also with eglandular trichomes. Receptacles glabrous to glabrate. Flowers with yellow corollas. Ray flower corollas 1.3–2.6 cm long, 2–4.5 mm wide, obovate-elliptic, apex generally with 3 teeth. Disk flower corollas 3.5–5 × 1–2.5 mm. Cypselae brown, with grooved-reticulate surface, homomorph, 2.5–4.5 × 0.5–1.5 mm, with eglandular trichomes or glabrate, sometimes with glandular trichomes. Pappus up to 5.5 mm, white. Chromosome number 2n = 60 (Favarger & Huynh, 1964; Favarger & Küpfer, 1968).

Illustrations. Jacquin (1776: tab. 349); Sturm (1814: tab 19.2); Reichenbach (1854: tab. 62); Săvulescu (1964: pl. 188 fig. 1); Bolòs & Vigo (1995: 837); Figure 3A, B.

Distribution. Central-western Europe. Open moist rocky places, scree, and near watercourses, altitude 900–3000 m (Fig. 22).

Variable in size and shape of basal leaves and type of indument. Based on the latter, two species were recognized in the previous revision of the genus (Cavillier, 1907), Doronicum viscosum and D. portae, which are separated virtually solely by glandular versus mainly eglandular indumentum, respectively. Although type material of D. viscosum was not seen, several populations from the type locality were studied. The type material of D. portae was found at FL, and its lectotype is designated above. Abundant intermediates preclude recognition of these two species, which are here placed as synonyms of D. grandiflorum.

To clarify as far as possible the confusion around the epithet “scorpioides” the lectotype for Doronicum scorpioides is designated above. In the protologue, Lamarck mentioned “Arnica scorpioides L.,” referring to Jacquin’s plate Arnica scorpioides L. (Jacquin, 1776: tab. 349). Although the type of Linnaeus’s name corresponds to D. pardalianches L., Jacquin’s plate represents a specimen of D. grandiflorum, as well as the only sheet kept at P-LA with the handwritten “Arnica scorpioides L.” (see comments below about D. pardalianches).

Although similar in their morphology, the differences in the type of indument among Doronicum grandiflorum, D. clusii, and D. glaciale are quite clear. In D. grandiflorum the trichomes are never entangled and always have a blunt apex (generally ending in two cells), and the stalked glands are similar to these trichomes (Fig. 3B) but with a glandular apex (generally two or more cells containing a brown substance). In D. glaciale the trichomes are stiff with an acute apex, and in D. clusii, which
also has this latter type of indumentum, trichomes are very thin, long, and entangled (see comments under D. clusi).

Some populations of Doronicum grandiflorum from the Cantabrian range in northern Spain have broadly ovate to suborbicular, scarcely dentate to subentire basal leaves, and are difficult to distinguish from D. carpetanum subsp. diazii. These two taxa are similar but the nature of their relationship is not clear. A likely hypothesis, which should be investigated, is that D. carpetanum subsp. diazii is of hybrid origin, its putative progenitors being D. grandiflorum and D. carpetanum subsp. carpetanum.

Although widely distributed in the European mountains, the most recent collection of Doronicum grandiflorum from Corsica was in 1917, suggesting that it is now extinct there.


Plant up to 100(+) cm tall. Rhizomes woody, glabrous, with or without leaf remains. Stems branched in the upper part, leaves distributed along the stem, upper internodes generally longer than the adjacent leaves. Indumentum of multiseriate and uniseriate white eglandular trichomes (ca. 0.2 mm), abundant near the capitula, sometimes glabrate. Leaves entire to dentate. Basal leaves sometimes present at flowering time; blade ca. 11 × 12–12.5 cm, orbicular or ovate, with cordate base and generally blunt apex, with actinodromous venation; petiole 12–20 cm long, with sheathing base, sheath ca. 6–8 cm long. Lower cauline leaves with blade ca. 23 × 18 cm; petiole (0.7)–37.5 cm long, similar to basal leaves. Middle cauline leaves ca. 16 × 9 cm, sessile, fiddle-shaped, semi-amplexicaul. Upper cauline leaves ca. 5 × 2.5 cm, similar to middle cauline leaves or ovate to obovate, sometimes bract-like. Indumentum similar to the adjacent part of the stem and with short-stalked glandular trichomes, generally scarce, more abundant on margins of leaves. **Capitula** up to 17(+), ca. 4 cm diam, including rays; involucres shorter than rays, ca. 2 cm diam.; sometimes turbinate at the base of capitula in fruit. **Phyllaries** herbaceous, ca. 1.3 cm long, 2 mm wide, obvate-lanceolate to obovate-lanceolate and acute. Margins scarcely and slightly fimbriate. Indumentum similar to the upper part of stem, sometimes with scarce multiseriate eglandular trichomes. **Receptacles** glabrous or glabrate. **Flowers** with yellow corollas. Ray flower corollas 1.3–1.6 cm long, 2–4 mm wide, obovate-elliptic to obovate-elliptic, apex generally with 3 teeth. Disk flower corollas 4–4.5 × 1.5 mm. **Cypsela** brown, with smooth to slightly grooved surface, dimorphic. Cypsela from ray flowers 4–6 × 1.5–2 mm, glabrous or glabrate, without pappus. Cypsela from disk flowers 3.5–4 × 1.2–1.7 mm, sometimes with eglandular trichomes; pappus 3.5–4.5 mm, white. Chromosome number unknown.

**Illustrations.** Figure 23F–J.

**Distribution.** Northern and central Turkey (provinces of Giresun, Kayseri, and Maras). Meadow and near watercourses, altitude 2100–2600 m (Fig. 24).
There are several Turkish species included in the same morphological group (see comments for D. cacaliifolium and D. dolichotrichum above) that are distinguished from each other only based on the type of indumentum. Doronicum haussknechtii is included in this group, and morphologically the most similar species is D. maximum, which also overlaps part of its area of distribution with D. haussknechtii (Fig. 24). In both D. haussknechtii and D. maximum, the indumentum on the phyllaries is very scarce or even absent (Fig. 23B, C, H, I), while the rest of the Turkish species have pubescent or glandular phyllaries. The characters to distinguish between these two species are the white pubescence at the top of the peduncle (base of the capitulum) in D. haussknechtii (Fig. 23F, G), which is glabrous in D. maximum (Fig. 23A), and the scarcely fimbriate margins of phyllaries in D. haussknechtii (Fig. 23H, I), which are entire, sometimes with glands in D. maximum (Fig. 23B, C).

The diagnostic characters used to separate Doronicum tobeyi (Edmondson, 1973) overlap substantially with those of D. haussknechtii, and its patterns of indumentum match those of D. haussknechtii. Accordingly, this name is considered a synonym.


Plant up to 80 cm tall. Rhizomes fleshy, glabrate to scarcely pubescent, with inconspicuous shining white-tinted trichomes on nodes, thick and short, sometimes stoloniform, with buds. Stems generally unbranched, scape-like. Indumentum mainly glandular, with short-stalked and long-stalked glandular trichomes, sometimes also uniseriate and multiseriate eglandular trichomes, more abundant near the capitula. Leaves entire, rarely subdeterminate. Basal leaves generally present at flowering time; blade 4–9 × 1–3 cm, oblong-elliptic with truncate or attenuate base, blunt apex, with acrodromous venation; petiole 4–8 cm long, 1–2 mm wide. Lower cauline leaves 3–11 × (0.5)1–2.6 cm, similar to basal leaves or sessile, elliptic to fiddle-shaped, sometimes semi-amplexicaul. Upper cauline leaves 2–5 × 0.4–1.3 cm, ovate-lanceolate, sometimes bractlike. Indumentum with uniseriate eglandular trichomes and short-stalked glands, scarce. Generally also with long multiseriate eglandular trichomes (up to 5 mm), mainly on the adaxial surface of middle vein. Capitula 1(2 to 3), 3–6 mm diam, including rays; involucrate a little shorter than rays or equaling them, 2.5–4.5 cm diam. Phyllaries herbaceous, ovate-subulate, generally with acute apex; the outer 1–1.5 cm long, 1–1.5 mm wide; the inner 1.1–1.8 cm long, 0.7–1 mm wide. Margins sometimes ciliate, with acute, stiff and equidistant multiseriate eglandular trichomes (up to 1 mm). Indumentum mainly glandular. Receptacles glabrous or scarcely pubescent. Flowers with yellow corollas. Ray flower corollas 1.4–2.5 cm long, 1–2(3) mm wide, oblong-elliptic, apex generally with 3 teeth. Disk flower corollas up to 4 mm long. Cypselae brown, with
rugose-reticulate surface, dimorphic. Cypsela from ray flowers 2–2.3 × 0.6–1 mm, generally glabrous, without pappus. Cypsela from disk flowers 1.7–2 × 0.7–1 mm, with eglandular trichomes; pappus up to 3.5 mm, white. Chromosome number 2n = 60 (Baksay, 1956).

Illustrations. Reichenbach (1854: tab. 65, fig. 966 I 1–8); Săvulescu (1964: pl. 98, fig. 1); Figure 1B.

Distribution. Eastern Europe (Balkans, Carpathians, and Ukraine). Forests and meadows, altitude 160–1900 m. Cultivated and sometimes naturalized (Fig. 25).

The name *Doronicum plantagineum var. hungaricum* Sadler (1840) was published before the accepted name for this species, *Doronicum hungaricum* Rehb. fil. (1854). Plants collected by Sadler are included in the protologue of Reichenbach’s specific name. However, in the protologue Reichenbach did not mention the earlier name, and so his name is not based on Sadler’s.

The name *Doronicum longifolium* Rehb. (1831–1832) is clearly a synonym of *Doronicum clusii* (All.) Tausch. However, when Grisebach (1846) combined it as *Doronicum plantagineum var. longifolium* (Rehb.) Griseb., his description and geographical distribution were those of *D. hungaricum*, not *D. clusii*. Later, the same author (Grisebach & Schenk, 1852) explicitly treated Reichenbach’s name as a synonym of *D. plantagineum var. hungaricum* Sadler. Thus, the names *D. longifolium* auct., non Rehb., and *D. plantagineum var. longifolium* (Rehb.) sensu Griseb. are synonyms of *D. hungaricum* Rehb. fil.

*Doronicum hungaricum* could be confused with *D. clusii*, *D. glaciale*, and the Caucasian *D. oblongifolium* because of the elliptic entire basal leaves and similar habit in some specimens of those species, but in the case of *D. hungaricum* the rhizome is fleshy with pubescent nodes, the basal leaf venation has a acrodromous pattern, and the phyllary margins are ciliate to somewhat ciliate. All these characters together lead to the inclusion of this species in the morphologic and phylogenetic “plantagineum” group (see Phylogeny above and Fig. 9). Within this group the most closely related species is *D. plantagineum*, which differs mostly in the shape of basal leaves (ovate in *D. plantagineum* vs. elliptic in *D. hungaricum*) and in the type of
Doronicum hungaricum is considered the vicariant species of D. plantagineum in eastern Europe, although it has a more restricted area than D. plantagineum has in western Europe and northern Africa (Fig. 25).

Selected specimens examined. BULGARIA. Pazardzhi: Belovo, May 1894, Străboun s.n. (E, K); Sestrimo, May 1907, Stibrný s.n. (E). Plovdiv: Krichim, May 1901, Stibrný s.n. (E). Ruse: Mt. Rhodope ad Casovo, 26 May 1900, Stibrný s.n. (W); Rhodope ad Stanimaka, May 1900, Stibrný s.n. (G). Varna: Varna, Gilliat-Smith 554 (K); Kamey, Schneider 300 (B, BM, MO). HUNGARY. Baranya: Vrabélyi s.n. (G); Kamerdzhi: Prope Budam, 16 May 1904, Degen s.n. (B); Mt. Haraszheg prope Budapest, May 1885, Degen s.n. (B); Mt. Kamen prope Pomáz, 16 May 1904, Degen s.n. (LE); vollis Farkasvölgy prope Budam, Filarszky & SchillerSZky s.n. (B, BM, E, G, K, MO, NY); Leopoldifeld bei Ofen, 1873, Freyn s.n. (W); Budapest, Crilleberc bei Budakeszi, 24 May 1933, Korb s.n. (W); Mt. Kopaszhegy, Nagykovács supra Budapest, 28 Apr. 1912, Kümmerle Szurdik & Tiňski s.n. (B, BM, E, G, K, MO, NY); Kammerwald, prope Budam, Richter 520 (B, BM, G, W). Tolna: Mt. Csikás, Simontornya, 27 May 1875, Tusscher s.n. (G, LE). ROMANIA. Alba: Blaj, Apr. 1923, Pop s.n. (E, G, K, MO, W). USAINE. Strasheinek, 28 May 1955, Anania s.n. (LE); Chernaya, 22 Apr. 1961, Fodor s.n. (LE); Zlotij, Bendery, 23 Apr. 1999, Pacczuki s.n. (LE); Stramenskogo, 6 May 1948, Shirokova s.n. (LE). YUGOSLAVIA. Srbija: Belgrad, Taperider, 1888, Bornmüller s.n. (B); Gabrovac prope Nischt, Petrosič 2200 (BM, G, K, W).


Plant up to 130 cm tall. Rhizomes woody to somewhat woody, glabrous. Stems branched in the upper part or sometimes from the base, internodes generally longer than the adjacent leaves. Indumentum in the lower part of stem made up of multiseriate, retrorse and white-tinted eglandular trichomes (up to 4 mm), sometimes absent, upper part of stem generally glandular, with long-stalked glandular trichomes (up to 4 mm), sometimes also with uniseriate or multiseriate eglandular trichomes, rarely without glands; apex of glandular trichomes capitate, with more than 6 cells, peduncle capillary. Leaves entire to slightly dentate. Basal leaves generally absent at flowering time; blade 3.5–6.5 × 3.5–7 cm, ovate to ovate-elliptic, with attenuate, truncate, or subcordate base and generally blunt apex, with pinnate-actinodromous venation; petiole 5–16 cm long, 1.5–2 mm wide. Lower cauline leaves 3–11 × (0.8)2.5–9 cm; petiole 3–13 cm long, 1.5–4 mm wide, similar to basal leaves. Middle cauline leaves 7–15.5 × 3–10 cm, sessile, fiddle-shaped, semi-amplexicaul. Upper cauline leaves (0.8)1.5–7.5(11.6) × (0.1)0.8–4.5(6.2) cm, ovate-lanceolate, sometimes bract-like. Indumentum similar to the adjacent part of the stem. Capitula 2 to 18, 1.5–4 cm diam. including rays; involucre shorter than rays, 0.8–3 cm diam.; pedenules 1–10(18.5) cm long, 0.5–1.5(2) mm wide. Phyllaries hermabaceous, ovate-subulate, generally with acute apex; the outer 0.6–1.2 cm long, 1–3 mm wide; the inner 0.6–1.2 cm long, 0.5–1.5 mm wide. Indumentum similar to the upper part of stem. Receptacles glabrous. Flowers with yellow corollas. Ray flower corollas 0.8–1.5 cm long, 1.2–2 mm wide, oblong-elliptic, apex generally with 3 teeth. Disk flower corollas 2.5–4 × 1–2.5 mm. Cyp- selae brown to brown-red with groove-reticulate surface, dimorphic. Cypselae from ray flowers 2–3.6 × 1–1.5 mm, glabrous or glabrate, without pappus. Cypselae from disk flowers 2–3 × 1–1.5 mm, with eglandular trichomes; pappus (1.7)2–4 mm, white to yellow. Chromosome number 2n = 60 (Vir Jee & Kachroo, 1989, as D. roylei).

Illustrations. Figures 8D, 20E–I.

Distribution. Central-southern Asia (Jammu-Kashmir to Nepal, Bhutan, and Tibet). Forests and meadows, elevation 1900–5000 m (Fig. 11).

There is only one species in central-southern Asia, Doronicum stenoglossum, which could become confused with D. kamaonense because of their similarities in habit. The differences between them are remarkable, since both have unique characters within the genus. Doronicum stenoglossum has corollas pale yellow to green shaded, linear ray flower corollas, and linear phyllaries (Fig. 4E, F). In D. kamaonense the type of indumentum at the base of the capitulum (glandular trichomes with a capillary peduncle and capitulate apex bearing 6 or more cells; Figs. 8D, 20E, F) is a character to distinguish it from other species. Although the area of distribution of D. kamaonense overlaps in part with D. briquetii and D. falconeri (see comments for these species and Figs. 11, 21), there are no noticeable morphological similarities between those and D. kamaonense.

The name Doronicum roylei DC. was in use until the recent realization that the name Fullartonia ka-
maonensis DC. represents the same species and that it has priority (Álvarez Fernández, 2001).

Selected specimens examined. BHUTAN-SIKKIM. Sikkim, Gharu napo, Cooper 2867 (E). CHINA. Sichuan: Shingling, Me La, Ludlow et al. 20406 (E); Tibet-Qinghai: Chumbi, Cooper 230 (E). INDIA. Uttar Pradesh: Chitona, Telhi, Koelz 22552 (NY); Ghahval, Gaunikând via Trjugi Naran and Máser Tal to Bilung, 1855, Schlagintweit s.n. (GH); JAMMU-KASHMIR. Grorai, Fisch., Cat. 19. Doronicum macrophyllum


Plant up to 120(+) cm tall. Rhizomes woody to somewhat fleshy, glabrous, with or without leaf remains. Stems branched in the upper part, leaves distributed along the stem or mainly on the basal part of stem, upper internodes generally longer than the adjacent leaves. Indumentum of uniseriate (ca. 0.2 mm), multiseriate (up to 1 mm) eglandular trichomes, and glandular trichomes (0.5–2 mm) generally abundant near the capitula, sometimes glabrate at the base. Leaves entire to dentate. Basal leaves sometimes present at flowering time; blade (8)19–26(30) × (7)17–23 cm, orbicular or ovate, with cordate base and blunt or acute apex, with actinodromous venation; petiole 7–18 cm long, with sheathing base, sheath 3–8(10.7) cm long. Lower cauline leaves with blade 6–24 × 15–19.5 cm; petiole 9–33 cm long, 1–5 mm wide, similar to basal leaves. Middle cauline leaves 5–21.5 × 2–16.5 cm, sessile, fiddle-shaped, semi-amplexicaul. Upper cauline leaves 3–17 × 0.9–14(15) cm, similar to middle cauline leaves or ovate to obovate, sometimes bract-like. Indumentum similar to the upper part of stem, more abundant on margins and on veins on the abaxial surface of leaves. Capitula 2 to 13, 3–5.5(7) cm diam. including rays; involucre shorter than rays, 1.5–3.5(4.5) cm diam.; peduncles (1.5)3–10.5(16) cm long, 1–1.6 mm wide, sometimes turbinate at the base of capitula (1.3 cm wide) in fruit. Phyllaries herbaceous or sometimes slightly papery at the base or at the margins, 0.6–1.5(2) cm long, 0.8–3(4) mm wide, ovate-lanceolate to obovate-lanceolate or subulate. Indumentum similar to the upper part of stem.

Receptacles glabrous or glabrate. Flowers yellow. Ray flower corollas 1.5(1.9)–3(3.5) cm long, (1.7)2.3–3.3(5) mm wide, obo-v-lanceolate to oblong-elliptic, apex generally with 3 teeth. Disk flower corollas (3)4–6 × 1.5–2.5 mm. Cypselae brown, with smooth to grooved surface, dimorphic. Cypselae from ray flowers 3–4.5 × 1–1.3 mm, glabrous or glabrate, without pappus. Cypselae from disk flowers (2)2.3–4.5 × 0.5–1.15 mm, sometimes with eglandular trichomes; pappus (1.5)3–5 mm, white. Chromosome number 2n = 30, 60 (data obtained from two indexes of plant chromosome numbers: Fedorov, 1969; Goldblatt, 1983; original sources not seen).

Illustrations. Figures 24, 26A–D.

Distribution. Northern Turkey and Caucasus. Growing in woods, open moist rocky places, meadows, and near watercourses, altitude 1500–3700 m.

The characters distinguishing this species from others in southwestern Asia are mainly based on the type of indumentum (see comments on D. dolichotrichum). Doronicum macrophyllum is a polymorphic species, and within it, two subspecies can be distinguished:

Key to the subspecies of Doronicum macrophyllum

1. Plants generally with more than 3 capitula and more than 3 cauleine leaves (including bract-like leaves) .................................................. 19a. D. macrophyllum subsp. macrophyllum

1’ Plants bearing 1 to 3 capitula and 2 or 3 cauleine leaves (including bract-like leaves) .......................... 19b. D. macrophyllum subsp. sparsipilosum

19a. Doronicum macrophyllum subsp. macrophyllum

Rhizome woody. Stem with more than 3 cauline leaves. Plants generally bearing more than 3 capitula, which are sometimes turbinate at the base (1.3 cm wide) in fruit. Chromosome number unknown.

Illustrations. Avetisyan & Oganesyan (1995: tab. 174); Figure 26A–D.

Distribution. Northern Turkey and Caucasus. Growing in woods, open moist rocky places, meadows, and near watercourses, altitude 1500–3700 m (Fig. 24).

All the specimens from the only collection of *Doronicum macrolepis* differ from *D. macrophyllum* in size of capitula. Although the population is somewhat anomalous, the name is treated as a synonym of *D. macrophyllum* subsp. *macrophyllum*. The diagnostic characters used to separate *D. balansae* (Caviller, 1911) overlap substantially with those of *D. macrophyllum* subsp. *macrophyllum*. Besides, the patterns of indumentum variability match those of *D. macrophyllum* subsp. *macrophyllum*. Accordingly, this name is considered a synonym.

Selected specimens examined. CAUCASUS. NORTH CAUCASUS: Dagestan, Dargi, Maara, Akoscha, Alexenko 12867 (LE); Sharoi, Sharooqun, Serchikhii, Aserianov et al. 2837 (LE); Schelbur dagh, Daghestani, Becker 132 (LE); Digoriya, Tatars, Digi-Or-Tors, 12 Aug. 1927, E. & N. Busch s.n. (LE); Stavropolskii, Karachaevo-Cherkesskaya, Pastvishnogo, Getman et al. 1179 (LE); Checheno-Ingusbsaya, Argun, Itum-kale, Getman et al. 2358 (LE); Beschtau, June 1932, Hohemacker s.n. (G, GH, K, W); Kulba, Kardtokiurt, 5 July 1890, Lipsky s.n. (LE); Kavardino-Balkariya, Bilini, Aktopark, 18 July 1990, Menitskij et al. s.n. (LE); Dagestan, Lakskij, 9 Sep. 1927, Poretsky & Schultz s.n. (LE). TRANCEAUCAUS: Ossetia, Britsabzeli, Didi Liachva, A. H. & V. F. Brotherus 500 a (S); Trsk, Adai-su, E. & N. Busch 47 (S); Teberda, 18 June 1968, Ehewald & Wendt s.n. (B); Cartalinia, Mts. Tkakura-Tzkharo, 9 July 1923, Juzepczuk s.n. (LE); Azerbajdzhan, Kuba, Leze, Schach-dagh, 8 July 1935, Karagin s.n. (NY); Azerbajian, Baku, Gandzha, Rashnar-dagh, 30 June 1929, Kasamova s.n. (LE); Azerbajian, Karabach, Lzyagorsk, 30 June 1929, Kolakowski s.n. (LE); Armenia, Daratschitsch, Radle 400 (LE); Tiffs, Mt. Sagharumot, 6 July 1919, Schischkin s.n. (BM); Svanetia, Latiuri inter flumina Hippum et Ingur, Somnier & Levier 709 (G); Gruzinskaya, Bogdanowskij, Bogdanovka, Tisev & Cher-panow 1932 (LE); Goris, Mts. Karabaksksoke, Brun, 27 July 1975, Voss k.s.n. (B); Tiffs, Wittmann 294 (LE); IRAN, Azerbajian, Qareh-Dagh, Aliabad, Lamond & Termin 4876 (E, G, IRAN, K, W). TURKEY. ARTVIN: Yusufeli, Altiparmak, Kaçkar Daglari, Aytas 2933 (GZAI).


Plant up to 90 cm tall. Rhizomes woody to somewhat fleshy. Stems with 2 or 3 cauline leaves. Blade of basal leaves 6.5–13.5 × 7–11 cm. Blade of lower cauline leaves 7.5–9.6 × 9.3–12 cm. Middle and upper cauline leaves 4.5–11 × 3–6 cm. Capitula 2 or 3, ca. 6.5 cm diam. including rays; involucre ca. 3.5 cm diam.; peduncles up to 16 cm long. Receptacles glabrous. Ray flower corollas 1.9–3.5 cm long, 1.7–4 mm wide. Disk flower corollas 3.5–4.5 mm long. Pappus 1.5–3.5 mm (on immature ovaries). Chromosome number unknown.

Distribution. Northern Turkey (provinces of Bolu and Kastamonu). Growing in woods and open moist rocky places, altitude 1700–2200 m (Fig. 24).

Selected specimens examined. TURKEY. BOLU: Ala dag, Kartal Kaya, Davis & Coode 57370 (E, K). KASTAMONU: Ilgaz Dag, Davis et al. 39312 (E, K); Ilgaz, Karakol, Çankirt, Nydegger 19037 (G).

This subspecies combines characters from two species of *Doronicum*. Rhizome, phylary shape, and indumentum are similar to *D. macrophyllum* subsp. *macrophyllum*, while size and leaf arrangement are similar to *D. orientale*. It was described as a subspecies of *D. bithynicum* J. R. Edm., which is considered a synonym of *D. reticulatum* Boiss., but the diagnostic character for this species (ovate phyllaries with a dark-colored major venation and a long tapered-acute apex) does not occur in sub-species *sparsipilosum*. The subspecies has the phylary type and other characters of *D. macrophyllum* subsp. *macrophyllum*, from which it differs mainly in having fewer capitula and in leaf arrangement, and there are intermediate specimens.

Plant up to 100(+) cm tall. Rhizomes woody, glabrous, with or without leaf remains. Stems branched in the upper part, leaves distributed along the stem, upper internodes generally longer than the adjacent leaves. Indumentum of multisieriate and uniseriate eglandular trichomes (ca. 0.2 mm) and glandular trichomes (up to 1.7 mm), scattered, sometimes glandular. Leaves entire to dentate. Basal leaves sometimes present at flowering time; blade 11–20 × 10–21.5 cm, orbicular or ovate, with cordate base and generally blunt apex, with actinodromous venation; petiole 8–36 cm long, with sheathing base, sheath ca. 3 cm long. Lower cauline leaves with blade 4.5–17 × 5.5–24 cm; petiole 6.5–40 cm long, 2–3.5 mm wide, similar to basal leaves. Middle cauline leaves 3–13 × 2–14 cm, sessile, blade-shaped, semi-amplexicaul. Upper cauline leaves 1.2–5.5 × 1–3.5 cm, similar to middle cauline leaves or ovate to obovate, sometimes bract-like. Indumentum similar to the adjacent part of the stem, generally scarce, more abundant on margins of leaves. Capitula 3 to 18(+), 2–4 cm diam. including rays; involucres shorter than rays, 1.5–2 cm diam., sometimes turbinate at the base of capitula (ca. 5 mm wide) in fruit. Phyllaries herbaceous, ovate-lanceolate to obovate-lanceolate and acute, glabrous or glabrate; the outer 0.7–1.2 cm long, 2–2.3 mm wide; the inner 0.9–1.2 cm long, 1.5–2.3 mm wide. Receptacles glabrous. Flowers with yellow corollas. Ray flow corollas 1.2–2 cm long, 1.5–3 mm wide, obovate-elliptic to oblong-elliptic, apex generally with 3 teeth. Disk flower corollas 4–5 × 1.5 mm. Cypselae brown, with smooth to slightly grooved surface, dimorphic. Cypselae from ray flowers 2.2–3.3 × 1–1.3 mm, glabrous or glabrate, without pappus. Cypselae from disk flowers 1.5–2.3 × 0.5–1 mm, sometimes with eglandular trichomes; pappus 3–5 mm, white. Chromosome number unknown.

*Illustrations.* Figures 8A, 23A–E.

*Distribution.* Eastern Turkey, south of Caucasus and south of the Caspian Sea. Moist rocky places and near watercourses, altitude 1700–3300 m (Fig. 24).

*Doronicum maximum* is morphologically close to those southwestern Asian species with a “macrophyllum” type of habit, and the type of indumentum is the only character to distinguish among them. Within this “macrophyllum” group it is more similar to *D. haussknechtii* than to any other (see comments on *D. haussknechtii*), but the almost absolute absence of indumentum at the base of the capitula in *D. maximum* makes it different (Fig. 23A–F).


Plant up to 50 cm tall. Rhizomes woody to somewhat woody, glabrous, generally with leaf remains forming fibers or dark scales. Stems not branched, leaves mainly in the lower middle of the stem. Indumentum of white eglandular trichomes (up to 2.5 mm), more abundant near the capitula, also with scarce glandular trichomes, sometimes glabrous at the base. Leaves entire to slightly dentate. Basal leaves generally present at flowering time; blade (1.8)2–6 × (0.9)1.5–3 cm, elliptic, with attenuate base, and generally blunt apex, with actinodromous to pinnate-actinodromous venation; petiole 3–10 cm long, 1–3 mm wide. Lower and middle cauline leaves 3.5–8(9.5) × 1.4–2.5 cm, similar to basal leaves or sessile, elliptic to ovato-elliptic, sometimes wide ovate to suborbiculate, semi-amplexicaul, with blunt apex. Upper cauline leaves (1.6)3–6 × (0.2)1–2 cm, similar to middle cauline leaves or ovato-lanceolate, sometimes bract-like. Indumentum similar to the adjacent part of stem, sometimes with white, tanged, uniseriate eglandular trichomes (up to 1 mm), more abundant on leaf margins. Capitula solitary, 4.5–7.5 cm diam. including rays; involucres shorter than rays, 2–5 cm diam. Phyllaries herbaceous, 1–1.5(2) cm long, 2.5–5 mm wide, ovato-lanceolate to elliptic. Indumentum similar to the upper part of stem, sometimes abundant. Receptacles glabrous. Flowers with yellow corollas. Ray flow corollas 2–3.5 cm long,
**2.5–5.5 mm wide, obovate-elliptic, apex with 2 or 3 teeth. Disk flower corollas 4–5 mm long. Cypsela brown, with striate-reticulate to warty surface, dimorphic, ca. 4 × 1 mm, generally glabrous, sometimes with eglandular trichomes or glabrate. Cypselae from ray flowers without pappus. Pappus up to 4.5 mm, white. Chromosome number 2n = 40, 60* (Davliandize, 1985; *Fedorov, 1969).**

**Illustrations.** Avetisyan & Oganesyan (1995: tab. 175); Figure 31, J.

**Distribution.** Caucasus. Open moist rocky places, and along watercourses, altitude 1400–3900 m (Fig. 24).

**Doronicum oblongifolium** is distinctive among the species from Caucasus. While the rest of the species in this area (except *D. orientale*) have the “macrophyllum” type of habit, *D. oblongifolium* bears only one capitulum and has elliptic basal leaves making it similar in habit to other European or central Asian species (e.g., *D. clusi*, *D. hungaricum*, *D. falconeri*, among others). Besides, the type of rhizome (woody, glabrous, and with fibrous leaf remains) is quite different from that of *D. orientale* (fleshy and with pubescent nodes). In addition, *D. oblongifolium* has a special type of indumentum on margins of basal leaves (Fig. 31, J).

The citation of the chromosome number 2n = 60 for *Doronicum oblongifolium* was found in Fedorov’s index (1969), but the original source for this data was not seen.

**Selected specimens examined.** CAUCASUS. North Caucasus: Dagestan: Kaitag, Tabassaran, Urgah, Dshufu dag, Alexeenko & Woronow 13358 (LE); Checheno-Ingushskaya, Argun, Iumi-kale, Averianov et al. 2421 (LE); Balkariya, Sukun, 1 July 1927, E. A. & N. A. Busch s.n. (LE); Karabach, Karabakht, Digoria, Ossetia, Alagir, Balkariya, Sukan, 1 July 1927, E. A. & N. A. Busch s.n. (LE); Dagestan, Kaitag, Tabassaran, Urgah, Dshufu dag, Alexcenko & Woronow 13586 (LE); Kaepes-Dagh, Karabach, June 1844, Kolenati s.n. (LE); Azerbajdzhan, Gandzha, Koshkar-dagh, 22 July 1928, Albiggina & Doluchanow s.n. (LE); Armenia, AlaÈgez, 20 July 1932, V. F. Brotherus 501 (BM, G, W); Armenia, Mt. Sanislo, 7 Aug. 1928, Kozlovsky s.n. (LE); Gruzinkaya, Chevsuretiya, Tsuvrovani, Choki, 6 Aug. 1982, Menitskij s.n. (LE); Azerbajdzhan, Nachitshevan, Zangezur, 27 May 1948, Kirpichnikov s.n. (LE); Azerbajdzhan, Mt. Akchur, Ardanucë, Kordevan dag, Yalnizcam Daglar, Davis & Hedge 30365 (E, K, W). Erzurum: Dumluda, Sorger & Buchner 82-123-9 (W).


**Selected specimens examined.** CAUCASUS. North Caucasus: Dagestan: Dukatag, Tabassaran, Urgah, Dshufu dag, Alexeenko & Woronow 13358 (LE); Checheno-Ingushskaya, Argun, Iumi-kale, Averianov et al. 2421 (LE); Balkariya, Sukun, 1 July 1927, E. A. & N. A. Busch s.n. (LE); Karabach, Karabakht, Digoria, Ossetia, Alagir, Balkariya, Sukan, 1 July 1927, E. A. & N. A. Busch s.n. (LE); Dagestan, Kaitag, Tabassaran, Urgah, Dshufu dag, Alexcenko & Woronow 13586 (LE); Kaepes-Dagh, Karabach, June 1844, Kolenati s.n. (LE); Azerbajdzhan, Gandzha, Koshkar-dagh, 22 July 1928, Albiggina & Doluchanow s.n. (LE); Armenia, AlaÈgez, 20 July 1932, V. F. Brotherus 501 (BM, G, W); Armenia, Mt. Sanislo, 7 Aug. 1928, Kozlovsky s.n. (LE); Gruzinkaya, Chevsuretiya, Tsuvrovani, Choki, 6 Aug. 1982, Menitskij s.n. (LE); Azerbajdzhan, Nachitshevan, Zangezur, 27 May 1948, Kirpichnikov s.n. (LE); Azerbajdzhan, Mt. Akchur, Ardanucë, Kordevan dag, Yalnizcam Daglar, Davis & Hedge 30365 (E, K, W). Erzurum: Dumluda, Sorger & Buchner 82-123-9 (W).
Doronicum (Asteraceae) pus (2.5)3–5 mm, white. Chromosome number 2n = 60 (Lindqvist, 1950, as D. cordatum; Baksay, 1956; Strid & Anderson, 1985).

Illustrations. Sadler in Nendtvich (1836: tab. 2): Săvulescu (1964: pl. 99, fig. 2); Figures 1A, 5E–H.

Distribution. Eastern Mediterranean region, from Syria to Sicily, and Caucasus (absent in northern Africa?). Cultivated and naturalized in central Europe. Forests, meadows, rocky places, and shady gullies, from sea level up to 2000 m in elevation (Fig. 27).

Both Doronicum orientale Hoffm. and D. caucasicum M. Bieb. were described in 1808 with the month of publication unknown. One year later the former name was chosen by Willdenow (1809) as the valid name, and, hence, it is the correct name (ICBN, Art. 11.5, Greuter et al., 2000). The type material of D. orientale has so far not been located, and although its description in the protologue matches the taxonomic identity recognized as D. orientale by Willdenow (1809), its formal identity needs to wait until a lectotype is designated. Since the lectotype. The only material of (ICBN, Art. 11.5, Greuter et al., 2000). The type of D. casicum M. Bieb. was described in 1808 with the former name was chosen by Willdenow (1809), its formal identity that matches the protologue was selected as the lectotype.

The possible occurrence of Doronicum orientale in North Africa requires further work (see comments for D. pardalianches and D. plantagineum).


Plant up to 150(+) cm tall. Rhizomes fleshy, pubescent to scarcely pubescent or glabrate with shining white-tinted trichomes on nodes, stoloniform, sometimes with buds. Stems scarcely branched in the upper part, with few leaves mainly distributed along the basal ¼ of the stem, internodes generally longer than the adjacent leaves. Indumentum of thin and acute multiserial eglandular trichomes (up to 5 mm) in the lower part, uniseriate eglandular trichomes and glandular trichomes in the middle and upper part, abundant near the capitula. Leaves entire to slightly dentate. Basal leaves sometimes present at flowering time; blade 3.6–16.5 × 3.3–14 cm, ovate with cordate base and blunt apex, with acrodromous to actinodromous venation; petiole 4.5–27 cm long, 1–4.5 mm wide. Lower cauline leaves 3.3–22 × 2.3–11 cm; petiole (3.4)6–10(27) cm long, 1–1.5 mm wide, similar to basal leaves. Middle cauline leaves (2.7)5–9(15.3) × (1.6)3–6(10) cm, sessile, fiddle-shaped, semi-amplexicaul. Upper cauline leaves (1)2–6(10) × (0.2)1–2.5 cm, ovate-elliptic to ovate-lanceolate, somewhat bract-like. Indumentum similar to the adjacent part of the stem. Capitula (1)2–7, 2–5.1 cm diam. including rays; involucral almost equaling rays, sometimes exceeding them, 1–3.3 cm diam.; peduncles (0.5)5–7(20) cm long, (0.5)0.8–1(2) mm wide. Phyllaries herbarious, (1)1.2–1.4(1.7) cm long, (0.7)1–1.5(2.7) mm wide, ovate-subulate, generally with acute apex. Margins sometimes ciliate, with acute, stiff and equidistant multiserial eglandular trichomes. Indumentum of glandular and eglandular trichomes. Receptacles pubescent or glabrate. Flowers with yellow corollas. Ray flower corollas 1.1–2.5 cm long, 2–3.5 mm wide, oblong-elliptic, apex generally with 3 teeth. Disk flower corollas 4–6 × 1–2.5 mm. Cypselae black and with warty surface in maturity, dimorphic. Cypselae from ray flowers 1.7–3.5 × 0.7–1.3 mm, glabrous, without pappus. Cypselae from disk flowers 1.2–1.8 × 0.7–1 mm, with eglandular trichomes; pappus (2.5)3–4 mm, white. Chromosome number 2n = 60, 120* (Lindqvist, 1950; *Moore, 1982, see comments below).

Illustrations. Jacquin (1776: t. 350); Reichenbach (1854: t. 64, fig. 2); Săvulescu (1964: pl. 97, fig. 2; pl. 189, fig. 1); Bolòs & Vigo (1995: 839); Figures 2A, B, 7A.

Distribution. Northeastern Iberian peninsula and central Europe. Cultivated and naturalized at least in Great Britain and Northern Europe, so that the limits of the natural distribution are uncertain. Forests, meadows, hedges, and near watercourses, from sea level up to 1800 m in elevation (Fig. 28).

As indicated above, in the protologue of Arnica scorpoides L., several pre-Linnaean synonyms are included. This name has been treated as a synonym of Doronicum grandiflorum Lam. by all the authors that combined it, probably because Jacquin (1776: 26, t. 349) illustrated it with a plant of D. grandiflorum Lam. However, the lectotype designated by Álvarez in Jarvis and Turland (1998) represents Doronicum pardalianches L., since all of the original elements of A. scorpoides belong to D. pardalianches L. Formally, all the combinations based on Arnica scorpoides L. are homotypic synonyms of Arnica scorpoides L. and thus synonyms of D. pardalianches L., even though the descriptions and references in protologues correspond mainly to Doronicum grandiflorum Lam. (see also comments above on D. scorpoides under D. grandiflorum Lam.).

Desfontaines (1798) cited Doronicum pardalianches in North Africa: “in cacumis Atlantis prope Belide,” but all the specimens from North Africa represent D. plantagineum. A few populations have broadly ovate basal leaves with subcordate bases that are similar to D. orientale, so their identity is uncertain. Doronicum pardalianches has similar basal leaves, but is quite different from both D. orientale and D. plantagineum in habit, number of capitula, number of cauleine leaves, and color of cypselae. Although no sheet from Desfontaines’s locality was seen, the presence of D. pardalianches in North Africa is unlikely. Desfontaines’s description matches D. plantagineum, or even D. orientale (whose presence in North Africa is questionable). Hybridization between D. plantagineum and D. orientale in this area is a possibility. (See comments for D. orientale and D. plantagineum.)

Determining the native distribution of Doronicum pardalianches is difficult. Records are scattered in central Europe, but absent in the Iberian peninsula, except for northeastern Spain, where it is notably abundant, exactly in the gap presented by D. plantagineum (Figs. 25, 28). This suggests these species do not overlap in their presumably natural areas of distribution, and that the native area of D. pardalianches reaches southwestern Europe in northeastern Spain.
The citation of the chromosome number 2n = 120 for *Doronicum pardalianches* was found in Moore’s (1982) index, but the original source for this data was not seen.


Plant up to 150 cm tall. *Rhizomes* fleshy, pubescent to very pubescent, with shining white-tinted trichomes on nodes, stoloniform, sometimes with buds. *Stems* generally unbranched, scape-like. *Indumentum* mainly glandular, with short-stalked and long-stalked glandular trichomes (up to 0.7 mm), sometimes also uniseriate and multiseriate eglandular trichomes, more abundant near the capitula. *Leaves* entire to slightly dentate. Basal leaves some-
times present at flowering time; blade (2.5)4–8(12) × (1.5)2.5–6(9.5) cm, ovate with truncate, attenuate or subcordate base, blunt or somewhat acute apex, with acrotrichous venation; petiole (2)4–8(19) cm long, (0.5)1.5–3(7) mm wide. Lower cauline leaves (1.5)3–7(19) × (12)2–8(3) cm, similar to basal leaves or sessile, fiddle-shaped to ovato-elliptic, semi-amplexicaul. Upper cauline leaves (1)2–4(9.5) × (0.1)0.7–2(5.5) cm, ovate-elliptic to ovate-lanceolate, sometimes bract-like, Indumentum mainly glandular, with short-stalked and long-stalked glandular trichomes, also with uniseriate (0.2 mm), and multiseriate (up to 2 mm) eglandular trichomes. 

**Capitula** 1(2 or 3), 3–4(6.5) cm diam. including rays; involucre almost equaling rays, sometimes exceeding them, 3–4(5.5) cm diam. 

**Phyllaries** herbaceous, ovate-subulate, generally with acute apex; the outer (1.1)5–2(5.3) cm long, (1.3)2–3(3) mm wide; the inner (1.1)5–2(2.5) cm long, 0.5–0.7(2) mm wide. Margins ciliate, with acute, stiff and equidistant multiseriate eglandular trichomes (up to 1.5 mm). Indumentum mainly glandular. 

**Receptacles** glabrous or scarcely pubescent. Flowers with yellow corollas. Ray flower corollas (1.1)1.5–2(5.3) cm long, (1.5)2–3(3) mm wide, oblong-elliptic, apex generally with 3 teeth. Disk flower corollas (4.3)4–5(5.5) × (1.1)1.3–1.5(2) mm. 

**Cypselae** olive-green or brown, with warty surface, dimorphic. Cypselae from ray flowers 2–2.8(4) × (0.7)1–1.3 mm, generally glabrous, without pappus. Cypselae from disk flowers (1.5)2–2.7(3) × (0.7)1–1.3 mm, with eglandular trichomes; pappus (3)3.5–4.5(5) mm, white. Chromosome number 2n = 120 (Lindqvist, 1950; Fernandes & Queirôs, 1971; Löve & Kjellqvist, 1974; Ruiz de Clavijo, 1993).

**Illustrations.** Reichenbach (1854: tab. 65, fig. 2); Hegi (1928: 711, fig. 420); Valdés et al. (1987: 77); Bolôs & Vigo (1995: 838); Figure 6A, B.

**Distribution.** Southwestern Europe (Portugal and Spain) and northern Africa (Morocco and Algeria). Cultivated and naturalized in Great Britain and central Europe. Limits of its native range uncertain. Forests, meadows, hedges, and on shady moist rocky places, altitude 400–2200 m (Fig. 25).

**Doronicum plantagineum** is variable for some characters (e.g., size and robustness of the plants, size and shape of basal leaves, number of leaves and capitula, type and abundance of indumentum). Cultivated, naturalized plants, and a few natural populations tend to have basal leaves broadly ovato-elliptic to elliptic, with slightly dentate margins, attenuate bases and somewhat acut e apices.

Some authors (Rouy, 1893; 1903a, 1903b; Legrand, 1894; Coutinho, 1939; Fournier, 1939) have given taxonomic recognition to these trends.

The North African populations are the most distinctive, generally being more robust and pubescent than the European, and having broadly ovate basal leaves with subcordate bases. The shape of the basal leaves in these plants does not allow a clear distinction between *Doronicum plantagineum* and *D. orientale*. These North African populations have been treated as subspecies or varieties of *D. par-dalianches* or *D. plantagineum* (Chabert, 1892; Barratte, 1893), or as a separate species, *D. atlanticum* (Chabert, 1891; Rouy, 1893), as in Cavilleri’s monograph (1907, 1911). A multivariate morphometric analysis (PCA and DA) of *Doronicum* (Álvarez Fernández & Nieto Feliner, 2001) reveals no morphometric support for the segregation of these populations as a species from the European populations of *D. plantagineum*. On the other hand, a phylogenetic analysis based on morphological, nuclear ribosomal (ITS), and chloroplast (trnL-F) data (Álvarez Fernández et al., 2001) showed differences in ITS sequences between these populations that somewhat support separate species status despite the poor morphological differentiation. Introggression from *D. orientale* into populations of *D. plantagineum* is not ruled out as the cause of sequence differences. Until further work is done, these populations are provisionally included in *D. plantagineum*.

The bulk of the records of *Doronicum plantagineum* are from the Iberian peninsula; a gap occurs in northeastern Spain and southern France, and most of the French records are from near Paris. This is the only representative of the genus in North Africa (northern Algeria and Atlas) and thus seems to be native to the Iberian peninsula and North Africa, its current area of distribution being expanded by human action.

**Selected specimens examined.** ALGERIA. Teniet el Had, pie des Cénes, Aiton & Simpson 37736 (BM); Djurdjura, Tala Guief, Bogni, Daris 59243 (BM, E); Kalylie, Mt. Magris, Reverchon 391 (BM, G). MOROCCO. Meknès: Ifrane, Azrou, Boucquet 10476 (BM); Ain Leuh, Jahnandez 306 (B, MA). FRANCE. Haute-Marne: Louze, Brienne-le-Château, Roz 89953 (G, MA, MACB, MAF). Seine-et-Marne: Fontainebleau, Feuilleasing 2872 (BR, MA). Seine-et-Oise: Port-Villez, 11 May 1873, Delacour s.n. (K); forêt de Bondy, Paris, 15 May 1846, Kralik s.n. (K); Yvelines, Véthenil, bois du Coudray, Lauzâtre 15798 (BR); Verrières-le-Buisson, Essonne, forêt de Verrières, Roz 67398 (BR, G, MA, MAF). Somme: bois de Lize près Ault, May 1862, Buettelette s.n. (G). Vaucluse bois de Mauret, 28 May 1884, Leresche s.n. (B). GREAT BRITAIN. England: Great Salving, Essex, Fox 780 (B, W); Belton, Grantham, 14 June 1887, Woodward s.n. (K). SCOTLAND: Blair, Culross, 18 Apr. 1872, Drummond s.n. (K); Amiston...
Plant up to 80(+) cm tall. Rhizomes woody to somewhat woody, glabrous, sometimes with leaf remains forming scales on nodes. Stems branched in the upper part, leaves mainly distributed in the lower middle portion, upper internodes generally longer than the adjacent leaves. Indumentum of uniseriate eglan- dular trichomes, sometimes abundant on veins on the abaxial surface of leaves. Capitula 3 to 5, 4–6.5 cm diam. including rays; involucres shorter than rays or equaling them, 3.5–4 cm diam.; peduncles up to 11 cm. Phyllaries herbaceous, sometimes slightly papery, ovate-lanceolate with very tapering acute apex, generally with 8 to 12 longitudinal veins dark-colored; the outer 1.5–2 cm long, 2.2–5.5 mm wide; the inner 1.4–1.6 cm long, 1.2–3 mm wide. Indumentum of glandular trichomes. Receptacles glabrous. Flowers with yellow corollas. Ray flower corollas 1.7–3 cm long, 4–6 mm wide, obovate-elliptic to oblong-elliptic, apex generally with 3 teeth. Disk flower corollas 5–6 × 1–3 mm. Cypselae brown, with slightly grooved-reticulate surface, di- morphic. Cypselae from ray flowers 3.5 × 0.8 mm, glabrous or glabrate, without pappus. Cypselae from disk flowers 3 × 1 mm, sometimes with eglandular trichomes; pappus ca. 4 mm, white. (Completely mature cypselae not seen.) Chromosome number unknown.

Illustrations. Figures 7B, 26E–H.

Distribution. Western Turkey (Bolu, Bursa, and Konya provinces). Growing in woods and open moist rocky places, altitude 1800–2200 m (Fig. 14).

Doronicum reticulatum is morphologically similar to those species with a “macrophyllum” habit in southwestern Asia, but it is quite distinctive because of its unique type of phyllaries (Fig. 26E, F), which are ovate-lanceolate ending in a long tapering apex, and with 8 to 12 longitudinal veins dark-colored. Doronicum reticulatum grows only in western Turkey where there is no overlap with any other species of the “macrophyllum” group, although it is geographically close to D. cacaliifolium. The only species that overlaps its area is D. orientale, which is morphologically quite different (i.e., habit, type of phyllaries, type of rhizome; Figs. 5E, F, 26E, F). See also comments on D. cacaliifolium and D. macrophyllum subsp. sparsipilosum.

The name Doronicum bithynicum J. R. Edm. was given by Edmondson (1973) for a pro parte of the illegitimate name D. thirkei Schultz Bip. ex Boiss. (Boissier, 1875: 379). Boissier’s name includes his D. reticulatum Boiss. (1844), which was collected in Tmolus Bogdagh, and also plants from Mt. Olympus in Bithynia. Edmondson (1973) considered these to be two different species, and he gave the name D. bithynicum for those plants from Mt. Olympus, reserving the name D. reticulatum for those from Tmolus Bogdagh. In this study, however, no diagnostic characters to separate D. bithynicum (Edmondson, 1973) and D. reticulatum were found.
Accordingly, these names are here considered synonyms.

Selected specimens examined. TURKEY. Bolu: Ala dag Kartalkoy, Alpay 2642 (E); Köröglo, Buchner 83-70-13 (W); Ala dag, Kortal Kaya, Davis & Coode 37372 (E, K). Bursa: Uludag, Aytaç & Eksi 6229 (GAZI); Uludag, A. & T. Baytop 20972 (E, K); Uludag, Bithyniae, Bernardi 18015 (G); Mt. Olympos; July 1873, Pechler s.n. (K); Belvedere above Bursa, Polunin 15054 (E); Uludag, 1968, Sorger 68-53a-6 (W); Uludag bei Bursa, H. & E. Walter 641 (B). Konya: Phrygia, Aksokeher, Mt. Sultandagh, Bornmüller 9620 (B).


Plant up to 120 cm tall. Rhizomes woody, glabrous, without leaf remains, sometimes with adventitious roots at the base of stem. Stems simple or branched, sometimes branched from the base, with leaves all along the stem. Indumentum of long-stalked glandular trichomes (0.5–1 mm), and sometimes also eglandular blunt trichomes (ca. 1 mm), more abundant near the capitula, sometimes glabrous to glabrate at the base. Leaves entire to very slightly dentate. Basal leaves absent at flowering time; blade ca. 6 × 3 cm, oblong elliptic, with attenuate base and blunt to subacute apex, with scattered short eglandular trichomes (ca. 1 mm). Pappus 4–6 mm, consisting of one row of white to white-yellow capillary bristles; pappus from ray flowers caducous as a whole crown. Chromosome number unknown.

Illustrations. Figures 4E–H, 6D.

Distribution. South-central China (provinces of Gansu, Sichuan, Tibet-Qinghai, and Yunnan). Open moist rocky places, woods, meadows, and near watecrourses, altitude 3000–5000 m (Fig. 21).

Doronicum stenoglossum is the most distinctive species within the genus. In fact, historically it was treated as a different section (Soulœasstrum), under D. souliei Cavill. by Cavillier (1911). Together, the large amount of autapomorphies makes its appearance quite different, specially regarding the capitula. The shape, size, and color of flowers and shape and size of phyllaries are unique within the genus (Fig. 4E, F). In a phylogenetic analysis based on molecular data (Álvarez Fernández et al., 2001) it is deeply nested within a group of central Asian species that share no morphological synapomorphies at all, indicating that its distinctive characters are autapomorphies and that the subgeneric treatment in this case is not appropriate. (See also comments under D. briquetii and D. kamaonense.)

Cavillier (1911: 360) included Doronicum sten-glossum in his section Soulœasstrum, but because he could not see the type material, he concluded that the treatment was tentative. He mentioned that based on its protologue, the most similar species is D. souliei Cavill. When type material of both names was studied, the same identity was determined in both cases. Thus, the name D. souliei is treated as a synonym of D. stenoglossum, which has priority. To clarify the identity of D. souliei, a lectotype was designated above based on Cavillier’s citation in the protologue. Two sheets that match his citation were found at G and K, respectively, and the one best preserved was selected as lectotype.

Selected specimens examined. CHINA. Gansu: Hai T’hoang mts, Lienc 4730 (BM, K); T’ao river, Morku valley, Rock 12941 (GH); Tebu, Drakana, Wapaku, Rock 14599 (E, K, NY). Sichuan: Sungpan-Issien, Fong 4129 (E, K, NY); Ms. Hu-li, Forrest 16825 (E, K); Mt. Kungala, 25 July 1885, Potanin s.n. (LE); Guma-Kika, 6 Aug. 1885, Potanin s.n. (LE); Mt. Mitzuga, Muli Gomba, Rock 16566 (E); Sikang, Kangting, Tachienlu, Changu Valley, Hsin-tientzii, Smith 11379 (BM, GH, MO, UPS, W); Dongergjo, Smith 3587 (E, UPS); Hsiho-shan, 19 July 1922, Smith 3380 (UPS); Tachienlu, Hadjaha, Stevens 392 (W); Sung-
pan, 1914. Weigold s.n. (W). *Tibet-Qinghai*: Dari Darlaq Xian, Sainanuuda, Jimai Gyunmai Xiang, Huang He, Bartholomew & Gilbert 1205 (E, MO); Reting, Ludlow & Sherif 9391 (BM, E).

**TAXA EXCLUDED FROM DORONICUM**


This taxon belongs in the genus *Aster* sect. *Alpigeni* subsect. *Homochaeta* (cf. Álvarez Fernández & Nieto Feliner, 2000). To clarify the identity of this name that was in current use until a recent study (Álvarez Fernández & Nieto Feliner, 2000), its lectotype was designated above.

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APPENDIX 1

LIST OF SPECIES AND SUBSPECIES

1. Doronicum altaicum Pall. [LT lectotype] by Álvarez Fernández & Nieto Feliner, 1999


3. Doronicum briquetii Cavill. [LT by Álvarez Fernández & Nieto Feliner, 1999]


5. Doronicum carpinicum (Griseb. & A. Schenck) Nyman


6a. Doronicum carpetanum Boiss. & Reut. ex Willk. subsp. carpetanum


6c. Doronicum carpetanum Boiss. & Reut. ex Willk. subsp. kuepferi (R. Chacón) Álv. Fern.

6d. Doronicum carpetanum Boiss. & Reut. ex Willk.
Annals of the Missouri Botanical Garden
von Mannagetta, June 1885 (9); G. Beck von Mannagetta & F. Fiala, 234 (9); A. Becker, 132 (19a), 220 (19a); H. Beger, 24 July 1909 (2), Aug. 1911 (15), 19 July 1912 (8), 23 July 1912 (15), 3 Aug. 1912 (15), 1 May 1913 (23), 7 July 1920 (15), 25 Aug. 1920 (8), July 1929 (14), 10 July 1939 (2); O. Behrendsen, 4 July 1902 (15), 14 July 1903 (9); F. Bellingham, 20 July 1961 (9); F. Bellot, 30 Mar. 1940 (24), 29 May 1953 (6d), 4 July 1902 (15), 14 July 1903 (9); F. Bellingham, 20 July 1961 (9); F. Bellot, 30 Mar. 1940 (24), 29 May 1953 (6d), 16 May 1965 (24); D. Belmonte, 18 May 1962 (24), 19 May 1982 (24); Beltrán, 19 May 1911 (24), Aug. 1911 (6a); Benedi, Blanché, Molero & Vallés, 14 July 1984 (6a); J. L. Benito & B. Gotí, 14 July 1996 (15), Berg, 12 Oct. 1924 (14); E. Berger, 30 May 1946 (23); Bernard, 20 July 1901 (15), Aug. 1902 (15); Bernardi, 1801 (23); J. Bernátisky, 20 May 1896 (8); W. Bernouilli, 14 Aug. 1883 (8); S. Besalet, 163 (22); S. H. Bickham, 876 (23); Bierbach, May 1903 (9), June 1903 (2), July 1903 (9); E. Biesalski, 469 (2); C. Billot, 26 June 1846 (2); Binder, Hagemann, Hempel & Raus, 297 (9); Binz, 405 (8) (15); E. Blanco, 1346 (24); G. Bocquet, 10476 (24); M. O. Bogolubow, 6 June 1909 (12), 14 June 1909 (12); Boissier & Reuter, July 1858 (6a); Bonnet, 19 June 1873 (23), 26 May 1873 (23), 6 May 1877 (24); Bonnier, 163 (9); N. L. Bor, 11498 (12); Borrow, July 1886 (23), July 1872 (23); A. Boreau, 27 Apr. 1846 (24); J. M. Borel, June 1850 (23), 13 July 1862 (15), 7 Aug. 1864 (15), 5 Aug. 1865 (15), 2 June 1866 (23); J. Borja & S. Rivas Martínez, 1962 (15); Borja, 18 July 1951 (6d); J. Bornmüller, 76 (17) (22), 127 (9), 176 (22), 688 (22), 11314 (22), 11315 (22), 11316 (22), 14245 (22), Apr. 1884 (9), 24 July 1893 (2); Carrasco, Casaseca, Fernández Diez & Velayos, 16 July 1799 (6a); Carrasco & Velayos, 13 Apr. 1907 (24); Carrisso & Mendoza, 25 Mar. 1926 (24); Carnel, 20 Apr. 1856 (9); B. Caseasa, 17 May 1968 (24), 30 Mar. 1973 (24), 19 July 1973 (6d); B. Caseasa, F. J. Fernández Diez, 16 July 1974 (6b); B. Caseasa, Fernández Diez & E. Rico, 8 Mar. 1977 (24), 4 Aug. 1977 (6c); Casaseca et al., 27 July 1979 (6d); J. L. Castillo & R. Cordero, 26 May 1891 (24), 1 May 1990 (24); S. Castroviejo, 10 July 1973 (6d); S. Castroviejo, B. Caseasa & E. Rico, 10835 (6a); S. Castroviejo & Fernández Quiro, 5868 (6a); S. Castroviejo, C. Fraile & T. Romero, 10709 (6a); S. Castroviejo & E. Valdés Beníeche, 917 (15), 14032 (15); S. Castroviejo et al., 7135 (6a), 11432 (6), 11615 (6), 10 July 1989 (6c); Cavanilles, May 1784 (24); L. Ceballos, 15 May 1933 (24), 1 June 1933 (24), 28 May 1934 (24); L. Ceballos & C. Vicioso, 1136 (6b); Celakovsky, May 1885 (22); Chabert, 2 June 1850 (23), 22 Aug. 1878 (23), 8 June 1892 (23); M. J. Chaffallon, 355 (12); D. Chamberlain, P. Cox & P. Hutchinson, 1899 (13); Chamberlain, Iwand & Kupicha, 206 (24); F. S. Chapman, 449 (12); A. Charpin, 15017 (6d), 15845 (9), 21087 (24), 24244 (23), 3 July 1959 (23), 10 May 1961 (23); A. Charpin & C. Deferrard, 16553 (24); A. Charpin & M. Dittrich, 17337 (15); A. Charpin, Dittrich, Greuter & Von Auw, 11014 (9), 11314 (9); A. Charpin, Jaquetot & Jeanmonod, 505 (24); A. Charpin & R. Salaman, 17480 (15); A. Charpin et al., 22 Sep. 1969 (15); Charrier, 230 (24); A. O. Chater, 310 (9), 515 (9), 562 (9); J. L. Chaworth-Musters, 3 May 1931 (22); Cheese, Mitchell & Watson, 2642 (24); P. Cheveaud, 31 July 1910 (8), 11 Aug. 1910 (9), 5 Aug. 1912 (15); V. L. Chequerpin & M. T. Lafetina, 12 Jul 1963 (1); L. E. Chiapella & L. Poldini, 28 May 1976 (9); H. G. Chick, 22A (9); Chick, Hill, Sandwith & Turrill, 2624 (22); Chinese collectors, D167 (3); J. R. Chad, 28. Mar. (24); J. R. Churchill, 9 Sep. 1907 (12), 1 Sep. 1907 (8), 5 July 1913 (9); S. Cimarolli, 8 July 1899 (15); D. & M. Cirta, 28 June 1972 (2); C. B. Clarke, 29267 (16), 30258 (12), 30482 (15), 47273 (15); Clemente, 1803 (24); P. Conrath, 1888 (21); A. Contardo, 3 June 1966 (2); E. Contré, 12 June 1955 (23); W. M. Conway, 211 (24), 267 (12); M. J. Coode & B. M. G. Jones, 408 (22), 1199 (15); A. Craig-Christie, 31 May 1873 (24); F. C.
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