

The genus *Barbarea* R.Br. (Cruciferae) in Britain and Ireland

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ABSTRACT

An account of the genus *Barbarea* R.Br. (Cruciferae) in Britain and Ireland is presented. A general description of the genus, and the four species that occur in these islands, *Barbarea stricta* Andrz., *B. vulgaris* R.Br., *B. intermedia* Boreau and *B. verna* (Miller) Asch., is given, together with a key and notes on their identification and distribution.

INTRODUCTION

The genus *Barbarea* R.Br. (Cruciferae) contains some 16 species, 13 of which occur in Europe. Four of these have been recorded from Britain and Ireland: *Barbarea stricta* Andrz., *B. vulgaris* R.Br., *B. intermedia* Boreau and *B. verna* (Miller) Asch. However, as the species are superficially similar and the published keys and descriptions available often unreliable, they have been frequently confused. During the last five years I have studied the genus in cultivation, field and herbarium, and the purpose of this paper is to clarify the taxonomy of these four species and to draw attention to characters by which they may be distinguished.

Barbarea is a well defined, natural genus and is usually placed in the tribe Arabideae with *Arabis*, *Cardamine*, *Cardaminopsis* and *Rorippa*. *Barbarea* may be defined in the British Isles as follows:

Biennial or short lived perennial (rarely annual) herbs, glabrous or sparsely pubescent below with simple hairs. Rosette leaves pinnate. Upper cauline leaves amplexicaul, sessile, entire to pinnatifid. Sepals erect, the inner slightly saccate at the base. Petals yellow, indistinctly clawed. Stigma entire to slightly emarginate. Style persistent in fruit, sessile or forming a short, sterile beak. Fruit a terete to four-angled, bivalvate, dehiscent siliqua, the valves with a strong median vein and weaker reticulate lateral veins. Seeds in one row in each loculus.

CYTOLOGY

There are no reported chromosomal data from native British material. Counts from European or cultivated material suggest that most of the species are diploid with a chromosome number of $2n=16$ (Manton 1932), although *B. stricta* has counts of $2n=14-18$ (Manton 1932; Tischler 1934) and *B. vulgaris* of $2n=14-16$ and $2n=18$ (Tischler 1934; Dvořák *et al.* 1981).

REPRODUCTIVE BIOLOGY

All four species begin flowering in spring or early summer, continuing under favourable conditions into July. *Barbarea intermedia* and *B. verna* are usually the first to come into flower in early April. Plants may flower in the autumn if they have been damaged earlier in the year. The pollination of *B. vulgaris* has been described in detail by Proctor & Yeo (1973) and the general mechanisms are probably essentially the same for the other species. Insects, mainly bees and flies, are attracted to the yellow inflorescences to collect nectar and/or pollen and effect self- or cross- pollination in the process. If that fails, or in dull weather, the two shorter outer stamens bend in towards the stigma and self-pollination occurs. Abundant seed is usually set in all species, although occasional plants of *B. vulgaris* with completely or partially aborted fruits have been found. It is unknown whether these plants are self-sterile. There are no specialized seed dispersal mechanisms.

Vegetative reproduction by cauline rosettes has been reported in *B. vulgaris* (MacDonald & Cavers 1974; Rich 1984).

HYBRIDS

B. stricta × *B. vulgaris* (*B.* × *schulzeana* Hausskn.) and *B. vulgaris* × *B. intermedia* (*B.* × *gradlii* J. Murr.) have been recorded from Europe (Hess, Landolt & Hirzel 1970; Lange 1937), but not from Britain or Ireland. They are apparently highly sterile and of rare occurrence. No hybrids with other genera have been recorded.

The hybrid *B. intermedia* × *B. verna* was synthesized in 1961 by P. M. Benoit from parents of Welsh origin (specimen in K). The resulting plants had leaves intermediate between the two parents and 60% sterile pollen. Fruit formation appeared to be normal, and the siliquae resembled those of *B. intermedia* in size, although it is not known if the seeds were viable.

IDENTIFICATION

The main characters used to separate the four species are as follows:

(a) *Rosette leaves*. The rosette leaves are very variable in outline and cannot usually be relied upon for identification, despite their use by Clapham (1962).

(b) *Stem leaves*. Failure to examine the uppermost leaves, which become inflorescence bracts if the lateral racemes develop, is the most common reason for mis-identification of *Barbarea* specimens. For instance, in *B. vulgaris* the leaves show a gradual transition from the pinnate rosette leaves to the nearly entire uppermost leaves, which are not pinnatifid, although they may be lobed. If the middle stem leaves are examined, this may prompt a mis-identification to *B. intermedia* as these leaves are often pinnate. Part of the problem also lies in the terms used to describe the leaves. The uppermost leaves of *B. intermedia* and *B. verna* should strictly be described as pinnatifid rather than pinnate, as the lateral lobes do not quite reach the midrib. The uppermost leaves of *B. stricta* are usually entire, but those of *B. vulgaris* may be entire or have one pair of lateral lobes at the base of the leaflet, whose divisions do not reach as close to the midrib as in *B. intermedia* and *B. verna*.

With practice, these leaves can provide the most useful characters, and typical uppermost stem leaves from the four species are shown in Fig. 1. The stem leaves of both *B. stricta* and *B. vulgaris* are diagnostic, but it is not possible to separate *B. verna* and *B. intermedia* using these alone.

(c) *Flower buds*. *B. stricta* can usually be distinguished from the other species by the sparsely hairy tips of the sepals, most easily seen in silhouette on the flower buds. However, these hairs are often lost in herbarium specimens with age, and very rarely *B. vulgaris* may have a few hairs on the sepals.

(d) *Flower colour*. There is much variability in flower colour and it cannot be used to separate the species reliably. However, *B. intermedia* does often seem to have paler flowers than the other species, and *B. stricta* has more uniformly deeper yellow petals.

(e) *Length of petals and sepals*. The ratio of sepal:petal length has been used to distinguish the species (e.g. Wiggington & Graham 1981), but is highly variable and is not reliable. A much better character is the length of the fresh petals, most easily measured by dissecting flowers and sticking the petals from at least five mature flowers onto sticky tape.

(f) *Fruit length*, measured from the base of the valve to the tip of the persistent style. This is a very useful character for distinguishing *B. verna* from the other species, as specimens usually have at least some fruits more than 4 cm long, which is beyond the range of the other species. Short-fruited variants of *B. vulgaris* also occur.

(g) *Persistent style length*, measured from the apex of the valves to the tip of the style. This character is very useful for distinguishing *B. vulgaris* in Britain and Ireland, but is not so reliable for European material.

(h) *Seed size*. The mean of at least ten seeds from different siliquae should be recorded.

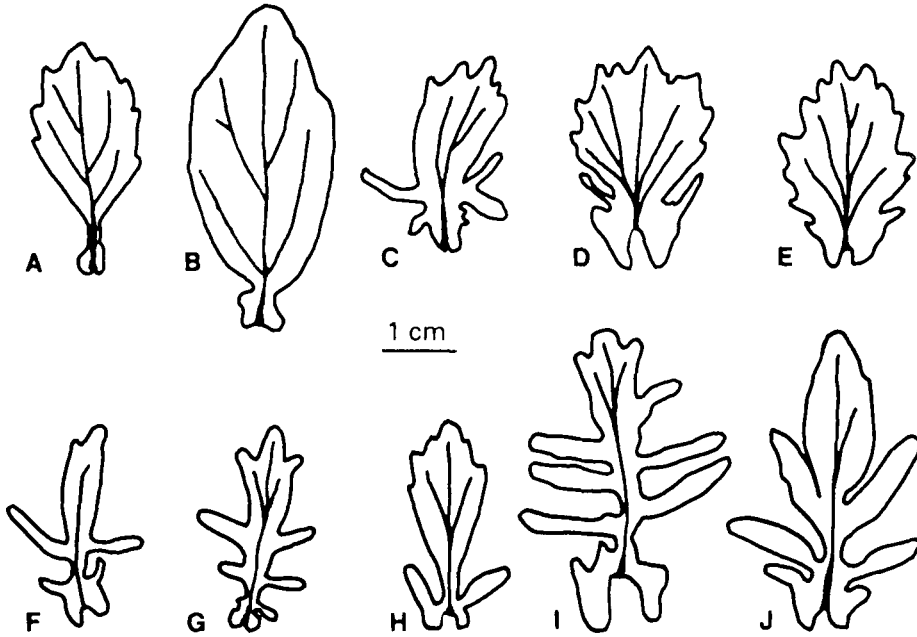


FIGURE 1. Uppermost stem leaves of *Barbarea* species. A–B, *B. stricta*. C–E, *B. vulgaris*. F–H, *B. intermedia*. I–J, *B. verna*.

SPECIES DESCRIPTIONS

KEY TO SPECIES

- 1 Uppermost cauline leaves and bracts simple, toothed or shallowly lobed, sometimes with 1 or 2 pairs of linear, lateral lobes, the terminal lobe broad, ovate to obovate; mean seed size ± 1.6 mm 2
- 1 Uppermost cauline leaves and bracts pinnatifid with 2 or more pairs of lateral lobes, the terminal lobe narrow, oblong to oblanceolate; mean seed size ± 2 mm 3
- 2 Flower buds at least sparsely pubescent at tips; persistent style of fruit 0.5–1.6(–2.3) mm 1. *B. stricta*
- 2 Flower buds glabrous; persistent style of fruit 2.0–3.5 mm 2. *B. vulgaris*
- 3 Fresh petals 4.0–5.6 mm; fruits 1.5–3.1(–3.6) cm 3. *B. intermedia*
- 3 Fresh petals (5.6–)6.0–8.4 mm; fruits (2.8–)3.5–7.1 cm 4. *B. verna*

The following descriptions have been prepared from British and Irish specimens: European material is usually more variable. Synonyms in use in the British and Irish literature are given. No infraspecific taxa merit recognition within the British Isles, with the possible exception of variants of *B. vulgaris*.

1. *B. STRICTA* Andrz. in Besser. *Enum. Pl. Volhyniae*, 72 (1822).

Common names: Upright Wintercress, Small-flowered Wintercress

Glabrescent biennial or short-lived perennial herb up to 100 cm. Basal leaves with a large, ovate-oblong terminal leaflet and (0-)1-3(-4) pairs of much smaller lateral leaflets. Stem leaves smaller, sessile and entire, the uppermost broad, ovate to obovate, coarsely but shallowly sinuately lobed. All foliage yellow-green. Inflorescence branches straight and erect, with dense racemes at anthesis. Buds at least sparsely hairy at tips. Petals 3.5-6.0 mm, suberect, deep yellow all over including the claw. Fruits on appressed (rarely more spreading) pedicels 3-7 mm, the silique 1.3-2.8(-3.5) cm, usually straight, with a stout persistent style 0.5-1.6(-2.3) mm. Seeds (1.0-)1.1-1.6(-1.7) mm, mean 1.4 mm. Flowering May to September.

B. stricta is closely related to *B. vulgaris*, and also to *B. orthoceras* Ledeb. of North America and eastern Asia. Sprague & Hutchinson (1908) give an excellent account of its distinction from *B. vulgaris* in the British Isles. It is a very local, lowland plant of canal, stream and river banks, quiet backwaters and also rarely as a casual on drier ground. It occurs in similar habitats to *B. vulgaris* but is perhaps more restricted to damper sites next to slow-moving water. It is widely distributed in England and eastern Wales, but is very rare in Scotland, and absent from Ireland.

Jackson (1908) described its history and distribution in Britain. The species was first reported in 1843 by W. Borrer from Yorkshire (v.c. 63) and Northants. (v.c. 32), but its status in the British Isles is uncertain. On the basis of the criteria of Webb (1985), it is impossible to come to any firm conclusion as to whether the plant is native or introduced. There are no reliable fossil records (Godwin 1975) since it is not possible to distinguish seeds of *B. stricta* from those of *B. vulgaris*. The relatively late first record could be due to the plant being overlooked as *B. vulgaris* or due to its recent arrival. In this respect, records from the River Thames are of interest, as although the species has been persistent on the banks near Kew since at least 1871, neither Brown (1812) nor Brewer (1863) mentioned the plant. This suggests that the Thames localities may be recent. Jackson (1908) pointed out that its habitats on the Continent are much the same as some of those in England, and its European distribution is consistent with it being a native plant. It is known to have become naturalized elsewhere (ignoring for the moment localities within Britain), but although it has reached New Zealand, it has yet to be recorded from Ireland. The species shows no obvious geographical pattern of variation. It reproduces by seed and, although fluctuating in abundance from year to year (e.g. Lousley 1976) in a similar manner to other biennials, it is remarkably persistent in some localities. Seeds of other *Barbarea* species may be introduced with grain (c.f. *B. verna*) and in some localities *B. stricta* is believed to have been brought in by barges (Gibbons 1975), presumably with ballast. Thus in the absence of any further information, the plant is best regarded as 'probably native'.

The world distribution of *B. stricta* is the western Mediterranean and central Europe to northern Scandinavia, eastwards to the Russian provinces of Orenburg and Perm, and southwards to Bosnia and Bulgaria (Sprague & Hutchinson 1908). It has been introduced to North America, New Zealand and probably Japan.

2. *B. VULGARIS* R.Br. in W. & W. T. Aiton, *Hortus Kew.*, 2nd ed., 109 (1812).

Erysimum barbarea L., *Sp. Pl.*, 660 (1753).

Barbarea barbarea Miller, *Gard. Dict.*, 8th ed. (1768).

B. taurica DC., *Syst.*, 2: 207 (1821).

B. arcuata (Opiz ex Presl) Reichenb., *Flora*, 5: 296 (1822).

B. stricta Boreau, *Fl. Cent. France*, 3rd ed., 2: 39 (1857).

B. lyrata Ascherson, *Fl. Brandenburg*, 1: 35 (1864).

B. rivularis Martr., *Fl. Tarn.*, 44 (1864).

B. sylvestris Jord., *Diagn.*, 1: 102 (1864).

Jackson (1916) details the synonymy of infraspecific taxa.

Common names: Wintercress, Yellow Rocket

Biennial to perennial herb up to 90(-130) cm, usually glabrous. Basal leaves pinnate, with an elliptic to ovate terminal leaflet and (0-)2-5(-6) pairs of lateral leaflets. Upper stem leaves usually sinuate-lobed, often with 1 or 2 pairs of small, spreading, linear lobes from base of leaflet, the

terminal lobe broad, obovate to broadly elliptic (rarely ovate) with a cuneate base. All foliage deep green, shining, with coarsely toothed or sinuate margins. Inflorescence crowded or lax. Buds glabrous or very rarely with a few hairs. Petals 4.9–7.0(–8.0) mm, deep to bright yellow with a paler claw, the limb spreading, becoming reflexed with age. Fruits on thin pedicels 3–6 mm long, spreading-erect. Siliqua (0.7–)1.5–3.2 cm, straight or curved with a slender persistent style 2.0–3.5(–4.0) mm. Seeds (1.1–)1.2–1.6(–1.8) mm, mean approx 1.5 mm. Flowering May to July.

B. vulgaris is a very variable species within which many infraspecific taxa have been described. In a critical study of the species in the British Isles, Jackson (1916) recognized four varieties:

var. *silvestris* Fries Plants usually small, with solitary stems. Lateral lobes of lower leaves very small or absent. Fruits short, about 12 mm long, appressed.

var. *campestris* Fries Plant robust, fruits usually longer, up to 25 mm, obliquely erect or slightly spreading.

var. *arcuata* Fries Inflorescence often laxer. Pedicels patent. Fruits arcuate- ascending, spreading at right angles to the axis, or even deflexed.

var. *transiens* Druce Plant stout, robust; lower stem leaves with oblong cuneiform terminal lobe, the lateral linear lobes well developed, up to five pairs, exceeding the terminal lobe in width.

The taxa are thus defined largely on a combination of somewhat variable characters. Since the size of plant varies according to habitat, and the size and shape of the leaves are usually linked to the robustness of an individual, var. *transiens* may just be a result of good growth conditions. The only general correlation between characters is the density of the inflorescence and the orientation of the pedicels and fruits – plants with laxer racemes usually have spreading fruits, and plants with dense racemes have erect fruits. This correlation can also be seen in *B. intermedia*. However, in some populations it is possible to find plants with both spreading and erect fruits, which makes the plants look distinct although they are identical in all other respects. This may suggest there is a simple genetic basis to this difference. The character of spreading fruits is essentially the basis on which var. *arcuata* (*B. arcuata* (Opiz ex Presl) Reichenb.) is distinguished from var. *campestris*; Jackson (1916) has shown that the other characters are unreliable, and he rightly included *B. arcuata* within *B. vulgaris* in the British Isles. However, Bush (1939) maintained it as a separate species in Russia, but there may be a geographical basis for this difference of opinion. The two variants are very similar in north-western Europe, but in eastern Europe and Asia, outside the range of typical *B. vulgaris*, plants with spreading fruits are much more common. There may also be clinal variation with other characters, since *B. vulgaris sensu lato* is often apparently annual in the eastern part of its range, a character not observed in any British plant.

A second character which makes some plants appear quite distinct is consistently short fruits, typically 7–12 mm long, and such plants have been described as var. *silvestris*. It seems that these are selectively collected and are far more frequent in herbaria than in the field! Other plants with a mixture of short and long fruits can also be found, but this may be due to partial self-sterility.

Sparse hairs on the lower parts of the plant are of no taxonomic value, as pubescence is probably environmentally determined. Material cultivated at Leicester in a constant environment room was sparsely hairy, whilst plants grown outside from the same seed batch were glabrous. Hairy and glabrous plants can also be observed in the field within the same population. A similar dimorphism occurs in *B. intermedia* and *B. verna*, where sparsely hairy plants are quite frequent.

Knowles (1967) recorded that a double-flowered variant 'Flore Pleno' and a variant 'Variegata' with golden netted foliage are grown in gardens. Tilney-Bassett (1963) has shown that the variegation in the latter is due to the action of a single recessive gene. *B. vulgaris* used to be cultivated as a salad plant, but has now been replaced by *B. verna*.

A more detailed study of the species and its possible segregates throughout its range must be made before it is possible to evaluate the infraspecific taxa critically. Until then the species is best treated as a single, highly polymorphic taxon.

B. vulgaris is the commonest member of the genus in Britain and Ireland. It is a locally abundant native species, most characteristic of places that are damp in the winter such as river levées and shingle, ditch margins and woodland rides, but also in more disturbed habitats such as road verges, edges of fields and waste ground. It can tolerate a wide range of soil conditions and only avoids the more acid sites. Widespread throughout the British Isles and Ireland, it is most frequent in the south, and is absent from much of northern and western Scotland.

The world distribution of *B. vulgaris* is Eurasia, from the Mediterranean to northern Scandinavia, and eastwards from Portugal to central Russia and the western Himalaya. It has been introduced to East Africa, Australasia and North America.

3. *B. INTERMEDIA* Boreau, *Fl. Cent. France*, 2nd ed., 48 (1840).

Common names: Intermediate Wintercress, Medium-flowered Wintercress

Biennial (rarely short-lived perennial) up to 60 cm, glabrous or sparsely pubescent below. Basal leaves with a large terminal leaflet and (0-)2-5(-6) pairs of smaller lateral leaflets. Stem leaves pinnatifid, with (1-)2-3 pairs of lateral lobes, the terminal lobe becoming narrow, oblong-ob lanceolate. Foliage green. Inflorescence crowded. Buds glabrous. Petals 4.0-5.6 mm, pale to bright yellow. Fruits on appressed (rarely spreading), stout pedicels 3-6 mm long, the siliqua 1.5-3.2(-3.6) cm, straight or slightly curved, with a stout persistent style 0.6-1.6(-1.7) mm. Seeds 1.7-2.3(-2.4) mm, mean 2.1 mm. Flowering (March) April to July.

B. intermedia occurs on roadsides, waste ground and disturbed places throughout the lowlands of England, Wales and Ireland, but is scarcer in Scotland. It is often associated today as a colonist of building and road construction sites, although formerly it was most frequent as an arable weed. It is rarely abundant, and is often found as a single individual, but is surprisingly persistent in some localities in view of its intolerance of competition from other plants.

Britten (1864) summarized the earliest records from the British Isles. The species was first recorded from Co. Armagh (v.c. H37) by A. J. More in 1844, although the plant was probably present for a number of years before then but undetected due to confusion with *B. vulgaris*. Lousley (1976) noted that it "has made little progress in a century".

It is probably native in southern and central Europe, from northern Portugal to southern Germany and southern Yugoslavia, and also in North and East Africa, and introduced elsewhere. Ham (1982) suggested that it is native in Holland. As with many other species that behave as arable weeds, it is impossible to determine the original range of the species with any certainty.

4. *B. VERNA* (Miller) Ascherson, *Fl. Brandenburg*, 1: 36 (1864).

Erysimum vernum Miller, *Gard. Dict.*, 8th ed. (1768).

E. praecox Sm., *Fl. Brit.*, 2: 707 (1800).

Barbarea praecox R.Br. in W. & W. T. Aiton, *Hortus Kew.*, 2nd ed., 4: 109 (1812).

B. brevistyla Jord., *Diagn.*, 1: 102 (1864).

Common names: Land-cress, American Wintercress, Early-flowering Yellow Rocket

Annual or biennial up to 75(-90) cm, glabrous or sparsely pubescent below. Basal rosette leaves with a large terminal leaflet and (0-)4-10(-11) pairs of lateral leaflets, the distal pair usually wider than the terminal leaflet. Upper stem leaves pinnatifid, with 2-4 pairs of lateral lobes, the terminal lobe narrow, oblong-ob lanceolate. Foliage green. Buds glabrous. Petals (5.6-)6.0-8.4 mm, bright yellow. Fruits on stout pedicels (2-)3-8 mm, the siliqua (2.8-)3.5-7.1 mm, arcuate-ascending, with a stout persistent style 0.6-2.0(-2.3) mm. Seeds (1.6-)1.7-2.3(-2.4) mm, mean 2.0 mm. Flowering (March) April to July.

B. verna is a casual weed of waste ground, railway embankments, roadsides, bare and stony ground, etc., usually close to habitation. It is an ancient salad crop, probably introduced as a winter substitute for watercress in the 16th or 17th century, and commercial seed is still widely available. White (1912) noted that some of the species of *Barbarea* taste different, *B. verna* being a desirable salad plant, whilst *B. intermedia* is unpleasantly bitter. *B. verna* is scattered throughout lowland Britain, although it is more common in the south, and is rare in Scotland and Ireland. Davie (1909) suggested it might be native in Cornwall. It is more persistent in the south

and west, and it may re-appear sporadically as its seeds can remain dormant for many years. Clement & Foster (1983) recorded *B. sicula* C. Presl from Britain, probably in error for *B. verna*.

The species is perhaps native in the western Mediterranean region and Macaronesia, but it is widely naturalized in western and central Europe, and its native range has been obscured by cultivation. It has been introduced to North America, South Africa, Japan and New Zealand, and is recorded as introduced with grain into Norway (Jørgensen 1969).

This species is phenotypically the most plastic member of the genus in the British Isles and is very variable in size in response to environmental conditions, as illustrated in Stace (1980). Small, depauperate annual specimens contrast markedly with robust biennials, and it is this enormous range of variation which has led to many problems in distinguishing *B. verna* from *B. intermedia*.

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