

## *Cycloloma atriplicifolia*, a new alien species in Hungary

*Cycloloma atriplicifolia*, nový adventivní druh pro Maďarsko

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A new alien species *Cycloloma atriplicifolia* (*Chenopodiaceae*) was found to occur in sandy sites in the Orgovány area in the Kiskunság National Park, central Hungary. It is the first record of this species for the country. The species is native to North America; in Europe, it has been reported to be naturalized in several other areas with unstabilized sandy substrate (France, Italy and Slovakia), i.e. in the same habitats where it preferably occurs in its native range. Moreover, *C. atriplicifolia* was found in some other localities across Europe, but they exhibited only an ephemeral character. It also occurs in Australia and South America. A brief species description, taxonomical and nomenclatorial problems, ecology, and habitat preferences are briefly described and discussed. We expect, according to the characteristics that it shows in its area of primary distribution, that the species can potentially invade extensive sandy areas across Europe. Thus, the species requires the attention of botanists and plant ecologists.

**Key words:** *Cycloloma atriplicifolia*, *Chenopodiaceae*, distribution, primary and secondary range, taxonomy, ecology

### Introduction

The annual species *Cycloloma atriplicifolia*<sup>1</sup> (Sprengel) J. M. Coulter (*Chenopodiaceae*), native to North America, was reported already to occur in Europe in the last century, first growing in botanical gardens and then later occurring spontaneously. Since then, the number of records has increased; however, the majority of localities were of only an ephemeral character (Aellen 1979). Májovský (1961) reported the species from moving sands near Marcelová village in southern Slovakia. His paper gave a precise description of the species' morphology and habitat preference with some remarks on its distribution in Europe. He suggested a possible occurrence of the species in sandy areas in northern and central Hungary. In 1995, the latter author of this paper found an unknown chenopodiaceous species in the Kiskunság National Park in central Hungary. The species was later determined as *Cycloloma atriplicifolia*. Because it is not referred to in any relevant sources (Soó 1970, Jávorka & Csapody 1979, Szujkó-Lacza & Kováts 1993, Horváth et al. 1995), we suppose that *C. atriplicifolia* is a new alien species for the country. The finding stimulated us to review its worldwide distribution, taxonomy, and ecology in both its primary and secondary ranges.

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<sup>1</sup> Nomenclature of the family *Chenopodiaceae* follows Kühn et al. (1993), for other plants Neuhäuslová & Kolbek (1982). In some problematic cases we used the authors names.

## Locality

*Cycloloma atriplicifolia* was first found on 21 September, 1995 in the following locality: central Hungary, Orgoványi landscape-protection area, scattered along the margins of sandy arable land and along roads and paths in the southern outskirts of Ágasegyháza. Other microlocalities were found on 19 September 1997: central Hungary, Orgoványi landscape-protection area, ca 3–5 km to the north of Orgovány, along the southern margin of the sand dune area of Fülöpháza, sandy roads and their margins, rarely also in the surrounding semi-natural sandy communities.

The following species were recorded to occur together with *C. atriplicifolia* in the road habitats: *Bromus squarrosus*, *Carex liparicarpos*, *Cenchrus echinatus* L.<sup>2</sup>, *Chenopodium album* s. str., *Conyza canadensis*, *Cynodon dactylon*, *Euphorbia cyparissias*, *Kochia laniflora*, *Polygonum arenarium* and *Salsola kali* L. subsp. *iberica* (Sennen et Pau) Rilke. The semi-natural vegetation on the adjoining sand dunes, where *Cycloloma* rarely occurred, was composed of the following species: *Alkanna tinctoria*, *Alyssum tortuosum*, *Artemisia campestris*, *Bothriochloa ischaemum*, *Centaurea arenaria*, *Dianthus serotinus*, *Festuca vaginata*, *Gypsophila fastigiata* subsp. *arenaria*, *Kochia laniflora*, *Koeleria glauca*, *Plantago scabra*, *Polygonum arenarium*, *Potentilla arenaria*, *Scirpoides holoschoenus*, *Secale sylvestre* Host, *Silene conica* and *Syrenia cana*.

## Nomenclature and taxonomy

*Cycloloma atriplicifolia* (Sprengel) J. M. Coulter, Mem. Torrey Bot. Club 5: 143 (1894).

Synonyms: *Salsola atriplicifolia* Spreng., Bot. Gart. Univ. Halle Nachr. 1: 35 (1801); *Kochia atriplicifolia* (Spreng.) Roth, Neue Beitr. 1: 177 (1802); *Salsola platyphylla* Michx., Fl. Bor. Am. 1: 174 (1803); *Salsola radiata* Desf., Ann. Mus. Paris 2: 28 (1803); *Kochia dentata* Willd., Hort. Berol., pl. 28 (1803); *Salsola atriplicis* Schultes, Obs. Bot. 52 (1809); *Chenopodium radiatum* Schrad., Neues Jour. Bot. 3(3): 85 (1809); *Kochia platyphylla* (Michx.) Schultes in Roem. et Schult., Syst. Veg. 6: 274 (1820); *Cyclolepis platyphylla* (Michx.) Moq., Ann. Sci. Nat. II. 1: 204 (1834); *Cycloloma platyphylla* (Michx.) Moq., Chenopod. Enum. 19 (1840); *Cycloloma platyphylla* (Michx.) Moq. var. *latifolia* Moq., Chenopod. Enum. 19 (1840); *Chenopodium atriplicifolium* (Spreng.) A. Ludw. ex Asch. et Graebn., Syn. Mitteleur. 5: 18 (1913).

*Cycloloma*<sup>3</sup> is a monotypic genus, which clearly differs from the other *Chenopodiaceae* in many characteristics. The unusual combination of morphological traits, especially the presence of an accrescent, chartaceous and winged perianth, led various authors to different opinions on which higher taxonomical units should include *Cycloloma*. For example, Moquin-Tandon (1849) divided the tribus *Chenopodieae* into two subtribes, *Bliteae* (*Blitum*, *Dysphania*, *Monolepis*, *Roubieva*) with vertical seeds, and the *Beteae* (*Aphanisma*, *Beta*, *Chenopodium*, *Cycloloma*, *Oreobliton*, *Rhagodia*, *Teloxys*) with horizontal seeds. Scott (1978) included the genus *Cycloloma* into the new subfamily *Camphorosmioideae*, tribus *Camphorosmeae*, subtribus *Kochiinae*, and stated that, although

<sup>2</sup> According to the regional flora (Szujkó-Lacza & Kováts 1993) *Cenchrus echinatus* is another new species of the Kiskunshag National Park. It is certainly the author's oversight in regards to the presence of this species in the majority of Hungarian floras (see Soó 1970, Jávorka & Csapody 1979, Horváth et al. 1995) and very common occurrence in the Kiskunshag National Park.

<sup>3</sup> *Cycloloma* – from the Greek “cyclos” = circle, and “loma” = border, referring to the winged perianth

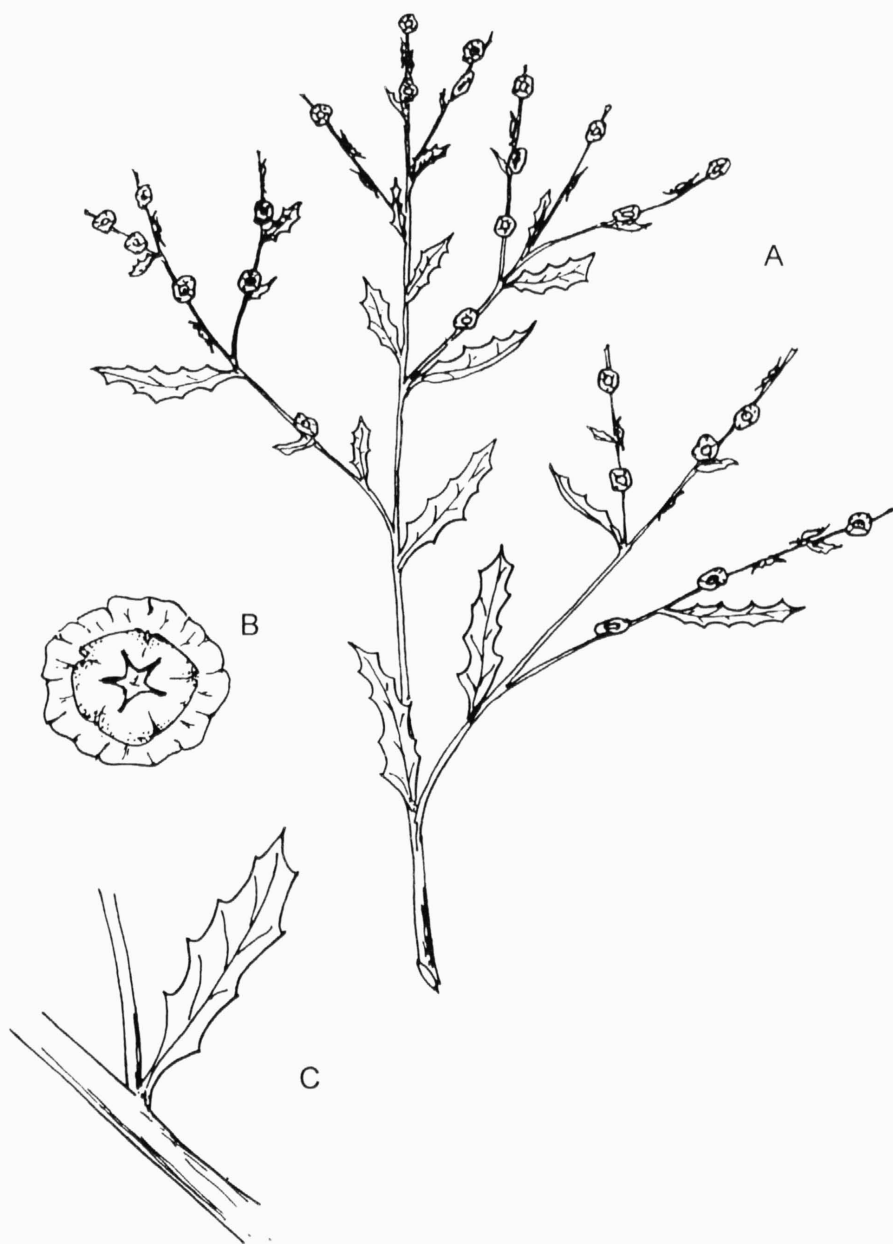


Fig. 1. – *Cycloloma atriplicifolia*; A – habitus, B – fruit, C – leaf (del. K. Bímová).

*Cycloloma* had usually been included into the *Chenopodieae*, it clearly differed from that tribe in possessing an accrescent, chartaceous and winged perianth. Kühn et al. (1993) did not accept Scott's classification and made subfamily *Camphorosmoideae* (ut "*Camphorosmioideae*") a synonym with *Chenopodioideae*. They characterized the valid tribus *Camphorosmeae* as plants with usually spiciform or paniculate inflorescence; with flowers usually ebracteolate; perianth persistent in fruit, chartaceous, membranous or scarious, unmodified opposite radicle. They included the following genera: *Kirilowia*, *Pandertia*, *Camphorosma*, *Cycloloma* and *Chenolea*.

A brief description of *Cycloloma atriplicifolia* (Fig. 1) follows based on both literature (Scott 1978) and our own field observations: An erect annual plant; leaves alternate, long petiolate, glabrous, oblong, sinuate-dentate; flowers bisexual or polygamous, solitary or few in the axils of short bracts forming a paniculate inflorescence; perianth pentamerous, segments connate to just above the middle, membranous, sparsely tomentose, keeled; fruiting perianth accrescent, chartaceous, with a broad, 5-lobed membranous wing which is often thickened along the tepaline veins and elongated into short spines; stamens 5, anthers oblong; stigmas 3 (–5), style short; ovule subsessile; pericarp membranous, more or less free; testa crustaceous, black, seeds horizontal, radicle centrifugal, embryo annular; endosperm abundant, meally (Scott 1978). *Cycloloma atriplicifolia* is a tetraploid species ( $2n = 36 -$  Kühn et al. 1993) with the  $C_3$  type of photosynthetic pathway (Carolin et al. 1975).

### Distribution and ecology

The species is native to North America, where it occurs in the majority of the territory of the United States and partly in Canada (Fig. 2). From 33 American local floras analysed, it is evident that *C. atriplicifolia* occupies predominantly natural sandy habitats and spreads from those to other mainly human-made sites, such as arable fields or roadsides (Fig. 3). The main, and probably native, range includes the central part of the present United States of America. In the past, the species was used by American Indians who made mush and cakes from the ground-up seeds (Kearney & Peebles 1942, Mabberley 1987).

The most preferable sites are sandy grounds and sandy banks of rivers or lakes (Fig. 3). Spreading is realized as in many wind-dispersed species of arid habitats: the whole plant breaks off easily and rolls over a plain while shedding seeds (Kühn et al. 1993). The occurrence in waste places and in arable fields as a weed is secondary; it indicates the ability of the species to grow in disturbed habitats as well as its certain invasive potential. Road margins and railroads seem to be important ways of the species spreading both in and outside its native range, similarly as in some other chenopodiaceous plants (as reported by Mandák & Pyšek 1998 for *Atriplex* species). Hence, the native distribution is sometimes rather obscure and very difficult to identify in these species. For example, Scoggan (1978) expected *C. atriplicifolia* to be probably mainly adventive in Canada, where it is now occurring as a weed in arable land and in various other human-made habitats. The species was introduced to the Ottawa district and to the St. Hubert airport near Montreal in Quebec apparently by airplane (Marie-Victorin 1964). Peattie (1930) stated that this plant is frequent along the beaches of Lake Michigan and this area probably represents its most eastern natural occurrence; farther to the east it is certainly introduced. The northern evidently

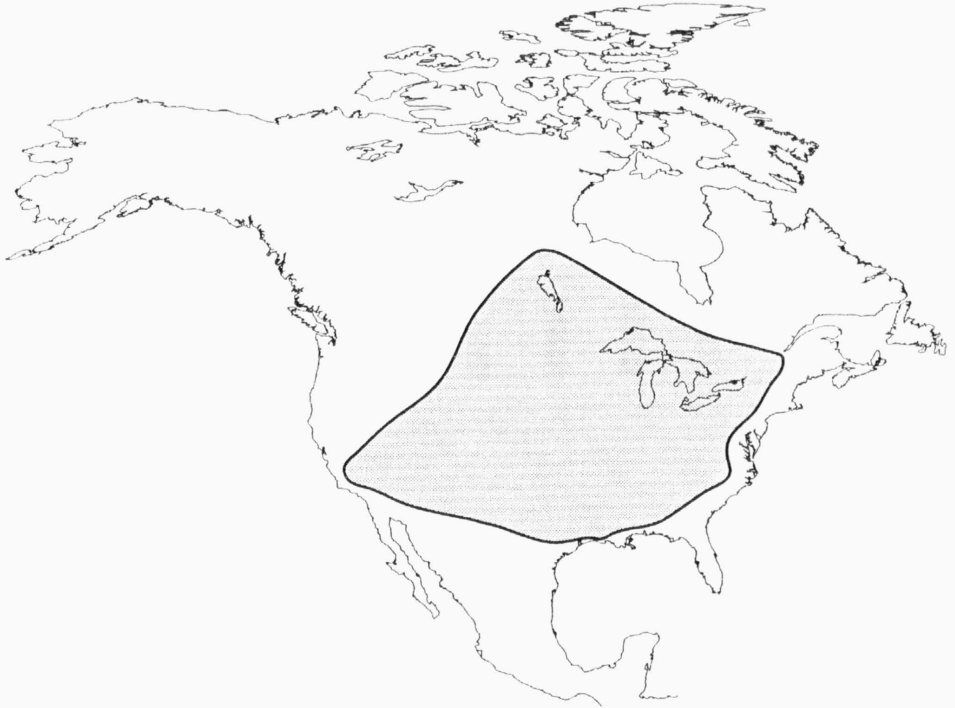


Fig. 2. – Primary distribution range of *Cycloloma atriplicifolia* in North America. The map is based on information from the following sources: Britton & Brown (1913), Wooton & Standley (1915), Peattie (1930), Small (1933), Kearney & Peebles (1942), Jones & Fuller (1955), Gleason (1958, 1963), McVaugh (1958), Moss (1959), Májovský (1961), John (1963), Steyermark (1963), Ball (1964), Hitchcock et al. (1964), Marie-Victorin (1964), Weber (1967), Radford et al. (1968), Lundell (1969), Correll & Johnston (1970), Long & Lakela (1971), Guinochet & de Vilmorin (1973), Stone (1973), Munz (1974), Fournier (1977), Taylor & MacBryde (1977), Scoggan (1978), Aellen (1979), Looman & Best (1979), Pignatti (1982), Wilson (1984), Voss (1985), Welsh et al. (1987), Andreas (1989), Yatskievych & Turner (1990), Gleason & Cronquist (1991), Hickman (1993).

adventive localities are in Saskatchewan (Baildon, SE of Moose Jaw) and Manitoba (near Brandon) (Scoggan 1978).

Currently, the secondary range consists of sparsely distributed populations in several continents. Kühn et al. (1993) and Scott (1978) stated that the alien occurrence of *C. atriplicifolia* is concentrated in Europe and South America; we include also Australia (see Wilson 1984). Whereas we have much information about the species distribution in Europe, its exact occurrence in South America is still uncertain. In Australia, *C. atriplicifolia* was found near Ouyen in northwestern Victoria in 1955 (Wilson 1984).

The first report of the presence of *C. atriplicifolia* in Europe comes from 1801; the species was planted in the botanical garden in Vegesack, Germany (Aellen 1979). Probably the first records of its spontaneous occurrence in nature are from 1880 (seashore at Chioggia near Pavia) and 1881 (sands along the Po river near Lugraro), both in Italy.

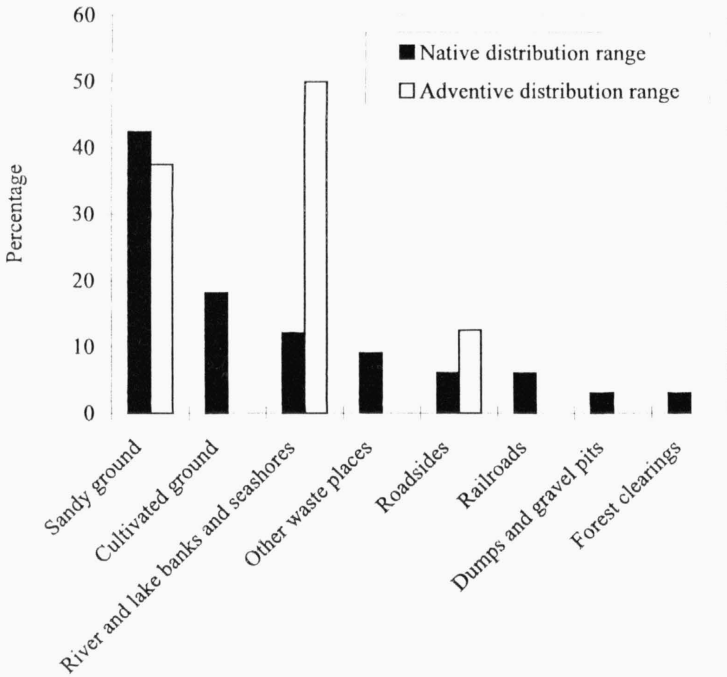


Fig. 3. –Habitat preferences in the primary and secondary ranges. The graph is based on the same sources as Fig. 2.

Nowadays, we are aware of four countries in Europe where *C. atriplicifolia* is naturalized and grows in semi-natural sandy communities. In Italy, it is probably fully naturalized in a higher number of localities (Aellen 1979, Pignatti 1982). Recently, *C. atriplicifolia* was reported from France by Guinochet & de Vilmorin (1973) and then Fournier (1977), from the Gard County in Gardon near Dions. The first locality from central Europe was published in 1961, from southern Slovakia, where it occurred in semi-natural vegetation on moving sands near Marcelová (Májovský 1961). Until now, it is the northernmost European locality where *C. atriplicifolia* is fully naturalized. The last record is that reported here from Hungary.

Additionally, there are several localities where the occurrence of *C. atriplicifolia* had an ephemeral character. Aellen (1979) stated that the species was introduced to some localities in Germany, probably with cereals: Dresden, a sandy shore of the Elbe river near Uebigau, 1898; Hamburg, 1903; Hafen von Mannheim, 1901; Luitpoldhafen in Ludwigs-hafen, 1901; Mannheim-Rheinau, sandy sites, 1934). Clement & Foster (1994) in their list of the British alien plants, considered *C. atriplicifolia* among those species which occurred only before 1930, without an exact locality given. Ball (1964) and Jalas & Suominen (1987) included Albania into European countries in which the species occurs, but we did not find any exact information. All of these localities probably do not exist today and we can consider them as only a temporal introduction to human-made habitats.

*C. atriplicifolia* is well adapted to grow on sandy soils. Thus, in regions where the frequency of sandy habitats is high, there is a relatively high probability that the species will

spread if diaspores would be introduced. It may concern also the extensive sandy plains and seacoast in W, NW and N Europe where the species has not been recorded yet. The climatic factors do not seem to be limiting, because the species occurs with high frequency in comparable climatic zones in North America.

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## Souhrn

V článku jsou publikovány údaje o výskytu nového adventivního druhu *Cycloloma atriplicifolia* (*Chenopodiaceae*) v Maďarsku a komentován výskyt tohoto druhu v jiných částech Evropy. *C. atriplicifolia* je původní v Severní Americe, kde se vyskytuje převážně na písčitých půdách téměř na celém území Spojených států a v přílehlé části Kanady, adventivní výskyt byl zaznamenán též v Austrálii a Jižní Americe. Biosférická rezervace a národní park Kiskunság ve středním Maďarsku je čtvrtou oblastí v Evropě, kde je druh naturalizován a proniká i do přirozených společenstev pohyblivých písků. Je vyslovena obava, že může rozšířit řadu druhů cizího původu, které invadují písčité stanoviště, a stát se tak nežádoucím invazním druhem v územích s vysokou frekvencí výskytu nezapojených písčitých půd.

## References

- Allen P. (1979): *Cycloloma*. – In: Conert H. J. et al. (eds.), G. Hegi Illustrierte Flora von Mitteleuropa, 3/2: 660–661, Verlag Paul Parey, Berlin & Hamburg.
- Andreas B. K. (1989): The vascular flora of the glaciated Allegheny plateau region of Ohio. – Columbus, Ohio.
- Ball P. W. (1964): 4. *Cycloloma*. – In: Tutin T. G. et al. (eds.), Flora Europaea, 1: 95, Cambridge University Press, Cambridge.
- Britton N. L. & Brown H. A. (1913): An illustrated flora of the Northern United States, Canada and the British Possessions, Vol. 2. – New York.
- Carolin R. C., Jacobs S. W. L. & Vesk M. (1975): Leaf structure in *Chenopodiaceae*. – Bot. Jahrb. Syst. 95: 226–255.
- Clement E. J. & Foster M. C. (1994): Alien plants of the British Isles. – Bot. Soc. British Isles, London.
- Correll D. S. & Johnston M. C. (1970): Manual of the vascular plants of Texas. – Texas Research Foundation, Texas.
- Fournier P. (1977): Les Quatre Flores de la France, Vol. 1. – Éditions Paul Lechevalier, Paris.
- Gleason H. A. (1958): Illustrated flora of the Northeastern United States and adjacent Canada, Vol. 2. – The New York Botanical Garden, Lancaster Press, Lancaster, Penna.
- Gleason H. A. (1963): The new Britton and Brown illustrated flora of the northeastern United States and adjacent Canada. – Hafner Publishing Company, New York & London.
- Gleason H. A. & Cronquist A. (1991): Manual of vascular plants of Northeastern United States and adjacent Canada. – The New York Botanical Garden, New York.
- Guinochet M. & de Vilmorin R. (1973): Flora de France. Vol. 1. – Centre National de la Recherche Scientifique, Paris.
- Hickman J. C. (ed.) (1993): The Jepson manual: Higher plants of California. – University of California Press, Berkeley etc.
- Hitchcock C. L., Cronquist A., Ownbey M. & Thompson J. W. (1964): Vascular plants of the Pacific Northwest, Vol. 2. – University of Washington Press, Seattle.
- Horváth F. et al. (1995): Flóra adatbázis 1.2. Taxon-lista és attribútum állomány. – Inst. Ecol. Bot. Hung. Acad. Sci., Vácrátót.
- Jalas J. & Suominen J. (1987): Atlas Florae Europaeae. – Distribution of vascular plants in Europe. II. – Cambridge University Press, Cambridge etc.
- Jávorka S. & Csapody V. (1979): Ikonographie der Flora des Südöstlichen Mitteleuropa. – Akadémiai Kiadó, Budapest.

- John H. S. (1963): Flora of southeastern Washington and of adjacent Idaho. – Edwards Brothers, California.
- Jones G. N. & Fuller G. D. (1955): Vascular plants of Illinois. – University of Illinois Press, Urbana & Illinois State Museum, Springfield.
- Kearney T. H. & Peebles R. H. (1942): Flowering plants and ferns of Arizona. – United States Government Printing Office, Washington.
- Kühn U. et al. (1993): *Chenopodiaceae*. – In: Kubitzky K., Rohwer J. G. & Bittrich V. (eds.), The families and genera of vascular plants, p. 253–281, Springer Verlag, Berlin etc.
- Long R. W. & Lakela O. (1971): A flora of tropical Florida. A manual of the seed plants and ferns of southern peninsular Florida. – University of Miami Press, Miami.
- Looman J. & Best K. F. (1979): Budd's flora of the Canadian prairie provinces. – Research Branch Agriculture Canada, Canada.
- Lundell C. L. (1969): Flora of Texas, Vol. 2. – Texas Research Foundation, Texas.
- Mabberley D. J. (1987): The plant-book. A portable dictionary of the higher plants. – Cambridge University Press, Cambridge etc.
- Májovský (1961): *Cycloloma platyphyllum* (Michx.) Moq. a *Amaranthus blitoides* S. Wats., dva nové druhy flóry Slovenska. – Acta Fac. Rer. Natur. Univ. Comen.-Bot., 8/10: 391–403.
- Mandák B. & Pyšek P. (1998): History of spread and habitat preferences of *Atriplex sagittata* (*Chenopodiaceae*) in the Czech Republic. – In: Starfinger U., Edwards K., Kowarik I. & Williamson M. (eds.), Plant invasions: Ecological mechanisms and human responses, p. 209–224, Backhuys Publisher, Leiden.
- Marie-Victorin F. (1964): Flore Laurentienne. – Les Presses de L'Université de Montréal, Montréal.
- McVaugh R. (1958): Flora of the Columbia county area, New York. – University of the State of New York, Albany & New York.
- Moquin-Tandon A. (1849): *Salsolaceae*. – In: de Candolle A.-P. (ed.), Prodrromus systematis naturalis regni vegetabilis, 13/2: 41–219, Masson, Paris.
- Moss E. H. (1959): Flora of Alberta. – University of Toronto Press, Toronto & Buffalo.
- Munz P. A. (1974): A flora of southern California. – University of California Press, Berkeley etc.
- Neuhäuslová Z. & Kolbek J. (eds.) (1982): Seznam vyšších rostlin, mechorostů a lišejníků střední Evropy užitých v bance geobotanických dat BÚ ČSAV. – Botanický ústav ČSAV, Průhonice.
- Peattie D. C. (1930): Flora of the Indiana dunes. – Field Museum of Natural History, Chicago.
- Pignatti S. (1982): Flora d'Italia. – Edagricole, Bologna.
- Radford A. E., Ahles H. E. & Bell C. R. (1968): Manual of the vascular flora of the Carolinas. – University of North Carolina Press, Chapel Hill.
- Scoggan H. J. (1978): The flora of Canada, Part 3. – National Museum of Canada, Ottawa.
- Scott A. J. (1978): A revision of the *Camphorosmioideae* (*Chenopodiaceae*). – Feddes Repert., 89: 101–119.
- Small J. K. (1933): Manual of the southeastern flora. – University of North Carolina Press, Chapel Hill.
- Soó R. (1970): A magyar flóra és vegetáció rendszertani növényföldrajzi kézikönyve, Vol. 4. – Akadémiai Kiadó, Budapest.
- Steyermark J. A. (1963): Flora of Missouri. – Iowa State University Press, Iowa.
- Stone W. (1973): The plants of southern New Jersey. – Quarterman Publications, Boston.
- Szujkó-Lacza J. & Kováts D. (1993): The flora of the Kiskunság National Park in the Danube-Tisza midregion of Hungary, Vol. 1. – Magyar Természettudományi Múzeum, Budapest.
- Taylor R. L. & MacBryde B. (1977): Vascular plants of British Columbia. – University of British Columbia Press, Vancouver.
- Voss E. G. (1985): Michigan flora. Part 2. – University of Michigan, Ann. Arbor., Michigan.
- Weber W. A. (1967): Rocky mountains flora. – University of Colorado Press, Boulder.
- Welsh S. L., Atwood N. D., Goodrich S. & Higgins L. C. (eds.) (1987): A Utah flora. – Great Basin Naturalist Memoir no. 9, Brigham Young University.
- Wilson P. G. (1984): *Chenopodiaceae*. – In: George A. S. (ed.), Flora of Australia, 4: 81–330, Australian Government Publishing Service, Canberra.
- Wootton E. O. & Standley P. C. (1915): Flora of New Mexico. Contributions from the United States National Herbarium. 19. – Washington.
- Yatskievych G. & Turner J. (1990): Catalogue of the flora of Missouri. – Braun-Brumfield, Ann. Arb., Michigan.