

SPHAEROCARDAMUM (CRUCIFERAE)

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Since it was published more than a century ago (S. Schauer, 1847), to my knowledge no specimens, other than the type, have been referred to *Sphaerocardamum nesliiforme* Schauer. Schulz (1936) recognized and illustrated the genus, but failed to associate any other species with it. Instead, he (1933) proposed the monotypic genus *Cibotarium*, apparently not realizing that *C. stellatum* (S. Watson) Schulz was in reality a second species of *Sphaerocardamum*. Schulz had an excellent opportunity to make the association between *S. nesliiforme* and what Watson (1890) called *Capsella stellata* because he had the type of the former available to him in Berlin, as well as material of *C. stellatum*. Possibly Schulz was misled because Schauer emphasized the resemblance of *Sphaerocardamum* to *Neslia* so strongly in his original publication. Certainly I was not able to make the appropriate association of these species merely from the descriptions of Schauer or of Schulz, or from the illustration given in *Die Pflanzenfamilien*. Even photographs of the type of *S. nesliiforme*, kindly supplied to me by Guy Nesom of Memphis, did not provide enough information for me to make the association. It was apparent that *Capsella stellata* and *Sphaerocardamum nesliiforme* were two species of the same genus only after I was able to see the type of *S. nesliiforme* itself. As a consequence of my studies, it is clear that *Cibotarium* must be abandoned in favor of *Sphaerocardamum*.

My former treatment of the species involved, which are all native of Mexico (Rollins, 1941), was somewhat tentative because of the paucity of available material. Since then, I have been able to observe populations of these plants in the field on several occasions and to obtain some material for cytological study (Rollins and Rüdénberg, 1977). One species, *Sphaerocardamum stellatum*, was successfully grown in the greenhouse. However, there is still too little material for a finished taxonomic treatment of the genus as a whole. Unlike many genera of the Cruciferae, *Lesquerella* for example, plants of *Sphaerocardamum* seem to be few in number where they occur and are often inconspicuous. This may account in part for the unsatisfactory representation of the genus in most herbaria.

Information previously published under the name *Cibotarium* (cf. above and Rollins, 1957) is applicable in detail to *Sphaerocardamum*, and it is not considered necessary to present a wholly new treatment at this time. A key to the species and a synopsis of *Sphaerocardamum* as given below provides a framework for the presentation of new information. A full description of *S. nesliiforme*, which was not treated as such earlier, is given as is a description for the newly described *S. ramosum*, but otherwise descriptions are not provided.

Sphaerocardamum Schauer, *Linnaea* 20: 720. 1847.

Cibotarium, O. E. Schulz, *Bot. Jahrb.* 66: 91. 1933.

Biennial or perennial herbs, often woody at base; stems one to several, branched at least above, densely pubescent throughout with dendritically branched trichomes; basal leaves lacking; cauline leaves linear-oblong to spatulate or oblanceolate, cuneate at base, entire to dentate or remotely denticulate, 1-nerved, densely pubescent; inflorescences racemose, terminating each branch; flowers small to minute, numerous; sepals oblong, pubescent, non-saccate, erect, usually hyaline-margined; petals spatulate, white, sometimes absent; stamens exerted, filaments subequal, anthers globose, usually purplish; fruiting pedicels slender, straight, pubescent, widely spreading to slightly ascending; siliques subglobose to oblong, densely pubescent on exterior, often pubescent on interior; styles glabrous; ovules 2 to 8 in each loculus; seeds wingless, oblong, plump, musilagenous when wetted; cotyledons incumbent to obliquely incumbent.

This genus, as presented here, consists of 8 species that occur only in central Mexico. The geographic area extends from the states of Hidalgo and Aguascalientes, north to Coahuila and eastward to Nuevo Leon. Several taxa apparently are very restricted in their occurrence. The most widespread is *Sphaerocardamum macropetalum* which has been found in Coahuila, Nuevo Leon, and Zacatecas. On the basis of counts in *S. stellatum* and *S. macropetalum*, the basic chromosome number appears to be $x = 8$.

KEY TO THE SPECIES

- A. Siliques spherical or nearly so; valves rounded on back; replum orbicular to broadly obovate or elliptical, 2 mm. or less from base to apex; ovules 2-3 in each locule ... 1. *S. nesliiforme*.
- A. Siliques oblong to obovate, compressed opposite to plane of septum in different degrees; valves either keeled or rounded on back; replum broadly oblong to narrowly linear, more than 3 mm. from base to apex except in *S. stellatum*; ovules 4 or more in each locule.
 - B. Siliques distinctly notched at base of style, obovate; valves of mature fruits definitely keeled on back.
 - C. Petals absent or minute, shorter than sepals if present; styles less than 0.5 mm. long; siliques 2 mm. or less long 2. *S. stellatum*.
 - C. Petals present, exceeding sepals in length; styles nearly 1 mm. long; siliques 3 mm. or more long 3. *S. fruticosum*.
 - B. Siliques truncate or rounded at base of style, oblong or obovate to nearly linear; valves of mature fruits either rounded or keeled on back.
 - D. Petals minute (sometimes absent), shorter than sepals, narrow, without an expanded blade 4. *S. macrum*.
 - D. Petals conspicuous, longer than sepals, obovate to spatulate; blade expanded, often abruptly so.
 - E. Siliques obovate; valves keeled on back 5. *S. ramosum*.
 - E. Siliques oblong to more elongated; valves either rounded or keeled on back.
 - F. Valves of siliques keeled on back; siliques strongly compressed opposite to plane of septum; replum narrowly linear 6. *S. compressum*.
 - F. Valves of siliques rounded on back; siliques moderately compressed opposite to plane of septum; replum oblong.
 - G. Petals spatulate, gradually tapering from blade to claw, less than 2 mm. long; styles 1 mm. or less long 7. *S. divaricatum*.

G. Petals obovate, abruptly narrowed from blade to claw, 2-3 mm. long; styles 1-2 mm. long 8. *S. macropetalum*.

1. *Sphaerocardamum nesliiforme* Schauer, *Linnaea* 20: 721. 1847.

Cibotarium microcarpum Rollins, *Rhodora* 59: 70. 1957.

Perennial, sometimes woody at base; stems single to rarely branched from base, virgately branched above, densely pubescent throughout with coarse dendritically branched trichomes, 1.5-2.5(-3) dm. tall; basal leaves not present; cauline leaves linear-oblong, cuneate at base, obtuse at apex, entire or remotely denticulate to shallowly sinuate-dentate, 1-nerved, densely pubescent with coarse dendritic trichomes, 1-2(-8) cm. long, up to 8 mm. wide; inflorescences racemose, terminating each branch; flowers minute, numerous; sepals oblong, pubescent, non-saccate, erect, hyaline-margined, 1 mm. or less long; petals minute, narrowly spatulate, white, shorter than sepals; stamens exserted, filaments subequal, anthers globose; fruiting pedicels slender, straight, pubescent, widely spreading, only slightly ascending, 2.5-3(-4) mm. long; siliques globose or nearly so to oval, disposed at same angle as pedicel, valves nearly hemispherical, rounded on back, densely pubescent on exterior, sparsely pubescent to nearly glabrous on interior, septum entire, replum nearly orbicular to slightly longer than broad, 1.2-1.5 mm. long; styles glabrous, 0.75-1.0 mm. long; ovules 2-3 in each loculus, funiculi usually attached near apex of replum; seeds wingless, oblong, plump, musilagenous when wetted, 1 mm. or less long; cotyledons incumbent to obliquely incumbent.

Mexico: without locality, *Aschenborn* 209 (B!, holotype). **Hidalgo:** dry rocky slopes of Barranca de Tolimán somewhat above the mines, 7.6 mi. from Zimapán on road to Mina Loma del Toro and Balcones, District of Zimapán, Oct. 30, 1949, *H. E. Moore, Jr.* 5443 (GH, holotype; BH, isotype of *Cibotarium microcarpum*). Same general locality, Oct. 18, 1983, *R. C. & K. W. Rollins* 83349 with *Mario Sousa P.* (GH, and to be distributed).

Following Schulz (1936), the original compounding of the epithet *nesliaeforme* is treated as an orthographic error. It has been corrected to *nesliiforme*. This is in accordance with Article 73 (73.8) of the International Code of Botanical Nomenclature.

The single plant constituting the holotype of *Cibotarium microcarpum* is woody below the leafy portion of the stem. This is the usual situation in older plants of several species of *Sphaerocardamum*. Plants do flower the first year of growth and these have not, at that point, developed a woody foot that is otherwise characteristic. In *S. nesliiforme*, the two specimens constituting the holotype do not have a woody base. However, it is possible that these are plants not yet old enough to have developed wood. Not only is the extent of woodiness variable from plant to plant within species of *Sphaerocardamum*, there are considerable differences between species. *Sphaerocardamum macropetalum* and *S. stellatum* are more woody than either *S. divaricatum* or *S. macrum* for example. There are other slight differences between the holotype of *Cibotarium microcarpum* and material of *S. nesliiforme*. For

example, the siliques on the holotype of *C. microcarpum* are slightly stipitate whereas they tend to be sessile in *S. nesliiforme*. Also, in the one or two fruits of *C. microcarpum* examined, there were three ovules in each locule and the replum was a little more elongated than in *S. nesliiforme* where the ovule number is usually only 2 per locule. But these distinctions may well fall within the total range of variation of *S. nesliiforme* when that is better known. Therefore, *C. microcarpum* has been placed in synonymy.

Because the genus *Sphaerocardamum* is not known south of the state of Hidalgo in Mexico and the mining areas of that state were visited by Aschenborn, the presumption is that the type of *S. nesliiforme* was collected somewhere in that state. Acting on that assumption, we spent four days in October, 1983, searching for *S. nesliiforme* in what we thought might be appropriate sites. Following the leads provided by the data from the collections of Moore (no. 5443) and Moore and Wood (no. 4253a), we found *S. nesliiforme* and *S. divaricatum* in the same areas where they had been collected in 1949 and 1948 respectively.

2. *S. stellatum* (S. Watson) Rollins, comb. nov., based on *Capsella stellata* S. Wats., Proc. Amer. Acad. **25**: 142. 1890.

Cibotarium stellatum (S. Wats.) O. E. Schulz, Bot. Jahrb. **66**: 91. 1933.

SPECIMENS STUDIED. Mexico. Aguascalientes: ladera S del Cerro Palmira, 4 km. al W de Asientos, 1-XI-1967, J. Rzedowski 25059 (ENCB). Coahuila: Caneros Pass, Pringle 2844 (GH, holotype); ca. 2 km. N of Estacion Carneros, E flank of Sierra El Chorreadero, M. C. Johnston et al. 10497A (GH); Carneros Pass, 26 mi. S of Saltillo, Rollins & Tryon 58133 (GH); 29 mi. S of Saltillo, Rollins & Roby 7490 (GH); Saltillo, Palmer 752 (GH). Nuevo Leon: 177 km. N of Matehuala, Rollins & Roby 76067 (GH). San Luis Potosí: 50 mi. NE of San Luis Potosí on road to Matehuala, Rollins & Tryon 58191 (GH). Zacatecas: ca. 15 (air) mi. E of Concepcion del Oro, Sierra del Astillero, Henrickson 13302b (GH).

Like many other herbaceous to suffrutescent species of the milder, arid parts of North America, *Sphaerocardamum stellatum* may produce inflorescences a few months after seed germination. This was shown when seeds planted in the greenhouse in October, 1976, produced plants that flowered in March, 1977. But the species is not an annual in the usual sense of the term. Even though they flower the first year, the plants of this species continue their growth to become woody at the base. Wild plants of *S. stellatum* often appear to be apetalous and it is possible that this is the case in some populations. Certainly the petals, when present, are minute and are very easily shed. Even in greenhouse grown plants, the petals were erratically present and were shed almost immediately after anthesis.

A chromosome number of $n = 8$ was found in Rollins & Roby 7490 from Coahuila and Rollins & Roby 76067 from Nuevo Leon (see citations above).

3. *S. fruticosum* (Rollins) Rollins, comb. nov., based on *Cibotarium fruticosum* Rollins, Contr. Dudley Herb. **3**: 187. 1941.

SPECIMENS STUDIED. Mexico. San Luis Potosí: Minas de San Rafael, Purpus 5374 (GH, holotype; NY, US, MEXU, isotypes); same locality, Purpus 5235, 5235' (UC); ca. 12 km. al SE de Armadillo, 10-VIII-56, J. Rzedowski 7964 (ENCB).

4. *S. macrum* (Standley) Rollins, *comb. nov.*, based on *Lepidium macrum* Standley, Field Mus. Nat. Hist. (Bot.) 17: 248. 1937.

Cibotarium macrum (Standley) Rollins, Contr. Dudley Herb. 3: 189. 1941.

SPECIMENS STUDIED. Mexico. Coahuila: 16 mi. S of Arteaga, Kenoyer & Crum 2807 (GH). Nuevo Leon: above San Enrique, Hacienda San Jose de Raices, Municipio de Derrumbadero, Mueller 2411 (GH, isotype).

5. *S. ramosum* Rollins, *sp. nov.*

Herba perennis; caulibus divaricato-ramosis, ca. 2 dm. altis, dense foliatis, pubescentibus; foliis oblanceolatis, sparse denticulatis, dense pubescentibus, sessilibus, 1-4 cm. longis, 4-8 mm. latis; sepalis oblongis, nonsaccatis, pubescentibus; petalis albis, spathulatis; pedicellis fructiferis patentibus, pubescentibus, 5-8 mm. longis; siliquis obovatis, pubescentibus, compressis, 3-4 mm. longis; stylis ca. 1 mm. longis; loculis 4-6 ovulatis; seminibus ca. 1 mm. longis; cotyledonibus incumbentibus.

Holotype in the Gray Herbarium, collected in Nuevo Leon on the east slope of Cerro Potosí at ca. 6050 ft. elev., dry open places in a waste area between corn fields, July 9, 1963, R. L. McGregor, L. J. Harms, A. J. Robinson, R. del Rosario & R. Segal 413.

Perennial, erect, leafy, ca. 2 dm. tall, densely pubescent throughout; trichomes dendritic; stems virgately branched and with a densely flowering inflorescence terminating each branch; leaves all cauline, sessile, oblanceolate, sparsely denticulate, 1-4 cm. long, 4-8 mm. wide; sepals oblong, nonsaccate, hyaline-margined, 1 mm. long or slightly more; petals white, spatulate, 1.5 to nearly 2 mm. long; claw very narrow at point of insertion; fruiting pedicels spreading at right angles to rachis, slender, straight, 5-8 mm. long; siliques obovate, compressed in a plane opposite to that of septum, truncate at base of style, 3-4 mm. long; valves moderately keeled on back; styles glabrous, ca. 1 mm. long, 4-6 ovules in each loculus; seeds plump, marginless, ca. 1 mm. long; cotyledons incumbent.

The siliques of *Sphaerocardamum ramosum* are much like those of *S. macrum* but the petals of that species are minute, being 1 mm. or less long with scarcely any expansion in the blade area whereas the petals of *S. ramosum* are comparatively conspicuous, ranging up to 2 mm. in length and with an expanded blade. The leaves of *S. ramosum* are all denticulate while those of *S. macrum* are nearly all entire. Branching begins near the base in *S. ramosum* but in *S. macrum* branching occurs near the top of the stems. Like several other species of *Sphaerocardamum*, there are trichomes present on the interior of the valves in *S. ramosum*. The type collection is the only one known of this species.

6. *S. compressum* Rollins, *comb. nov. et stat. nov.*, based on *Cibotarium divaricatum* var. *compressum* Rollins, Contr. Dudley Herb. 3: 180. 1941.

SPECIMENS STUDIED. Mexico. Coahuila: Sierra de Parras, Purpus 4603 (GH, holotype).

The strongly compressed siliques in this species result in a very narrow replum which has an acute angle at the apex and the valves are strongly keeled on the back. This is quite in contrast to the situation in *S. divaricatum* where the replum is oblong with an obtuse angle at the apex and the valves are rounded on the back. The pubescence of *S. divaricatum* is so dense that

the plants are canescent whereas the evenly spaced trichomes on plants of *S. compressum*, particularly on the siliques, provide only a grayish to greenish aspect. The interior of the valves are glabrous in *S. compressum* while these surfaces are covered with trichomes in *S. divaricatum*. These differences support the elevation of the taxon I treated earlier as a variety to the rank of species.

7. *S. divaricatum* (Rollins) Rollins, *comb. nov.*, based on *Cibotarium divaricatum* Rollins, *Contr. Dudley Herb.* 3: 189. 1941.

SPECIMENS STUDIED. Mexico. Coahuila: Sierra de Parras, *Purpus* 1027 (GH, holotype; NY, isotype); Saltillo, *Palmer* 347 (GH, NY, UC, US); La Casita, *Kenoyer & Crum* 3067 (GH). Hidalgo: El Capulin, between Actopan and Ixmiquilpan, *Moore & Wood* 4253a (GH); same locality, Oct. 17, 1983, *Rollins et al.* 83347 (GH).

8. *S. macropetalum* (Rollins) Rollins, *comb. nov.*, based on *Cibotarium macropetalum* Rollins, *Contr. Dudley Herb.* 3: 190. 1941.

SPECIMENS STUDIED. Mexico. Coahuila: Carneros Pass, *Pringle* 2848 (GH), *Pringle* 3195 (GH, NY, UC, US); 12 mi. E of Saltillo, *Rollins & Tryon* 58139 (GH); 59 km. S of Saltillo, *Stanford et al.* 290 (GH); 29 mi. S of Saltillo, *Rollins & Roby* 7489 (GH); 26 mi. S of Saltillo, *Rollins & Tryon* 58134 (GH); 4 mi. E of Carneros, *Correll & Johnston* 21325 (GH). Nuevo Leon: 34 mi. S of Saltillo, *Rollins & Roby* 76065 (GH); between Saltillo and Matehuala, 4 mi. S of turn-off to Hacienda de San Jose Raices, *Rollins & Tryon* 58181 (GH); 1.5 km. E of El Barrosite in southern part of Sierra la Tomita, *Wendt et al.* 8008 (GH). San Luis Potosí: ca. 6 km. E of Laguna Seca, Mpio. de Charcas, 10-IX-55, *J. Rzedowski* 6551 (ENCB). Zacatecas: Puerto de Rocamontes, *M. C. Johnston et al.* 10487 (GH, MEXU); 1.5 km. ESE of Salaverna on road to Concepcion del Oro, *Chiang et al.* 7936 (GH); Sierra del Astillero, *M. C. Johnston et al.* 11564 (GH, MEXU); near Concepcion del Oro, *Palmer* 297 (GH, holotype; NY, UC, US, isotypes); same locality, *Pennell* 17399 (GH); ca. 16 (air) mi. E of Concepcion del Oro, *Henrickson* 13289 (GH); 9.6 mi. W of Concepcion del Oro, *Rollins & Roby* 74137 (ENCB, GH).

As is evident from the number of specimen citations, *Sphaerocardamum macropetalum* is the best known species of the genus. It often grows in the same locations as *S. stellatum* and was confused with that species by Watson (1890). However, the two species are amply distinct and can be readily recognized in the field. In the two places where I have observed them, there is no evidence of hybridization. The chromosome number of *S. macropetalum* is $n = 8$ (Rollins & Rüdénberg, 1977).

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