

SYSTEMATIC STUDIES IN THE COREOPSIDINAE (COMPOSITAE): NEW COSMOS FROM MEXICO

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COSMOS ochroleucoflorus Melchert, sp. nov.

Perennis caespitosa multicaulis suffruticosa rhizomatosa *C. crithmifolio*, affinis, differt floribus disci albidis vel ochroleucis, stylorum ramis purpureis, achaeniis minoribus (10-15 mm longia, 1 mm. latis) cum aristis longioribus (15-30 mm.).

Clumped, multi-stemmed, suffruticose perennials from elongate, branching rhizomes; stems herbaceous and slender above, but stiffly erect, 45-80 cm tall, leafy throughout, essentially terete, but multi-ridged, the ridges usually stramineous, the depressions greenish, glabrous or with scattered, antrorsely appressed, multi-cellular hairs; leaves narrowly linear, undivided, the principal ones mostly 4.5-13.0 cm long, 0.5-1.5 (2) mm wide, or sometimes 1 (2)—pinnatifid with 3-5 linear segments, these mostly 2.5-5.0 mm long, 0.5-1.5 mm wide, the margins sub-revolute, antrorsely, spinulose-ciliate, the surface glabrous or appressed-hispid; heads 1-few per stem; peduncles slender, 6-15 cm. long; outer involucre of (5-) 8 (-9), linear-lanceolate or linear-subulate phyllaries, these usually with numerous, blackish-green striations and a narrow, scarious border, often becoming stramineous with age; outer palea broadly linear-ovate, becoming increasingly linear toward the center of the head, 9-12 mm long, 0.5-1.5 mm wide; ray florets 5, light pink or lavender, often drying to a deep purple-lavender, broadly obovate, 16-18 mm long, 11-12 mm. wide, 3-toothed at the apex; disc floret 11-17 (-20), white to ochroleucous, their teeth occasionally pinkish-tipped, 8.5-10.5 mm long, scattered pilose, the tube 1.5-2.0 mm long, the limb cylindric, 7.0-8.5 mm long, shallowly toothed, these 1.0-1.5 mm long; filaments densely, short pilose; style branches purple; mature achenes blackish-brown, linear, tetragonal with rounded edges and once sulcate on each face, narrowed apically, but not decidedly rostrate, erect setose, especially above, the body 8-15 mm long, mostly 1 mm wide; pappus of 4 or 5 (-6) retrorsely barbed awns, these 1.5-3.0 mm long, sub-equal or 1 or 2 slightly to much shorter than the others; chromosome number, $n = 22$.

The inclusion of the Durango *Cosmos* populations treated here as *C. ochroleucoflorus* within *C. crithmifolius* by Sherff (1964b) is completely understandable when one considers the many exomorphic features

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shared by these species. Both are suffruticose, multi-stemmed, rhizomatous perennials with slender, sub-glabrous, rigid stems and narrowly-linear, undivided or once-pinnatifid leaves. Furthermore, while most *Cosmos* species are 8-rayed, both *C. ochroleucoflorus* and *C. crithmifolius* have 5 pinkish, or lavender, ray florets.

Though these species are indeed very similar, an examination of their disc florets quickly yields several diagnostic differences. The 11-16 (-18) disc florets of *C. ochroleucoflorus* have white to ochroleucous corollas and purple style branches. By contrast, those of *C. crithmifolius* are mostly 21-27 in number, have corollas which are deep to golden yellow above, grading to light yellow below, and yellow style branches. The size of the mature achenes and pappus lengths also differ quantitatively. The achenes of *C. ochroleucoflorus* have bodies which are 10-15 mm long and mostly 1 mm wide, and awns which are 15-30 mm long (fig. 5). Those of *C. crithmifolius* are 12-18 mm long, 1.2-1.5 mm wide, and have awns which are 3-5 mm long (fig. 6).

Both *C. ochroleucoflorus* and *C. crithmifolius* frequent stony, roadside ledges or roadcuts in mountainous, pine-oak dominated communities. While appearing to be very similar, ecologically, they are decidedly allopatric and seemingly isolated cytogenetically. *C. crithmifolius* is the only wide-ranging, rhizomatous species in the genus occurring from western Jalisco southeastward along the mountains to Guatemala and Honduras; and in eastern Mexico, northward along the Sierra Madre Oriental into Nuevo Leon. By contrast, *C. ochroleucoflorus* is apparently endemic to a small area in the mountains ca 20-40 road miles west of Ciudad Durango, Durango. Chromosome numbers have been determined from 8 Mexican populations of *C. crithmifolius*. In every instance the meiotic complement was $n = 33$ or ca 33 (Melchert, unpublished). When viewed during diakinesis I, two or three tetravalents were usually present. Disjunction of these rings is seemingly regular for cells viewed during prophase II. Each cell always had a complement of 33 chromosomes in each half of the diad. Unlike these hexaploids, the 2 populations of *C. ochroleucoflorus* examined were tetraploid, $n = 22$. Meiosis was either completely regular or an occasional ring of 4, or, in one instance, 2 trivalents were seen during prophase I.

SPECIMENS EXAMINED:

MEXICO: DURANGO: Region of mixed pine, oaks, and *Arbutus*; fairly dry and rock region 20 mi w of Cd Durango and 2 mi e of El Soldado along Route 40, 4 Sep 66, Melchert, Sorensen & Crawford 6283 (Holotype IA); among boulders in pine and oak region 1 mi w of El Soldado along Route 40, 4 Sep 66, Melchert, Sorensen & Crawford 6285 (IA); in rocky rhyolite soil in open oak and pine woodland about 30 mi w of Durango, 28 Sep 1962, Cronquist 9540 (MICH, NYBG); 34 mi w of Cd Durango, on highway to El Salto, plateau w of Arroyo Mimbres, sparsely wooded grassland in a pine shaded ravine, 29 Aug 1951, J. H.

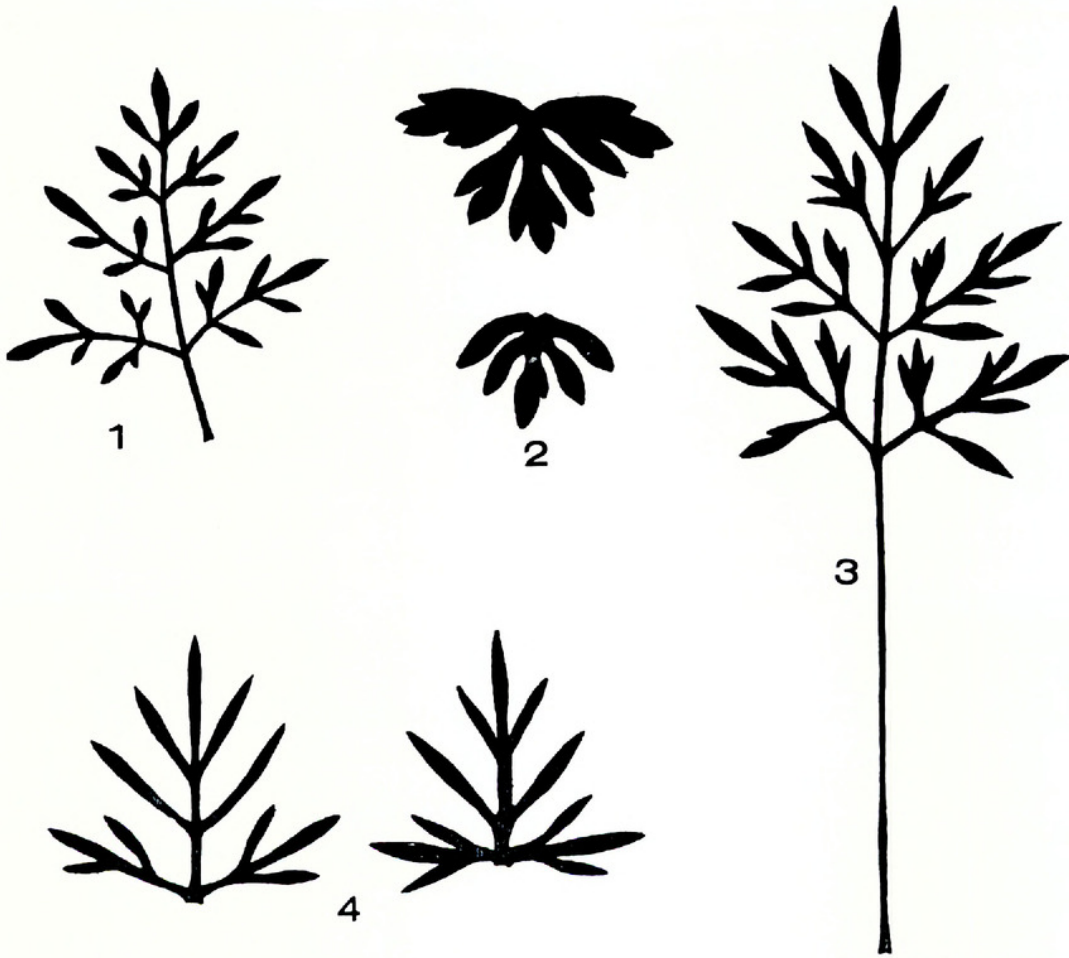
Maysilles 7550 (MICH, F); Quebrada de San Juan, 26 rd mi n of railroad at Coyotes, on rd to San Luis, steep canyon walls and shaded, cool moist ravines, Jul-Aug 1955, J. H. *Maysilles* 8048 (MICH); rocky, andesitic pineland canyon, near El Salto, 31 Aug 1934, F. W. *Pennell* 18509 (NYBG). Clay and rocky talus slop eat base of cliff 11 mi e of km 1091 and 11 mi e of El Ciudad along Route 40, 6 Aug 1965, *Melchert & Sorensen* 6039 (IA).

COSMOS *sherffii* Melchert, sp. nov.

Perennis erecta glabra pluricaulis e radicibus tuberiferis; folia 2—3-pinnatisecta laminis 5—7 (—10) cm. longis, petiolis 10—17 mm. longis; capitula solitaria pedunculis elongatis; flores radii rosacei (sicci lavandulo-purpurei), disci flavi.

Erect, glabrous perennials with several stems from a cluster of tuber-forming roots, stem simple below, branching above, terete; internodes 3-12 cm long; leaves 2-3 pinnatisect, 5-7 (-10) cm long, petiolate, these 10-17 mm long, the lowest pair of primary divisions 2.5-3.5 (-5.0) cm long, the ultimate segments linear-lanceolate or linear-oblongate, mostly 2-10 mm long, 1-2 mm wide, the terminal segments to 2.8 cm long, 3.8 mm wide, glabrous, spinulose-ciliate; heads solitary on elongate peduncles, these to 20 cm long; outer involucre of 5-8, lance-linear phyllaries, these 5-8 mm long, light-green, with 3-5, blackish-green veins; inner involucre of 8, oblong-lanceolate phyllaries, these semi-translucent, striate, scarious margined; chaff yellowish-transparent, brown striate, 9.5-11.0 mm long; rays 5-8, sterile, rosaceous, often drying to lavender-purple, narrowly obovate, 20 mm long, 5-6 mm wide, shallowly 3-notched apically; disc florets yellow, 5.5-8.0 mm long, their teeth yellowish-papillate, their tubes 2 mm long; filaments with matted, yellow, pilose hairs; style branches yellow, the stigmatic lines brown; mature fruits unknown; ovaries at anthesis 2-awned, these 1-2 mm long, each with 4 triplets of retrorse barbs; chromosome number, $n = 12$.

Cosmos sherffii is, without doubt, very closely related to the Jalisco endemic *C. longipetiolatus*. A comparative discussion of these two species is found below. Interestingly, the mountainous area ca 25-30 mi nw of Ciudad Oaxaca, where *C. sherffii* is found, abounds with *C. diversifolius*. Like *C. sherffii* the latter is also a lavender-rayed, yellow-disked, tuber-producing perennial. Though distinct morphologically (*C. diversifolius* is primarily scapose, has once-pinnatifid or simple leaves and broadly oblong-lanceolate outer phyllaries; whereas *C. sherffii* is uniformly leafy throughout with 2-3 pinnatisect leaves and has lance-linear outer phyllaries), both species occur in the same pine-oak dominated communities and both have meiotic chromosome complements of $n = 12$ II. While hybridization might be expected under these circumstances, morphological intermediates are unknown. This may be due, at least in part, to phenological differences. In this area of Oaxaca, *C. diversifolius* finishes flowering by late August or early September, at which time *C. sherffii* is just developing noticeable buds.



Figs. 1-4. Leaf silhouettes of *Cosmos* species. Fig. 1. *C. sherffii*. Fig. 2. *C. sessilis*. Fig. 3. *C. longipetiolatus*. Fig. 4. *C. stellatus*.

The only other Oaxacan *Cosmos* species with which *C. sherffii* might be confused is *C. nelsonii*, another Oaxacan endemic with lavender rays, yellow disc florets and 2-3 pinnatisect leaves. They differ, however, in the shape and size of their ultimate segments (broadly lanceolate and mostly 3-5 mm wide in *C. nelsonii* and narrowly-lanceolate and 1-2 mm wide in *C. sherffii*, and in the number and length of their awns (2 awns, these 1-2 mm long at anthesis in *C. sherffii*, and 4 or 5 awns, these 3-5 mm in *C. nelsonii*).

SPECIMENS EXAMINED:

OAXACA: Lightly wooded area high on a steep slope in a zone of pine, oak, and *Arbutus*, soil a clay loam, 30 rd mi s of Nochixtlan and ca 36 rd mi nw of Cd Oaxaca on Route 190, 22 Aug 1966, Melchert & Sorensen 6165 (Holotype IA); zone of pine, oak, and *Arbutus* ca 29 rd mi nw of Cd Oaxaca and 3-3.5 rd mi n of small village of La Carbonera along route 190, 25 Sep 1966, Melchert, Sorensen & Crawford 6476 (IA). **COSMOS longipetiolatus** Melchert, sp. nov.

Praecedenti peraffinis, differt foliis 10—23 cm. longis (petiolis 3—9 cm.).

Erect, glabrous perennials with several to many stems from a cluster of tuber-forming roots; stems simple below, branching above, terete, herbaceous, but becoming stramineous and subligneous below; internodes conspicuously elongate, 6-16 cm long; leaves 2 (-3) pinnatisect, 10-23 cm long, petiolate, these 3-9 cm long, the lowest pair of primary divisions 4.0-7.5 cm long, the ultimate segments linear-lanceolate to narrowly lanceolate or oblanceolate, mostly 3-14 mm long, 2-3 mm wide, the terminal segments to 4 cm long, 5 mm wide, glabrous, spinulose-ciliate; heads numerous, solitary on elongate peduncles, these 8-27 cm long; outer involucre of 8, lance-linear phyllaries, these 8-11 mm long, 1-15 mm wide, light-green with 3-5 blackish-green veins; inner involucre of 8, oblong-lanceolate phyllaries, these with numerous, blackish striations, narrow, scarious margins and rosaceous, puberulent tips; rays 8, lavender-purple, sterile, their tips obtuse, sometimes one-notched; disc florets yellow, 5.0-6.5 mm long, their teeth yellow papillate, their tubes rosaceous, 1.5 mm long; filaments short pilose; style branches yellow; achenes 9-12 mm long, glabrous blackish-brown, linear, narrowing slightly apically, tetragonal with rounded edges, each face once-sulcate; pappus wanting, or of 2 minute awns, these to 1 mm long, retrorsely barbed; chromosome number unknown.

Exomorphically, *C. longipetiolatus*, which is known only from one Jalisco collection, appears most closely related to the above-described, Oaxacan endemic *C. sherffii*. Among the tuber-producing species, these are the only taxa with lavender rays and yellow discs whose leaves are both: 1) evenly distributed along their stems and 2) 2-3 pinnatisect with narrowly-lanceolate segments (fig. 1 & 3). While the leaves of these two species are superficially similar, their absolute size ranges are quite different and can be used as reliable diagnostic characteristics. With petioles included, the leaves of *C. longipetiolatus* are 10-23 cm long, as compared to 4-8 cm. in *C. sherffii*. Likewise, the petioles of the former are considerably more elongate (3-9 cm) than are those of *C. sherffii* (1-2 cm).

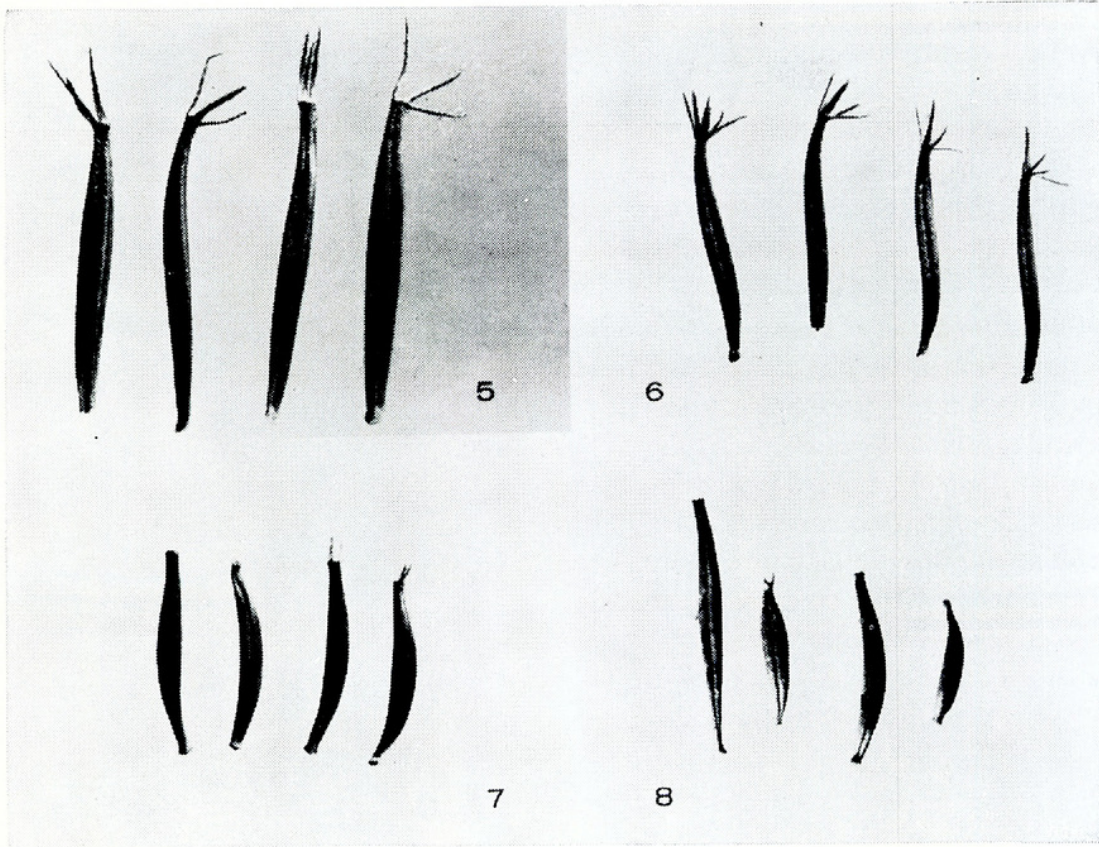
SPECIMEN EXAMINED:

JALISCO: Open, oak-pine woods in the mountains ca 32 rd mi w of Ayutla and ca 70 m nw of Autlan, elevation ca 6300 ft. 4 Nov 1962, Cronquist 9803 (Holotype NYBG, Isotypes, F, MICH).¹

COSMOS SESSILIS Sherff, Brittonia 16:71. 1964

As originally described, *Cosmos sessilis* appeared to have several features which were unique or at least very unusual in *Cosmos*. Most notable among these were its discoid heads and its completely awnless

¹This specimen was cited by Sherff (1964) in the list of representative specimens following his description of *Cosmos intercedens*. The latter species belongs to the rhizomatous section of the genus and is not close to *C. longipetiolatus*.



Figs. 5-8. Photographs of *Cosmos* achenes. Fig. 5. *C. crithmifolius*. Fig. 6. *C. ochroleucoflorus*. Fig. 7. *C. longipetiolatus*. Fig. 8. *C. sessilis*.

achenes. All other *Cosmos* species are rayed and, with the exception of *C. mcvaughii* and a few awnless individuals of *C. bipinnatus*, *C. sulphureus*, and *C. caudatus*, which were treated as varieties by Sherff (1955), all produce well-developed barbed awns. It now appears that the original description of *C. sessilis*, accurate for the plants involved, merely describes one phase in its floral development. During a visit to the type locality on September 6, 1966, a considerable number of these plants were found in various stages of anthesis. Contrary to the original description, all individuals viewed during the early stages of anthesis had 8 well-developed rays. These were dark, almost blackish-sanguinous, with white pubescence on the veins of the lower surface, obovate, mostly 15-20 mm long, 6-9 mm wide, and irregularly, 1-3 toothed apically. Plants with heads in somewhat later stages of anthesis, however, either had fewer rays, or were completely rayless. These rays proved to be quite delicate and it was difficult to remove a plant from the ground without losing some of them. This ephemeral nature of the ray florets plus the fact that the type collection (R. McVaugh 19997) was made almost a month later, October 9, 1960, undoubtedly accounts for the previous treatment of *C. sessilis* as a discoid species.

Sherff's descriptions of the exaristate *Cosmos* varieties mentioned above all include statements indicating that the achenes are even awnless in the ovarial stages. This is certainly not true of *C. sessilis*. At a comparable stage most of its ovaries support 2 minute awns. These are ca 2 mm long and are either smooth or armed with two pairs of retrorse barbs. Apparently, these awns dehise as the achene matures, a developmental feature which accounts for the 2 minute projections at the summit of the mature achene. Certainly, the occurrence of occasional individuals with well-developed awns would not be surprising in *C. sessilis*.

In discussing *C. sessili*, Sherff (1964a) states that "it appears closest to *C. stettatus*. *C. sessilis* differs, however, in being simple below (not basally branched into several stems), with larger, greener leaves, these in pairs, not at all suggesting stars; its head discoid, not beautifully radiate with dark-purplish-red rays; and its ovaries exaristate, not biaristate with retrorsely barbellate aristae."

With the finding of dark-purplish-red rays and awned ovaries in *C. sessilis* these taxa now appear more like geographical variants than species. Morphologically, they differ significantly only in habit (*C. sessilis* has a single stem per plant, whereas the single collection of *C. stellatus* has several stems arising from its tuberous roots) and in the size and degree of dissection of their sessile leaves (fig. 2 & 4). Additionally, the leaves of *C. sessilis* either diverge from the stem at a right angle, or, more commonly, droop downwards, while those of *C. stellatus* appear to be somewhat apically directed. However, before too much importance is placed on these particular leaf differences it should be noted that their leaf texture is extremely similar and that they are the only two *Cosmos* species with sessile leaves. Furthermore, the degree of leaf variation distinguishing these species is no greater than that found at the infra-populational level in many *Cosmos* and *Bidens* species, cf. *C. palmeri*, *C. ocellatus*, *B. pilosa*, etc. Again, though *C. stellatus* is known from one collection in Michoacan and *C. sessilis* from one Jalisco population, they are both located in the same general range of mountains. Additional information regarding their distributions, their infra- and inter-population patterns of morphological variation, and their chromosome complements are certainly desirable.

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