Harms, R.T. and T. Wendt. 2023. A study of the *Evolvulus sericeus* complex (Convolvulaceae) in the southwestern United States and northern Mexico, including the resurrection of *E. discolor* Benth. and a new variety *E. sericeus* var. *cymosus* R.T. Harms. Phytoneuron 2023-26: 1–39. Published 24 July 2023. ISSN 2153 733X

A STUDY OF THE *EVOLVULUS SERICEUS* COMPLEX (CONVOLVULACEAE) IN THE SOUTHWESTERN UNITED STATES AND NORTHERN MEXICO, INCLUDING THE RESURRECTION OF *E. DISCOLOR* BENTH. AND A NEW VARIETY *E. SERICEUS* VAR. *CYMOSUS* R.T.HARMS

ROBERT T. HARMS† & TOM WENDT[1]
Plant Resources Center
The University of Texas at Austin
1 University Station F0404
Austin, Texas 78712

Abstract

Although van Ooststroom (1934) treated *Evolvulus sericeus* (Convolvulaceae) as comprising four varieties, including three in the USA and Mexico, most recent authors have considered *Evolvulus sericeus* Sw. (including *E. discolor* Benth.) to be a taxonomically undifferentiated species in that area. Field studies in Travis, Hays, and Jeff Davis counties in Texas and examination of herbarium material from throughout the southwestern USA and northern and central Mexico indicate that: (1) *E. discolor* is distinct at the species level; (2) a geographically coherent race with long peduncles constitutes the new variety *E. sericeus* Sw. var. **cymosus** R.T.Harms; and (3) *E. choapanus* J.A. McDonald should be considered a synonym of *E. sericeus* var. *sericeus*. Evidence is provided in support of these changes. Descriptions of these taxa are provided for the southwestern USA and Mexico, and a revised key that also includes related species is provided. It is noted that the varietal combination *E. sericeus* var. *discolor* (Benth.) Gray (1886) used by van Ooststroom and subsequent authors was superfluous when published, an older varietal name based on the same type (*E. holosericeus* var. *obtusatus* Choisy, 1845) being available.

Resumen

Aunque van Ooststroom (1934) trató a *Evolvulus sericeus* Sw. (Convolvulaceae) como una especie con cuatro variedades, incluyendo tres variedades en los EUA y México, la mayoría de los autores recientes consideran a *E. sericeus* (incluyendo a *E. discolor* Benth.) como una especie sin taxones infraespecíficas en los EUA y México. Estudios en el campo en los condados de Travis, Hays y Jeff Davis en Texas, así como de ejemplares de herbario del sudoeste de los Estados Unidos y del norte y centro de México, indican que: 1) *E. discolor* es distinto taxonómicamente a nivel de especie; 2) una raza geograficamente coherente con pedúnculos largos constituye la variedad nueva *E. sericeus* Sw. var. **cymosus** R.T.Harms; y 3) *E. choapanus* J.A. McDonald debe considerarse como un sinónimo de *E. sericeus* var. *sericeus*. Se proporcionan los datos que sustentan estos cambios. Se presentan las descripciones de estos taxones presentes en el sudoeste de los EUA y México, así como una clave revisada, que incluye otras especies cercanamente relacionadas. Se hace notar que la combinación *E. sericeus* var. *discolor* (Benth.) Gray (1886) utilizada por van Ooststroom y autores posteriores, es supérflua, puesto que existe un nombre varietal mas antiguo --*E. holosericeus* var. *obtusatus* Choisy (1845)--basado en el mismo tipo.

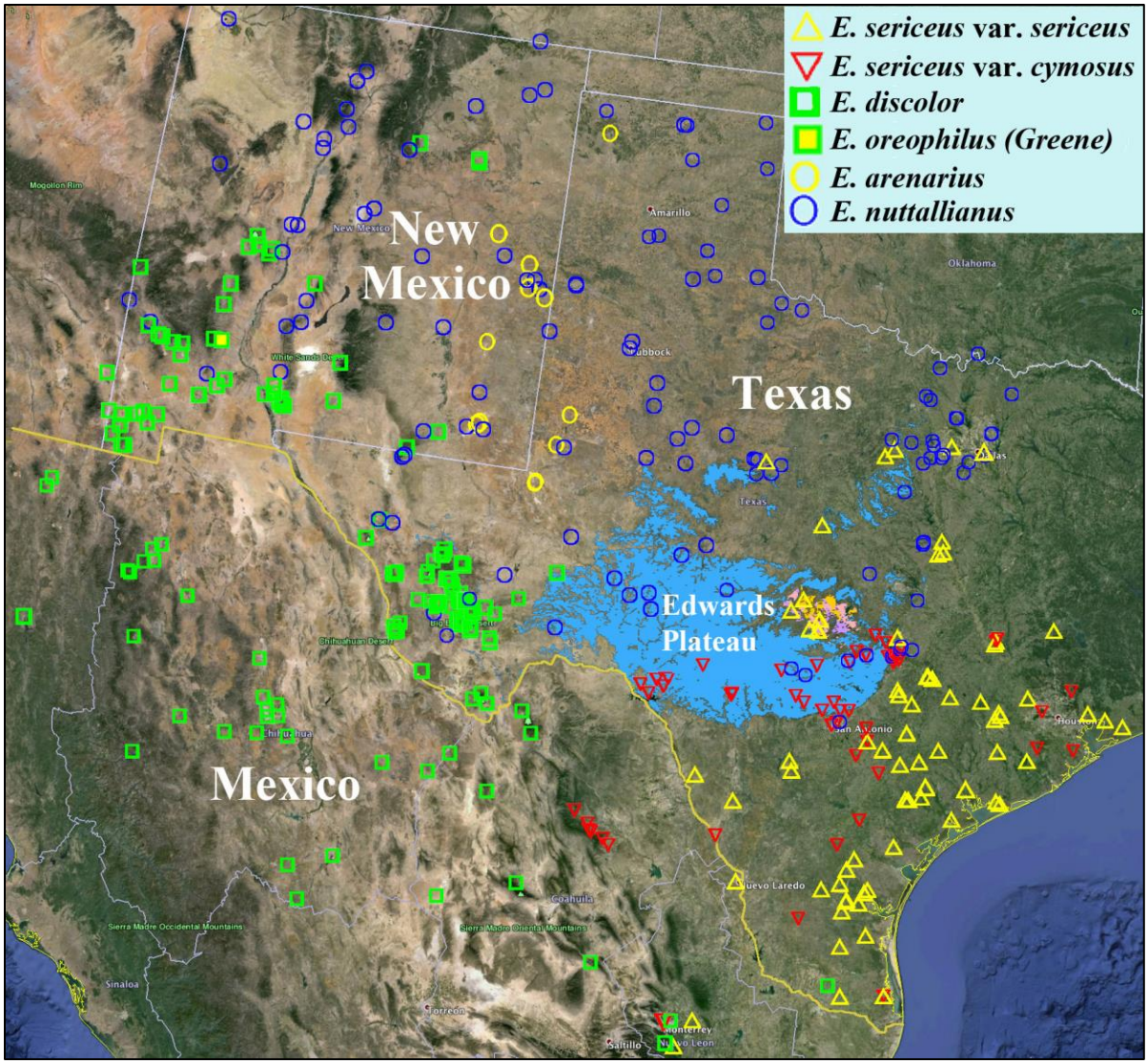
[1] Robert T. (Bob) Harms died after a short illness in October of 2016, age 84, and left an advanced but incomplete manuscript for the current work. The work of the second author has been to bring that manuscript to publishable form. The taxonomic concepts and decisions in this work are Bob's, and statements in the first person singular refer to Bob. The new variety is to be attributed to Bob. All illustrations are as he left them. The second author has edited, added, rearranged, completed, and dealt with loose ends as he thought necessary, trying nevertheless to maintain Bob's style and flow, having discussed the incomplete manuscript with Bob before his death. For 3 complex figures (Figs. 2, 5, and 24), it was not possible to ascertain the voucher specimens.

The *Evolvulus sericeus* complex is defined here as those taxa included in *E. sericeus* Sw. as circumscribed by van Ooststroom (1934). It occurs in the United States from northern Arizona and New Mexico, eastward through north central Texas to Florida, hence southward through Mexico, Central America and the West Indies to South America. The present paper began with an attempt to understand the complex in Texas and the southwestern United States, but it quickly became evident that an understanding of Mexican populations would be needed to accomplish this goal. Thus the present study can be considered a revision of the complex for the southwestern USA and northern Mexico; material from the rest of the range was not studied intensively, although material from Jamaica, the locality of the type of *E. sericeus*, as well as images of the type itself, were consulted to assure correct application of the name.

Simon Jan van Ooststroom, in his careful 1934 monograph of the genus, treated *Evolvulus sericeus* as comprising four varieties: the widespread var. *sericeus*, var. *discolo*r (Benth.) Gray of the southwestern USA and Mexico, var. *holosericeus* (H.B.K.) Ooststr. from central Veracruz, Mexico, southward, and the entirely South American var. *falcatus* (Griseb.) Ooststr. However, more recent authors treating the southwestern USA and northern and central Mexican populations of this complex generally have not recognized var. *discolor* as distinct (e.g., Correll & Johnston, 1970; Austin, 1998; Díaz Betancourt, 2001; Carranza, 2008, 2015; Felger et al. 2012). Those recent workers who do distinguish var. *discolor* from the typical variety (as evidenced mostly by herbarium annotations) often appear to follow Kearney & Peebles (1951) and Martin & Hutchins (1980) in using vestiture (or lack thereof) of the upper leaf surface and flower color in distinguishing the varieties, even though van Ooststroom specifically noted that both varieties have similar variation in these characters. Van Ooststroom distinguished these two varieties mostly by leaf shape, habit, and rather subtle differences in vegetative pubescence. Allred et al. (2020) have recognized var. *discolor* based on character-states that I had posted on-line (which they cited) and which are included in the present publication.

It should be noted that van Oostroom's use of the name *Evolvulus sericeus* var. *discolor* (Benth.) Gray is incorrect, Gray's 1886 combination having been superfluous when published. An older varietal name for the same taxon, citing *E. discolor* as a synonym in the protologue and based on the same type, is available: *E. holosericeus* H.B.K. var. *obtusatus* Choisy (Choisy 1845). The required combination would still need to be made if *E. discolor* were to be treated at the varietal level in the future, not the case in the current work. On the other hand, Manitz (1982), in his study of Cuban *Evolvulus*, essentially followed van Oostroom's infraspecific classification of *E. sericeus* but used the subspecies level to do so, in which case *E. sericeus* subsp. *discolor* (Benth.) Manitz is the correct name for the taxon. He reported only subsp. *sericeus* for Cuba.

Evolvulus discolor Benth., based on a Mexican type with glabrous upper leaf surface (as is the case with the Jamaican type of *E. sericeus*), was accepted by Asa Gray (1878, p. 219) as distinct from *E. sericeus* Sw., citing the former's "shorter and procumbent or prostrate stems, ovate or oblong obtuse leaves, more villous pubescence and larger corolla." At that point, Gray considered it to be a Mexican species which did not occur in the USA. However, later Gray (1886, p. 436) assigned it varietal rank and considered it a member of the USA flora, noting that "the stouter varieties [of *E. sericeus*] which prevail in W. Texas, Arizona, and Mexico, pass freely into **var. *discolor*** (*E. discolor* Benth. Pl. Hartw.), a more depressed form, with the lower leaves … oblong or lanceolate-oblong and obtuse — Arizona and New Mexico." I agree with Gray in the sense that all material from western Texas, New Mexico, and Arizona represents a single species, but as this study will show, that single species is *E. discolor*, which I consider distinct at the species level from *E. sericeus*. A geographical gap of ca. 100 miles separates the westernmost USA collection of *E. sericeus* and the easternmost USA collection of *E. discolor* (Map 1).

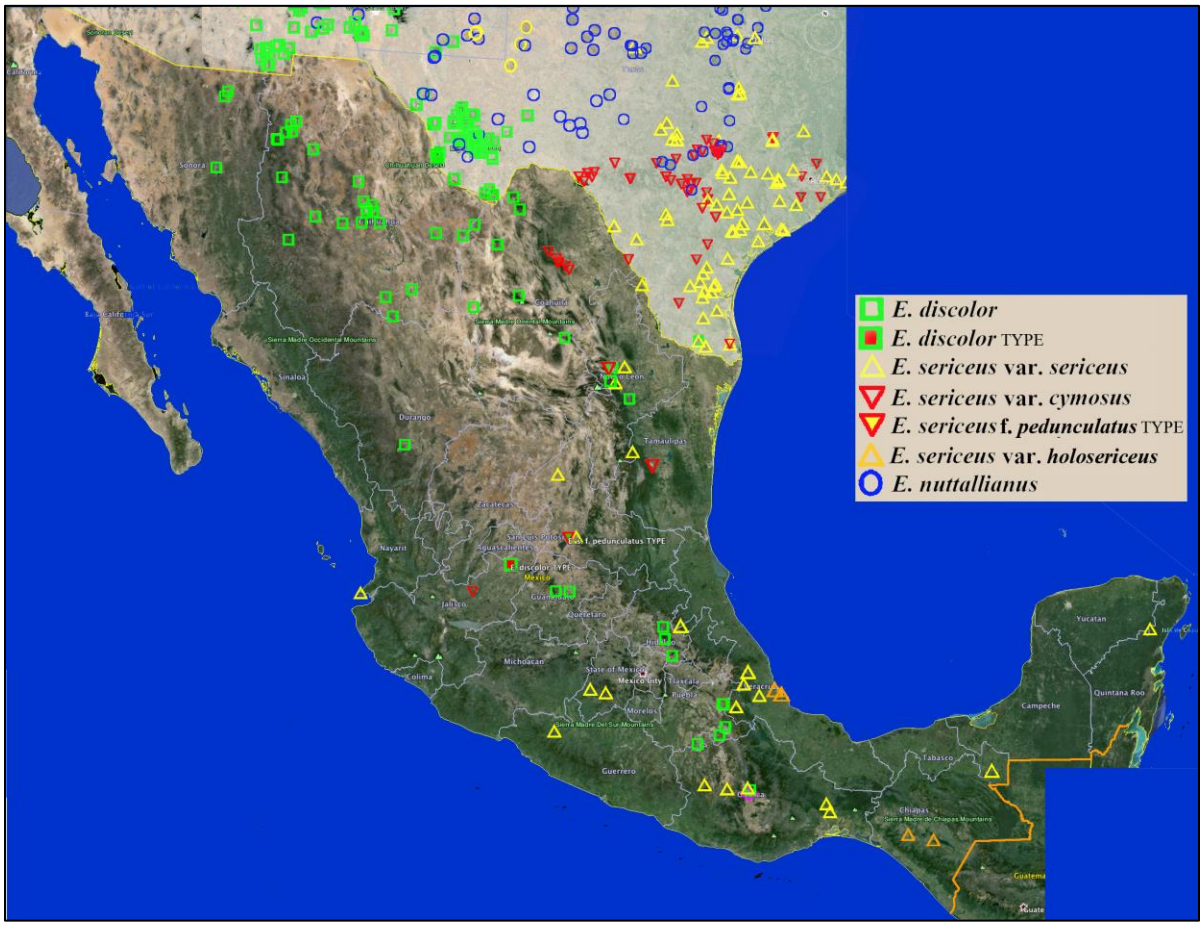


Map 1. Distribution of *E. sericeus* complex and related species in New Mexico, Texas and northern Mexico, following the classification proposed in the present study.

E.L. Greene (1905, p. 151) proposed a new species from New Mexico, *Evolvulus oreophilus*, "depressed and compact, the stems many from the subligneous branched crown of a thick tap-root … leaves … with a dense appressed silky pubescence." Van Ooststroom (1934) considered *E. oreophilus* Greene to be synonymous with *E. sericeus* var. *discolor*, a determination that I consider to be correct (as opposed to Austin 1991's treatment as synonymous with *E. nuttallianus* based in part on "indumentum on both leaf surfaces" [p. 448]). Specimens of the *Evolvulus sericeus* complex have not infrequently been incorrectly determined as the more generally northern *E. nuttallianus* Roem. & Schult. or *E. arenarius* R.T.Harms, and for that reason those two species (Harms 2014a, 2014b) will be included in maps, discussion and key in the present paper.

Taxonomic confusion between the *Evolvulus sericeus* complex and *E. nuttallianus* Roem. & Schult. in the southwestern U.S. has been widespread. This arises mostly from concepts and keys which distinguish the two by leaf pubescence, as typified by the key characters in Correll & Johnston (1970):

--*E. sericeus* [*sensu* van Ooststroom, including his var. *discolor*]: "Leaf blades densely pubescent beneath with closely appressed hairs and commonly some loose ones as well, glabrous or loosely pilose above."
--*E. nuttallianus*: "Leaf blades densely pilose on both surfaces with loosely appressed to spreading hairs."



Map 2. Distribution of *Evolvulus sericeus* complex plus *E. nuttallianus* in Mexico and adjacent USA, following the classification proposed in the present study. Note that *E. nuttallianus* is not recorded for Mexico.

Van Ooststroom (1934) clearly noted that, throughout the totality of their ranges, *Evolvulus sericeus* var. *sericeus* and var. *discolor* can have their upper leave surfaces either glabrous or pubescent, and, according to his descriptions, that the upper surface pubescence of var. *discolor* (when present) is rather like that of *E. nuttallianus* (which he treated as *E. pilosus* Nutt.). It thus can be seen why specimens that van Ooststroom referred to *E. sericeus* var. *discolor* might have been misidentified as *E. nuttallianus*. Indeed, using different characters to key *E. nuttallianus* (see key toward the end of this article), it was found that, among 363 West Texas, New Mexico, and Mexico collections seen in the present study with pubescent upper leaf surface and formerly determined to be *E. nuttallianus*, ca. 67% were in fact *E. discolor*.

In the current study, I have found three morphological character states that support the separation of *Evolvulus sericeus* and *E. discolor* at the species level: (1) leaf venation, (2) underground stem and root structure, and (3) stem trichome morphology. None of these characters has been used previously in attempting to distinguish these taxa, and the nature of these characters,

their patterns of variation, and the geographical distributions that emerge lead me to treat the two taxa at species rank. A discussion of these characters is presented below, followed by a summary of the bases for recognizing the two taxa as separate species. A discussion of the reasons for recognizing a new variety within *E. sericeus* then follows, and a taxonomic synopsis of the group in the southwestern USA and northern Mexico is presented. More complete details on taxonomy and synonomy are of course included in the taxonomic synopsis, but for ease of understanding the discussions below, the following is an outline of the classification presented here for *E. sericeus* sensu Ooststroom in the United States and Mexico:

Evolvulus sericeus
- *E. sericeus* var. *sericeus*
- *E. sericeus* var. *holosericeus*
- *E. sericeus* var. *cymosus* (var. nov.) (syn. *E. sericeus* f. *pedunculatus*)

Evolvulus discolor (syn. *E. oreophilus*)

METHODOLOGY

Over 800 herbarium specimens of *Evolvulus* deposited in the herbaria F, GH, NMC, NMCR, SRSC, TEX–LL, UNM, and US were examined. The JSTOR Plants website (plants.jstor.org) was also consulted for type material not seen from the above-cited herbaria.

Populations of *Evolvulus sericeus* var. *cymosus* and *E. discolor* were studied intensively in the field at two study sites, listed below. Voucher specimens of individuals from both study sites are deposited at the Plant Resources Center (TEX). The study sites are these:

Evolvulus sericeus var**. *cymosus,*** northern Hays County: over 500 plants, all easily accessible, widely distributed over 50+ acres of previously ranched land on the Purola Preserve (personal property of the first author) and Keyes Ranch, at latitude 30º17'18" N and longitude 98º09'57" W; elevations range from 298 to 335 m. The study habitat is limited to relative flat grassy areas with sparse grasses and other small forbs, all on calcareous clay soil in full sun. This study site is the type locality for the new variety proposed in this publication.

Evolvulus discolor, northeastern slopes of the Davis Mountains, Jeff Davis County: on the Cherry Canyon Ranch, ca. 30.85º N, 104.04º W, elevation ± 1370–1465 m. A full range of morphological variation (i.e., corolla color, adaxial leaf vestiture, leaf length/width ratio, internode length) for this species was observed at various times from 2007 to 2013, photographed but in many cases not collected. Plants were relatively rare, in drought years not present at all. The first collections, in September 2011 following a destructive wildfire, were limited to branchlets. The habitat is on sandy stony soils along creeks and roads below rhyolite slopes.

Methodologies for specific morphological characters discussed below are given under those sections. A web site with many results, details, and numerous images from the study can be found at <http://w3.biosci.utexas.edu/prc/EV/>.

RESULTS

Leaf venation

Leaf venation in *Evolvulus* presents useful taxonomic characters, but its study is complicated by two factors. First, in most taxa leaves are characterized by low (1r) "leaf rank" as defined by the Leaf Architecture Working Group (1999). This means that the level of organization of the leaf venation is relatively low, with vein course and other characteristics often more or less irregular. The practical implication of this is that differences in venation between species may not be apparent on all leaves, but when venation is well developed and visible, patterns are distinctive. Second, the venation, even when strong, is often obscured by pubescence and mounting on herbarium sheets. Several methods of determining venation have proven successful when fresh material or loose leaves

from packets are available. First, shining a bright light through the leaf works very well with fresh collections. This was generally done by using the film scan utility of an Epson Perfection 4180 Photo scanner. Second, with dried leaves, rehydrating with boiling water or weak aerosol solution renders the veins more transparent for transmitted light, especially for *E. sericeus* and *E. discolor* (Figs. 1, 2). Finally, leaf clearing plus basic fuchsin stains the lignified tissues (e.g., veins) red and renders the others (including hairs) transparent. Leaf clearing and staining were done in the lab of Dr. James Mauseth at the University of Texas at Austin using his methodology. Leaf samples were placed in a 1% aqueous solution of basic fuchsin to which 10 gm of solid NaOH had been added and were left overnight at 60° C. Further details of the methodology are available at <https://w3.biosci.utexas.edu/prc/EV/clearstain.html>. In *E. nuttallianus* and *E. arenarius*, transmitted light does not generally reveal secondary veins without clearing.

Figure 1. Transmitted light scans of *Evolvulus discolor* (top), *Worthington 36166*, Eddy Co., NM; *E. sericeus* (bottom), *Warnock & McBryde 15030*, Val Verde Co., TX. Scale = 5 mm.

To compare *Evolvulus sericeus* and *E. discolor*, numerous leaves were studied using the above techniques, and images of some of the results are shown in Figure 2. In addition, in a small selection of specimens, attached leaves were rehydrated and transverse sections were cut so that the relative diameters of the central and secondary veins could be compared. In the case of *E. discolor*, the secondary veins arise together at the base of the leaf at the attachment point to the stem, and so both primary and secondary lateral vein diameters were measured at that point. In *E. sericeus*, the secondary veins arise above the attachment to the stem and typically are not in opposite pairs; the diameter of the first secondary vein to diverge was measured at its base and the diameter of the central vein at that same point.

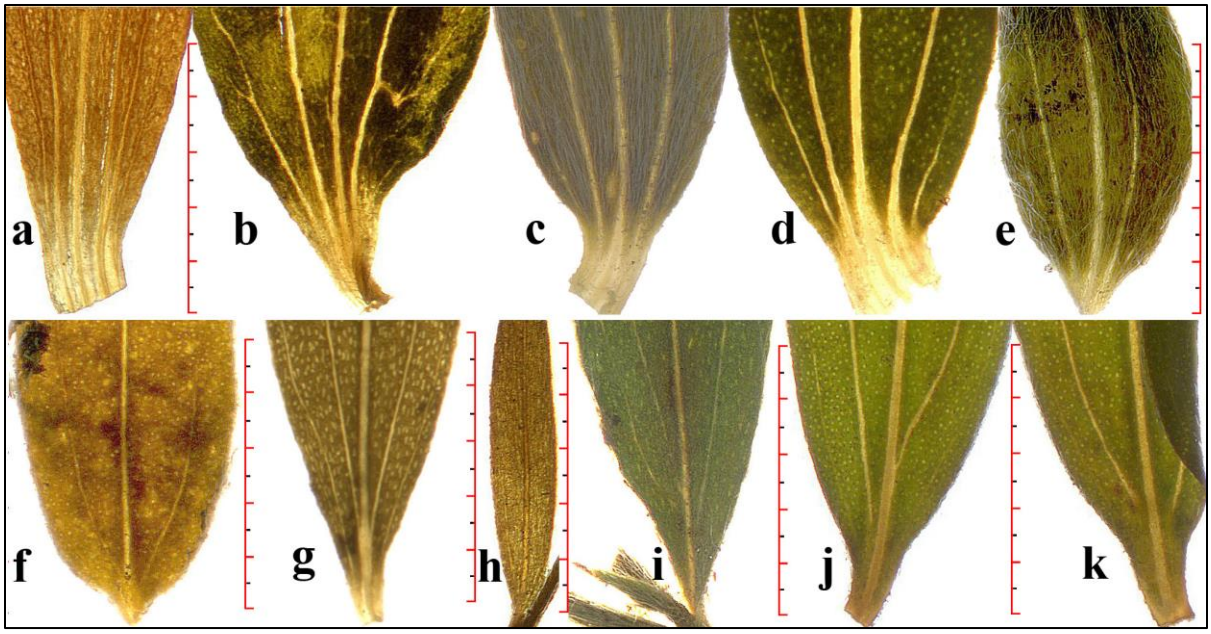


Figure 2. 5 mm base details of rehydrated leaves imaged with transmitted light. Top row, *Evolvulus discolor*: a. Jeff Davis Co., Tex.; b. Hidalgo, Mex.; c. Presidio Co., Tex.; d. Eddy Co., NM.; e. Chihuahua, Mex. Bottom row, *E. sericeus*: f. Coahuila, Mex.; g. Coffee Co., Georgia; h. Clarendon Par., Jamaica; i. Goliad Co., Tex.; j-k. Hays Co., Tex, both from the same stem.

Figure 3. Secondary vein variation with *Evolvulus sericeus* (from Hays Co., Texas, study site). Leaf 1 was also imaged with transmitted light (see Fig. 2-j).

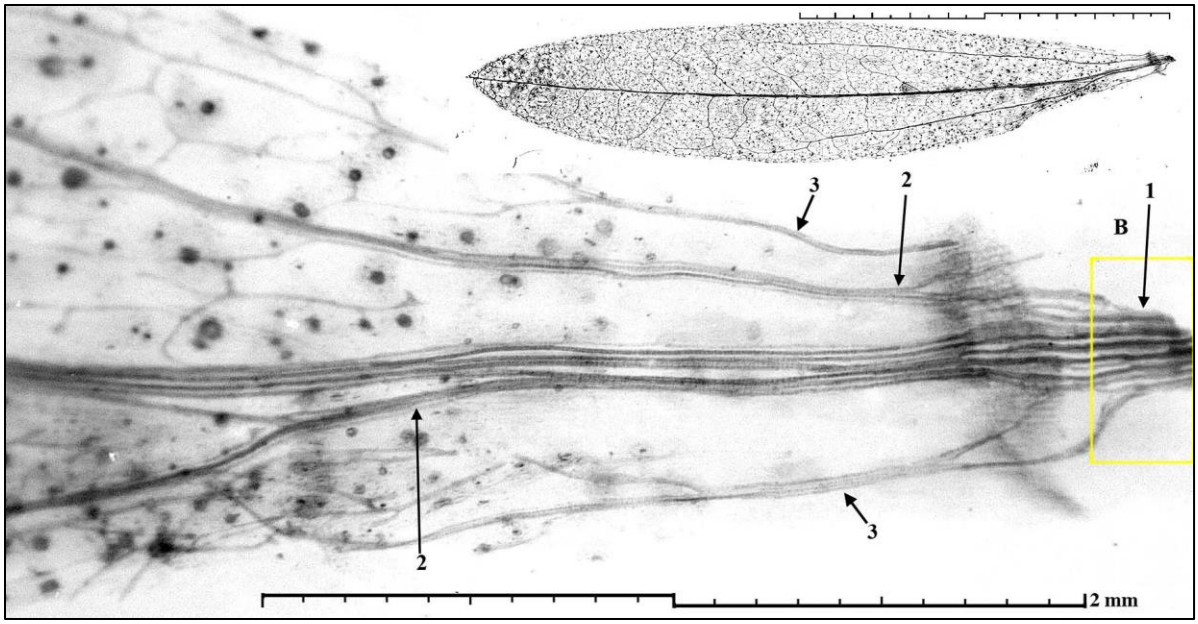


Figure 4. Primary, secondary and tertiary veins of *Evolvulus sericeus* (*Crockett 8523*, Brazos Co., Texas) with leaf clearing (full leaf insert at top). The two secondary veins do not emerge from the very base nor do they diverge at the same point. The secondaries are more or less symmetrically paired and parallel to the leaf edge to the mid point, after which tertiary pinnate venation occurs.

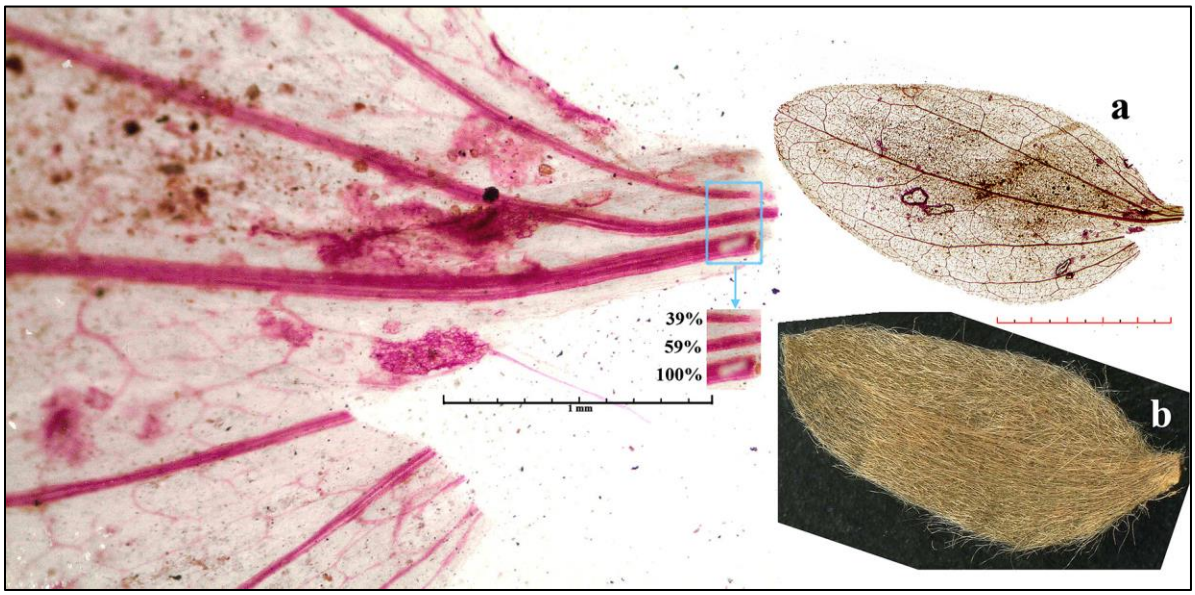


Figure 5. Primary and secondary veins of *Evolvulus discolor* (Brewster Co.) with leaf clearing (full leaf insert at top right – a; the same leaf prior to clearing, bottom left –b). Two pairs of secondary veins emerge from the very base. The innermost secondaries are ca. 59% of the width of the primary vein; the outermost, ca. 39%. Without clearing (or rehydrating for transmitted light imaging) venation is not visible under the dense pubescence of this leaf (b).

These studies (Figs. 1-5) show that *Evolvulus discolor* leaves have a broad clasping base, with 1-3 pairs of strong secondary veins arising at the very base and arching toward the apex, the innermost pair well over half the blade length. The basal diameter of the secondary veins is 61% – 77% (–101%) the diameter of the central veins. *E. sericeus* leaves, in contrast, are subsessile with a

single primary vein at the base, with usually only 1 weakly developed pair of secondary veins diverging from the midvein close to but distinctly above the base, the secondaries arching toward the apex and typically not arising opposite each other. The basal diameter of the secondary veins is 36% – 42% the diameter of the central veins. A survey of numerous other herbarium specimens supports this pattern.

Although van Ooststroom (1934) noted "lateral nerves in the narrow leaves absent," I found that even with the narrowest *Evolvulus sericeus* leaves, transmitted light reveals the suprabasal secondary veins as described above.

The strong *Evolvulus discolor* secondaries were observed in both the isotype *Hartweg 20* (GH; Fig. 6) without special treatment, with glabrous upper leaf surface, as well as in the lectotype of the synonymous *E. oreophilus*, *Metcalfe 1228* (US; Fig. 7), with strong upper-surface pubescence. Material of *E. sericeus* var. *holosericeus* (Fig. 8), on the other hand, displays the weaker suprabasal secondaries typical of *E. sericeus* in general.

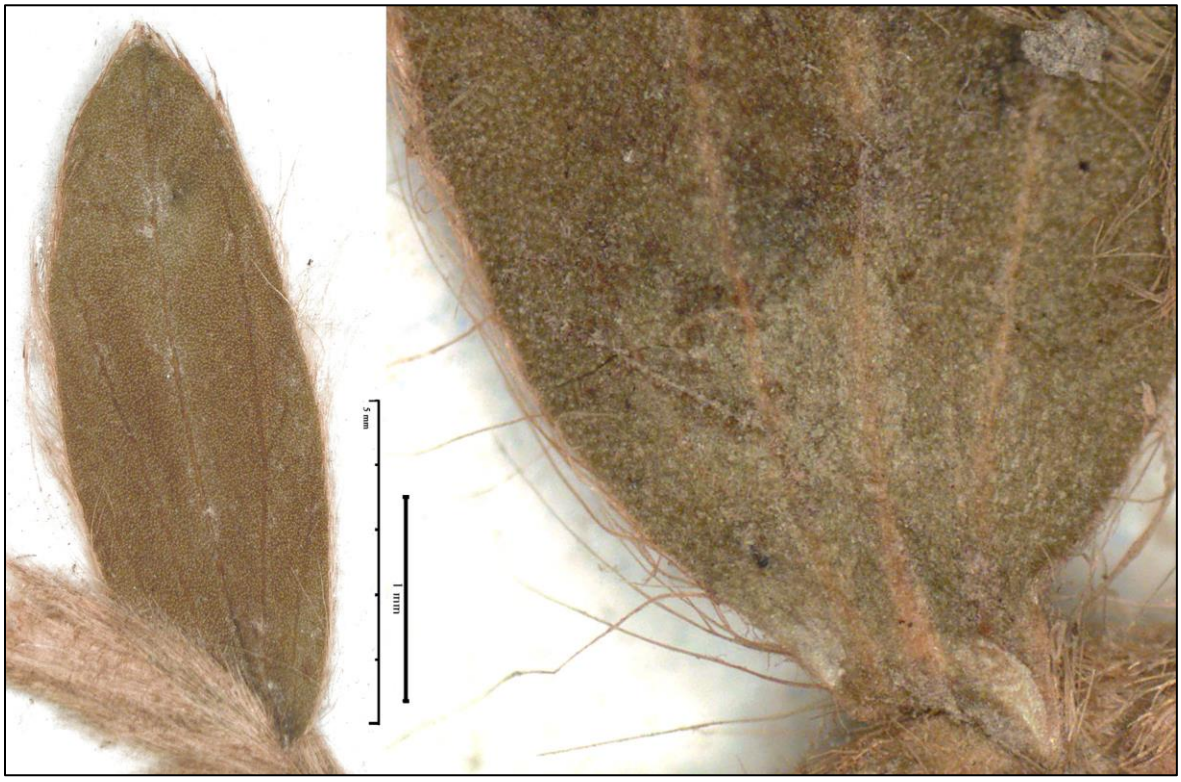


Figure 6. Venation of isotype specimen of *Evolvulus discolor* (adaxial view), *Hartweg 20* (GH), Mexico.

Figure 7. Venation of lectotype specimen of *Evolvulus oreophilus* (abaxial right; adaxial left), *Metcalfe 1228* (US), New Mexico.

Figure 8. *Evolvulus sericeus* var. *holosericeus* pubescence on both leaf surfaces, and with transmitted light scan to show the suprabasal acrodomous venation typical of *E. sericeus* (Chiapas, *Matuda 5908* [LL]).

Stems, rhizomes, and taproots

The underground root-rhizome systems of *Evolvulus sericeus* and *E. discolor* are quite different when well developed. *Evolvulus sericeus* typically develops a spreading underground system of horizontal rhizomes, giving rise to scattered vertical stems (Figs. 9, 11), while *E. discolor* develops a more or less vertical thick rhizome with all aerial stems arising close together (Fig. 12, 13). Of course, in young or poorly developed plants the differences will often not be apparent.

In discussing these underground systems, I use the following definitions:

RHIZOME: an underground elongate root-like structure having a vascular anatomy typical of stems; i.e., a well-defined ring of vascular bundles inside the pericycle surrounding a pith core (Fig. 10, e-f). Both vertical and horizontal rhizomes were noted. They have scale leaves and often produce buds for rhizome-branches (stems), which may or may not develop below ground. They also may give rise to adventitious roots. Direct examination of rhizome cross sections were made for *E. sericeus* var. *cymosus*, for which fresh collections were available. Other determinations were based on the presence of stem buds and scale leaves, or traces of these. In general the diameter of a rhizome was relatively constant over its length.

STEM BASE: the stem at the ground level, immediately above the rhizome proper and below any widening of the stem formed by repeated branching over time at ground level (common with *E. discolor*). One minor problem in taxon identification is that a tape attaching the plant to the herbarium sheet frequently covers that spot. With *E. sericeus* the large spread of rhizomes when mounted often makes it difficult to determine where the ground line is with lignescent stems. With young (green) stems the color shift to green indicates the base.

ROOT: an underground elongate root-like structure having a vascular anatomy typical of roots; i.e., a core consisting of vascular tissue with well-defined xylem cells in the center, with pith absent (Fig. 10, a-d). Roots may branch downward and produce an abundance of lateral adventitious roots. They do not produce stem buds or scale leaves. The diameter of a root is generally reduced as it lengthens.

The underground stem (rhizome) and root systems of *Evolvulus sericeus* and *E. discolor* are different. Unfortunately, relatively few collections of either species provide more than short fragments of underground stems, often with adventitious roots, and only rarely are sections of true root included. Nonetheless the stem base alone generally provides sufficient evidence to distinguish the two, and the underground material available provides a clear consistent distinction.

The horizontal rhizomes of *Evolvulus sericeus* (Figs. 9-11) may be distributed over an area up to 2 dm wide. From these arise narrow multiple vertical rhizomes rarely >2 mm wide, from as deep as 9 cm, with scale leaves and sparse adventitious roots, occasionally branching, becoming green stems above ground, and lignescent with age. The stem base is typically less than 1.5 mm wide (only rarely to 2 mm). In the absence of transverse sections for examination, rhizomes and roots are often difficult to distinguish based on thickness and lignescent epidermis, especially with older stems. Rhizomes generally differ little in diameter over their length and may be recognized by the presence of rhizome branches, scale leaves, undeveloped stem buds – or traces of these in an older epidermis. In one instance a vertical rhizome arose directly from a root area, as verified by cross section (Fig. 10 c–d).

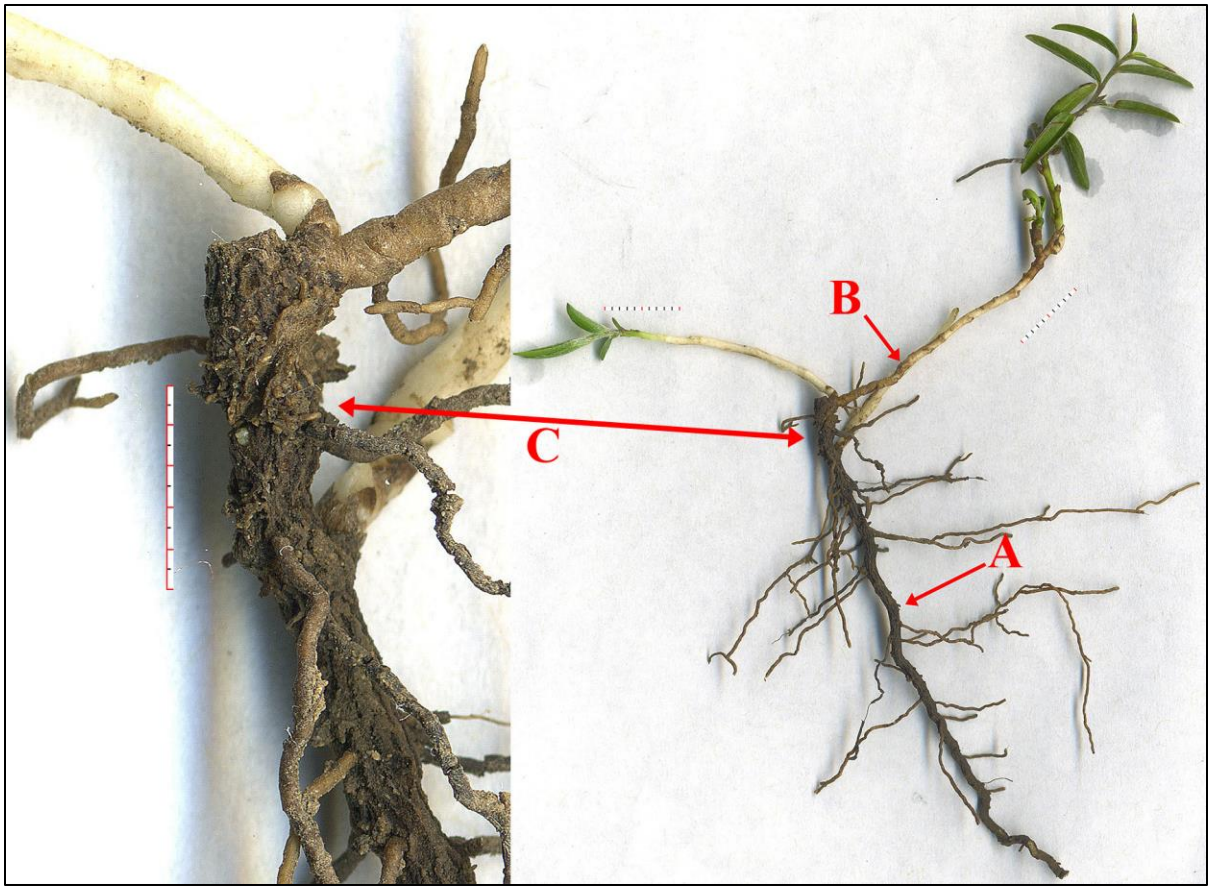


Figure 9. *Evolvulus sericeus* var. *cymosus* (at Hays Co., Texas study site), plant with root and rhizomes (underground stems). Transverse sections were taken from root (A, Fig. 10 a–b) and rhizome (B, Fig. 10 e–f). The enlarged area at **C**, between branching rhizomes, was initially assumed to be a rhizome, but a cross section (Fig. 10 c–d) showed that it is root.

Evolvulus discolor (Figs. 12, 13) has only woody vertical rhizomes, arising from deep roots, often well over 2 mm thick, from as deep as 8 cm, with scale leaves, and with stem buds which rarely develop - in which case they form vertically rising branched rhizomes. The stem base widens with age up to 7 mm wide (Fig. 14 b–d).

E.L. Greene (1905), in describing his new *Evolvulus oreophilus* (a synonym of *E. discolor*), stated "stems many from the subligneous branched crown of a thick tap-root" — a unique reference to the underground morphology, and a good description of the *E. discolor* underground system, although present studies indicate that the “tap-root” is actually a vertical rhizome (Greene's many *E. oreophilus* isolectotype collections do not include true root, indicating that he was referring to the woody vertical rhizome). The isotypes of *E. discolor* itself at GH and E do appear to include root, below a vertical rhizome, but those at K (holotype), LD, NY have only rhizomes at the base.

Both species occur in a wide variety of environments with no variation in basic stem/root morphology, and thus it seems very unlikely that the differences observed are environmental (due to different soil types or textures). They are sympatric at Monterrey, Nuevo León. *Evolvulus nuttallianus*, by contrast, does not form vertical rhizomes; the stem base is above the tap root with only a short transition.

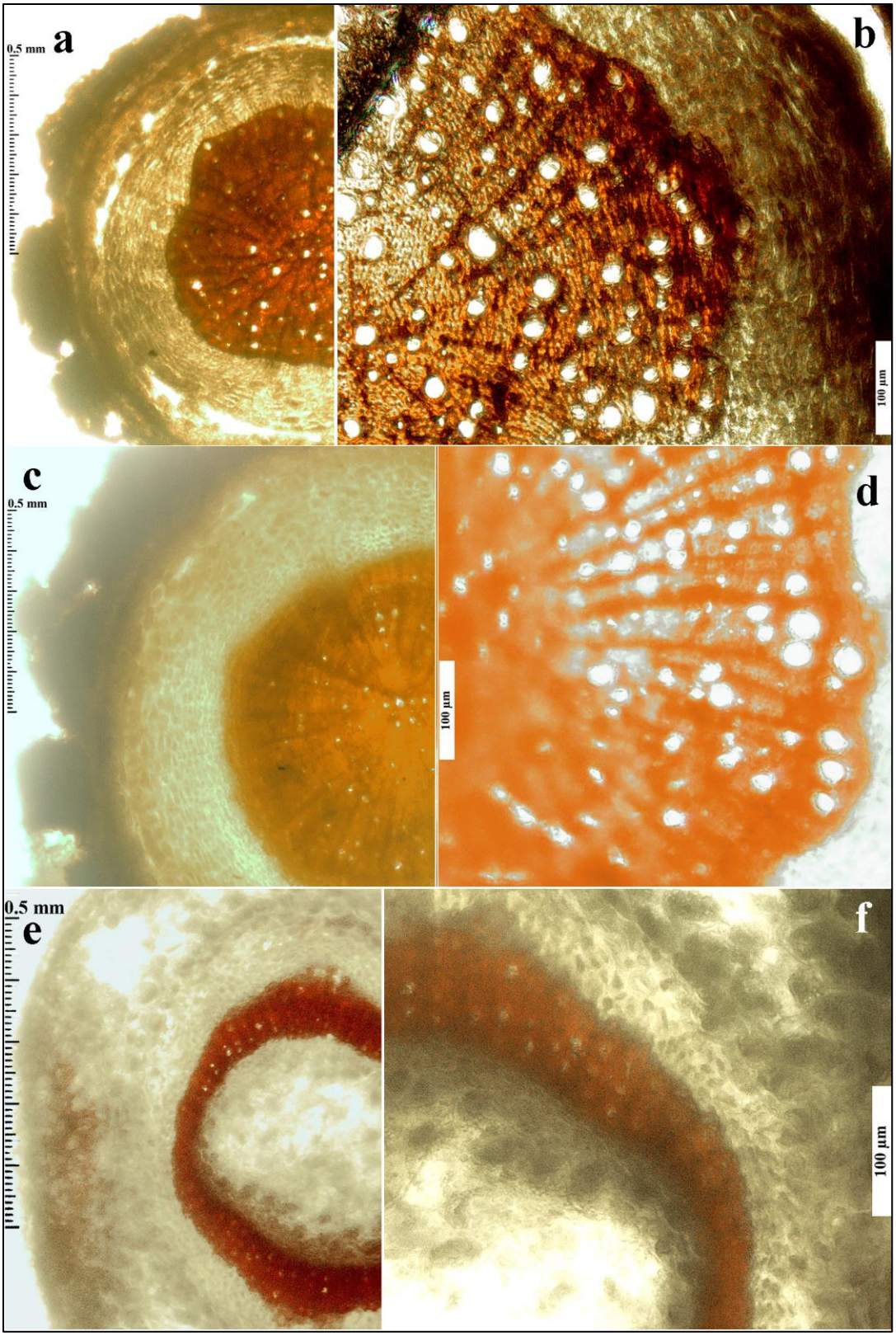


Figure 10. Freehand cross sections of points A, C, B in Fig. 9, stained red/orange with phloroglucinol to show xylem due to the presence of lignin. Left column was imaged at 40x; right column, 100x. a–b are root at point A; c–d, root at point C; e–f, rhizome at point B.

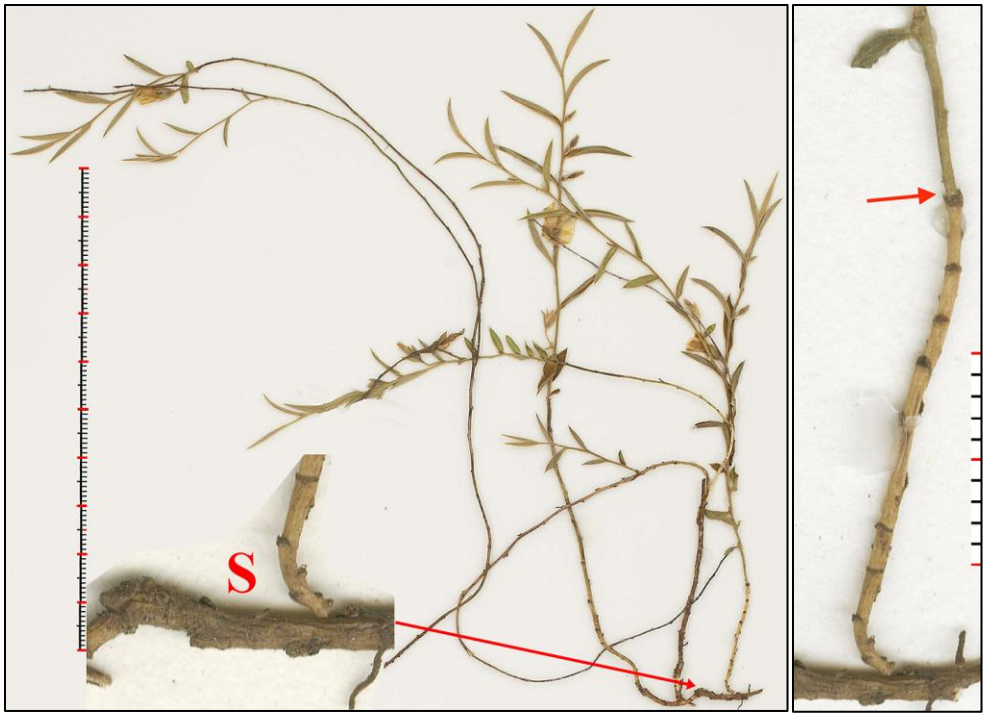


Figure 11. *Evolvulus sericeus* var. *cymosus* (Tamaulipas, Mexico, *Nesom 6300*). Insert S details vertical rhizome branching from horizontal rhizome. Image on right enlarges the rightmost shoot, with the stem base at the arrow. Scale = 10 mm in 1 mm divisions.

Figures 12-13. Fig. 12 (left), *Evolvulus discolor* (Jeff Davis Co., *Warnock & Churchill 7731*) long root (R) below vertical rhizome (S). Fig. 13 (right). *E. discolor* (Presidio Co., *Carr & Benesh 31330*) with 8 cm long rhizome (S).

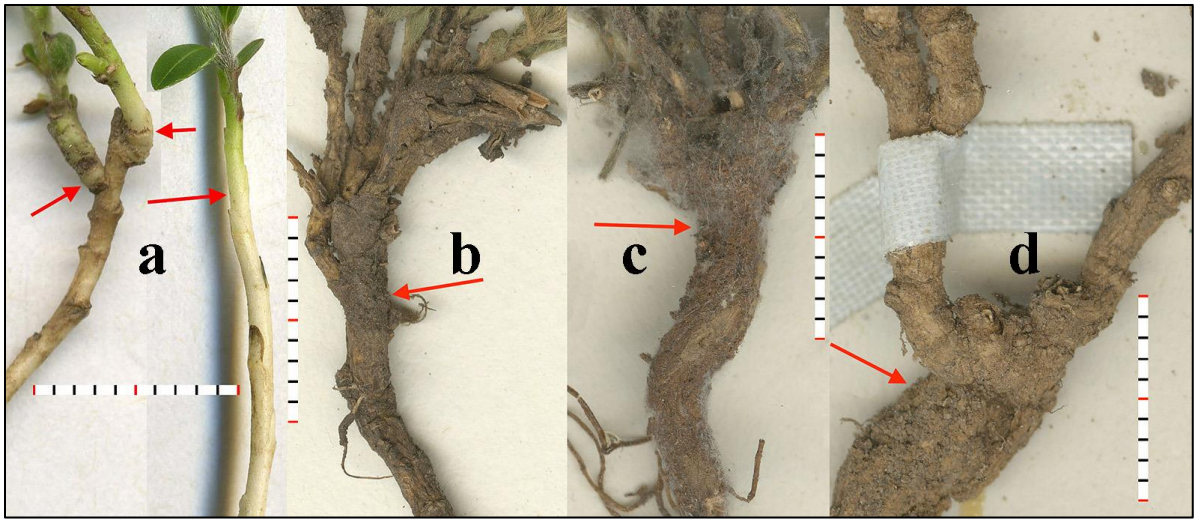


Figure 14. *Evolvulus sericeus* (a) and *E. discolor* (b–d) stem bases. a: Hays Co.(study site) ; b: Jeff Davis Co. (*Larke 483*); c: Puebla, Mexico (*Torke et al. 383*); d. Presidio Co. (*Warnock 10581*). Red arrows indicate area of stem base; scales all 1 cm.

Evolvulus sericeus collections with clear rhizomes: Jamaica, *G. R. Proctor 23610*; Tamaulipas, Mexico, *Wooton s.n*; Blanco Co., TX, *Nesom et al. 5619*; Brazos Co., TX, *R. G. Reeves 35*; Chambers Co., TX, *Rosen & Singhurst 4014* (with root); Val Verde Co., TX, *Warnock & McBryde 15030* (with root).

Evolvulus discolor collections with rhizomes: Chihuahua, Mexico, *F. Shreve 8084*; Dona Ana Co., NM, *Wooton 128*; Hidalgo Co., NM, *Moir 109* (with root), *Castetter 7621*; Luna Co., NM, *Jercinovic 1223* (with root); Jeff Davis Co., *Warnock & Churchill 7731* (with root); Presidio Co., *Carr & Benesh 31330*.

Vegetative hair morphology

General vestiture characteristics are often noted in treatments of *Evolvulus*, even in taxonomic keys (e.g., Correll & Johnston 1970; Felger et al. 2012), as previously noted, but little attention has been paid to the distinctive forms of the hairs themselves. The *Evolvulus* trichome is a single bifurcate cell, with two branches from a very short shared base, as shown in Figure 15:

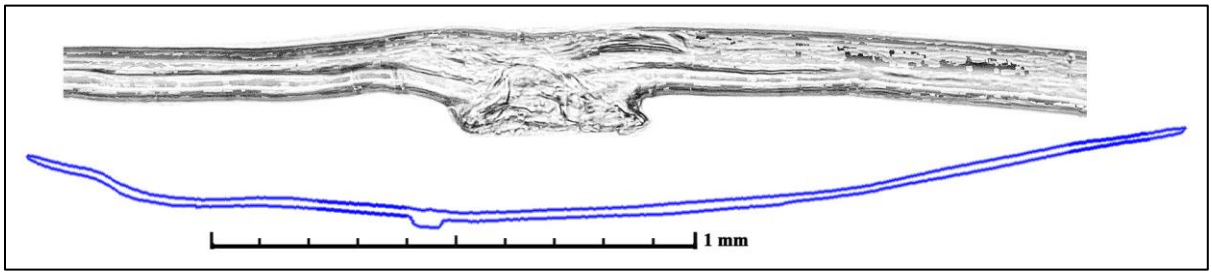


Figure 15. Typical *Evolvulus sericeus* trichomes scraped from leaf blades. The lower (blue) image gives the outline of a hair imaged with a dissecting microscope at 45X; the base is the enlarged area to the left of center. The upper image is a detail of the base of another hair at 200X with a compound microscope.

Taxonomic differences among *Evolvulus* taxa are noted in relative length of the two forks and the angle of each fork within 0.2 mm from the base (cf. Harms 2014a). In the above image of *E. sericeus*, the two forks do not rise at the base—that is, they remain parallel to the leaf surface (cf. also Figs. 17b, 19). In *E. discolor*, on the other hand, the forks rise from the base typically at angles 15–

45º to the leaf surface (cf. Figs. 18 c-d, 20). This difference is a strong tendency but not absolute; scattered hairs of each species will approach those of the other species in this regard.

Determining micromorphology of hairs within the *Evolvulus sericeus* complex faces several difficulties. Although individual hairs may vary from the norm, most hairs follow a general pattern ("typical"). Top-down viewing of individual hairs on a flat leaf surface, as with a dissecting microscope, is not satisfactory. The hairs are too dense, with great overlap obscuring the end points and even the location of the point of attachment, and angles are not discernable (Fig. 24). On stems, when the pubescence is not dense, the possibility of a lateral (as opposed to a top-down) perspective often permits viewing the orientation of individual hairs, even the angle of the trichome branches at attachment (cf. Figs. 21-23). Distinguishing the taxa is thus best done near the top of the stem, with mature but not dense hairs.

To study leaf hairs, hairs were scraped with a razor into weak aerosol solution, mounted on slides, and examined with both dissecting and compound microscopes (Fig. 16). One potential problem with this method is that wetting the hairs and transferring them to slides might distort their overall profile, adding unnatural curvature. Any such distortion seems to have been minimal, as consistent differences between the two taxa were noted. As a control, SEM imaging with 45º tilt to show the trichome bases gave results consistent with the forms of the scraped leaf hairs as well as observations made from hairs still attached to young stems (Figs. 19, 20).

Definitions for this study:

ADPRESSED: tightly pressed against the epidermis (Figs. 19, 21) (in contrast with current common usage of "appressed," which seems to mean "not spreading"; e.g., Felger et al. 2012, p. 477).

BOW-SHAPED: rising from the base and then descending toward the epidermis (Figs. 20, 22, 23) (apparently included in "appressed"; e.g., Felger et al. 2012, p. 481).

Trichomes of *Evolvulus sericeus* are typically adpressed at the base, straight and tightly aligned parallel to the leaf main vein or stem; those of *E. discolor* are typically rather curved and bow-shaped from the base, only loosely aligned parallel to the main vein or stem axis. In areas of dense pubescence, the situation is less clear; trichome formation may vary, with the base and extended portions of hair branches rising over the hairs below them. With *E. discolor* such hairs are often tangled. With scraped hairs, as in Fig. 16, the straight hairs of *E. sericeus* contrast with the greatly curved hairs of *E. discolor*, this curvature possibly exaggerated to some extent by the narrow width of the trichomes and the effect of the wetting agent. Significantly, the base branching angles are not distorted by this process. As a consequence, when pressed under a cover glass the relatively straight trichomes of *E. sericeus* are little affected and may present a top-down orientation (Fig. 17a) as well a lateral view (Fig. 17b). The angled branches of *E. discolor*, by contrast, are forced to a lateral or near-lateral position by the cover glass (Figs. 18 c,d).

A difference in vestiture was noted by van Ooststroom 1934 for his var. *discolor* (p. 133): "the hairs not so appressed as in the preceding form," that is, var. *sericeus*.

The difference in hair width shown in Figs. 16-18, typical for the geographical areas these were collected from, initially led me to suspect that this might be distinctive. However, a survey of collections from a wide range of areas showed considerable variation in hair width for both taxa; e.g., Fig. 24.

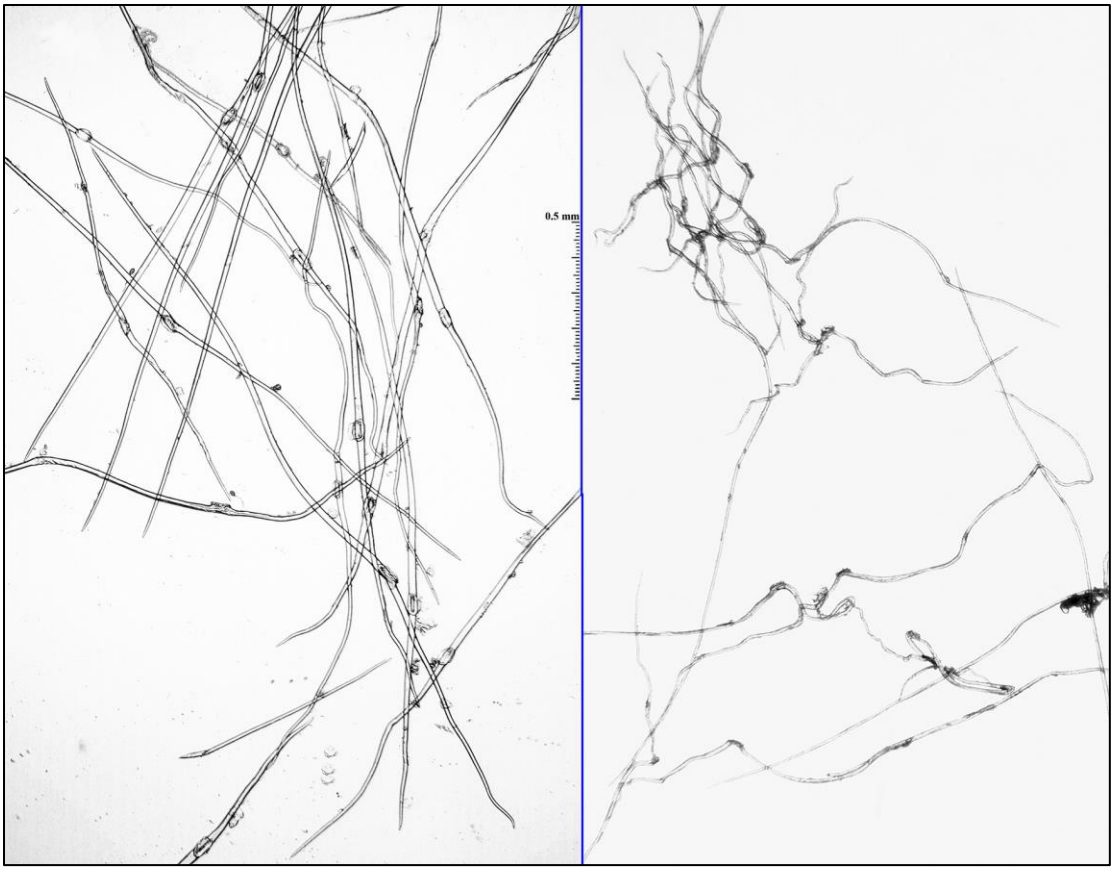


Figure 16. *Evolvulus sericeus*, Hays Co. study site (left), and *E. discolor*, Jeff Davis Co. study site (right), hairs imaged at 40X.

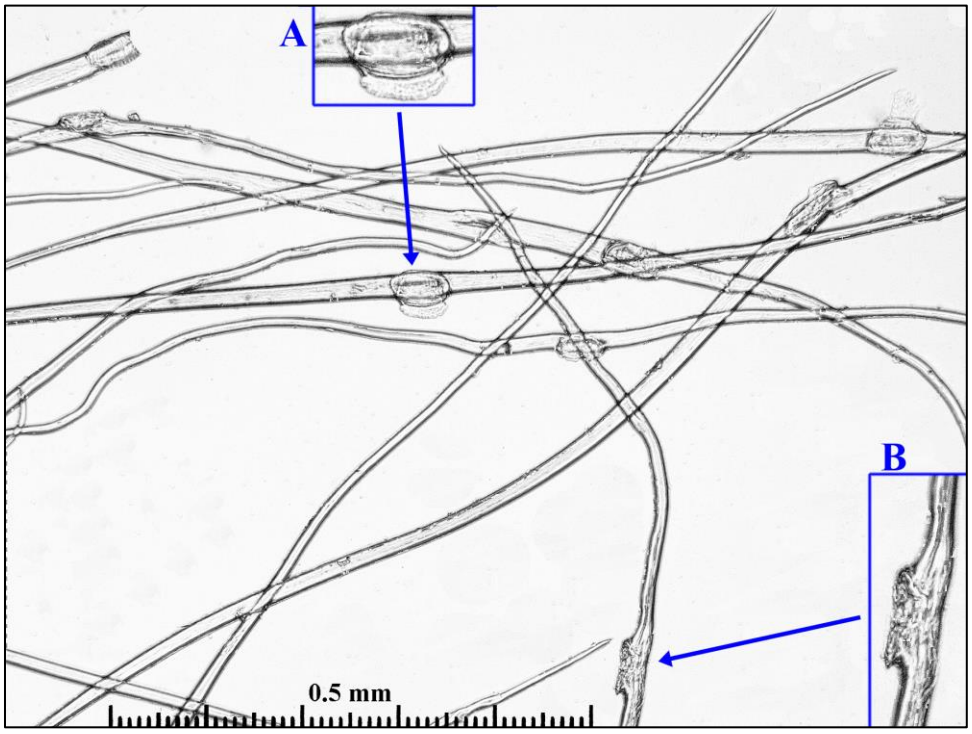


Figure 17. Detail of *Evolvulus sericeus* hairs in Fig. 16 imaged at 100X. A and B detail trichome bases.

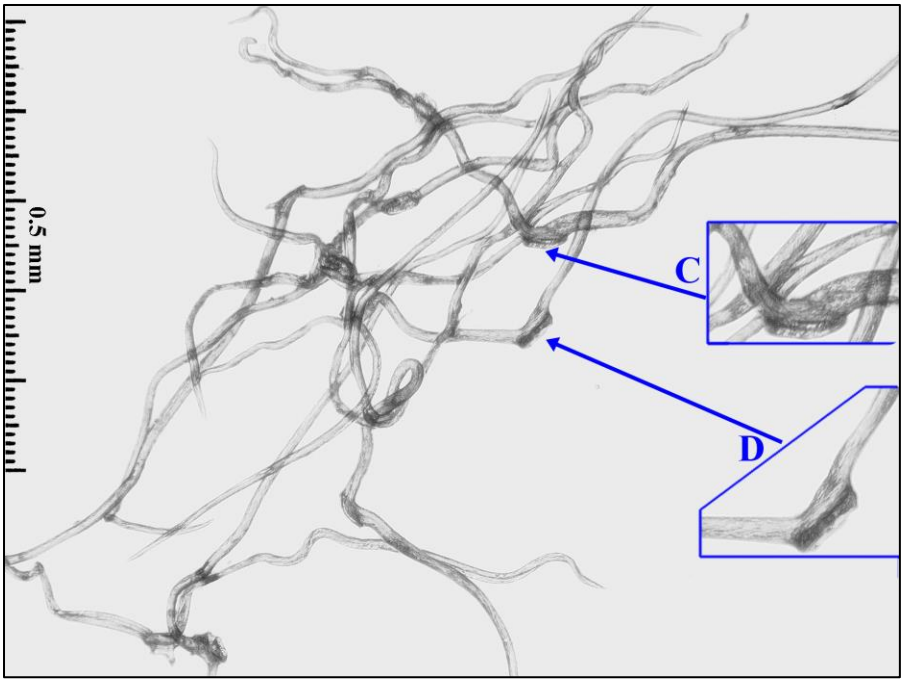


Figure 18. Detail of *Evolvulus discolor* hairs in Fig. 16 imaged at 100X. C and D detail trichome bases.

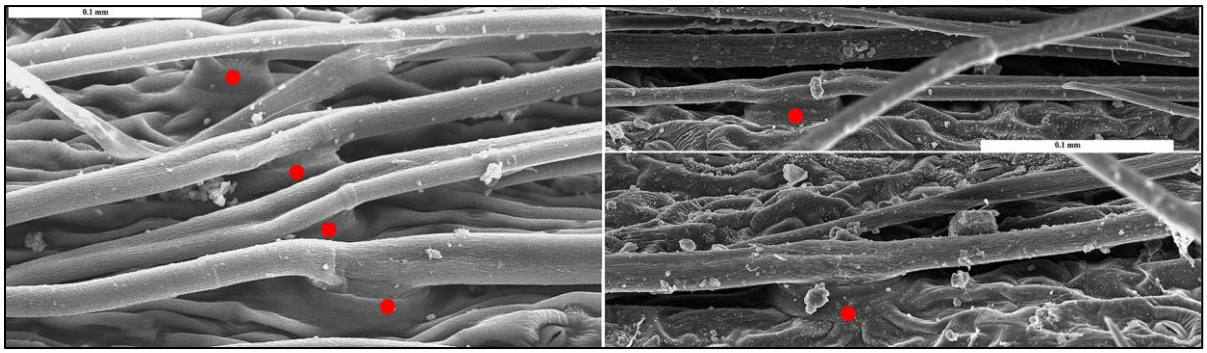


Figure 19. SEM scan of lower leaf blade of *Evolvulus sericeus* var. *cymosus* (Hays Co. study site) on left, *E. sericeus* var. *sericeus* (Tarrant Co., *Killian 6958*) on right. Red dots mark trichome bases, the point of bifurcation.

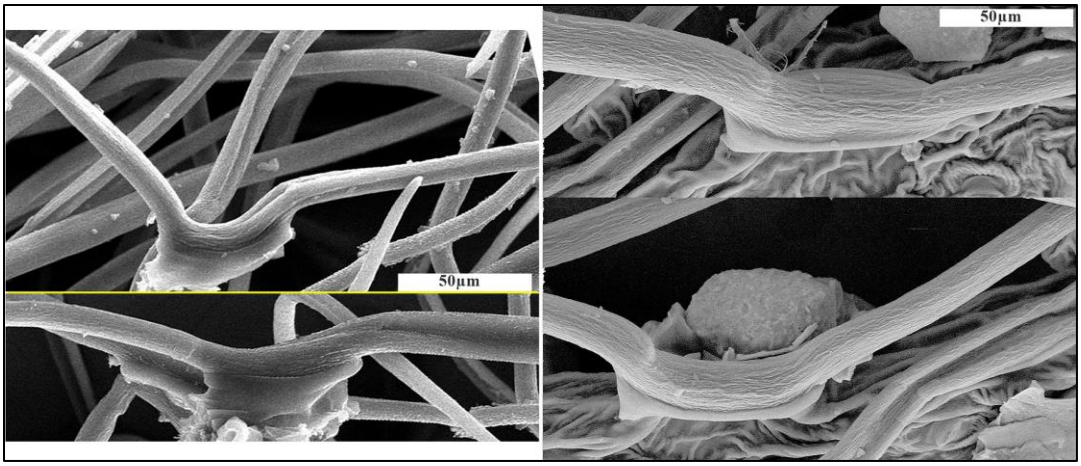


Figure 20. SEM scan of leaf blade trichomes of *Evolvulus discolor*: Jeff Davis Co. study site on left; Coahuila (*Henrickson & Lee 15938a*) on right.

Figure 21. *Evolvulus sericeus* stem pubescence. a. Jamaica (*Proctor 23610*); b. Hidalgo Co ., TX (*Runyon 1695*); c. Tarrant Co., TX (*Killian 6958*); d. Val Verde Co., TX (*Carr 30614*); e. Coahuila, Mex. (*Villarreal et al. 489*).

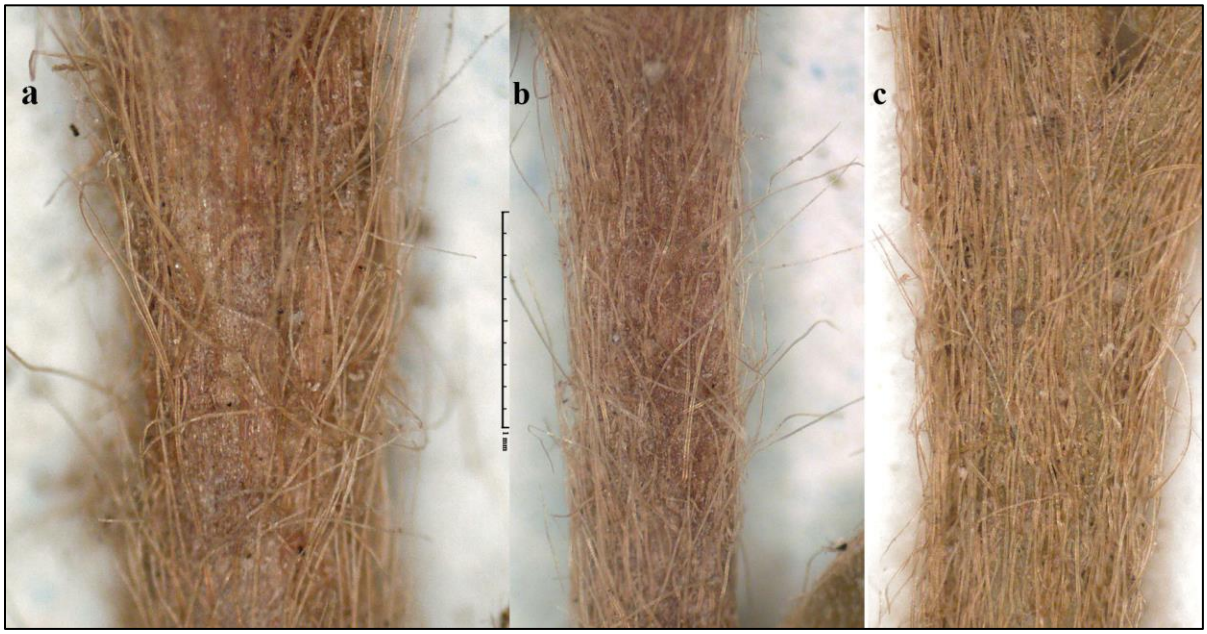


Figure 22. *Evolvulus discolor* stem pubescence. a–b. Isotype, *Hartweg 20, Mexico* [GH]); c. Lectotype of *E. oreophilus*, Metcalfe 1228, Sierra Co., NM.

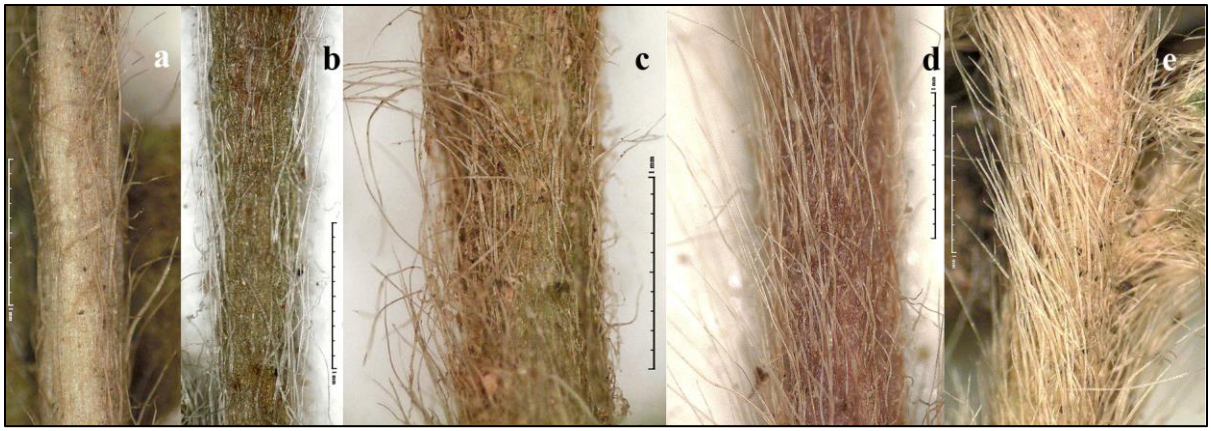


Figure 23. *Evolvulus discolor* stem pubescence. a. Hidalgo, Mex. (*Rzedowski 18317*); b. Presidio Co., TX (*Carr & Benesh 31253*); c. Hidalgo Co., NM (*Ivey 1B*); d. Durango, Mex. (*Correll & Johnston 21467*); e. Coahuila, Mex. (*Henrickson 15938a*).

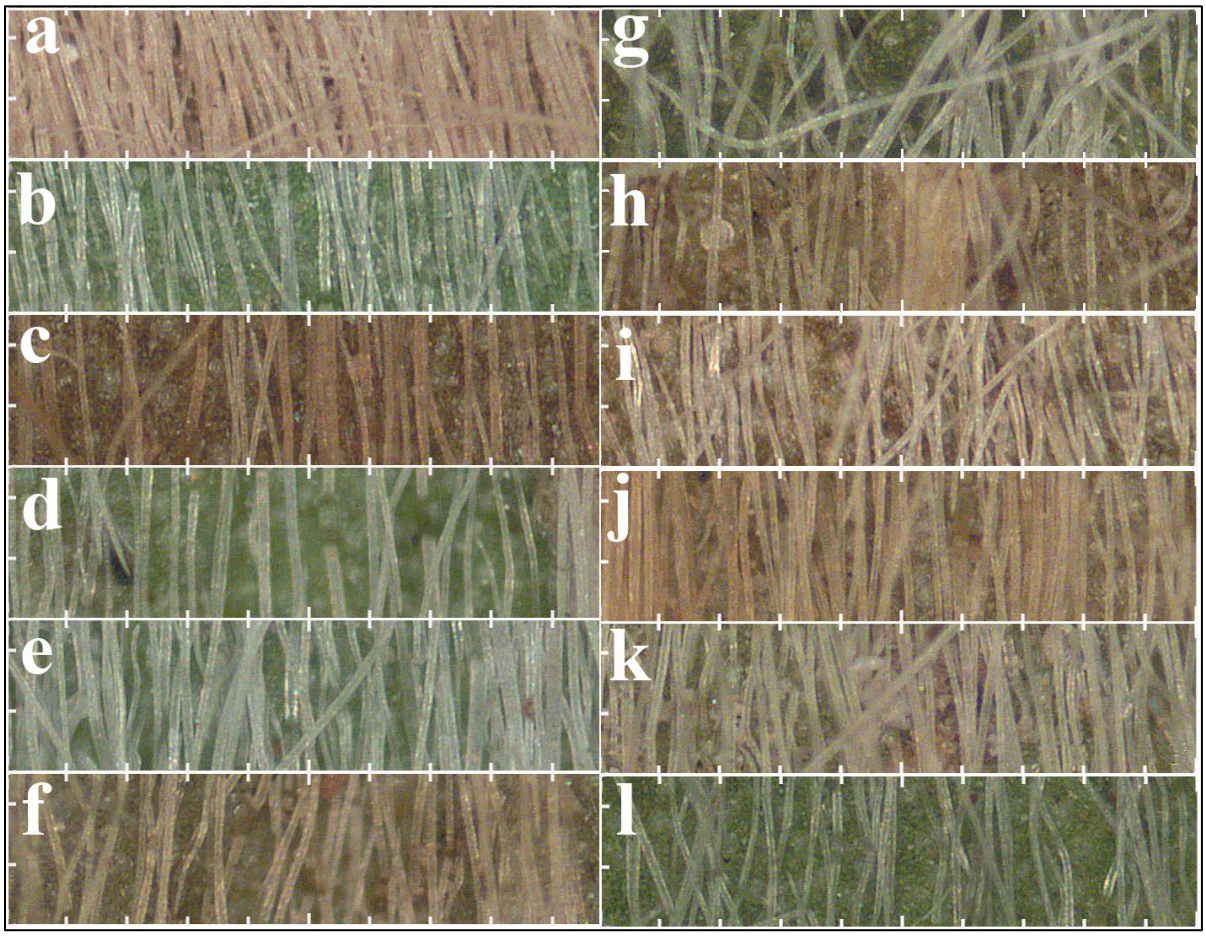


Figure 24. Examples of leaf blade hair widths imaged at 45x, scale marks at 0.1 mm, from different areas: *E. sericeus* in left column, a–f (all undersurface); *E. discolor* (undersurface unless indicated), g–l. a: Jim Wells Co., b: Val Verde Co., c: Llano Co., d: Wilson Co, e: Brown Co., f: San Saba Co, g: Chihuahua, Mex., h: Coahuila, Mex., i: Jeff Davis Co (upper surface glabrous), j: Jeff Davis, k: Presidio Co. (upper surface), l: Presidio Co.

There thus appears to be a subtle but significant difference in typical or average vegetative vestiture between the two species, a difference that caught the attention of van Ooststroom and others. However, it is a difference that is difficult to use as a key character due to its subtlety, its variability especially when vestiture is dense, and to the difficulty of easy observation of the fine details of the trichome bases. It is best used when directly comparing multiple specimens of both species.

Interplical pubescence

The corollas of *Evolvulus* species are plicate, with the interplical areas, which alternate with the sepals, exposed in bud and in many species abaxially variously hairy, while the hidden infolded plicae are abaxially glabrous. House (1906), in his description of *Evolvulus wilcoxianus* (= *E. discolor*), wrote "the plicae villous without" (referring in fact to the interplicae). Initial inspection of our two species seemed to support this as a differentia. The interplical vestiture of *E. sericeus* is in general sparse and not villous, while that of *E. discolor* is dense and often villous. But exceptions were found; for example, in the material of *E. sericeus* shown in Figure 25 the hairs of 'd' are relatively dense and those of 'c' spreading villous; with *E. discolor* in Fig. 26 the hairs of 'a' are relatively sparse. Thus, while this appears to be difference between the species on the average, there is overlap and, like vegetative vestiture, it is hard to use as a defining key character.

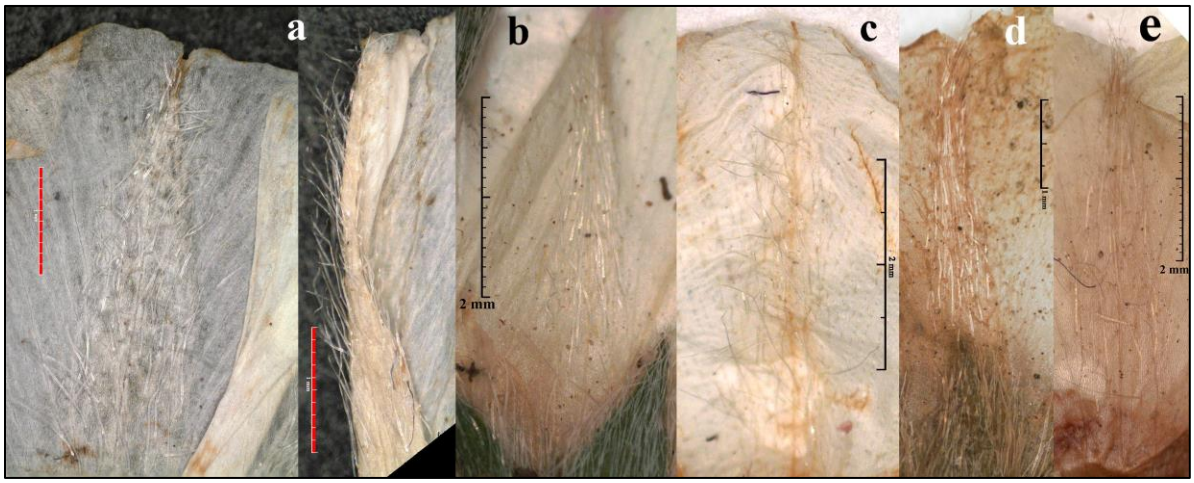


Figure 25. *Evolvulus sericeus* plicae. a: Hays Co. (study site); b: Brown Co. (*Hansen 7125*); c: Real Co. (*Harms 99*); d. Kleberg Co. (*Carr 24607*); e: Cameron Co. (*Fleetwood 3803*).

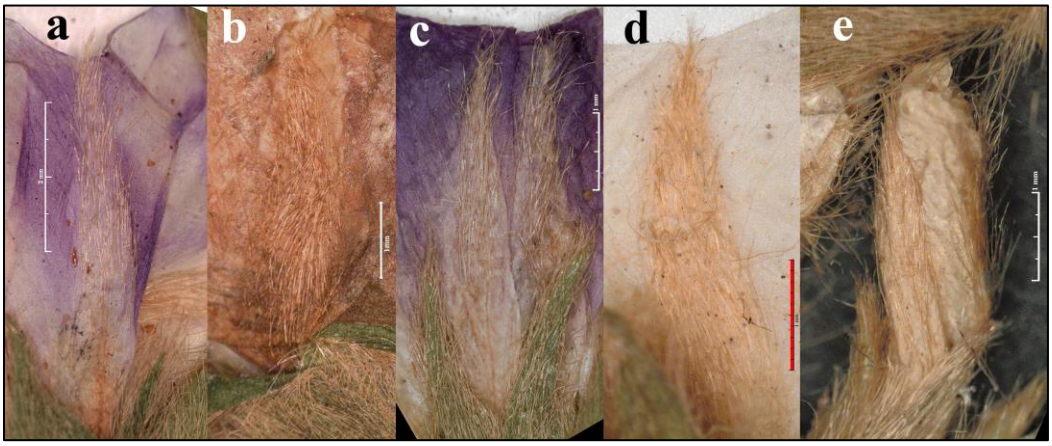


Figure 26. *Evolvulus discolor* plicae. a: Dona Ana Co., NM (*Zumwalt 19*); b: Socorro Co. (*Goodrow 928*); c: Sierra Co., NM (isolectotype of *E. oreophilus* Greene [*Metcalfe1228*, NMC]); d: Durango, Mexico (*Correll & Johnston 21467*); e: Grant Co., NM (paratype of *E. wilcoxianus* House, *Metcalfe100*, US).

Recognition of *Evolvulus discolor* as a separate species

The preceding information supports the recognition of *Evolvulus discolor* as a taxon distinct from typical *E. sericeous*. Multiple characters distinguish the taxa, chief among them leaf venation, subterranean morphology, and vegetative vestiture. In the USA, they are geographically distinct, with the range of the more eastern *E. sericeus* separated from that of the more western *E. discolor* by more than 100 miles (Map 1). No defined areas of morphological intermediacy are found, even in Mexico where the ranges overlap somewhat.

In addition to the characters mentioned above, the presence or absence of vestiture on the upper leaf surface is significant and useful in identification. Although, as previously noted, van Ooststroom noted that both *Evolvulus sericeus* var. *sericeus* and var. *discolor* (here treated as *E. discolor*) present upper leaf surfaces that vary from glabrous to pubescent, *in the area of the current study at least* the situation is different. *Evolvulus discolor*, endemic to the USA and Mexico, is variable in this character, even at times in the same population; the upper surface may be hairy or glabrous. But populations of the two varieties of *E. sericeus* (var. *sericeus* and var. *cymosus*, see below) in the southwestern USA and northern and central Mexico—the range of *E. discolor*—always have the upper surface glabrous (see discussion under *E. sericeus* in the taxonomy section, below). At the same time, the range of *E. sericeus* var. *sericeus* extends well beyond this area to Central and South America and the Caribbean, and in those areas pubescent upper leaf surfaces are reported by van Ooststroom. In Mexico, *Evolvulus sericeus* var. *holosericeus* can have the upper surface hairy or glabrous, but this variety is more tropical and ranges into Mexico only as far north as central Veracruz, outside of the current area of study.

The new variety *Evolvulus sericeus* var. *cymosus*

Van Ooststroom (1934) describes forma *pedunculatus* within *Evolvulus sericeus*, based on a type from San Luis Potosí, Mexico, and gives its distribution as Texas and northern Mexico. He distinguishes it from typical *E. sericeus* by its development of a peduncle up to 25 mm long, a feature completely lacking in the typical form. Shinners, in his treatment of *Evolvulus* in Correll & Johnston (1970), states that this form is rare in Texas. Early in my studies of this group I was struck by how common these pedunculate forms actually are in central Texas populations and specimens. However, once I understood the development of these inflorescences and how to recognize them in their early stages, I found that this inflorescence type is actually nearly universal throughout a coherent geographical range, being the only form along the southern and eastern edge of the Edward's Plateau, from Val Verde Co. to Bexar Co. to Travis Co. in the north, and directly south to Mexico (Map 3). Its distribution in Mexico is not well known, although in the north it occurs along the eastern edge of the Sierra Madre Oriental, where it is sympatric in Monterrey with both *E. sericeus* var. *sericeus* and *E. discolor*. This geographical pattern led me to consider this to be not a form but a variety of *E. sericeus*, and I designate it (below) as *E. sericeus* var. *cymosus*.

The new variety differs from other *Evolvulus sericeus* varieties in its well developed dichasial cymes with peduncles from 3 mm long to longer than subtending leaves (Fig. 28 a–b, 29), with up to 3 orders of development noted, although only one lateral branch normally develops. "Peduncle" is unfortunately a rather confused and confusing term in botany, and so some discussion is needed here. Van Ooststroom 1934, pp. 6–7, described the inflorescences of *Evolvulus* as follows:

> The inflorescences are of dichasial character. This is distinctly expressed in the species with developed peduncles and with more-flowered inflorescences, the flowers of which are *distinctly pedicellate*. At the base of the pedicel of the terminal flower occur 2 bracteoles, each with a lateral branch in their axil. In their turn these branches also bear terminal flowers and bracteoles, with or without developed flowers. If the lateral branches of the dichasium are not developed, then we get a peduncle, which is one-flowered. … *Should the peduncle be missing, then the flowers are situated immediately in the leaf-axils, with or without pedicels* [emphasis mine].

Evolvulus sericeus var. *cymosus* cymes most frequently found may be characterized by the three schemata shown in Figure 27. Single-flowered forms (leftmost) in which neither lateral branch develops are the most common form, but also noted were instances of two-flowered cymes (middle) with a single lateral branch or its bud. The rightmost image is from one instance with 3 pairs of bracteoles and flowers (or flower buds) with lower pedicels/flowers having disarticulated (cf. Fig. 28a).

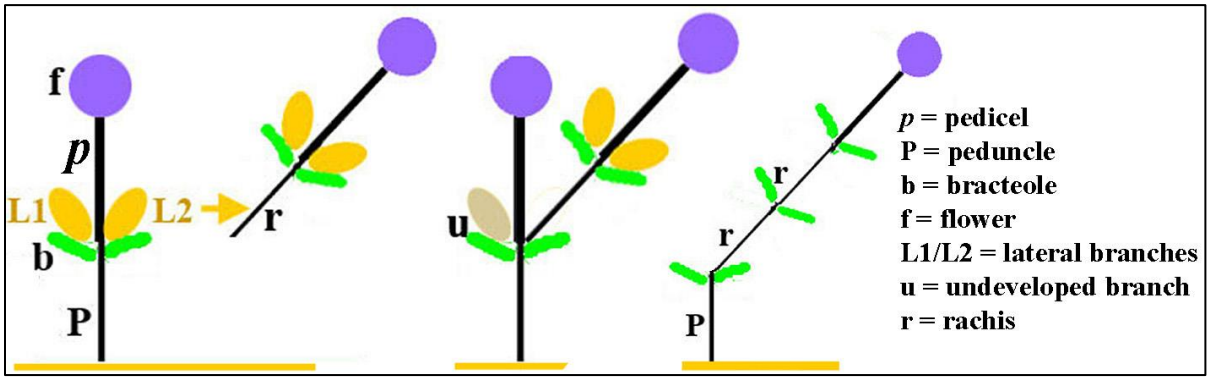


Figure 27. Schematic inflorescence structure in *Evolvulus*; see text.

Evolvulus literature (and botanical literature in general) is variable in defining peduncles and pedicels. Contrast the key of Shreve & Wiggins (1964, p. 1139), for *E. sericeus* var. *discolor* in the Sonoran Desert: "flowers sessile or short-pedicellate in axils of leaves, not pedunculate" with the descriptions in Austin (1998, p. 66): ''Inflorescences axillary, 1-flowered, sessile or on stout peduncles 3-4 mm long" and Felger et al. (2012, p. 481): "Inflorescences solitary, axillary, sessile or on peduncles to 4 mm long; bracteoles subulate, to 2-4.5 mm long. Flowers lacking pedicels." Pedicel and peduncle do not have the same meaning in these cases, presumably arising from the different ways in with the terms are defined. The most common usage, at least in the USA, defines "peduncle" as the "stalk of a flower or group of flowers" and "pedicel" as the "stalk of a single flower in a flower cluster or of a spikelet in grasses" (Correll & Johnston 1970); that is, pedicels only occur in inflorescences. However, other botanists define them differently and more logically: a peduncle is the "stalk of an inflorescence" and a pedicle is the "stalk of a single flower," whether or not it is in an inflorescence (Hickey & King 2000; van Ooststroom (1934) as quoted above). Due to this variation in definition, Van Ooststroom's name "forma *pedunculatus*," assigned to long-peduncled *E. sericeus*, is thus unfortunate and a source of possible confusion. The variety name *cymosus* is an attempt to avoid this pitfall.

In the other varieties of *Evolvulus sericeus*, the inflorescence is reduced to a single flower (very rarely two) and the true peduncle is absent or less than 2 mm long (fig. 28c); the flowers thus typically appear to be single flowers with two bracts in leaf axils and not in an inflorescence, with no development of a separate inflorescence peduncle. A difficulty in determining whether a given plant is var. *cymosus*, and surely a major reason that this form was considered rare, is that the first flowers of immature plants of this variety often lack developed peduncles. When I first learned that the "rare" long peduncles were known in Central Texas, I examined flowers on my study plot in Hays Co. and did not find long peduncles. But later in the summer the same plants had them. Subsequent summer collections from Travis Co. and Real Co. plus the collections at TEX/LL showed that this is the common and standard form in a large continuous area.

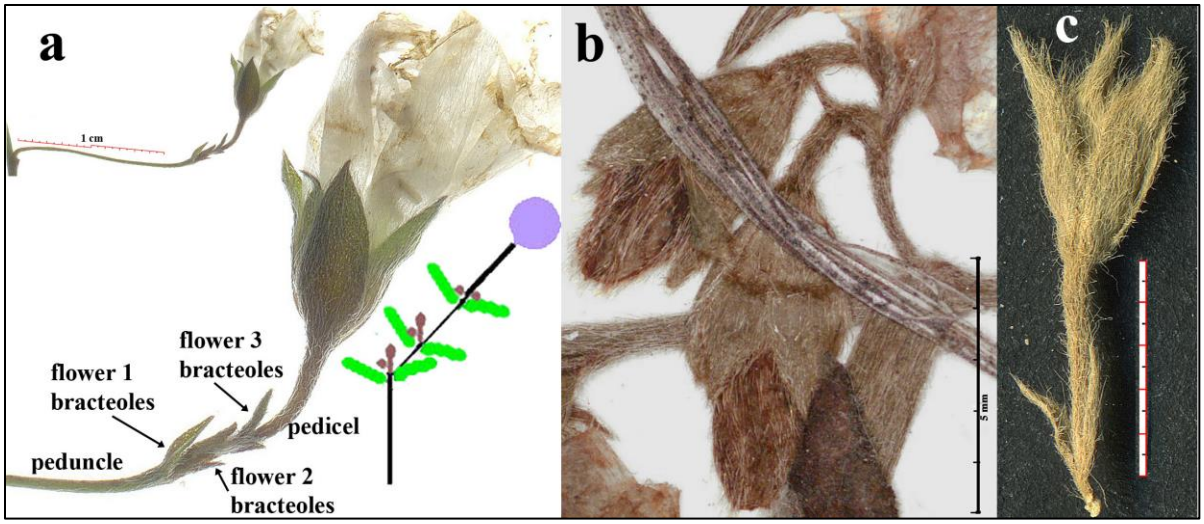


Figure 28. a–b. *Evolvulus sericeus* var. *cymosus*. a: 3-flowered cyme (Hays Co. study site); b: 2-flowered cyme, Cameron Co. (*Johnston 249-2*); c: *E. discolor*, pedicel ca. 5 mm, peduncle < 0.4 mm, Chihuahua, Mex. (*Shreve 8084*).

Figure 29. *Evolvulus sericeus* in Wilson Co., Texas: var. *cymosus* (left 2: *Carr 21135*, *Palmer 914*) & var. *sericeus* (right: *Thompson & Graham 47)*. *Palmer 914*, with a single long peduncle (insert, red arrow) with several immature stems was determined as *E. sericeus* Sw. by van Ooststroom. *Thompson & Graham 47* is clearly a mature plant with numerous flowers, all with long pedicels.

A survey of *Evolvulus* peduncle lengths at the Hays Co. study site was made during spring and summer of 2014, May 24 – July 26, a total of 111 stems with 285 peduncles. The results are in Table 1. Identification of var. *cymosus* requires a mature stem. Since mature plants are constantly

producing new stems from rhizomes, season alone does not suffice to determine maturity. However, stems with more than two flowers are almost certain to give a safe determination. Of the 46 stems surveyed with 3 or more peduncles, only one did not have a peduncle over 2.4 mm long (its longest was 0.8 mm). Of all stems with only 1 inflorescence, even including early immature stems, some 66% had peduncles exceeding 2.4 mm in length. Also surveyed were all Texas *E. sericeus* var. *sericeus* collections at TEX/LL. Peduncles on these plants did not exceed 1 mm. An example of how a collection might be incorrectly identified is *Palmer 914* [US 1336088] with several epedunculate immature stems determined by van Ooststroom in 1934 as "*Evolvulus sericeus* Sw." (Fig. 29 middle). But as the long peduncle (enlarged insert) shows, this is var. *cymosus*. One mature plant (*Mears 632*) with many flowers in Travis Co., an area where var. *cymosus* is expected, lacked peduncles – but it was collected from a landscaped area on the University of Texas campus, a location with sod, seed and nursery plants from outside areas. In contrast, an early 1906 collection from the UT campus, *Wolf 840*, has long peduncles, as do the 12 other collections from Travis Co. Although similar questions arise with collections from roadsides and urban parks, in general var. *sericeus* and var. *cymosus* are not sympatric. Both have been collected in Wilson Co., but var. *cymosus* (*Carr 21135* and *Palmer 914*) was in the west near Bexar Co. and var. *sericeus* (*Thompson & Graham 47*) was in the far east of the county (Fig. 29). April blooms are more likely to be indecisive and require a larger sample than just a few stems.

date	**24-May**	**29-May**	**5-Jul**	**12-Jul**	**26-Jul**	**Total**
Total stems	17	22	32	11	29	111
Total peduncles	24	52	63	32	114	285
Longest peduncle	16 mm	16 mm	15 mm	21 mm	22.2 mm	
Stems w 1 inflorescence	15	5	16	3	2	41
Stems w 1 infl. w peduncle > 2.4 mm long	8	4	11	3	1	27
Stems w 2 inflorescences	2	9	6	2	5	24
Stems w 2 infls. w peduncle > 2.4 mm long	2	9	6	2	1	20
Stems w > 2 inflorescences	1	8	10	6	21	46
Stems w > 2 infls. with no peduncle > 2.4 mm	**0**	**0**	**1**	**0**	**0**	**1**

Table 1. Survey of peduncle lengths at study site, Hays Co., May–July 2014.

It is likely that both peduncle and pedicel continue to lengthen during the growing season, since the maximum peduncle length tends to be greatest at the end of summer with the longer peduncles lower on the stem (Fig. 30).

Roughly half of the peduncles of var. *cymosus* surveyed in July were bare, the pedicels having disarticulated, leaving behind the peduncle and bracteoles (Fig. 30). 18 instances (ca. 9%) of flowers on a lateral branch (with or without the central flower having disarticulated) were found, a clear indication that the cyme structure had continued to develop during the summer. The rachis of a lateral flower is only rarely visible, so without careful examination, when the central flower has disarticulated, leaving only a tiny scar, the status of the second flower is easily misidentified as central (Fig. 31).

Peduncles are typically narrower (typically < 0.3 mm diameter) than pedicels (± 0.4 mm diameter), but exceptions are found, especially when pedicels are longer than peduncles (Fig. 31).

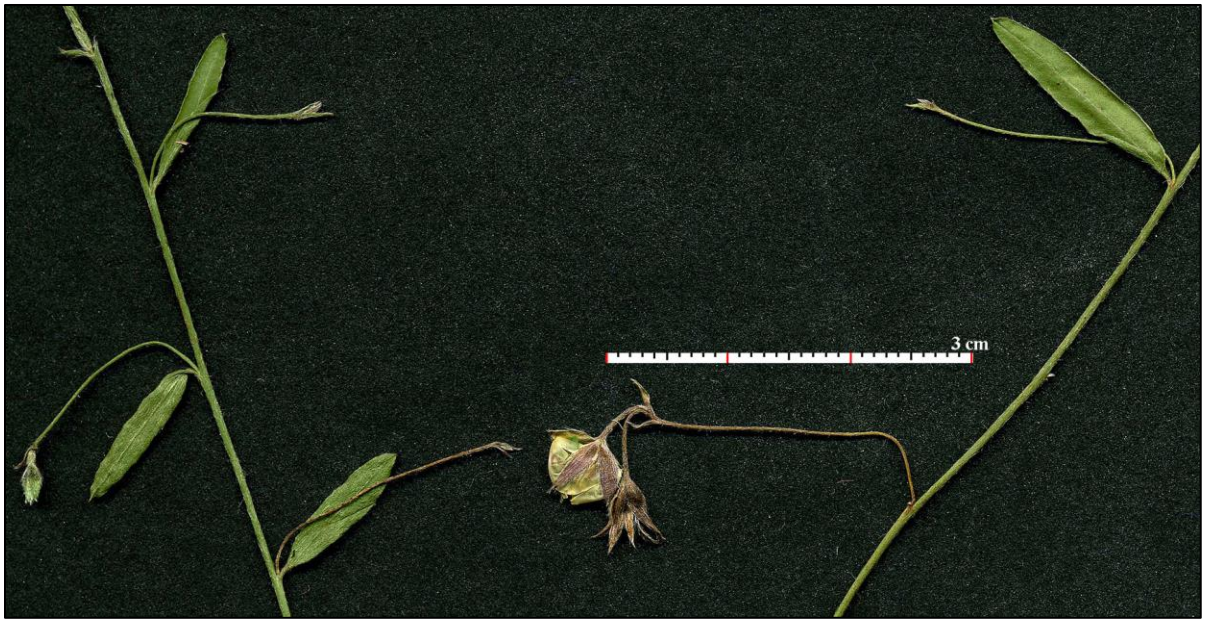


Figure 30. Long peduncles at study site, 4 Aug 2014. Four flowers with their pedicels have disarticulated above the bracteoles. (Hays Co. TX study cite)

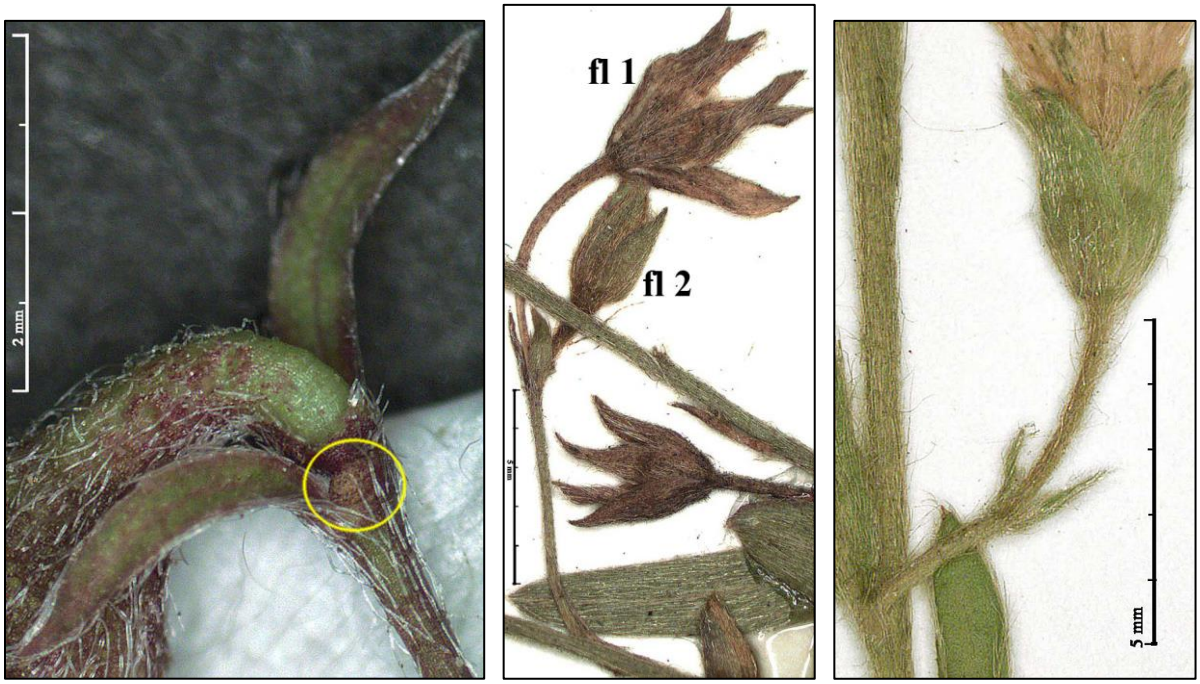
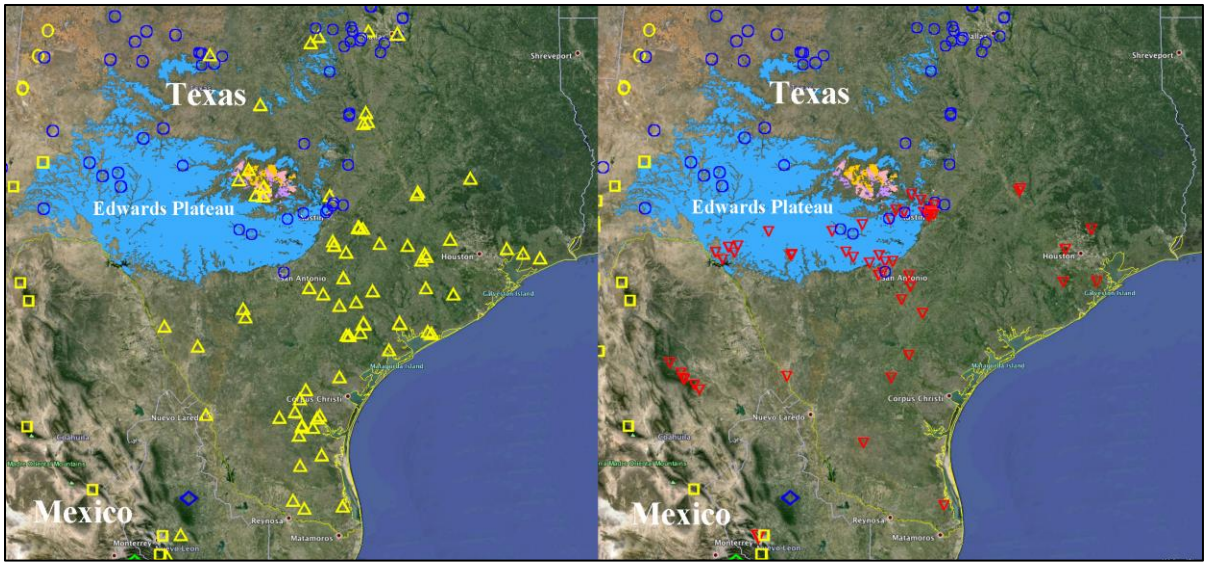
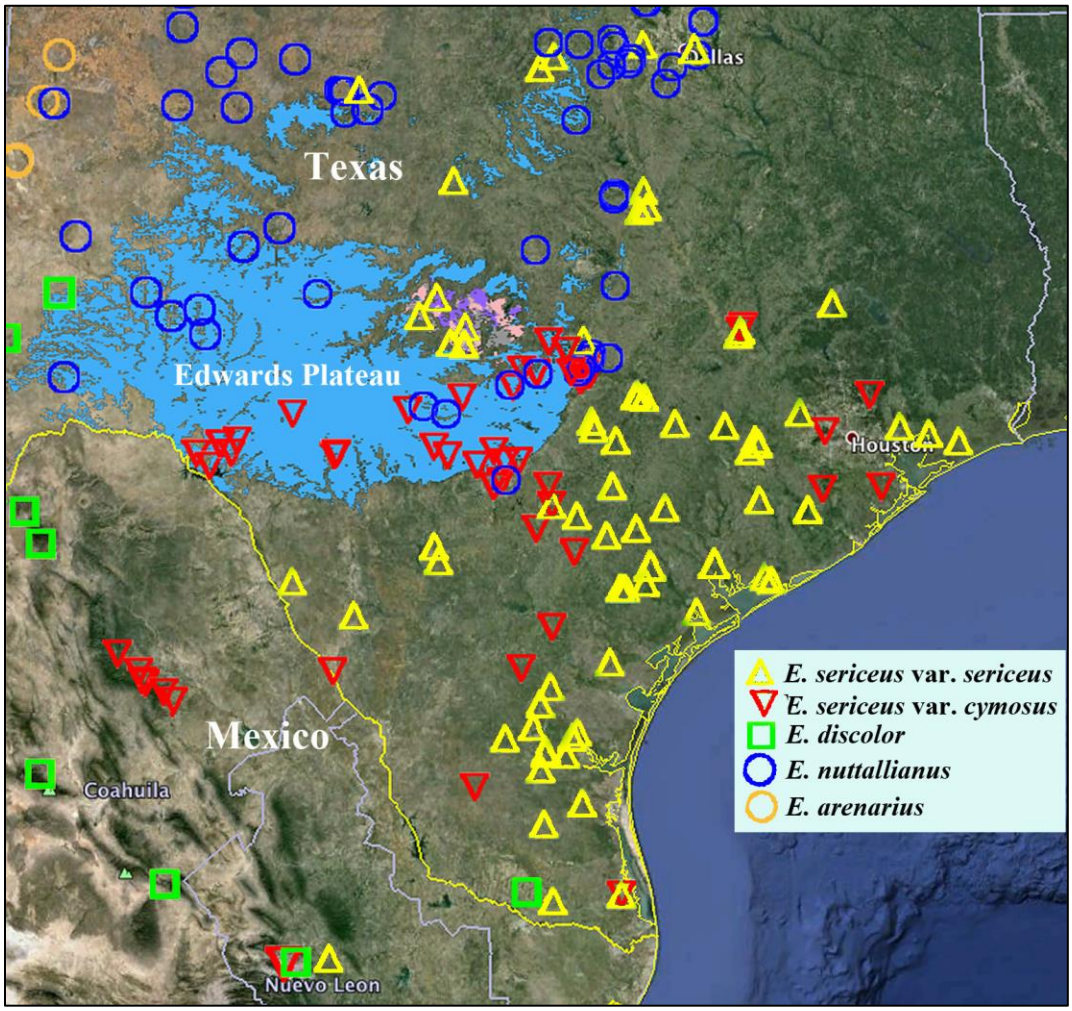


Figure 31. *Evolvulus sericeus* var. *cymosus* inflorescence details. Left: disarticulation scar, Hays Co. study site. Center: 2-flower cyme, Travis Co. (*Brown s.n.*) Right: peduncle wider than pedicel, Tamaulipas (*Nesom et al. 6300*).





Map 3. Distribution of *Evolvulus sericeus* var. *sericeus* and var. *cymosus* in Texas and northern Mexico. A gap of over 100 miles separates the westernmost var. *cymosus* from the easternmost *E. discolor*, although *E. nuttallianus* is found in this area. Only var. *sericeus* is found in the granitic Llano Uplift at the northeastern corner of the Edwards Plateau.

Figure 32. *Evolvulus sericeus* var. *cymosus*, cross section of stem, peduncle base, petiole base, Hays Co. study site.

In *Evolvulus discolor*, the stalk beneath the flower (i.e., pedicel), subtended by 2 bracteoles, is often to 4 mm long, even longer in fruit, and the stalk beneath the inflorescence (i.e., peduncle) is absent or less than 0.5 mm (Fig. 28c), but in rare cases may reach 5 mm. 2- and 3-flowered inflorescences of *E. discolor* were noted with several collections from southwestern New Mexico (Hidalgo and Dona Ana counties) and Coahuila, Mexico. Peduncles up to 4.5 mm were noted with these cymes, and several collections from the areas had exceptionally long (to 11 mm) bracteoles (Fig. 33). In these forms the bracteoles of the lateral branches were only several mm.

Figure 33. *Evolvulus discolor* 3-flowered cyme and multi-flowered stem, *Ivey 2*, Animas Mountains, Hidalgo Co., NM.

TAXONOMY

Descriptions of *Evolvulus sericeus* and *E. discolor* and the formal diagnosis of the new variety are given below. Where images are cited, these are online images at JSTOR Plants <plants.jstor.org>. Character-states that differ significantly between the two species are highlighted in ***italic bold***.

1. Evolvulus sericeus Sw., Prodr. [O.P. Swartz] 55. 1788. **TYPE**: **JAMAICA**. *Swartz s.n.* (holotype: S, S-R-2223, image!; isotypes: BM-image!, M-image!).

Evolvulus choapanus J.A. McDonald, Phytologia 65: 152. 1988. **TYPE**: **MEXICO**. **Veracruz**. Mpio. Las Choapas, a 11 km del entronque Las Choapas con la carretera Cárdenas-Coatzacoalcos, 17°57 'N, 94°06' W, alt. 50 m.s.n.m., sabana primaria, 17 Jun 1970, *A.D.L. Orozco S. 188* (holotype: XAL not seen; isotypes F 1827587!, MEXU 00232198-image!).

PERENNIAL HERB with ***multiple stems arising from pale vertical rhizomes 1-2 mm wide, these from horizontal rhizomes or directly from the taproot, and often branching below ground, turning green and forming a lignescent base above ground, within an area up to 2 dm wide*** (Figs. 9-10).
STEMS ±erect to 2.5 dm long, ***0.2-0.7 mm wide, slightly wider at the base, rarely densely branched, mid stem internodes (2–)8–18 mm long***; ***upper stems with tightly appressed, straight bifurcate trichomes parallel to the stem,*** whitish to tawny (Figs. 16-18), **commonly sparse**; older stems often with denser, less tightly aligned pubescence, the distal branches of the trichomes gradually spreading upward.
PHYLLOTAXIS distichous.
LEAVES above the base elliptic ***to narrow-linear***, 5–25 mm long, 2–6 mm wide, ***length/width ratios 4–10***, with acute apex, sometimes mucronate, narrowing to ***subsessile base***, rising at very base at ±25º, then recurved at the base and very tip; conduplicate, ***often slightly recurved in the upper half of the stem***, midrib sometimes slightly curved; lower leaves wider, length/width ratios 1–3, not conduplicate;
glabrous above in southwestern U.S. and northern Mexico, with ***appressed, aligned, straight trichomes below***;
VENATION ***with a single primary vein at the base with 1 weakly developed pair of secondary veins diverging from the midvein just above the base and arching toward the apex, usually not opposite, occasionally over half the blade length; pinnate secondary veins common above half the blade length***.
INFLORESCENCE 1-, rarely 2-flowered vestigial cyme, or ***cyme developed with var. cymosus;*** PEDUNCLE ***absent or < 2 mm, or if present > 2mm in mature var. cymosus, 3–5 mm in diameter;*** PEDICEL straight or curved, to 5 mm long at anthesis, ***to 7 mm in fruit***, 4-8 mm in diameter, generally wider than the peduncle; BRACTEOLES ***linear-subulate, 1–5.5 mm long.***
COROLLA white, ***rarely pale lilac or bluish, occasionally yellow in dried state,*** rotate to broadly funnelform, entire; 7–15 mm in diameter; PLICAE pubescent on the outside, ***this typically sparse;*** FILAMENTS 2—3 times as long as the oblong anthers; outermost SEPALS ovate narrowing to an acute to attenuate apex, 4–5 mm long, adnate on the receptacle.
OVARY AND CAPSULE subglobose, glabrous, 3–4 1-seeded valves.
SEEDS brown, smooth.

Phenology. Blooming ***March to November***.

Distribution in North America and Mexico. Texas E of the Pecos River from N Central Texas east to Florida and southward in Mexico to Oaxaca, Tabasco, Quintana Roo.

Evolvulus sericeus in Mexico and the southwestern USA is considered here to comprise three varieties: var. *sericeus*, var. *holosericeus* (discussed below), and a new variety based on the previous discussion.

1a. Evolvulus sericeus var. **sericeus**

I know of no specimens identified by the name *Evolvulus choapanus* apart from the type collection. The definitive stem tip inflorescence noted by McDonald is shown in Figure 35 (left). I was unable to determine exactly what this was, but it appears to be a galled inflorescence or other *monstrum*. I did however find what appears to be the same stem-tip formation on an *E. sericeus* (as determined by van Ooststroom) collection made by Wooton (Fig. 35, right) from Tamaulipas (US 989782). In addition, van Ooststroom (1934), in his discussion of synonyms of *E. sericeus*, noted that the South American type of *Convolvulus proliferus* Vahl "is based on a specimen, misformed by a gall; the leaves are partly closely approximate and form an almost globular body at the top of the stems." He treated this name as synonymous with *E. sericeus* in what appears to be a parallel case to *E. choapanus*. In the description of *E. choapanus*, MacDonald indicated that it has "venation palmate with 3-5 major nerves" (p. 152) — thus seemingly distinct from the palmatipinnate *S. sericeus* (compare McDonald 1993, p. 28: "**venación** palmada, 3–5 nervaduras mayores" for *E. choapanus* versus p 32: "**venación** palmatipinnada, las 3 nervaduras mayores…" for *E. sericeus*). However, the F isotype of *E. choapanus* has venation is identical with that of *E. sericeus* described above.

Van Ooststroom (1934, p. 130, 132) stated that in *Evolvulus sericeus* var. *sericeus* the upper leaf surface can be either glabrous or pubescent. After applying the new characters used in the present work to identify material, this is not true, at least in the study area — all *E. sericeus* var. *sericeus* specimens from this area have the upper leaf surface glabrous. Van Ooststroom's statement as it pertains to the area of the present study apparently is based on specimens that he misidentified; of 32 collections at US determined by van Ooststroom as var. *discolor*, I determined 3, including one from Travis Co., to be *E. sericeus*; of 26 determined by him to be *E. sericeus*, I determined 6, from the Trans-Pecos or central Mexico, to be *E. discolor*. Since van Ooststroom was careful in his 1934 work to indicate which specimens examined had glabrous upper leaf surfaces and which had them pubescent, it is possible to see that his report of upper surface pubescence in *E. sericeus* var. *sericeus* in the study area is based on specimens identified here as *E. discolor*.

Figure 34. Unusual stem tip formations, left: isotype specimen of *Evolvulus choapanus* (Veracruz, *Orozco 188*, F); right: *E. sericeus* var. *sericeus* (Tamaulipas, *Wooton s.n.*).

Figure 35. *Evolvulus sericeus* var. *cymosus*. Holotype, *Harms 94*, Hays Co. (TEX).

1b. Evolvulus sericeus var. **cymosus** Harms, **var. nov**. **TYPE**: **USA**. **Texas**. Hays Co.: grassy area above Deadman's Creek on Purola Preserve, 0.41 airmiles WNW of intersection of Hays Co 187 and Raeford Crossing, 30°17'21" N, 98°09'58" W, elev. 980 ft, 14 Jul 2010, *R.T. Harms 94* (holotype: TEX!). Figure 34.

Evolvulus sericeus forma *pedunculatus* Ooststr., Meded. Bot. Mus. Herb. Rijks Univ. Utrecht 14: 130. 1934. **TYPE**: **MEXICO**. **San Luis Potosí**. Minas de San Rafael, Bagre, May 1911, *C.A. Purpus 5402* (holotype: US 463928!).

Similar to the type variety of the species but developing cymes with peduncles from 3 mm to greater than 2 cm long (then exceeding the length of subtending leaves). Leaves generally narrower and more recurved than with the type variety. Occurring in Texas from Val Verde Co. east and northward along the SE edge of the Edwards Plateau then southward to the Mexican border; in Mexico generally just E of the Sierra Madre Oriental from Coahuila south to San Luis Potosi and Jalisco. It is sympatric with var. *sericeus* in several locations, as well as with *E. discolor* in Nuevo Leon. Map 3.

This is published as a new variety with its own type, not as a new status and new name based on van Ooststroom's forma *pedunculatus*. The epithet "pedunculatus" is misleading and a different epithet is preferable. Var. *cymosus* is typified with a specimen from a population that I have studied in detail, not a Mexican specimen from a population I have not seen.

1c. Evolvulus sericeus var. **holosericeus** (H.B.K.) Ooststr., Meded. Bot. Mus. Herb. Rijks Univ. Utrecht 14: 130. 1934. *Evolvulus holosericeus* H.B.K.**,** Nov. Gen. Sp. Plant. 3: 116 [quarto], 91 [folio]. 1819. **TYPE**: **Columbia**. Pastures near La Cuesta de Toluca and near Ibague. (type material not seen, not in Bonpland & Humboldt herbarium at Paris, fide the 1968 IDC microfiche of the P-Bonpl Herbarium and the on-going JSTOR Global Plants online database at plants.jstor.org, not found at the Berlin Negatives Digitization Project database in the Field Museum <https://collections-botany.fieldmuseum.org/project/6454]>.

This variety is not known from the study area (southwestern USA and northern Mexico) but does occur in southeastern Mexico and thus was briefly examined for comparison. It differs from southwestern USA and Mexican material of vars. *sericeus* and *cymosus* in having the upper leaf surface pubescent. All specimens seen by van Ooststroom in Mexico had this feature, unlike those he cited from South America. The leaf tip was distinctively long acute with a mucro and a "bundle of hairs" (noted by van Ooststroom). Stem hairs and venation were determined to be of the *Evolvulus sericeus* type (Fig. 8). The Mexican collections are all from Veracruz and Chiapas. Whether these two groups represent separate taxa is uncertain, but this is beyond the geographical purview of the present paper. Map 2.

2. Evolvulus discolor Benth., Pl. Hartw. 1839, p. 6. **TYPE**: **MEXICO**. Between Lagos (Jalisco) and Aguascalientes (Aguascalientes), [col. July 1837 fide McVaugh 1970], *T. Hartweg 20* (holotype: K-herb. Benth. K000613102-image!; isotypes: GH!, NY [image!], LD-image!, E-image!). Figure 36.

Evolvulus holosericeus Kunth var. *obtusatus* Choisy 1845 [nom. et stat. nov. for *E. discolor*].

Evolvulus sericeus Sw. var. *discolor* (Benth.) A.Gray 1886, nom. superfl.

Evulvulus oreophilus Greene, Leafl. Bot. Observ. Crit. 1:151. 1905. **LECTOTYPE** (designated here): **USA**. **New Mexico**: [Sierra Co.] S end of the Black Range, 1 mi W of Hillsboro, dry hills, 5500 ft, 16 Aug 1904, *Metcalfe 1228* (US 00111219!; isolectotypes: US 01094792!, NMC!, MO-image!, NY-image!, ILL-image!, WIS-image!). Felger et al. 2012 designated the lectotype as being at US but did not choose between the two US specimens.

Evolvulus wilcoxianus House, Bull. Torrey Bot. Club 33:315. 1906. TYPE: U.S.A. Arizona: near Ft. Huachuca, 1894, *T.E. Wilcox 96* (holotype: US-barcode 00982052, image!; isotype: NY-image!).

Figure 36. *Evolvulus discolor*. Isotype of *Hartweg 20*, Mexico (GH). The GH sheet holds 2 different collections, *Palmer 912* and *Coulter 1018*, cropped out here.

PERENNIAL HERB with ***multiple stems branching from the crown of an underground, thick (to 6 mm wide), woody vertical rhizome***.

STEMS ±erect to 2.5 (rarely >3) dm long, ***0.5–2 mm wide, becoming woody toward the base with age, to 6 mm wide, often densely branched with short internodes 2–8 (–12) mm***; ***with loosely appressed bifurcate trichome branches rising from the base, often tangled.***

PHYLLOTAXIS distichous.

LEAVES oblong, ovate to ovate-elliptic narrowing to an acute apex, often mucronate, narrowing to a ***sessile, clasping base***; conduplicate, ***uniformly falcate at mid stem*** (may not be apparent with pressed specimens), ***flattened blades often asymmetrical, slightly curved*** (Fig. 2), 9–22 mm long, 3–5 (–7) mm wide, **length/width ratios 2–4 (–6)**; ***indumentum on both surfaces or above glabrous*** or more weakly pubescent, **bifurcate trichomes often much curved, tangled;** VENATION ***with midvein and 1-3 paired strong secondary veins running from the very base and arching toward the apex, the innermost pair well over half the blade length.***

INFLORESCENCE a 1-flowered ***(rarely 2- or 3-flowered in N Mexico & SW New Mexico***) vestigial cyme but rarely developed; ***PEDUNCLE absent or < 0.5 mm long (but rarely to 4.5 mm with developed cyme);*** ***PEDICEL*** straight, 1 to 5 mm long at anthesis***, in fruit to 8 mm often recurved***, 4-8 mm in diameter.

BRACTEOLES subulate to linear-lanceolate, 2–5 (–11) mm long.

COROLLA ***white, sky blue, or lavender (drying purple)***, rotate to broadly funnelform, entire, 7–15 mm in diam; PLICAE pubescent on the outside, ***this typically dense, villous;*** FILAMENTS 2—3 times as long as the

oblong anthers; outermost SEPALS ovate or oblong lanceolate often narrowing to a ***recurved*** long attenuate apex, 4–5 mm long, adnate on the receptacle.
OVARY AND CAPSULE subglobose, glabrous, 3–4 1-seeded valves.
SEEDS brown ***or black***, smooth.

Phenology. Blooming ***April to October***.

Distribution in North America. Arizona, New Mexico, Texas west of the Pecos River, mountain and desert inland Mexico from Sonora and Nuevo León southward to Oaxaca. (Maps 1, 2.)

ARTIFICIAL KEY FOR THE *EVOLVULUS SERICEUS* COMPLEX AND RELATED SPECIES IN THE SOUTHWESTERN USA AND NORTHERN MEXICO

1. Inflorescence pedunculate and upper leaf surface pubescent **Evolvulus alsinoides** (**E. arizonicus**)[1]
1. Inflorescence either not pedunculate or pedunculate with upper leaf surface glabrous.
   2. Leaves with prominent midvein and weakly defined pinnate venation (secondaries visible only with leaf clearing); phyllotaxis pentastichous 2/5, upper leaves flat or slightly u-shaped and erect (rarely falcate); if upper leaf surface glabrous, then lower surface is also.
      3. Foliage sparse with internodes commonly > 4 mm; mid leaves linear, length/width ratio > 8:1; trichomes strongly asymmetrical with weak forks ca. 0.25 mm long; hairs denser on upper surface; corolla yellowing with age. ..... **Evolvulus arenarius**
      3. Foliage dense with internodes rarely > 4 mm; mid leaves elliptical, length/width ratio < 8:1; trichomes weakly asymmetrical with weak forks > 0.25 mm long; hairs denser on lower surface; corolla not turning yellow with age. ..... **Evolvulus nuttallianus**
   2. Leaves venation palmatipinnate, e.g., with several strong lateral veins from at or near the base and pinnate venation in the distal half (generally visible on some leaves without clearing); upper leaves distichous, conduplicate, and often falcate; if upper leaf surface glabrous, then lower surface is sericeus.
      4. Leaves with broad clasping base, with 1 or more pairs of strong secondary veins from the point of attachment; upper stem hairs rising from the base of the trichome fork and curving back down as they lengthen; multiple stems arising from a branched crown above an underground vertical subligneous rhizome > 2 mm wide that extends as far as 8 cm down to the taproot; mid leaves consistently falcate (may not be apparent with pressed specimens); upper leaf surface glabrous or hairy; in the USA never occurring east of the Pecos River (except rarely in deep South Texas) ..... **Evolvulus discolor**
      4. Leaves with narrow subsessile base, with 1 pair of weak secondary veins from just above the point of attachment, with pinnate venation above the mid point; upper stem hairs straight and pressed flat close to the stem; multiple stems, < 2 mm wide at the base, becoming lignescent only above ground, often branched below ground, arising as narrow vertical rhizomes from thicker horizontal rhizomes; mid leaves slightly recurved, never strongly falcate; *in southwestern USA and northern Mexico at least*, leaves always glabrous above; in the USA never occurring west of the Pecos River ..... **Evolvulus sericeus**

[1] This species, apparently not closely related to the *Evolvulus sericeus* complex, is included here only because it is the most common species of the genus in much of the study area, and the only other species in the southwestern USA. In my opinion a case for treating *E. alsinoides* and *E. arizonicus* as distinct species has yet to be made. Van Ooststroom 1934 (pp. 75-76) had reservations about the status of *E. arizonicus*, noting that "both the Arizona specimens and the Argentina ones are rather variable in habit, size, form of the leaves and indumentum." The differentiae presented by Austin 1990 and Felger et al. 2012. — i.e., sepal length, corolla size, vestiture, leaf shape – are partially overlapping. Measurements of

collections in TEX/LL and SRSC show even greater variability and overlap than indicated by Felger et al. 2012, especially in stem vestiture, sepal length and corolla width.

ACKNOWLEDGEMENTS

The authors thank the curators of the herbaria that made specimens available for this study: F, GH, LL, NMC. NMCR, SRSC, TEX, UNM, US. Dr. James Mauseth of the Dept. of Integrative Biology, UT Austin, provided the senior author with extensive mentoring, space, and facilities in his plant anatomy lab. John Mendenhall of the Dept. of Neuroscience, UT-Austin, graciously made SEM images of hairs. Kanchi Gandhi at Harvard University provided nomenclatural insight. Barbara Hellenthal (NDG) checked their database and the Greene Herbarium to confirm that no type material of *Evolvulus oreophilus* is present in that herbarium and provided insight into where type material for that species would logically be. Both authors thank the Billie L. Turner Plant Resources Center for the needed space and facilities to undertake this study.

LITERATURE CITED

Allred, K.W., E.M. Jercinovic, and R.D. Ivey. 2020. Flora Neomexicana. III: An Illustrated Identification Manual. Part 2: Dicotyledonous Plants. Second Edition. Self-published.

Austin, D.F. 1990. Annotated checklist of New Mexican Convolvulaceae. Sida 14: 273–286.

Austin, D.F. 1991. Annotated Checklist of Arizona Convolvulaceae. Sida 14: 443–457.

Austin, D.F. 1998. Vascular Plants of Arizona: Convolvulaceae: morning glory family. J. Arizona-Nevada Acad. Sci. 30: 61–83.

Austin, D.F. 2001. Convolvulaceae Juss. Pp. 653–679, in W. D. Stevens et al. (eds.). Flora de Nicaragua, Vol. 1. Monographs Syst. Bot. Missouri Bot. Gard. vol. 85(1). Missouri Bot. Gard., St. Louis.

Austin, D.F., J.A. McDonald, and G. Murguía-Sánchez. 2012. *Evolvulus* L. Pp. 322–324, in C. Ulloa Ulloa (ed.). Flora Mesoamericana, Vol. 4 Parte 2, Rubiaceae a Verbenaceae. Missouri Bot. Gard. Press, St. Louis.

Carranza, E. 2008. Convolvulaceae II. In J. Rzedowski y G. Calderón de Rzedowski (eds.). Flora del Bajío y de Regiones Adyacentes, Fasc. 155. Instituto de Ecología, Pátzcuaro, Michoacán, Mexico.

Carranza, E. 2015. Convolvulaceae. In R. Medina Lemos (ed.). Flora del Valle de Tehuacán-Cuicatlán, Fasc. 135. Instituto de Biología, UNAM, Cd. México, Mexico.

Choisy, J.D. 1845. Convolvulaceae. Pp. 523–562, in A. de Candolle (ed.). Prodromus Systematis Naturalis Regni Vegitabile, Vol. 9. Treuttel et Würtz, Paris.

Correll, D.S. and M.C. Johnston. 1970. Manual of the Vascular Plants of Texas. Contr. Tex. Res. Found. no. 6. Texas Research Foundation, Renner, Texas.

Díaz Betancourt, M.E. 2001. *Evolvulus* L. Pp. 583–584, in G.C. de Rzedowski y J. Rzedowski (eds.). Flora Fanerogámica del Valle de México. Ed. 2. Instituto de Ecología, Pátzcuaro, Michoacán, Mexico.

Felger, R.S., D.F. Austin, T.R. Van Devender, J.J. Sánchez-Escalante, and M. Costea. 2012. Convolvulaceae of Sonora, Mexico. I. *Convolvulus, Cressa, Dichondra, Evolvulus, Ipomoea, Jacquemontia, Merremia* and *Operculina*. J. Bot. Res. Inst. Texas 6: 459–527.

Gray, A. 1878. Synoptical Flora of North America, Ed. 1, Vol. 2, Pt. 1. Ivison, Blakeman, Taylor & Co., New York.

Gray, A. 1886. Synoptical Flora of North America, Ed. 2, Vol. 2, Pt. 1. Smithsonian Institution, Washington.

Greene, E.L. 1905. New plants from southwestern mountains. Leafl. Bot. Observ. Crit. 1: 145–154.

Hammel, B.E. 2010. Convolvulaceae. Pp. 72–126, in B.E. Hammel et al. (eds.). Manual de Plantas de Costa Rica, Vol. V, Dicotiledóneas (Clusiaceae-Gunneraceae). Monographs Syst. Bot. Missouri Bot. Gard. vol. 119. Missouri Bot. Gard., St. Louis.

Harms, R.T. 2014a. A new species of *Evolvulus* (Convolulaceae) from the High Plains of the Texas-New Mexico border. Phytoneuron 2014-20: 1–20.

Harms, R.T. 2014b. Variation in *Evolvulus nuttallianus* (Convolvulaceae) in central Texas. Phytoneuron 2014-91: 1–10.

Hickey, M. and C. King. 2000. The Cambridge Illustrated Glossary of Botanical Terms. Cambridge Univ. Press, Cambridge.

House, H.D. 1906. Studies in North American Convolvulaceae. I. Bull. Torr. Bot. Club 33: 313–318.

Kearney, T.H. and R.H. Peebles. 1951. Arizona Flora. Univ. California Press, Berkeley.

Leaf Architecture Working Group. 1999. Manual of Leaf Architecture -- Morphological Description and Categorization of Dicotyledonous and Net-veined Monocotyledonous Angiosperms. Smithsonian Institution, Washington, D.C.

Manitz, H. 1982. Die Arten der Gattung *Evolvulus* in Cuba. Revista Jard. Bot. Nac. Univ. Habana 3: 103–127.

Martin, W.C. and C.R. Hutchins. 1980. A Flora of New Mexico, 2 vols. J. Cramer, Vaduz.

McVaugh, R. 1970. Introduction to the Facsimile Reprint of George Bentham's 'Plantae Hartwegianae.' Verlag con J. Cramer, Lehre, Germany.

Van Ooststroom, S.J. 1934. A Monograph of the Genus *Evolvulus*. Med. Bot. Mus. & Herb. R. Univ. Utrecht no. 14.

Weakley, A.S. and Southeastern Flora Team. 2022. Flora of the Southeastern United States, Edition of April 24, 2022. Produced from FloraManager database system, Univ. of North Carolina Herbarium, North Carolina Botanical Garden, Chapel Hill.

APPENDIX: CITED AND OTHER REPRESENTATIVE SPECIMENS

Evolvulus sericeus* var. *sericeus

JAMAICA. Clarendon Parish, 0.5 mi W of Osborne Store, elev. ca. 200 ft, 6/8/1963, *Proctor 23610* [LL]. **MEXICO. Guerrero.** Calavera-Filo, Dist. Mina, elev. 1000 m, 8/28/1936, *Hinton et al. 9346* [GH]. **Mexico.** Dist. Temascaltepec, Vigas, elev. 1080 m, 4/8/1933, *Hinton 4480* [GH, LL, US]. **Nayarit.** Punta Mita, 7/22/1932, *Howell 10378* [GH, US]. **Nuevo León.** 20 km NW of Montemorelos near Río Ramos, elev. 1000 ft, 9/1/1942, *Weaver 1025* [GH, US]; Zaragoza, Dulces Nombres, elev. 1870 m, 8/2/1994, *Hinton et al. 24559* [TEX]. **Oaxaca.** near Oaxaca, elev. 5000 ft, 7/11/1897, *Pringle 6733* [F, GH, US]; Chivela, 3/16/1934, *Mell 2267* [US]; between Guichocovi & Lagunas, elev. 600-900 ft, 6/27/1895, *Nelson 2745* [US]; Rincón Antonio, 4/21/1910, *Orcutt 3261* [F, GH, US]. **Quintana Roo.** Cobá, June-July 1938, *Lundell & Lundell 7733* [LL, TEX, US]. **San Luis Potosi.** chiefly in the region of San Luis Potosí, elev. 6000-8000 ft, 1878, *Parry & Palmer 628½ [GH]*. **Tabasco.** Estapilla, Tenosique, 6/27/1937, *Matuda 3504* [GH]. **Tamaulipas.** Buena Vista Hacienda, 6/21/1919, *Wooton s.n.* [US]. **Veracruz.** Casitas Gutierrez Zamora, cerca Ejido Villa Cuauhtemoc, 6/21/1970 , *Gomez-Pompa & Nevling 1190* [GH]; 5 km del límite de los estados Puebla y Veracruz, autopista, elev. 2600 m, 7/8/1970, *Gomez-Pompa &Nevling 1342* [GH]; Orizaba, March (no year given), *Botteri 882* [US]; Zacuapan & vicinity, July 1906, *Purpus 2365* [F, US]; Rancho de la Secretaría de Salubridad y Asistencia (antes Rancho "Tres Pasos"), Mpio. El Castillo, elev. 1050 m, 5/10/1977, *Avendaño R. A-223* [F] . **UNITED STATES. Texas. Austin Co.:** S side of I-10 just W of int. US 90, ca 3 mi SW of Sealy, ca 0.5 mi W of RR and 0.5 mi E of Little Bernard Creek, just W of Pershel Lane, 29°45'40"N, 96°11'40"W, elev. 200-206 ft, 5/23/1990, *Bridges & Kindscher* 13776 [TEX]. **Bastrop Co.:** Bastrop-Buescher State Park, 5/11/1937, *Tharp s.n.* [TEX]. **Brazoria Co.:** Nash Ranch, W of CR 25, ca. 8.7 mi. N of its jct. with Hwy 35 in West Columbia, 7/15/2004, *Rosen 3011* [TEX]. **Brazos Co.:** College Station, 4/20/1946, *Crockett 8523* [LL]; Bryan, 4/22/1940, *Reeves 35* [LL]. **Brown Co.:** NE of Brownwood, at Muse Wildlife Management Area, along Sandy Loop Road, near Blind 11, 4/25/2013, *Hansen 7125* [TEX]. **Caldwell Co.:** String Prairie geology, 6/27/1951, *Tharp, Gimbrede & Yang 51-1441* [TEX]. **Calhoun Co.:** near bay near Long Mott, 6/14/1953, *Johnston 53249.1* [TEX]. **Cameron Co.:** Laguna Atascosa Refuge, 9/21/1961, *Fleetwood 3803* [TEX]. **Chambers Co.:** Smith Point, Candy Abshier WMA, E side of Galveston Bay, 29.53055°N, 94.76492°W, 3/30/2007, *Rosen & Singhurst 4014* [TEX]. **Colorado Co.:** Attwater Prairie Chicken NWR, on and N of Co. Rd. 3013, 15.7 km W of its intersection with state hwy 36, SW of town of Sealy, bluffs that drain to Coushatta Creek in an area

known locally as the Duncan Prairie, 29°40'37.0"N, 96°16'50.8"W, 7/29/2012, *Rosen, Carter & Reid 5868* [TEX]. **Dallas Co:** Dallas, n.d., *Reverchon s.n.* [US 2607199]. **DeWitt Co.:** Western DeWitt Co., 5/2/1942, *Riedel s.n.* [TEX]. **Dimmit Co.:** Along road from Carrizo Springs to Chupendaro Ranch, 5 mi. from Carrizo Springs, 1898-06-05, *Vaughan s.n.* [TEX, mixed with *E. alsinoides*] **Fayette Co.:** S side of TX 71, ca. 0.4 mi. W of jct. Fayette Co. roads 100 & 124 in Plum, ca. 7.4 mi. W of jct. TX 71 bypass on W side of La Grange, 29°56'05"N, 96°58'47"W, elev. 300-330 ft, 6/26/1989, *Orzell &. Bridges 10786* [TEX]. **Frio Co.:** Melon, 8/8/1939, *Muller 2607* [LL]. **Goliad Co.:** E-W stretch of main loop road in NE 1/4 of Parks Ranch, ca. 0.3 mi or less E of N gate, 0.9-1.0 airmiles S to SSW of jct. US Rt. 59 and FM 2506 at Fannin, 28°40'59.2"N, 97°14'16.9"W, elev. 135 - 140 ft, 4/21/2004, *Carr 23048* [TEX]. **Gonzales Co.:** [no further locality] 4/16/1927, *Bogusch 1884* [TEX]. **Harris Co.:** Katy Prairie Conservancy's Jack Road prairie, on and S of Jack Road, 2 km W of its intersection with Katy-Hockley Road, 7 km S of the town of Hockley, 29°57'48.04"N, 95°49'44.85"W, 5/21/2014, *Rosen 6464* [TEX]. **Hidalgo Co.:** 17 miles N of Edinburg on side of Hwy 66, elev. 25 m, 5/13/1937, *Runyon 1695* [TEX]. **Jackson Co.:** Vanderbilt, 5/11/1916, *Palmer 9728* [US]. **Jim Wells Co.:** between county road and exotic hay meadow, at 90° turn in perimeter fence at S end of SE arm of Naval Auxiliary Landing Field Orange Grove, ca. 3.7 airmiles E of jct. US Rt. 281 and Co. Rd. 220, 27°52'51.8"N, 98°01'35.8"W, elev. 200 ft, 7/11/2006, *Carr 24863* [TEX]. **Kenedy Co.:** 3 mi. E of hdqtrs., Norias Div. of King Ranch, 7/5/1954, *Johnston 541052* [TEX]. **Kleberg Co.:** near main gate to Naval Air Station Kingsville, 1.2 airmiles ESE of jct. US Rt. 77 and St. Rt. 425, 1.8-1.9 airmiles NE to NNE of jct. FM 1717 and FM 1720, 27°29'18.7"N, 97°49'25.3"W, elev. 50 ft., 6/13/2006, *Carr 24607* [TEX]. **Llano Co.:** Llano, 05/14/1899, *Bray s.n.* [TEX]. **Mason Co.:** SE of Mason, at Double H Ranch, 1.2 mi E of hwy 1723, dirt road that is 1.9 mi S of State Hwy 87, 9/3/2013, *Hansen 7640* [TEX]. **Matagorda Co.:** Mad Island Marsh Preserve, 4/26/1994, *K. Bruce s.n.* [TEX]. **Maverick Co.:** on sand ridge 15 mi. E of Eagle Pass, June 20, 1898, *Bray s.n.* [TEX, mixed with *E. alsinoides*]. **McLennan Co.:** North of Gholson., 4/7/1947, *Smith 835* [TEX]. **Palo Pinto Co.:** Brazos, Sept. 1931, *Wadsworth s.n.* [TEX]. **Parker Co.:** Millsap, 8/15/1927, *Wadsworth s.n.* [TEX]. **San Patricio Co.:** Welder Wildlife Refuge, near Sinton, 4/16/1958, *Gould & Hycka 8036* [TEX]. **San Saba Co.:** extreme SW corner of county, 4.8 mi. E of Fredonia (Mason County), 5/19/1955, *Turner & Johnston 2519* [TEX]. **Tarrant Co.:** Arlington, May 1927, *Killian 6958* [TEX]. **Travis Co.:** in front of Journalism bldg. [Univ. of Texas campus], 7/29/1966, *Mears 632* [TEX]. **Victoria Co.:** 10½ mi W of Victoria, roadside, 3/29/1949, *Cory 55118* [US]. **Walker Co.:** ca. 2.0 mi N of TX 19 at Thessalonto Church, ca. 5 mi SW of Riverside, 30°49'25"N, 95°27'16"W, elev. 230-240 ft, 6/29/1989, *Orzell & Bridges 10943* [TEX]. **Wharton Co.:** on and NW of intersection of FM 2674 and Co. Rd. 320, 4.9 km S of Hwy 71, S of El Campo, 5/5/2008, *Rosen 4791* [TEX]. **Williamson Co.:** 2 mi. SW of Georgetown, 10/2/1944, *Wolcott 305* [TEX]. **Wilson Co.:** 5 mi. S of Nixon on Hwy 97, at roadside park, 4/28/1958, *Thompson & Graham 47* [TEX].

Evolvulus. sericeus* var. *cymosus

MEXICO. Coahuila. Sa. de Santa Rosa, 40 km al NW de Múzquiz, 28°05'N, 101°50'W, elev. 650-700 m, *Villarreal, Vázquez y Alumnos de Postgrado 4894* [TEX]; roadside between Melchor Muzquiz & Nacimiento de los Kickapoo, 6/27/1963, *Latorre 39* [TEX]; Km 1061, Mexican National RR, 6/28/1905, *Rose, Painter & Rose 8238* [US]. **Jalisco.** Road between Huejuquilla & Mesquitic, 8/25/1897, *Rose 3574* [US]. **Tamaulipas.** vicinity of Victoria, elev. ca. 320 m, May 1 to Jun 13, 1907, *Palmer 529* [US]; Papalote de la Mirandena, 3 mi SSW of headquarters, Loreto Ranch, 24°20'N, 98°W, 9/16/1960, *Johnston & Crutchfield 5568C* [TEX]; Mpio. San Carlos, Sa. de San Carlos, ca 5 mi S of San Carlos, N side of Bufa El Diente, 24°31'N, 98°58'W, elev. 1080-1200 m, 4/15/1988, *Nesom, Martínez & Jiménez 6300* [TEX]. **UNITED STATES. Texas. Bexar Co.:** Near Bracken, 7/1/1903, *Groth 35* [US]; 25 mi N of San Antonio, 5/15/2020, *Schulz 138* [US]; Government Canyon State Natural Area, SE quadrant, 29°33'55"N, 98°43'14"W, elev. 1130 ft, 8/5/2003, *Lott, Moore & Green 4478* [TEX]; San Antonio, 1918, *Slater s.n.* [US 891778]. **Blanco Co.:** "Miller Creek Road" ca 6 mi S of Johnson City, 0.6 mi W of jct with Hwy 290-281, 4/18/1987, *Nesom, Dorr, & Moffatt 5619* [TEX]. **Cameron Co.:** eastern Cameron Co., Horse Island, June 1952, *Johnston 249-2* [TEX]. **Duval Co.:** 9.5 miles NE of Freer on road 202, 10/10/1954, *Tharp & Johnston 542048* [TEX]. **Fort Bend Co.:** Brazos Bend State Park, on and E of FM 762, 2.5km north of its intersection with FM 1462, near the entrance gate and park residence, 29°22'17.7"N, 95°38'21.5"W, 7/21/2011, *Rosen & Winzer 5346* [TEX]. **Harris Co.:** Houston, 4/20/1872, *Hall 488* [US]; Houston, 4/20/1918, *Fisher 68* [US]. **Karnes Co.:** 3 mi. S of Helena, FM 792, 10/27/1952, *Johnson 1099* [TEX]. **Kendall Co.:** Old Tunnel Wildlife Management Area, across Alamo Springs Road at the overflow parking lot, 8/23/2008, *Hansen 6091* [TEX]. **Kerr Co.:** [without further locality], May 1943, *Blakey s.n.* [US 3509947]. **Real Co.:** On private ranch ca. 4.3 air miles E of Camp Wood, 29°39'50", 99°55'50"W, elev. 1655 ft, 8/27/2010, *Harms 99* [TEX]. **Travis Co.:** Watkins Ranch in NW Travis

Co. above Cow Creek on Lake Travis, 6/2/1951, *Tharp et al. 51-970* [TEX]; ca. 8 mi from Austin on Bee Cave Rd, 6/1/1946, *York 46120* [US]; campus of Univ. of Texas., 4/21/1909, *Wolf 840* [TEX]; valley of Barton Creek, ca. 2 mi. upstream from Barton Springs in Zilker Park and 2.5 mi from Colorado River, ca. 0.5 mi NE of Loop 360 bridge over creek, 30°14'55"N, 97°47'47"W, elev. 600-650 ft, 5/31/1989, *Orzell & Bridges 10215* [TEX]; S of Camp Mabry, Austin, 7/7/1948, *Brown s.n.* [TEX]. **Val Verde Co.:** 10-12 mi N of Del Rio toward Alta, elev. 1050 ft., 6/22/1957, *Warnock & McBryde 15030* [LL, SRSC]; near main entrance of "bat cave" on M. J. Rose Jr. ranch in Comstock., 9/18/1958, *Thompson 223* [TEX]; head of Little Satan Canyon, ca 8.7 airmiles W of jct US 277 and US 377, 29°43'28.1"N, 100°57'59.6"W, elev. 1580-1620 ft, *Carr 30614* [TEX]. **Webb Co.:** Along roadside, ca. 35 mi. S of El Indigo [sic: Indio] towards Laredo, 1975, *Turner s.n.* [TEX]. **Wilson Co:** Ca. 0.9-1.1 airmiles S to SSE of St. Rt. 97 bridge over San Antonio River, N and E of quarry pit at Rancho de las Cabras NHS, 29°05.784'N, 98°09.999'W, elev. 400-410 ft, 7/11/2002, *Carr 21135* [TEX]; Southerland [sic: Sutherland] Springs, Aug. 22 to 30, 1879, *Palmer 914* [US].

Evolvulus discolor

MEXICO. Chihuahua. Vicinity of Chihuahua, elev. ca. 1300 m, April 8 to 27, 1908, *Palmer 102* [GH]; foothills of the Sierra Hechiceros, 9 km S of Rancho Hechiceros, not far from the Coahuilan boundary, 10/1/1940, *Stewart 217* [GH]; broad valley 10 km S of Rancho de Encinillas, 7/6/1941, *Stewart 703* [GH]; 5 mi E of Cd. Jiménez, elev. ca 4500 ft, 7/31/1939, *White 2130* [GH]; N of Chihuahua, 8/1/1936, *LeSueur s.n.* [TEX]; 10 mi E of Hidalgo del Parral along Toll Rd to Jiménez, ca 26°57'N, 105°30'W, elev. ca. 17000 m, 9/10/2003, *Henrickson 23316* [TEX]; 22 mi S of Chihuahua, elev. 4400 ft, 7/30/1937, *Shreve 8084* [US]. **Chiapas.** Monserrate, rocky plains, June [no year given], *Purpus 10292* [GH]. **Coahuila.** End of road from T. Armendaiz N into the Sierra del Pino, vicinity of La Noria, Aug. 20-26, 1940, *Johnston & Muller 628* [GH]; E slope of Sierra del Carmen, 9 km N of Rancho El Jardín on road to Mina El Popo, ca 7 km S of Canyon del Diablo, 29°09'30"N, 102°42'30"W, elev. 1575 m, 7/28/1973, *Johnston, Chiang, Wendt & Riskind 11845* [LL]; 6 km E of El Tule, S foothills of igneous Sierra Hechiceros, ca. 24 km due N of Castillon & close to Chihuahuan boundary, 6/13/1941, *Stewart 472* [GH, LL]; 30 airmi. WNW of Cuatro Ciénegas in limestone Cañon los Pozos, ca. 3-4 mi W of Rancho Cerro de la Madera along trail to Cañon Desiderio, 27°08'N, 102°28'W, elev. 1400 m, 5/1/1977, *Henrickson & Lee 15938a* [TEX] . **Durango.** Vicinity of Rancho Ojito, 5/5/1959, *Correll & Johnston 21467* [LL]. **Guanajuato.** 10 mi E of Guanajuato, elev. 7500 ft, 6/22/1963, *Harris 25685* [GH, mixed with *E. prostratus*]. **Hidalgo.** Sierra de Pachuca, July 20 & 24, 1905, *Rose, Painter & Rose 8747* [US]; 6 km al NE de Tepeapulco, sobre las laderas del Cerro Xihuingo, elev. 2600 m, *Rzedowski 18317* [TEX]. **Jalisco.** Hwy 45, ca. 15 mi from Lagos de Moreno, 8/17/1957, *Solbrig & Ornduff 4495* [GH]. **Nuevo León.** Monterey [sic], Feb. 17-26, 1880, *Palmer 912* [US]. **Oaxaca.** Cerro de San Felipe, 8/29/1897, *Conzatti & González 441* [US]. **Puebla.** Esperanza, Sept. 1911, *Purpus 5671* [GH, US]; 41.5 mi SE from Tehuitzingo along hwy 190, elev. 4000 ft, 8/2/1975, *Torke, LeDoux & Ellis 383* (LL). **Sonora.** San Pedro, Sept. 10-20, 1890, *Hartman 859* [GH]; 23 mi NE of Bacoachic, elev. 4470 ft, 5/10/1948, *Wiggins 11737* [US].

UNITED STATES. New Mexico. Catron Co.: Apache N.F., Saddle Mt. area, at bridge that crosses Pueblo Creek near campground, 33.59180°N, 108.96230°W, elev. 1900 m, 8/7/2001, *Johnson 604* [NMCR]. **Dona Ana Co.:** Organ Mts, Filmore Canyon, 5/23/1905, *Wooton s.n.* [US]; Filmore canyon; Organ mountains, 5/26/1905, *Wooton s.n.* [NMC]; Organ Mts, 7/11/1897, *Wooton 128* (NMC); Las Cruces, 9/5/1936, *Zumwalt 19* (UNM). **Eddy Co.:** Queen, elev. ca. 5900 ft, 8/1/1909, *Wooton s.n.* [NMC]; Guadalupe Mts., Dark Canyon along FSR 69, 2.8 air mi E or Klondyke Gap near Stone Canyon Ranch, elev. 5850 ft., 7/19/2010, *Worthington 36166* [SRSC]. **Grant Co.:** near Silver City, 7/12/1880, *Greene s.n.* [US]; Mangas Spgs, 18 mi NW of Silver City, elev. 4770 ft, 6/2/1903, *Metcalfe s.n.* [US], *Metcalfe 100* [NMC, US]. **Hidalgo Co.:** East llano of Little Hatchet Mountains, 8/20/1954, *Castetter s.n.* [UNM]; several mi N of Antelope Wells turnoff on Rt 81, 5/13/1955, *Castetter 7621* [UNM]; Gray Ranch, Animas Mountains, T31S R18W, 11/8/1990, *Ivey 2* [UNM], *1-B* [UNM]; San Simon Valley, between Rodeo and Ariz-NM line, elev. 4100 ft, 7/28/1977, *Moir 109* [NMC]. **Luna Co.:** top of ridge along old mining road, T20S R9W, SE1/4 sec 13, elev. 6840 ft, 7/17/1986, *Columbus 302* [NMCR]; N end of Florida Mts, Rockhound State Park, Spring Canyon, 32°08.676'N, 107°36.988'W, elev. 1566 m, 5/5/2012, *Jercinovic 1223* [UNM]; Gage, 8/6/1938, *Castetter 10692* [UNM]. **San Miguel Co.:** Conchas Dam E of north campground, elev. 4000 ft,11/1965, *Broeke MO-6* [UNM]. **Sierra Co.:** in and around the S end of the Black Range, Kingston, elev. ca. 6700 ft, 8/25/1904, *Metcalfe 1259* [NMC, US]; Lake Valley, Sept. 1914, *Beals s.n.* [US]. **Socorro Co.:** 15 mi W of Socorro near the Water Canyon turnoff on hwy 60, 7/16/1973, *Higgins 7719* [NMC]; S end of San Mateo Mts, elev. 6900 ft, 8/28/1963, *Goodrow 928* [UNM]. **Texas. Brewster Co.:** Ca. 9 mi SE of Alpine, elev. ca. 5300 ft., 9/16/2006, *Powell & Powell 6663a* [SRSC]; Alpine, 6/13/1926, *[collector not given] J16-165* [SRSC]; Sul Ross Hill, 3/29/1957, *McBryde 365* [SRSC].

Hudspeth Co.: Sierra Diablo, head of Victoria Canyon, T.A. Beards lodge, elev. 5500 ft., 8/18/1953, *Warnock 11513* [SRSC]; W slopes of Eagle Mts., Hayter ranch, elev. 4000 ft., 7/12/1959, *Warnock et al. 17996* [SRSC]. **Jeff Davis Co.:** Davis Mts State Park, NW of Ft. Davis, 6/18/1963, *Correll & Wasshausen 27908* [LL]; Davis Mts., Limpia Canyon at Wild Rose Pass, Kokernot ranch, elev. 5500 ft., 4/6/1948, *Warnock & Churchill 7731* [LL, SRSC]; Davis Mts., Madera Canyon, 10 mi from Observatory on Scenic Drive, elev. 5900 ft., 5/25/1947, *Warnock 5683* [SRSC]; Cherry Canyon Ranch [*E. discolor* study site], ca. 0.5 mi SE of the Lodge, 30.854723°N, 104.044988°W, elev. 4756 ft, *Harms 144* [TEX]. **Pecos Co.:** Madera Mts., 25 mi. S of Fort Stockton., 6/15/1964, *Correll, Gentry & Hansen 29700* [LL]; 30 mi E of Fort Stockton, Escondido Ranch, elev. 3300 ft., 7/10/1961, *McKenzie 575* [SRSC]; Espy Ranch, near Big Bear Tank, northeastern Davis Mts., elev 4600 ft, 6/26/1986, *Larke 483* (SRSC). **Presidio Co.:** Along main road in SE part of Mimms Ranch, ca. 1.0 airmiles N to NNW of jct. US Rte 67 and US Rt. 90 in downtown Marfa, 30°19.377'N, 104°01.548'W, elev. 4740-4750 ft, 7/17/2012, *Carr & Benesh 31253* [TEX]; SW part of Mimms Ranch, ca. 4.0-4.1 airmiles NW to WNW of jct. US Rt 67 and US Rte 90 in downtown Marfa, 30°20.638'N, 104°04.492'W, elev. 4880 ft, *Carr & Benesh* 31330 [TEX]; ca. 24 airmiles NNW of Presidio on the SW side of Chinati Mts. in Chinati Mtns. State Natural Area, San Antonio Canyon NE of the San Antonio cabin area, 29°54', 104°29'W, elev. 4100 ft., 8/30/2005, *Henrickson & Riskind 24225* [TEX]; Mimms Ranch, just N of pens at ranch house, ca. 0.8-0.9 airmiles NNW of jct US 67 & US 90 in downtown Marfa, 30°19.252'N, 104°01.634'W, elev. 4720-4730 ft, 7/16/2012, *Carr & Benesh 31161* [TEX]; Elephant Mt., N slope, elev. 5675 ft., 5/11/1959, *Allen 45* [SRSC]; along highway about 3 mi S of Marfa toward Shafter, elev. 4100 ft, 7/12/1952, *Warnock 10581* (LL, SRSC).