

**KEYS TO THE FLORA OF FLORIDA - 24,
CROTALARIA (LEGUMINOSAE)**

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ABSTRACT

Crotalaria (Leguminosae) is represented in Florida by 13 species. Of these, 7 are native and 6 are introduced. A reappraisal is provided of the *C. rotundifolia* complex, with five taxa recognized at specific rank. One species, *C. avonensis*, is rated as endangered. Five species reported for Florida are excluded. An amplified key is given to the Florida taxa. *Phytologia* 92(1): 3-14 (April 2010).

KEY WORDS: *Crotalaria*, Leguminosae, Florida flora.

Crotalaria (Leguminosae) is a genus of perhaps 600 species (D. J. Mabberley, 1996), with the great majority native to tropical Africa. In Florida the genus consists of representatives of two sections encompassing five different series. Sect. *Simplicifoliae* is simple leaved, with ser. *Alatae* a difficult complex of native species often marked by inversely sagittate, decurrent stipules; and ser. *Erectae* of robust Old World species. Sect. *Crotalaria* (= sect. *Trifoliolatae*) has ternate leaves, with ser. *Macrostachyae* formed of species largely African in origin, with inflorescences prominent and terminal; ser. *Incanae*, mostly New World tropics, with the style bent downward at right angles to the ovary then abruptly upward; and ser. *Longirostres*, widespread in the tropics, with the style only slightly curved. [This generic structure follows Baker (1914). Polhill (1968) differs in certain respects.]

The native and introduced Florida species are easily assigned: *Crotalaria avonensis*, *C. linaria*, *C. maritima*, *C. purshii*, and *C. rotundifolia* (as well as the native southeastern but non-Florida *C.*

sagittalis) fall into ser. *Alatae*; *C. retusa* and *C. spectabilis* into ser. *Erectae*; *C. lanceolata*, *C. ochroleuca*, *C. pallida*, and *C. zanzibarica* into ser. *Macrostachyae*; *C. incana* into ser. *Incanae*; and *C. pumila* into ser. *Longirostres*.

North American *Crotalaria*, both native and introduced, were well surveyed by H. A. Senn (*Rhodora* 41: 317-367. 1939), with southeastern species addressed in greater detail by D. Isely (*Vasc. Flora S.E. U.S.* 1990). Southeastern unifoliolate species have been monographed by D. R. Windler (*Rhodora* 76: 151-204. 1974). And the enormous profusion of African *Crotalaria*, a few of which have been introduced into Florida, is excellently treated by R. M. Polhill (*Crotalaria in Africa and Madagascar*. 1982).

The non-native *Crotalaria* pose little difficulty of identification, though their nomenclature is heavily dependent upon taxonomic studies elsewhere, primarily in Africa. Their appearance in Florida is a consequence of the incautious enthusiasm in the early and mid-20th century for plant introductions of foreign species some of which were of great value but others which were either disappointments or actually of major economic and environmental cost. *Crotalaria* has conformed to this pattern. The earliest introduction was of *C. pallida* (then known as *C. striata*) in 1909, soon followed by *C. spectabilis*, *C. ochroleuca* (as *C. intermedia*), and others (R. McKee & C. R. Enlow, U.S.D.A. circ. 137. 1931). Much of the research on these introductions was centered at Gainesville, Florida. By 1931 some 35 species had been grown and tested for agricultural value as green manure and forage, with test samples distributed within the State and throughout the Southeast. Perhaps fortunately, few of these species escaped and have persisted outside of cultivation. But for those that did escape, a generous literature soon developed addressing their varying levels of toxicity, both green and dried (J. M. Kingsbury, *Poisonous Plants of U.S. and Canada*. 1964). Quickly, the economic value of the genus was realized to be far less than the potential harm, and commercial use of *Crotalaria* was abandoned. Six species -- five from Africa, one (*C. spectabilis*) from Asia -- remain as an apparently permanent part of the

Florida flora, while a further five species merit listing as having been reported in that status.

The nomenclature of certain of the persisting species has required repeated correction. In several, the name under which they were first introduced has been found to refer to another taxon or to be synonymous of an earlier name (Polhill, 1982). The plant known to McKee & Enlow (1931) and J. K. Small (1933) as *C. striata* DC. (1825), and later by Senn (1939) and R. L. Wilbur (1963) as *C. mucronata* Desv. (1814), has now been assigned a still-earlier name, *C. pallida* Ait. (1789). The plant known to McKee & Enlow and Senn as *C. usaramoensis* Baker f. (1914) has become *C. zanzibarica* Benth. (1843); another name employed for this species, *C. trichotoma* Bojer, has been dismissed as "not a *Crotalaria*" (Polhill, 1982). The plant first known in Florida as *Crotalaria intermedia* Kotschy (1865) and later as *C. brevidens* Benth. (1843) [or *C. brevidens* var. *intermedia* (Kotschy) Polhill] appears to be *C. ochroleuca* G. Don (1832), a second species of a large-flowered narrow-leaflet group of subtly separated African taxa. [The taxonomy of this group is conflicted. Florida materials (FLAS) have been identified as *C. brevidens* var. *brevidens* (R. M. Polhill, pers. comm., Sept. 1982). Their flowers are clear yellow (as in *C. brevidens*), yet their legumes are broad (as in *C. ochroleuca*).]

In contrast, the native species of *Crotalaria*, especially those of series *Alatae* related to *C. rotundifolia*, are nomenclaturally straightforward but taxonomically complex. As treated by Windler (1974), this group consists of 12 species, three native to the American Southeast, the others in Mexico, Central, and northern South America. The southeastern species recognized by Windler were: *C. sagittalis* L.; *C. rotundifolia* (Walt.) Gmel., consisting of var. *rotundifolia* and var. *vulgaris* Windler; and *C. purshii* DC. Windler's study, though answering many questions and relied on by most later workers, did not give fully satisfactory answers as to the number of taxa in the Southeast worthy of recognition nor the characters by which they may best be distinguished.

The present study has concluded that recognition of no less than six *C. rotundifolia*-related species is necessary if the great majority of specimens in the Southeast are to be satisfactorily assigned to discrete groups: (in order of publication) *Crotalaria sagittalis* L. (1753), *C. rotundifolia* Walt. ex Gmel. (1792), *C. purshii* DC. (1825), *C. maritima* Chapm. (1878), *C. linaria* Small (1933), and *C. avonensis* DeLaney & Wunderlin (1989).

Crotalaria sagittalis, the first-named of this complex, though widespread in the continental United States and extending into Mexico, is only an infrequent introduction to the eastern coastal plain. Senn (1939) cited this species from Florida stations in Lake, Levy, and Polk counties, and J. Patman (USF) in an informal study in the 1960s annotated specimens with this name from six additional counties extending well into southern Florida. Not all of these specimens have been examined, but of the several to which access has been possible, only one (Alachua County) appears indubitably *C. sagittalis* -- a cultivated plant from the legume introduction gardens at Gainesville. The other specimens seen have been *C. maritima*, or *C. purshii* with the perennial base of that species not yet well developed, or fragmentary and indeterminate. Windler (1974) and Isely (1990), probably correctly, excluded *C. sagittalis* from Florida, and the species appears not to have contributed to the taxonomic complexity of ser. *Alatae* as seen in the state.

Crotalaria purshii is the coastal plain analogue of the more inland *C. sagittalis*. It is very largely a species of the "high pine," the longleaf pine-wiregrass association once so extensive across northern Florida. By and large, this species is readily recognized by its upright habit and glabrous upper leaf surfaces. But occasional intermediates, apparent hybrids, with *C. maritima* ("*C. rotundifolia*") have been reported by Windler (1974).

Crotalaria rotundifolia is a familiar name but a poorly understood taxon. Though mapped by Windler (1974, as his var. *vulgaris*) as extending south to central peninsular Florida (Hillsborough, Highlands, Polk counties), no specimens have been

confirmed south of a line somewhat farther north in the upper peninsula (Hernando, Lake, Volusia counties). In the northern part of its range, especially in that part north of influence by *C. maritima*, *C. rotundifolia* is recognized by its broadly ovate, often almost orbicular, non-succulent leaves, paler beneath, and pubescent above as well as below; and by stem pubescence in which most hairs are spreading and often longer (2-3 mm.) than the diameter of the stem itself (with an underlay of somewhat appressed shorter hairs).

This species was first published by Thomas Walter (1788) as *Anonymous rotundifolia*, an illegitimate combination (Ward, Rhodora 64: 87-92. 1962; J. Bot. Res. Inst. Texas 1: 407-423. 2007). The name *Crotalaria rotundifolia* was later legitimately published by J. F. Gmelin (1792). But Gmelin's basis was Walter's description and, hence, whatever materials Walter had as a type. Walter, however, kept no types (Ward, Taxon 56: 917-926. 2007). A folio herbarium (BM) prepared in 1787 by John Fraser contains a specimen of *Crotalaria*; it was seen by Walter and labeled by him as "*Lupinus affinis*" ("allied to *Lupinus*"). A series of authors (Fernald & Schubert, 1948; Ward, 1962; Windler, 1974) have termed this Fraser specimen Walter's "type" of *C. rotundifolia*. This designation was corrected to "neotype" (Ward, J. Bot. Res. Inst. Texas 1: 410. 2007).

The Fraser specimen, however, has been repeatedly identified (J. Lewis, N. Robson, D. Windler, D. B. Ward) as corresponding to *Crotalaria maritima*. This taxon, though overlapping the range of *C. rotundifolia* (*s. str.*) is essentially unknown north of southeastern Georgia, to which region Fraser is known to have traveled (and where he may have made the collection). Walter would surely have known the frequent *Crotalaria* of eastern South Carolina and could not have encountered *C. maritima*, and did not recognize the Fraser specimen as the species he had described. I.C.B.N., Art. 9.16 has thus been invoked to supersede the Fraser specimen as neotype of *C. rotundifolia*, and to replace it with a different neotype from South Carolina. This issue has been thoroughly reported elsewhere (Ward, J. Bot. Res. Inst. Texas 3: 219-225. 2009).

Crotalaria maritima was encountered and first described by A. W. Chapman (Bot. Gaz. 3: 4. 1878). Chapman at least once traveled by small boat from Apalachicola, his home in the central panhandle, along the western peninsular coast, to Key West, to visit his friend and correspondent, Dr. John Blodgett, physician and botanist of that city. The date of this journey is unknown, but must have preceded Blodgett's death in 1853. It is likely on this trip, although perhaps on even less documented later trips, that he briefly put ashore on the sandy beach of Cape Sable, the southwestern tip of peninsular Florida. He reported his collection as from "Palm Cape," a largely forgotten name for the central point of the cape. Windler (1974) did not trace this collection site; he reported *C. maritima* only as "Type: not located." A replacement type -- a neotype, in this case also a "topotype" -- has been selected from the Middle Cape of Cape Sable, surely a descendant of the population that Chapman knew so long ago (Ward, J. Bot. Res. Inst. Texas 3: 3: 219-225. 2009).

The distribution of *Crotalaria maritima* in Florida remains uncertain. At times *C. maritima* is dismissed as no more than a synonym of *C. rotundifolia* (e.g., Wunderlin & Hansen, 2003) and as such is stated to occur nearly throughout the state. Though both *C. rotundifolia* and *C. maritima* are found in the Florida panhandle, the *C. maritima* component seems uncommon there; Chapman (1878), it would appear, believed the plant on Cape Sable to be something new and different from plants he encountered near his panhandle home. Northward, it extends into southeastern Georgia, but apparently not beyond.

Crotalaria maritima, as it is found in the southern peninsula, below the southernmost well-defined *C. rotundifolia* in the northern peninsula, is most surely separated by stem pubescence that is loosely upwardly appressed, the individual hairs relatively short, appreciably less than the stem diameter; and by the succulence of the fresh leaves, so turgid they often break when folded, uniformly green above and below. In many populations (as Cape Sable) the leaves of all plants are of similar shape, consistently elliptic to ovate; in other areas leaf shape

will vary on the same plant, the uppermost much narrower, even linear. This character leads into the following taxon.

Crotalaria linaria is allied to and sometimes submerged within *C. maritima* (when that taxon is distinguished from *C. rotundifolia*). J. K. Small first encountered it on Big Pine Key, where it is occasional (G. Avery, his notes, 1963-1967). Later authors have stumbled over this taxon, either reducing it to varietal status (Senn, 1939) or addressing it only as a puzzling footnote (Windler, 1974; Isely, 1990). Certainly *C. linaria* is more closely allied to *C. maritima* than to any other taxon. But the plants are usually small, often upright or nearly so, and at least in the typical form have the diagnostic small linear leaves; the flowers, too, are small (relatively to *C. maritima*), and the calyces are frequently quite maroon-tinted. These morphological distinctions, though often faint or even absent, are to some extent supported by what appears to be a strong habitat preference for coastal dune thickets and dry swales, extending north along both coasts. The taxon is quite absent in the northern range of *C. maritima*.

Crotalaria avonensis is the surprising newcomer to the Florida *Crotalaria* flora. Apparently only a single collection was made prior to the 1980s: Ray Garrett, 22 June 1950, "in deep sand NE of Sebring, Highlands Co., Florida" (FLAS). This specimen was recognized as odd, and was described in some detail: "...a single sheet bearing nine plants or fragments of plants of a *Crotalaria* native to Florida and different from any other species. It is obviously a [*rotundifolia*]-*maritima* derivative, but not a close one. It is from 'deep sand NE of Sebring.' It is a perennial, from deeply buried erect rootstock. Leaves closely crowded on exposed portions of stem, rather uniform in shape on a given plant. The broadest are broadly ovate... Inflorescences are quite erect and extend well above the plant. And, most striking of all, the stems, leaves, and back of the calyx are covered with a dense upwardly-appressed pubescence of coarse stiff straight brown hairs, much in excess of that present on the other species. I'm sure it is one of those scrub endemics of which Small found so many but by no means all." -- [letter to Jacqueline Patman (recently of USF), from D.B.W., 1 Aug 1962]. These observations regrettably were then set aside.

In 1986, quite without knowledge of the Garrett collection, Kris R. DeLaney discovered two populations of the same plant near Avon Park, in the extreme northwestern corner of Highlands County. DeLaney & R. P. Wunderlin (*Sida* 13: 315-324. 1989) then very fully described and illustrated the new species; it has since been rated as endangered at both State and Federal levels. DeLaney & Wunderlin contrasted plants of the Avon Park populations with nearby (but allopatric) *Crotalaria maritima* ("*C. rotundifolia*" in their interpretation), and found differences in 14 features. Most striking, and to some extent unsettling, was their description and illustration of the style as "smoothly incurved." The other presumably related taxa of series *Alatae* all have abruptly geniculate styles. This character, elsewhere (Polhill, 1968), is treated as of sectional or even subgeneric importance. That it should appear to arise within a Florida population calls for further investigation.

The five species allied to *Crotalaria rotundifolia* and recognized here to hold that rank are unquestionably difficult to treat taxonomically in that an appreciable number of individuals fall into intermediate status. Yet, by treating these five taxa and the non-Florida *C. sagittalis* as of specific rank, it is believed fewer individuals will be seen as aberrant to their assigned species, and the obvious differences they show will not be obscured in a relatively heterogeneous mélange.

The following amplified key reasonably well represents the salient features of the Florida species of *Crotalaria*.

CROTALARIA L. Rattleboxes¹

1. Leaves trifoliolate.
2. Mature legumes <2 cm. long; longest terminal leaflets <2 cm. long; flowers in short several-flowered terminal or lateral racemes. Perennial herb, to 1 m. Open pinelands, dry woodlands, dune swales. South peninsula; frequent on east coast (Dade, n. to Volusia County), rare on west coast (Monroe, n. to Sarasota). All year.
Crotalaria pumila Ortega
2. Mature legumes 2.5-5.0 cm. long; longest terminal leaflets >2 cm. long (or if shorter, plant long-pubescent).
 3. Leaflets linear to narrowly lanceolate.
 4. Flowers 0.8-1.0 cm. long; legumes 2.5-3.0 cm. long, 0.4-0.6 cm. broad. Annual herb, to 1.2 m. Ditches, dry woodlands. Throughout; frequent (rare in panhandle). Summer-fall.
* ***Crotalaria lanceolata*** E. Mey.
 4. Flowers 1.5-2.0 cm. long; legumes 3.5-5.0 cm. long, 1.5-1.8 cm. broad. Annual herb, to 1.2 m. Roadsides, old fields. Scattered in panhandle (Escambia, Leon, Jefferson counties), south to mid-peninsula (Hardee, Highlands); infrequent. Summer-fall. [*Crotalaria brevidens*, misapplied, *Crotalaria intermedia* Kotschy]
 - * ***Crotalaria ochroleuca*** G. Don

3. Leaflets broadly elliptic to obovate.

1. This paper is a continuation of a series begun in 1977. The "amplified key" format employed here is designed to present in compact form the basic morphological framework of a conventional dichotomous key, as well as data on habitat, range, and frequency. Amplified keys are being prepared for all genera of the Florida vascular flora; the present series is restricted to genera where a new combination is required or a special situation merits extended discussion.

5. Stem, petioles, and legumes loosely covered with long brown pubescence; racemes few-flowered, often overtopped by uppermost leaves. Annual herb, to 1.5 m. Roadsides, sandy fields, beach ridges. South and central peninsula (n. to Hillsborough, Brevard counties); frequent. Spring-summer-fall.

Crotalaria incana L.

5. Stem, petioles, and legumes nearly glabrous; racemes many-flowered, extending well above uppermost leaves.
6. Keel with dark striations; leaflets obtuse to emarginate. Annual herb, to 1.5 m. Roadsides, fencerows, old fields. Throughout; common (rare in peninsula). Summer-fall.
 [*Crotalaria mucronata*, misapplied; *Crotalaria striata*, misapplied] * **Crotalaria pallida** Ait. var. **ovovata** (G. Don) Polhill
6. Keel not striate; leaflets acute to obtuse. Annual herb, to 1.2 m. Disturbed areas. South peninsula (Dade County); rare. Summer-fall. [*Crotalaria trichotoma*, misapplied; *Crotalaria usaramoensis* Bak. f.] * **Crotalaria zanzibarica** Benth.

1. Leaves unifoliolate.
7. Flowers large, ± 2 cm. long, upper petal conspicuously longer than the calyx lobes; larger leaves 6-14 cm. long, obovate with broadly rounded apex.
8. Flowers subtended by minute linear bracts. Erect annual herb, to 0.8 m. Old fields, roadsides. Peninsula; infrequent on lower east coast (Dade to St. Lucie County), rare northward (Polk, Alachua, Leon). Summer-fall. * **Crotalaria retusa** L.
8. Flowers subtended by broad foliaceous bracts. Erect annual herb, to 1.2 m. Old fields, roadsides, disturbed areas. Throughout; common. Summer-fall. [*Crotalaria Retzii* Hitchc.] **YELLOW RATTLEBOX.** * **Crotalaria spectabilis** Roth
7. Perennial; flowers small, ± 1 cm. long, with upper petal scarcely exceeding the calyx lobes; leaves ranging from short (1.5 cm.) and orbicular to long (10 cm.) and lanceolate or linear, the longer leaves always with acute apices.

9. Leaves glabrous above, linear to lanceolate (or lowermost ovate); plants erect. Perennial herb, to 40 cm. Sandy fields, open pinelands. Panhandle and north Florida, south to upper peninsula (Marion, Lake counties); frequent. Spring-summer.
***Crotalaria purshii* DC.**
9. Leaves appressed-strigose above, ovate to elliptic; plants erect to decumbent or prostrate.
10. Leaves uniformly linear (entire plant), ± 2 mm/ wide, 10-15 mm. long; sepals reddish abaxially. Much-branched perennial herb, to 30 cm. Coastal dunes, dry pinelands. South peninsula; keys (Monroe County: Big Pine Key), north along coasts (to Pinellas County on west, Palm Beach County on east); infrequent, rarely adventive inland. Winter-spring. Endemic. [*Crotalaria maritima* Chapm. var. *linaria* (Small) Senn]
***Crotalaria linaria* Small**
10. Leaves elliptic to ovate or orbicular (or if some linear, only uppermost on stem); sepals wholly green.
11. Pubescence of stem spreading or ascending (hair length \pm equal to diameter of stem); plants prostrate to decumbent; leaves broadly ovate to orbicular, relatively thin (not breaking when folded), whitish-green beneath, semimucronate (mucron largely formed of clustered hairs). Perennial herb. Open pinelands. Panhandle and north Florida, south to mid-peninsula (Hernando, Lake, Volusia); common. Spring-summer. [*Crotalaria angulata*, misapplied]
RABBIT-BELLS.
***Crotalaria rotundifolia* Walt. ex Gmel.**
11. Pubescence of stem upwardly appressed (hair length much less than diameter of stem); plants prostrate to erect; leaves thick, succulent (fresh leaves breaking when folded), uniformly green on both surfaces.
12. Stems prostrate from central rootstock; leaves lance-ovate (or a few linear). Perennial herb, branches trailing to 0.6 m. Dry sands. Throughout; common. Winter-spring-summer. Near-endemic. [*Crotalaria rotundifolia*, misapplied]
***Crotalaria maritima* Chapm.**

12. Stems erect from buried horizontal rootstock (buried branches?). Perennial herb, to 12 cm. White sand of sand pine scrub. Central peninsula (Highlands County: Avon Park, Sebring); rare (2 known populations). Spring-summer. Endemic. ENDANGERED (Federal, State listings).

Crotalaria avonensis DeLaney & Wunderlin

Excluded names:

Crotalaria angulata Mill.

This name applied in error to the native *Crotalaria rotundifolia* (Senn, 1939; Wilbur, 1963; etc.). True *C. angulata* is Asian.

Crotalaria grantiana Harvey

Crotalaria virgulata Klotzsch

ssp. *grantiana* (Harvey) Polhill

First grown in Florida in 1928 (Renfrow - FLAS; McKee & Enrow, 1931), but not persisting. Only known non-cultivated spm.: "road to Highlands Hammock State Park," Highlands Co. (Garrett, Oct 1948 - FLAS).

Crotalaria juncea L. Sunn Hemp

Sometimes grown as a cover crop or as green manure (McKee & Enrow, 1931), but does not persist outside of cultivation.

Crotalaria sagittalis L.

Reported for Florida (Small, 1933; Senn, 1939; etc.). But not a coastal plain species (Windler, 1974). Spms. examined have been *C. maritima*, *C. purshii*, or *C. rotundifolia*.

Crotalaria verrucosa L.

Noted in 1974 as naturalized at Subtropical Research Station, Dade Co. (Avery 1490 - FLAS). Not otherwise known outside of cultivation.