The Genus *Crotalaria* (Fabaceae) in Alabama

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ABSTRACT The primary objectives of this project were to determine which species of *Crotalaria* (Fabaceae) occur in Alabama and the county distribution of each species. *Crotalaria*, known commonly as rattlebox, is recognized as consisting of seven species in Alabama. The most common species are *Crotalaria sagittalis*, *C. rotundifolia*, and *C. spectabilis*. The less common species are *C. purshii*, *C. lanceolata*, *C. pallida*, and *C. ochroleuca*. In Alabama, introduced species of *Crotalaria* (*C. lanceolata*, *C. ochroleuca*, *C. pallida*, and *C. spectabilis*) generally have showier inflorescences and reach greater maximum heights than native species (*C. purshii*, *C. rotundifolia*, and *C. sagittalis*). The dichotomous key and descriptions we present are modifications from earlier authors; however, all measurements are based on morphological features of the vegetative and reproductive structures of the more than 460 specimens studied during this project. Data for the county-level distribution maps were compiled entirely from herbarium vouchers.

Key words: Alabama, *Crotalaria*, Fabaceae, floristics, systematics.

INTRODUCTION *Crotalaria* consists of approximately 600 species worldwide (Isely 1990). Twenty species have been reported from the United States, and 16 species have been reported from the southeastern United States (NatureServe 2012). Seven of these species have been reported from the state of Alabama (Kral et al. 2012).

The genus *Crotalaria* is a member of the legume family (Fabaceae, Leguminosae), subfamily Papilionoideae, and tribe Crotalarieae (Polhill 1981). Tribe Crotalarieae is monophyletic (Boatwright et al. 2008) and thought to have evolved from the southern African tribe Liperieae (Goldblatt 1981). Crotalarieae is sister to tribe Genisteae (Kass and Wink 1997). *Crotalaria* is closely related to the genus *Bolusia* (tribe Crotalarieae). Although *Bolusia* was originally suggested to be a local derivative of *Crotalaria* (Polhill 1981, van Wyk 1991), recent work using both morphological observations and nucleotide sequence analyses indicates that the two genera are sister groups (Boatwright et al. 2008).

Several species of *Crotalaria* were introduced with other legumes into the southeastern Coastal Plain of the United States during the 1940s and 1950s for soil improvement, erosion control, and forage. After some of these introduced species of *Crotalaria* were found to be poisonous, their use in agriculture was abandoned. Most of the introduced species are now established, often outnumbering the native species, and are subsequently regarded as weeds (Isely 1990).

Two species of *Crotalaria* that occur in Alabama, native *C. sagittalis* L. and introduced *C. spectabilis* Roth., have been documented as containing the poisonous alkaloids monocrataline and retusamine of the pyrrolizidine group. These alkaloids are concentrated pri-
marily in the seeds of the plant, but are also located in the leaves, stems, and roots; thus, the entire plant is considered poisonous (Gibbons et al. 1990). While cases of poisoning from Crotalaria typically appear in livestock and fowl, some cases have been observed in humans. These cases are usually the result of food contamination (Westbrooks and Preachers 1986).

The primary objectives of this study were to determine which species of Crotalaria occur in Alabama and report the county-level distribution of each. Additional goals included providing a dichotomous key, species descriptions, and illustrations for the taxa of Crotalaria found in Alabama.

MATERIALS AND METHODS Data for the distribution maps were gathered from more than 460 plant specimens deposited in the herbaria of Troy University (TROY), J.D. Freeman (AUA), The University of Alabama (UNA), the University of South Alabama (USAM), Anniston Museum of Natural History (JSU), University of North Alabama (UNAF), and Southern Methodist University (SMU) and Vanderbilt University (VDB), both of which are housed at the Botanical Research Institute of Texas (BRIT) in Fort Worth.

The dichotomous key is a modification of that of Isely (1990) and Weakley (2007); however, all measurements are based on morphological features of the vegetative and reproductive structures of the plants examined during this project. Descriptions for each taxon are based on those of Isely (1990), with modifications incorporating measurements taken from the specimens studied. Illustrations are by the second author. The lists of specimens examined are limited to one record from each county.

Herbarium specimens were initially divided into groups based on overall morphological similarity and the species concept established by Isely (1990). Morphological measurements were then made from selected specimens of each group. Field studies were also conducted to observe the species in their natural habitats and make personal collections.

RESULTS Seven species of Crotalaria occur in Alabama, three native species—C. purshii DC., C. rotundifolia J.F. Gmelin, and C. sagittalis L.—and four introduced species—C. lanceolata E. Meyer, C. ochroleuca G. Don, C. pallida Aiton, and C. spectabilis Roth. The most common species of Crotalaria in the state is C. sagittalis, represented in 40 counties. Crotalaria rotundifolia and C. spectabilis are also relatively common, each represented in 36 counties. Less common species are C. purshii (15 counties), C. lanceolata (7 counties), C. pallida (3 counties), and C. ochroleuca (3 counties).

Taxonomic Treatment of Crotalaria

Herbs. Stems prostrate, ascending or erect, strigose or pilose. Leaves palmately trifoliolate or unifoliolate, petioled or subsessile; leaflets entire, estipulate, broadly ovate to linear; stipules obsolescent or conspicuous, decurrent on stem in some species. Inflorescence usually exserted, leaf-opposed racemes that appear terminal or axillary; bracteoles usually present. Calyx lobes often subequal, longer or shorter than tube; corolla papilionaceous, usually yellow, commonly dark-striate, sometimes partly red- or orange-suffused, keel slenderly porrect-tipped, often exserted and conspicuous; androecium monadelphous; style barbellate. Fruits shortly stipitate, dehiscent, inflated or turgid, ovoid to oblong, commonly black at maturity. Seeds several to numerous.

Key to the Alabama Species of Crotalaria
1. Leaves unifoliolate ........................................ 2
1. Leaves trifoliolate ........................................ 5
2. Corolla 1.7–3.0 cm long; leaflets 4–15 cm long, 1.5–4.0 times longer than wide; stipules obsolescent or 4–7 mm long, not decurrent ....................... 1. C. spectabilis
2. Corolla 0.7–1.4 cm long; leaflets 1–8 cm long, if exceeding 4 cm, 5–15 times longer than wide; stipules obsolescent or conspicuous on upper leaves, decurrent ............... 3
3. Plant annual, erect; stems pilose, the longer hairs 1–2 mm long; upper leaflets 4–8 times longer than wide ............... 2. C. sagittalis
3. Plant perennial, decumbent, sprawling or erect; stems strigose or pilose, the longer hairs less than 1.2 mm long; upper leaflets 1.5–4.0 times longer than wide ............... 4
4. Plant erect or ascending; stems inconspicuously strigose; leaflets glabrous above,

Herbs. Stems erect, to 1.5 m tall, of glabrous appearance, but stems striigulose. Leaves unifoliolate, shortly petioled or subsessile; leaflets obovate to elliptic, 4–15 cm long, 1.5–4.0 times longer than wide; legumes puberulous . . . . . . . . . . 5. C. pallida 6. Corolla 8–10 mm long; legumes strigose . . . . . . . . . . 6. C. lanceolata 6. Corolla 14–20 mm long; legumes 14–16 mm in diameter, apically curved … 6. C. lanceolata oblong, 1–5 cm long, 1.5–4.0 times longer than wide; legumes striigulose below; stipules obolescent or ovate to curved-lanceolate, flap-like, circa 4–7 mm long, semipersistent. Inflorescence racemose, terminal, apically clustered and exserted, or intercalary, 1–5 dm long, bearing usually numerous crowded flowers more than one-half of axis length; bracts 5–8 mm long, persistent. Calyx 10–15 mm long, glabrous; corolla 1.7–3.0 cm long. Fruits 3.0–4.5 cm by 1–2 cm, usually pendent, inflated, ovoid, subterete, glabrous. Seeds numerous.

Native of south Asia, now pantropical; introduced in southern United States. Habitat and distribution in Alabama: ruderal, agricultural, and disturbed sites, road-sides, old fields and margins, waste areas; widely scattered throughout the state, more abundant in southern half (Figure 1b).

Figure 1. a) Illustration of Crotalaria spectabilis; b) distribution of C. spectabilis; c) illustration of C. sagittalis; d) distribution of C. sagittalis.
sessile; lower leaflets elliptic to oblong, 1–5 cm long, approximately 2.5–4.0 times longer than wide, medial and upper leaflets elliptic-oblong to linear-lanceolate, 1–8 cm long, 4–8 times longer than wide, pubescent both surfaces; stipules of lower leaves obsolete, those of upper leaves well developed, tapering-decurrent, and with ascending lobes 0.5–1.5 cm long. Raceme(s) intercalary or shortly exserted, 2–8 cm long, with 2–5 flowers variously distributed along axis. Calyx 10–12 mm long, pilose; corolla 7–14 mm long. Fruits 1.0–2.5 cm long, 5–10 mm wide, usually obliquely pilose; corolla 7–14 mm long. Fruits ellipsoid, inflated, 1.5–3.0 cm long.

Native of southeastern United States.

Habitat and distribution in Alabama: sandy, open, dry or mesic disturbed areas, old fields and road sides; scattered throughout the state (Figure 1d).


3. Crotalaria purshii de Candolle, Prodr. 2: 124. 1825 (Figure 2a).

Crotalaria laevigata Pursh, Fl. Amer. Sept. 369. 1814, non Lamarck 1786.

Crotalaria sagittalis Linnaeus var. linearis Michaux, Fl. Bor.-Amer. 2: 55. 1803.

Crotalaria cuneifolia Rafinesque, New Fl. 2: 55. 1837 (“1836”), nom. illegit. et non (Forsskål) Schrank 1828.

Crotalaria linearis (Michaux) Rafinesque, New Fl. 2: 54. 1837 (“1836”).

Crotalaria longipes Rafinesque, New Fl. 2: 54. 1837 (“1836”).


Herbs. Stems erect or ascending, 1–5 dm tall, inconspicuously strigose. Leaves unifoliolate, shortly petioled or subsessile; leaflets of lower leaves elliptic or spatulate to obovate-oblong, 2–5 cm long, 2.5–4.0 times longer than wide, those of medial leaves usually oblong-lanceolate to linear, 3–10 cm long, 5–15 times longer than wide, glabrous above; stipules of medial and upper leaves conspicuous, tapering, decurrent, with ascending free lobes. Raceme moderately or strongly exserted, 6–15 cm long, loosely 2–5 flowered approximately one-half of axis length. Calyx 9–12 mm long, strigose; corolla 8–12 mm long. Fruits ellipsoid, inflated, 1.5–3.0 cm long.
Figure 2. a) Illustration of Crotalaria purshii; b) distribution of C. purshii; c) illustration of C. rotundifolia; d) distribution of C. rotundifolia.
by 8–10 mm wide, usually obliquely furrowed, glabrous. Seeds several to numerous.

Endemic to southeastern United States.

Habitat and distribution in Alabama: moist pine flatwoods, savannahs, and pocosins; scattered primarily throughout southern tier of the state, some distributed along eastern perimeter (Figure 2b).


4. *Crotalaria rotundifolia* L. J. F. Gmelin, Syst. Nat. 2: 1095. 1792 (Figure 2c).


*Crotalaria ovalis* (Michaux) Pursh, Fl. Amer. Sept. 469. 1814.


*Crotalaria leptoclona* Schauer, Linneea 20: 737. 1847.


*Crotalaria linaria* Small, Man. S.E. Fl. 679, 1505. 1933.

*Crotalaria maritima* Chapman var. *linaria* (Small) H. Senn, Rhodora 41: 347. 1939.


Herbs. Stems prostrate, decumbent, or low-ascending, 1–7 dm long, either pilose with hairs less than 1.2 mm long or strigose with some hairs to 1 mm long. Leaves unifoliolate, sub sessile; leaflets broadly ovate to elliptic-oblong, but ranging to linear, 1–5 cm long, 1.5–4.0 times longer than wide, apices rounded to apiculate, strigose above; when present, stipules evident as narrow, decurrent wings terminated by short, free tips. Raceme(s) long-exserted, 4–20 cm long, loosely 2–5 flowered on upper one-half of axis. Calyx 8–12 mm long, villosulous or strigose; corolla 8–13 mm long. Fruit 7–12 mm long, usually obliquely furrowed, glabrous. Seeds numerous.

Native of southeastern United States.

Habitat and distribution in Alabama: open, usually dry, sandy areas, disturbed woodlands; southern half of the state, some distributed along northwestern perimeter (Figure 2d).

County: M.K. Dooley 177, 18 May 1972 (VDB).
Marengo County: R. Kral 55595, 20 May 1975 (VDB).
Marion County: James Pharr s.n., 8 July 1972 (UNAF).
Mobile County: R. Kral 55645, 21 May 1975 (VDB).
Montgomery County: A.R. Diamond 16789, 12 August 2004 (TROY).
Monroe County: A.R. Diamond 14600, 12 August 2006 (TROY).
Perry County: C. Mohr s.n., 26 April 1884 (UNA).
Pickens County: Sidney McDaniel 7684, 21 August 1966 (VDB).
R. Kral 2001-152, 2 May 2002 (AUA).
Tallapoosa County: Charles R. Claybrook 151, 30 April 1974 (AUA).
Washington County: R. Kral 26506, 8 May 1966 (VDB).

5. Crotalaria pallida Aiton var. obovata (G. Don) Polhill, Kew Bull. 22: 265. 1968 (Figure 3a).
Crotalaria falcata Vahl ex de Candolle, Prodr. 2: 132. 1825.
Herbs. Stems erect, to 2 m tall, strigulose. Leaves trifoliolate, well petioled; leaflets obovate, 2–7 cm long, 1.5–3.5 times longer than wide, strigulose below; stipules minute, semi-persistent. Raceme(s) shortly or well exerted, 1.0–2.5 dm long, flowering usually one-half of axis length; bracts caducous. Calyx 6–8 mm long, strigulose; corolla 14–20 mm long. Fruits oblong-oblancoeleate, often moderately upwardly falcate, turgid, 3–4 cm long by approximately 5–6 mm wide, puberulous. Seeds several to numerous.
Native of Old World tropics, now widely established in both hemispheres; introduced in southern United States.
Habitat and distribution in Alabama: agricultural land, old fields, and borders, disturbed roadsides, and ruderal sites; southern tier of counties in the state (Figure 3b).
Mobile County: Michel G. Lelong 9525, 22 September 1976 (USAM).

Herbs. Stems erect, 0.5–1.5 m tall, strigulose. Leaves trifoliolate, well petioled; leaflets lanceolate to linear or all linear, 4–10 cm long, approximately 3.5–10.0 times longer than wide, strigulose below; stipules obsolete. Raceme(s) exerted, 1.0–3.5 dm long, with numerous contiguous flowers mostly on upper one-half of axis; pedicles strigulose. Calyx 3.0–3.5 mm long, initially strigose, often glabrate at anthesis; corolla 8–10 mm long. Fruits scarcely inflated, narrowly cylindric, apically curved, 2–4 cm long by 4–6 mm wide, strigose. Seeds several to numerous.
Native of Africa; introduced in southeastern United States.
Habitat and distribution in Alabama: disturbed and ruderal sites, roadsides, ditches, old fields; southern half of the state (Figure 3d).
Covington County: John R. MacDonald 12017, 19 September 1998 (TROY).
Geneva County: John R. MacDonald 12353, 24 October 1998 (UNA).
Houston County: John R. MacDonald 12262, 1 September 1981 (VDB).

7. Crotalaria ochroleuca G. Don., Gen. Hist. 2: 138. 1832 (Figure 4a).
Herbs. Stems erect, to 1.5 m tall, strigose. Leaves trifoliolate, well petioled; leaflets linear-lanceolate to linear, 5–15 cm long, 8–20 times longer than wide, strigose below; stipules obsolete. Raceme(s) exerted, 1.5–3.5 dm long, loosely 5–10 flowered above middle or for most of axis length; bracts semipersistent. Calyx 4–6 mm long, glabrous; corolla 14–20 mm long. Fruits oblong, inflated, 3–5 cm long by 14–16 mm wide, strigose. Seeds several to numerous.
Native of Africa; introduced in southeastern United States.
Figure 3. a) Illustration of Crotalaria pallida; b) distribution of C. pallida; c) illustration of C. lanceolata; d) distribution of C. lanceolata.
Habitat and distribution in Alabama: ruderal sites, roadsides, old fields; extreme southern tier of counties in the state (Fig. 4b).


**DISCUSSION** In Alabama, *Crotalaria* is a conspicuous taxon of roadsides, ditches, old fields, and agricultural land. The native species also may be associated with disturbed woodlands.

The seven taxa of *Crotalaria* in this treatment are a combination of native and introduced species. *Crotalaria purshii*, *C. rotundifolia*, and *C. sagittalis* are native species, with *C. purshii* being endemic to the southeastern United States (Isely 1990). *Crotalaria lanceolata*, *C. ochroleuca*, *C. pallida*, and *C. spectabilis* are introduced species.

The introduced species of *Crotalaria* in the state of Alabama are showier and have a greater maximum height range than the native species (1.5–2.0 m versus 0.4–0.7 m, respectively). Two of the introduced species—*Crotalaria lanceolata* and *C. ochroleuca*—are similar in morphology, with trifoliolate leaves and narrow, linear leaflets; however, the difference in corolla length of *C. lanceolata* and *C. ochroleuca* (8–10 mm vs. 14–20 mm, respectively) is useful in separating the two species. *Crotalaria spectabilis* is distinguished from the other Alabama species by its showy raceme, large, unifoliolate leaves, and large, inflated legumes. *Crotalaria pallida* is recognized by its trifoliolate leaves with broad, ovate leaflets and upwardly falcate legumes. In Alabama, *Crotalaria pallida* is represented by *C. pallida* var. obovata.

A combination of morphological traits can be used to differentiate the three native species of *Crotalaria* in Alabama. *Crotalaria sagittalis* is characterized by conspicuous foliolate stipules, abundant pilose pubescence, and erect growth. The stipules of the other two
natives—Crotalaria purshii and C. rotundifolia—are typically smaller and scale-like, but some foliolate stipules may be present; therefore, additional clarification may be necessary. Crotalaria purshii is distinguished from C. sagittalis by its glabrate or strigose pubescence. Crotalaria rotundifolia is easily separated from the other natives by a decumbent, prostrate growth.

Crotalaria incana L. has been reported from ballast grounds in Mobile County, Alabama, based on an 1891 collection (Senn 1939). Another taxon, C. brevidens Benth. var. intermedia (Kotschy) Polhill (= C. intermedia Kotschy), is included by Kral et al. (2011). However, based on the herbarium vouchers studied and field observations conducted during our study, there is no evidence to support the occurrence of C. incana or C. brevidens var. intermedia in Alabama.

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LITERATURE CITED


