

IDENTIFICATION OF MISSOURI SPECIES OF THE TRIBE DESMODIEAE (FABACEAE) USING VEGETATIVE CHARACTERS

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Abstract. The legume tribe Desmodieae in Missouri consists of four genera: *Desmodium* (17 species and one named hybrid), *Hylodesmum* (3 species), *Kummerowia* (2 species), and *Lespedeza* (11 species). The genera and species are distinguished mainly by reproductive features of the mature fruit which are not present during most of the growing season. The two largest genera, *Desmodium* and *Lespedeza*, are considered especially “difficult” groups because species can be difficult to distinguish, even with complete specimens. This paper provides a key to the Missouri species of this tribe based largely on vegetative traits present throughout most of the growing season.

Keywords: Flora of Missouri, Desmodieae, *Desmodium*, *Lespedeza*, *Kummerowia*, *Hylodesmum*, key to vegetative specimens.

The tribe Desmodieae (Benth.) Hutch., as presently recognized, includes 30 genera and approximately 527 species (Ohashi 2005). The number of genera is up from 27 previously recognized by Ohashi et al. (1981) due to the splitting out of several small genera, primarily from *Desmodium* Desv. Four genera traditionally placed in this tribe have been reassigned to other tribes based on molecular evidence (Kajita et al. 2001; Lavin et al. 2001). The more narrowly circumscribed Desmodieae is nested within the tribe Phaseoleae, but the sampling within the Desmodieae has not been extensive enough to determine if this tribe is a monophyletic lineage (Wojciechowski 2003). A synapomorphy that helps to define the tribe on a molecular level is the absence of the chloroplast *rpl2* intron (Bailey et al. 1997).

The tribe Desmodieae has a nearly worldwide distribution but is absent from Europe and western North America. Both the generic and species diversity is greatest in east Asia (Ohashi 2005) but species-rich radiations have occurred in two genera, *Desmodium* and *Lespedeza* Michx., in eastern North America (Isely 1998).

Traditionally, Missouri species of this tribe have been placed in two genera, *Lespedeza* and *Desmo-*

dium (Steyermark 1963), based partly on conspicuous differences in fruit; the former genus with one-seeded loments and the latter with multiseeded loments. In this paper, one segregate genus has been split from each, *Kummerowia* Schindl. from *Lespedeza* and *Hylodesmum* H. Ohashi & R.R. Mill from *Desmodium*.

The two annual species of a broadly defined genus *Lespedeza*, both native to east Asia but widely introduced in North America, may be distinct enough to merit generic recognition under the name *Kummerowia* (Schindler 1912). Traits of *Kummerowia* not shared by *Lespedeza* include an annual habit, prominent secondary veins that diverge from the midrib at right angles and seldom branch, broader stipules, and near absence of petiolules. The highly reduced axillary inflorescences have been variously considered as fundamentally different from *Lespedeza* (Akiyama & Ohba 1985) or rather similar to *Lespedeza cuneata* (Dum. Cours.) G. Don especially (Nemoto & Ohashi 1993). Many authors have recently recognized *Kummerowia* as distinct from *Lespedeza* in phylogenetic treatments (Bailey et al. 1997; Doyle et al. 1995; Endo & Ohashi 1998; Kajita et al. 2001) and regional floras (e.g., Ohwi 1965; Isely 1990,

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1998; Jones et al. 1997; Wunderlin 1998; Rhoades & Block 2000), although there are exceptions (e.g., Magee & Ahles 1999; Turner 2003; Jones 2005). The more narrowly defined genus *Lespedeza* consists of 11 species in Missouri, eight are native and three naturalized members of the flora (Yatskievych & Turner 1990).

Three Missouri species are affected by a recent proposal to split 14 species out of *Desmodium* and place them into the newly described genus, *Hylodesmum* (Ohashi & Mill 2000). These species, *D. glutinosum* (Muhl. ex Willd.) Alph. Wood, *D. nudiflorum* (L.) DC., and *D. pauciflorum* (Nutt.) DC., are distinct from the remainder of the North American *Desmodium* species and previously had been placed in section *Podocarpium* Benth. (Isley 1951) or series *Americana* B.G. Schub. (Schubert 1950a & b). The segregation of *Hylodesmum* renders moot a nomenclatural issue involving *Desmodium glutinosum*. The long-standing question has been if Alphonso Wood (1845) intended to transfer *Hedy-*

sarum glutinosum Muhl. ex Willd. to *Desmodium* based on a direct translation of a description of *Hedysarum glutinosum*, the argument used by Schubert (1942), or if the entity described by Wood should be considered a new species that would then block the later valid transfer by Schindler (1926), as discussed by Isely (1951).

Members of this tribe are widespread and common components of the flora of Missouri. The species in *Lespedeza* and *Desmodium* can present significant identification difficulty (Schubert 1950a & b; Clewell 1966a & b). The species often occur together in nature and interspecific hybridization has been well documented in *Lespedeza* (Clewell 1964, 1966a & b) and to a lesser extent within *Desmodium* (Raveill 1995, 2002). Typically, keys to genera and species rely on reproductive features that are generally not present until mid to late summer. To aid in identification, a key that uses primarily vegetative traits is presented that does not require that genus be initially determined.

METHODS

Specimens were examined from eight herbaria (KANU, MWSJ, MO, NEMO, SMS, UMO, WARM and Powell Botanical Gardens, Kingsville) which included relevant Missouri collections (Raveill 2005). Most measurements were taken from MO or UMO specimens collected in Missouri. However for the rarest species, *D. ochroleucum* M.A. Curtis ex Canby, *D. strictum* (Pursh) DC., and *D. viridiflorum* (L.) DC., measurements were taken from specimens collected outside of the state.

Nomenclature follows Yatskievych & Turner (1990) except for the following: 1) the recognition of *Hylodesmum* as distinct from *Desmodium* (Ohashi

& Mill 2002); 2) the use of the name *Lespedeza violacea* (L.) Pers. as a replacement for *L. intermedia* Britton, and *L. frutescens* (L.) Hornem. for the taxon traditionally called *L. violacea* (Reveal & Barrie 1991); 3) a sporadically occurring hybrid between *D. rotundifolium* (Michx.) DC. and *D. paniculatum* (L.) DC. (or related species) has been formally recognized as *D. x humifusum* (Muhl. ex Willd.) L.C. Beck; 4) the variety, *D. cuspidatum* var *longifolium* (Torr. & A.Gray) B.G. Schub. is mentioned in the key but is not formally recognized; 5) five named hybrids in *Lespedeza* are not included since they are not easily characterized using vegetative features.

RESULTS AND DISCUSSION

A key to the species of the tribe Desmodieae (Fabaceae: Faboideae) using primarily vegetative traits is presented. The construction of the key does not require that species initially be determined to genus, although the genera can be distinguished using vegetative characters. One feature that distinguishes *Lespedeza* and *Kummerowia* from *Hylodesmum* and *Desmodium* is the leaf tip. In the two former genera, the midrib extends beyond the

blade as a distinct, mucronate tip; while in the latter two, the midrib does not extend beyond the blade. Stipels are absent in *Lespedeza*, *Kummerowia*, and *Hylodesmum* (except for *H. nudiflorum* (L.) H. Ohashi & R.R. Mill) but are usually apparent in *Desmodium*.

Two of the genera, *Desmodium* and *Lespedeza*, are traditionally considered to have species that are difficult to distinguish (Isely 1998) and when re-

productive characters are excluded, identification can be even more problematic. Two pairs of species, *Lespedeza frutescens*/ *L. violacea* and *Desmodium nuttallii* (Schindl.) B.G. Schub./ *D. viridiflorum* require reproductive structures to make conclusive identifications. Between several other taxa, no single vegetative trait is definitive and a suite of overlapping characters must be considered. Hybridization may be responsible for the occurrence of a limited number of specimens that blur the distinction between species. Reproductive characters are used selectively in the key, especially when comparing species not normally placed together in keys based on reproductive structures.

Other keys based on sterile material are available for some members of this tribe. An extensive key to vegetative legumes was presented by Fassett (1939) for all the Wisconsin members of the family. Twelve members of the tribe Desmodieae were included, but the nomenclature has become dated. Keys for vegetative *Desmodium* (including *Hylodesmum*) species are available for North Carolina species (Klings 2004) and for species found in the North-central United States (Isely 1955). The former emphasized the pubescence of the lower leaf and included 18 species that are a part of the Missouri flora while the latter included 17 Missouri species.

KEY TO THE MISSOURI SPECIES IN TRIBE DESMODIEAE

1. Introduced shrubs up to 3 m tall, rarely occurring far from plantings with mature individuals..... 2.
- 1'. Native or introduced, annual or perennial herbs generally less than 2 m tall, occurring in groups or as single individuals 3.
2. (1.) Leaflets elliptic to broadly oblong or rarely obovate, 2–3 times longer than broad *Lespedeza thunbergii* (DC.) Nakai
- 2'. Leaflets oval or broadly elliptic, 1.5–2.0 times longer than broad *Lespedeza bicolor* Turcz.
3. (1'.) Annual herbs with a single stem from a taproot; central leaflets nearly sessile or on a stalk up to 1 mm long; secondary veins of leaflets prominent, all nearly the same size and nearly parallel, unbranched or infrequently dichotomously branched near the margins, no smaller veins or reticulation evident..... 4.
- 3'. Perennial herbs, often multiple stemmed from a somewhat woody caudex slightly below ground level; central leaflets generally with a noticeable stalk, those of larger leaves at least 1 mm long; secondary veins of the leaflets similar to small veins except slightly larger, veins diverging from the midrib of different sizes and often branching, reticulation more or less conspicuous 5.
4. (3.) Stems pubescent with upward-pointing hairs; leaves with conspicuous petioles, those of lower and median leaves 4–10 mm long; leaflets pubescent with conspicuous, spreading hairs on the margins and lower midrib *Kummerowia stipulacea* (Maxim.) Makino
- 4'. Stem pubescent with downward-pointing hairs; leaves nearly sessile, the petioles of lower and median leaves 1–2(–4) mm long; leaflets glabrous or pubescent with inconspicuous appressed hairs on the margins and lower midrib..... *Kummerowia striata* (Thunb.) Schindl.
5. (3'.) Plants prostrate, decumbent or weakly ascending..... 6.
- 5'. Plant more or less upright..... 12.
6. (5.) Stipels absent..... 7.
- 6'. Stipels present..... 9.
7. (6.) Stem pubescence conspicuous and primarily spreading..... *Lespedeza procumbens* Michx.
- 7'. Stem pubescence inconspicuous, primarily appressed, or with a few spreading hairs, or nearly glabrous..... 8.

8. (7'.) Plants weakly ascending; small axillary leaves generally present; stipules 3–6 mm long.....
..... *Lespedeza frutescens* (L.) Hornem.
- 8'. Plants decumbent although young stems may initially be upright; small axillary leaves generally absent; stipules 1.5–3 mm long..... *Lespedeza repens* (L.) Barton
9. (6'.) Stipules lance-attenuate to linear-attenuate and not clasping, up to 3 mm wide, semipersistent or deciduous 10.
- 9'. Stipules ovate with short acuminate tip, 3–7 mm wide, semiclasping and persistent..... 11.
10. (9.) Stipules linear-attenuate, base symmetrical, early deciduous, 2–5 mm long and 0.2–0.5 mm wide
..... *Hylodesmum pauciflorum* (Nutt.) H. Ohashi & R.R. Mill
- 10'. Stipules lance-attenuate, base slightly to strongly asymmetrical, semipersistent or deciduous, 4–8 mm long and 0.5–3.0 mm wide..... *Desmodium x humifusum* (Muhl. ex Willd.) L.C. Beck
11. (9'.) Central leaflet ovate; lower surface of leaflets with hooked pubescence and prominent reticulation; rare species with historical distribution in southeast Missouri.....
..... *Desmodium ochroleucum* M.A. Curtis ex Canby
- 11'. Central leaflet orbicular, broadly ovate, broadly obovate, or rhombic; lower surface with only straight hairs and inconspicuous reticulation; widespread species in southeast 2/3 of state.....
..... *Desmodium rotundifolium* (Michx.) DC.
12. (5'.) Stipels absent; stipules less than 0.5 mm wide (slightly wider in *H. glutinosum*) 13.
- 12'. Stipels present; stipules generally more than 0.5 mm wide (sometimes less in *D. ciliare* and *D. marilandicum*) 22.
13. (12.) Leaves mostly in a single cluster at the tip of the vegetative stem 14.
- 13'. Leaves alternate along the length of the stem 15.
14. (13.) Stipules 9–12 mm long and 0.3–0.8 mm wide, semipersistent; central leaflet broadly ovate to nearly orbicular, 6–12 cm long and 6–10 cm wide, tip very long acuminate; lateral leaflets 3–10 cm long and 2–7 cm wide; inflorescence coming from the tip of the cluster of leaves
..... *Hylodesmum glutinosum* (Muhl. ex Willd.) H. Ohashi & R.R. Mill
- 14'. Stipules 2–4 mm long and about 0.1 mm wide, early deciduous; central leaflet rhombic, broadly elliptic, ovate or obovate, 3–8.5 cm long and 2–6 cm wide; tip acute to short acuminate; lateral leaflets 2–6.5 cm long and 1.5–4 cm wide; inflorescence not coming from the same branch as the leaves but from one or more branches at or slightly below ground level.....
..... *Hylodesmum nudiflorum* (L.) H. Ohashi & R.R. Mill
15. (13'.) Petioles 1–6 mm long, stout, 0.75–1.00 mm thick and densely pubescent
..... *Lespedeza capitata* Michx.
- 15'. Petioles of at least the lower leaves 5–20(–70 in *Hylodesmum pauciflorum*) mm long (upper leaves may be nearly sessile), slender to stout, 0.20–0.75 mm thick, nearly glabrous to densely pubescent..... 16.
16. (15'.) Stem pubescence conspicuous and primarily spreading..... 17.
- 16'. Stem pubescence inconspicuous, primarily appressed, or with some spreading hairs, or pubescence nearly absent..... 18.
17. (16.) Leaflets of broad outlines, 1.3–1.8 times longer than broad, elliptic to broadly oblong or oval, rarely broadly ovate or broadly obovate, flowers predominately yellow with purple on the banner petal..... *Lespedeza hirta* (L.) Hornem.
- 17'. Leaflets of narrow outlines, 1.5–3.5 times longer than broad, oblong or elliptic, flowers pinkish-purple..... *Lespedeza stuevei* Nutt.

18. (16'.) Primary leaflets elliptic, ovate, obovate, or broadly oblong, less than three times longer than broad..... 19.
- 18'. Primary leaflets narrowly oblong, narrowly oblanceolate, or linear, more than 3 times longer than broad..... 21.
19. (18.) Leaves of nearly equal size with little if any growth from axillary buds, central leaflets 2–8 cm long, 2–6 cm wide, obovate, rhombic or ovate, tips short to long pointed or rarely with lower leaves somewhat rounded but not mucronate.. *Hylodesmum pauciflorum* (Nutt.) H. Ohashi & R.R. Mill
- 19'. Leaves of two sizes, primary leaves often with smaller leaves from axillary branches, central leaflets of primary leaves 1.2–4.0 cm long, and 0.8–3.0 cm wide, broadly oblong to elliptic or rarely slightly obovate or ovate, tips broadly rounded and distinctly mucronate, sometimes with a terminal notch..... 20.
20. (19'.) Small axillary leaves numerous at most nodes; stems often branching below the middle; persistent calyx of cleistogamous flowers about 1/5 as long the fruit; some flowering branches much longer than the associated leaves *Lespedeza frutescens* (L.) Hornem.
- 20'. Small axillary leaves few in number (absent); stems branching only above the middle; persistent calyx of cleistogamous flowers 1/4–1/3 as long as the fruit; flowering branches shorter than the associated leaves or barely exceeding them..... *Lespedeza violacea* (L.) Pers.
21. (18'.) Leaflet bases cuneate, tips truncate or notched; stems thick, near base 2–5 mm wide, green with conspicuous vertical white ridges extending the length of the stem, pubescence largely confined to the ridges; flowers cream colored with purple on the banner petal, in clusters of 1–4 from most middle and upper leaf axils..... *Lespedeza cuneata* (Dum.Cours.) G.Don
- 21'. Leaflet bases rounded or acute but not gradually tapered, tips obtuse or rounded; stem thin, near base 1.5–3.0(–4.0) mm wide, uniformly reddish-brown below and green above or inconspicuous ridges somewhat lighter, pubescence evenly distributed on stem or only slightly denser on ridges; flowers pinkish-purplish in clusters of 4–10 from most middle and upper leaf axils *Lespedeza virginica* (L.) Britton
22. (12'.) Leaves mostly clustered at the tip of a vegetative stem; inflorescences from one of more separate, usually leafless, shoots originating near or slightly below ground level..... *Hylodesmum nudiflorum* (L.) H. Ohashi & R.R. Mill
- 22'. Leaves scattered along the length of the stem; inflorescences axillary and/or terminal 23.
23. (22'.) Stipules large, 7–20 mm long..... 24.
- 23'. Stipules small, 2–7 mm long (8 mm in *D. laevigatum* where stipules drop about the time the accompanying leaf fully expands)..... 27.
24. (23.) Leaflet tips acuminate; stipels 5–9 mm long; stems and leaves glabrous or nearly so (*D. cuspidatum* var. *longifolium* (Torr. & A. Gray) B.G. Schub. may have acute leaflet tips, shorter stipels and moderately to rarely densely pubescent stems and leaves) *Desmodium cuspidatum* (Muhl. ex Willd.) Willd. ex Loudon
- 24'. Leaflet tips obtuse to acute; stipels 1.5–4.0 mm long or in *D. illinoense* to 6 mm; stems and leaves conspicuously pubescent..... 25.
25. (24'.) Lower leaf surface without hooked hairs or with a few hooked hair confined to the midrib..... *Desmodium canadense* (L.) DC.
- 25'. Lower leaf surface with many hooked hairs on veins of all sizes 26.

26. (25'.) Stipules at maturity appressed or spreading; stem generally unbranched except near the tip; network of raised veins on lower leaf surface conspicuous; white spreading hairs in the rachis absent; largely confined to prairie habitat *Desmodium illinoensis* A. Gray
- 26'. Stipules at maturity reflexed; stems generally with multiple branches; network of raised veins on lower leaf surface inconspicuous; rachis with many long, white, spreading hairs; found in a variety of habitats including disturbed places..... *Desmodium canescens* (L.) DC.
27. (23'.) Lower leaf surfaces velvety-hairy; stipules generally dark reddish-brown at maturity and reflexed (rarely *D. nuttallii* with pale red or brown appressed stipules)28.
- 27'. Lower leaf surfaces glabrous to densely hairy but not velvety to the touch; stipules brown at maturity and appressed or somewhat spreading.....29.
28. (27.) Leaves averaging larger, 4–11 cm long and 3–8 cm wide, deltoid or more rarely ovate or rhombic; fruit composed of 4–5 segments (fewer by abortion), straight or slightly upturned in outline, individual segments angular; know only from extreme southeast Missouri (Stoddard, Dunklin, and Scott counties) *Desmodium viridiflorum* (L.) DC.
- 28'. Leaves averaging smaller, 2.5–9 cm long, 2.5–5.5 cm wide, lanceolate, ovate, rhombic, oblong or rarely deltoid; fruit composed of 2–4 segments, downturned in outline, individual segments rounded in outline; occurring in the southeast 1/3 of the state as far north as Franklin County west to McDonald County [mature fruit necessary to conclusively distinguish this species from the previous]..... *Desmodium nuttallii* (Schindl.) B.G. Schub.
29. (27'.) Central leaflets more than four times longer than broad30.
- 29'. Central leaflets less than four times longer than broad32.
30. (29.) Petioles short, generally less than 3 mm long or occasionally up to 6 mm in lower leaves; stem densely covered with hooked hairs..... *Desmodium sessilifolium* (Torr.) Torr. & A. Gray
- 30'. Petioles of medial leaves 5–50 mm long; stems nearly glabrous to moderately covered with hooked and/or spreading hairs..... 31.
31. (30'.) Central leaflets narrowly linear, 3–8 mm wide, generally folded lengthwise, lower surface with a conspicuous network of raised veins, secondary veins diverging from the midrib perpendicular and arching either toward the tip or the base of the leaflet; fruit 1–2(3)-segmented, each segment rounded below and nearly straight above or slightly indented in the middle of each segment, indentation between segments nearly entirely from below..... *Desmodium strictum* (Pursh) DC.
- 31'. Central leaflets lanceolate, or narrowly oblong, 5–25 mm wide, held flat, lower surface with an inconspicuous network of raised veins, secondary veins diverging from the midrib at an angle less than 90 degrees and directed toward the tip; fruit 4–5-segmented (less by abortion), each segment angular and rhombic in shape with indentation between segments slightly deeper below..... *Desmodium paniculatum* (L.) DC.
32. (29'.) Leaves and stem glabrous or nearly so 33.
- 32'. Leaves and stem more or less hairy 35.
33. (32.) Central leaflets narrow, lanceolate or narrowly oblong..... *Desmodium paniculatum* (L.) DC.
- 33'. Central leaflets broad, ovate to nearly orbicular 34.
34. (33'.) Central leaflets large, 3–8 cm long, and 2.5–5.5 cm wide, prominently glaucous on stems and upper and lower leaf surfaces; stipules 2–3 mm wide and early deciduous *Desmodium laevigatum* (Nutt.) DC.

- 34'. Central leaflets small, 1–4 cm long and 0.7–2.5 cm wide, glaucousness absent or apparent only on the lower leaf surface; stipules less than 1 mm wide and semipersistent.....
.....*Desmodium marilandicum* (L.) DC.
35. (32'.) Medial portion of stem with long, straight spreading hairs and possible shorter hooked hairs.
.....36.
- 35'. Medial portion of stem with primarily short hooked hairs or if straight spreading hairs present then largely confined to the nodes.....38.
36. (35.) Central leaflets small with a rounder outline, 0.5–4 cm long and 0.3–2.5 cm wide, elliptic to somewhat rhombic or rarely ovate, raised network of veins on the lower surface prominent.....
.....*Desmodium ciliare* (Muhl. ex Willd.) DC.
- 36'. Central leaflets large with a narrow outline, 3–8(10) cm long and 1.5–4 cm wide, ovate to elliptic-ovate or rarely lanceolate, raised network of veins on the lower surface evident to inconspicuous.....
.....37.
37. (36'.) Petioles 2–5 cm long and only slightly shorter above; stem often branched below the inflorescence; lower leaf surface pubescence nearly even, only slightly more concentrated on the primary veins; corolla 6–9 mm long; stipe in fruit 3–5 mm long and well exerted from the persistent calyx; fruit segments angular and rhombic with only slightly more indentation below than above
.....*Desmodium perplexum* B.G. Schub.
- 37'. Petioles of leaves in the middle of the stem 1–3 cm long and much reduced above with upper leaves nearly sessile; stem often unbranched below the inflorescence; lower surface of leaves with pubescence much more dense on the primary veins and becoming progressively less dense on the smaller veins; corolla 8–13 mm long; stipe at most 2 mm long and shorter than the persistent calyx; fruit segments nearly straight above and rounded below.....*Desmodium canadense* (L.) DC.
38. (35'.) Central leaflets oblong at ovate-oblong or less commonly elliptic; lower leaf surface with hooked hairs on many of the larger veins, network of raised veins very conspicuous
.....*Desmodium obtusum* (Muhl. ex Willd.) DC.
- 38'. Central leaflets suborbicular, elliptic, rhombic, or ovate; lower leaf surface lacking hooked hairs or if present confined to midrib, network of raised veins inconspicuous or somewhat conspicuous.....39.
39. (38'.) Central leaflets large, 2–10 cm long and 1.5–6 cm wide, rhombic to ovate or lanceolate; stipules generally more than 1 mm wide*Desmodium glabellum* (Michx.) DC.
- 39'. Central leaflets small, 0.5–4.0 cm long and 0.3–2.5 cm wide, suborbicular, elliptic, rhombic or broadly ovate; stipules up to 0.7 mm wide.....40.
40. (39'.) Petioles 1–10 mm long; stem moderately to densely (rarely sparsely) covered with hooked hairs and sometime with spreading hairs.....*Desmodium ciliare* (Muhl. ex Willd.) DC.
- 40'. Petioles 5–30 mm long; stem nearly glabrous to rarely moderately covered with hooked hairs.....
.....*Desmodium marilandicum* (L.) DC.

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