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REVISION OF THE GENUS *ORBEXILUM* (FABACEAE: PSORALEEAE)

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Abstract: *Orbexilum* Raf. is a wholly North American genus confined to the southeastern U.S.A. and Mexico. Grimes provided a revision of the complex in which eight species were recognized. Turner added two additional species, *O. chiapasanum* and *O. oliganthum*, these subsumed under the fabric of *O. melanocarpum* by Grimes. The latter worker also recognized a var. *gracile* of the widespread *O. pedunculatum* that in the present account I treat as a species, ***Orbexilum gracile***. This brings to 11, the number of species currently recognized for the genus. Detailed descriptions and a key to the taxa are provided, along with maps showing their distributions.

Keywords: *Orbexilum*, *Psoralea*, Fabaceae, Mexico, North America.

The present revision is occasioned by my upcoming treatment of *Orbexilum* for the *Flora of North America*. In particular, I wished to show dot-maps, by county, for the species of the U.S.A., this not provided for by current treatments of the *Flora*. In the process, I thought it also reasonable to bring the taxonomy up to date.

As treated by Grimes (1990), *Orbexilum* is a genus of eight closely related species confined to North America, this largely confirmed by DNA data (Egan and Crandall, 2008). Turner (2007) proposed two additional species for the genus, *O. chiapasanum* and *O. oliganthum*, both part of *O. melanocarpum*, sensu Grimes. In the account that follows I have also elevated *O. pedunculatum* var. *gracile* to specific rank, bringing to 11 the number of species recognized for the genus. Since a complete synonymy for all of the taxa is provided by Grimes (1990), I have accounted only for those names pertinent to the present study.

Orbexilum Rafinesque, Atl. Journ. 145. 1832.

PERENNIAL HERBS or sprawling subshrubs to 2 m high. STEMS stiffly erect to ascending, arising from slender lignescent rhizomes or fusiform taproots. STIPULES linear-lanceolate to somewhat foliolate, per-

sistent or soon deciduous. LEAVES unifoliate to palmately or pinnately 3-7 foliolate; leaflets lanceolate to ovate or oval, variously pubescent to glandular-punctate, or glabrous. INFLORESCENCE spicate, bracteate, markedly pedunculate. Flowers short-pedicelate, the petals violet to purple. CALYX tubular-campanulate, the tube 2-3 mm long, the teeth 2-3 times as long as the tube. COROLLAS with well-developed banner, wings and keel, the latter fused apically. STAMENS mostly fused, the dorsal one less so; anthers introrse, in two series, those of the upper series basifixed, those of the lower series dorsifixed. FRUITS elliptic to ovate, dark brown to black, rugose or papillose, glandular to glabrous, deciduous above the receptacle. SEEDS reniform, 3-6 mm long. BASE CHROMOSOME NUMBER: $x = 11$.

Diagnosis of *Orbexilum*. Along with most other North American genera characterized by Grimes (1990), *Orbexilum* is resolved as monophyletic in a combined phylogenetic analysis of nuclear and chloroplast loci of the tribe Psoraleeae (Egan and Crandall, 2008). *Orbexilum* is readily distinguished among the genera of Psoraleeae by its thick glabrous pod walls that are distinctively rugose and by its calyx that is scarcely accrescent,

KEY TO THE SPECIES

1. Leaves unifoliate 11. *O. virgatum*
1. Leaves 3–7 foliolate.
 2. Leaves palmately 5–7 foliolate 3. *O. lupinellus*
 2. Leaves pinnately 3-foliate.
 3. Leaflets cordate at base 4. *O. macrophyllum*
 3. Leaflets not cordate at base.
 4. Plants eglandular throughout; stipules subfoliaceous, 1.0–1.3 mm long ... 10. *O. stipulatum*
 4. Plants to some extent glandular, at least on the upper leaflets; stipules lanceolate to linear, to 1 cm long.
 5. Fruit papillose 7. *O. onobrychis*
 5. Fruit glabrous or glandular, never papillose.
 6. Flowers 5–7 mm long.
 7. Bracts, calyces and fruits eglandular, or nearly so; bracts narrowly ovate, 5–8 mm long, 1.0–2.5 mm wide; Atlantic Coastal Plain 2. *O. gracile*
 7. Bracts, calyces and fruits markedly glandular; bracts broadly ovate, 6–10 mm long, 2–5 mm wide; south-central U.S.A. 8. *O. pedunculatum*
 6. Flowers 8–12 mm long.
 8. Leaflets ovate, widest at or near the middle; south-central U.S.A. ... 9. *O. simplex*
 8. Leaflets ovate, widest well below the middle; Mexico.
 9. Fruits ca 6 mm long; seeds ca 3 mm long; Chiapas, Mexico 1. *O. chiapasanum*
 9. Fruits ca 10 mm long; seeds ca 6 mm long; northern Mexico.
 10. Plants upright, 10–20 cm high; leaflets mostly 2.9 cm long or less; montane habitats 2000–2500 m, s Coahuila, s Nuevo Leon, n Zacatecas 6. *O. oliganthum*
 10. Plants sprawling herbs 30–80 cm high; leaflets mostly 3 cm long or more; submontane habitats, 1000–1900 m; Coahuila, Nuevo Leon, Tamaulipas, Queretaro, and Hidalgo 5. *O. melanocarpum*

1. ORBEXILUM CHIAPASANUM B.L. Turner, *Phytologia* 89: 70. 2007. Fig. 1

PERENNIAL SPRAWLING HERBS or subshrubs to 2 m tall. STEMS erect, upwardly appressed-pubescent, arising from slender rhizomes. LEAVES pinnately trifoliate; petioles mostly 2–4 cm long; leaflets ovate to lanceolate, 3–5 cm long, 1.5–3.0 cm wide. INFLORESCENCE a columnar spike 3–5 cm long; peduncles 6–12 cm long. CALYX 6–7 mm long, glandular-punctate. FLOWERS mostly 7–9 mm long, purple to violet-purple; banner ovate, 4–5 mm long, 3–4 mm wide; wing petals 5–7 mm long; keel petals 4–6 mm long. FRUIT ovoid, ca 6 mm long, 4 mm wide; seeds ca 3.5 mm long, 2.0 mm wide. CHROMOSOME NUMBER: unreported. FLOWERING: Mar–Nov; eastern Chiapas, in mostly pine-oak woodlands of montane rain forests, 1000–1800 m.

Grimes (1900) included this taxon within his concept of *Orbexilum melanocarpum*. As noted by Turner (2007), however,

the two taxa are readily distinguished by habit, fruits, seeds and geography.

2. ***Orbexilum gracile*** (Torr. & A. Gray) B.L. Turner, **stat. nov.** Fig. 2

Based upon *Psoralea melilotoides* Michx. var. *gracilis* Torr. & A. Gray, *Fl. N. Amer.* 1: 303. 1838.

Orbexilum pedunculatum var. *gracile* (Torr. & A. Gray) Grimes

Characters given in the above key, expanded upon by Wilbur (1963), and otherwise very similar to *O. pedunculatum*, as noted in more detail under the latter.

CHROMOSOME NUMBER: unreported.

FLOWERING: May–Jun; Atlantic Coastal Plain from Virginia south to northeastern Florida, mostly along railroads and highways in sandy pine-flats.

Isely (1998, Map 307) shows *Orbexilum pedunculatum* as occurring in eastern Virginia. I recognize such collections as but aberrant forms of *O. gracile*, as presumably did Wilbur (1963).

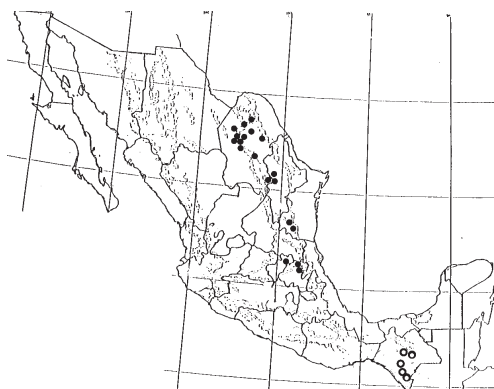


FIG. 1. Distribution of *Orbexilum chiapasnum* (circles) and *O. melanocarpum* (dots).

3. *ORBEXILUM LUPINELLUS* (Michx.) Isely, Sida 11: 432. 1986. Fig. 3

Psoralea lupinellus Michx., Fl. bor.-amer. 2: 58. 1803.

PERENNIAL HERBS to 0.75 m high. STEMS slender, glabrous, arising from elongate slender ligneous tap roots or slender rhizomes. LEAVES mostly palmately 7-foliolate; petioles 1–4 cm long; blades linear, glabrous or nearly so, glandular, 2–7 cm long, 0.5–3.5 mm wide. INFLORESCENCE an elliptic

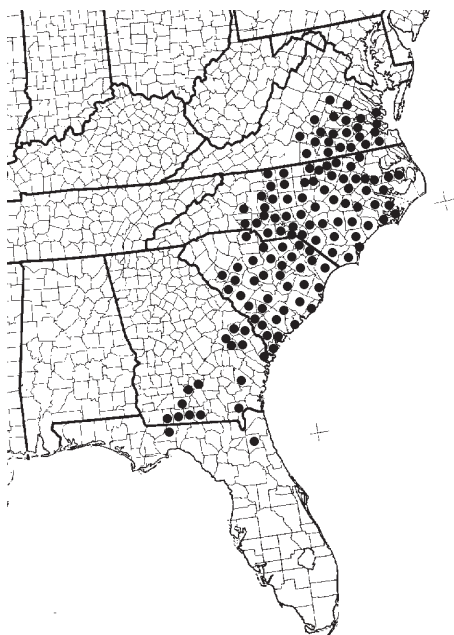


FIG. 2. Distribution of *Orbexilum gracile*.

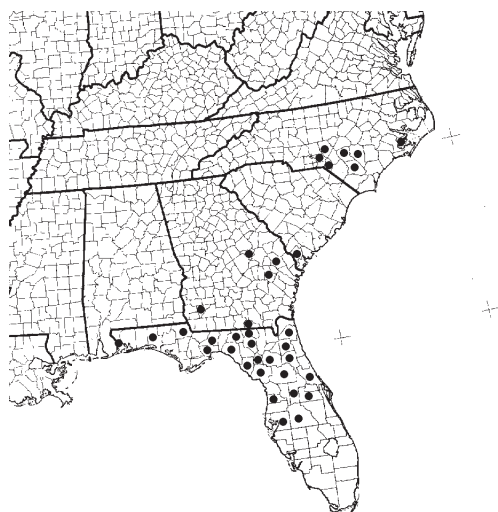


FIG. 3. Distribution of *Orbexilum lupinellus*.

spike 1–6 cm long; peduncles 3–10 cm long. CALYX 2–3 mm long, glabrous to sparingly pubescent, glandular. FLOWERS mostly 5–7 mm long; petals purplish-blue; banner rounded, 4–5 mm long, ca 3.5 mm wide; wing petals 5–6 mm long; keel petals 3.5–4.5 mm long. FRUIT 9–11 mm long, 5–6 mm wide, rugose, glabrous, glandular; seeds reniform, 5–7 mm long.

CHROMOSOME NUMBER: unreported.

FLOWERING: May–Aug; mostly in pine-oak forests in sandy soils, North Carolina to Florida.

Isely (1998) noted that “this feathery-foliaged *Orbexilum*” has been treated as a monotypic genus (*Rhytidome*) by both Rydberg (1928) and Small (1933), but both Isely (1998) and Grimes (1990) included the taxon in *Orbexilum*.

4. *ORBEXILUM MACROPHYLLUM* (Rowlee) Rydb., N. Amer. Fl. 24: 5. 1919. Fig. 4

Psoralea macrophylla Rowlee, in Small, Flora s. e. U. S. 623. 1903.

PERENNIAL HERBS to 1 m (?) tall. STEMS retrorsely pubescent with fine hairs, the roots unknown. LEAVES pinnately trifoliate; petioles 3–9 cm long; blades broadly ovate, cordate at base, 6–7 cm long, 5.2–6.3 mm wide. INFLORESCENCE columnar, 10 cm long or more; peduncles 11–15 cm

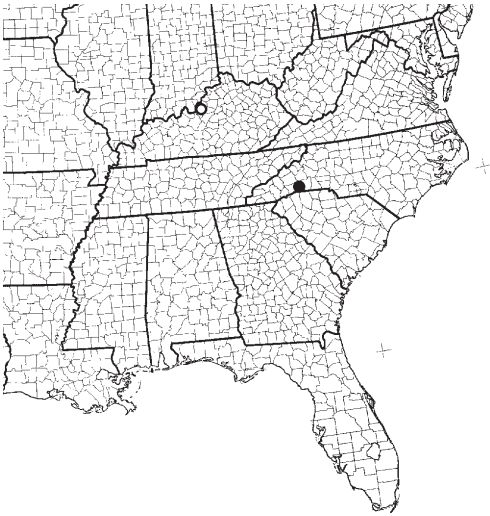


FIG. 4. Distribution of *Orbexilum macrophyllum* (dot) and *O. stipulatum* (circle).

long. CALYX 7–8 mm long, eglandular, villous. FLOWERS ca 9 mm long, color unknown; banner ovate, ca 8 mm long, 7 mm wide; wing petals ca 9 mm long; keel petals ca 7.5 mm long. FRUIT unknown.

CHROMOSOME NUMBER: unreported

FLOWERING: Jun; according to Isely (1990) “This distinctive species was collected in 1897 at ‘White Oaks’ in Polk County, North Carolina, which has been interpreted as Tryon Mountain. It has not been seen again despite repeated searching.” The species is presumably extinct.

5. *ORBEXILUM MELANOCARPUM* (Benth.) Rydb., N. Amer. Fl. 24: 6. 1919. Fig. 1

Psoralea melanocarpa Benth. in Hemsl., Biol. cent-amer., Bot. 1: 234. 1880.

PERENNIAL SPARSELY BRANCHED HERBS 30–80 cm tall. STEMS relatively few arising from slender rhizomes, pubescent with upwardly-appressed hairs. LEAVES pinnately trifoliolate; petioles mostly 3–5 cm long; leaflets ovate, 3–5 cm long, 2–3 cm wide, sparingly appressed-pubescent and glandular-punctate above and below. INFLORESCENCE columnar, mostly 3–6 cm long; peduncles 5–10 cm long. CALYX 7–10 mm long, sparingly pubescent and markedly glandular-punctate. FLOWERS 8–9 mm long;



FIG. 5. Distribution of *Orbexilum oliganthum*.

corollas dark violet to purple; wing petals 7–9 mm long; keel petals 5–7 mm long. FRUITS ovoid, 9–10 mm long, rugose, glandular-punctate, often with a few tubercles; seeds 5–7 mm long, 2–4 mm wide.

CHROMOSOME NUMBER: unreported.

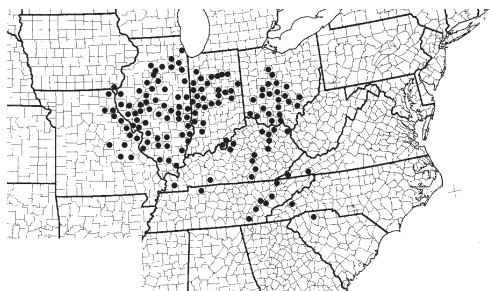
FLOWERING: May–Aug, mostly oak forests below 1000 m, in calcareous soils, Coahuila, Nuevo León, Tamaulipas, Queretero, and Hidalgo.

Grimes (1990) included *Orbexilum oliganthum* and *O. chiapasanum* under the rubric of this species; I consider the two taxa to be worthy of specific rank (Turner, 2007).

6. *ORBEXILUM OLIGANTHUM* (Brandegee) B.L. Turner, Phytologia 89: 71. 2007. Fig. 5

Psoralea oligantha Brandegee, Univ. Calif. Publ. Bot. 4: 179. 1911.

PERENNIAL, OFTEN DECUMBENT, HERBS 10–20 cm tall. STEMS mostly numerous, arising from slender rhizomes, pubescent with upwardly-appressed hairs. LEAVES pinnately trifoliolate; petioles mostly 2–4 cm long; leaflets ovate, 1.5–3.0 cm long, 0.5–1.5 cm wide, sparingly appressed-pubescent and glandular-punctate above and below. INFLORESCENCE more or less capitate or ovoid, mostly 2–3 cm long; peduncles 5–10 cm long. CALYX 5–7 mm long, sparingly pubescent and markedly glandular-punctate. FLOWERS 8–9 mm long; corollas dark violet to purple; wing petals 7–9 mm long; keel petals 5–7 mm long. FRUITS ovoid, 9–

FIG. 6. Distribution of *Orbexilum onobrychis*.

10 mm long, rugose, glandular-punctate, often a few tubercles; seeds 4–5 mm long, 2–3 mm wide.

CHROMOSOME NUMBER: unreported.

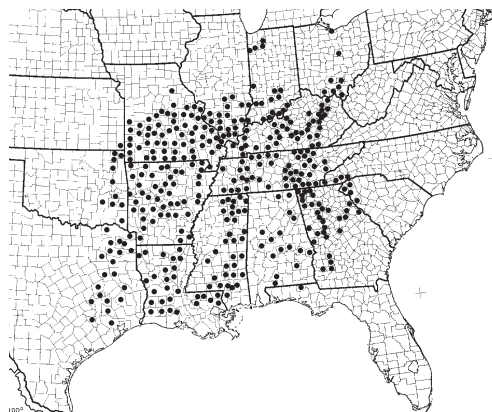
FLOWERING: May–Jun; pine-oak woodlands at higher elevations of the Sierras, mostly 1000–2400 m, calcareous or gypsum soils, s Coahuila, Nuevo León, and ne Zacatecas.

Grimes (1990) included this taxon within his broad concept of *Orbexilum melanocarpum*, as noted by Turner (2007). The type of *O. oliganthum* is from the higher elevations of the Sierra Parras, Coahuila, and appears worthy of specific rank, although Grimes thought the characters that separated the two population-systems too variable to justify such recognition. I find that the two taxa differ consistently in habit, leaf size, and calyx features, the latter commented upon by Grimes.

7. *ORBEXILUM ONOBRYCHIS* (Nutt.) Rydb., N. Amer. Fl. 24: 5. 1919. Fig. 6

Psoralea onobrychis Nutt., Gen. N. Amer. pl. 2: 104. 1818.

PERENNIAL HERBS to 1 m tall. STEMS mostly single and stiffly erect, pubescent at first but soon glabrate, arising from ligneous rhizomes. LEAVES pinnately trifoliate; petioles 2–9 cm long; blades lanceolate to elliptic-lanceolate, 4–12 cm long, 1.5–5.0 cm wide, sparingly pubescent above and below. INFLORESCENCE an elongate spike 3–20 cm long; peduncles 5–15 cm long. CALYX 2–3 mm long, puberulent, 10-veined. FLOWERS 5.0–6.5 mm long; petals violet to purple; banner rounded, 4–5 mm long, 3.0–3.5 mm wide; wing petals 5.5–6.0 mm long; keel petals 4–5 mm long. FRUIT obovate, 8–

FIG. 7. Distribution of *Orbexilum pedunculatum*.

12 mm long, 5.0–5.5 mm wide; seeds reniform, 4–6 mm long.

CHROMOSOME NUMBER: unreported.

FLOWERING: May–Jun; northeastern plains of the U.S.A. from Iowa to Ohio, southwards to Tennessee, mostly along roadsides and in dry open woods and fallow pastures.

8. *ORBEXILUM PEDUNCULATUM* (Mill.) Rydb., N. Amer. Fl. 234: 7. 1919. Fig. 7

Hedysarum pedunculatum Mill., Gard. Dict. *Hedysarum* no. 17. 1768.

PERENNIAL HERBS to 80 cm tall. STEMS 1–8, stiffly erect or ascending, sparingly strigose to glabrate, arising near ground level from ligneous, often tuberous, taproots or slender rhizomes. LEAVES pinnately trifoliate; petioles 0.2–5.0 cm long; leaflets lanceolate to elliptic, 2–7 cm long, 0.6–2.2 cm wide. INFLORESCENCE columnar, 2–13 cm long; peduncles 4–16 cm long. CALYX 4–7 mm long, sparingly pubescent, glabrous or not. FLOWERS 5–7 mm long; petals violet to purple; banner ovate, 5–7 mm long, 4–5 mm wide; wing petals 5.5–6.5 mm long; keel petals 3–4 mm long. FRUIT obovate, 3–5 mm long, 3–4 mm wide, rugose, glabrous or somewhat glandular; seeds round-obovate, 3.0–3.5 mm long, 2.0–2.5 mm wide.

CHROMOSOME NUMBER: $2n = 22$.

FLOWERING: May–Jul; open woods and grasslands throughout most of the eastern U.S.A.

Orbexilum pedunculatum is allopatric with its closest relative, *O. gracile*, but the

two taxa show little evidence of intergradation in regions of near contact (as noted by Isely 1990), hence their recognition as distinct species. This was also commented upon by Grimes (1990), "The varieties are usually easily distinguished; I have seen very few intermediate specimens." He goes on to add, "Along with the glandularity, there are some quantitative differences between the two, differences subject to too much overlap and exception to be diagnostic." Which seems to be the case, the best characters by which to distinguish the two are given in the above key.

Isely (1998) also commented upon the relationship of the two taxa, as follows:

"... the eastern Coastal Plain form [var. *gracile*], is usually glandular on all plant parts, conspicuously so on bracts, and the undersides of leaflets. Var. *pedunculatum*, lacking such glands or nearly so, is widely distributed from Texas and Oklahoma east into the Appalachians." He further noted that "Varietal segregation is not entirely 'air-tight'; there are some intermediacy in the mountains and a few weakly glandular forms may be encountered farther west. But most material is clearly one or the other and it seems worthwhile to retain this now traditional varietal bifurcation despite, perhaps, its rather trivial nature."

Perhaps the most perceptive comments on the relationship of *Orbexilum pedunculatum* to *O. gracile* have been those of Wilbur (1963). He provided an excellent key for their recognition and noted that the two taxa "seem most distinct within North Carolina and also throughout their ranges." Such is also reflected in his distribution maps for the North Carolina species, almost exactly as I have discerned (independently) the taxa concerned.

9. *ORBEXILUM SIMPLEX* (Nutt. ex Torr. & A. Gray) Rydb., N. Amer. Fl. 24: 6. 1919. Fig. 8
Psoralea simplex Nutt. ex Torr. & A. Gray, Fl. N. Amer. 1: 303. 1838.

PERENNIAL HERBS to 75 cm tall. STEMS appressed-pubescent, glabrate with age, only



FIG. 8. Distribution of *Orbexilum simplex*.

1 or rarely 2 arising from fusiform taproots. LEAVES highly variable, either simple, palmately 5–7 foliolate, or more often pinnately trifoliate; petioles mostly 0.5–7.0 cm long; leaflets elliptic to elliptic-lanceolate, 4–8 cm long, 0.6–1.5 cm wide, sparingly pubescent above and below, obscurely to prominently glandular-punctate. INFLORESCENCE columnar, 2–6 cm long; peduncle 3–10 cm long. CALYX sparingly pubescent and glandular, 5–7 mm long. FLOWERS 8–10 mm long; petals purple; wing petals 8–10 mm long; keel petals 7–8 mm long. FRUITS obovate, 4–6 mm long, rugose, glabrous; seeds 3–4 mm long, 2–3 mm wide.

CHROMOSOME NUMBER: unreported.

FLOWERING: May–Jun; south-central U.S.A., Oklahoma and Arkansas, south to e Texas, Louisiana, Mississippi and Alabama in mostly low sandy soils and/or marshy areas.

10. *ORBEXILUM STIPULATUM* (Torr. & A. Gray) Rydb., N. Amer. Fl. 24: 6. 1919. Fig. 4
Psoralea stipulata Torr. & A. Gray, Fl. N. Amer. 1: 688. 1840.

PERENNIAL HERBS to 1 m tall. STEMS striate, sparingly pubescent to glabrate, the roots unknown. LEAVES pinnately trifoliate; petioles 1.0–3.5 cm long; blades elliptic to oblanceolate, glabrate and eglandular above and below. INFLORESCENCE ovoid, 1–2 cm long; peduncles 4–10 cm long. CALYX

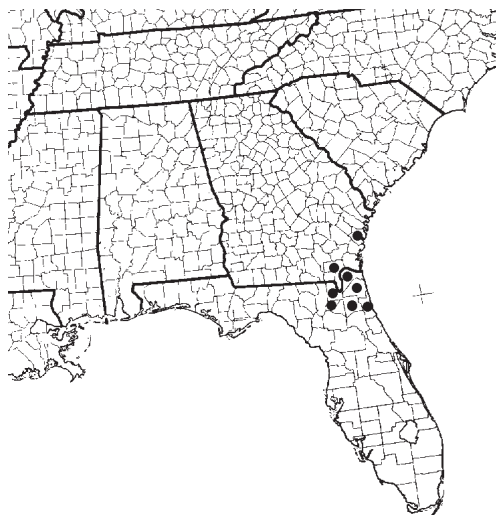


FIG. 9. Distribution of *Orbexilum virgatum*.

sparingly pubescent, 6–8 mm long. FLOWERS 10–11 mm long; petal color unknown; banner elliptic, 10–11 mm long, 5–6 mm wide; wing petals 9–10 mm long; keel petals 8–9 mm long. FRUITS unknown.

CHROMOSOME NUMBER: unreported.

FLOWERING: Jun; occurring in “flood-scoured river bank bedrock, gravel bars, and limestone barrens and glades” (McCormick, 2007).

This species is known only by collections from Rock Island, a locality just below the Falls of the Ohio river where it descends into the state of Kentucky. First collected by C.W. Short in 1841, it was last collected in 1881 and is now presumably extinct (McCormick, 2007). I follow Grimes (1990) in positioning this taxon in the genus *Orbexilum*, although it might belong elsewhere in that the fruit is unknown (Rydberg, 1928).

11. *ORBEXILUM VIRGATUM* (Nutt.) Rydberg, N. Amer. Fl. 24: 6. 1919. Fig. 9

Psoralea virgata Nutt., Gen. N. Amer. 104. 1818.

PERENNIAL HERBS to 0.5 m tall. STEMS slender, appressed-pubescent, arising from well-defined ovoid or globose tubers. LEAVES unifoliate, 0.1–3.5 cm long; petioles 0.1–3.5 cm long; blades elliptic to narrowly lanceolate, mostly 2–9 cm long, 0.3–1.2 cm wide. INFLORESCENCE an ovoid to long-

ellipsoid spike 1–4 cm long; peduncles 2–13 cm long. CALYX 3–5 mm long, appressed-pubescent, glandular, 10-veined. FLOWERS mostly 5–7 mm long; petals purple; banner obtrullate, 5–7 mm long, 4–5 mm wide; wing petals 6–7 mm long; keel petals 6–7 mm long. FRUIT round-obovate, ca. 4 mm long, 4 mm wide, rugose, glabrous, glandular; seeds obovate, ca. 2 mm long.

CHROMOSOME NUMBER: unreported.

FLOWERING: May–Jun; mostly along swamps and highways in flat pine barrens, north-eastern most Florida and closely adjacent Georgia.

ACKNOWLEDGEMENTS

The dot maps are based upon the work of Grimes (1990), Isely (1998), specimens on file at LL, TEX, and from data provided by federal and state sources on the web, at least where they seemed accurately portrayed according to my own studies of the taxa concerned.

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