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Aureolaria (Orobanchaceae)

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X. AUREOLARIA Rafinesque, New Fl. 2: 58. 1837 * Yellow false foxglove [Latin *aureolus*, golden, and *-arius*, possession, alluding to corolla]

Jeffery J. Morawetz

Herbs, annual or perennial; hemiparasitic, caudex knotted. **Stems** erect, not succulent, glabrous, sparsely to densely puberulent, densely villose, or glandular-pubescent. **Leaves** basal and cauline, opposite, leathery; petiole present; blade margins entire to pinnatifid, or 2-pinnatifid. **Inflorescences** terminal, loose racemes; bracts present. **Pedicels** present; bracteoles absent. **Flowers**: sepals 5, calyx radially symmetric, campanulate or turbinate, lobes linear to deltate, sometimes lanceolate; petals 5, corolla yellow, campanulate, abaxial lobes 3, adaxial lobes 2; stamens 4, adnate to corolla, didynamous, (thecae apiculate), filaments glabrous or ciliate, staminode 0; ovary 2-locular, placentation axile; stigma truncate. **Capsules** symmetric, dehiscence loculicidal. **Seeds** 300--500, brown to blackish, ovoid to deltoid, winged or not winged.

Species 8 (7 in the flora): c, e North America, n Mexico.

Molecular phylogenetic analysis supports a close relationship of *Aureolaria* with *Agalinis*, *Esterhazyia* J. C. Mikan, and *Seymeria* (J. R. Bennett and S. Mathews 2006). Further evidence for these relationships is similarities in floral morphology among these genera.

Aureolaria greggii (S. Watson) Pennell is the only species not represented in our flora, occurring broadly throughout northern Mexico.

SELECTED REFERENCES Musselman, L. J. 1969. Observations on the life history of *Aureolaria grandiflora* and *Aureolaria pedicularia* (Scrophulariaceae). Amer. Midl. Naturalist 82: 307--311. Pennell, F. W. 1928. *Agalinis* and allies in North America: I. Proc. Acad. Nat. Sci. Philadelphia 80: 339--449.

1. Calyx lobes crenate or pinnatifid; plants annual.
 2. Leaf margins deeply 2-pinnatifid, sometimes undivided or less deeply divided on basal leaves; calyx tubes campanulate; corolla tubes floccose..... 1. *Aureolaria pectinata*
 2. Leaf margins shallowly pinnatifid to shallowly 2-pinnatifid (first division is deeper than second division when both are present); calyx tubes turbinate; corolla tubes glabrous or sparsely pubescent..... 2. *Aureolaria pedicularia*
1. Calyx lobes entire; plants perennial.
 3. Stems and leaves sparsely to densely brown-pubescent; capsules densely pubescent. 3. *Aureolaria virginica*
 3. Stems and leaves glabrous or white-puberulent; capsules glabrous.
 4. Leaf margins serrate to pinnatifid proximally, becoming entire on distal 1/4--1/2. 4. *Aureolaria patula*
 4. Leaf margins entire to serrate or shallowly to deeply pinnatifid.
 5. Stems and leaves white-puberulent..... 5. *Aureolaria grandiflora*
 5. Stems and leaves glabrous.
 6. Leaf margins usually entire to serrate, rarely proximal leaves pinnatifid 6. *Aureolaria levigata*
 6. Leaf margins usually shallowly to deeply pinnatifid or basal leaves 2-pinnatifid, rarely entire 7. *Aureolaria flava*

1. ***Aureolaria pectinata*** (Nuttall) Pennell, Bull. Torrey Bot. Club 40: 414. 1913 * Comleaf yellow false foxglove E

Gerardia pedicularia Linnaeus var. *pectinata* Nuttall, Gen. N. Amer. Pl. 2: 48. 1818; *G. pectinata* (Nuttall) Bentham

Plants annual. **Stems** branched, 0.3--1.2 m, densely white-villose, glandular-pubescent. **Leaves** lanceolate, (0.5--1)-5 x 0.6--2.6 cm, margins deeply 2-pinnatifid, sometimes undivided or less deeply divided on basal leaves,

glandular-pubescent; petiole 0.1--0.8 cm. **Bracts** leaflike, 1--1.6 x 0.4--1 cm, margins pinnatifid to 2-pinnatifid. **Pedicels** 0.5--2 cm, villose, glandular-pubescent. **Flowers:** calyx villose, glandular-pubescent, tube campanulate, 0.3--0.8 cm, lobes linear, 0.7--1.5 x 0.1--0.3 cm, margins pinnatifid; corolla tube 2.5--4 cm, (gibbous), floccose, lobes 0.7--1.1 x 0.6--1.5 cm, margins glabrous or ciliate; filaments 1.2--1.8 cm, ciliate; style 3--5 cm. **Capsules** pyriform, 1.1--1.5 x 0.5--0.7 cm, hispid. **Seeds** winged.

Flowering Jun--Sep. Sandy soil in oak-pine scrub; 0--700 m; Ala., Ark., Fla., Ga., Ky., La., Miss., Mo., N.C., Okla., S.C., Tenn., Tex., Va.

Although *Aureolaria pectinata* was elevated to the species level by F. W. Pennell, some authors have included *A. pectinata* within *A. pedicularia* (for example, R. P. Wunderlin 1998). Although these two taxa bear a close resemblance, they can be reliably separated and recognized as distinct species. While Pennell (1935) recognized four infraspecific taxa, these were distinguished based upon subtle characters that are difficult to discern on herbarium specimens (for example, upper leaves and bracts smaller but not excessively reduced versus upper leaves and bracts very much reduced). Partly for this reason, no infraspecific taxa are recognized here.

2. *Aureolaria pedicularia* (Linnaeus) Rafinesque ex Pennell, Bull. Torrey Bot. Club 40: 412. 1913 * Fernleaf yellow false foxglove E

Gerardia pedicularia Linnaeus, Sp. Pl. 2: 611. 1753; *Aureolaria pedicularia* var. *ambigens* (Fernald) Farwell; *A. pedicularia* var. *austromontana* Pennell; *A. pedicularia* var. *intercedens* Pennell; *G. pedicularia* var. *ambigens* Fernald; *G. pedicularia* var. *austromontana* (Pennell) Fernald; *G. pedicularia* var. *intercedens* (Pennell) Fernald

Plants annual. **Stems** simple or branched, 0.4--1 m, glabrous or white-pubescent to sparsely glandular-pubescent. **Leaves** lanceolate, 1.2--7 x 0.8--3 cm, margins shallowly pinnatifid (less than 1/2 to midvein) to shallowly 2-pinnatifid (first division is deeper than second division when both are present), white-ciliate along margins, rarely on nerves and lamina; petiole 0.3--0.5 cm. **Bracts** leaflike, 0.9--1.5 x 0.4--0.6 cm, margins pinnatifid to (rarely) 2-pinnatifid. **Pedicels** (0.2--)0.8--1.3 cm, pubescent to glandular-pubescent. **Flowers:** calyx pubescent to glandular-pubescent, tube turbinate, 0.4--0.8 cm, lobes linear or sometimes narrowly lanceolate, 0.4--1.2 x 0.1--0.3 cm, margins crenate to pinnatifid; corolla tube 1.7--3.2 cm, glabrous or sparsely pubescent, lobes 0.8--1.6 x 0.5--1.3 cm, margins glabrous or ciliate; filaments 1.5--2.2 cm, ciliate; style 2.5--2.7 cm. **Capsules** elliptic, 1--1.3 x 0.5--0.6 cm, hispid. **Seeds** not winged. $2n = 28$.

Flowering Jun--Sep. Roadsides, oak woods, pine barrens, clearings in dry, sandy soil; 10--900 m; Ont.; Conn., Del., D.C., Ga., Ill., Ind., Ky., Maine, Md., Mass., Mich., Minn., N.H., N.J., N.Y., N.C., Ohio, Pa., R.I., S.C., Tenn., Vt., Va., W.Va., Wis.

Species of *Aureolaria* typically parasitize oaks (*Quercus* spp.); however, two studies have documented *A. pedicularia* parasitizing non-oak species: *Pinus taeda* Linnaeus and *Vaccinium arboreum* Marshall (L. J. Musselman and H. E. Grelen 1979), and unidentified Ericaceae (C. R. Werth and J. L. Riopel 1979). Further, in a study of seed coat morphology of *Aureolaria* and a selection of related genera, *A. pedicularia* was documented to be the only species in the genus with unwinged seeds (J. M. Canne 1980). F. W. Pennell (1935) recognized five infraspecific taxa within *A. pedicularia* based on subtle characters (for example, stem distally closely pubescent, not or only slightly glandular, and leaves puberulent, scarcely or not glandular, versus stem distally glandular-pubescent to hirsute, and leaves glandular puberulent to pubescent). Additionally, he recognized these infraspecific taxa at both the varietal and subspecific ranks, (at different times), and these both have been variously used by different authors. Partly for these reasons, no infraspecific taxa are recognized here.

3. *Aureolaria virginica* (Linnaeus) Pennell, Bull. Torrey Bot. Club 40: 409. 1913 * Downy yellow false foxglove E F

Rhinanthus virginicus Linnaeus, Sp. Pl. 2: 603. 1753 (as *virginica*); *Aureolaria dispersa* (Small) Pennell; *A. microcarpa* Pennell; *Gerardia virginica* (Linnaeus) Britton, Sterns & Poggenburg

Plants perennial. **Stems** simple or branched, 0.5--1.5 m, sparsely to densely brown-pubescent. **Leaves** lanceolate to oblong, 2.4--14 x 0.8--3.1 cm, margins serrate to pinnatifid, brown-pubescent; petiole 0.2--0.5 cm. **Bracts** leaflike, 1.1--3.2 x 0.3--0.9 cm, margins entire to crenate. **Pedicels** 0.3--0.5 cm, pubescent. **Flowers:** calyx densely pubescent, tube campanulate, 0.5--0.6 cm, lobes deltate, margins entire, 0.4--0.9 x 0.2--0.3 cm; corolla tube 2.5--3.5 cm, glabrous, lobes 0.9--1.4 x 1--1.5 cm, margins glabrous or ciliate; filaments 0.9--1.4 cm, ciliate; style 2.1--3.3 cm. **Capsules** pyriform, 0.8--1.5 x 0.6--0.8 cm, densely pubescent. **Seeds** winged.

Flowering Jun--Sep. Oak and pine woods and slopes; 0--700 m; Ont.; Ala., Conn., Del., D.C., Fla., Ga., Ind., Ky., La., Md., Mass., Mich., Miss., N.H., N.J., N.Y., N.C., Ohio, Pa., R.I., S.C., Tenn., Tex., Vt., Va., W.Va.

This treatment follows G. L. Nesom and L. E. Brown (1998) and R. P. Wunderlin (1998) in including *Aureolaria dispersa* and *A. microcarpa* as synonyms of *A. virginica*; it is impossible to distinguish these taxa from *A. virginica*.

4. *Aureolaria patula* (Chapman) Pennell, Proc. Acad. Nat. Sci. Philadelphia 71: 271. 1920 * Spreading yellow false foxglove E

Dasystoma patulum Chapman, Bot. Gaz. 3: 10. 1878 (as *patula*); *Gerardia patula* (Chapman) Chapman ex A. Gray

Plants perennial. **Stems** branched, 0.5--0.9 m, glabrous. **Leaves** lanceolate, 3--13 x 0.5--8.7 cm, margins serrate to pinnatifid proximally, becoming entire on distal 1/4--1/2 glabrous; petiole 0.3--3 cm. **Bracts** lanceolate, 1.5--3.6 x 0.6--0.7 cm, margins entire. **Pedicels** 1.1--2.3 cm, sparsely villose to puberulent. **Flowers:** calyx glabrous to sparsely pubescent, tube campanulate, 0.3--0.5 cm, lobes lanceolate, margins entire, 0.7--0.9 x 0.1--0.2 cm; corolla tube 1.8--2.7 cm, glabrous, lobes 1.1--1.2 x 1--1.3 cm, margins glabrous or ciliate; filament 1.5--2.8 cm, glabrous or ciliate; style 2.5--3 cm. **Capsules** ovoid to pyriform, 1--1.1 x 0.5--1 cm, glabrous. **Seeds** winged.

Flowering Aug--Oct. Limestone substrates near edges of lakes or rivers; 200--250 m; Ala., Ga., Ky., Tenn.

Aureolaria patula is a poorly known species with the most restricted distribution within the genus. Very little information is available in the literature, and few specimens exist. This species is state-listed as threatened in Tennessee and of special concern in Kentucky.

5. *Aureolaria grandiflora* (Bentham) Pennell, Rhodora 20: 135. 1918 * Large-flower yellow false foxglove E

Gerardia grandiflora Bentham, Compan. Bot. Mag. 1: 206. 1836; *Aureolaria grandiflora* var. *cinerea* Pennell; *A. grandiflora* var. *pulchra* Pennell; *A. grandiflora* var. *serrata* (Bentham) Pennell; *G. grandiflora* var. *cinerea* (Pennell) Cory; *G. grandiflora* var. *pulchra* (Pennell) Fernald

Plants perennial. **Stems** simple to branched, 0.5--1.5 m, white-puberulent. **Leaves** lanceolate, 5--10.5 x 3--4 cm, margins pinnatifid and serrate, rarely serrate and lacking pinnatifid divisions, puberulent; petiole 0.8--1.8 cm. **Bracts** leaflike, 1.5--2.2 x 0.3--0.7 cm, margins serrate to weakly pinnatifid at base. **Pedicels** 0.4--1.1 cm, puberulent. **Flowers:** calyx puberulent, tube campanulate, 0.6--1 cm, lobes linear to lanceolate, 0.3--1.2 x 0.1--0.4 cm, margins entire; corolla tube 3--4 cm, glabrous, lobes 0.7--1.1 x 1--1.6 cm, margins glabrous or ciliate; filaments 1.3--2.7 cm, ciliate; style 2.9--3.5 cm. **Capsules** pyriform, 1--1.6 x 0.8--1.2 cm, glabrous. **Seeds** winged.

Flowering Jul--Oct. Maple, pine, and oak woodlands, roadsides; 0--400 m; Ont.; Ark., Ill., Ind., Iowa, Kans., La., Mo., Okla., Tex., Wis.

J. C. McFeeley and E. P. Roberts (1974) documented *Aureolaria grandiflora*, typically a parasite of oaks, parasitizing *Juniperus virginiana* Linnaeus in addition to oak species. F. W. Pennell (1935) recognized four infraspecific taxa within *A. grandiflora*. These are differentiated based upon subtle characters (for example, bracts serrate versus more cut, leaf blades more versus less pinnatifid). Additionally, he recognized these infraspecific taxa at both the varietal and subspecific ranks (at different times), and these both have been variously used by different authors. For these reasons, no infraspecific taxa are recognized here.

There is a historic record of *Aureolaria grandiflora* from Houston County, Minnesota, collected in 1899.

6. *Aureolaria levigata* (Rafinesque) Rafinesque, New Fl. 2: 59. 1837 * Entire-leaf yellow false foxglove E

Gerardia levigata Rafinesque, Ann. Nat. 1: 13. 1820

Plants perennial. **Stems** simple or branched, 0.4--2.5 m, glabrous [not glaucous]. **Leaves** lanceolate to oblong, 1.5--12.7 x 0.4--3.4 cm, margins usually entire to serrate, rarely proximal leaves pinnatifid, glabrous; petiole 0.2--0.3 cm. **Bracts** leaflike, 0.8--1.5 x 0.2--0.5 cm, margins entire. **Pedicels** 0.1--0.3 cm, glabrous. **Flowers:** calyx glabrous, tube campanulate, 0.5--0.7 cm, lobes lanceolate to narrowly deltate, margins entire, 0.5--0.6 x 0.2--0.3 cm; corolla tube 1.9--3 cm, glabrous, lobes 0.9--1.1 x 1.1--1.6 cm, margins glabrous or ciliate; filaments 1.2--2 cm, ciliate; style 2.1--2.9 cm. **Capsules** ovoid to pyriform, 0.8--1.2 x 0.6--0.7 cm, glabrous. **Seeds** winged.

Flowering Jul--Oct. Rocky wooded slopes, mixed hardwoods; 10--1800 m; Ala., Ga., Ky., Md., Miss., N.C., Ohio, Pa., S.C., Tenn., Va., W.Va.

In addition to occurring in northeastern Mississippi, *Aureolaria levigata* is disjunct in southwestern Mississippi. There is a well-documented affinity between the floras of the Appalachian and Ozark mountains and the loess hills of southwestern Mississippi (H. R. Delcourt and P. A. Delcourt 1975).

7. **Aureolaria flava** (Linnaeus) Farwell, Rep. (Annual) Michigan Acad. Sci. 20: 188. 1919 * Smooth yellow false foxglove E

Gerardia flava Linnaeus, Sp. Pl. 2: 610. 1753; *Aureolaria calycosa* (Mackenzie & Bush) Pennell; *A. flava* var. *macrantha* Pennell; *A. flava* var. *reticulata* (Rafinesque) Pennell; *G. calycosa* (Mackenzie & Bush) Fernald; *G. flava* var. *macrantha* (Pennell) Fernald; *G. flava* var. *reticulata* (Rafinesque) Cory

Plants perennial. **Stems** branched, 0.4--2.2 m, glabrous, (glaucous). **Leaves** lanceolate, 6--16 x 1.2--6 cm, margins usually shallowly to deeply pinnatifid or basal leaves 2-pinnatifid, rarely entire, glabrous; petiole 0.7--2.5 cm. **Bracts** leaflike, 1--4.8 x 0.2--0.5 cm, margins entire to pinnatifid. **Pedicels** 0.7--1.2 cm, glabrous. **Flowers:** calyx glabrous, tube campanulate, 0.4--0.8 cm, lobes linear to narrowly deltate, margins entire, 0.4--0.7 x 0.1--0.2 cm; corolla tube 2.5--3.8 cm, glabrous, lobes 0.5--0.9 x 0.6--1.5 cm, margins glabrous or ciliate; filaments 1.2--2.6 cm, glabrous; style 2.7--3.1 cm. **Capsules** ovoid to pyriform, 1.1--1.3 x 0.9--1.1 cm, glabrous. **Seeds** winged. $2n = 24$.

Flowering Jul--Oct. Oak or oak-pine woods and roadsides; 0--1500 m; Ont.; Ala., Ark., Conn., Del., Fla., Ga., Ill., Ind., Ky., La., Maine, Md., Mass., Mich., Miss., Mo., N.H., N.J., N.Y., N.C., Ohio, Pa., R.I., S.C., Tenn., Tex., Vt., Va., W.Va.

Despite the nuanced variation within this broadly distributed species recognized variously at both the varietal and subspecific levels by F. W. Pennell (1935), R. P. Wunderlin (1998) recognized a broad *Aureolaria flava* with no varietal designations; that concept is followed here.