

FOUR NEW ANNUAL SPECIES OF *EUPHORBIA* SECTION *TITHYMALUS* (EUPHORBIACEAE) FROM NORTH AMERICA

Mark H. Mayfield

Herbarium, Division of Biology
Kansas State University
Manhattan, Kansas 66506-4901, U.S.A.
markherb@ksu.edu

ABSTRACT

Four new annual species of *Euphorbia* section *Tithymalus* (subgenus *Esula*) are described. *Euphorbia austrotexana* is endemic to Texas; *E. georgiana* is endemic to Georgia; *E. nesomii* is from the state of Nuevo Leon in Mexico; and *E. ouachitana* occurs in the states of Arkansas, Missouri, Oklahoma, Tennessee and Texas. In addition, *E. austrotexana* is described with two varieties: *E. austrotexana* var. *carrii* and the nominate *E. austrotexana* var. *austrotexana*. All known collections of these new species post-date the taxonomic treatment of Norton at the turn of the 20th century. The distributions, ecology, and comparative details of these new taxa are described and discussed. Chromosome counts are reported for *E. austrotexana* var. *austrotexana*, *E. longicuris*, *E. peplidion* and *E. roemeriana* and compared with existing reports for species of North American members of section *Tithymalus*. A key including all native North American non-perennial species of section *Tithymalus*, as well as similar, common, non-native congeners is provided.

RESUMEN

Se describen cuatro nuevas especies anuales de *Euphorbia* sección *Tithymalus* (subgénero *Esula*). *Euphorbia austrotexana* es endémica de Texas; *E. georgiana* es endémica de Georgia; *E. nesomii* del estado de Nuevo León en México; y *E. ouachitana* se da en los estados de Arkansas, Missouri, Oklahoma, Tennessee y Texas. Además, *E. austrotexana* se describe con dos variedades: *E. austrotexana* var. *carrii* y la nominada *E. austrotexana* var. *austrotexana*. Todas las colecciones conocidas de estas nuevas especies posdatan el tratamiento taxonómico de Norton a la vuelta del siglo XX. Se describen y discuten las distribuciones, ecología, y detalles comparativos de estos nuevos taxa. Se citan recuentos cromosómicos de *E. austrotexana* var. *austrotexana*, *E. longicuris*, *E. peplidion* y *E. roemeriana* y se comparan con citas existentes de especies de Norte América miembros de la sección *Tithymalus*. Se aporta una clave que incluye todas las especies no perennes nativas de Norte América de la sección *Tithymalus*, así como congéneres similares, comunes, no-nativos.

KEY WORDS: Chromosome numbers, *Euphorbia*, Euphorbiaceae, floristics, seed morphology, taxonomy

INTRODUCTION

North American species of *Euphorbia* L. include members of three of the four major clades discovered and corroborated by numerous recent phylogenetic studies (e.g., Steinmann & Porter 2002; Bruyns et al. 2006; Horn et al. 2012). Among those clades, the one circumscribed as *Euphorbia* subgenus *Esula* Pers. is highly diverse in the Old World (>400 spp.), while in the New World (<50 spp.) it is primarily represented by *Euphorbia* section *Tithymalus* (Gaertn.) Roep. The taxonomic limits of section *Tithymalus* were recently refined by Riina et al. (2013): with the new circumscription this section is unique within subg. *Esula* in that most of its diversity occurs in the New World, with 35–40 species of annual and perennial herbs. All of the members of section *Tithymalus* share a lack of stipules, cyathial glands having either horns from the lateral margins, or having marginal crenae (with or without long horns), seeds with conspicuous caruncles and smooth to variously pitted or reticulate seed surfaces. The most recent complete taxonomic revision for North American species of this group was by Norton (1899), who treated all taxa north of Mexico belonging to section *Tithymalus* (sensu Boissier [1860], with nearly the same constitution as the contemporary subg. *Esula* sensu Riina et al. 2013). Geltman et al. (2011) recently updated the nomenclature including a novel synonymy and lectotypifications for essentially the same set of taxa (i.e., *Euphorbia* subgenus *Esula* sensu Riina et al. 2013) "... as a precursor to the treatment of *Euphorbia* for the Flora of North America." The latter made no taxonomic changes (other than lectotypification) to the suite of short-lived taxa of the revised sect. *Tithymalus* relative to the same species in

Norton's treatment.

The annual North American members of section *Tithymalus* (not including *E. commutata* and *E. crenulata*, which are usually biennials) are much less well known and more restricted in distribution in comparison to the non-annual taxa, and they have been more stable taxonomically. From the time of Norton's (1899) treatment to now, these have included five species within the southern central U.S. states of Arkansas, Kansas, Louisiana, Oklahoma, and Texas. Notably, all five species occur primarily or exclusively in Texas wherein three are endemic and two are chiefly distributed (Correll and Johnston 1970; Turner et al. 2003). These species have strong ecological affinities and clear separations in morphology and geography (Berry et al., *Flora of North American North of Mexico*, submitted). Most conspicuous among these is the relatively robust *E. roemeriana* Scheele, endemic to the shaded canyonlands of the Balcones Escarpment of Central Texas. It is highly branched, bearing conspicuous yellow-green, horizontal subcylindrical bracts ("raylet leaves" in Riina, et al 2013), and having seeds with reticulate ridges. The remaining four species are more sparingly branched from the base, and have raylet leaves that are greenish and are held at an oblique angle or perpendicular to the horizontal (directed away from the axis of the plant). *Euphorbia helleri* Millsp. occurs on clayey soils near the Texas coast from the lower Rio Grande Valley to the Coastal Bend area, and inland to Gonzales and Karnes Counties (reports from Louisiana [e.g., Thomas & Allen 1996] were misidentified). *Euphorbia longicruris* Scheele occurs sparsely across a broad swath of the central Texas Hill Country to the southern half of Oklahoma's prairies on thin soils over limestone and sandstone outcroppings, and in the Ouachita Mountains to Hot Springs, Arkansas, on gladey shale outcrops. *Euphorbia peplidion* Engelm. is most prevalent in the Coastal Bend area, but ranges widely from there north to Travis County, and west to eastern Pecos and Val Verde Counties (the latter not indicated by Turner et al. [2003]). It grows in margins of eastern post oak, in Tamaulipan thornscrub, live oak sandylands, and adjacent to coastal scrublands, where it seems to prefer silty or sandy soils over limestone. Although it has yet to be collected from Mexico, from an ecological perspective, it is one of the more likely of these species to have a natural distribution yet to be discovered there, as speculated by Johnston (1975). Lastly, *E. tetrapora* Engelm. is here considered to be endemic to the western Gulf Coastal Plain from central Louisiana to Wilson County, Texas, and north within the Cross Timbers to southern central and southeastern Oklahoma (I have seen no specimens that can reliably be placed from east of the Mississippi River [e.g., "Boykin, Georgia", Engelmann 1858] and it has never been well-documented from there). It occurs in loose, sandy soils in openings in mixed upland savannah woodlands with post oak (or sand post oak), often with loblolly pine.

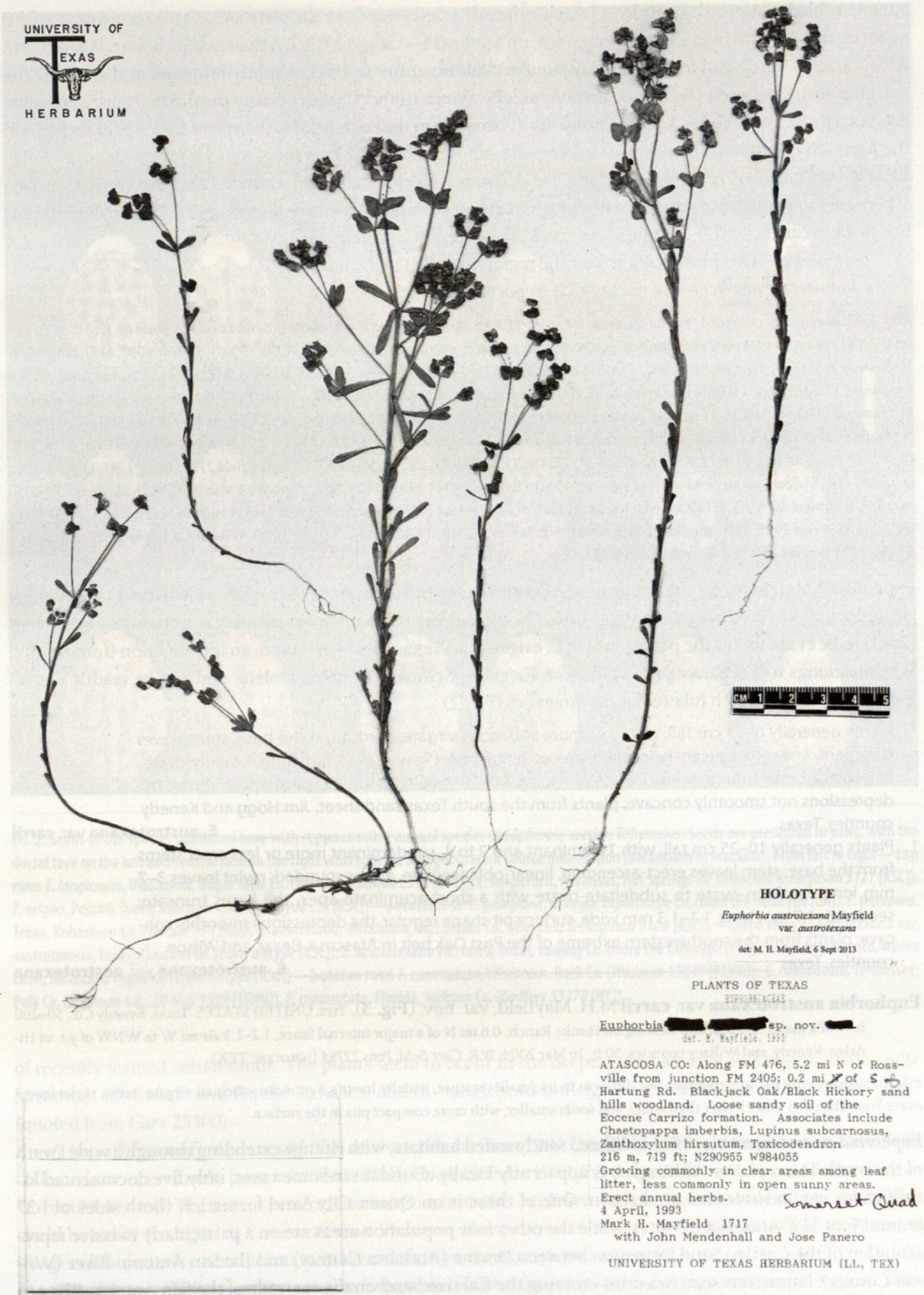
This study presents four previously undescribed annual species and one variety within *Euphorbia* section *Tithymalus* (sensu Riina et al. 2013). Field and herbarium work by the author on New World *Euphorbia*, including access to collections not available to earlier authors, has enabled discernment of this diversity. This work advances understanding of diversity in New World *Euphorbia*, and lays groundwork for broader, phylogenetic study of section *Tithymalus* (Peirson et al., in prep).

NEW SPECIES DESCRIPTIONS

Euphorbia austrotexana M.H. Mayfield, sp. nov. (**Fig. 1**). TYPE. UNITED STATES. TEXAS. Atascosa Co.: along FM 476, 5.2 mi N of Rossville from jct. FM 2405, 0.2 mi S of Hartung Road, [elev.] 719 ft, N29°09'55", W98°40'55", 4 Apr 1993, M.H. Mayfield 1717, with J. Mendenhall & J. Panero (HOLOTYPE: TEX; ISOTYPES: BRIT, DAV, F, GH, KSC, LSU, MICH, MO, NY, PH, RSA, TAES, UC, US).

Similar to *Euphorbia longicruris* Scheele, but differing in the smaller in stature, with narrower, almost linear leaves, and seeds 1.4–1.7 mm long, rotund-ovoid and covered with minute crowded, concave depressions.

Glabrous annual herbs with taproots, 6–25(–28) cm tall, stems erect, 1 to a few stems spreading from the base. Stem leaves alternate, sessile, strongly ascending to divergent (with age) above, blades 5–18 mm long, 0.8–2.5 mm wide at the widest point, narrowly oblanceolate to nearly linear, less often somewhat spatuliform, bases linear to linear-attenuate, apices rounded to obtuse or acute. Ray leaves 3, sessile, 5–33 mm long, 1.5–3.0 mm wide, narrowly oblong to narrowly lanceolate. Primary inflorescence rays 3, usually with 1 to 3 internodes from 1.5–3.5 cm long, upper nodes becoming monochasial, secondary rays 0 to 3 in the upper mainstem leaf axils. Raylet leaves free at the base, 3–8(–13) mm long, length/width ratio 0.7–1.5(–3.0), reniform-ovate to subdeltate-ovate, rarely broadly lanceolate, bases obliquely truncate to rounded, apices broadly acuminate to



HOLOTYPE

Euphorbia austrotexana Mayfield
var. *austrotexana*

det. M. H. Mayfield, 6 Sept 2013

PLANTS OF TEXAS
EUPHORBACEAE

Euphorbia [redacted] sp. nov. [redacted]
det. M. Mayfield, 1993

ATASCOSA CO: Along FM 476, 5.2 mi N of Ros-
ville from junction FM 2405; 0.2 mi ~~X~~ of S of
Hartung Rd. Blackjack Oak/Black Hickory sand
hills woodland. Loose sandy soil of the
Eocene Carrizo formation. Associates include
Chaetopappa imberbis, *Lupinus subcarnosus*,
Zanthoxylum hirsutum, *Toxicodendron*
216 m, 719 ft; N290955 W984055
Growing commonly in clear areas among leaf
litter, less commonly in open sunny areas.
Erect annual herbs.
4 April, 1993
Mark H. Mayfield 1717
with John Mendenhall and Jose Panero

Somerset Quad

UNIVERSITY OF TEXAS HERBARIUM (L.L., TEX)

FIG. 1. The holotype of *Euphorbia austrotexana*: Mayfield 1717 (TEX).

attenuate, blades oriented vertically, adaxial surface directed away from the plant axis. Cyathia: involucre funnelform, 0.8–1.0 mm high, 0.6–0.7 mm wide, on a stalk 0.1–0.2 mm long; cyathial glands lunate, 0.3–0.4 mm wide, horns 0.5–0.7 mm long, relatively stout and blunt, entire to rarely slightly bifurcate at the apices, the margins entire between the horns, involucre lobe apices rounded, short-ciliate on the margins; staminate flowers 5 to 10. Pistil: styles 3, ca. 0.3 mm long, free nearly to the base, bifid at the apices for $\frac{1}{3}$ – $\frac{2}{3}$ of the length, the lobes divergent and spreading away, capitate. Capsules 2.0–2.2 mm long, 3.0–3.2 mm wide, columellas 1.8–2.0 mm long. Seeds 1.4–1.7 mm long, 1.0–1.3 mm wide, rotund-ovoid, rounded in cross-section, surface ashen-gray to whitish at maturity, with deep, irregular to rounded, concave depressions crowded over the entire surface; caruncles 0.7–0.8 mm wide, reniform-ovate, stipe present.

Etymology.—This plant is named for the region in which it occurs.

Chromosome number.— $n = \text{ca. } 12\text{--}13 \text{ II}$ (reported here, below).

Additional specimens examined (var. *austrotexana*): **U.S.A. TEXAS. Atascosa Co.:** E side of northbound exit 113 ramp on IH-37, ca. 3.5 air mi ESE of Leming and 1.2 mi E of Gallinas Creek, 460 ft, [corrected coordinates: N 29°02'59" W 98°25'52"], 22 Mar 1992, M.H. Mayfield & M. Phaneuf 1170 (KSC, LSU, MICH, TEX), also 20 Mar 2010, M.H. Mayfield et al. 3843 (KSC, LSU, MICH, TEX); Exit 113 on southbound Interstate 37, E of onramp, S of Brite Cemetery Road, 460 ft, [corrected coordinates: N 29°03'06" W 98°25'59"], 29 Mar 1992, M.H. Mayfield & M. Phaneuf 1173 (LSU, MICH, TEX), also 26 Mar 1995, M.H. Mayfield & C.J. Ferguson 2160 (LSU, TEX). **Bexar Co.:** W side of IH-37, ca. 500 ft N of mile marker 124, 1.3 roadmiles N of overpass at Priest Road-Mathis Road exit, 29°12'00"N, 98°25'12"W, 560–570 ft, 20 Mar 1993, W.R. Carr & M. Mayfield 12504 (BRIT, KSC, LSU, MICH, TENN, TEX, UARK), also 13 Mar 1995 M.H. Mayfield 2128 (BRIT, LSU, TEX, UARK); U.S. Hwy 281, S of San Antonio, 4.1 mi N of jct. with 536 (in Espey), 650 ft, 29°09'59"N, 98°28'56"W, 13 Mar 1994, M.H. Mayfield, C. Ferguson, & A.L. Hempel 1874 (LSU, TEX); 0.6–0.7 road mi ENE of I-37 [at exit 122] on E side of Priest Road, S end of county, 620 ft, 29°11'15"N, 98°24'53"W, 4 Apr 1993, M.H. Mayfield, J. Mendenhall & J. Panero 1720 (BRIT, KSC, LSU, MICH, TEX). **Wilson Co.:** Gene Dodgen property, E side of FM [road] 1303. W.R. Carr et al. 13345 (TEX).

Populations of this species occurring on the South Texas sand sheet are recognizable as a distinct variety, with the following key to distinguish them from the typical variety. Some of these plants were taken by Turner (2011) to be evidence for the persistence of *E. exigua* L. in Texas; the latter taxon, an introduction from the Old World, belongs to a separate section, *E. sect. Exiguae* (Geltman) Riina & Molero, and can be readily distinguished by its seeds with tubercular prominences (Fig. 2).

1. Plants generally 6–13 cm tall, with 3 or more subequal, virgate stems from the base; stem leaves divergent, linear to scarcely lanceolate, apices acute; raylet leaves 8–15 mm long, broadly ovate-lanceolate, bases rotund; seeds 1.4–1.5 mm long, 1.0–1.1 mm wide, surface pit shape irregular, the depressions not smoothly concave; plants from the south Texas sand sheet, Jim Hogg and Kenedy counties, Texas ***E. austrotexana* var. *carrii***
1. Plants generally 10–25 cm tall, with 1 dominant and 2 to 4, subdominant more or less erect stems from the base; stem leaves erect-ascending, linear-oblong-lanceolate, apices rounded; raylet leaves 3–7 mm long, reniform-ovate to subdeltate-ovate with a short-acuminate apex, the bases truncate; seeds 1.6–1.7 mm long, 1.1–1.3 mm wide, surface pit shape regular, the depressions smoothly concave; plants from the southwestern extreme of the Post Oak belt in Atascosa, Bexar, and Wilson counties, Texas ***E. austrotexana* var. *austrotexana***

Euphorbia austrotexana* var. *carrii M.H. Mayfield, var. nov. (**Fig. 3**). TYPE: UNITED STATES. TEXAS. Kenedy Co.: 50–200 ft W of a major N-S pipeline clearing on Hunke Ranch, 0.6 mi N of a major internal fence, 1.2–1.3 air mi W to WNW of jct. of Hidalgo, Kenedy, and Willacy counties, 50 ft, 16 Mar 2004, W.R. Carr & M. Pons 22784 (HOLOTYPE: TEX).

Like *E. austrotexana* var. *austrotexana* but different in its smaller stature, usually having 3 or more subequal virgate stems, raylet leaves ovate-lanceolate (1.5 times longer than wide), and seeds smaller, with more compact pits in the surface.

Euphorbia austrotexana occurs in stabilized sandy soiled habitats, with a range extending through a wide swath of the south Texas plains. Although it is apparently locally abundant in some cases, only five documented localities for var. *austrotexana* are known. One of these is on Queen City Sand formation (both sides of I-37 around Exit 113, Atascosa County), while the other four population areas are on a particularly massive representation of the Carrizo Sand formation between Devine (Atascosa County) and the San Antonio River (Wilson County). Numerous searches criss-crossing the Carrizo Sand on the east side of the San Antonio River in suitable post oak/blackjack sandy savannah only yielded *E. tetrapora* in the southwestern-most part of its distribution. The populations of *E. austrotexana* var. *carrii* are scattered across the south Texas Sand Sheet, an area



FIG. 2. Seeds of the species published here with representative annual species of *Euphorbia* section *Tithymalus*. Seeds are presented in pairs, with the dorsal face on the left and ventral face on the right with voucher and geographic source information (herbarium in brackets). From left to right—**top row:** *E. longicuris*, Oklahoma, Roger Mills Co. (Taylor & Ballman 2572 [OKL]); *E. longicuris*, Arkansas, Hot Springs Co. (Mayfield & Ferguson 3127 [KSC]); *E. exigua*, Poland, Tunel, Miechów County (Wayda s.n. [KSC])—**second row:** *E. georgiana*, Georgia, Oglethorpe Co. (from the holotype [GA]); *E. tetrapora*, Texas, Robertson Co. (Hardin 536 [US]); *E. ouachitana*, Oklahoma, McCurtain Co. (Mayfield & Ferguson 3108 [KSC])—**third row:** *E. austrotexana* var. *austrotexana*, Texas, Atascosa Co. (from isotype [KSC]); *E. austrotexana* var. *carrii*, Texas, Kenedy Co. (from the holotype [TEX]). *E. nesomii*, Mexico, Nuevo Leon, Municipio Higuera (from isotype [KSC])—**bottom row:** *E. commutata*, Wisconsin, Rock Co. (Wadman 15639 [PENN]), *E. commutata*, Tennessee, Polk Co. (Sherman s.n., 20 May 1959 [TENN]), *E. commutata*, Florida, Jackson Co. (Godfrey 53170 [NY]).

of recently formed eolian sands. The plants seem to occur in the deepest sand areas of this region in Mesquite Savannah (El Canelo and Hunke Ranches) and in “tanglehead-buffelgrass grassland on reddish sandy loam” (quoted from Carr 25500).

The earliest confirmed record of *E. austrotexana* is from 1992 (Mayfield 1170), although it may have been collected once previously from near Flour Bluff, Texas (28 Mar 1959, F.B. Jones 2925 [WWR, held at the Corpus Christi Museum]). The latter specimen includes a plant of *E. peplidion* and three plants of another species that could be either *E. exigua* or *E. austrotexana*. However, the specimen could not be obtained on loan, and digital images obtained were insufficient to make a definitive determination.

Etymology.—This taxon is named to honor one of the most active botanists in Texas’ recent history: William R. Carr. His thoughts and tremendous collecting efforts with respect to this and many other projects have greatly advanced the field of floristics and conservation in Texas.

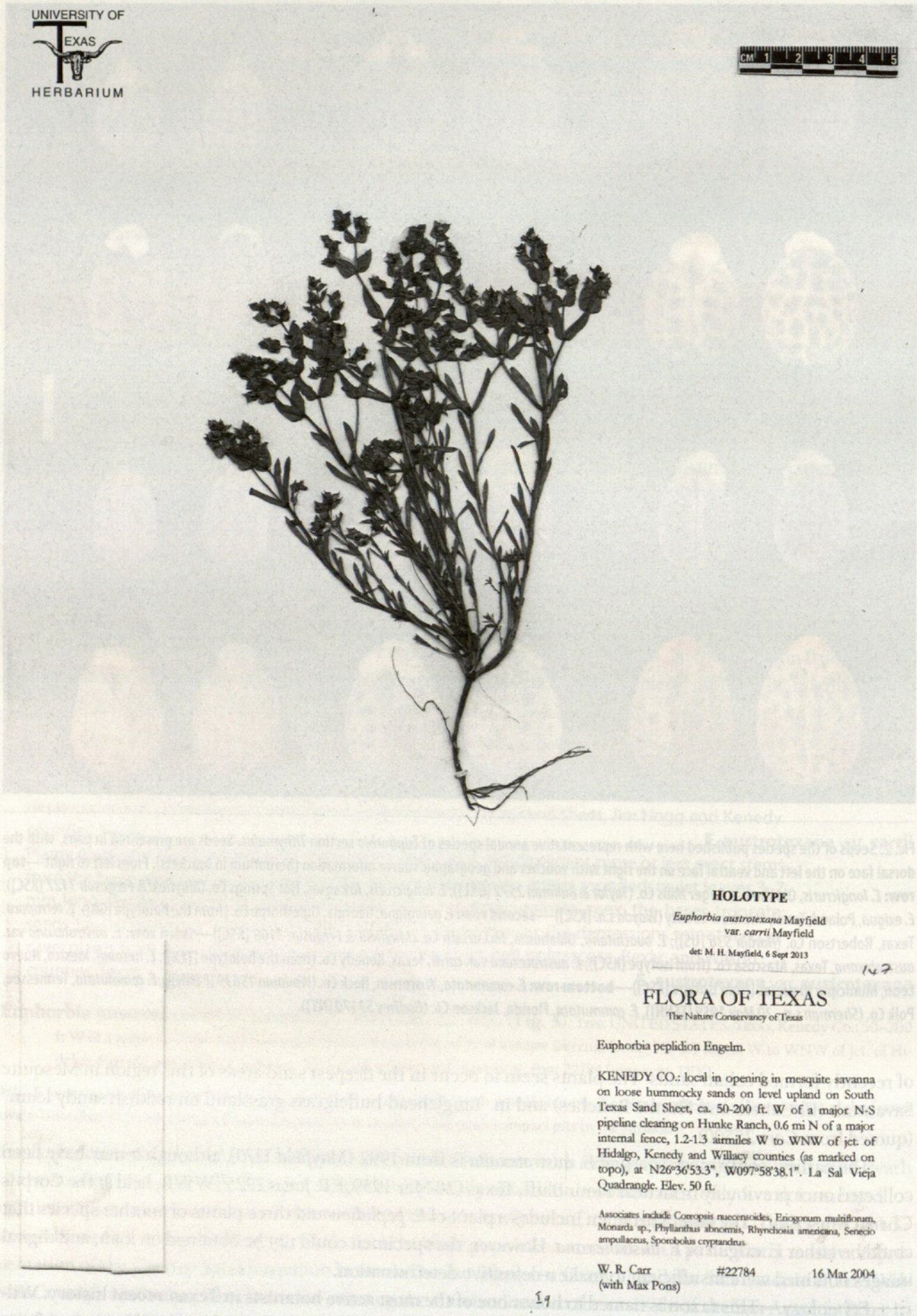


FIG. 3. The holotype of *E. austrotexana* var. *carrii*: Carr & Pons 22784 (TEX).

Additional specimens examined (var. *carrii*): **U.S.A. TEXAS. Jim Hogg Co.:** ca. 0.9 air mi S of Balderas Windmill, 1.2 mi N to NNW of El Nuevo Windmill, Eshelman-Vogt Ranch, SE of Hebbronville, at N27°16'12.6", W98°36'38.5", elev. 480–490 ft, 13 Mar 2007, W.R. Carr *et al.* 25500 (TEX 00167463). **Kenedy Co.:** El Canelo Ranch, N side of E-W stretch of road leading to 'Broken Windmill,' ca. 0.3 mi W of that windmill and ca. 0.5 mi NNE to NE of HQ compound, elev. 35–45 ft, 26°40.038'N 97°49.703'W, 7 Mar 2002, W.R. Carr 20435 (TEX); ca. 0.1 mi W to WNW of the Broken Windmill, ca. 0.8 NE of HQ compound, 26°40.086'N 97°49.316'W, 8 Mar 2002, W.R. Carr 20440 (TEX); 0.6 mi NE (51°) of El Canelo Ranch building complex, N 26.66879° W97.82212°, 20 Mar 2010, Mayfield *et al.* 3839 (KSC); medium [sic] of hwy 77, 6 mi S of hwy 628 and N of Sarita, 15 Mar 1993, L.E. Brown 16768 (SBSC).

Euphorbia georgiana M.H. Mayfield, sp. nov. (**Fig. 4**). TYPE: UNITED STATES. GEORGIA. Oglethorpe Co.: shallow soil, newly exposed area, Echols Mill granitic outcrop, 9.3 mi N, 45° east of Lexington, Piedmont Province, 13 May 1965, D. Blake and F. Montgomery 136 (HOLOTYPE: GA).

Similar to *E. austrotexana* M.H. Mayfield but with seeds that are larger and much more deeply pitted, and leaves that are oblanceolate; also similar to *E. commutata* Engelm., but the plants are smaller and have seed pits that are more crowded and confluent, and much deeper.

Glabrous annual herbs with taproots, 10–18 cm tall, stems erect, 1 to 3 from the base. Stem leaves alternate, sessile, ascending, blades 5–12 mm long, 3–5 mm wide at the widest point, oblanceolate to broadly oblanceolate, bases attenuate, apices rounded. Ray leaves 3, sessile, 9–11 mm long, 5–7 mm wide, rotund-obovate. Primary inflorescence rays 3, usually with 3 or 4 internodes from 1.5–2.5 cm long, upper nodes mostly dichasial, secondary rays 0 or 1 in the upper mainstem leaf axils. Raylet leaves free at the base, 3–6 mm long, length/width ratio 0.5–0.7, broadly deltate to subreniform, the bases truncate to emarginate, apices rounded to bluntly acuminate, blades oriented vertically, adaxial surface directed away from the plant axis. Cyathia: involucre funnellform, 1.0–1.1 mm high, 0.4–0.5 mm wide, on a stalk 0.3–0.5 mm long; cyathial glands lunate, 0.3–0.4 mm wide, horns 0.3–0.5 mm long, attenuate-filiform, the margins entire between the horns, involucre lobe apices attenuate, ciliate on the margins; staminate flowers 5 to 10. Pistil: styles 3, ca. 0.5 mm long, free to the base, bifid at the apices $\frac{1}{3}$ – $\frac{1}{2}$ of the length, the lobes ascending, capitate. Capsules 2.2–2.4 mm long, 3.2–3.4 mm wide, columellas 2.0–2.1 mm. Seeds 1.6–1.7 mm long, 1.4–1.6 mm wide, ovoid, rounded in cross-section, surface grayish on the ridges, nearly black within the pits, lustrous at maturity, with deep, variably sized, rounded, concave pits crowded and irregularly disposed over the entire surface; caruncles 0.6–0.7 mm wide, reniform-ovate, stipe concealed.

Euphorbia georgiana is apparently restricted to granitic outcrops and is probably endemic to the region of Georgia where these occur, but more focused study in the field is needed to adequately determine its distribution. The diminutive annual habit is quite distinct from the more robust biennial plants of *E. commutata*, the only species of the same section occurring in the area. These two species are also expected to be well-separated ecologically, as *E. commutata* grows in areas with basic soils derived from limestone. *Euphorbia georgiana* is generally most similar to *E. austrotexana* and *E. longicuris*, which also share its affinity for open glade areas.

Etymology.—This species is named for the state of Georgia, in which it is endemic.

Additional specimen examined: **U.S.A. GEORGIA. Wilkes Co.:** N of Danburg, Porphyritic granite flatrock at end of dirt road trending NW from GA hwy 44, about 1.6 mi S of the Lincoln Co. line, 29 Apr 1980, J.R. Allison 1410 (GA).

Euphorbia nesomii M.H. Mayfield, sp. nov. (**Fig. 5**). TYPE: MEXICO. NUEVO LEON. Municipio Higuera: Cuesta Mamulique, along old unused road through pass (N of the summit), N facing slope above road to 1 km W of Hwy. [85], with *Fraxinus greggii*, *Acacia*, *Yucca*, *Ungnadia speciosa*, dark soil in talus slopes at the base of the bluff, 26°12'10"N, 100°06'25"W (WGS84), elev. 600 m, common annuals along base of bluff, mostly ca. 5–8 cm tall, M.H. Mayfield 1905, with C.J. Ferguson and A.L. Hempel (HOLOTYPE: MEXU; ISOTYPES: ANSM, LSU, KSC, MICH, TEX).

Similar to *E. roemeriana* in having petiolate leaves and a multibranched spreading habit, but differing in having stem leaf blades that are rhombic-ovate to elliptic, raylet leaves being free to the base and subdeltate, and cyathial glands that are smaller and with longer horns.

Glabrous annual herbs with taproots, 8–18 cm tall, stems laxly ascending, basally decumbent, several from the base. Stem leaves alternate, petiolate, spreading, horizontal, petioles 3–6 mm long, blades 5–15 mm long, 3–7 mm wide at the widest point, blades subrhombic to rhombic-obovate, bases cuneate, apices obtuse to rounded. Ray leaves 3, sessile, 5–19 mm long, 4–7 mm wide, broadly elliptic to broadly oblanceolate. Primary inflorescence rays 3, usually with 2 to 4 internodes from 1.5–3.5 cm long, upper nodes mostly dichasial, secondary rays 0 to 2 in the upper mainstem leaf axils. Raylet leaves free at the base, 4–7 mm long, length/width ratio

Specimen examined for
Georgia Flora & Atlas Project



HOLOTYPE

Euphorbia georgiana Mayfield

det: M. H. Mayfield, 6 Sept 2013

Herbarium of The University of Georgia

OGLETHORPE COUNTY

FLORA OF GEORGIA

Euphorbia communatus Englem.

Shallow soil, newly exposed area. Echols
Mill granitic outcrop, 9.3 mi N 45° E of
Lexington. **PIEDMONT PROVINCE**

D. Blake
F. Montgomery 136 13 May 1965

UNIV. OF GEORGIA
HERBARIUM
133687

FIG. 4. The holotype of *Euphorbia georgiana*: Blake & Montgomery 136 (GA).



ISOTYPE

Euphorbia nesonii Mayfield

det. M. H. Mayfield, 6 Sept 2013

PLANTS OF NUEVO LEON, MEXICO
EUPHORBACEAE

Euphorbia nesonii Mayfield
TYPE COLLECTION

Municipio Higuera: Cuesta Mamulique, along old unused road through pass (north of the summit), north facing slope above road to 1 km west of highway [85]; with *Fraxinus greggii*, *Acacia*, *Yucca*, *Ungnadia speciosa*; dark soil in talus slopes at the base of the bluff.

N 26° 12' 10" W 100° 6' 25" (WGS84). Elev. 600 m
common annuals along base of bluff, mostly ca. 5–8 cm tall;
Coordinates are near middle of population collected which stretches along road in the more mesic areas.

M. H. Mayfield 1905
with C. J. Ferguson and A. L. Hempel

17 Mar 1994

Fig. 5. TEX isotype of *Euphorbia nesonii*: Mayfield 1905.

0.5–0.9, deltate to broadly deltate, the bases truncate, apices obtuse to abruptly acuminate, blades oriented nearly horizontally, the adaxial facing upwards. Cyathia: involucre broadly cup-shaped, 0.8–1.3 mm high, 0.6–0.10 mm wide, on a stalk 0.3–0.5 mm long; cyathial glands lunate, 0.9–1.1 mm wide, horns 0.5–0.7 mm long, attenuate-filiform, the margins entire between the horns, involucre lobe apices truncate and crenate on the margins; staminate flowers 10 to 15. Pistil: styles 3, ca. 1.5 mm long, connate at the base ca. 0.2 mm, bifid at the apices for $\frac{1}{4}$ – $\frac{1}{3}$ of the length, the lobes divergent and ascending, capitate. Capsules 1.8–1.9 mm long, 2.3–2.5 mm wide, columellas 1.7–1.9 mm. Seeds 1.3–1.5 mm long, 0.6–0.7 mm wide, oblong-ovoid, rounded dorsally, slightly flat ventrally in cross-section, surface white to tan, darker in the depressions at maturity, with irregularly shaped broad concave depressions over the entire surface, ridges bordering pits rounded in relief; caruncles 0.4–0.5 mm wide, reniform-ovate, base stipe absent or inconspicuous.

Euphorbia nesomii is the first annual species of the section to be described from Mexico, where it occurs on relatively mesic limestone north-facing slopes in the mountains of northern Nuevo Leon in montane oak chaparral habitat under *Brahea* spp., *Cheiropetalum schiedeanum*, *Fraxinus greggii*, *Osmanthus* sp., and *Ungradiad speciosa*. In addition to similarities in leaf and habit shared with *E. roemeriana*, its seeds resemble those of *E. peplidion* in size and shape. Otherwise it has no clear shared features that might link it to any other of the other annual species. Like the last species described above, it has been poorly collected and warrants additional documentation and study.

Etymology.—This species is named for Dr. Guy L. Nesom, who first brought this plant to the author's attention when he collected it in 1993. In addition to being invaluable as a mentor during the early phase of the author's career, he has had an indelible impact on the field of Plant Taxonomy. The epithet honors his many contributions to botany and his generous spirit.

Additional specimens examined: **MEXICO. Nuevo Leon. Municipio Agualeguas:** Arroyo 5 km S of Ojo de Agua de Agualeguas, 400 m, 3 Feb 1983, C.P. Cowan, with K.C. Nixon, M.C. Johnston, A.D. Zimmerman, and R. Allen 3773 (TEX). **Municipio Bustamante:** along switchbacks of road below the Grutas de Bustamante from opening of cave to ca. 4 road km below cave, 18 Mar 1994, M.H. Mayfield with C.J. Ferguson and A.L. Hempel 1906 (LSU, MEXU, TEX). **Municipio Higuera:** Cuesta Mamulique, ca. 40 km S of Sabinas Hidalgo on Mex. Hwy 85, W side of "libre" highway, N-facing slope along base of roadcut of old discontinued road, ca. 520 m, 26 Mar 1993, G. Nesom, B.L. Turner, J. Bain 7549 (MEXU, TEX). **Municipio de San Pedro:** in Chipinque 200 yards above gate, Monterrey, Feb 1961, R.F. Smith M456 (TEX).

Euphorbia ouachitana M.H. Mayfield, sp. nov. (**Fig. 6**). TYPE: UNITED STATES. OKLAHOMA. Pushmataha Co.: 3.2 mi SE (130.0°) of Nashoba, slopes N of the mouth of Watson Creek (Little River), elev. 640 ft N 34.45261° W 95.17233°, 25 Apr 2002, M.H. Mayfield 3551 (HOLOTYPE: BRIT; ISOTYPES: KANU, KSC, MICH, TEX, OKL, OKLA, UARK).

Similar to *E. commutata* and *E. tetrapora*, but differing in the seeds being consistently brown and somewhat lustrous (not whitened) at maturity, and in having deeper pits on the seeds.

Glabrous annual herbs with taproots, from 12–28(–32) cm tall, stems erect-ascending, often basally decumbent, 1 to a few stems from the base. Stem leaves alternate, sessile or briefly petiolate, laxly ascending to horizontal and spreading, petioles 0–3 mm long, blades 8–20 mm long, 3–9 mm wide at the widest point, broadly oblanceolate to subspatulate, bases attenuate, apices rounded. Ray leaves 3, sessile, 10–25 mm long, 15–32 mm wide, ovate-deltate to subrhombic-ovate. Primary inflorescence rays 3, usually with 3 or 4 internodes from 2.5–6.5 cm long, upper nodes dichasial, secondary rays 1 to 5 in the upper mainstem leaf axils. Raylet leaves connate to ca. 3 mm at the base, 6–18 mm long, length/width ratio 0.8–1.2, broadly deltate to subreniform, bases truncate to broadly obtuse, apices obtuse to bluntly acuminate, blades oriented obliquely, adaxial surface directed upwards and away from the plant axis. Cyathia: involucre funnelform, 1.3–1.6 mm high, 1.0–1.2 mm wide, on a stalk 0.4–0.7 mm long; cyathial glands oblong, 0.7–1.0 mm wide, horns 0.2–0.4 mm long, attenuate-filiform, the margins entire between the horns, involucre lobe apices rounded, short-ciliate on the margins; staminate flowers 15 to 20. Pistil: styles 3, ca. 0.8 mm long, free to the base, bifid at the apices for $\frac{1}{3}$ – $\frac{1}{2}$ of the length, lobes ascending, capitate. Capsules 2.6–2.7 mm long, 2.5–2.7 mm wide, columellas 2.0–2.1 mm long. Seeds 1.8–2.1 mm long, 1.1–1.2 mm wide, oblong-ovoid, rounded dorsally, slightly flat ventrally in cross-section, surface dark-brown, lustrous at maturity, with deep, rounded, uniformly spaced pits in vertical rows (3–4 in a vertical row per each ventral facet, 14–18 in 4 rows on the dorsal facet); caruncles 0.6–0.7 mm wide, reniform-ovate, base stipe present, umbonate.

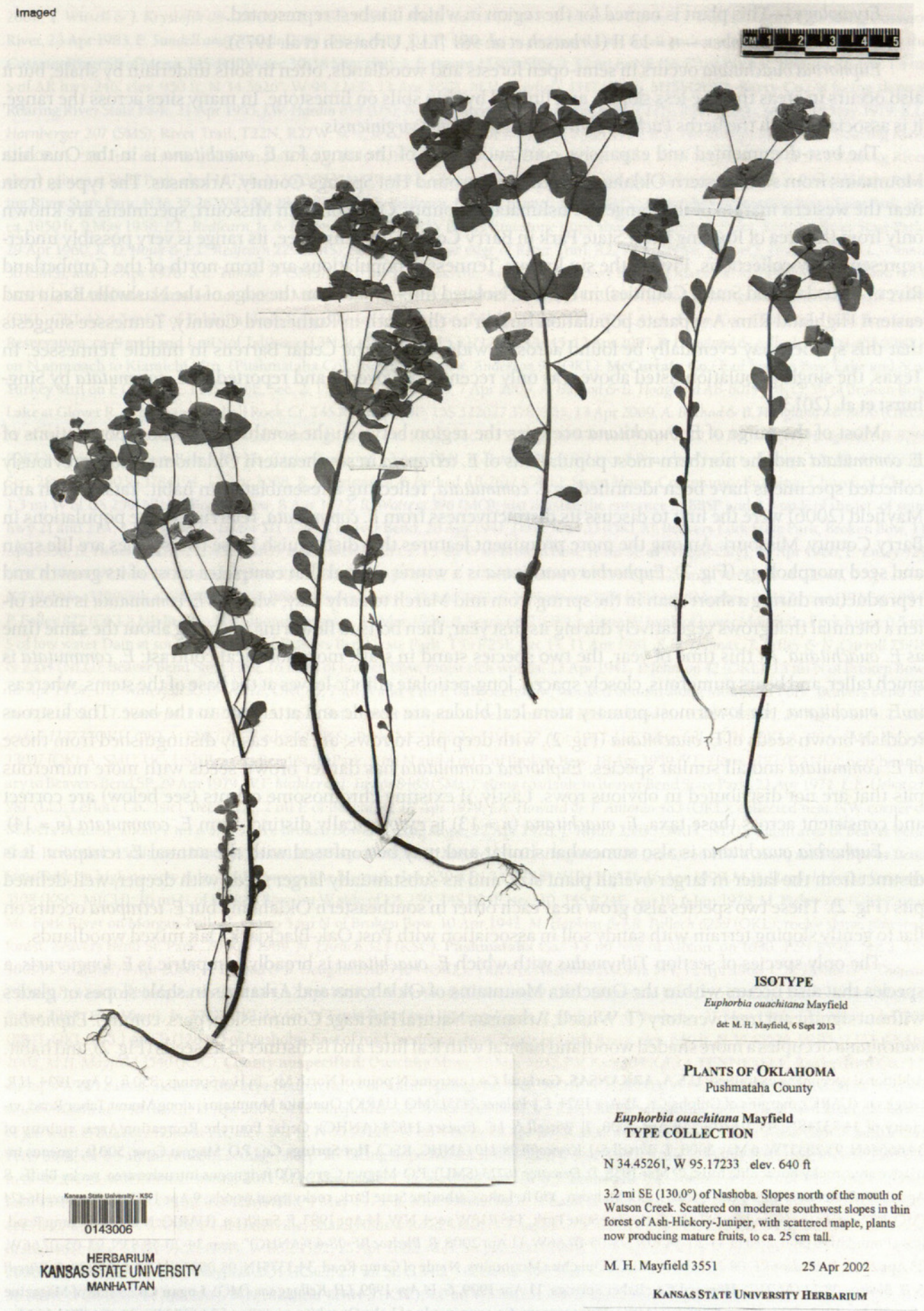


Fig. 6. KSC isotype of *Euphorbia ouachitana*: Mayfield 3551.

Etymology.—This plant is named for the region in which it is best represented.

Chromosome Number.— $n = 13$ II (Urbatsch et al. 1981 [LL], Urbatsch et al. 1975).

Euphorbia ouachitana occurs in semi-open forests and woodlands, often in soils underlain by shale; but it also occurs in areas that are less sloped, and limited by thin soils on limestone. In many sites across the range, it is associated with the herbs *Packera obovata* and *Saxifraga virginensis*.

The best-documented and expansive continuous part of the range for *E. ouachitana* is in the Ouachita Mountains from southeastern Oklahoma to the area around Hot Springs County, Arkansas. The type is from near the western margin of this range in Pushmataha County, Oklahoma. In Missouri, specimens are known only from the area of Roaring River State Park in Barry County. In Tennessee, its range is very possibly under-represented by collections. Five of the six known Tennessee populations are from north of the Cumberland River (Trousdale and Smith Counties) in the low, isolated hills situated on the edge of the Nashville Basin and eastern Highland Rim. A separate population further to the south in Rutherford County, Tennessee suggests that this species may eventually be found across a wider area of the Cedar Barrens in middle Tennessee. In Texas, the single population listed above was only recently discovered and reported as *E. commutata* by Sing-hurst et al. (2013).

Most of the range of *E. ouachitana* occupies the region between the southwestern-most populations of *E. commutata* and the northern-most populations of *E. tetrapora* in southeastern Oklahoma. Most previously collected specimens have been identified as *E. commutata*, reflecting a resemblance in habit. Yatskievych and Mayfield (2006) were the first to discuss its distinctiveness from *E. commutata*, referring to the populations in Barry County, Missouri. Among the more prominent features that distinguish these two species are life span and seed morphology (Fig. 2). *Euphorbia ouachitana* is a winter annual that completes most of its growth and reproduction during a short span in the spring from mid March to early May, whereas *E. commutata* is most often a biennial that grows vegetatively during its first year, then bolts to flowering in spring about the same time as *E. ouachitana*. At this time of year, the two species stand in stark morphological contrast: *E. commutata* is much taller, and bears numerous, closely spaced, long-petiolate elliptic leaves at the base of the stems, whereas, in *E. ouachitana*, the lowermost primary stem leaf blades are sessile and attenuate to the base. The lustrous reddish-brown seeds of *E. ouachitana* (Fig. 2), with deep pits in rows, are also easily distinguished from those of *E. commutata* and all similar species. *Euphorbia commutata* has darker brown seeds with more numerous pits that are not distributed in obvious rows. Lastly, if existing chromosome counts (see below) are correct and consistent across these taxa, *E. ouachitana* ($n = 13$) is cytologically distinct from *E. commutata* ($n = 14$).

Euphorbia ouachitana is also somewhat similar and may be confused with the annual *E. tetrapora*. It is distinct from the latter in larger overall plant size, and its substantially larger seeds with deeper, well-defined pits (Fig. 2). These two species also grow near each other in southeastern Oklahoma but *E. tetrapora* occurs on flat to gently sloping terrain with sandy soil in association with Post Oak-Blackjack Oak mixed woodlands.

The only species of section *Tithymalus* with which *E. ouachitana* is broadly sympatric is *E. longicruris*, a species that also occurs within the Ouachita Mountains of Oklahoma and Arkansas in shale slopes or glades without significant tree overstory (T. Witsell, Arkansas Natural Heritage Commission, pers. comm.). *Euphorbia ouachitana* occupies a more shaded woodland habitat with leaf litter and is distinct in its seeds (Fig. 2), and habit.

Additional specimens examined: **U.S.A. ARKANSAS. Garland Co.**: extreme N point of North Mt., in Hot Springs, 850 ft, 9 Apr 1934, H.R. Gregg s.n. (UARK); margins of Gulpha Cr., 25 Apr 1924, E.J. Palmer 24551 (MO, UARK); Ouachita Mountains, along Mount Tabor Road, vicinity of 34.73248N, 93.31670W, 18 Apr 2008, T. Witsell & J.C. Fraiser 14824 (ANHC); Cedar Fourche Recreation Area, vicinity of 34.66646N, 93.28357W, 6 May 2008, T. Witsell & J. Krystofik 08-110 (ANHC, KSC). **Hot Springs Co.**: P.O. Magnet Cove, 500 ft, igneous intrusive area, rocky novaculite hills, 19 Mar 1938, D. Demaree 16713 (SMU); P.O. Magnet Cove, 600 ft, igneous intrusive area, rocky Bluffs, 8 Apr 1939, D. Demaree 18874 (MO, SMU); P.O. Malvern, 350 ft, Lake Catherine State Park, rocky open woods, 9 Apr 1955, D. Demaree 36424 (MO, RSA); near the boundary of Lake Catherine State Park, T4S R18W sec4, NW, 14 Apr 1983, F. Smith s.n. (UARK); N of Land Camp Road, Ross Foundation land, area of 34-20-36.10N, 93-05-07.66W, 11 Apr 2008, R. Bledsoe RF-08-6 "(ANHC)"; near 34-20-58.83N, 93-05-07.66W, 23 Apr 2008, R. Bledsoe RF-08-21 (ANHC, KSC). Ouachita Mountains, N side of Camp Road, 34.33751N, 93.05338W, 23 Apr 2008, T. Witsell & R. Bledsoe 08-23 (ANHC). **Howard Co.**: Baker Springs, 11 Apr 1909, & 14 Apr 1909, J.H. Kellogg s.n. (MO). **Logan Co.**: S side of Magazine Mtn, 30 Apr 1942, D.M. Moore 420077 (UARK). **Montgomery Co.**: peninsula of Lake Ouachita, vicinity of 34.61820N, 93.49467W, 16 May 2005, T. Witsell & P. McKenzie 05-419 (ANHC); N of Lake Ouachita, on both sides of Forest Service Road 5140, vicinity of 34.65100N, 93.42377W, 6 May 2008, T. Witsell & J. Krystofik 08-124 (ANHC); E side of the Iron Forks River, vicinity of 34.72089N, 93.40869W, 6 May

2008, T. Witsell & J. Krystofik 08-120 (ANHC, KSC, UARK). **Polk Co.**: ca 15 mi S of Mena in Caney Cr Wildlife Mgmt area along Cossatot River, 23 Apr 1983, E. Sundell and J. Guldin 2999 (BRIT, NLU, UAM; adjacent to parking lot of a small park at the highway 246 bridge over the Cossatot River SE of Mena, T4S-R30W-sec 30, 18 May 1991, L.E. Brown 15365 (SBSC); 7.7 mi ExNE (56.7°) of Wickes, Polk Co Rd 490, 1.4 mi S of AR hwy 246, elev. 950 ft, N 34.3626°, W 94.2245°, 11 Apr 2002, M.H. Mayfield 3547 (KSC). **MISSOURI. Barry Co.**: N facing slope at Roaring River State Park, 21 Apr 1955, J.W. Hardin 654 (US); N of hatchery past the picnic area, T22N, R27W, ne¼, sec 27, 18 May 1979, K.L. Hornberger 207 (SMS); River Trail, T22N, R27W, se¼, sec 27, and ne¼, ne¼ sec. 34, 5 Jun 1979, K.L. Hornberger 272 (SMS); Roaring River State Park. 500 ft N on river trail from State Rd F, 1040 ft, N 36.58197, W 93.83395, 30 Apr 2003, M.H. Mayfield 3578 (KSC); Roaring River above cabins at State Park, elev. 1075 ft, N 36°35'53" W93°49'52", 28 Apr 2009, M.H. Mayfield & D.V. Geltman 3789 (KSC); Piber Hollow, Roaring River State Park, N36.35.26 W93.50, 28 Apr 2001, P.L. Redfearn, Jr. & M. Brunell 39969 (SMS); Piber Hollow, Roaring River State Park, alt. ca. 1050 ft, 9 May 1958, P.L. Redfearn, Jr. & D. Houk 3558 (SMS); W facing limestone slope above the Roaring River, Roaring River State Park, 29 Apr 1960, R. D. Houk & P.L. Redfearn 229 (SMS); South slope near edge of River Trail, R27W T22N sec 34, neQ, 14 Apr 1978, S.L. Timme 36 (SMS), and 14 Apr 1978, S.L. Timme 37 (SMS); ca. 6 mi S of Cassville, wooded trail above Roaring River, 30 Apr 1989, W.W. Holland 6061 (KSP). **OKLAHOMA. Latimer Co.**: Buffalo Valley, ½ mi e and 1 ½ mi S of B.V. School [34.73190 -95.24563], 22 Apr 1966, F.H. Means, Jr. 2437b (OKL, OKLA); 4.5 mi N of Talihina along Bengal Road, 11 Apr 1966, F.H. Means, Jr. 2421 (OKLA). **LeFlore Co.**: Camp Tom Hale Boy Scout Reservation, ca. 9 mi E and 1 mi S of Talihina, T3N, R23E, Sec 16; 15 327129 3845445, 12 Apr 2007, B. Hoagland & A. Buthod CTH-455 (OKL); on N approach to Kiamichi Mtn. (Pushmataha Co), 18 Apr 1950, J.M. Anderson 91 (OKL). **McCurtain Co.**: E of Broken Bow Lake and N of Turkey Mtn on E Otter Cr., T14S R26E, Sec. 2; 15S 357310 3789599, 7 Apr 2009, A. Buthod & B. Hoagland AB-8014 (OKL); W of Broken Bow Lake at Glover R, nr crossing of Shell Rock Cr, T4S R23E, Sec 30; 15S 322027 3783505, 13 Apr 2009, A. Buthod & B. Hoagland AB-8076 (OKL); W of Broken Bow Lake/hwy 259, NW of West High Peak, T4S R23E, Sec 5; 15S 332378 3789110, 9 Apr 2010, A. Buthod & B. Hoagland AB-8798 (OKL); 16 mi n of Broken Bow, near Mt. Carter Lookout, 13 Apr 1941, B. Paxton 115 (OKL); ca 5.9 mi due N of jct. of hwy 3 & 98, T4S R23E, Sec. 28; 15S 325038 3784194, 17 Apr 2008, B. Hoagland & A. Buthod AB-7617 (OKL); Sweet Home Community Building, Church of Christ, 1.3 mi W of US 259, NW of Broken Bow, 8 Apr 1972, B. Watters 396 (MO); just outside the entrance to BBSP and 3.5 mi E of the jct. of state hwy 21 and 21A, 2 Apr 1961, C. Taylor 511 (OKL); Beaver Bend, 20 Apr 1941, D.H. Dunn 33 (OKLA); Beavers Fork State Park, Broken Bow, 11 Apr 1936, D. Demaree 12052 (OKL, SMU); near Horsehead Cr, 15 mi W of Broken Bow, [1 mi SE of Wright City], 15 Apr 1966, E. Ensey 429 (KSC); above W shore of Mountain Fork River, BBSP, 10 Apr 1948, G.T. Robbins 2894 (NY, OKL, UC); small stream E of Glover, 9 Apr 1949, G.T. Robbins 3228 (NY, OKL, SMU, UC); BBSP, dry pine forest, 27 Apr 1952, G.J. Goodman 5504 (OKL); Wilderness Area, N part, 19 May 1994, P. Folley 827 (OKL); NE Broken Bow, mountain sides, 13 May 1930, P. Sears 1492 (OKL); along W bank of lower Mountain Fork River, 0.5 mi S of low water Dam at south boundary of Beavers Bend State Park, T5S R25E, sec 14, 11 Apr 1981, R.D. Thomas, T. Briley & N. Carroll 75418 & 2554 (NLU); Beaver Bend State Park, 16 mi N of Broken Bow, moist rich woods, 13 Apr 1941, T. Johnson 42 (OKL); 13 mi N of Broken Bow, 16 Apr 1950, U.T. Waterfall 9353 (ARIZ, OKLA); 7 mi N and 4 mi E of Broken Bow, wooded bottom along Mountain Fork, Beavers Bend SP, 26 Apr 1952, U.T. Waterfall 10681 (OKLA, RSA, SMU); near hairpin curve, 15 mi N of Broken Bow [on road to BBSP], 19 Apr 1953, U.T. Waterfall 11373 (OKL, OKLA, SMU, UC); edge of BB St. Park, NE of Broken Bow, 27 Apr 1957, U.T. Waterfall 13036 (OKLA, RSA, SMU, UC) & 13037 (OKLA, SMU, UC, US); Beavers Bend State Park, 6 mi N and 4 mi E of Broken Bow, 18 Apr 1959, V.L. Harms 192 (KANU); near boundary to Beavers Bend SP, 29 Apr 1979, W.F. Mahler & J. Taylor 8488 (SMU); along roadside in Beaver Bend State Park, 22 Apr 1972, L.E. Urbatsch 981 (LL); Leflore Co.: [sic], Beech Cr., 2 mi E of Beachton, 18 Apr 1979, J.A. Howard & T. Antonio 483 (OKL); collected near NW corner of Beavers Bend SP, about 7 mi n and 3 mi e Broken Bow. N facing slope, 22 Apr 1978, J. Taylor 25855 (BRIT, NLU); Cabin area of Beaver Bend State Park, elev. 450 ft, 34.13280, W 94.68151, 16 Apr 1999, M.H. Mayfield & C.J. Ferguson 3109 (KSC); on HWY 259A, road to Beaver Bend State Park on high narrow ridge under power line by road, elev. 830 ft, N 34°07'18" W 94°41'57", 16 Apr 1999, M.H. Mayfield & C.J. Ferguson 3108 (KSC, MICH); 16 mi N of Broken Bow, on W side of US 259, T4S R24E, sec. 10, T4S R24E, sec 10, 6 Jun 1978, M. Fisher s.n. (OKL); near Mt. Fork River on Morgan-Pollock Camp 5 mi N of Broken Bow, 10 Apr 1942, M. Hopkins & J.R. Pollock 6259 (OKL); rocky slope, pine-oak forest, Beavers Bend St. Park, 20 Apr 1969, N. Ehrlich 323 (KSC). **Pushmataha Co.**: 4.1 mi NW of Albion, on 1630, T2N R20E, Sec.2; 15S 300915 3838627, 3 Apr 2008, A. Buthod & B. Hoagland AB-7404 (OKL); 3 mi E of Nashoba on Okla 144, 12 Apr 1968, C.H. Perino & F. Duncan 79 (SMU); 4 mi E of Nashoba on Okla 144, 12 Apr 1968, C.H. Perino & F. Duncan 79 (OKL); Kiamichi River, 0.5 mi S and 2 mi E of Tuskahoma, 5 Apr 1968, F.H. Means, Jr. 3042 (OKLA); jct. of Little River and Watson Creek, 2 mi E, 2 S of Nashoba, 27 May 1968, F.H. Means, Jr. 3209 (BRIT, OKLA); 3.1 mi SE (128.0°) of Nashoba, East of road on slopes above E side of Little River, elev. 640 ft, N 34.45526, W 95.17323, 11 Apr 2002, M.H. Mayfield 3540 (KSC). **County unspecified**: Ouachita Mtns, 12 May 1937, P.V. Beck 108 (OKL). **TENNESSEE. Rutherford Co.**: 1.5 air mi NW of Leanna, along W. Buckeye Bottom Rd, N of Sulfur Springs Rd, elev. 490 ft, N 35.95065, W 86.45351, 8 Apr 2008, M.H. Mayfield & C.G. Mayfield 3748 (KSC); 11 Apr 2009, M.H. Mayfield & S.R. White 3784 (KSC); 1.2 air mi NW of Leanna, along Joe Brown Road, SE corner of jct. with E Buckeye Bottom Rd, elev. 591 ft, N 35.95124, W 86.44586, 11 Apr 2009, M.H. Mayfield & S.R. White 3781B (KSC). **Smith Co.**: Petty Bluff, ca. 3.5 air mi NW of Carthage, steep SW facing slope above Cumberland R. and Hwy 25, just S of large Powerline R-O-W, elev. 610 ft, N 36.29195, W 85.99561, 30 Mar 2011, M.H. Mayfield & C.G. Mayfield 3885 (KSC). **Trousdale Co.**: limestone bluffs of N bank of Cumberland River by TN 141, 0.5 mi S of Hartsville, 4 May 1973, R. Kral 49808 (MO); N bank of Cumberland at 141, 8 May 1969, K.E. Blum 3363 (TENN); 4.5 mi WNW (301.5°) of Hartsville, Snake Hollow Road south of Templew, ca. 0.7–0.8 road mi from jct. with TN 260 (Browning Branch Rd), elev. 725 ft, N 36.42511, W 86.23582, 15 Apr 2002, M.H. Mayfield 3550 (KSC), 24 Apr 2004, M.H. Mayfield 42404-1 (KSC), 8 Apr 2008, M.H. Mayfield & C.G. Mayfield 3751 (KSC); 2.7 mi SE (134.2°) of Hartsville, Starlite Road, 0.4 road mi E of Lock 6 Rd, elev. 680 ft, N 36.3646, N 86.1319, 24 Apr 2004, M.H. Mayfield 42404-3 (KSC); 4.0 mi WSW (251.0°) of Hartsville, Oldham Road, ca. 0.3 road mi E of Carey Road jct., elev 700 ft, N 36.37295, W 86.2341, 24 Apr 2004, M.H. Mayfield 42404-2 (KSC), 8 Apr 2008, M.H. Mayfield & C.G. Mayfield 3753 (KSC). **TEXAS. Red River Co.**: 3.5 mi S of the jct. of Tex. Hwy 195 and [Red River] County Rd. 2245 ... Little Pine Creek, 20 Apr 2013, J.R. Singhurst & H. Peters 19327 (BAYLU, KSC; Singhurst et al. 2013).

CHROMOSOME NUMBERS FOR NEW WORLD SECTION *TITHYMALUS*

Chromosome study was undertaken where possible for taxa of *Euphorbia* sect. *Tithymalus*. Developing buds were field-collected in a solution of four parts chloroform, three parts 95% ethanol and one part glacial acetic acid; with later transfer to 70% ethanol. Following the technique of B.L. Turner described in Jones & Luchsinger (1986), anthers were dissected out, stained with acetocarmine solution, squashed and examined for meiotic figures. A new count of $n = 13\text{II}$ was made for *E. longicruris* (Mayfield 2174 [TEX], Lampasas Co., Texas); and imperfect meiotic figures were observed for *E. austrotexana* var. *austrotexana* ($n = \text{ca. } 12\text{--}13\text{II}$, Mayfield & Ferguson 2160 [TEX], Atascosa Co., Texas), *E. peplidion* ($n = \text{ca. } 14\text{II}$, Mayfield & Ferguson 2161 [TEX], Atascosa Co., Texas), and *E. roemeriana* ($n = \text{ca. } 14\text{II}$, Mayfield 2158). One previously published count for "*E. tetrapora*" of $n = 13\text{II}$ corresponds to *E. ouachitana* (Urbatsch et al. 1975). A chromosome number of $2n = 28$ was reported by Perry (1943) for the common eastern annual/biennial *E. commutata*. Among North American perennials, a chromosome number of $n = 14\text{II}$ was reported for *E. brachycera* Engelm. from Otero Co., New Mexico (Urbatsch et al. 1975), whereas Ward (1984) reported $n = 13$ for the perennial *E. chamaesula* Boiss. Numbers for three additional perennial taxa from the western U.S.A. are documented by herbarium specimen annotations as having $n = 13$ chromosomes: *E. lurida* Engelm. (Garfield Co., UT, Windham 96-035 [MO]), *E. sp. nov. aff. lurida* (Clark County, Nevada, Windham 98-239 [MO]), and *E. yaquiana* Tidestr. (Gila Co., Arizona, Windham 94-24 [MO]). *Euphorbia peplus*, a species closely related to the North American section *Tithymalus* (Riina et al. 2013), has a haploid number of 8 (numerous counts in the literature; see Tropicos, <http://www.tropicos.org/Name/12800171?tab=chromosomecounts>). Together, these data suggest that the North American species may have undergone significant chromosomal evolution prior to their diversification, and that aneuploidy may have played a role in speciation. It is therefore likely that further investigations into the chromosome numbers may provide insight into evolution of the New World members of *E.* section *Tithymalus*.

KEY TO THE NON-PERENNIAL SPECIES OF *EUPHORBIA* SECTION *TITHYMALUS*
IN THE NEW WORLD (AND SIMILAR NON-NATIVE TAXA)

- 1. Plants biennial; seeds ≥ 1.8 mm long; primary ray bracts about as wide as long or wider, generally suborbicular to broadly ovate; plants occurring outside of Texas.
- 2. Seeds rotundly ovoid, strongly pitted, with distinct, round depressions on a generally flat surface; plants of the eastern United States and southern Ontario, Canada (northeastern Oklahoma north to Wisconsin, east to Pennsylvania, and south to Florida and Mississippi) _____ **E. commutata**
- 2. Seeds oblong-ellipsoid, weakly dimpled, with shallow, irregularly shaped depressions bordered by weak reticulating ridges, surface nowhere flat; plants of the western United States (southern California to northwestern Oregon), also local in southern Colorado and northern New Mexico _____ **E. crenulata**
- 1. Plants annual; seeds **mostly** ≤ 1.7 mm long; primary ray bracts **usually** longer than wide; plants often occurring in Texas and elsewhere.
- 3. Stem leaves generally erect-ascending at maturity, if lax, the blades less than 3 mm wide at the widest point.
- 4. Raylet leaves at least $1.5 \times$ longer than wide, the apices acute.
- 5. Seeds rotund; stems mostly strict, erect or virgate _____ **E. austrotexana** var. **carrii**
- 5. Seeds oblong; stems laxly ascending.
- 6. Seeds with troughlike and rounded pits, the surface not pimpled _____ **E. peplidion**
- 6. Seeds without pits, the surface pimpled _____ **E. exigua**
- 4. Raylet leaves about as long as wide, or wider than long.
- 7. Leaves linear to linear-ob lanceolate _____ **E. austrotexana** var. **austrotexana**
- 7. Leaves spatulate to oblanceolate.
- 8. Seeds uniformly covered with deep, well-defined rounded pits on both surfaces _____ **E. longicruris**
- 8. Seeds with 4 (or 5) shallow ventral pits, and 4 rows of indistinct pits on the dorsal surface _____ **E. tetrapora**
- 3. Stem leaves generally divergent or lax at maturity, and over 4 mm wide at the widest point.
- 9. Stem leaves with petioles or elongated petiole-like bases.
- 10. Raylet leaves apically obtuse, subdeltate; plants 8–18 cm tall _____ **E. nesomii**
- 10. Raylet leaves apically rotund, subreniform to scarcely deltate; plants 15–35 cm tall.
- 11. Capsules with longitudinal wings along the ridges; seeds 1.3–1.5 mm long, bearing two longitudinal sulcae on the ventral facet _____ **E. peplus**
- 11. Capsules without longitudinal wings along the ridges; seeds 1.8–2.0 mm long, smooth to pitted, but not sulcate on the ventral facet.
- 12. Seeds smooth (10 \times), lacking reticulating ridges _____ **E. helleri**
- 12. Seeds not smooth (10 \times), with reticulating ridges _____ **E. roemeriana**

9. Stem leaves sessile, or attenuate to a brief, petiole-like base.
13. Seeds with few well-separated shallow pits in vertical rows; plants occurring on sandy soils within the Gulf Coastal Plain (Louisiana, Oklahoma, and Texas) *E. tetrapora*
13. Seeds with crowded, sharply defined, deep pits; plants only occurring on granite outcrops within the Piedmont Province of Georgia *E. georgiana*

ACKNOWLEDGMENTS

I thank many colleagues for valuable discussions and other assistance with this work, including Paul Berry, Bill Carr, Carolyn Ferguson, Dmitry Geltman, Cleo Mayfield, Guy Nesom, Tom Wendt, and Ray White. Thanks to Paul Berry and Jess Peirson for their comments on an earlier draft, to Carolyn Ferguson for editing the manuscript, to Geltman and Eugene Wofford for helpful comments in review, and to Zianning Zhao for help with interpreting chromosomes counts. I gratefully acknowledge the following herbaria for loans and assistance during visits: ANHC, ARIZ, BRIT, GA, GH, MO, LL/TEX, KSP, LSU, NLU, NY, PH, OKL, OKLA, RSA, SBSC, SMS, TENN, UARK, UC, US. This is contribution number 14-157-J of the Kansas Agricultural Experiment Station.

REFERENCES

- BRUYNS, P.V., R.J. MAPAYA, AND T. HEDDERSON. 2006. A new subgeneric classification for *Euphorbia* (Euphorbiaceae) in southern Africa based on ITS and *psbA-trnH* sequence data. *Taxon* 55:397–420.
- CORRELL, D.S. AND M.C. JOHNSTON. 1970. Manual of the vascular plants of Texas. Texas Research Foundation, Renner.
- ENGELMANN, G. 1858. *Euphorbia*. In: J. Torrey, W.H. Emory, Rep. U.S. Mex. Bound. 2(1):185–193.
- GELTMAN, D.V., P.E. BERRY, R. RIINA, AND J. PEIRSON. 2011. Typification and synonymy of the species of *Euphorbia* subgenus *Esula* (Euphorbiaceae) native to the United States and Canada. *J. Bot. Res. Inst. Texas* 5(1):143–151.
- HORN, J.W., B.W. VAN EE, J.J. MORAWETZ, R. RIINA, V.W. STEINMANN, P.E. BERRY, AND K.J. WURDACK. 2012. Phylogenetics and the evolution of major structural characters in the giant genus *Euphorbia* L. (Euphorbiaceae). *Molec. Phylogen. Evol.* 63:310–324.
- JOHNSTON, M.C. 1975. Studies of the *Euphorbia* species of the Chihuahuan Desert region and adjacent areas. *Wrightia* 5:120–143.
- JONES, S.B. AND A.E. LUCHSINGER. 1986. Plant systematics, second edition. McGraw-Hill Book Company, New York.
- NORTON, J.B.S. 1899. A revision of the North American species of *Euphorbia* of the section *Tithymalus* occurring north of Mexico. Missouri Botanical Garden, St. Louis (Re-issued as Ann. Rep. Missouri Bot. Gard. 11:85–144. 1900).
- PEIRSON, J.A., R. RIINA, M.H. MAYFIELD, C.J. FERGUSON, L.E. URBATSCH, AND P.E. BERRY. in prep. Evolution of New World leafy spurge: phylogeny and taxonomy of *Euphorbia* sect. *Tithymalus*.
- RIINA, R., J.A. PEIRSON, D.V. GELTMAN, J. MOLERO, B. FRAJMAN, A. PAHLEVANI, L. BARRES, J.J. MORAWETZ, Y. SALMAKI, S. ZARRE, A. KRYUKOV, P.V. BRUYNS, AND P.E. BERRY. 2013. A worldwide molecular phylogeny and classification of the leafy spurge, *Euphorbia* subgenus *Esula* (Euphorbiaceae). *Taxon* 62:316–342.
- SINGHURST, J.R., J.N. MINK, AND W.C. HOLMES. 2013. A short chronicle of *Euphorbia commutata* (Euphorbiaceae) in Texas. *Phytoneuron* 2013-60:1–6.
- STEINMANN, V.W. AND J.M. PORTER. 2002. Phylogenetic relationships in Euphorbieae (Euphorbiaceae) based on ITS and *ndhF* sequence data. *Ann. Missouri Bot. Gard.* 89:453–490.
- THOMAS, R.D. AND C.M. ALLEN. 1996. Atlas of the vascular flora of Louisiana, Volume II: Dicotyledons Acanthaceae—Euphorbiaceae. Louisiana Department of Wildlife and Fisheries Natural Heritage Program, Baton Rouge.
- TURNER, B.L. 2011. Persistence of the weed *Euphorbia exigua* in Texas. *Phytoneuron* 2011-20:1–3.
- TURNER, B.L., H. NICHOLS, G.C. DENNY, AND O. DORON. 2003. Atlas of the vascular plants of Texas. Volume 1—Dicots. Sida, Bot. Misc. 24(1). BRIT Press, Fort Worth, Texas.
- URBATSCH, L.E., J.D. BACON, R.L. HARTMAN, M.C. JOHNSTON, T.J. WATSON, JR., AND G.L. WEBSTER. 1975. Chromosome numbers for North American Euphorbiaceae. *Amer. J. Bot.* 62:494–500.
- WARD, D.E. 1984. Chromosome counts from New Mexico and Mexico. *Phytologia* 56:55–60.
- YATSKIEVYCH, G. AND M.H. MAYFIELD. 2006. Euphorbiaceae. In: G. Yatskievych. Steyermark's flora of Missouri: Vol. 2:1010–1057. Missouri Department of Conservation, Jefferson City.



Mayfield, Mark H. 2013. "FOUR NEW ANNUAL SPECIES OF EUPHORBIA SECTION TITHYMALUS (EUPHORBIACEAE) FROM NORTH AMERICA." *Journal of the Botanical Research Institute of Texas* 7(2), 633–647.

View This Item Online: <https://www.biodiversitylibrary.org/item/236065>

Permalink: <https://www.biodiversitylibrary.org/partpdf/263401>

Holding Institution

Missouri Botanical Garden, Peter H. Raven Library

Sponsored by

Missouri Botanical Garden

Copyright & Reuse

Copyright Status: In copyright. Digitized with the permission of the rights holder.

Rights Holder: Botanical Research Institute of Texas

License: <http://creativecommons.org/licenses/by-nc-sa/4.0/>

Rights: <http://biodiversitylibrary.org/permissions>

This document was created from content at the **Biodiversity Heritage Library**, the world's largest open access digital library for biodiversity literature and archives. Visit BHL at <https://www.biodiversitylibrary.org>.