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# THE GENUS ECHINOCHLOA IN NORTH AMERICA.

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In the seventeenth volume of this journal (Rhodora xvii. 105. 1915) Fernald showed that in eastern North America we have, in addition to *Echinochloa crusgalli* L. and the maritime *E. Walteri* (Pursh) Nash, another species, *E. muricata* (Michx.) Fernald. In the field the writer has noted other forms of *Echinochloa* which were not easily placed in any of the described categories. For this reason an investigation of the genus was attempted, the results of which are presented in the following pages. The study soon led into the warmer portions of America where the genus is well represented, and it was decided to include in the treatment all of the region north of Panama. Our knowledge of some of the forms, especially from the tropics, is as yet fragmentary, and more material will doubtless modify the ranges, and perhaps in some cases even the limits of species. This paper was nearly ready for the press when the recent revision of the genus *Echinochloa* by Hitchcock (Contr. U. S. Nat. Herb. xxii. pt. 3, 133–153. 1920) was received. The two treatments were found to differ so widely that the publication of the paper still seemed wise.

The species of *Echinochloa* do not fall into well-marked groups and almost every character that may be selected to define a group presents one or more exceptions, so that the construction of a key or synopsis has been extremely difficult; yet to one engaged in their study the ultimate species and forms seem well marked. Besides the size and form of spikelets and size and nature of the spinules, the length of the anther has been found of service in indicating relationship and in helping to establish boundaries between species.

In all, several hundred measurements have been made, and the constancy of size for each species and variety is remarkable. The measurements of anthers given in the key are all from herbarium material, and are probably somewhat smaller than would be those made from fresh material. The presence or absence of stamens in the lower floret seems to characterize a fundamental group of species, but the presence or absence of the palet of this floret, though generally reliable, breaks in two species, and is probably not of primary importance; also the presence of the ligule is apparently not fundamentally important as a group character, though valuable in separating species. The perennial or annual habit, on the contrary, seems to be more fundamental.

The following key is really a synopsis in key form of the species, varieties and forms of *Echinochloa* in North America. It is based on the material in the Gray Herbarium, Herbarium of the New England Botanical Club, Herbarium of the New York State College of Agriculture, and the Herbarium of Mr. F. Tracy Hubbard; also some types have been seen at the New York Botanical Garden. In the lists of specimens given in the text following the synopsis many specimens have been omitted in regions where the species is common.

*a.* First floret with or without a palet, neutral, very rarely staminate; lower glume inserted close to the upper or but slightly distant; ligule wanting or rarely a trace in *E. oplismenoides*, but ligular region sometimes pubescent; plant glabrous except in *E. Walteri*, annual, in low or upland soils.

*b.* Spikelets 4.5 mm. long or less, ellipsoid, ovoid or oval, from scarcely echinate to very strongly and coarsely so.

*c.* Upper glume not awned, except rarely in *E. muricata;* lower lemma awned or awnless; spikelets ellipsoid or ovoid; anthers 0.3–1 mm. long.

*d.* Spikelets ovoid or oval, approaching ellipsoid in varieties of *E. zelayensis;* coriaceous lemma ovate or oval.

*e.* Coriaceous lemma subacute or obtuse, the tip withering; spikelets moderately echinate to almost unarmed, never appearing very bristly to the unaided eye.

*f.* Panicle narrow, usually open; branches short, 1–2.5, rarely 4 cm. long, slender, usually simple, the small (2–2.9 mm. long), oval, unarmed, often obtuse, scarcely echinate spikelets in few rows; leaf-blades 3–6 mm. broad; (coriaceous lemma obtuse; anthers 0.7–0.8(–0.9) mm. long; lower palet present; branch- and nodal hairs of the panicle usually poorly developed; low slender grasses).

*g.* Leaves entirely green.....1. *E. colonum.*
*g.* Leaves cross-banded with purple.....forma *zonalis.*
*f.* Panicle broader, often ovoid, open or dense; branches longer (2–6, rarely –9 cm. long), usually compound and usually more densely flowered; spikelets larger, 2.5–4 mm. long, ovoid or oval, obtuse to strongly acute or awned, echinate or unarmed; leaf-blades 5–30 mm. broad.
*g.* Coriaceous lemma subacute; spinules minute and almost uniform in size or wanting; lower palet often wanting; anthers 0.7–1 mm. long; nodal and branch-setae of the panicle much reduced or wanting (spinules scarcely swollen at base).
*h.* Spikelets 3.3–4 mm. long, 1.7–2 mm. broad, awnless, soft-tipped; coriaceous lemma 2.7–3 mm. long.....2. *E. zelayensis.*
*h.* Spikelets 2.5–3 mm. long, 1.1–1.5 mm. broad, sometimes awned; coriaceous lemma 1.9–2.5 mm. long.
*i.* Spikelets awnless, soft-tipped.....var. *macera.*
*i.* Spikelets or some of them short-awned.....var. *subaristata.*
*g.* Coriaceous lemma in most spikelets obtuse; spinules if present more strongly developed on the sides of the spikelet or on the lower lemma; lower palet present; anthers 0.6–0.85 mm. long; nodal and branch-setae usually well developed; (spikelets 2.8–3.7 mm. long, 1.5–2.3 mm. broad).
*h.* Spikelets with very short inconspicuous—mostly slender-based spinules, or these nearly wanting, subglabrous, broad and turgid, mostly obtuse and soft-tipped, awnless; lower palet almost always purple; panicle dense, chocolate-purple, the branches often incurved at apex; leaves in well-developed specimens 15–25 mm. broad.....3. *E. frumentacea.*
*h.* Spikelets with numerous spinules of medium length, the lateral usually with swollen bases, less turgid, strongly apiculate, firmer-tipped; lower palet whitish; panicle usually rather open, with straight spreading branches, green or purple; leaves 15 mm. broad or less.
*i.* Awns none, or a few spikelets with short awns.....4. *E. crusgalli.*
*i.* Awns prominent, longer, many or all of the spikelets awn-bearing.....forma *longiseta.*
*e.* Coriaceous lemma subacuminate, the tip firmer; spikelets from moderately to very strongly echinate, often appearing very hispid even to the unaided eye; (branch- and nodal setae usually poorly developed).
*f.* Spikelets large, 3.3–4.5 mm. long, 1.8–2.2 mm. broad; anthers 0.7–0.8(–0.9) mm. long.

*g.* Spinules numerous, very coarse and bristly; some spikelets awned; panicle open or moderately dense.....5. *E. muricata.*

*g.* Spinules few, short and inconspicuous; spikelets awnless; panicle usually dense. var. *ludoviciana.*

*f.* Spikelets small or medium (2.5) 2.8–3.4 mm. long, rarely longer in var. *multiflora* due to the long point, 1.4–1.8 mm. broad; anthers (0.3) 0.4–0.7 mm. long; (spikelets awnless or with short awn-tips; panicle normally rather dense).

*g.* Spinules not very bristly, slightly swollen at base, the dorsal ones of the upper glume minute or none; panicle green or purple-tinged; (anthers 0.5 (0.4–0.6) mm. long).....var. *occidentalis.*

*g.* Spinules long, coarse and bristly, strongly swollen at base, the dorsal well developed, spreading; panicle usually dark violet-purple or the albinos green.

*h.* Spikelets apiculate or short-acuminate, very rarely subulate-tipped; panicle dense, 7–20 cm. long; anthers 0.3–0.5 (–0.6) mm. long.....var. *microstachya.*

*h.* Spikelets long-acuminate, often subulate-tipped; panicle longer and looser, (9–)15–40 cm. long; anthers 0.6–0.7 mm. long.....var. *multiflora.*

*d.* Spikelets ellipsoid or broadly ellipsoid, more densely aggregated; coriaceous lemma elliptical; (spikelets with short purple awns or rarely almost awnless; spinules mostly uniform in size on the various ribs, slender, ascending, scarcely swollen at base; lower palet present; coriaceous lemma subacute; nodal and branch-setae of the panicle moderately developed).

*e.* Spikelets 2.8–3.2 mm. long; anthers 0.6 (0.5–0.8) mm. long.....6. *E. echinata.*

*e.* Spikelets 3.5 mm. long; anthers 1–1.2 mm. long. var. *decipiens.*

*c.* Upper glume short-awned, very rarely awnless (see also sometimes *E. muricata*); lower lemma with a long purple awn; spikelets ellipsoid; anthers 0.9–1 (0.6–1.2) mm. long; (spikelets softly but plainly echinate; spinules equally developed on the various ribs or stronger on the lateral; coriaceous lemma elliptical, subacute; lower palet present; panicle broad, dense, usually purple, nodding; the nodal and branch-setae well developed).

*d.* Sheaths papillose-hispid and pubescent.....7. *E. Walteri.*

*d.* Sheaths glabrous.....forma *laevigata.*

*b.* Spikelets 4.7–6 mm. long, ellipsoid, slightly or not at all echinate, the spinules fine; (lower glume broad subtruncate-acute; upper glume acuminate or awn-tipped; lower lemma short-awned; lower palet present or absent; anthers 0.6–0.8 mm. long; panicle narrow, with or without nodal and branch-setae). 8. *E. oplismenoides.*

*a.* First floret without a palet, neutral; lower glume distant from the upper, narrow; ligule a row of hairs; coarse glabrous perennial plants of wet places; (spikelets large, 6–8 mm. long, ellipsoid not turgid, very minutely echinate or unarmed, short-awned, upper glume often awn-pointed; awn of lemma (1–)2–4 cm. long; panicle usually large, broad and dense, with copious nodal and branch-setae; anthers 1.1–1.4 mm. long). 9. *E. holciformis.*

*a.* First floret with a palet, staminate; lower glume inserted close to the upper; ligule a row of hairs or wanting; coarse glabrous or hairy perennial plants of wet places; (spikelets ovoid or elliptic-ovoid, the ribs all nearly equally and finely echinate; awn of lemma short or none; panicle large but rather narrow).

*b.* Ligule a line of hairs.

*c.* Spikelets 4.8–6 mm. long, short-awned; coriaceous lemma 4–5 mm. long; anthers 2 mm. long; nodal and branch-setae of the panicle usually copious; leaf-blades 15–25 mm. broad; sheaths usually hairy; nodes densely hairy.....10. *E. polystachya.*

*c.* Spikelets 3–3.8 mm. long, awnless or nearly so; coriaceous lemma 2.5–3 mm. long; anthers 1 mm. long; nodal and branch-setae moderately developed; leaf-blades 5–10 mm. broad; sheaths and nodes glabrous.....11. *E. guadeloupensis.*

*b.* Ligule wanting, but ligular region often pubescent; (anthers 1–1.5 mm. long; spikelets short-awned or awnless; branches of panicle with few or no setae; nodal hairs medium; leaf blades 8–30 mm. broad; nodes and sheaths glabrous).

*c.* Spikelets 3.5–3.8 mm. long, 1.8–2 mm. broad, green. 12. *E. paludigena.*

*c.* Spikelets 2.8–3.5 mm. long, 1.4–1.5 mm. broad, usually purple-tinged; branches of the panicle less densely flowered.....var. *soluta.*

1. E. COLONUM (L.) Link,[1] Hort. Berol. ii. 209 (1833). *Panicum colonum* L. Syst. ed. 10. 870 (1759).—A weedy grass in damp cultivated fields and waste places: South Carolina, Tennessee and Arkansas to Florida, Texas and southern California, also in Mexico, Central America and the West Indies; almost cosmopolitan in the warmer countries; sporadic in the northeastern states (Charlotte, Vermont, *Pringle;* Philadelphia, *Parker*).

Forma **zonalis** (Guss.) comb. nov. *Panicum zonale* Guss. Fl. Sic. Prod. i. 82 (1827). *P. colonum*, var. *zonale* L. H. Dewey, Contr. U. S. Nat. Herb. ii. 502 (1894). *Echinochloa zonalis* Parl. Fl. Panorm. i. 119 (1839).—Leaves cross-banded with purple. Massachusetts, Texas, Arizona, and probably elsewhere. Specimens examined: MASSACHUSETTS: Amherst, "ornamental," 1875, *W. H. Blanchard.* TEXAS: about Kerrville, 1894, *A. A. Heller*, no. 1,923. ARIZONA: Chiricahua Mountains, 1907, *J. C. Blumer*, no. 2,268.

[1] Hitchcock, following Greene, has called attention to the fact that the name *colonum* is not an adjective and hence should not be declined (see Mex. Grasses, Contr. U. S. Nat. Herb. xvii. pt. 3, 256, 1913).

*E. colonum* is generally smaller and narrower-leaved than other species of the genus. It varies slightly in size and bluntness of the spikelets, and in extent of overlapping of the slender branches of the panicle, but is on the whole a clearly marked species.

2. E. zelayensis (HBK.) Schult. Mant. ii. 269 (1824). *Oplismenus zelayensis* HBK. Nov. Gen. et Sp. 89 (1815). *E. crusgalli zelayensis* Hitchc., U. S. Dept. Agr. Bull. 772, 238 (1920).—Damp, sandy soil, Texas, Oklahoma, Kansas and southern California, southward through Mexico. Northern specimens examined were: Texas: San Elizario, *Bigelow;* Big Springs, 1902, *S. M. Tracy,* no. 8,291. Oklahoma: Olustee, 1913, *G. W. Stevens,* no. 1,178; Hopeton, 1913, *Stevens,* no. 1,691. Kansas: Grant County, 1895, *A. S. Hitchcock,* no. 573. New Mexico: Mesilla, 1897, *E. O. Wooton,* no. 36. Arizona: Ft. Yuma, *Major Thomas;* Mule Mountains, 1910, *L. N. Goodding,* no. 926. California: New River near Rockwood, Salton Basin, 1912, *S. B. Parish,* no. 8,240; Colorado Valley, *J. G. Cooper,* no. 2,227.

Var. **macera** var. nov., spiculis minoribus 2.5–3 mm. longis, 1.5 mm. latis, lemmatibus coriaceis 1.9–2.5 mm. longis.—Western Texas to southern California and northern Mexico. Texas: western Texas, *Berlandier,* no. 1,009; Waco, 1916, *J. A. Minier.* California: Tulare County, 1892, *E. Palmer,* no. 2,713; Talma Valley, *Heerman.* Mexico: Matamoros, 1831, *Berlandier,* no. 890 (type in Gray Herb.).

Var. **subaristata** var. nov., spiculis minoribus 2.5–3 mm. longis, 1.5 mm. latis nonullis spiculis breviaristatis.—Western Texas. Texas: Pierce, 1901, *S. M. Tracy,* no. 7,743 (type in Gray Herb.); from western Texas to El Paso, 1849, *C. Wright,* no. 794.

The var. *macera* is clearly but a small form of *E. zelayensis* with all the features of that species represented in miniature. The var. *subaristata* has less the appearance of *E. zelayensis,* but the absence of the lower palet and certain general resemblances would seem to place it here. Possibly, when more material is at hand, this variety may prove to be a distinct species. In all of the specimens of *E. zelayensis* and its varieties from the United States the lower palet was absent. This was the case in only about one-third of those from Mexico and Central America, including the var. *macera.*

3. E. frumentacea (Roxb.) Link, Hort. Berol. i. 204 (1827). *Panicum frumentaceum* Roxb. Hort. Beng. 7 (1814). *E. crusgalli edulis* Hitchc. U. S. Dept. Agr. Bull. 772, 238 (1920).—Widely cultivated in the United States and southern Canada as Japanese or Barnyard Millet, or Billion-dollar Grass; native of southeastern Asia. *E. crusgalli* and *E. frumentacea* represent a group of Old World forms characterized by the blunt coriaceous lemma and well-developed setae of the panicle.

4. E. CRUSGALLI (L.) Beauv. Agrost. 53 (1812). *Panicum crusgalli* L. Sp. Pl., ed. i. 83 (1753). *P. crusgalli, α brevisetum* Döll, Fl. Baden, i. 232 (1857).—Introduced by roadsides and in waste places through the eastern United States and Canada, and sparingly westward; native of Europe. A few of the specimens examined were: PRINCE EDWARD ISLAND: Southport, 1912, *Fernald, Long & St. John*, no. 6,824. NEW BRUNSWICK: Shediac Cape, 1916, *F. T. Hubbard*, nos. 755 & 763 (type collection of forma *vittata* Hubbard). NOVA SCOTIA: Sable Island, 1913, *H. St. John*, no. 1,131. MAINE: North Berwick, 1891 & 1894, *J. C. Parlin*. NEW HAMPSHIRE: Jaffrey, 1898, *B. L. Robinson*, no. 566. VERMONT: Manchester, 1898, *M. A. Day*, no. 272. RHODE ISLAND: Old Harbor, Block Island, 1913, *Fernald, Long & Torrey*, no. 8,664. CONNECTICUT: Southington, 1898, *L. Andrews*, no. 622. NEW YORK: Canton, 1914, *O. P. Phelps*, no. 175; Cayuga Lake Basin, *E. L. Palmer*, no. 93, *F. P. Metcalf*, no. 5,567, *A. J. Eames*, no. 9,171, *Eames & Wiegand*, no. 11,255. ONTARIO: Ottawa, 1894, *J. Macoun;* Plevna, 1902, *J. Fowler*. IOWA: Iowa City, 1889, *A. S. Hitchcock;* Ames, *C. R. Ball*, no. 146. IDAHO: Boise, 1911, *J. A. Clark*, no. 308. CALIFORNIA: Redding, 1914, *L. E. Smith*, no. 745. OREGON: John Day Ferry, 1894, *J. B. Leiberg*, no. 872.

Forma LONGISETA (Trin.) Farwell, Rep. Mich. Acad. Sci. xxi. 349 (1919). *Panicum cruris-galli*, var. *longisetum* Trin. Sp. Gramin. ii. t. 162 (1829). *E. crusgalli*, var. *aristata* S. F. Gray, Nat. Arr. Brit. Pl. ii. 158 (1821).—Scattered throughout the range of the species and in similar situations, but perhaps proportionally more frequent westward; introduced from Europe. Some specimens studied were: MAINE: East Livermore, 1878, *K. Furbish*. NEW HAMPSHIRE: Haverhill, 1917, *M. L. Fernald*, no. 15,499, transitional. MASSACHUSETTS: Arlington, 1913, *Long & St. John*, no. 8,665; Kelly's Pond, Dennis, 1918, *Fernald & Long*, no. 16,180. NEW YORK: western New York, 1830–33, *A. Gray*, transitional; Cayuga Lake Basin, *E. L. Palmer*, no. 94, *F. P. Metcalf*, nos. 1,570 & 5,568, *Eames & Wiegand*, nos. 11,258, 11,259 & 11,260, *Eames, Randolph & Wiegand*, no. 11,257. ONTARIO: Toronto, 1905, *Wm. Scott*. NEBRASKA: Ewing, 1898, *J. M. Bates*. NEVADA: Wadsworth, 1902, *Griffiths & Hunter*, no. 549. OREGON: Salem, 1917, *J. C. Nelson*, no. 1,811. BERMUDA ISLANDS: Devonshire Marsh, 1914, *Brown, Britton & Bisset*, no. 1,961.

In the first edition of the Species Plantarum Linnaeus published *Panicum crusgalli*, giving as a description: "spicis alternis conjugatisque, spiculis subdivisis, glumis aristatis hispidis. Habitat in Europae, Virginiae cultis. Variat aristis, in aliis longitudine glumarum, in aliis decies longioribus." He also proposed a var. *β*, giving the following quotation from Bauhin (Pinax 8) as the sole description: "gramen paniceum, spica divisa, aristis longis armata."

Very little that is definite can be derived from the extended synonomy given by Linnaeus under his $\alpha$ except the reference to the Hortus Cliffortianus. There another reference leads to Morison (Hist. iii. p. 189 & sect. 8, t. 4, f. 15), where the figure is plainly an awnless form of *Echinochloa*, and it is said to grow: "ad agrorum & vinearum margines in hortis item & viridariis, nullo satu, apud Germanos, Italos & Gallos, rarius in Anglia, reperitur." The Bauhin reference under $\beta$ gives no indication that his long-awned form came from America, neither does the reference in Lobelius which Bauhin cites. Morison also described and figured a long-awned variety (l. c. fig. 16), giving the same reference to Lobelius as did Bauhin. The locality given by Morison for this variety was: "Gramen praecedens (*i. e.*, the short-awned) frequenter ut in Tritico, Lolio." It is therefore evident that both a short-awned and a long-awned European form of the barnyard grass were known to Linnaeus. Hitchcock in his "Types of American Grasses" (Contr. U. S. Nat. Herb. xii. pt. 3, 117, 1908) argues that certain American specimens must be considered types of Linnaeus' $\alpha$ and $\beta$. The type of $\alpha$, he says, is determined by a specimen in the Linnean herbarium bearing the mark "K," which agrees with the description, and is the only specimen to which Linnaeus attached the name *Panicum crusgalli*. Fastened to the Kalm sheet, Hitchcock says, are two other sheets, both from Gronovius, one of which is a large-panicled short-awned form, which seems to be the same as the plant cited by Gronovius as Clayton's no. 591; and the other a long-awned form with hispid sheaths, which is now called *E. Walteri*, and to which he says was probably due Linnaeus' statement "in Virginiae cultis" and his conception of *P. crusgalli* var. $\beta$. However, if it be considered that Linnaeus must have known well the common barnyard grass of Europe, that his reference under both $\alpha$ and $\beta$ refer to European material, and that his only mention of America was founded on a long-awned plant which would fall under his var. $\beta$, we are scarcely warranted in taking this Kalm specimen, apparently incidentally labelled *Panicum crusgalli*, as the type of a species which Linnaeus himself said grows in Europe. Neither is it necessary to consider the long-awned Virginian plant as the type of Linnaeus' var. $\beta$, as he very probably confused this plant with the long-awned plant of Europe already known to him, and this confusion very likely gave rise to the accidental insertion of "Virginiae cultis"

in the original account. There is no good reason for considering the var. β of Linnaeus as other than the long-awned form of Europe.

This long-awned form of Europe, which Linnaeus noted but did not name and which is now introduced widely in North America, was first named *Echinochloa crusgalli* var. *aristata* by S. F. Gray and later *Panicum crusgalli* var. *longisetum* by Trinius, but the latter name was used by Farwell, who was the first to treat the plant as a form. Trinius' variety was founded on both American and Caucasian material, but the latter only was figured. He said that it differed from *Panicum crusgalli* solely in the elongated awns, and the figure would seem to bear this out. His plant was certainly not the *P. echinatum* Willd. as some authors have stated. Whether Pursh's *Panicum crusgalli* α *aristatum* (Fl. Am. Sept. 66, 1814) is this form or *E. muricata* it is impossible to say. A variegated form of *E. crusgalli* has been described by F. T. Hubbard as forma *vittata* (Rhodora xviii. 232, 1916).

5. E. muricata (Michx.) Fernald, Rhodora xvii. 106 (1915). *Panicum muricatum* Michx. Fl. Bor. Am. i. 47 (1803). *E. crusgalli* var. *muricata* Farwell, Rep. Mich. Acad. Sci. xxi. 350 (1919). Illustration: Hitchcock, Contr. U. S. Nat. Herb. xxii. pt. 3, fig. 30 (1920). Native in low grounds, mostly on gravelly or sandy shores; Maine to Florida and westward to Illinois, Kansas, Oklahoma and New Mexico. The following are among the specimens examined: Maine: Woolwich, 1916, *Fernald & Long*, no. 12,565; Limington, 1916, *Fernald, Long & Norton*, no. 12,564. New Hampshire: Derry, 1916, *C. F. Batchelder*. Massachusetts: Gloucester, 1913, *Fernald, Hunnewell & Long*, no. 8,672; Lakeville, 1913, *Fernald & Long*, no. 8,668; Orleans, 1918, *Fernald & Weatherby*, no. 16,177. Rhode Island: Great Salt Pond, Block Island, 1913, *Fernald, Long & Torrey*, no. 8,674; Crescent Beach, Block Island, 1913, *Fernald & Long*, no. 8,667. Connecticut: Berlin, 1900, *J. N. Bishop*. New York: Staten Island, 1917, *A. Gershoy*, no. 761; Cayuga Lake Basin, *Eames & Wiegand*, no. 11,270, *Wiegand*, no. 11,271, *E. L. Palmer*, nos. 95 & 96, *F. P. Metcalf*, nos. 1,571 & 5,569. New Jersey: Atlantic County, 1895, *F. L. Scribner*. District of Columbia: B. & O. R. R. tracks, 1904, *A. H. Moore*. Maryland: Great Falls, 1915, *T. Holm*. West Virginia: Sweet Springs, 1903, *E. S. & Mrs. Steele*, no. 210; near Harman, 1904, *J. M. Greenman*, no. 52; Huttonsville, 1904, *A. H. Moore*, no. 2,456. North Carolina: Biltmore, 1897, *Biltmore Herb.*, no. 809a. Georgia: Lafayette, 1900, *R. M. Harper*, no. 343. Florida: Apalachicola, *Biltmore Herb.*, no. 809b. Illinois: White Heath, 1912, *A. S. Pease*, no. 14,090; Makanda, 1902, *H. A. Gleason*, no. 2,170. Missouri: White-

side, 1911, *J. Davis*, no. 1,017. Oklahoma: near Miami, 1913, *G. W. Stevens*, no. 2,265. Kansas: Riley County, 1895, *J. B. Norton*, nos. 574 & 884b. New Mexico: 1847, *A. Fendler*, no. 995.

Var. **ludoviciana** var. nov., spiculis muticis 3.5 mm. longis, 1.8–2.2 mm. latis sparse et tenuiter strigosis vel subglabratis, spinulis parvis, gluma superiore nervo medio plerumque inechinata.—Sandy river banks; Louisiana to New Mexico. Louisiana: without locality, *Hale;* New Orleans, old specimen without collector's name; Baton Rouge, 1903, *F. H. Billings*, no. 14 (type in Gray Herb.). New Mexico: Kingston, 1904, *O. B. Metcalf*, no. 1,351.

Var. **occidentalis** var. nov., spiculis brevi-apiculatis 2.8–3.3 mm. longis, 1.5–1.7 mm. latis strigosa-hispidis, spinulis in spiculis brevibus vel subbrevibus mollibus paulum vel non omnino basi tumidis eis in lemmate inferiore exceptis, spinulis in nervo medio glumae superioris parvis absentibusve.—Waste places and open grounds in damp, rich soil; Maine and New Hampshire to southeastern Massachusetts and Rhode Island, also Illinois to Washington and southward to Missouri and New Mexico. Some specimens examined were: Maine: Milford, 1916, *Fernald & Long*, no. 12,568; South LaGrange, 1916, *Fernald & Long*, no. 12,567. New Hampshire: Randolph, 1908, *A. S. Pease*, no. 11,684; Jefferson, *Pease*, no. 16,870. Massachusetts: West Cambridge, *Pease*, no. 11,400; Harwich, *Fernald & Long*, no. 16,176; Worthington, 1912, *B. L. Robinson*, no. 613. Rhode Island: Block Island, 1913, *Fernald & Long*, nos. 8,675 & 8,666. Illinois: Champaign, 1900, *H. A. Gleason*, no. 1,930; Grand Tower, *Gleason*, no. 1,720 (type in Gray Herb.). Wisconsin: Marinette County, 1894, *J. H. Schuette*. Missouri: Aberdeen, 1911, *J. Davis*, no. 945; Kansas City, 1918, *B. F. Bush*, no. 8,821. Oklahoma: Longdale, 1913, *G. W. Stevens*, no. 813. North Dakota: Leeds, 1899, *J. Lunell*. South Dakota: Deadwood, 1913, *W. P. Carr*, no. 153. Iowa: Mount Pleasant, 1894, *J. H. Mills*. Nebraska: Middle Loup River near Mullen, 1893, *P. A. Rydberg*, no. 1,590. Kansas: Riley County, 1896, *J. B. Norton*, no. 884. Idaho: New Plymouth, 1910, *J. F. Macbride*, no. 713. Wyoming: Cummins, 1895, *A. Nelson*, no. 1,500. Colorado: Salida, 1892, *A. I. Mulford*, no. 104. New Mexico: Fort Bayard Watershed, 1905, *J. C. Blumer*, no. 136. Arizona: Walnut Cañon, 1898, *D. T. MacDougal*, no. 353; horseshoe bend of the Colorado River, 1889, *E. Palmer*, nos. 749 & 750. Nevada: northwest Nevada, 1867, *W. W. Bailey*, no. 1,351. California: Napa Creek, 1866, *Bolander*, no. 2,419; north of Oroville, 1914, *A. A. Heller*, no. 11,418. Oregon: Hayden Island, 1917, *J. C. Nelson*, no. 1,974; Wasco County, 1894, *J. B. Leiberg*, no. 866. Washington: Waitsburgh, 1897, *R. M. Horner*, nos. R265–B527.

Var. **microstachya** var. nov., spiculis 3–3.2 mm. longis, 1.4–1.8 mm. latis crasse echinatis, spinulis numerosis firmis plus minusve divaricatis basi tumidis, spiculis igitur facie valde hispidis, gluma

superiore echinato item in nervo medio.—Native in low, rich ground along river banks and in other open grassy places, often in clay; Maine, Rhode Island and Connecticut westward through Ontario, New York, Wisconsin and Illinois to South Dakota, Wyoming, Texas, Arizona, northern Mexico and the West Indies. Some specimens examined were as follows: MAINE: Woolwich, 1916, *Fernald & Long*, no. 12,566. VERMONT: Manchester, 1903, *W. H. Blanchard*, no. 22. MASSACHUSETTS: Boston, 1916, *F. S. Collins*, no. 3,717. CONNECTICUT: Pomfret, 1916, *C. A. Weatherby*, no. 4,034. NEW YORK: Oneida, 1906, *H. D. House*, no. 2,776; Cayuga Lake Basin, *Dean & Eames*, no. 3,489, *E. L. Palmer*, no. 97 (TYPE in Gray Herb.), *Wiegand*, no. 11,268, *Eames, Randolph & Wiegand*, nos. 11,261, 11,265, 11,267 & 11,268, *F. P. Metcalf*, no. 5,570. ONTARIO: Galt, 1908, *W. Herriot*. ILLINOIS: Waukegan, 1906, *Gleason & Shobe*, no. 320. MICHIGAN: Alma, 1895, *C. A. Davis*. WISCONSIN: Milwaukee, *J. A. Lapham*. MINNESOTA: Ft. Snelling, 1891, *E. A. Mearns*, no. 39. SOUTH DAKOTA: Huron, 1897, *D. Griffiths*, no. 773. UTAH: Murray, 1916, *F. T. Hubbard*, no. 21. COLORADO: Dry Creek, Larimer County, 1900, *A. Nelson*, no. 8,207; Denver, 1891, *E. L. Hughes*, no. 38. NEW MEXICO: near Pecos, 1908, *P. C. Standley*, no. 5,016. ARIZONA: Wilgus Ranch, Chiricahua Mountains, 1907, *J. C. Blumer*, no. 1,782; Ft. Verde, 1891, *D. T. MacDougal*, no. 614. MEXICO: between Colonia Garcia and Pratt's Ranch below Pacheco, Chihuahua, 1899, *E. W. Nelson*, no. 6,244. WEST INDIES: St. Thomas, *Eggers*.

Var. **multiflora** var. nov., paniculis amplissimis, in statu elato ad 35 cm. longis elliptico-ovoideis sublaxis, spiculis 3–3.5 mm. longis, 1.5 mm. latis acuminatissimis copiose submuricato-hispidis, spinulis subtenuibus longitudine mediocribus, gluma superiore nervo medio rare et brevissime spinulato, lemmate coriaceo acuminatissimo.—Oklahoma and Kansas to northern Mexico. OKLAHOMA: Lincoln County, 1895, *J. W. Blankenship* (TYPE in Gray Herb.). KANSAS: Solomon River, 1894, *C. L. Shear*, no. 169; Riley County, 1896, *J. B. Norton*, no. 884a. TEXAS: western Texas to El Paso, 1849, *C. Wright*, no. 796. NEW MEXICO: 1852, *C. Wright*, no. 2,089. MEXICO: Chihuahua State, 1885, *E. Palmer*, no. 18, not typical; Santiago Papasquiaro, Durango, 1896, *E. Palmer*, no. 466.

In the first copy of this manuscript, *E. muricata* and the varieties *ludoviciana, occidentalis, microstachya* and *multiflora* were all treated as separate species. In reality, however, the differentiating characters were mainly those of general appearance. Moreover, though sufficiently distinct locally, the material from other regions generally intergraded between the various proposed species. Thus, while the eastern var. *microstachya* was distinct from var. *occidentalis* and from typical *E. muricata*, the western var. *microstachya* tended to

bridge over the gap between these forms. It has seemed wise, therefore, to proceed for the present on a conservative basis, and treat these forms as varieties of a common stock. *E. muricata* in this broad sense is a well-defined unit characterized by the acute coriaceous lemma, short nodal hairs and the general reduction or absence of branch-setae.

The var. *ludoviciana*, when well developed, differs from the typical form of *E. muricata* in the muticous spikelets, great reduction of spicules and dense inflorescence. The var. *occidentalis* is the less bristly, often awn-pointed extreme of the small-spikeleted *microstachya* type. Var. *microstachya* is densely bristly as is the typical form of the species, but the spikelets are smaller and more generally muticous, and the color of the panicle is usually dark chocolate-brown. The var. *multiflora* resembles var. *microstachya* but the panicle is larger and more open, and the spikelets more acuminate and slightly less bristly. The anthers vary slightly through the different varieties, though they are remarkably constant for each variety. The smallest anthers are those of var. *microstachya* and the largest those of typical *E. muricata*. The anthers of var. *microstachya* are indeed the smallest in the genus. Some specimens of the typical form of the species from Georgia and Florida have awned upper glumes. It will be noted that in general the variations of *E. muricata* are geographical. Whether Pursh's names *Panicum crusgalli β mite* and *γ purpureum* apply to forms of this species or to variations of *E. crusgalli* cannot now be determined.

6. E. ECHINATA (Willd.) Beauv. Agrost. 53 (1812). *Panicum echinatum* Willd. Enum. Pl. Berol. 1032 (1809). *Oplismenus crus-pavonis* HBK. Gen. et Sp. i. 88 (1815). *E. sabulicola* Hitchc., Contr. U. S. Nat. Herb. xvii. pt. 3, 257 (1913), probably not *Panicum sabulicolum* Nees. Agrost. Brasil. 258 (1829). *E. crusgalli crus-pavonis* Hitchcock, Contr. U. S. Nat. Herb. xxii. pt. 3, 148 (1920).—Mexico through Central America to northern South America and Brazil. MEXICO: Saltillo, Coahuila, 1898, *E. Palmer*, no. 418; Durango, 1896, *E. Palmer*, no. 730; Guadalajara, Jalisco, 1896, *E. Palmer*, no. 430A; Orosco, Jalisco, 1910, *A. S. Hitchcock*, no. 7,373; Queretaro, 1910, *A. S. Hitchcock*, no. 5,866; Valley of Mexico, 1901, *C. G. Pringle*, nos. 8,572 & 9,606; Orizaba, *Botteri*, no. 718. GUATEMALA: Coban, Alta Verapaz, 1887, *H. von Tuerckheim*, no. 1,287. PANAMA: Chagres, 1850, *A. Fendler*, no. 365.

Var. **decipiens** var. nov., spiculis longioribus 3.5 mm. longis, antheris longioribus 1 mm. longis.—Central Mexico: Etzatlan,

Jalisco, 1903, *E. W. D. Holway,* no. 5,096; Zamora, Michoacan, 1901, *C. G. Pringle,* no. 8,480 (TYPE in Gray Herb.).

This plant is provisionally appended to *E. echinata* as a variety, with which species it is most closely related, and from which it differs in characters of degree only. A wider range of specimens may show it to be a distinct species. Pringle's no. 8,480 was listed by Hitchcock under *E. oplismenoides.*

In 1809 Willdenow (Enum. Pl. Berol. 1032) published *Panicum echinatum,* the description containing the statement: " . . . glumis aristatis muricato echinatis. . . . Habitat in America meridionale." It was similar to *P. crusgalli,* he says, but "minus et valvulis muricato-echinatis." He gave as a synonym *P. muricatum* Hornem., Cat. Hort. Haf., p. 28, but the writer has not had access to the Horneman reference. There are very few species of *Echinochloa* in Central America, and only the present species agrees at all closely with Willdenow's description. Although several authors have refused to take up the name *echinatum* and others have treated it in widely different ways, its application to this species seems sufficiently clear to warrant its acceptance. Judging from the description, the *Oplismenus crus-pavonis* HBK. can be no other than the present species. The *Panicum sabulicolum* Nees. is more questionable. It was described from sandy ground in Para, and from Montevideo and Paraguay. The last two regions and possibly the first are outside the range of *E. echinata* as known to the writer. The author recognized it in addition to *P. crus-pavonis* which he made a synonym of *P. echinatum* Willd., moreover his description does not fit our species very well. Trinius seems to have figured as *Panicum sabulicolum* (Gram. ii. no. 163, 1829) a specimen of *E. echinata,* and a somewhat similar confusion seems to exist in Döll's treatment (in Mart. Fl. Brasil. ii. pt. 2, 142, 1842). Kunth (Enum. Plant. i. 145, 1833) made *P. sabulicolum* a synonym of *P. echinatum,* but separated it from *P. crus-pavonis.* It is possible that Nees had in hand some member of this genus not included in the present study, material of which is not available.

7. E. WALTERI (Pursh) Nash[1] in Britton's Manual 78 (1901). *Panicum Walteri* Pursh, Fl. Amer. Sept. i. 66 (1814), not Muhl.

[1] Heller in his Cat. N. A. Plants, ed. 2, 21 (1900) listed *E. Walteri* (Pursh) but with no description or synonymy. Notwithstanding that Pursh's name is in parenthesis, the reference is too vague to warrant the acceptance of this as a valid publication of the combination.

or Ell. *P. hispidum* Muhl. Gram. 105 (1817). *P. crusgalli*, var. *hispidum* Ell. Fl. S. C. & Ga. i. 114 (1821).—Brackish marshes along the coast from New Hampshire to Florida, Texas and the West Indies, also inland about the Great Lakes, apparently absent from Mexico and Central America. Inland specimens studied were as follows: New York: Ithaca, 1913, *E. L. Palmer*, no. 98, 1914, *Wiegand*, no. 1,572, 1916, *Eames & Metcalf*, no. 5,571. Ohio: St. Marys, 1900, *A. Wetzstein* in Kneucker Gram. Exsic., no. 75; Bay Point, 1914, *MacDaniels & Eames*, no. 289. Indiana: Little Chapman Lake, Kosciusko County, *C. C. Deam*, no. 21,975. Illinois: Calumet Lake, Chicago, 1900, *Agnes Chase*, no. 1,426. Wisconsin: 1861, *T. J. Hale*.

Forma **laevigata** forma nov. *Panicum longisetum* Torr., Amer. Jour. Sci. iv. 58 (1822). *E. longearistata* Nash in Small's Fl. S. E. U. S., 84 (1903).—Vaginis glabris. Massachusetts to Illinois and Arkansas (South Carolina to Louisiana, *Nash*). Massachusetts: West Barnstable, 1916, *St. John & Hunnewell;* Chilmark, 1894, *S. Harris*. New York: Oswegatchie River at DeKalb, 1915, *O. P. Phelps*, no. 1,107. Illinois: Fox River, 1821 (type of *Panicum longisetum* Torr. in Herb. Columb. Univ.). Arkansas (?): *Hale* (type of *E. longearistata* Nash in Herb. Columb. Univ.). The specific names of Torrey and Nash would be so inappropriate if used for this form that a new name has been selected.

8. E. oplismenoides (Fourn.) Hitchcock, Contr. U. S. Nat. Herb. xxii. pt. 3, 136 (1920). *Berchtoldia oplismenoides* Fournier, Mex. Pl. ii. 41 (1886).—Low grounds; northern Mexico to Guatemala. Specimens examined were: Mexico: Cananea, Sonora, 1910, *Rickets;* Sierra Madre, Chihuahua, 1887, *C. G. Pringle*, no. 1,404; Durango, 1896, *E. Palmer*, no. 253 in part; 1910, *A. S. Hitchcock*, no. 7,616; Toluca, Mexico, 1910, *Hitchcock*, no. 6,914. Guatemala: Estanzuela, Santa Rosa, 1892, *Heyde & Lux* in exsic. J. D. Smith, no. 3,911.

This plant resembles *E. holciformis* superficially and was at first placed by the writer with that species; but the narrow panicle, approximate, broader and more obtuse lower glume, general absence of a ligule, shorter anthers, and annual habit render it abundantly distinct. In about one-half of the specimens the lower palet was absent, and in one specimen some spikelets possessed the palet while others did not. No spikelets were found with the lower floret staminate as mentioned by Fournier.

9. E. holciformis (HBK.) Chase, Proc. Biol. Soc. Wash. xxiv. 155 (1911). *Oplismenus holciformis* HBK. Nov. Gen. et Sp. i. 88 (1815).—Ditches and swamps, Central Mexico to Central America. Mexico: Lower California near Guadalupe, 1865–66, *Bourgeau*, no. 910; Durango, 1896, *E. Palmer*, no. 253; Acambaro, Guanajuato,

1910, *A. S. Hitchcock,* no. 6,946; Valley of Mexico, 1901, *C. G. Pringle,* no. 8,622; near Morelia, Michoacan, 1909, *G. Arsène,* no. 3,079.

10. E. POLYSTACHYA (HBK.) Hitchcock, Contr. U. S. Nat. Herb. xxii. pt. 3, 135 (1920). *Oplismenus polystachyus* HBK. Nov. Gen. et Sp. i. 88 (1815).[1] *Panicum spectabile* Nees, Agrost. Brasil. 262 (1829). *P. aristatum* Macfad. in Hooker's Bot. Misc. ii. 115 (1831). *Oplismenus jamaicensis* Kunth, Enum. Pl. i. 147 (1833).—Swamps and ditches, Mexico (Hitchcock), the West Indies and northern South America to Argentina (Hitchcock).

Whether the name *Oplismenus polystachyus* HBK. applies to this species is not entirely clear. Certain characters mentioned in the original description, as lower flower male, glumes hispid, first lemma ovate, paleas two, and ligule pilose, leave no doubt that it belongs to some member of this group of species. However, the foliage is described as glabrous, but the writer has seen no specimens with glabrous foliage. Until the accumulation of more material has shown that the name belongs to some seggregate of the present species, it would seem wise to retain the name for the group rather than the next later name, *E. spectabilis* (Nees) Link. From the description, *Panicum aristatum* Macfad. would clearly seem to be this species, though Hitchcock states that the type specimen is *E. crusgalli crus-pavonis,* which is our *E. echinata.* In Macfadyen's description the ligule is said to be a line of long hairs, the sheaths ciliato-setose, the culms geniculate at base, 4–5 ft. high, and the leaves a foot long, broad, linear and hispid.

11. E. **guadeloupensis** (Hackel) comb. nov. *Panicum spectabile* var. *guadeloupense* Hackel, Notizbl. Bot. Gart. Berlin, i. 328 (1897). *E. pyramidalis* Hitchcock & Chase, Contr. U. S. Nat. Herb. xviii. pt. 7, 345 (1917) and Hitchc., *ibid.* pt. 3, 134 (1920), not *P. pyramidale* Lam., Tab. Encyc. i. 171 (1791) and Encyc. iv. 735, misprinted 745 (1796).—Island of Guadeloupe: *P. Duss,* no. 3,920 (Hackel's type specimen was *Duss,* no. 3,176).

Hitchcock and Chase (l. c.) credit *E. pyramidalis* (Lam.) Hitchc. & Chase to Guadeloupe as introduced from Africa, the type station being Senegal, and say that it is the same as *Panicum spectabile* var. *guadeloupensis* Hackel, which was based on a collection made in Guadeloupe by Duss. However they do not state on what ground it is assumed to have been introduced. There is in the Gray Herbarium a specimen of *Echinochloa* from Guadeloupe collected by

[1] The first volume of Humboldt's work in the library of Cornell University bears the date 1815, and the above species is described on p. 88, not on p. 107 in 1816 as frequently cited.

Duss (no. 3920) which agrees with Hackel's description. There is also a specimen from Senegal labelled *Panicum pyramidale.* Both specimens have a hairy ligule. This in the case of the Guadeloupe plant, together with certain other rather remote resemblances, may have led Hackel to place this form with *P. spectabile.* The Senegal specimen resembles the one from Guadeloupe superficially, but does not agree with Lamarck's original description of *P. pyramidale* where he says "fleurs . . . glabres ou presque glabres," it having plainly echinate spikelets. Kunth says of *P. pyramidale* that it is related to *P. plicatum* Willd., which is a true *Panicum* and not an *Echinochloa.* However, the Senegal plant differs from the Guadeloupe plant in two important particulars: it has distinctly larger spikelets (4.5–5 mm. long as opposed to 3.5 mm. long), and much larger anthers (1.5–2 mm. long as opposed to 1 mm. long). In these respects the Senegal plant approaches *E. polystachya* (*E. spectabilis*). Since the Guadeloupe plant is apparently distinct from *E. pyramidalis* and also from other American members of the genus, it should be treated as a species, using the varietal name of Hackel.

12. E. **paludigena** sp. nov., robusta vel tenuis plerumque decumbens glabra, foliis 8–25 mm. latis, ligulis nullis, zona ligulari plerumque pubescenti, paniculis viridibus 10–45 cm. longis angustis lanceolatis apertis, pilis ex nodis subbrevibus, ramis adscendentibus 1.5–7 cm. longis simplicibus vel subsimplicibus sparse vel omnino non setosis, ramis inferioribus distantibus, spiculis mediocribus 3.5–3.8 mm. longis, 1.8–2 mm. latis late elliptico-ovoideis acutis sparse strigosis, nervis copiose echinatis, spinulis mediocribus vel longis tenuibus adscendentibus basi subtumidis, spiculis igitur facie inhispidis, flore inferiore masculino, gluma inferiore acuminata plus minusve echinata, gluma superiore in nervis omnibus echinata, lemmate inferiore plerumque breviaristato, arista 2–8 mm. longa, lemmate coriaceo 2.5–3 mm. longo ovato acuto, paleis duabus, antheris 1–1.4 mm. longis.—Swamps, southern Florida: Hillsborough County, 1904, *A. Fredholm,* no. 6,390 (TYPE in Gray Herb.); Miami, 1904, *S. M. Tracy,* no. 9,399; Cutler, 1904, *A. A. Eaton,* no. 959.

Var. **soluta** var. nov., paniculis purpureo-variegatis, spiculis anguste ovoideis vel ellipticis 2.8–3 mm. longis, 1.4–1.5 mm. latis subacuminatis, lemmate coriaceo elliptico subacuto 2.5 mm. longo.—Swamps, southern Florida: Everglades, Lee County, 1905, *A. A. Eaton,* no. 1,314; Myers, 1900, *A. S. Hitchcock,* no. 476; Manatee, 1901, *S. M. Tracy,* no. 7,754 (TYPE in Gray Herb.).

This species is most closely related to *E. polystachya* and *E. guadeloupensis,* differing from them primarily in the absence of a ligule.

From *E. polystachya* it differs also in the smaller anthers and glabrous foliage. The var. *soluta* differs from the typical form mainly in the more purple narrower spikelets, but at times has the aspect of a distinct species.

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## ADDITIONS TO THE FLORA OF MOUNT DESERT, MAINE.

WM. RANDOLPH TAYLOR.

THE appearance in 1894 of a Flora of Mount Desert, Maine, by E. L. Rand and J. H. Redfield marked the culmination of the efforts of several enthusiastic naturalists to make a complete botanical survey of the island. This very valuable list was soon followed by a series of reports of the discovery of additional species. These were mostly phanerogams reported in RHODORA by Mr. Rand, but lesser extensions of the other groups of plants have also been made. In 1908 the Josselyn Botanical Society of Maine held a summer meeting at the village of Manset, and later published a list of the plants noted in the neighborhood.[1] It has become increasingly evident that the island, due to its position, conformation and geological history, supports an exceedingly varied and interesting flora. Because of its unique character it seems advantageous to extend the list of plants known to occur there as rapidly as possible. This is especially so now that we have a very accurate list from the islands just southwest of the Mount Desert group, a Flora of the Penobscot Bay Region by Albert F. Hill, with which a comparison of the Flora of Mount Desert shows many interesting similarities.[2]

The writer, in the company of Dr. J. M. Macfarlane, spent a large part of the summer of 1915 on the island, and returned for a part of the summer of 1920, on both occasions making Manset the headquarters for botanical work. A considerable number of additional forms were found, as well as new localities for plants reported in the Rand and Redfield Flora as rare. The following list is presented of material collected by Dr. Macfarlane and the writer in 1915, and by the latter alone in 1920. With great kindness Miss Annie Lorenz

[1] Bulletin of the Josselyn Botanical Society of Maine, No. **2**: 1–23. 1908.
[2] Proceedings of the Portland Society of Natural History **3**: 199–304. 1919.

Wiegand, K. M. 1921. "The genus Echinochloa in North America." *Rhodora* 23, 49–65.

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