



<https://www.biodiversitylibrary.org/>

SIDA, contributions to botany.

[Dallas :W. F. Mahler, etc.]1962-

<https://www.biodiversitylibrary.org/bibliography/8113>

v.18 (1998): <https://www.biodiversitylibrary.org/item/34589>

Page(s): Page [1031], Page 1032, Page 1033, Page 1034, Page 1035, Page 1036, Page [1037], Page 1038, Page 1039, Page 1040, Page 1041, Page 1042, Page 1043, Page 1044, Page 1045, Page 1046, Page 1047, Page 1048

Holding Institution: Missouri Botanical Garden, Peter H. Raven Library
Sponsored by: Missouri Botanical Garden

Generated 24 October 2017 11:18 AM
<https://www.biodiversitylibrary.org/pdf4/070850400034589>

This page intentionally left blank.

PENNISETUM ADVENA SP. NOV.
(POACEAE: PANICEAE): A COMMON
ORNAMENTAL GRASS THROUGHOUT
THE SOUTHERN UNITED STATES

JOSEPH K. WIPFF

Pure Seed Testing, Inc.
P.O. Box 449
Hubbard, OR 97032, U.S.A.
joseph@turf-seed.com

J.F. VELDKAMP

Rijksherbarium (L)/ Hortus Botanicus
P.O. Box 9514
NL-2300 RA
Leiden, THE NETHERLANDS
veldkamp@rnlrhb.leidenuniv.nl

ABSTRACT

Pennisetum advena Wipff & Veldkamp, a common ornamental grass in the southern United States, is described and illustrated. A key is provided to separate it from similar taxa (*P. macrostachys*, *P. orientale*, and *P. setaceum*). *Pennisetum advena* is readily distinguished from *P. setaceum*, its closest putative relative, by vegetative, inflorescence, fascicle, and spikelet characters.

RESUMEN

Se describe e ilustra *Pennisetum advena* Wipff & Veldkamp, una gramínea ornamental frecuente en el sur de los Estados Unidos. Se ofrece una clave para separarla de taxa similares (*P. macrostachys*, *P. orientale*, y *P. setaceum*). *Pennisetum advena* se distingue fácilmente de *P. setaceum*, la especie más próxima, por los caracteres vegetativos, de la inflorescencia, del fascículo y de la espiguilla.

Pennisetum Rich., a genus of \pm 80 species, is found in tropical, subtropical, and temperate regions (Clayton & Renvoize 1986). It occupies a diverse range of habitats, including riparian, savanna, desert, forest, and montane. Of the \pm 80 species, 40 are known to occur in the New World. Twenty-six of the 40 are native to México, Central and/or South America, 14 are introduced into the New World. Seventeen species have been introduced into the United States. This genus contains species that are important as grain (cereals) [e.g. *P. glaucum* (L.) R.Br.], forage [e.g. *P. ciliare* (L.) Link, *P. flaccidum* Griseb., *P. glaucum*, *P. orientale* Willd. ex Rich., and *P. purpureum* Schumach.], soil binding and lawns (e.g. *P. clandestinum* Hochst. ex Chiov.; and orna-

mentals [e.g. *P. advena* Wipff & Veldkamp, *P. alopecuroides* (L.) Spreng., *P. macrostachys* (Brongn.) Trin., *P. orientale*, *P. purpureum*, *P. setaceum* (Forssk.) Chiov., and *P. villosum* R.Br. ex Fresen.].

Aposporous apomixis has been reported in Old World species of *Pennisetum* [e.g. *P. advena* (reported under the name *P. setaceum* purple-type, by Simpson & Bashaw 1969), *P. ciliare*, *P. flaccidum*, *P. orientale*, *P. setaceum*, and *P. villosum*]. Research is still needed to understand the intricate morphological patterns and relationships, that are complicated by the presence of aposporous apomixis. The genus is morphologically and nomenclaturally complex and is in need of revision. In some cases the relationship of *Pennisetum* to allied genera (e.g. *Cenchrus* L.) is unresolved.

Since *Pennisetum* is not native in the United States, it is not well known to American agrostologists. This, in part, has led to the overlooking of *P. advena* as a distinct species which has become a common ornamental grass in the United States. This overlooked species will be referred to as *P. setaceum* 'Rubrum,' its current horticultural name.

The first record of *P. setaceum* 'Rubrum' in the United States was reported by Hitchcock (1916) as a form of *P. ruppelii* Steud. (= *P. setaceum*). Hitchcock (1916) wrote, "A half-hardy form with dark purplish foliage and purplish crimson spikes has recently been intro. under the name *P. cupreum*. It does not reproduce reliably from seed." The name *P. 'cupreum'* is a horticulture name and was never validly published [see also the index to Bailey (1917), where *P. 'cupreum'* is cited as a horticultural name and a form of *P. ruppelii*]. The use of *P. cupreum* Hitchc. (or Hitchc. ex L.H. Bailey) is incorrect, since Hitchcock and other authors have only accepted it as a horticulture name for a "form" or "horticultural variety" of *P. setaceum* and not as a validly published combination (Greuter et al. 1994: Article 34.1). Since its introduction in 1916, *P. setaceum* 'Rubrum' has since become one of the most popular ornamental grasses in the United States (Greenlee 1992). Darke (1994) commented that *P. setaceum* 'Rubrum' might not belong to *P. setaceum*.

Simpson and Bashaw (1969) published cytological and reproductive characteristics of *P. setaceum*. The two morphological types of plants studied were designated as "green" or "purple." The description of the "purple" type appeared to refer to *P. setaceum* 'Rubrum'. Fortunately, Simpson (Texas Agricultural Experiment Station, Stephenville, Texas) had maintained a clone of this plant in a greenhouse. In 1987, Kenneth Hignight and the senior author were able to examine this plant and confirmed that it was *P. setaceum* 'Rubrum'. So began a 10-year search for a valid scientific name for *P. setaceum* 'Rubrum'.

In 1987, a specimen of *P. setaceum* 'Rubrum' sent to the Royal Botanical Gardens (K) was reported as being "similar" or "with affinities" to *P. macrostachys*, a robust species from Malesia which also has purple leaves. This research into *P. setaceum* 'Rubrum' continued as time permitted. In November 1992,

while working on the treatment of *Pennisetum* for the forthcoming *Manual of North American Grasses*, photographs of the plate of *Gymnotrix macrostachys* Brongn. (= *Pennisetum macrostachys*) in Duperrey (1829) and of the type specimen from the Muséum National d'Histoire Naturelle (P), were obtained. Upon examination, it was obvious that *P. setaceum* 'Rubrum' and *P. macrostachys* were not the same taxon. *Pennisetum macrostachys* has only antrorsely scaberulous bristles in a fascicle, one spikelet per fascicle, and a puberulous inflorescence axis. *Pennisetum setaceum* 'Rubrum' has two kinds of bristles in a fascicle; an inner series of plumose, ciliate bristles and an outer series of antrorsely scaberous bristles, 1–3 spikelets per fascicle and a papillose pubescent inflorescence axis.

Germplasm of *P. macrostachys* from National Germplasm Center in Georgia was obtained. This accession (PI 354266), originally collected in New Guinea (Malesia), is actually a green form of *P. setaceum* 'Rubrum'. In 1995, the senior author sent a specimen of *P. setaceum* 'Rubrum' to the junior author, who is an authority on the grasses of Malesia. The junior author spent two years searching for the validly published name for this taxon. Also, in 1995, W.D. Clayton (K) was contacted for assistance, but he too was not able to put a name to this mysterious taxon.

After years of unsuccessful searching for a satisfactory identification and careful examination of the species of *Pennisetum* known to science, we believe that this is an undescribed species.

***Pennisetum advena* Wipff & Veldkamp, sp. nov. (Fig. 1).** TYPUS: UNITED STATES. TEXAS. Brazos Co.: Cultivated at Texas A&M University, College Station, Texas, commonly used ornamental grass in the area, 18 Sep 1990, *Joseph K. Wipff 1723* (HOLOTYPE: L; ISOTYPES: K, MO, US, UTC).

Pennisetum advena a *P. setaceo* cognatio sua proxima ut videtur facile distinctum in folii laminis 6–11 mm latis planis costa non-incrassata, culmo in nodis aeriis plerumque iterum ramoso, inflorescentiae medio involucris 10–17 per sectionem 1 cm ramo primario 1–2 mm longo, involucri setarum serie interiore setis 8–16 ciliatis vel plumosis, gluma primaria 0.5–1 mm longa, flore inferiore staminato.

Plants perennial (annual in temperate climates), cespitose, without rhizomes or stolons. *Culms* 100–150 cm tall, erect; *nodes* glabrous, usually with some secondary branching at aerial nodes. *Leaves*: (measurements taken from the 2nd and 3rd uppermost leaves); *sheaths* glabrous, margins ciliate; *ligules* 0.5–0.8 mm long, a ciliate membrane; *blades* 33–52 cm long, 6–11 mm wide, flat, burgundy (rarely green), mid-vein not noticeably thickened, margins antrorsely scaberulous and ciliate at base. **Panicles** 23–32 cm long, 30–58 mm wide, flexuous and drooping, burgundy (rarely pale or whitish-green); *central axis* terete, pubescent with papillose trichomes. **Fascicles (Involucres)**: 10–17 per 1 cm section (mid-inflorescence), with 1–3 spikelets. *Primary branch* 1–2 mm long (the length from base of branch to uppermost bristle (primary bristle)). *Fascicle stalk (or stipe)* 0.5–1.1 mm long [the length

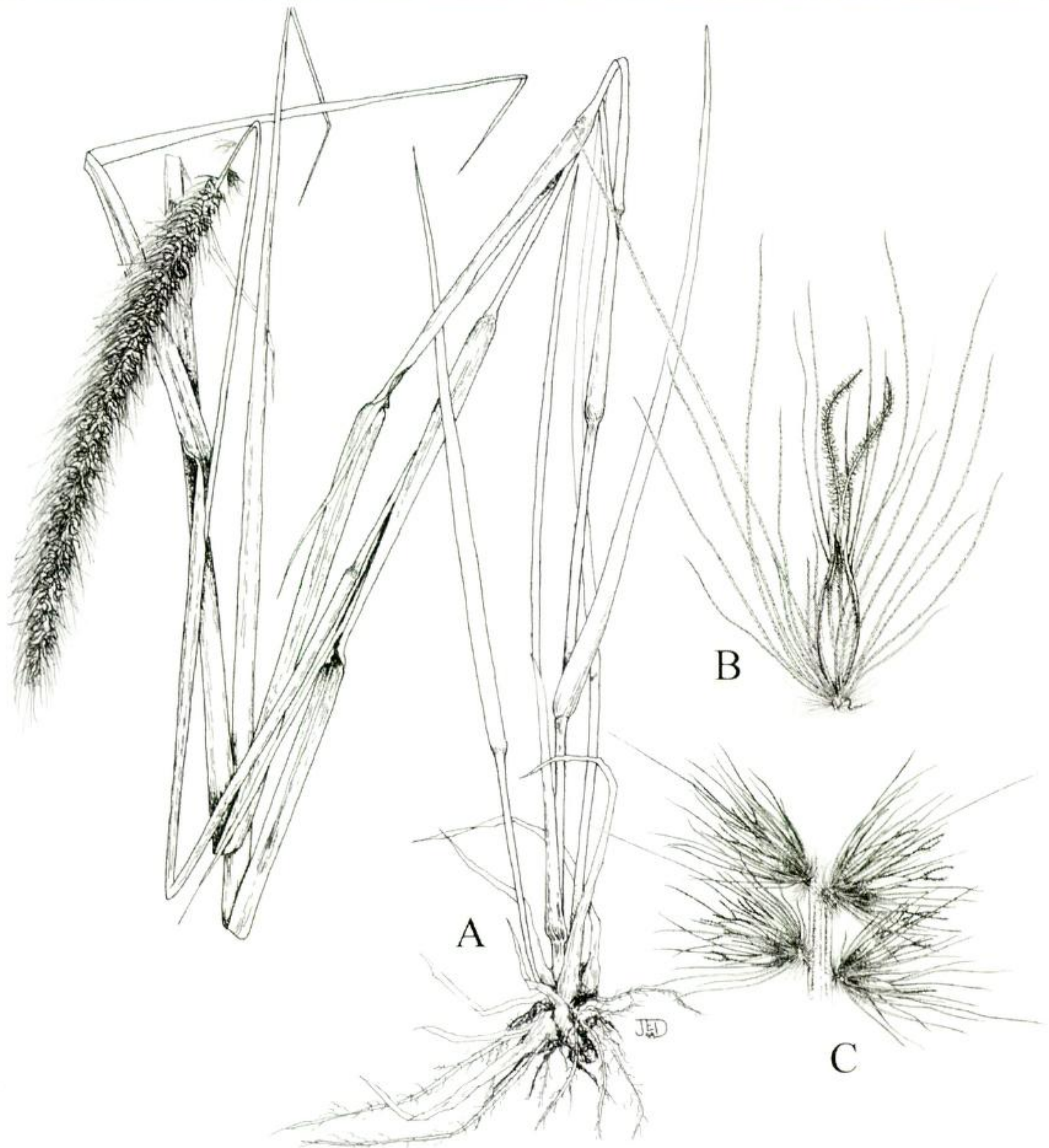


FIG. 1. *Pennisetum advena* (Wipff 1723). A. Habit. B. Fascicle. C. 1 cm section of panicle showing central axis and fascicle arrangement.

from base of primary branch to first (or lowermost) bristle]. *Primary bristle* 21.3–33.6 mm long, noticeably longer than the other bristles, papillose ciliate. Two types of bristles in fascicle: an *outer bristles series* of 43–68 bristles, 1.2–18.5 mm long, antrorsely scaberulous; an *inner bristles series* of 4–10 bristles, 11.7–25 mm long, papillose ciliate. *Spikelets* subsessile or pedicelled in fascicle. **Central Spikelet** 5.3–6.5 mm long; *pedicel* 0.1–0.3 mm long. *Glumes* unequal; *first glume* 0.5–1 mm long, 0-veined; *second glume* 1.9–3.6 mm long, 0–1-veined, about 1/2 as long as spikelet; **Lower Floret** staminate. *First lemma* 4.7–6.1 mm long, 5(–6)-veined. *Palea* 4.5–5.0 mm long.

Anthers 3, 2–2.5 mm long. **Upper Floret:** *second lemma* 5.2–6.1 mm long, 5-veined. *Palea* 4.7–5.6 mm long, 2-veined. *Anthers* 3, 2.5–2.7 mm long. *Caryopses* infrequently produced in United States plants.

Chromosome number.— $2n = 54$ [reported under the name *P. setaceum* purple-type (Simpson & Bashaw 1969)].

Method of reproduction.—aposporous apomixis [reported under the name *P. setaceum* purple-type (Simpson & Bashaw 1969)].

Phenology.—May until first freeze.

Distribution.—Cultivated throughout the United States. Will not persist in areas where winter temperatures fall below freezing for any length of time. In areas with below freezing temperatures, it is used as an annual and replanted every year or moved into a greenhouse. In southern Florida, Texas, and California, and Hawaii it will persist, but rarely escapes.

Etymology.—The specific epithet, *advena*, is Latin for “visitor” or “stranger”; referring to its mistaken identity and unknown origin. It is believed to have originated from the Old World.

KEY TO SIMILAR TAXA OF *PENNISETUM*

1. Fascicle with two types of bristles: an inner series (bristles closest to spikelet) with bristles long-ciliate, and an outer series of antrorsely scaberulous bristles. Primary bristle noticeable longer than other bristles in fascicle. Fascicles with 1–10 spikelets per fascicle. Inflorescence axis pubescent 2
1. Fascicle with all bristles antrorsely scaberulous. Fascicles with only 1 spikelet per fascicle. Primary bristle not noticeably longer than other bristles in fascicle. Inflorescence axis puberulous **P. macrostachys**
2. Mid-culm leaf blades (3–)3.5–11 mm wide, flat, green or burgundy; mid-vein not noticeably thickened 3
2. Mid-culm leaf blades 2–3.5 mm wide, convolute or folded, green; mid-vein noticeably thickened **P. setaceum**
3. Culm nodes pubescent. Plants with rhizomes. Ligule 1–2 mm long. Fascicles white. Outer bristle series of fascicle with 0–24 terete, scaberulous bristles. Leaf blades green. Inflorescence erect or arching **P. orientale**
3. Culm nodes glabrous. Plants without rhizomes. Ligule less than 1 mm long. Fascicles burgundy (rarely pale green). Outer bristle series of fascicle with 43–58, terete, scaberulous bristles. Leaf blades burgundy (rarely green). Inflorescence flexuous and drooping **P. advena**

Pennisetum advena is readily distinguished from *P. setaceum*, its closest putative relative, by the following characters. *Pennisetum advena*: 1) leaf blades 6–11 mm wide; flat, mid-vein not thickened; 2) usually with secondary branching at aerial culm nodes; 3) 10–17 fascicles per 1 cm section (mid-inflorescence); 4) primary branch of fascicles (mid-inflorescence) 1–2 mm long; 5) inner bristle series of fascicle with 4–10 ciliate or plumose bristles; 6) first glume 0.5–1 mm long; and 7) lower floret staminate. *Pennisetum setaceum*: 1) leaf blades 2–3.5 mm wide, convolute, mid-vein conspicuously thickened; 2)

no secondary branching at aerial culm nodes; 3) 8–10 fascicles per 1 cm section (mid-inflorescence); 4) primary branch of fascicles (mid-inflorescence) 2.3–4.5 mm long; 5) inner bristle series of fascicle with 8–16 ciliate or plumose bristles; 6) first glume absent (rarely present, up to 0.3 mm long); and 7) lower floret neuter (rarely staminate).

ACKNOWLEDGMENTS

We thank the curators at P for assistance with type specimens (photographs), the research librarians at BRIT and NY for their support with requests for literature, and W.D. Clayton (K) for his time and assistance. We thank Stanley D. Jones (BRCH) and Gretchen D. Jones (USDA, AWPMRU) for their review and suggestions on the manuscripts. The illustration was prepared by Eddy Dawson.

REFERENCES

- BAILEY, L.H. 1917. The standard cyclopedia of horticulture, Vol VI-Z (Vol. 6). The MacMillan Company, New York.
- CLAYTON, W.D. and S.A. RENVOIZE. 1986. Genera graminum: Grasses of the World. Kew Bull., Addit. Ser. XIII. Her Majesty's Stationery Office; London.
- DARKE, R. 1994. Manual of the grasses. In: M. Griffiths, ser. ed. The new royal horticultural society dictionary of gardening series. Timber Press, Portland, OR.
- DUPERREY, L.I. 1829. Voyage autour du monde. Phanerogamie. Arthur Bertrand, Paris.
- GREENLEE, J. 1992. The encyclopedia of ornamental grasses. Rodale Press, Emmaus, PA.
- GREUTER, W., ET AL. 1994. International code of botanical nomenclature (Tokyo Code). Koeltz Scientific Books, Königstein, Germany.
- HITCHCOCK, A.S. 1916. *Pennisetum*. In: L.H. Bailey. The standard cyclopedia of horticulture. Vol. V-PR (Vol. 5). The MacMillan Company, NY.
- SIMPSON, C.E. and E.C. BASHAW. 1969. Cytology and reproductive characteristics in *Pennisetum setaceum*. Amer. J. Bot. 56:31–36.

NEW COMBINATIONS IN *SETARIA* (POACEAE: PANICEAE)

WILLIAM E. FOX, III and STEPHAN L. HATCH

S.M. Tracy Herbarium (TAES)
Department of Rangeland Ecology & Management
Texas A&M University
College Station, TX 77843-2126, U.S.A.
s-hatch@tamu.edu

ABSTRACT

Setaria subgenus *Reverchoniae* is proposed. New combinations in subgenus *Reverchoniae*, *Setaria reverchonii* (Vasey) Pilg. subsp. *ramiseta* (Scribn.) W.E. Fox, *S. reverchonii* (Vasey) Pilg. subsp. *firmula* (Hitchc. & Chase) W.E. Fox are proposed. New combinations in subgenus *Paurochaetium*, *S. utowanaea* (Scribn.) Pilg. var. *ophiticola* (Hitchc. & Ekman) W.E. Fox, *S. utowanaea* (Scribn.) Pilg. var. *subtransiens* (Hitchc. & Ekman) W.E. Fox are also proposed. Keys separating the subgenera, subspecies of *S. reverchonii*, species of subgenus *Paurochaetium*, and varieties of *S. utowanaea* are included.

RESUMEN

Se propone *Setaria* subgénero *Reverchoniae*. Son propuestas combinaciones nuevas en el subgénero *Reverchoniae*, *S. reverchonii* (Vasey) Pilg. subsp. *ramiseta* (Scribn.) W.E. Fox y *S. reverchonii* (Vasey) Pilg. subsp. *firmula* (Hitchc. & Chase) W.E. Fox. Son también propuestas combinaciones nuevas en el subgénero *Paurochaetium*, *S. utowanaea* (Scribn.) Pilg. var. *ophiticola* (Hitchc. & Ekman) W.E. Fox y *S. utowanaea* (Scribn.) Pilg. var. *subtransiens* (Hitchc. & Ekman) W.E. Fox. Se incluyen claves para separar los subgéneros, subespecies de *S. reverchonii* y las variedades de *S. utowanaea*.

INTRODUCTION

Setaria P. Beauv. is a cosmopolitan genus important in cultivated crops [*S. italica* (L.) P. Beauv.], perennial forage grasses [*S. macrostachya* H.B.K.] and noxious weeds [*S. viridis* (L.) P. Beauv.].

Setaria (Poaceae:Paniceae) is one of several genera closely related to *Panicum*. Tribal and generic arrangement of the species of the Poaceae as classified by Häckel (1887) has been revised by Prat (1936), Pilger (1954), Stebbins (1956), Clayton and Renvoize (1986) and Soderstrom (1986). However, the circumscription of the Paniceae has remained rather stable. For additional discussion of previous work see Fox (1999). Most taxa in *Setaria* can be easily differentiated from its closest relatives *Panicum* and *Paspalum* by the presence of bristles subtending the spikelets, these representing modified inflorescence branches.

Rominger (1962) monographed the species of *Setaria* from North America and classified 43 species occurring in three subgenera: *Ptychophyllum* (6 species), *Setaria* (27 species) and *Paurochaetium* (10 species). Twenty-five are native to North America, ten originate from South America and eight are from the Old World (Rominger 1962).

The subgenus *Paurochaetium* forms an "artificial group" (Rominger 1962) distinguished from the remainder of the genus by the occurrence of only one bristle usually below the terminal spikelet of the primary branches. The subgenus occurs as two separate complexes. The first complex ranges from southern Florida through the West Indies and into the Yucatan region of Mexico and Belize. The complex includes *Setaria distantiflora* (A. Richard) Pilg., *S. pradana* (Léon) Léon, *S. leonis* (Ekman) Léon, *S. ophiticola* (Hitc. & Ekman) Léon, *S. subtransiens* Hitc. & Ekman, *S. utowanaea* (Scribn.) Pilg., and *S. chapmanii* (Vasey) Pilg.. The second complex occurs from northeastern Mexico through the western two-thirds of Texas, into southern Oklahoma and west into New Mexico. It extends from the Balcones Escarpment of Texas to Chaves County, New Mexico. The complex includes *S. firmula* (Hitc. & Chase) Pilg., *S. ramiseta* (Scribn.) Pilg. and *S. reverchonii* (Vasey) Pilg.. Not included in Rominger (1962) is the species *S. variifolia* (Swallen) G. Davidse found in the Yucatan Peninsula of Mexico and south.

Rominger (1962) separated the subgenus from the remainder of *Setaria* by the presence of a single bristle "usually" below the terminal spikelet of each primary branch. Gould (1975) used the same character to separate the species that occur in Texas; however, he reported a problem with the identification of specimens based on this character. These problems led to the current research in the subgenus.

The objectives of the research were to 1) determine the relationships of the taxa in the Texas/Mexico/Oklahoma/New Mexico complex and 2) provide a taxonomic treatment of all taxa recognized by Rominger (1962) in the subgenus *Paurochaetium* and *S. variifolia*.

MATERIALS AND METHODS

Field collections were made during the flowering periods of the species throughout Texas, Florida and Belize. To insure isolation between the populations, a minimum distance of five miles was traveled between successive collection sites. Ten independent specimens from each site were semi-randomly collected and pressed; selection was biased in favor of mature plants that did not show any signs of damage from insects, herbivores, trampling, etc. The West Indies species were studied from herbaria specimens. In some cases sufficient samples were available of a single collection to serve as a "real" population. In others, "artificial" populations were created based upon similar geographic location. A total of 78 populations were studied for the subgenus.

Table 1 lists the 52 characters measured from representative populations to determine the relationship between the 11 species. All characters of selected populations were measured and statistically analyzed to determine significant characters for the detailed study of the subgeneric relationships. Nineteen characters were determined to be significant and included in that analysis. The following hypothesis was tested: taxa of subgenus *Paurochaetium* should be classified in one subgenus versus the need to describe a new subgenus. Two hundred and ninety two operational taxonomic units (OTU's), representing all species included in the study, were measured.

Univariate statistics (mean, standard deviation and range) were obtained using the PSI-Plot software package (Poly Software International 1996). Multivariate statistics of principal component analysis (PCA) was obtained using the NT-SYS software package (Rohlf 1990). Principal components were derived using correlation matrices.

RESULTS AND DISCUSSION

SUBGENERIC STUDY

Based upon the analysis of the 11 species classified in *Setaria* subgenus *Paurochaetium*, two distinctly separate entities were discovered. These differences matched the two complexes within subgenus *Paurochaetium* mentioned earlier. Figure 1 illustrates the separation between the two complexes.

Based upon the relationships revealed through the PCA, geographical separation, consistent morphological differences and similar habitat requirements of the complexes, the subgenus *Reverchoniae* is proposed.

***Setaria* subgenus *Reverchoniae* W.E. Fox, subgenus nov.** BASIONYM: *Panicum reverchonii* Vasey, Bull. U.S. Dept. Agric. Div. Bot. 8:25. 1889. TYPE: *Reverchon s.n.* (US!). TYPUS: *Setaria reverchonii* (Vasey) Pilg.

Setaria subgeneris *Reverchoniae* ab subgeneri *Paurochaetio* per absentiam paleae flosculi inferior, paniculam erectam, spiculam grandiolem (2.1–4.5 mm long, 1.2–2.6 mm latam) fortuito dispositam (non dispositam), atque axe inflorescentiae scabro differt.

Setaria subgenus *Reverchoniae* differs from subgenus *Paurochaetium* in the absence of a palea of the lower floret, erect panicle, larger spikelets (2.1–4.5 mm long, 1.2–2.6 mm wide) that are randomly disposed (not distichous), and the scabrous axis of the inflorescence.

Setaria subgenus *Reverchoniae* contains three taxa previously classified in the subgenus *Paurochaetium* (Rominger 1962) including the proposed subspecies: *Setaria reverchonii* (Vasey) Pilg. subsp. *reverchonii*, *S. reverchonii* (Vasey) Pilg. subsp. *ramiseta* (Scribn.) W.E. Fox and *S. reverchonii* (Vasey) Pilg. subsp. *firmula* (Hitchc. & Chase) W.E. Fox. *Setaria variifolia* was included in the subgenus, but was not treated originally by Rominger (1962). The lack of a palea in the lower floret best circumscribes the subgenus *Reverchoniae*

TABLE 1. Fifty-two characters used to assess morphological and reproductive variation in *Setaria* subgenus *Paurochaetium*. All characters were measured for quantitative variation except those labeled as TS [two-state (binary)] and MS [multi-state qualitative]. Italicized characters were found as significant and used in the final analysis.

Vegetative: *growth habit* (MS), *culm height*, culms branched/unbranched (BS), internodes hollow/solid (BS), node pubescence present/absent (BS), leaves basal/throughout (BS), leaf sheath pubescence present/absent (BS), leaf sheath pubescence length (if present), *leaf length*, *leaf width* (widest point), *leaf base width*, *leaf inrolled/not inrolled* (BS), leaf pubescence abaxial present/absent (BS), leaf pubescence adaxial present/absent (BS), leaf pubescence margin present/absent (BS), collar pubescence present/absent (BS), collar pubescence length (if present), auriculate trichomes present/absent (BS), *auriculate pubescence length* (if present), ligule type (MS), *ligule length*

Inflorescence: *inflorescence length*, inflorescence axis pubescence present/absent (BS), distance between lower primary branches, distance between upper primary branches, terminal bristle length lowest branch, terminal bristle length upper primary branches, terminal bristle length terminal primary branch, bristle exceeding spikelet lowest branch (BS), bristle exceeding spikelet upper branch (BS), bristle exceeding spikelet terminal branch (BS)

Spikelet: *spikelet length*, *spikelet width*, *lower glume clasping* (BS), lower glume apex shape, lower glume # of veins (MS), *lower glume length*, upper glume equal/not equal fertile lemma, *upper glume length*, lower glume # veins (MS), sterile lemma equal/not equal fertile lemma (BS), *sterile lemma length*, sterile lemma # veins (MS), sterile palea present/absent (BS), *sterile palea length*, fertile lemma rugose (BS), *fertile lemma length*, *fertile palea length*, *caryopsis length*, *caryopsis width*, filament length, *anther length*, anther width

(exception *S. variifolia* that shares other characters aligning it with the subgenus). None of the members of subgenus *Reverchoniae* are sympatric with subgenus *Paurochaetium*. For further detail of the relationships of the two subgenera refer to Fox (1999).

KEY TO SUBGENERA OF *SETARIA*

1. Bristles one to many below each spikelet (some without bristles); leaf blades plicate 2
2. Leaf blades plicate; bristles present below only some of the spikelets **Ptychophyllum**
2. Leaf blades not plicate; bristles below all spikelets (rarely missing) **Setaria**
1. Bristles present usually only below the terminal spikelet of branch as an extension of branch; leaf blades not plicate 3
3. Panicles nodding (except *S. pradana*), bearing remote, appressed, mostly racemose branches with spikelets two ranked on an undulating axis; central inflorescence axis glabrous; palea of lower florets present and conspicuous **Paurochaetium**
3. Panicles erect; spikelets arranged randomly on branch; central inflorescence axis scabrous; palea of lower florets absent (except *S. variifolia*) **Reverchoniae**

SUBGENUS *REVERCHONIAE*

Four taxa are classified in the subgenus *Reverchoniae*: *Setaria reverchonii* subsp. *reverchonii*, *S. reverchonii* subsp. *ramiseta*, *S. reverchonii* subsp. *firmula* and *S. variifolia*. Figure 2 illustrates the relationship of the taxa in *Reverchoniae*.

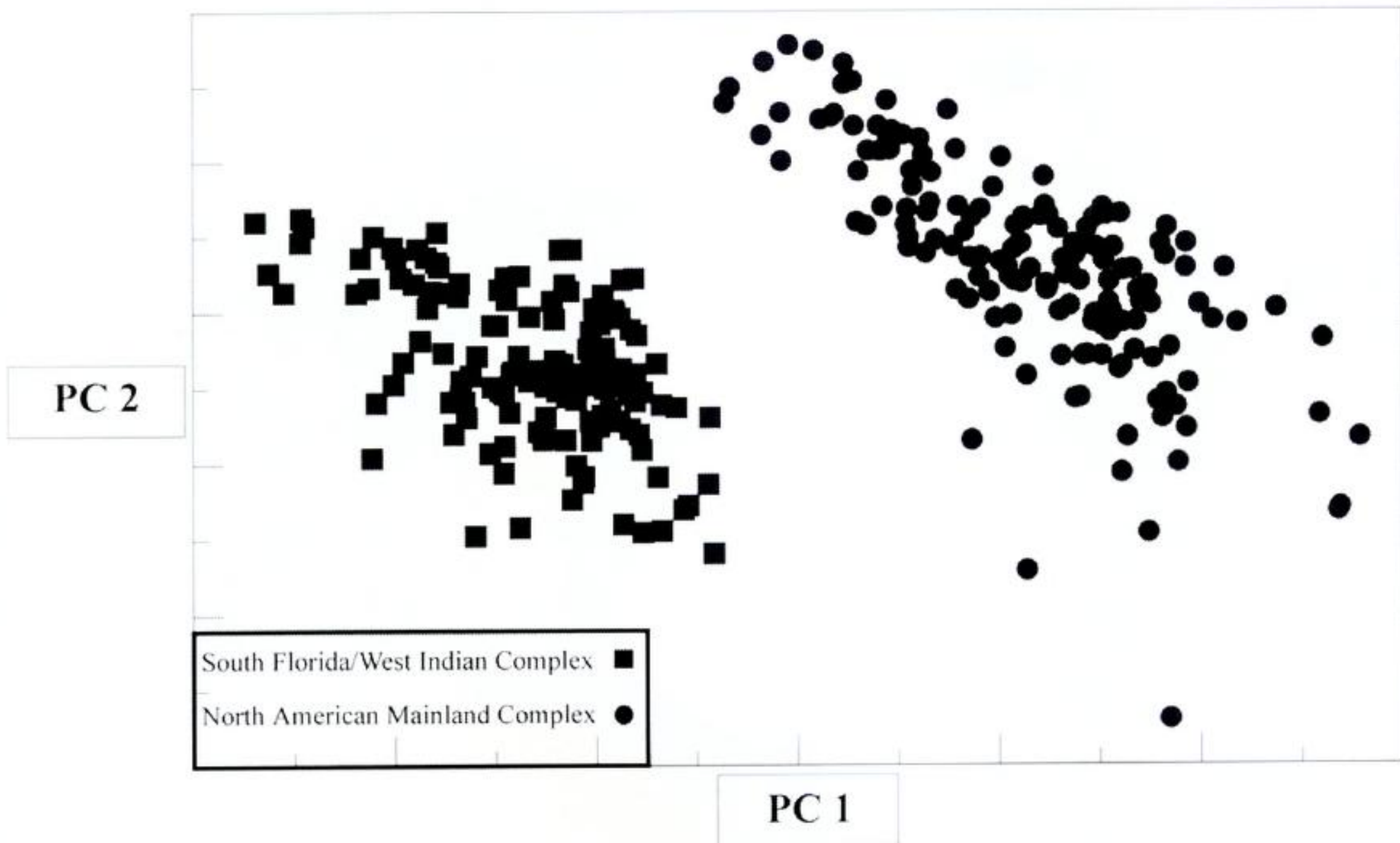


FIG. 1. Two-dimensional representation of all populations measured for the genus *Setaria* subgenus *Paurochaetium* (Rominger 1962).

Rominger (1962) classified *S. reverchonii*, *S. ramiseta*, and *S. firmula* as separate species following the combinations proposed by Pilger (1940). Other authors who have classified these taxa as species include Hitchcock (1935), Silveus (1942), Hitchcock (1951) and Gould (1975). When using the keys prepared by these authors, it becomes evident that the characters used do not result in consistent identifications. This problem resulted in the study of this complex and the following combinations.

***Setaria reverchonii* (Vasey) Pilg. subsp. *ramiseta* (Scribn.) W.E. Fox, comb. nov.** BASIONYM: *Panicum ramisetum* Scribn., Circ. U.S. Dept. Agric. Agrost. 27:9. 1900. *Setaria ramiseta* (Scribn.) Pilg., Engler & Prantl, Die Nat. Pflanzenf. 14e:72. 1940. TYPE: *G. Nealley* s.n. (LECTOTYPE: US!, by Rominger 1962).

Panicum subspicatum Vasey, Bull. U.S. Dept. Bot. 8:25. 1889, non *Panicum subspicatum* Desv., Opusc. Sci. Phys. Nat. 84. 1831.

Additional references and illustrations.—Hitchcock & Chase, Contr. U.S. Natl. Herb. 15:24, fig. 5. 1910; Hitchcock, Man. Grasses U.S. 611, fig. 1271. 1935.

***Setaria reverchonii* (Vasey) Pilg. subsp. *firmula* (Hitchc. & Chase) W.E. Fox, comb. nov.** BASIONYM: *Panicum firmulum* Hitchc. & Chase, Contr. U.S. Natl. Herb. 15:27, fig. 9. 1910. *Setaria firmula* (Hitchc. & Chase) Pilg. in Engler & Prantl, Die Nat. Pflanzenf. 14e:72. 1940. TYPE: *D. Griffiths* 6446 (HOLOTYPE: US!)

Additional references and illustrations.—Additional reference and illustration: Hitchcock, Man. Grasses U.S. 612, fig. 1273. 1935.

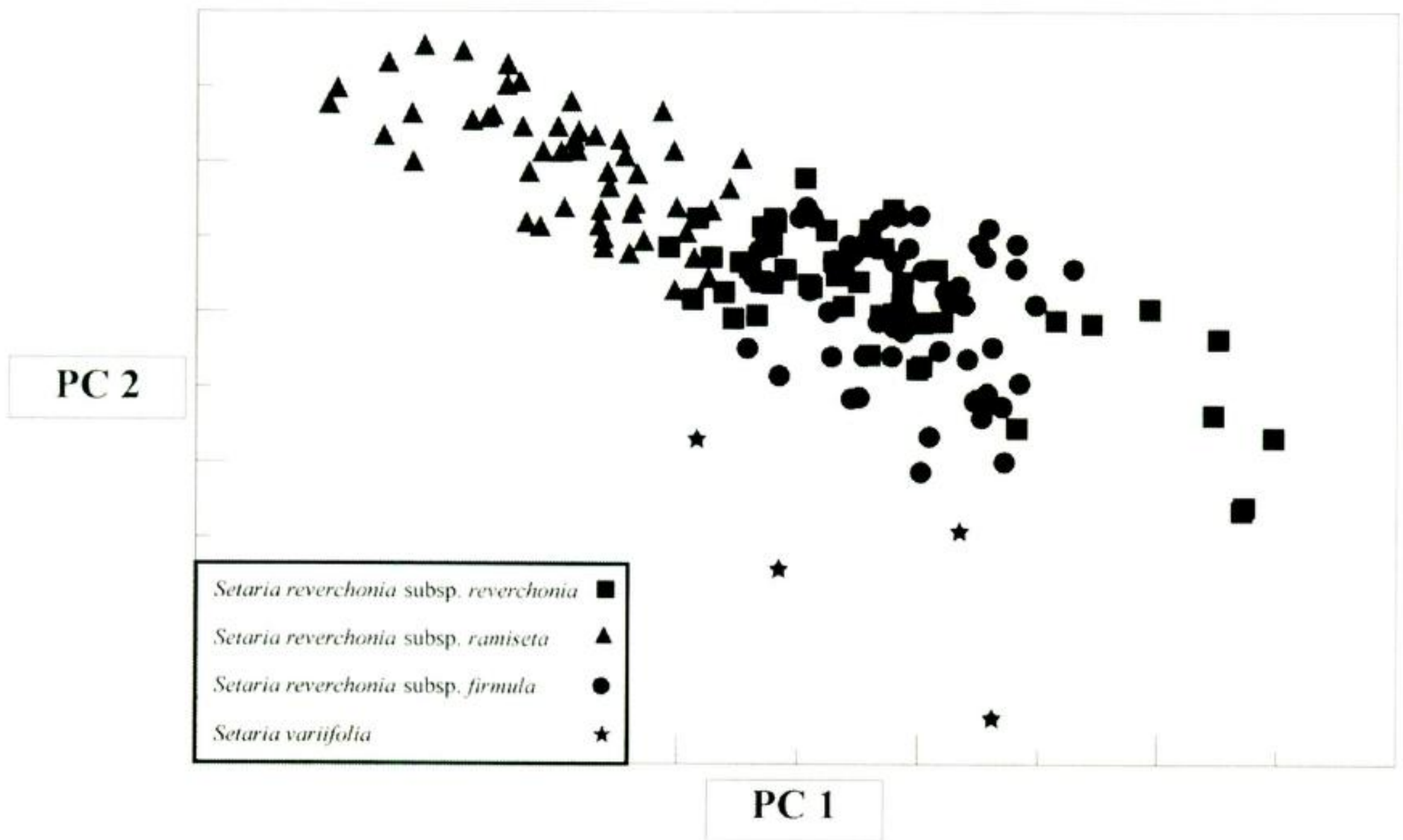


FIG. 2. Two-dimensional representation illustrating the relationships of the taxa described in *Setaria* subgenus *Reverchoniae*.

Setaria reverchonii subsp. *ramiseta* can be separated from the other taxa of the subgenus *Reverchoniae* with a shorter culm length, shorter penultimate leaf length, narrower leaf width, shorter second glume, shorter upper and lower lemma and shorter palea of the upper floret. *Setaria reverchonii* subsp. *reverchonii* is separated from subsp. *firmula* by a longer, narrower and usually involute leaf blade, a narrower leaf blade base above the collar and a longer lemma of the lower floret. Further references to the subspecies can be found in Fox (1999).

KEY TO SUBGENUS *REVERCHONIAE*

1. Palea of lower florets present and well developed; palea of upper (fertile) florets 3.0–3.1 mm long; distribution Yucatan peninsula of Mexico and Central America *S. variifolia*
1. Palea of lower florets absent or rudimentary; palea of upper florets (1.0–)1.8–2.5(–3.1) mm long; distribution Texas, New Mexico, Oklahoma and northern Mexico 2
2. Spikelets (2.4–)2.7–2.8(–3.4) mm long, (1.1–)1.5–1.6(–1.9) mm wide; second glumes (1.9–)2.4–2.5(–3.1) mm long; lemma of lower florets (1.0) 2.3–2.5(–3.2) mm long; lemma of upper florets (1.0–)2.2–2.3(–2.9) mm long; penultimate leaf blades (3.0–)6.8–7.6(–12.1) cm long; panicles (3.7) 17.7–20.7(–38.1) cm long *S. reverchonii* subsp. *ramiseta*
2. Spikelets (2.9–)3.2–3.4(–4.0) mm long, (1.2–)1.8–2.0(–3.6) mm wide; second glumes (2.4–)2.8–3.0(–3.6) mm long; lemma of lower florets (1.4) 2.8–3.0(–3.7) mm long; lemma of upper florets (2.2–)2.7–2.9(–3.4) mm long; penultimate leaf blades (3.6–)7.9–13.3(–28.6) cm long; panicles (9.5) 25.3–32.6(–64.8) cm long 3

3. Penultimate leaf blades (3.6–)11.7–13.3(–28.6) cm long, (1.4–)2.1–2.3(–3.4) mm wide, involute; leaf blade bases above collar (0.7–)1.3–1.5(–2.1) mm wide; lemma of lower florets (1.4–)2.9–3.0(–3.7) mm long *S. reverchonii* subsp. *reverchonii*
3. Penultimate leaf blades (5.1–)7.9–8.8(–15.4) cm long, (2.7–)4.4–4.7(–9.2) mm wide, flattened; leaf bases above collar (1.4–)3.0–3.2(–5.3) mm wide; lemma of lower florets (1.9–)2.8–2.9(–3.2) mm long *S. reverchonii* subsp. *firmula*

SUBGENUS *PAUROCHAETIUM*

The remaining seven taxa are retained the subgenus *Paurochaetium* as described by Rominger (1962). These include the original species of *Setaria distantiflora*, *S. leonis*, *S. ophiticola*, *S. pradana*, *S. subtransiens*, *S. utowanaea* and *S. chapmanii*. Taxonomic interpretation was difficult in the subgenus *Paurochaetium* due to a small sample size. Unfortunately, few specimens have been collected over time and available for the study. Hitchcock (1936) and Rominger (1962) classified *S. utowanaea*, *S. ophiticola* and *S. subtransiens* as distinct species. However, based upon the specimens examined in this study the following combinations are proposed.

***Setaria utowanaea* (Scribn.) Pilg. var. *ophiticola* (Léon) W.E. Fox, comb.**

NOV. BASIONYM: *Panicum ophiticola* Hitchc. & Ekman ex Hitchcock, U.S. Dept. Agric. Misc. Publ. 243:293, fig. 282. 1936. *Setaria ophiticola* (Hitchc. & Ekman) Léon in Fl. Cuba 163. 1946. TYPE: *E.L. Ekman 12712* (HOLOTYPE: US!).

***Setaria utowanaea* (Scribn.) Pilg. var. *subtransiens* (Hitchc. & Ekman)**

W.E. Fox, comb. NOV. BASIONYM: *Panicum subtransiens* Hitchc. & Ekman ex Hitchcock, U.S. Dept. Agric. Misc. Publ. 243:351, fig. 323. 1936. TYPE: *E.L. Ekman 16828* (HOLOTYPE: US!).

Based upon the mid-leaf width, leaf base width, spikelet length, lower lemma length and palea length of the upper floret, the varieties of *Setaria utowanaea* are classified separately from the remainder of subgenus *Paurochaetium*. Figure 3 illustrates the relationship of the three taxa in the *Setaria utowanaea* complex. *Setaria utowanaea* var. *subtransiens* differs from the other members of the species with a single bristle present below most spikelets on the branch, bristle length exceeding the spikelet, and spikelet width. *Setaria utowanaea* var. *utowanaea* is separated from *S. utowanaea* var. *ophiticola* by blade length, spikelet width, lack of tufted basal leaves and the presence of involute leaves on the upper culm. *Setaria utowanaea* var. *ophiticola* has shorter leaf blades, narrower spikelets, a tufted lower leaf arrangement and upper leaves that are slightly folded or flat. The following key separates the species of subgenus *Paurochaetium*. A key to separate the varieties of *Setaria utowanaea* will follow. Further reference to the taxa of subgenus *Paurochaetium* can be found in Fox (1999).

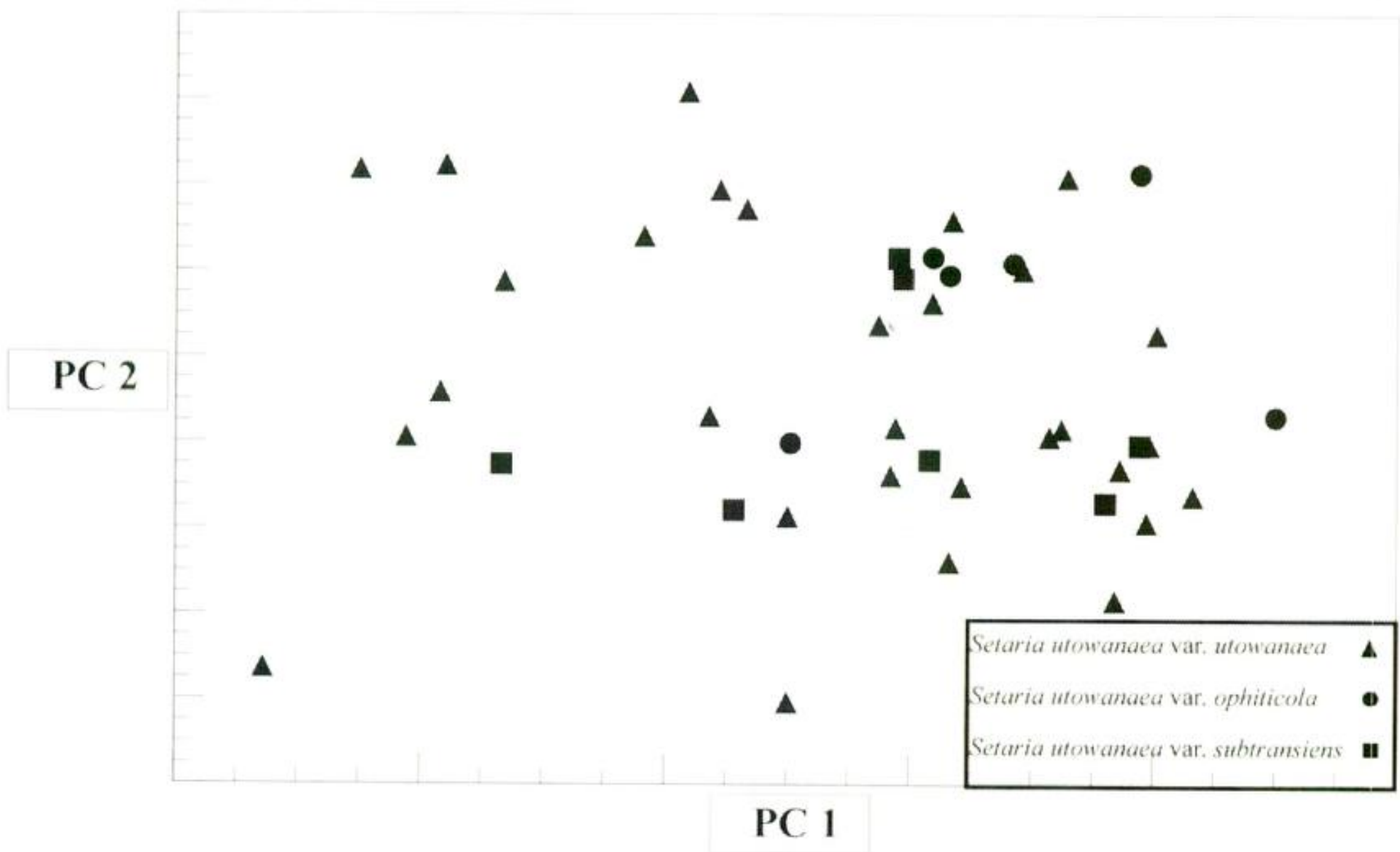


FIG. 3. Two-dimensional representation of the relationship between *Setaria utowanaea* var. *utowanaea*, *S. utowanaea* var. *ophiticola* and *S. utowanaea* var. *subtransiens*.

KEY TO SUBGENUS PAUROCHAETIUM

1. Spikelets (1.8–)2.0–2.2(–2.4) mm long, (1.0–)1.1–1.2(–1.3) mm wide, ovate, lacking palea of lower florets; penultimate leaf blades (9.3–)15.1–19.1(–34.4) cm long, (2.3–)3.2–3.9(–7.7) mm wide; leaf blade bases above collar (1.1) 1.2–2.7(–6.0) mm wide; second glumes subequal to equal fertile lemmas *S. chapmanii*
1. Spikelets (1.3–)1.4–2.4(–2.5) mm long, paleas of lower floret conspicuously present; leaf blade bases above collar (0.3–)0.4–1.4(–1.8) mm wide; second glumes conspicuously shorter than fertile lemmas 2
2. Panicles erect; spikelets (1.7–)1.8–2.0(–2.5) mm long, spreading; lower lemmas (1.4–)1.6–1.8(–2.1) mm long; lower paleas (0.4–)0.8–1.1(–1.4) mm long; upper paleas (1.2–)1.3–1.5(–1.9) mm long *S. pradana*
2. Panicles subflexuous; spikelets (1.8–)2.2–2.4(–2.5) mm long [except *S. distantiflora* (1.3–)1.4–1.5(–1.7)], not spreading; lower lemmas (1.6–)1.9–2.2(–2.4) mm long; lower paleas (0.8–)1.2–1.8(–1.9) mm long; upper paleas (1.4–)1.6–1.9(–2.1) mm long 3
3. Spikelets (1.3–)1.4–1.5(–1.7) mm long; first glumes (0.4–)0.6–0.7(–0.9) mm long; second glumes (0.6–)0.9–1.1(–1.3) mm long; lower lemmas (1.1–)1.3–1.4(–1.5) mm long; palea of lower florets (0.3–)0.9–1.1(–1.3) mm long; palea of upper florets (0.9–)1.0–1.1(–1.3) mm long *S. distantiflora*
3. Spikelets (1.6–)1.8–2.4(–2.5) mm long; first glumes (0.6–)0.7–1.3(–1.4) mm long; second glumes (0.7–)1.2–1.7(–2.1) mm long; palea of lower florets (1.2–)1.6–2.2(–2.4) mm long; palea of upper florets (1.2–)1.4–1.9(–2.1) mm long 4
4. Penultimate leaf blades (3.6–)4.7–5.9(–7.4) mm wide; leaf blade base above collar (1.1–)1.3–1.5(–1.8) mm wide; spikelet (1.6–)1.8–2.0(–

- 2.3) mm long; lemma of lower florets (1.2–)1.6–1.8(–2.2) mm long;
 palea of upper florets (1.2–)1.4–1.5(–1.7) mm long *S. leonis*
4. Penultimate leaf blades (0.9–)1.1–1.3(–1.4) mm wide; leaf blade above
 collar 0.4–1.3(–1.4) mm wide; spikelets (1.8–)2.2–2.4(–2.5) mm long;
 lemma of lower florets (1.6–)1.9–2.2(–2.4) mm long; palea of upper
 florets (1.4–)1.6–1.9(–2.1) mm long *S. utowanaea*

KEY TO VARIETIES OF *SETARIA UTOWANAEA*

1. Bristles present below most spikelets on branch, (2.5–)4.0–5.1(–6.4) mm
 long, exceeding spikelet *S. utowanaea* var. *subtransiens*
1. Bristles present below only terminal spikelet of branch, (0.4–)0.5–3.3(–3.9)
 mm long, not exceeding spikelet 2
2. Leaf blades (7.8–)13.1–16.0(–21.9) mm long; spikelets 0.7–0.8(–0.9) mm
 wide; basal leaves not tufted, upper leaves involute *S. utowanaea*
 var. *utowanaea*
2. Leaf blades 3.3–5.4(–6.2) mm long; spikelets 0.5–0.7 mm wide; basal
 leaves tufted, upper leaves flat or slightly folded toward apex *S. utowanaea*
 var. *ophiticola*

CONCLUSIONS

Rominger (1962) stated that the separate classification of *Setaria* subgenus *Paurochaetium* is "artificial." However, based upon this study and input from various others, it is our opinion that, although "artificial" by definition, the eleven taxa form a distinct group distinguishable from the remainder of *Setaria*. Based upon this analysis, keys have been developed that consistently separate the taxa from the subgenera *Setaria* and *Ptychophyllum*.

However, our understanding of the relationships within what was originally classified as *Setaria* subgenus *Paurochaetium* have changed based upon these analyses. The proposal of the new subgenus, *Setaria* subgenus *Reverchoniae*, provides a natural separation of the original taxa recognized by Rominger (1962). With the proposal of the new subgenus, *Setaria* now has four recognized subgenera.

The inclusion of *Setaria variifolia* with the remainder of *Setaria* subgenus *Reverchoniae* added a little known taxon to the subgenera of *Setaria* that has a single bristle usually only below the terminal spikelet of the branch. Davidse (1981) suggested that *S. variifolia* was closely related to taxa of subgenus *Paurochaetium* as defined by Rominger (1962). This taxon provides a challenge to its classification due to the overlapping characteristics with several of the subgenera. However, based upon these analyses, the taxon is best classified with the subgenus *Reverchoniae*. *Setaria variifolia* warrants further study to determine if this classification is truly defined. A comparative analysis of all of the subgenera would determine if the classification is correct.

Within *Setaria* subgenus *Reverchoniae* two name combinations have been proposed. Based upon numerical study of morphology, leaf anatomy and

DNA content analyses *S. reverchonii* subsp. *firmula* and *S. reverchonii* subsp. *ramiseta* have been proposed (Fox 1999). The taxa of the subgenus (excluding *S. variifolia*) show a substantial amount of intergradation.

The remainder of the species originally classified by Rominger (1962) are retained in the subgenus *Paurochaetium*. However, name combinations have been proposed for two of the taxa, *S. utowanaea* var. *ophiticola* and *S. utowanaea* var. *subtransiens*.

There is a need for the study of the reproductive behavior of the three subspecies of *S. reverchonii*. The results of such research would help better understand the relationship of the taxa. If these taxa do not hybridize, it may indicate a trend towards speciation.

ACKNOWLEDGMENTS

We are grateful to Stanley D. Jones (BRCH) and Gretchen D. Jones (USDA, AWPMPRU) for reviewing the manuscript. We would also like to thank Paul Fryxell for the Latin translation of subgenus *Reverchoniae* and Jesus Valdes Renya for the Spanish translation of the abstract. Thanks is also given to the following herbaria for loans of specimens used in the study: ARIZ, BRIT, ENCB, F, FLAS, FTG, JBSD, LL, MO, MICH, NMC, NY, OKL, OKLA, PAUH, TAES, TEX, UPR, UPRRP, US and USF.

REFERENCES

- CLAYTON, W.D. and S.A. RENVOIZE. 1986. Genera graminum: Grasses of the world. Her Majesty's Stationary Office. London.
- DAVIDSE, G. 1981. *Setaria variifolia* (Swallen) G. Davidse, a new combination (Gramineae: Panicoideae). Ann. Missouri Bot. Gard. 68:226.
- FOX, W.E. 1999. A biosystematic study of the genus *Setaria* subgenus *Paurochaetium* and the newly proposed subgenus *Reverchonia*. Ph.D. Dissertation. Texas A&M University, College Station.
- GOULD, F.W. 1975. The grasses of Texas. Texas A&M University Press, College Station.
- HÄCKEL, E. 1887. Echte Graser. In: Engler & Prantl, Die Natürlichen Pflanzenfamilien. 2(2):1–97.
- HITCHCOCK, A.S. 1935. Manual of the grasses of the United States. U.S. Dept. Agric. Misc. Publ. 200. U.S. Government Printing Office, Washington, D.C.
- HITCHCOCK, A.S. 1936. Manual of the grasses of the West Indies. U.S. Dept. Agric. Misc. Publ. 243. U.S. Government Printing Office, Washington, D.C.
- HITCHCOCK, A.S. 1951. Manual of the grasses of the United States. 2nd Ed. U.S. Dept. Agric. Publ. 200. U.S. Printing Office, Washington, D.C.
- PILGER, R. 1940. Gramineae III: Unterfamilie Pancoideae. In: Engler & Prantl Die. Nat. Pflanzen. 143:70–73.
- PILGER, R. 1954. Das system der Gramineae. Bot. Jahrb. 76:281–384.
- PRAT, H. 1936. La systématique des Graminées. Ann. Sci. Nat. Bot., Ser. 10, 18:165–258.
- POLY SOFTWARE INTERNATIONAL. 1996. Psi-Plot Ver. 5.02, Salt Lake City, Utah.

- ROHLF, F.J. 1990. NTSYS-pc: Numerical taxonomy and multivariate analysis system, Ver. 1.8. Exeter Software, New York.
- ROMINGER, J.M. 1962. Taxonomy of *Setaria* (Gramineae) in North America. Illinois Biol. Monogr. 29. University of Illinois Press, Urbana.
- SILVEUS, W.A. 1942. Grasses: classification and description of species of *Paspalum* and *Panicum* in the United States. Published by author, San Antonio, Texas.
- SODERSTROM, T.R.; K.W. HILU; C.S. CAMPBELL, and M.E. BARKWORTH (eds.) 1986. Grass systematics and evolution. Smithsonian Institution Press, Washington, D.C.
- STEBBINS, G.L. 1956. Cytogenetics and evolution of the grass family. Amer. J. Bot. 43:890-905.

BOOK REVIEW

LAURENCE C. WALKER 1996. **Forests: A Naturalist's Guide to Woodland Trees.** (ISBN 0-292-79112-7, pbk.). The University of Texas Press, P. O. Box 7819, Austin, TX 78713-7819. \$19.95. 302 pp., 68 B & W photos, 12 figures, 3 tables.

This book is aimed at the amateur naturalist, to introduce the major groups of timber trees, their uses, and the forests they grow in. While I have difficulty with terms such as "male flowers" of Spruce and Fir (microsporangiate strobili), I understand that the author is purposely trying to keep as many of the species descriptions parallel throughout the text, which he accomplishes. The text is filled with interesting trivia, important general ecological concepts, important dendrological and morphological features of the trees, many of their uses and distribution. It is copiously illustrated and extremely easy to "leaf" through. There are numerous editorial comments, akin to those sometimes made by senior distinguished lecturers, but they do not seriously affect the delivery of important information in the text. It is obvious that Walker is a pragmatic practitioner, and while the theoretical concepts may be slightly out of date, the general summary information for each group of species is very useful, particularly to those unfamiliar with which species are commercial, where they grow, and what is important about them.

Perhaps because I am not a forester, I found such terms as "stink-bomb tree" for *Ginkgo* amusing, as I did the discussion of its "leaf spigots" and "living scissors" (Chapter 28). While the terminology may be "folksy" and very informal, it is aptly suited to the intended audience and painlessly injects some biological knowledge directly into the reader. The "Projects for the Amateur Naturalist" section at the end of every chapter are clever exercises that teach the audience how foresters do their work. While most are very straightforward, they are all time- and resource-consuming, but again, most things worth doing are. The reading lists and glossary are extremely useful.

In summary, I recommend this book for every backyard naturalist who is curious to know how the forestry community views the most important kinds of timber trees and their environments.—*John J. Pipoly III.*