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A TAXONOMIC STUDY OF VARIATION IN *LEPTOCHLOA FASCICULARIS* (LAM.) GRAY IN THE CENTRAL GREAT PLAINS

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The morphology of *Leptochloa fascicularis* (Lam.) Gray (Poaceae) was studied in 25 locations in eastern and central Nebraska to determine if this grass was separable into two distinct taxa as suggested in several recent sources. Field collections were supplemented with herbarium specimens from other parts of the Central Great Plains. Glume and lemma lengths, the characters used in published keys, provided no separations useful in dividing the material into two species or varieties. However, individual local populations exhibited significant differences from each other in these characters. Such local differences appear to be reasonable given the high degree of inbreeding that appears to be prevalent at most locations.

† † †

INTRODUCTION

Leptochloa fascicularis (Lam.) Gray is an annual grass found in muddy or wet soils in marshes, along ditches and as a weed in parking lots. Gleason and Cronquist (1963) recognized this taxon as one species with three varieties, of which *L. fascicularis* var. *fascicularis* and *L. fascicularis* var. *acuminata* (Nash) Gleason are found in the Great Plains. Separation of varieties by Gleason and Cronquist was based on the length of the glumes and lowest lemma.

McNeill (1979) (who placed these taxa in the genus *Diplachne*) considered *L. acuminata* (Nash) Mohlenbrock (as *D. acuminata* Nash) a species distinct from *L. fascicularis* (as *D. fascicularis* (Lam.) Beauv.) based on the length of the glumes and the lowest lemma and on the scabrosity of the panicle and blade. In McNeill's treatment, *L. fascicularis* was reported to have a first-glume length of 1.3–2.0 mm, second-glume length of 2.2–3.5 mm and lowest lemma length of 2.0–4.0 mm. *L. acuminata* was said to have a first-glume length of 2.0–4.0 mm, second-glume length of 3.5–5.0 mm and lowest lemma length of 4.0–5.0 (8) mm and a more scabrous panicle and blade than *L. fascicularis*.

Fernald (1950) and Dore and McNeill (1980) also recognized both *L. fascicularis* and *L. acuminata* (as *Diplachne*) as did Mohlenbrock (1973) (as *Leptochloa*). All of these authors made separations similar to those made by McNeill, although Fernald suggested a gap in measurements between the two species. Dore and McNeill cited one collection from a railroad yard near Niagara Falls as evidence of a separate species. Mohlenbrock (1973) recognized distinct species based on 12 collections of *L. fascicularis* and one collection of *L. acuminata*.

MATERIALS AND METHODS

Collections of the *Leptochloa fascicularis* complex were made in 22 locations in eastern and central Nebraska between July and September in a wide variety of habitats. Habitats collected from included roadsides, wet ditches and parking lots in sand, mud, gravel on crushed rock substrates. These collections were supplemented with 96 herbarium specimens borrowed from the University of Kansas (KANU). This material contained plants from a wide variety of habitats in New Mexico, Texas, Oklahoma, Kansas, Nebraska, South Dakota, North Dakota and Illinois. In the text which follows, the term "Great Plains collections" includes both the 22 field collections and the 96 herbarium specimens. In addition to this general sample, large population samples, termed

"individual population collections" were collected in three locations in eastern Nebraska during July and August so that the extent of variability in single populations could be estimated.

Morphology of the spikelet was observed and measurements were recorded for the length of the first and second glume, lowest lemma, lemma awn, pedicel, spikelet and ligule. All data were obtained from spikelets on the middle of the panicle. The Duncan Multiple Range Test, the Student-Newman-Keuls Test, and Scheffe's Test (Allen, 1982) were used for characters measured on the three individual population collections. A hybrid index (Bell, 1967) was also applied to these populations so that several characteristics could more easily be visualized at the same time. The separations used in the construction of this index were mainly those of Fernald (1950), since he left room for intermediate conditions. However, the separation used for first-glume length was that of McNeill (1979), since Fernald did not discuss that character. Blade width and scabrosity of the panicle and blade were also recorded on much of the material. All of these measurements were made using an ocular micrometer in a dissecting microscope. Field observations of the florets were made using a hand lens to determine if the anthers were exserted at the time of collection.

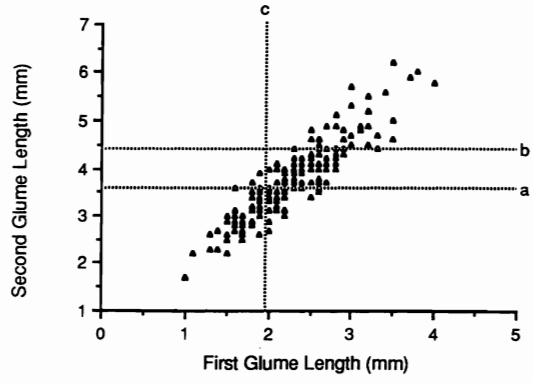
OBSERVATIONS AND RESULTS

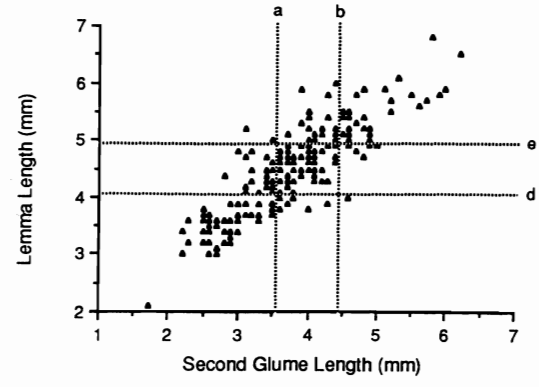
Collections made in early July showed that *Leptochloa fascicularis* commonly flowered within the sheath. Upon dissection of the individual florets, anthers were found to be tangled in the stigmas. Later in the flowering period the panicles were commonly exserted from the sheath, but the frequency of the anthers being exserted from the florets depended on the habitat. Plants collected in wet habitats commonly had some, but not all, anthers exserted on individual spikelets. Plants collected in dry habitats normally did not have any anthers exserted.

Great Plains collections

The characters analyzed, the lengths of the two glumes and the lemma, were those used by previous workers. Other characters measured either 1) showed very similar patterns of variation (e.g., pedicel length), or 2) varied erratically over a wide range (e.g., ligule length and scabrosity of panicle and blade), or 3) varied over such a narrow range that it was impossible to measure them precisely using the available equipment (e.g., anther length).

In the Great Plains collections, first-glume length ranged from 1.0–4.0 mm, second glume from 1.7–6.2 mm, and lowest lemma from 2.1–6.8 mm. Scatter diagrams involving these three characteristics (Figs. 1 and 2) show no obvious separation into two populations. Using McNeill's or Fernald's separations, a number of individual plants would have been identified as one species using first-glume length and another species using second-glume length with similar consequences when comparing second-glume length and lemma length. Using Fernald's separations, a high percentage of the plants of this collection were intermediate between the two taxa.





Figures 1, 2: 1 Scatter diagram of first-glume length vs. second-glume length for Great Plains collections. Lines *a* and *c* represent the points of separation between McNeill's (1979) two species. The gap between lines *a* and *b* represents the separation Fernald (1950) creates between his two species (Fernald does not utilize first-glume length). 2. Scatter diagram of second-glume length vs. lowest-lemma length for Great Plains collections. Lines *a* and *d* represent the points of separation between McNeill's (1979) two species. The gaps between lines *a* and *b* and between *d* and *e* represent the separation Fernald (1950) creates between his two species.

Table I. Ranges and means for lengths of first glumes, second glumes and lemmas for the Two Rivers, Salt Marsh, and U.N.O. populations. All values for parameters between populations differ significantly ($p = 0.05$) using the Duncan Multiple Range Test, Student-Newman-Keuls Test, and Scheffe's Test (Allen, 1982).

Populations	First glume (mm)	Second glume (mm)	Lemma (mm)
Two Rivers	1.8–3.7 x = 2.5	3.1–4.9 x = 4.0	3.6–4.9 x = 4.8
Salt Marsh	2.2–3.4 x = 2.9	3.7–5.5 x = 4.7	5.0–6.3 x = 5.5
U.N.O.	1.5–2.6 x = 2.1	2.9–4.3 x = 3.6	3.8–4.8 x = 4.3

Table II. Measurements used and index values assigned in the construction of the hybrid indices in Fig. 4.

Character	Hybrid index value 0	Hybrid index value 3	Hybrid index value 6
First-glume length (mm)	< 2.0	2.0	> 2.0
Second-glume length (mm)	< 3.5	3.5–4.5	> 4.5
Lowest-lemma length (mm)	< 4.0	4.0–5.0	> 5.0
Total index value	0	3–15	18
Species designation	*L. fascicularis*	intermediate	*L. acuminata*

Individual population collections

A total of 157 plants were collected from three locations in eastern Nebraska. Seventy-five plants were collected along the Platte River at Two Rivers State Recreation Area, Douglas County, Nebraska, on August 12. All plants were collected in wet, sandy soil along the river bank. Cleistogamy was observed in the majority of plants, but some were observed to have some anthers exserted on the florets, indicating some chasmogamous reproduction. Thirty-two plants, also largely cleistogamous, were collected in a salt marsh on 27th street in Lincoln, Lancaster County, Nebraska on August 31. Fifty plants were collected in a disturbed habitat in the parking lot of the University of Nebraska at Omaha (U.N.O.), Douglas County, Nebraska, in an area in which the soil appeared to be very dry. Twenty-four

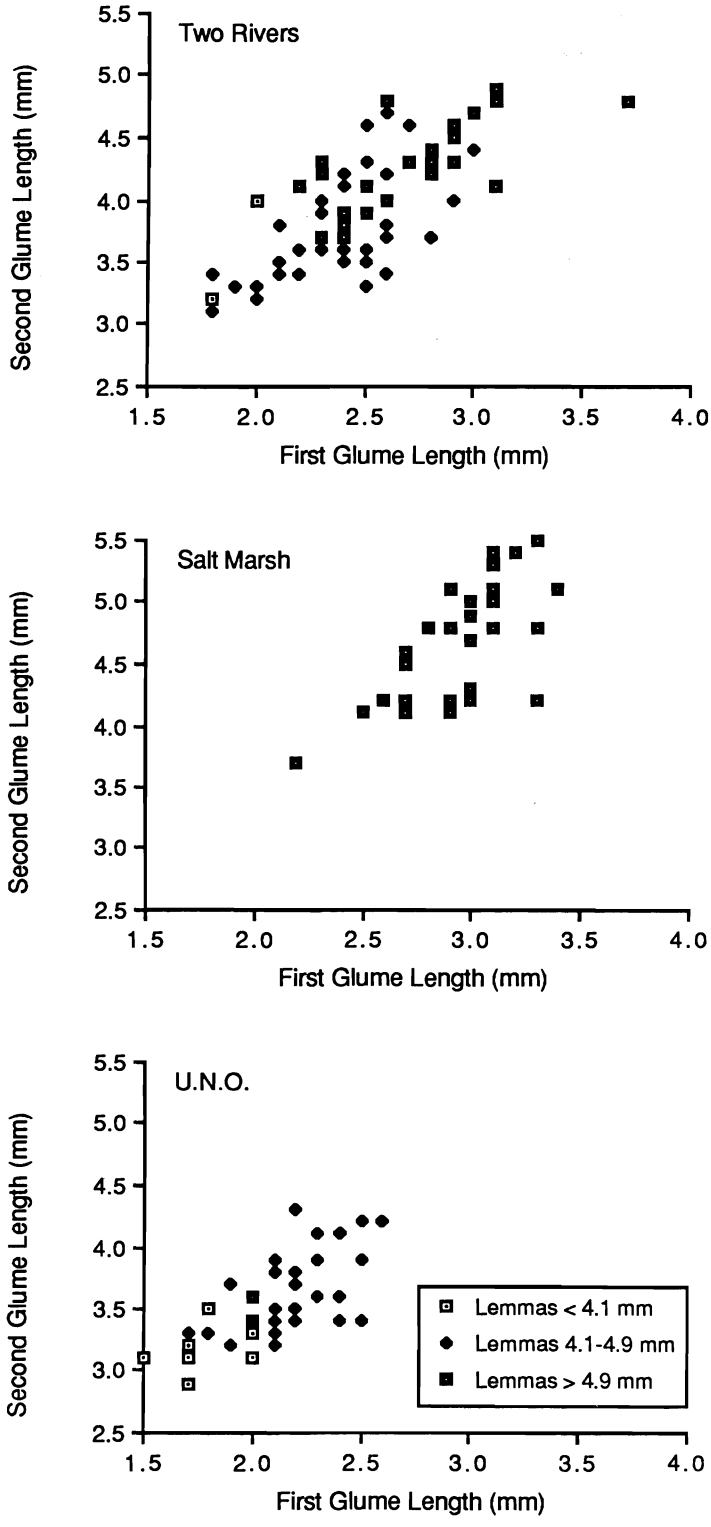


Figure 3. Scatter diagrams plotting first-glume length vs. second-glume length for the Two Rivers, Salt Marsh and U.N.O. populations, with lemma-length categories indicated by symbols.

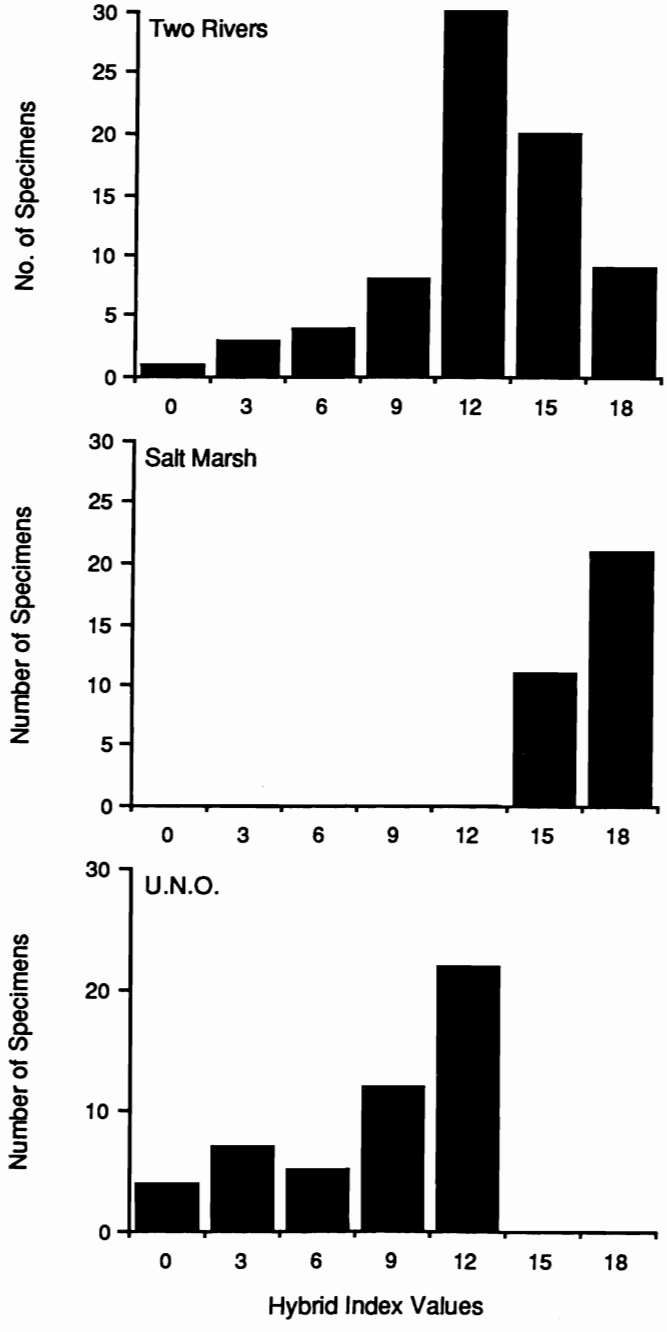


Figure 4. Hybrid index plots for the Two Rivers, Salt Marsh, and U.N.O. populations combining first-glume length, second-glume length, and lemma length. See Table II.

of the 50 U.N.O. plants were mature on June 27, and were collected at that time. The remaining 26 plants represented in the U.N.O. data were collected on July 7. No plants from this population were observed to have anthers exserted from the florets.

The ranges and means for lengths of first glumes, second glumes and lowest lemmas for these three populations are given in Table I. The three statistical tests applied showed that all three characteristics were significantly different for all three populations.

When the three characteristics were considered together in scatter diagrams, each population formed its own distinct cluster, but none of the three populations showed any internal separations (Fig. 3) In the Two Rivers and U.N.O. populations, a number of individuals which were intermediate with respect to lemma length could be seen to be assignable to one species or the other based on glume length.

When the characteristics were combined in a hybrid index, each population again was shown to be distinctly different (Table II, Fig. 4). The hybrid index for the Two Rivers population assigned only one specimen to *L. fascicularis* and nine specimens to *L. acuminata*, the remaining 65 plants being intermediates. The Salt Marsh population had no plants assignable to *L. fascicularis*, 21 plants assignable to L. acuminata and the remaining 11 as intermediates. Four plants from the U.N.O. were assignable to *L. fascicularis*, none to *L. acuminata*, and the remaining 46 as intermediates.

CONCLUSIONS

Using glume and lemma lengths, the *Leptochloa* complex in the Great Plains appears to represent a single taxon, but with individual populations significantly different from other populations. Authors basing the separation of species on data obtained from a small number of small collections (Dore and McNeill, 1980; McNeill, 1979; Mohlenbrock, 1973) have not observed the continuous range of variation that occurs in reality. Though the number of populations sampled is not reported by Fernald in his separation of the taxa, it would appear that he may have based his separation on a few populations as evidenced by the large number of intermediate individuals collected for this study. This study indicates that local populations may differ markedly from each other, even when geographical distance between them is not great and particularly

when populations exhibit a high frequency of cleistogamy.

ACKNOWLEDGMENTS

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