COLLECTION AND CHARACTERIZATION OF GERMPLASM RESOURCES OF THE FORAGE LEGUME *AESCHYNOMENE AMERICANA* IN LOUISIANA

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ABSTRACT

Aeschynomene americana *L., a self-pollinating annual legume, occurs throughout the Caribbean region. In Louisiana, this species was found to be restricted to disturbed sites within the Mississippi Delta south of Lat 30°30′ N. Sixty-seven Louisiana collections of* A. americana *and the check cultivar Florida Common were characterised at an alluvial site (silty clay loam soil) and at an upland site (silt loam soil). The alluvial location was significantly more favourable for early-season forage production of* A. americana. *At both locations, plant and leaf dry matter yields were correlated (r > 0.99); however, leaf/stem ratio was negatively correlated with both yield variables (r = from −0.19 to −0.46). Seedling height was a good indicator of plant and leaf dry matter yields (r = 0.50 and 0.48) only at the upland location, where grass competition was permitted. Stem diameter was independent of seedling height and plant and leaf dry matter yields at the alluvial location but positively correlated with plant and leaf dry matter yields at the upland location (r = 0.37 and 0.38). Semi-prostrate branching habit was positively correlated with plant and leaf dry matter yields at both locations (r = 0.28 to 0.37). No relationship was detected between collection site characteristics and agronomic traits of collections. Absence of detectable differentiation among collections could indicate recent derivation from a common source and supports other evidence that* A. americana *is newly arrived in the Mississippi Delta. All Louisiana collections had significantly smaller seedlings and finer stems than Florida Common and differed in stem and flower colour, suggesting that Louisiana populations of* A. americana *are not derived from Florida progenitors. The possibility of hybridisation of material and selection for special agronomic features is discussed.*

RESUMEN

La leguminosa anual autopolinizada, Aeschynomene americana *L., se encuentra a lo largo de la región del Caribe. En Louisiana, se notó que esta especie está limitada a sitios disturbados en el Sur del Delta del Mississipi, a una latitud 30°30′ Norte. Sesenta y siete colecciones de* A. americana *en Louisiana y el cultivar Florida común, fueron caracterizados en suelo aluvial (franco limo-arcilloso) y un suelo alto (franco-limoso). La localidad aluvial fue significativamente más favorable para la producción de* A. americana *a comienzos de temporada. En ambas localidades, los rendimientos de materia seca de planta y hoja estuvieron altamente correlacionados (r > 0.99); sin embargo, la relación hoja/tallo estuvo negativamente correlacionada con ambas variables de rendimiento (r = de −0.19 a −0.46). La altura de plantas fue un buen indicador de rendimiento de materia seca y de hojas (r = 0.50 y 0.48) sólo en la localidad alta, donde la competencia de pastos fue permitida. El diámetro del tallo era independiente de la altura de planta y los rendimientos de materia seca de planta y hoja en la localidad aluvial, pero estuvo correlacionada positivamente con rendimientos de materia seca de planta y hoja en la localidad alta (r = 0.37 y 0.38). El hábito de ramaje semipostrado estuvo correlacionado positivamente con los rendimientos de materia seca total y de hoja en ambas localidades (r = 0.28 a 0.37). No se detectó relación alguna entre las características del sitio de colección y los rasgos agronómicos de las colecciones. La ausencia de diferencia detectable entre colecciones, podría indicar una derivación reciente de una fuente común y respaldar la evidencia de que* A. americana *as de arribo reciente en el delta del Mississipi. Todas las colecciones de Louisiana mostraron ser plantas de tamaño significativamente más pequeño y tallos más delgados*

que Florida común y diferir en el color del tallo y de la flor, implicando que las poblaciones de Louisiana de A. americana *no se derivan de progenitores de Florida. Se discute la posibilidad de hybridización y selección de materiales para caracteristicas agronómicas específicas.*

INTRODUCTION

Advantages of mixed grass-legume summer pastures for the southeastern USA have been eclipsed by the convenience of nitrogen-fertilized summer perennial grasses. Because of recent low beef prices and higher nitrogen costs in the USA, livestock production costs must be reduced. As a result, interest in summer forage legumes has increased. *Aeschynomene americana* L. (aeschynomene or American jointvetch) is a self-pollinating (Hardy and Quesenberry 1984) tropical and subtropical annual, native to regions around the Carribean Sea (Rudd 1955). A selection of *A. americana* collected by the USDA Soil Conservation Service in 1958 in Arcadia County, Florida (PI 421680, 'Florida Common'), is used as a commercial forage in south Florida (Hodges *et al.* 1982). Florida was the only known North American extent of the range of *A. americana* (Rudd 1955) until Dooley (1972; cited in Lasseigne 1973) collected *A. americana* on a sandy Gulf Coast beach on the southern edge of the Mississippi Delta in Louisiana.

Germplasm collections of the genus *Aeschynomene* are held by the University of Florida, USA, CSIRO, Australia, and CIAT, Colombia. The combined world collection, including 98 accessions of *A. americana*, has been characterised in south Florida (Kretschmer and Bullock 1980) and north central Florida (Quesenberry and Ocumpaugh 1981). These characterization experiments provided basic information for an *Aeschynomene* breeding program at the University of Florida. In Queensland, Australia, a forage legume screening program resulted in the release of a Mexican collection of *A. americana* as the cultivar Glenn (Bishop *et al.* 1986).

In most years, rainfall in late spring and early summer is higher and more uniformly distributed in Louisiana than in south Florida (Louisiana Office of Climatology, 1980-1985 and previous). Consequently, *A. americana* can be planted up to 2 months earlier in Louisiana than in Florida (in April or May instead of June). *Aeschynomene americana* genotypes with high early growth rates might be ready for grazing as early as late June in Louisiana.

No seed collections of *A. americana* were made in Louisiana prior to 1982; consequently, no Louisiana accessions were represented in the world collection. Two collections were made in 1982 and compared to Florida Common in a small-plot experiment in 1983 and 1984 at 2 locations (Thro and Shock 1987). In 1985, a systematic collection was made of *A. americana* in Louisiana. The collection was evaluated the following year in field experiments at an alluvial site typical of the range of *A. americana* and at a site outside the range of the species but typical of the upland cattle-producing regions of Louisiana. Objectives of the research were to document the distribution of *A. americana* in Louisiana and to characterize the genetic resources represented by Louisiana accessions of this legume, particularly with regard to plant breeding programs selecting for early-summer forage production.

MATERIALS AND METHODS

Exploration and Collection

The range of *A. americana* in Louisiana was defined by exploration during the autumn of 1985. Road sides, swamp, marsh, beaches, cultivated and fallow fields, pastures, river banks and wooded areas were searched when mature seed was present (from September to November), from the Gulf Coast as far north as 32° N Lat, and 100 km into upland regions west and east of the Mississippi alluvial basin. Seed samples were collected every 8 to 16 km along the exploration route but more frequently if distinct changes were encountered in land use, soil type, or vegetation and less

frequently when no populations were found. Seed collected from each site was a bulk of many plants. Land use and associated vegetation at each site was recorded. Soil Conservation Service soil survey maps were used to identify soil type at each site. Annual rainfall and mean temperatures at collection sites were estimated from Louisiana Office of Climatology (1980-1985) data from state experiment stations located in Baton Rouge and Houma (Fig. 1). Daylength was determined from US Naval Observatory (1946) tables.

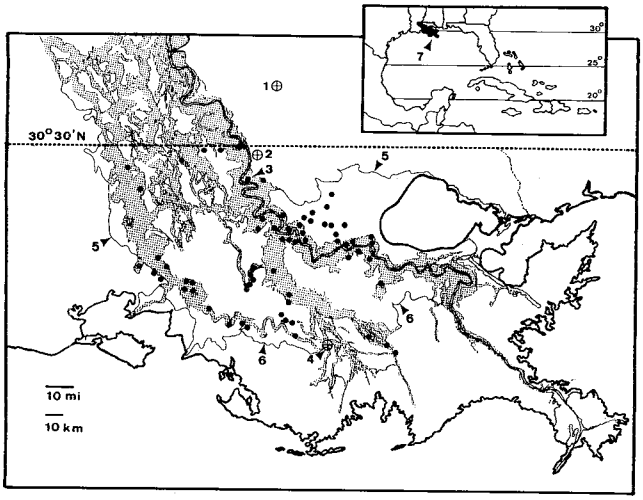

FIGURE 1

Collection sites (closed circles) of *Aeschynomene americana* in the lower Mississippi Delta in Louisiana. Shaded areas are natural levee formations. (Louisiana Geological Survey, 1984). 1 = Clinton (Idlewild Research Station); 2 = Baton Rouge; 3 = Ben Hur Research Farm; 4 = Houma; 5 = boundary, alluvial soil/upland soil; 6 = boundary, alluvial soil/marsh. Small map shows the lower Mississippi Delta (7) in relation to the Gulf of Mexico and Caribbean Region.

Germplasm Characterization

The characterization experiment was conducted in 1986 at the Ben Hur Research Farm at Baton Rouge (30° 25′N) and at the Idlewild Research Station at Clinton, LA (30° 50′N) (Fig. 1). Soil at Ben Hur was a Mhoon silty clay loam (fine-silty, mixed, non-acid, thermic fluventic Haplaquept) formed from recent alluvium with pH 6.2 and organic matter 1.7%. The Idlewild Research Station lies north of the range of *A. americana*, on upland loessial terrace soils. The soil at Idlewild was a Providence silt loam (fine-silty, mixed, thermic typic Fragiudalf) with pH 4.5 and soil organic matter 1.2%. At Idlewild, lime was applied at a rate of 4480 kg/ha to bring the soil to a post-liming pH of 5.5; no other fertilizer was used at either location. Soil nutrient status at Ben Hur was medium for phosphorus (P) (73 mg/kg), potassium (K) (258 mg/kg), and calcium (Ca) (2993 mg/kg) and high for magnesium (Mg) (699 mg/kg). Pre-liming soil nutrient status at Idlewild was low for P (20 mg/kg), very high for K (362 mg/kg) and Ca (601 mg/kg), and medium for Mg (109 mg/kg).

Sixty-seven Louisiana collections of *A. americana*, plus Florida Common (included as a check cultivar), were planted on April 29 at Idlewild and May 1 at Ben Hur. Five dehulled seeds of each collection and Florida Common, inoculated with "cowpea" rhizobia, were planted to a hill with 1.5 m between hills within rows and 1.5 m between rows. Plots at each location were arranged in a randomized complete block design with 4 replications; each plot consisted of 10 hills of a given collection or Florida Common.

At Idlewild, the field was rapidly overgrown with annual and perennial grasses which were kept mown between rows and allowed to compete with *A. americana* within rows. At Ben Hur, where major weeds were *Sorghum halepense* (L.) Pers (johnsongrass), *Ipomoea* spp. (morning glories), and *Euphorbia heterophylla* L. (wild poinsettia), hand weeding was used to clear a 30 cm radius around each seedling at the time of emergence. Morning glory vines were removed by hand throughout the growing season to facilitate harvest of *A. americana.*

Each hill was thinned to a single plant approximately 2 weeks after seedling emergence. On the same date and again 3 weeks later, seedling height to the growing point was measured to the nearest 0.5 cm. One replicate was harvested per day from July 15 to July 18 at Clinton and from July 22 to July 25 at Ben Hur. Plants were harvested individually at a height of 15 cm above the soil. Harvested plant samples were oven dried, and leaf and stem fractions were separated and weighed immediately. Total plant dry weight was calculated as the sum of leaf dry weight and stem dry weight. Leafiness was expressed as the ratio of leaf dry weight to stem dry weight. Branching pattern of individual plants was rated at harvest as "prostrate" (lower-most branches prostrate on the soil); "semi-prostrate" (lower-most branches at soil level but ascending); branched at medium height (lowest branches above soil level but below 5 cm); and high-branched (lowest branches above 5 cm). Branching pattern data were converted to percent of plants within a plot showing each pattern. Stem diameter in millimeters of the thickest post-harvest regrowth stem on each plant was recorded approximately 1 month after harvest, measured 20 cm from the growing point.

Data for seedling height, leaf dry matter yield, plant dry matter yield, leaf/stem ratio, and stem diameter were subjected to an analysis of variance including pre-planned single-degree-of-freedom contrasts between Florida Common and the Louisiana collection. Both original data and data transformed to square roots were analyzed. Data transformation reduced the coefficient of variation (CV) by approximately one-half for all traits. However, results of all analyses were similar whether original or transformed data were used. Analyses of original data are therefore reported. For Louisiana collections only, correlations were calculated between all traits within locations and by trait between locations. Ranking of all collections and Florida Common for each trait was compared over locations using Spearman's rank correlation coefficient (Steel and Torrie 1980). Relationship of characteristics of Louisiana collections to collection sites was examined using parish, habitat type, and soil classification of the collection site as sources of variation in separate analyses of variance and by calculation of correlation coefficients between measured variables and collection site data. All analyses were performed on a plot basis. Most plots of one replicate at Ben Hur were lost to accidental mowing and one replicate at Ildewild was grazed by deer: these replicates were omitted from the analyses.

RESULTS

Exploration and collection

Collections of *A. americana* were made at 67 sites, all within the Mississippi Delta and south of Lat 30° 30′ N (Fig. 1). Annual rainfall ranges from 1470 mm at the northern edge of this distribution to 1630 mm at the southern edge. Average temperatures are similar throughout the area, 32°C in summer and 14°C in winter. Daylength is 14 hours at midsummer at Lat 30° N, in the center of the Louisiana distribution of *A. americana,* and decreases to 11 hours by November 16, the average local date of first frost. The frost-free growing season varies from 300 days in the south to 260 days in the north (Reiling and Wiegmann 1979). A further decrease in the average length of the growing season, from 260 to 250 days, is the only climatic or edaphic change that could be associated with the observed 30° 30′ northern boundary of *A. americana* distribution.

Except for 2 collections found on loessial terrace sites at the extreme southwestern edge of the distribution, all collections of *A. americana* were found on natural levees (shaded areas, Fig. 1) (Louisiana Geological Survey 1984) or alluvial areas between levee and backswamp. On saturated soils of the backswamps, *A. americana* was replaced by *A. indica.* Most common soil textures at *A. americana* collections sites were silt loam (29% of all collection sites), silty clay loam (29%), and clay (26%). Soil reaction ranged from slightly acid (pH 6.1 to 6.5) to moderately alkaline (pH 7.9 to 8.4).

TABLE 1

Classification of habitat and soils at 65 Aeschynomene americana *collection sites in Louisiana.*

Habitat	Percent of collection sites	Soil classification	Percent of collection sites
		Entisols	
Edge of sugarcane field	26	Aeric Fluvaquent	38
Roadside	26	Typic Fluvaquent	2
Edge of soybean field	23	Fluventic Haplaquent	5
Ditch bank	12	Typic Hydraquent	6
Fallow field	5	Inceptisols	
Mown highway median	3	Vertic Haplaquept	17
Within soybean field	3	Unclassified swamp soils	3
Edge of backswamp	2	Alfisols	
	100	Albic Glossic	
		Natraqualf	2
		Aeric Ochraqualf	5
		Udollic Ochraqualf	2
		Vertic Ochraqualf	9
		Mollisols	
		Typic Agriaquoll	3
		Vertic Haplaquoll	3
		Unmapped	5
			100

Seventy-one percent of *A. americana* collection sites were located on young soils (Entisols, Inceptisols, and unclassified swamp soils) (Table 1). All *A. americana* collections in Louisiana were from disturbed sites such as roadsides and edges of cultivated fields (Table 1); *A. americana* was absent from undisturbed sites occupied by native plants. Plant species most commonly found in association with *A. americana* were *S. halepense* (associated with 55% of the collections); *Solidago altissima* L. (common goldenrod) (38%); *Cynodon dactylon* (L.) Pers. (bermudagrass) (28%); and *Ambrosia trifida* L. (giant ragweed) (23%).

Germplasm Characterization

In the combined analysis of variance over locations, collections were a significant source of variation only for seedling height and stem diameter. Separate analyses for each location gave similar results. The check cultivar Florida Common had faster-growing seedlings and thicker stems than the Louisiana collections at both locations, but was not higher yielding than the mean of the Louisiana collections at either location.

Location effects, in contrast to collection effects, were highly significant for all traits except leaf/stem ratio. Environmental conditions were more favourable for vegetative growth of *A. americana* at Ben Hur than at Idlewild, as shown by the higher values for seedling height at 2 and 5 weeks after emergence, and leaf and total dry matter yield at Ben Hur (Table 2). Although collection × location interaction was not significant for any trait, between-location rank correlations were not significant for any trait except seedling height at 2 weeks after emergence ($r = 0.25^*$), indicating that,

for most traits, collections were not ranked similarly in the 2 locations. In addition, with the exception of seedling height at 2 weeks (r = 0.33**) and percent of plants having a high branching pattern (r = –0.25*), traits were uncorrelated between the 2 locations.

TABLE 2

Location mean values and ranges of seedling height at 2 (HT1) and 5 (HT2) weeks after emergence; percent of plants per plot with prostrate (%PB) or semiprostrate (%SPB) lowest branches, lowest branches between 0 and 5 cm from the soil surface (%MB), or lowest branches higher than 5 cm above the soil surface (%HB); leaf (LDW) and plant (PDW) dry weight; leaf/stem ratio (L/S); and stem diameter (SD) of Aeschynomene americana *'Florida Common' and 67 Louisiana collections of* A. americana.

	Location					
	Ben Hur (alluvial site)			Idlewild (upland site)		
Trait	Florida common	Louisiana collect-tions	Combined range	Florida common	Louisiana collect-tions	Combined range
HT1 (cm)	6.1	4.8	2.2– 7.7	3.5	3.0	1.9– 3.7
HT2 (cm)	22.1	20.9	14.4– 26.2	18.2	16.0	11.8–20.0
%PB	0	0.2	0– 5.6	3.8	2.7	0–12.5
%SPB	54.4	61.1	33.3–100.0	52.9	57.1	24.4–87.5
%MB	40.8	30.7	0– 56.9	31.4	27.7	5.6–53.0
%HB	4.8	8.0	0–100.0	12.1	12.4	0–62.5
PDW (g)	8.4	9.3	3.4– 18.7	2.8	2.9	1.0– 9.7
LDW (g)	4.8	5.1	1.9– 15.4	1.6	1.6	0.6– 5.2
L/S	1.5	1.5	0.9– 3.0	1.4	1.6	1.2– 2.5
SD (mm)	2.8	2.0	1.8– 2.8	2.5	1.8	0.9– 2.5

TABLE 3

Correlations between seedling height at 2 (HT1) and 5 (HT2) weeks after emergence; stem diameter (SD); leaf (LDW) and plant (PDW) dry weight; leaf/stem ratio (L/S); and percent of plants per plot with lowest branches prostrate (%PB), semiprostrate (%SPB), or between 0 and 5 cm from the soil surface (%MB) among 67 Louisiana Aeschynomene americana *collections. All correlations with percent of plants with lowest branches higher than 5 cm above the soil surface (%HB) were similar to correlations with %MB. N = 201.*

	Trait								
Trait	HT1	HT2	SD	PDW	LDW	L/S	%PB	%SPB	%MB
	Ben Hur								
HT1		0.16*	–0.13	–0.34**	–0.34**	0.08	0.08	–0.14*	0.09
HT2	0.62**		–0.01	0.34**	0.34**	–0.26**	0.02	0.09	–0.08
SD	0.12	0.19**		0.04	0.05	0.09	–0.09	0.01	–0.07
PDW	0.15**	0.54**	0.37**		0.99**	–0.46**	–0.02	0.37**	–0.24**
LDW	0.48**	0.51**	0.39**	0.99**		–0.42**	–0.02	0.37**	–0.24**
L/S	–0.40**	–0.47**	0.04	–0.24**	–0.19**		–0.01	–0.27**	0.22**
%PB	–0.18**	–0.09	0.08	–0.06	–0.05	0.09			
%SPB	0.25**	0.29**	0.10	0.30**	0.28**	–0.24**			
%MB	–0.11	–0.24**	–0.05	–0.17*	–0.16*	0.16*			
	Idlewild								

*, **: correlation significantly different from zero at the 1% and 5% levels of probability, respectively.

Correlations between traits of Louisiana collections of *A. americana* within each location are shown in Table 3. Leaf dry matter yields and total plant dry matter yields were highly correlated (r > 0.99**) at both locations. Traits positively correlated with leaf and total plant dry matter yields were seedling height at 5 weeks after emergence and plants within a collection with semiprostrate branching pattern. Traits negatively associated with dry matter yields were leaf/stem ratio and percent of plants with mid-height and high branching patterns. Relationship of seedling height at 2 weeks

and of stem diameter to dry matter yields varied with location: both were positively correlated with the 2 yield variables at Idlewild, but at Ben Hur, seedling height at 2 weeks was negatively correlated with yield and stem diameter was independent.

Louisiana collections of *A. americana* were morphologically distinct from Florida Common. Florida Common was homogeneous for red stem color and buff to apricot colored flowers; most Louisiana collections were homogenous for green stem color and all had pink flowers. No relationship was detected between location, habit, or soil type of Louisiana collection sites and performance of Louisiana *A. americana* collections in the characterization experiment.

DISCUSSION

Exploration and Collection

The occurrence of *A. americana* on young soils and its restriction to the relatively new land formation of the Mississippi Delta is consistent with the edaphic distribution of the genus *Aeschynomene* section *Aeschynomene* (including *A. americana*) as discussed by Rudd (1955). The absence of *A. americana* from beaches was surprising because Dooley's (1972) original Louisiana report of *A. americana* was from a beach site and Rudd (1955) cites sandy beaches among common habitats of the section *Aeschynomene.*

With the exception of goldenrod, most plant species found associated with *A. americana* are introduced species that are also restricted to disturbed sites. This suggests that *A. americana* may be an introduced rather than native species in the delta. The absence of any report of *A. americana* in Louisiana prior to 1972 is probably not due to botanical oversight; other legume genera occurring in Louisiana are documented by specimens in the Louisiana State University Herbarium dating into the 19th Century. The absence of any *A. americana* specimens dated prior to 1972 may indicate that it was not present in the state until recently.

Aeschynomene americana could have arrived in Louisiana in several ways. Dispersal of *Aeschynomene* species around the Caribbean area by hurricanes, as suggested by Rudd (1955), could explain the recent appearance of *A. americana* on a Louisiana Gulf Coast beach. For example, in September of 1971, one year before *A. americana* was first observed in Louisiana, Hurricane Edith brought high wind and waves into south Louisiana after traversing the southern and western shores of the Caribbean (Neumann *et al.* 1981). Two years earlier, in 1969, Hurricane Camille hit the US Gulf Coast after crossing over Cuba. These or earlier tropical storms could have carried seed of *A. americana.* The observed present restriction of *A. americana* to disturbed sites raises a second possibility, accidental introduction through agriculture. Highway margins in south Louisiana are commonly planted to warm-season grasses using seed imported from Florida and it has been suggested that *A. americana* may arrive as a contaminent in these seed lots. Because the distribution of *A. americana* in Louisiana coincides with the sugarcane production region, it is also possible that *A. americana* seeds might have been carried on "seed" cane imported from Florida or the Caribbean to sugarcane breeding stations in the Mississippi Delta.

Germplasm Characterization

Environmental effects

The significant location effect observed in these experiments may include effects of differences in harvest date and plant physiological stage as well as differences in characterization sites. The Idlewild location was harvested first because, though plants were smaller at that location, they were in a more advanced stage of physiological maturity compared to plants at Ben Hur. Early flowering of some collections at Idlewild was noticed on July 11. By July 14, 1 day before harvest, at least 1 plant of every collection except Florida Common was flowering at Idlewild. After

harvest, flowers were not observed again until all collections flowered at the expected time in September/October. No collections initiated flowering at Ben Hur until autumn, nor was early flowering observed when Florida Common and the two 1982 Louisiana collections of *A. americana* were grown at Idlewild in 1983, 1984, 1985 and 1987. Critical maximum daylength for flowering of *A. americana* accessions in the world collection is reported to range from 12.5 to 11 h (Kretschmer and Bullock 1980; Quesenberry and Ocumpaugh 1981) but daylength at Idlewild between May 19 and July 9 was never less than 14 h.

Drought stress is known to stimulate reproductive development in some summer forage legumes (Hopkinson and Reid 1979) and could have been a cause of the early flowering response of plants at Idlewild. From May through September, 1986, the Louisiana Office of State Climatology reported drought indices (Palmer 1965) of "moderate drought" to "severe drought" for both Idlewild and Ben Hur. Plants at Idlewild may have had restricted root systems and less available water in the soil profile compared to plants at Ben Hur, causing the effective drought stress to be more severe at Idlewild than at Ben Hur. The soil at Idlewild has a fragipan layer, high bulk density, and low pH (USDA/SCS 1985). The dense fragipan layer limits root penetration and also limits moisture/holding capacity of the soil profile above the fragipan. Acidity in the subsoil could further limit root growth of *A. americana* at Idlewild. In contrast, the soil at Ben Hur has a lower bulk density and higher pH, characteristics that may permit better root system development, and higher plant-available moisture holding capacity (USDA/SCS 1981). The proximity of the Ben Hur site to the Mississippi River (1.6 km), and the common occurrence along the river of sand lenses through which lateral flow influences soil moisture status of the surrounding soils, suggests that plants at Ben Hur may have been able to draw on sub-aerially-supplied water.

Agronomic characters and plant selection

Animals grazing *A. americana* generally consume only leaves and those stems less than 4 mm in diameter (Gildersleeve 1982). Desirable forage cultivars should therefore have high values for leaf/stem ratio and leaf dry matter yield, and low values for stem diameter. Because leaf/stem ratio is negatively correlated with leaf dry matter yield in Louisiana *A. americana* collections, material selected for high leaf/stem ratio will not be the desired plant type. However, the very high positive correlation of leaf dry matter yield with plant dry matter yield suggests that selection of genotypes with high plant dry matter yield may by an efficient way to identify *A. americana* genotypes that have high leaf dry matter yield in the vegetative growth stage, thereby providing increased quantities of leafy forage to selectively-grazing animals.

The results of the analysis of the agronomic characteristics of the collection suggest that the feasibility of developing a cultivar of *A. americana* with finer stems, i.e., with an increase in the palatable and digestible proportion of stem dry weight, may differ with target environment. It appears that it is possible to identify Louisiana collections of *A. americana* with yields at least equal to present commercial yields of Florida Common and which possess finer stems. Moreover, if seedling height and stem diameter are independent in populations derived from hybridization between Florida Common and selected Louisiana collections of *A. americana*, recombinant hybrid progeny may combine the more robust seedlings of Florida Common with the finer stems of the Louisiana parent and forage yield similar to both parents.

The positive association of the proportion of plants having a semi-prostrate branching pattern with plant and leaf dry matter yield is favorable to development of agronomically desirable cultivars because low branches and buds are associated with grazing tolerance of forage legumes (Edye and Cameron 1984). Semi-prostrate growth habit may be a useful selection criterion during preliminary screening of very large heterogeneous populations of *A. americana.*

Tall seedlings were not a good indicator of plant productivity at Ben Hur, where hand-weeding eliminated competition at the time of seedling emergence, as indicated by the negative correlations of seedling height with plant and leaf dry matter yield at that location. The positive correlation of seedling height with forage yield at Idlewild, where grass was allowed to grow within the rows, may reflect greater competitive ability of taller, faster-growing seedlings.

Origin of Louisiana populations of A. americana

Absence of detectable local differentiation among Louisiana collections of *A. americana* may be another indication of the recent arrival of this species in the Mississippi Delta. Homogeneity would be expected, particularly in a self-pollinating species, if all collections originated from a limited sample introduced relatively few generations prior to the generation collected.

Further, the results of the characterization experiment suggest that *A. americana* did not arrive in Louisiana from Florida. In a nursery of 123 *A. americana* accessions from the University of Florida collection planted at Ben Hur in 1985, most had red stems and apricot, buff, or yellow flowers (Thro, unpublished data), similar to Florida Common and distinct from the green-stemmed, pink-flowered Louisiana collections. Numerous collections of *A. americana* have been made in Florida and all have been found to be phenotypically indistinguishable from Florida Common (K. H. Quesenberry and A. E. Kretschmer, personal communications). Because gene frequencies at these easily-observed stem and flower colour loci differ between the Florida and Louisiana populations, the otherwise plausible theory that Louisiana *A. americana* populations are derived from seed introduced from Florida (either through natural causes or agriculture) should probably be rejected. Progenitors of Louisiana *A. americana* more likely arrived from some other part of the Caribbean region.

Hybridization between populations that are genetically distinct at critical loci can result in recombinant progeny with novel genotypes that produce higher yields than either parent population (Langer *et al.* 1978). Because Florida Common and the Louisiana collections of *A. americana* have different geographic histories, their genetic divergence may extend to loci affecting yield and it may be possible to improve not only seedling competitive ability and fineness of stems but also forage yield of *A. americana* through hybridization between the 2 sources.

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REFERENCES

BISHOP, H. G., WALKER, B., LUDKE, D. H. and RUTHERFORD, M. T. (1986)—*Aeschynomenes*—a legume genus with potential for the Australian tropics. p. 160–161. *In* Proceedings of the XVth International Grassland Congress, Kyoto, Japan, 24–31 August 1985.

DOOLEY, R. W. (1972)—A preliminary survey of the vascular flora of St. Mary Parish, Louisiana. M.S. thesis, Northeastern Louisiana University, Monroe, Louisiana, USA.

EDYE, L. A. and CAMERON, D. G. (1984)—Prospects for *Stylosanthes* improvement and utilization. p. 547-570. *In* Stace, H. M. and Edye, L. A. (eds). "The biology and agronomy of *Stylosanthes*." (Academic Press: Sydney).

GILDERSLEEVE, R. R. (1982)—Agronomic evaluations of *Aeschynomene* species under mob grazing conditions. M.S. thesis. University of Florida, Gainesville.

HARDY, S. R. and QUESENBERRY, K. H. (1984)—Artificial hybridization of *Aeschynomene americana* L. (A tropical forage legume). *Proceedings of the Soil and Crop Science Socity of Florida* **43**: 163–166.

HODGES, E. M., KRETSCHMER, A. E., JR., MISLEVY, P., ROUSCH, R. D., RUELKE, O. C. and SNYDER, G. H. (1982)—Production and utilization of the tropical legume *Aeschynomene.* Florida Agricultural Experiment Station Circular S-290.

HOPKINSON, J. M. and REID, R. (1979)—Significance of climate in tropical pasture/legume seed production. p. 343-360. *In* P. A. Sanchez and Tergas. L. E. (eds.). "Pasture production in acid soils of the tropics". (CIAT: Cali, Colombia).

KRETSCHMER, A. E., JR. and BULLOCK, R. C. (1980)—*Aeschynomene* spp.: Distribution and potential use. *Proceedings of the Soil and Crop Science Society of Florida* **39:** 145–152.

LANGER, L., FREY, K. J. and BAILEY, T. B. (1978)—Production response and stability characteristics of oat cultivars developed in different eras. *Crop Science* **18:** 938–942.

LASSEIGNE, A. (1973)—Louisiana legumes. Southwestern Studies: Science Series No. 1., Univ. of Southwestern Louisiana, Lafayette, Louisiana, USA.

LOUISIANA GEOLOGIC SURVEY (1984)—Geologic map of Louisiana. Dept of Natural Resources, Baton Rouge, Louisiana, USA.

LOUISIANA OFFICE OF STATE CLIMATOLOGY and DEPARTMENT OF GEOGRAPHY AND ANTHROPOLOGY, LOUISIANA STATE UNIVERSITY (1980–1985)—Louisiana agroclimatic information: Annual climatic summaries. Baton Rouge, Louisiana, USA.

NEUMANN, C. J., CRY, G. W., CASO, E. L. and JARVINEN, B. R. (1981)—Tropical cyclones of the north Atlantic Ocean, 1871–1980. Rev. ed. (National Climatic Center: Ashville, NC, USA).

PALMER, W. C. (1965)—Meteorological drought. Research Paper No. 45, US Weather Bureau, National Oceanic and Atmospheric Administration Library and Information Service, Washington, DC, USA.

QUESENBERRY, K. H. and OCUMPAUGH, W. R. (1981)—Forage potential of *Aeschynomene* species in north central Florida. *Proceedings of the Soil and Crop Science Society of Florida* **40:** 159–162.

REILING, S. D. and WIEGMANN, F. H. (1979)—Louisiana agriculture: Economic trends and current status, 1940–1977. Louisiana Agricultural Experiment Station Bulletin 718.

RUDD, V. E. (1955)—The American species of *Aeschynomene.* Contribution US National Herbarium 32 (Part 1), Bulletin of the US National Museum (Smithsonian Institution), Washington, DC, USA.

STEEL, F. G. D. and TORRIE, J. H. (1980)—Principles and procedures of statistics. (McGraw-Hill Book Co.: New York).

THRO, A. M. and SHOCK, C. C. (1987)—Performance of subtropical forage legumes in Louisiana, south central USA. *Tropical Agriculture (Trinidad)* **64:** 297–304.

US NAVAL OBSERVATORY (1946)—Supplement to American Ephemeris. Nautical Almanac Office, US Naval Observatory, Washington, DC, USA.

USDA/SCS (SOIL CONSERVATION SERVICE) (1981)—Official soil interpretation for the Mhoon series. (US Government Printing Office: Washington, DC, USA).

USDA/SCS (SOIL CONSERVATION SERVICE) (1985)—Official soil interpretation for the Providence series. (US Government Printing Office: Washington, DC, USA).

USDA SOIL CONSERVATION SERVICE and LOUISIANA AGRICULTURAL EXPERIMENT STATION (1924–1986)—Soil surveys of Ascension, Assumption, East Baton Rouge, Iberia, Iberville, Lafourche, St. James, St. John the Baptist, St. Martin, St. Mary, Terrebonne, and West Baton Rouge Parishes, Louisiana. Washington, DC, USA.

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