EFFECTS OF SELECTION ON MORPHOLOGICAL CHARACTERISTICS IN *SETARIA SPHACELATA* (SCHUMACH.) MOSS

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Abstract

Cattle production in Florida is limited by the lack of available warm-season forages adapted to the cool winters of the region. Setaria (*S. sphacelata*) has demonstrated green growth during cool conditions in subtropical climates around the world, and has the potential to fill this niche in cattle production in Florida. Four populations were selected in Gainesville and Ona, Florida: two cycles of selection for increased head number, one cycle for increased leaf width and one cycle for grazing tolerance. The objectives of this research were to compare these populations morphologically to determine changes due to selection. Selection for leaf width increased this trait while maintaining other morphological characteristics constant. Selection for head number decreased plant height and increased head number in each cycle, and decreased leaf width and inflorescence length in the second cycle. Selection for grazing regrowth resulted in reduced plant height and inflorescence length. Concern regarding susceptibility of *Setaria* to chinch bug and possible winter killing in Florida remain to be resolved before this species may be commercialized in Florida.

Keywords: *Setaria sphacelata*, morphological characteristics, selection, grass breeding, leaf width, inflorescence number.

Introduction

One of the reasons for the low efficiency of cattle production from pastures in the south-eastern United States, is the lack of adapted high quality forages. Bahiagrass is the most widely grown cultivated species in Florida, but live-weight gains of 0.45 kg/head/day or less are the norm (Sollenberger et al, 1988). Other species are used to a limited extent, but usually have problems of poor cold tolerance.

The tropical forage grass *Setaria sphacelata* has potential for cattle production in Florida, since it is known to be adapted to wet soil conditions and cool season growth in many subtropical climates of the world (Hacker and Bray, 1981). A plant breeding program with this species has been underway at the University of Florida since 1996. The objectives of this research were to study the changes in morphological characteristics that occurred in the species due to selection for increased inflorescence number, increased vegetative leaf width and regrowth after grazing.

Material and Methods

The experiment was conducted at the University of Florida Agronomy Forage Research Unit near Gainesville and at the Beef Cattle Research and Education Center near Ona, Florida, USA. Two thousand seedlings of a *S. sphacelata* population were planted on 90 cm centers in August 1996 in Gainesville (population FRU) and in Ona (population ONA). These populations were a bulk of seeds from lines of *Setaria* cvs. Narok, Kazungula and Solander, and roadside plants harvested by Dr. P. Mislevy at Ona.

In the fall of 1996, grid selection for fall vigor was made in the FRU population. Two inflorescences of each selected plant were harvested and allowed to randomly intercross in the greenhouse. Seed from selected plants were germinated, and the 50 lines with the best germination percentage were selected (population VIGOR). Twenty plants of these fifty half-sib families were transplanted to the field in April 1997, in two replications of ten plants each. Two cycles of selection were then conducted for increased number of inflorescences (populations HEAD 1 and HEAD 2) and one cycle of selection for increased leaf width (population LEAF). Three inflorescences of each of the 5 best progenies of selected half-sib families were placed in a bucket of water, covered with a large paper bag and allowed to randomly intercross.

Selection in the Ona population was made for plant vigor and leafiness. Eighteen seedlings of each of 95 selected plants were planted on 40-cm centers in two replications. The area was mob grazed with yearling cattle every 28-35 days totaling 5 grazing periods during 1997/8. In the summer 1998, an attack of chinch bug (*Blissus lucopterus*) killed about 90% of the field. Seeds of plants that survived were harvested (population MOB).

In summer 1999, a total of sixty four seedlings from remnant seed of each population and of the Australian released cv. Solander (population SOLAN) were planted in Gainesville in a randomized complete block design with four replications. Plants were evaluated in late fall for vegetative plant height (VH), reproductive plant height (RH), mean length of five inflorescences (INFL), number of

inflorescences per plant (HEAD) and mean width of five vegetative leaves (LEAF). Data was analyzed using GLM of SAS and means were compared using Waller-Duncan multiple mean comparison procedure.

Results and Discussion

Broad variability was found for all morphological characteristics for each population (Table 1). The correlation between vegetative and reproductive heights was 0.62 ($P<0.01$) but low correlation was found between the other variables.

Comparisons of population means for the morphological characteristics showed that the tallest populations were FRU, ONA and VIGOR (Table 2). Cv. Solander was not different from these populations in height. There was a tendency for the selected populations (Head 1, Head 2, Leaf and Mob) to be shorter than the initial populations. The shortest populations were Head 2 and Mob. This was expected for the grazed population and agrees with Hacker (1987) who found that *Setaria* plants grown from commercial seed were more erect and taller than grazed populations.

Selection for increased leaf width was successful (Table 2). LEAF population and cv. Solander had wider leaves than all other populations. The trait leaf width had the highest heritability of all characteristics studied (e.g. 0.68 vs. 0.40 for number of heads), thus it was expected that one cycle of selection would significantly increase leaf width. In Australia, Hacker and Bray (1981) found high heritability estimates for leaf width and a positive correlation with flower head number. In our experiment, this correlation was low and negative (- 0.14, $p<0.01$).

The longest inflorescences were found for cv. Solander, however it only differed statistically from populations Head 2, Mob and Ona. Populations Head 2 and Mob presented the shortest

inflorescences, therefore, selection for number of heads in the second cycle and for grazing tolerance resulted in a reduction in the length of the inflorescences.

The populations that were selected for number of inflorescences showed superiority when compared with the populations from which they were selected (FRU and VIGOR), however, the differences were not significant (Table 2). One possible reason for the lack of differences between these populations is that heritability estimates were only intermediate for this characteristic (0.47 and 0.58 for cycles 0 and 1, respectively). Hacker and Cuany (1997), however, obtained higher broad sense heritabilities (0.63 to 0.80) for 4 cultivars. Solander had the least number of inflorescences.

In conclusion, selection for leaf width increased the width of leaves without changing the other measured morphological characteristics. Selection for head number increased head number but decreased plant height, leaf width and inflorescence length in one or both cycles. Selection for grazing regrowth resulted in reduced plant height and inflorescence length. Concerns regarding susceptibility of *Setaria* to chinch bug and possible winter killing in Florida remain to be resolved before this species may be commercialized in Florida.

References

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Table 1 - Means and variation in morphological characteristics in *S. sphacelata*.

Characteristic	Mean ± St.	Range
Vegetative plant height (cm)	88 ± 15	30 – 130
Reproductive plant height (cm)	154 ± 19	60 – 200
Mean leaf width (cm)	1.2 ± 0.3	0.6 – 2.1
Mean inflorescence length (cm)	20 ± 4	11 – 37
Number of heads per plant	56 ± 28	0 - 145

Table 2 - Means of morphological characteristics for 8 populations of *S. sphacelata.*

	Morphological characteristic				
Population	VH[1] (cm)	RH (cm)	LEAF (cm)	INFL (cm)	HEAD #
FRU	88 ab	161 a	1.2 b	21 ab	56 a
ONA	92 a	156 ab	1.1 c	20 b	59 a
VIGOR	91 ab	159 ab	1.2 b	21 ab	54 ab
HEAD 1	86 bc	154 bc	1.2 b	21 ab	57 a
HEAD 2	82 c	144 d	1.1 bc	18 c	64 a
LEAF	88 ab	155 abc	1.4 a	21 ab	57 a
MOB	82 c	150 cd	1.1 c	19 c	59 a
SOLAN	91 ab	152 c	1.4 a	22 a	44 b
Min Sign Diff	5	6	0.8	1.3	11

[1] VH= Vegetative plant height; RH= Reproductive plant height; LEAF= Mean leaf width; INFL= Mean inflorescence length; HEAD= Number of heads/plant.

Means followed by different letters in a column differ statistically at $P<0.05$.