FITNESS OF APOMICTIC AND SEXUAL BUFFELGRASS GERMPLASM

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ABSTRACT

Breeding apomictic grasses is based on either the direct selection of apomictic landraces or the hybridization of sexual and apomictic types and selection of apomictic F_1 hybrids. Little is known about the potential of sexual hybrids as cultivars in apomictic species. To determine if method of reproduction (MOR) was related to plant vigor, parental, S_1, and F_1 hybrids of buffelgrass differing in method of reproduction (apomictic or sexual) were established in a common garden in 1994 and 1995. In both years severe inbreeding depression was observed in the S_1 progeny as they were shorter, produced less biomass, and had low seed-set when compared to the sexual parents or the F 1 hybrids. In contrast, the apomictic and sexual F_1 hybrids produced similar biomass, tiller numbers, and were similar in plant height. This study suggests that while severe inbreeding depression occurs in buffelgrass, sexual F_1 hybrids are as vigorous as apomictic hybrids and could be considered for potential use as cultivars.

KEYWORDS

Apomixis, buffelgrass, fitness, inbreeding, plant breeding

INTRODUCTION

Apomixis, or asexual reproduction through seed, has been reported in more than 300 species (Hanna and Bashaw, 1987). Apomixis is prevalent among perennial forage grasses and has been reported in more than 125 species. Although several reviews of apomictic reproduction (Asker and Jerling, 1992; Nogler, 1975; and Nygren, 1954) and breeding apomictic plants have been published (Bashaw, 1980; Hanna and Bashaw, 1987; Savidan, 1983; Voigt and Burson, 1983), research on breeding apomictic forage grasses may still be regarded to be in its infancy (Bashaw and Hanna, 1990).

In most apomictic species, cultivar development has been accomplished by the direct selection of highly apomictic landraces (Bogdan, 1977). In other species, apomictic cultivars have been developed by selecting highly apomictic hybrids obtained from crossing rare sexual and highly apomictic plants (Bashaw, 1980; Hanna and Bashaw, 1987). Although little is known about the potential use of sexual hybrids in apomictic species, the fact that sexual plants are rare in natural habitats of apomictic grasses have led researchers to suggest that sexual progeny are less fit than apomictic progeny (Harlan et al., 1964; Taliaferro and Bashaw, 1966). Moggie (1992) has postulated that the high frequency of apomictic plants in native habitats (assuming equal fitness) is merely associated with the predicted increase of a dominant trait (apomixis) these populations.

The objective of this study was to compare the vegetative and reproductive fitness of full-sib progeny of buffelgrass differing in method of reproductive (apomictic vs sexual) with their parents and S_1 progeny.

MATERIALS AND METHODS

The plant materials used in this study consisted of a sexual buffelgrass plant (C48507), a highly rhizomatous, apomictic plant introduction (PI 409164), the S_1 progeny from the sexual parent (C48507) and sexual, obligate and facultatively apomictic F_1 hybrids (C48507 X PI409164). All S_1 progeny were from C48507 and were sexual. Twenty sexual, apomitic, and facultative plants were selected at random from an F_1 population consisting of ca. 250 progeny which had been previously classified for method of reproduction (MOR). These progeny, along with clones of the two parents, and 60 S 1 progeny were established in field nurseries in 1994 and 1995. In 1994, a RCB design consisting of 3 replications was established on a Weswood silt loam (fine-silty, mixed thermic Fluventic Ustrochrepts) soil. Individual plants were grouped according to reproductive class and established on a 1x1 m grid. In 1995, the clonal ramets of the plants used in 1994 were established using either 1x1 m grids or 0.3 x 0.3 m grids in a honeycomb design (Fasoulas, 1993). Two field replications of each density were established in 1995.

In both years, the plants were evaluated for plant height, plant width, tiller density, biomass, seed production, and pollen germination in the summer (July-Aug.) and fall (September-October).

RESULTS AND DISCUSSION

Severe inbreeding depression was observed for the S_1 progeny which were shorter, had fewer tillers, and produced less biomass than either parent or the F_1 progeny (Table 1). The S_1 plants also had the lowest seed set, and the lowest pollen germination. Because of the reduced fitness of the S_1 plants and their poor survival in a more competitive environment (data not shown), it would be predicted that selfed progeny would fail to survive in direct competition with either parental or hybrid progeny in native habitats. These results are in agreement with Bashaw (1980) and Burton and Forbes (1960) who reported a rapid loss in vigor in subsequent sexual generations of buffelgrass and bahiagrass (*Paspalum notatum* Flugge), respectively.

In contrast to the S_1 progeny, all reproductive classes of F_1 progeny were similar to their parents in plant height and tiller number. Heterosis was observed for biomass with the F_1 hybrids progeny producing ca. 40% more forage than the parents. No difference was observed between F_1 hybrids for vegetative traits regardless of reproductive class.

Although no difference in pollen germination was observed between parental and F_1 progeny, all sexual plants (C48507, F_1, S_1) had a lower mean seed set than the apomictic plants. Although the mean seed-set of the sexual plants was lower than that of the apomictic plants, seed-set was not a reliable indicator of MOR because several sexual F_1 hybrids were observed to have a seed-set greater than apomictic hybrids.

Previous investigations of plant height, plant spread, and plant width of sexual and obligate apomictic buffelgrass hybrids revealed that the apomictic plants had a greater tiller density and spread than the sexual plants although no difference in plant height was observed (Taliaferro, 1966). This study suggests that sexual F_1 hybrids are similar in vegetative vigor to their apomictic full-sib progeny and could be evaluated in forage breeding programs for potential release as cultivars.

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Table 1
Mean performance (1994-1995) of parental and hybrid buffelgrass genotypes differing in method of reproduction.

Genotype	Seed Set %	Pollen germination %	Biomass g $plant^{-1}$	Ht. cm	Tillers No. $plant^{-1}$
Parents					
409164	52.5	51	775	123	224
C48507	27.6	63	741	111	270
Progeny					
S_1	6.5	41	448	81	190
F_1 Hybrids					
Apomictic	53.2	58	1108	132	314
Faculative	56.4	56	986	127	304
Sexual	34.3	60	1073	131	306