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Evaluation of Winterhardy Buffelgrass (*Cenchrus ciliaris* L.) Germplasm

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Summary

Buffelgrass (*Cenchrus ciliaris* L.) is used extensively in South Texas, northern Mexico, and throughout other warm semi-arid regions of the world. While buffelgrass is able to tolerate extended periods of drought, a lack of winterhardiness limits its range in the United States and Mexico. Following the collection of approximately 700 new accessions of buffelgrass in 1976, approximately 50 genotypes were identified which were believed to have enhanced levels of winterhardiness. Replicated, multi-location field evaluations of representative genotypes from this collection (409704, T-704) along with a winterhardy check (*Pennisetum orientale* L. cv. 'Cowboy') and three commercially available buffelgrass cultivars ('Common', 'Llano', 'Nueces') were conducted at six locations throughout Texas (1986 to 1988). Field survival notes indicate no commercial buffelgrass cultivar survived at locations north of College Station, Texas (32° N. lat.). Winterkill ranged from 15 to 56 percent for 409704 and T-704 depending upon location and it was concluded that 409704 and T-704 are both significantly more winterhardy than the cultivars Common, Llano, and Nueces. No winter damage was observed in north Texas for *P. orientale*.

Introduction

Improving the winterhardiness of buffelgrass (*Cenchrus ciliaris* L.) has been the major objective of a joint forage improvement program conducted in Texas by the USDA-ARS and Texas Agricultural Experiment Station since the mid-1950's. To date, these programs have failed to make significant improvements in the winterhardiness of buffelgrass due to the lack of an adequate germplasm base.

Field survival of 49 pentaploid ($2N=4X=45$) buffelgrass plants following the 1979 winter at College Station in which the majority of buffelgrass germplasm suffered winterkill, suggested that germplasm might be available with increased levels of winterhardiness. The objective of this study was to evaluate the most promising accessions from this collection in replicated multilocation evaluations to determine if this germplasm differed significantly in winterhardiness from the cultivars Common, Llano, and Nueces.

Procedure

Selected germplasm was established at six locations (Beeville, College Station, Knox City, Stephenville, Uvalde, and Vernon, Texas) during spring and summer 1986. For each accession, a minimum of 60 plants was started in the greenhouse. These were later transplanted (30 seedlings per

replication) and hand watered to facilitate stand establishment. The germplasm evaluated consisted of a winterhardy check, 'Cowboy' (*P. orientale*), the cultivars Common, Llano, and Nueces and the genotypes 409704 and T-704. Genotype 409704 is a pentaploid plant introduction collected by Dr. Bashaw in South Africa, which has consistently shown the greatest vegetative vigor of any of the pentaploids evaluated at College Station. The entry T-704 ($2N=63$) is a chance hybrid between 409704 and an unknown rhizomatous plant. All locations were monitored after spring "greenup" in 1987 and 1988 and all plants which suffered winterkill were replaced with healthy seedlings in 1987 only. The data are expressed as percent survival from each location.

Results and Discussion

Data are only presented for those locations where winterkill was observed (College Station, Knox City, Stephenville, and Vernon). The entries in the nurseries located at Vernon and Knox City suffered the greatest damage in both years of the study (32 and 41 percent survival, respectively). Across the three north Texas locations (Knox City, Stephenville, and Vernon), 409704 and T-704 averaged 63 percent survival compared to 0 percent survival for the cultivars Common Llano and Nueces (Table 1). At all locations, no damage was observed for the winterhardy check (Cowboy).

The failure of Nueces and Llano to survive the relatively mild winters in north Texas was surprising since both cultivars were selected for increased winterhardiness at Stephenville and tend to escape winter damage by the development of an extensive root system (rhizomes). Since all plants entered the winter with a well developed plant canopy, it was assumed that "some" plants of Llano and Nueces would survive. It should be noted that the failure of these cultivars to escape winter damage is consistent with observations by ranchers in South Texas who have noted that unless there is extensive rhizome development before frost Llano and Nueces appear to have no more winterhardiness than Common buffelgrass.

The excavation and physical examination of remnant plants (Llano and Nueces) revealed that no rhizomes had developed, even though the plants were established in early spring and had sufficient time to develop rhizomes. We believe that the failure to develop rhizomes was the result of the low nitrogen status of the soils on which these evaluations were conducted (data not shown). Since buffelgrass is utilized for rangeland pastures (with limited N application and soils of low N status), the observation concerning the relative winterhardiness of Llano and Nueces buffelgrass may be directly attributed to the lack of rhizome development. This hypothesis still needs to be tested.

KEYWORDS: Rhizomes/winter survival/warm-season grass.

	Stephenville	Knox City	Vernon	College Station
T-704	85	60	44	100
409704	83	57	48	100
Nueces	0	0	0	100
Llano	0	1	0	100
Common	0	0	0	60
Cowboy	100	100	100	100
Mean	45	41	32	93

The evaluation of buffelgrass survival at College Station was not successful in separating the cultivars Nueces and Llano from the genotypes 409704 and T-704. This lack of separation may be attributed to the mild temperatures observed throughout this study. At College Station (i.e., high N soils and N fertilization) only Common buffelgrass suffered winterkill. This damage was greatest on those plots which were mowed regularly at shorter height (i.e., 2 inches) where 70 percent of the Common buffelgrass plants died during the 1987 to 1988 winter. Throughout the study no damage was observed on the cultivars Nueces, Llano, 409704, or T-704 at College Station (Table 1). An evaluation of plant root systems showed development of extensive rhizome systems for Nueces and Llano of College Station in contrast to the observations in north Texas.

Since crown non-structural carbohydrate content (CHO) has been shown to be highly correlated to winter survival in certain forage species, CHO was monitored at College Station during the 1986 to 1988 winters (Table 2), however, the lack of winterkill at this location makes the interpretation of this data difficult. The winterhardy check *P. orientale* was observed to have significantly higher crown carbohydrate content in both years (10.86 and 9.34 percent, respectively) while the least winterhardy entry, Common buffelgrass, had the lowest values (6.0 and 4.81 percent, respectively). No significant difference was observed in crown carbohydrate content of the other entries in the study, even though the field survival data collected in north Texas indicated 409704 and T-704 were more winterhardy than either Llano or Nueces. Several possibilities may exist for this discrepancy. First, it is possible that crown carbohydrate content is not a good predictor of winter survival in warm-season perennial gras-

ses. A second explanation may be that the non-rhizomatous entries 409704 and T-704 have winterhardiness equal to that of Llano and Nueces (when Llano and Nueces are allowed to develop an extensive rhizome system). However, we believe the second hypothesis to be less creditable, since 409704 has survived at College Station (1979 to 1980) in years where Llano and Nueces have suffered 100 percent kill. Both hypotheses should be tested by further research.

The lack of 100 percent survival of 409704 and T-704 in north Texas during the mild winters of 1986 and 1987 was disappointing. However, it does appear that this buffelgrass germplasm will be useful in the breeding program and should help enhance the reliability of buffelgrass south of a line from San Antonio to Del Rio.

	1987	1988	Average
T-704	7.36	6.22	6.79
409704	6.74	6.96	6.85
Llano	8.98	6.39	7.69
Nueces	6.47	6.33	6.40
Common	6.00	4.81	5.41
Cowboy	10.86	9.34	10.10
Mean	7.74	6.68	7.21