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FERTILITY AND FORAGE YIELD OF SORGHUM X SUDANGRASS HYBRIDS IN A1 AND A3 CYTOPLASM

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Sorghum x sudangrass hybrids produce a forage that grows rapidly, tolerates drought stress, is high yielding, and has excellent regrowth potential. They play an important role in the management plans of many livestock producers, particularly in areas such as the Great Plains. Most sorghum x sudangrass hybrids are produced in A1 male-sterile cytoplasm. Availability of a new alternate cytoplasmic sterility system, A3, allows for development of new sorghum x sudangrass hybrids that may have superior forage characteristics. Results indicate that A3 sorghum x sudangrass hybrids can be produced from a pool of inbreds not previously utilized for this purpose, and that the resulting hybrids are largely male-sterile.

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Abstract

Most sorghum x sudangrass hybrids are currently produced in A1 male-sterile cytoplasm. Availability of alternative cytoplasmic sterility systems allows production of sorghum x sudangrass hybrids that may have superior forage characteristics. A study was conducted to compare the agronomic performance of A1 and A3 sorghum x sudangrass hybrids. A bulk of eight sudangrass populations was used to pollinate four grain sorghum inbreds normally used as females that had been sterilized in both A1 and A3 cytoplasm, and two inbreds normally used as males that had been sterilized in A3 cytoplasm. The hybrids were evaluated in 1990. Results indicate that male-sterile sorghum x sudangrass hybrids can be made using A3 cytoplasm male-sterilized inbreds from the heterotic pool of inbreds normally used as pollinators. Additionally, the high level of fertility restoration by sudangrass in A3 cytoplasm male-sterilized sorghum normally used as females indicates that sudangrass may contribute much needed A3 restorers to the sorghum industry.

Introduction: Sorghum x sudangrass hybrids are grown extensively to provide forage for animals as pasture, greenchop, silage, and hay. These hybrids produce a forage that grows rapidly, tolerates drought, are high yielding, and have excellent regrowth potential. With the discovery of A1 cytoplasmic male sterility, a method became available to produce large quantities of hybrid seed on grain sorghum females with a minimal amount of effort. Current commercial production of sorghum-sudangrass hybrid seed has been estimated to be as high as 100,000,000 pounds annually (Kalton, 1989).

Two grain sorghum lines male-sterilized in an alternate cytoplasm, A3, have recently been released (Schertz et al., 1990). Grain sorghum hybrids produced by topcrossing 18 different lines onto one of these were all male-sterile (Lee, 1990). No information is available comparing the agronomic performance of A1 and A3 sorghum-sudangrass hybrids, but based on grain sorghum research results, A3 sorghum x sudangrass hybrids would be expected to be male-sterile. If grown in isolation, such male-sterile hybrids would not set seed. Additionally, A3 sterilization of grain-sorghum lines used as males (fertility restorers) in A1 systems would provide an entirely new heterotic pool for sorghum-sudangrass hybrid production. These features could provide some very practical benefits for seedsmen and forage producers.

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The objectives of this study were to compare the percent seed set, days to 50% anthesis, and forage yield of A1 and A3 sorghum sudangrass hybrids.

Materials and Methods: In 1989 a bulk of eight sudangrass populations (NP22, NP23, NP25, NP28, NP29, NP30, NP31, and NP35) was used to pollinate four grain sorghum lines that had been sterilized in both A1 and A3 cytoplasm (Martin, Redbine 58, Wheatland, and Ks24), and two lines sterilized in A3 cytoplasm that are fertility restorers in A1 cytoplasm (Tx430 and Tx7000). Hybrids were planted 21 May, 1990 at the University of Nebraska Field Laboratory, Mead in a split plot design with inbreds (females) as whole plots, cytoplasms as subplots, and replicated three times. Plots were 2 rows 21.5 ft long and 30 in apart. The entire experiment was planted twice to allow collection of forage yield data as well as seed set data. Nitrogen fertilizer was applied prior to planting at 70 lb N/acre. Ramrod/atrazine at 1 gal/acre was applied preemergent for weed control.

Days to 50% anthesis was recorded every two days during the blooming period. Several heads per row were bagged prebloom and visually evaluated for percent seed set in the fall. Forage was harvested 19 July and 26 September with a flail harvester to a stubble height of 6 in, weighed, and subsampled to determine dry matter content.

Results and Discussion: The germination of the Tx430 and Tx7000 hybrids was poor. These hybrids were not included in the forage trial, but observations for days to 50% bloom and percent seed set were obtained. Significant differences among hybrids were noted for days to 50% anthesis and for percent seed set (Table 1). Differences among hybrids for days to 50% anthesis were expected due to known maturity differences in the inbreds used as females. Cytoplasm did not affect days to anthesis.

Differences in percent seed set among the group of inbreds usually used as females in A1 seed production systems (Martin, Redbine 58, Wheatland, and Ks24) indicate that variability for fertility restoration exists among these inbreds. Generally, fertility restoration by sudangrass was greater in A1 than in A3 cytoplasm, but no good male-sterile hybrids resulted from A3 sorghum x sudangrass crosses with this group of inbreds. However, when A3 sorghum x sudangrass hybrids were produced with the inbreds used as pollinators (fertility restorers) in A1 grain sorghum systems (a different heterotic group), hybrids were largely male-sterile with A3 Tx430 hybrids being almost completely male-sterile. With the exception of one inbred at one harvest date, yield was not affected by cytoplasm.

This research indicates that male-sterile sorghum x sudangrass hybrids can be made using A3 male-sterilized inbreds from the heterotic pool used as pollinators, or fertility restorers, in A1 grain sorghum hybrid production systems. Using such A3 cytoplasm male-sterilized inbreds for sorghum x sudangrass hybrid development opens an entire heterotic group of sorghums for use in forage hybrid development.

Additionally, the high level of fertility restoration by sudangrass in A3 sorghum normally used as females in A1 systems indicates that sudangrass may contribute much needed A3 restorers to the sorghum industry.

Literature Cited:

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Table 1. Days to 50% anthesis and percent seed set of sorghum x sudangrass hybrids.

Female(inbred)	Cytoplasm	Days to 50% anthesis	Seed set
		days	%
Martin	A1	77	67*
	A3	77	25
Redbine 58	A1	76	91*
	A3	76	77
Wheatland	A1	82	71
	A3	82	41
Ks24	A1	79	89
	A3	79	72
Mean	A1	79	79*
	A3	79	54
Tx7000	A3	86	9
Tx430	A3	82	1

*Significant differences due to cytoplasm $P \leq 0.05$ using orthogonal contrasts within inbreds and F-test for mean.

Table 2. Total dry matter yield and yield by harvest date of sorghum x sudangrass hybrids.

Female(inbred)	Cytoplasm	Dry matter yield		
		19 July	26 Sept.	Total
		----------ton/acre-------		
Martin	A1	1.6	3.2*	4.8
	A3	1.7	3.8	5.5
Redbine 58	A1	1.7	3.8	5.6
	A3	1.7	3.7	5.4
Wheatland	A1	1.3	3.3	4.6
	A3	1.4	3.4	4.8
Ks24	A1	1.4	3.5	4.9
	A3	1.5	3.4	5.0
Mean	A1	1.5	3.5	5.0
	A3	1.6	3.6	5.2

*Significant differences due to cytoplasm $P \leq 0.05$ using orthogonal contrasts within inbreds and F-test for mean.