Drought Tolerance in Pearl Millet

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INTRODUCTION

Water is one of the single most limiting factors to crop production. Nowhere is this water shortage more serious than in the arid and the semi-arid regions of the world where erratic low rainfall, poor soils and extremely high temperatures result in crop failure and famine disasters. In such an environment pearl millet (Pennisetum americanum) (L.K. Schum) can often outyield sorghum in both forage and grain production.

Recently, there has been considerable interest in the physiological and agronomic variation that exists among germplasm sources of this crop. This remarkable drought tolerance of pearl millet is not fully understood. The principle objective of this work was to investigate the performance of three millet entries under variable soil moisture conditions.

MATERIALS AND METHODS

The study was conducted at the Campus Agricultural Center in 1985. A hybrid and its two parents were planted on April 19. Each entry was grown in 13 rows, 1 m apart and 5 m long, and replicated four times along a sprinkler line. The field was irrigated twice a week by this gradient system, applying water ranging from 70mm at the driest to 450mm at the wettest end of the field. Physiological and agronomic measurements were taken at three water levels. These plots were designated as high, medium and low irrigation levels and were, respectively, 1 m to 2 m, 6 m to 7 m and 11 m to 12 m away from the line source.

Plant samples were taken each week to measure leaf area, dry matter, plant height and number of tillers. At the end of the growing season, yield and yield components were recorded and entries were evaluated for their performance across the gradient.

RESULTS AND DISCUSSION

Water stress significantly reduced yield and most yield components except head size for the hybrid and for the male parent, and number of tillers for female parent (Table 1). The hybrid and its male parent produced twice the grain weight of the female parent. The higher yield of these two entries was apparently due to significantly larger head size and a larger percentage of productive tillers. The female parent did not produce any viable panicles at the dry end of the field.

The amount of water stress applied significantly reduced the dry matter production for all genotypes (Table 2). The hybrid and its male parent accumulated more dry matter at a much faster rate. This was particularly true in the early part of the season. Such behavior is a good example of drought-escaping genotype, and consequently, a good criteria of selection for drought tolerance.

Differences in germplasm response to drought conditions suggests that improvement in millet can be made through appropriate selection and plant breeding techniques.

Table 1. Yield and yield components of three millet genotypes grown under a sprinkler gradient system in 1985.

Entry	Water Level	Head No.	Head leng.	Head width	Tillers	Prod. Tillers	-----Grain Yield----- Total	Main Culm	Tiller Culm
		(no./m2)	(cm)	(cm)	(no./m2)	(%)		(g/m2)	
Hybrid	High	22.8a	19.4a	7.6a	74.0a	25.2a	248a	128a	120b
	Med.	14.5b	18.6a	7.5a	65.6b	13.5b	42c	24b	24c
	Low	5.5c	18.5a	5.7b	44.5b	1.4c	0.5d	0.4c	0.1d
Female	High	29.0a	16.5a	6.5b	82.1a	23.4a	122b	43b	79bc
	Med.	17.8b	10.5b	6.1b	80.2a	8.4b	4.9d	1.7c	3.2d
	Low	----	-----	----	79.5a	----	----	----	----
Male	High	22.3a	20.5a	7.7a	70.8a	28.3a	274a	108a	166a
	Med.	13.3b	20.0a	7.4a	52.0b	14.9b	41c	28b	13d
	Low	4.3c	18.5a	5.2b	45.1b	1.3c	0.4d	0.2c	0.2d

* Means followed by the same letter within each column are not significantly different at the 5% level according to the SNK method.

Table 2. Dry matter accumulation of three millet genotypes grown under a sprinkler gradient line in 1985

Entry	Water Level	----------DAYS AFTER PLANTING---------- 41	48	55	62	69	75	95
		----------Dry matter (g/plant)----------						
Hybrid	High	40.2a*	89.2a	107.6b	150.5a	161.9b	154.0a	182.6a
	Medium	38.6a	72.8a	112.1b	93.0b	133.4c	111.1b	121.6b
	Low	29.4b	57.0b	43.7d	63.3c	50.1e	70.0c	60.2c
Female	High	22.3c	58.8b	82.2c	125.0b	151.1b	107.8b	111.4b
	Medium	19.3d	49.0c	79.5c	105.0b	105.1d	82.4c	108.0b
	low	17.1d	41.3c	41.7d	63.9c	81.7c	40.8d	65.2c
Male	High	24.6c	71.6a	147.4a	149.3a	186.7a	149.2a	195.4a
	Medium	30.6b	55.7b	100.4b	117.7b	104.0d	112.0b	117.1b
	low	24.7c	34.7d	57.3d	57.3c	70.9c	85.8c	65.3c

*Means followed by the same letter within each column are not significantly different at the 5% level according to the SNK Method.