Sorghum

SORGHUM SEEDLING DROUGHT TOLERANCE

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Summary

Eleven grain sorghum lines were germinated and grown in the lab under different levels of water stress and at different temperatures. Percent germination and lengths and dry weights of the roots and shoots were used to determine growth response to moisture and temperature stress.

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Research is being conducted throughout the world to identify and then breed for morphological and/or physiological characteristics of agronomic crops that will increase their tolerance to drought. Rapid but reliable techniques for evaluating plant response to drought need to be developed.

This study compared 11 grain sorghum genotypes that were grown under artificially induced water stress in the laboratory.

Seeds of each sorghum line were planted in germination paper, then wrapped and placed upright in solutions of the osmoticum polyethylene glycol (PEG) of molecular weight 6000. PEG concentrations equalling 0, -10 and -12 bars were used. Three replications of each PEG treatment were planted for each genotype. All testing was done in a growth chamber. Three runs were made, each at a different constant temperature: 18C, 26C or 34C (approx. 64F, 79F and 93F).

Fourteen days after planting, the seedlings were measured for shoot and root length, shoot and root weight and percent germination. Mean values for these variables at the three temperatures and three PEG levels are illustrated in Figure 1.

Overall germination and seedling growth decreases under PEG-induced water stress. The values for root percentage and root:shoot ratios indicate that shoot growth is inhibited much more by stress than is root growth.

Seedling response to water stress changes with temperature. Growth of the control (0 bars) is lowest at the coolest temperature, 18C, while growth of the PEG treatments is least at the warmest temperature, 34C. This supports the concept that under drought conditions in the field, low moisture availability and the high temperatures that usually accompany it act together in reducing crop growth and yield.

Table 1 lists the seedling total dry weight for each sorghum genotype at each PEG level and temperature.

Table 1. Total dry weight of 11 sorghum lines grown at 3 temperatures and 3 moisture levels.

		TOTAL DRY WEIGHT (mg)									
		PEG Concentration									
		0 Bars			-10 Bars			-12 Bars			
		--Temperature--			--Temperature--			--Temperature--			
		34C	26C	18C	34C	26C	18C	34C	26C	18C	MEAN
1.	RS 610	35.7	41.2	4.0	4.7	5.1	6.4	0	0.9	0	10.9
2.	81 M 438	10.8	18.9	5.1	1.7	9.2	2.2	0	4.6	0	5.8
3.	PI 170797	13.3	13.7	4.0	0	4.6	7.1	0	3.7	4.3	5.6
4.	TX 7000	11.2	18.4	8.4	0.2	6.5	11.4	0.3	6.1	11.2	8.2
5.	81 M 392	15.6	20.8	8.4	0	21.2	1.3	0	3.8	0	7.9
6.	B35-6	6.1	18.1	5.8	0.8	6.5	5.3	0.9	2.5	2.7	5.4
7.	Custer	4.2	14.7	4.0	0	11.3	17.3	3.3	3.4	3.5	6.9
8.	81 M 571	15.3	15.2	4.6	0	4.3	10.4	0	4.4	0	6.0
9.	81 M 450	28.0	21.6	6.0	0	8.8	13.3	4.3	2.7	0	9.4
10.	SC 599-6	10.0	17.6	5.0	0	2.1	3.5	0	2.9	0	4.6
11.	TX 7078	19.2	24.7	7.1	0	10.3	0.3	0	4.9	0	7.4

Although none of the genotypes performed across all treatments with consistently high or low vigor, it is interesting that RS610, a hybrid which is particularly known for its drought tolerance, averaged the greatest amount of growth of the 11 entries.

Preliminary field data with these same entries show that such PEG work may reveal more about the germination, emergence and stand establishment of sorghum under water and temperature stress than it does final grain yields. Individual plant characteristics, such as rooting volume and depth or the ability to osmoregulate under stress which might impart drought tolerance to the plant, can also be analyzed using this system.

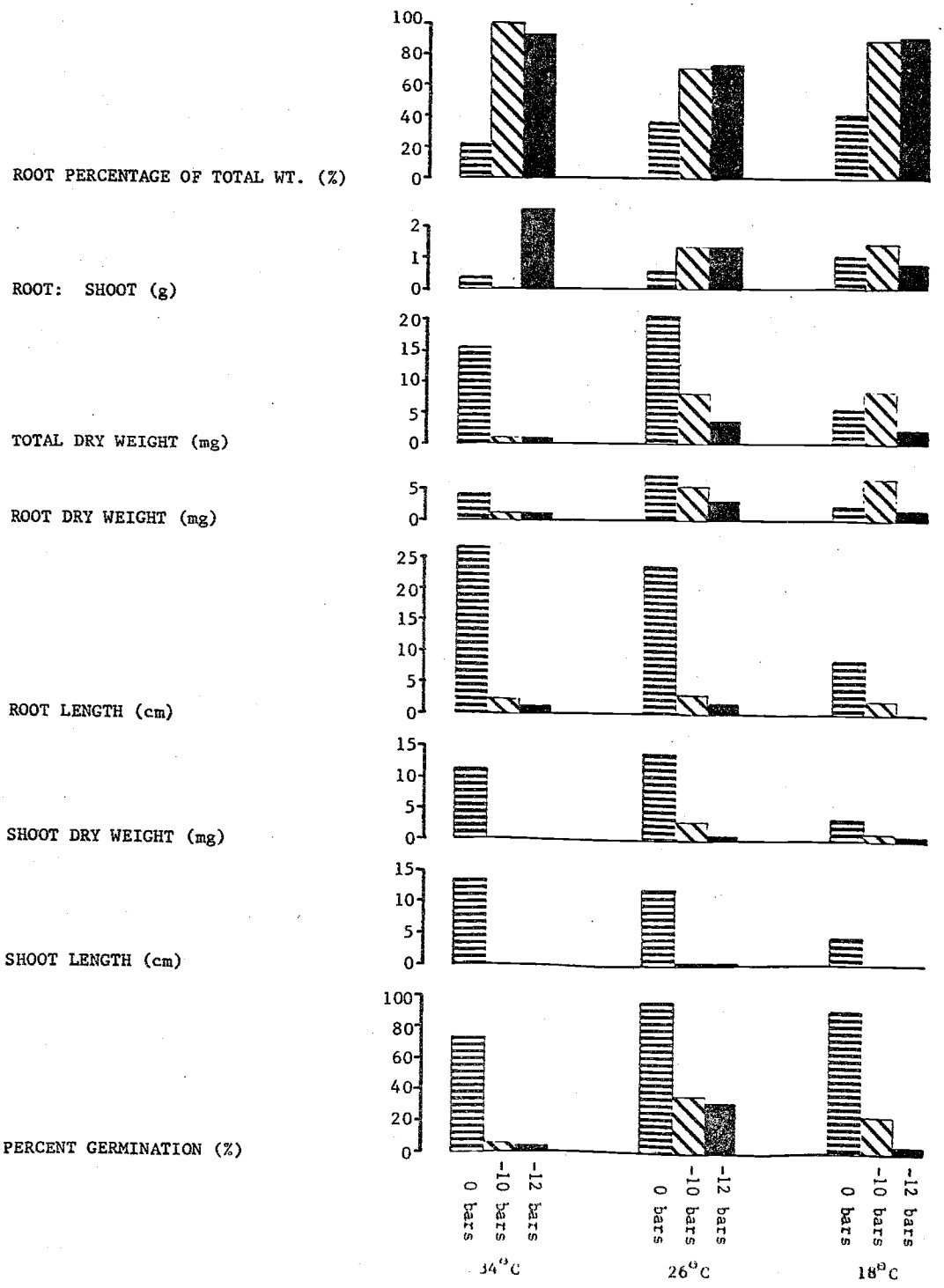

Figure 1. Several characteristics evaluated on sorghum grown at 3 temperatures and 3 levels of moisture stress.