The Relative Influences of Moisture and Nitrogen Fertilizer on Sorghum Development for Grain and Forage Production Under Full Season Growth

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ABSTRACT

Three high-yielding and three low-yielding grain sorghum hybrids were grown for a full season for grain yield and total dry weight of forage with two levels of irrigation (dry and wet) and two levels of nitrogen (0 and 100 lbs/acre). The experiment was conducted at the University of Arizona Marana Agricultural Center. The combined high nitrogen fertilizer and high water irrigation increased grain yield and total dry matter of sorghum over the dry moisture condition and no nitrogen fertilizer application more than the applied increases of nitrogen fertilizer or irrigation water alone as expected. Both high- and low-yielding groups of sorghum hybrids had the same basic relative percentage potential for increased grain yield from additional nitrogen fertilizer under either wet or dry conditions.

INTRODUCTION

Irrigation water and nitrogen fertilizer are the most important controllable factors in determining the yield production of sorghum. Exposing the sorghum crop to severe moisture stress resulted in failure of sorghum to grow and develop (2). Eck and Musick (1) found the yield of sorghum was reduced up to 50% when the plants were stressed at the early boot to heading stage. It was found that applying water to sorghum was not enough for maximum yield production. When nitrogen fertilizer was added at 100 lbs/acre to irrigated sorghum, the yield was increased up to 79% (3).

The present experiment was undertaken to evaluate the relative influences of variable water irrigation and nitrogen fertilizer and their interactions on the yield of grain sorghum and its total plant dry weight under full season growth.

MATERIALS AND METHODS

Three high-yielding (Asgrow Double TX, Funk Seeds HW 5449, Taylor Evan Y77) and three low-yielding (Funk Seeds HW6125, Triumph Two 62 YG, Triumph Two 64YG) hybrids grain sorghums, whose relative yielding ability had been determined in previous years, were grown under two levels of irrigation and two levels of nitrogen fertilizer for a full season. The high- and low-yield hybrid grain sorghums were planted on May 21, which represented the full season planting date.

During the season, the plants under the wet treatment received 32.05 inches of water from irrigation and 1.48 inches from rainfall. Plants under dry conditions received 23.53 inches from irrigation and 1.48 inches from rainfall. The nitrogen fertilizer, applied at rates of 0 and 100 lbs/acre, was broadcast on the soil surface by hand on the both sides of the plant row. The nitrogen fertilizer particles were then incorporated into the soil with a hand rake. Light irrigation was provided to take the nitrogen fertilizer to a depth where it was less likely to be lost. Atrazine was applied, post emergence, at 1 1/2 lbs/acre for weed control.

A split plot design with four replications (blocks) was used. Each replication contained 24 plots representing the total combined treatments. Each plot also had two rows, 20 ft. long with 40 in. between rows. The seeding rate was 7 seeds/ft.; total plant dry weight and grain yield were taken at the end of the season. The grain yield and weight was corrected for bird damage percentage.

RESULTS AND DISCUSSION

The grain yield results are presented in Table 1. The three high-yielding hybrids, as selected and labelled according to previous field tests, performed generally as expected for grain yield except for Funk Seeds HW 5449. HW 5449 appeared not to produce quite as well under the dry conditions encountered in this test. Combined increases of nitrogen and irrigation water increased grain yields of all hybrids more than applying additional nitrogen or irrigation water alone as expected.

The increases in grain yield from adding nitrogen fertilizer under dry conditions averaged about 15% for both high- and low-yielding groups of hybrid sorghums. The increases in grain yield from adding nitrogen fertilizer under wet conditions averaged about 12.5% for both high- and low-yielding groups of hybrid sorghums. This indicates that both groups of sorghum hybrids had the same basic relative percentage potential for increased grain yield from additional nitrogen fertilizer under either wet or dry conditions.

The increases in grain yield from adding irrigation water (with no nitrogen fertilizer applied) averaged 28% and 21% for the high yielding and low yielding groups, respectively. The increases in grain yield from adding irrigation water under additional applied nitrogen fertilizer averaged 24% and 18% for the high- and low-yielding groups, respectively. This indicates that higher yielding sorghum hybrids may be more efficient in use of irrigation water than lower yielding hybrids. These results may also indicate the existence among sorghum hybrids of more genetic variability for water use than for fertilizer use for grain production.

The total above-ground dry matter production data are presented in Table 2. As expected, combined increases of nitrogen and irrigation water increased total plant dry matter of all hybrids more than applying additional nitrogen or irrigation water separately.

The increases in total plant dry matter from adding nitrogen fertilizer under dry conditions averaged 0% and 2.4% for the high and low yielding groups, respectively. The increases in total dry matter production from adding nitrogen fertilizer under wet conditions averaged about 14.1% and 10.3% for the high and low yielding groups, respectively.

The increases in total plant dry matter from adding irrigation water under no applied nitrogen fertilizer averaged 10.5% and 16% for the high- and low-yielding groups respectively. The increases in total plant dry matter from adding irrigation water under additional applied nitrogen fertilizer averaged 26% and 24.8% for the high and low groups respectivley.

In general, these results revealed that including both nitrogen and water irrigation is necessary for maximum grain yield and total dry weight production under full season. Additional water was more effective with the high yielding genotypes than was additional fertilizer with either high or low groups.

REFERENCES

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Table 1. Grain yield data of hybrid grain sorghums grown full season as influenced by nitrogen fertilizer and water irrigation at the Marana Agricultural Center, University of Arizona - 1985

Hybrids	----- Dry -----		----- Wet -----	
	Nitrogen (0)	Nitrogen (100)	Nitrogen (0)	Nitrogen (100)
	----------Grain yield (kg/ha)----------			
High Yielders				
Asgrow Double TX	4645	5987	5732	6338
Funk Seeds HW5449	3650	4142	5476	6191
Taylor Evan Y77	5038	5192	5805	6455
Average	4444	5107	5671	6328
Low Yielders				
	4128	4754	4977	5615
Funk Seeds HW6125	3802	4187	4538	5310
Triumph Two 62YG	4106	4989	5055	5474
Triumph Two 64YG	4477	5087	5338	6062
Average	4128	4754	4977	5615

Table 2. Total plant dry weight of hybrid grain sorghums grown full season as influenced by nitrogen fertilizer and water irrigation at the Marana Agricultural Center, University of Arizona - 1985

Hybrids	----- Dry -----		----- Wet -----	
	Nitrogen (0)	Nitrogen (100)	Nitrogen (0)	Nitrogen (100)
	------Total plant dry weight (kg/ha)-----			
High Yielders				
Asgrow Double TX	10920	11310	12360	13310
Funk Seeds HW5449	13990	12630	14450	16180
Taylor Evans Y77	11310	12300	13210	16170
Average	12073	12080	13340	15220
Low Yielders				
Funk Seeds HW6125	10980	12210	13550	14340
Triumph Two 62YG	11440	10360	12230	14230
Triumph Two 64YG	11830	12520	13930	15220
Average	11417	11697	13237	14597