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Response of Sorghum Genotypes to Different Water Levels Created by Sprinkler Irrigation

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Abstract : Eight sorghum genotypes were subjected to different levels of water stress through line source sprinkler, in field experiments on a loamy sand soil in Al-Ain, UAE. Grain and forage yields were significantly reduced by moisture stress. Grain sorghum genotypes had significantly higher grain yield than others, with Feterita and Um Benin being the best in 1991 and 1992, respectively. Forage sorghum genotypes yielded significantly higher fodder with Pioneer being the best in both the seasons. Drought tolerance index showed significant differences between grain sorghum and fodder sorghum but the differences within each group were not significant. Water-use efficiency decreased with stress in all the genotypes in both the years. The study suggested that whenever water is limiting for production, the emphasis should be towards maximum economic production per unit of applied water rather than on maximum yield.

Key words : Drought, genotype, moisture gradient, sorghum, forage, grain.

Sorghum (*Sorghum biocolor* L. Moench) has been a vital source of food for millions of people in arid and semi-arid tropics, where more than half the world's sorghum is grown. It is considered to be one of the most important staple cereals because of its potential for higher production to help feed the under nourished population of the developing nations (House, 1992). Environmental conditions in these areas severely limit crop production. Fortunately, sorghum is grown as a dry land crop. The deep rooting habit enables the crop to withstand and recover from drought. Ibrahim (1993) suggested different mechanisms and modifications of the crop to evade and/or tolerate drought.

The line source procedure has been very useful for creating moisture gradient. It has been used successfully to screen a large number of genotypes (INTSORMILL, 1984). The system has been successfully used with sorghum (Garrity *et al.*, 1983; Hofmann *et al.*, 1984), wheat (*Triticum aestivum* L. cm. Thell) (Hang and Miller, 1993), dry beans (*Phaseolus vulgaris* L.) (Miller and Burke, 1983), and pearl millet (*Pennisetum americanum* L. Leeke) (Ibrahim and Marcarian, 1984; Ibrahim *et al.*, 1985, 1986, 1990, 1993, 1995; Ibrahim, 1992) to facilitate measurements of various crop features over a wide range of moisture levels.

Sorghum, the most drought tolerant crop, has a great economic potential for both grain and forage production in the arid Emirates. Unfortunately, there is a paucity of research on drought resistance characteristics and response of sorghum to water stress in the area. The primary objective of this research was to study the response of sorghum genotypes to moisture stress for both grain and forage production.

Material and Methods

The experiment was carried out in 1991 and 1992 at Al-oha Farm, Al-Ain, UAE (latitude 24°15′, longitude 55°45′ and Altitude 301.6 m above sea level) in a sandy loam soil. Eight sorghum genotypes, four for grain (Feterita, Dabar, Um Benin and Gadam elhamam) and four for fodder (Honey drip, Pioneer, Sudax and FS.SX-17 Dekalb) were planted on March 15, 1991 and March 19, 1992 with 50 cm spacing between rows and 20 cm between plants within row, with a seed rate of 25 kg ha^{-1}. The crop received 120 kg N ha^{-1} in three equal doses applied before planting, after germination, and at heading. Super

Table 2. Performance of sorghum genotypes under different water levels - 1992

Name of genotypes	Water levels	Grain yield (t ha^{-1})	Dry matter yield (t ha^{-1})	Harvest index (%)	Drought tolerance index (%)	WUE (kg ha^{-1} cm^{-1} water) Grain	WUE (kg ha^{-1} cm^{-1} water) Fodder
Feterita	High	2.9	16.9	17.2	34.5	52.2	304.0
	Medium	1.8	12.2	14.8		43.2	292.6
	Low	1.0	3.8	26.3		37.7	179.2
Dabar	High	2.8	16.8	16.7	28.6	51.0	305.5
	Medium	1.9	11.8	16.1		46.5	287.8
	Low	0.8	2.8	28.6		38.3	134.0
Honey drip	High	2.5	20.2	12.4	28.0	45.5	357.9
	Medium	1.5	14.1	10.6		36.3	341.4
	Low	0.7	6.8	10.3		33.5	325.4
Pioneer	High	2.3	22.1	10.4	34.8	42.2	405.5
	Medium	1.6	15.0	10.7		40.1	375.0
	Low	0.8	7.1	11.3		37.7	334.9
Sudax	High	2.5	21.0	11.9	28.0	45.5	381.8
	Medium	1.8	14.8	12.2		43.7	359.2
	Low	0.7	6.9	10.1		33.2	327.0
Um Benin	High	3.4	17.1	19.9	29:4	61.7	310.3
	Medium	2.1	12.1	7.4		51.3	295.8
	Low	1.0	4.1	24.4		45.2	185.5
Gadam elhamam	High	3.2	18.2	17.6	28.1	58.4	332.1
	Medium	2.0	11.8	16.9		48.5	286.4
	Low	0.9	3.9	23.1		43.1	186.6
FS.SX-17 Dekalb	High	2.6	20.4	12.7	30.8	47.3	370.9
	Medium	1.9	14.2	13.4		46.5	347.2
	Low	0.8	5.4	14.8		38.3	258.4
CD		1.4	6.2	6.1	2.9	12.5	58.4

low water levels for grain sorghum genotypes, while there were no differences for forage sorghum genotypes, between high and medium or medium and low water levels. Genotype Feterita was the most efficient genotype in water use for grain production at both low and high water levels in 1991, while Um Benin was the best in 1992. The decrease in WUE, on yield basis, with increasing stress, was in agreement with the results of Singh and Kanemasu (1980) and Ibrahim *et al.* (1993).

Water-use efficiency for fodder production was significantly different for all sorghum genotypes, at all water levels in 1991 (Table 1). In 1992, it was significant for grain sorghum genotypes, but not for fodder sorghum genotypes (Table 2). WUE was higher for fodder sorghum genotypes at all water levels in 1992, but it was not consistent in 1991. The most efficient genotype for fodder production at both low and high water levels was Feterita in 1991, and Pioneer in 1992. The decrease in WUE for dry matter with stress were similar to the findings of Ibrahim *et al.*, (1993), that the increased watering level improved the WUE for total dry matter. WUE at all water levels and for all genotypes was much higher in 1991 (Table 1) than in 1992 (Table 2) due to higher yield and dry matter or increased water application.

In this study, WUE was calculated by the actual amount of water applied after the stress was imposed. Stewart *et al.* (1993) calculated WUE of sorghum both on the basis of kg grain m^{-3} evaporation (ET) and kg grain m^{-3} applied irrigation water. The method of the actual applied water was used in this study because water is the main limiting factor for production in this environment, and the emphasis should be geared towards maximum economic production per unit of applied water rather than maximum yield.

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