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EVALUATION OF SORGHUM GENOTYPES FOR CERTAIN PHYSIOLOGICAL CHARACTERS WITH YIELD AND INTERRELATIONSHIP ANALYSIS UNDER WATER STRESS CONDITION

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ABSTRACT

A total number of 21 sorghum varieties was screened for stress resistance at the vegetative stage of the crop. The grain yield was less affected compared to nonstress. The cultivars *viz.*, SPV 393, KS 7193, KS 6312 and TWC 120 were found to be drought tolerant after evaluating for most of the physiological characters and yield. The intercorrelation of ten characters showed that grain yield showed significantly positive correlation for number of closed stomata both in stress and nonstress condition. Highest non significant correlation was noticed for grain yield and leaf wilting/rolling, DMP/plant and stomata count under stress.

KEY WORDS : Sorghum, Physiological Characters, Yield, Stress, Non-Stress

Drought is a common occurrence for crops raised under rainfed cultivation. Sorghum withstand better drought and able to yield without failure. The yield of the crop depends upon the stages of crop growth where the drought or water stress occurred. Soil characters may also alter the water availability to the crop. The best growth is achieved by frequent fairly light irrigation rather than from infrequent heavy irrigation. Generally as the drought occurred later in the crops life, yield potential assumes a greater role in determining the genotypes for drought response, indicating the poor yield output. Hence, the performance of the crop in early drought can be assessed for selecting the genotype. The study also provides an opportunity to assess the effects of yield potential and certain physiological characters on genotype sensitivity to droughts of different kinds.

Table 1. Characters of experimental field
Soil fertility : 39.2 kg N/acre 6.4 kg p/acre 240.0 kg K/acre Water holding capacity : 34.1 %
Moisture content at different stages of the crop

Vegetative stage (upto 35 days)			
Start of stress		End of stress	
DAS	Moisture content (%)	DAS	Moisture content (%)
10	20.4	20	18.1
		30	16.3
		35	14.4

MATERIALS AND METHODS

Twenty one cultivars of sorghum were evaluated at the Agricultural Research Station, Tamil Nadu Agricultural University, Kovilpatti during summer 1990- 91 in a randomised block design with three replications. The size of the plot was 3 x 2.7 m and distance from row to row and plant was 45 cm and 15 cm respectively. The experiment was laid out during rain free months of summer from April to July (after summer rains). The water stress was imposed by withholding irrigation immediately after life irrigation so as to induce drought artificially in the early vegetative stage of crop and then the crop was revived after the vegetative stage was over by irrigating to 50 per cent of available soil moisture level. Normal irrigations were given to the control plots. The data on soil properties and moisture of soil at frequent intervals are given in Table 1. Observation were

Table 2. Mean performance of sorghum genotypes under stress and non-stress condition for different physiological characters and yield

Entries	Leaf wilting/rolling score		Leaf water potential %		Green leaf area cm^2		Root length cm		Volume of root cm^3	
	Stress	Non-strees	Stress	Non-strees	Stress	Non-strees	Stress	Non-strees	Stress	Non-strees
SPV 351	3.2	1.2	66.25	58.31	62.1	73.1	12.2	16.6	1.68	2.52
SPV 393	4.7**	3.2**	88.12*	86.72**	78.2*	96.2**	11.2	17.8	1.82	2.92
SPV 462	2.2	1.4	70.20	68.82	56.0	63.2	10.5	18.6	1.10	3.12
SPV 472	3.5	1.8	64.66	60.41	62.4*	76.6	13.0	20.1	1.58	1.92
SPV 475	3.7	1.9	81.20	83.32*	50.5	66.7	11.4	17.5	0.95	1.35
SPV 496	3.8	1.7	65.01	52.11	35.6	41.3	12.0	16.6	1.05	1.31
SPV 544	3.8	2.2	56.02	43.32	53.7	59.7	10.6	21.1	1.15	1.82
SPV 678	2.4	1.7	86.20*	85.52**	35.8	39.7	10.8	22.1	2.05	2.30
ICSV 190	3.4	1.1	72.00	63.22	42.1	48.8	12.4	18.8	2.10	2.75
A 3649	2.2	1.5	85.90*	86.16**	55.4	57.6	19.5**	25.6**	1.85	2.10
TNS 31	3.8	1.6	80.20	76.71	50.2	58.1	10.5	15.4	1.45	2.17
KS 7193	4.5**	3.3**	87.21*	88.31**	72.2	79.9	12.5	16.5	2.35*	3.12
KS 6312	3.2	1.7	86.16*	87.63**	47.3	59.6	14.0	18.8	2.16	2.95
KS 6317	2.8	1.1	70.25	56.62	68.4**	93.1**	13.2	19.1	2.12	2.78
KS 7078	3.0	1.2	72.55	61.72	65.5**	81.2**	12.6	17.5	1.75	2.10
CO 23	3.4	1.4	62.89	52.41	36.1	41.7	10.3	15.6	1.60	1.68
CO 25	4.0*	3.2**	83.30	80.15	62.1	88.9**	9.4	17.1	2.05	3.15*
K 4	3.3	1.2	70.46	62.72	53.1	59.1	13.5	20.5	1.90	2.10
K 6	3.1	1.7	76.24	70.13	62.5*	69.9	14.0	17.2	2.55**	2.75
K 7	3.6	2.1	84.50	83.31*	35.1	55.4	11.8	13.4	1.85	2.15
TMC 120	4.0*	3.0**	72.42**	70.11	64.2*	91.7**	21.5**	29.6	2.28	3.85*
Mean	3.4	1.86	75.28	70.31	54.69	66.7	12.69	18.83	1.78	2.43
SE	0.18	0.19	3.26	3.74	2.66	4.41	0.71	1.43	0.16	0.24
CD (0.05)	0.53	0.56	9.62	11.03	7.85	13.01	2.09	4.21	0.47	0.71
CD (0.01)	0.72	0.76	13.11	15.04	10.70	17.74	2.85	5.75	0.65	0.96

* Significance at 5% level of significance ** Significance at 1% level of significance.

Entries	Stomatal count/cm^2		No. of closed stomata/cm^2		DMP/plant g		Straw yield t/ha		Grain yield q/ha	
	Stress	Non-strees	Stress	Non-strees	Stress	Non-strees	Stress	Non-strees	Stress	Non-strees
SPV 351	52.5	58.6	13.0	10.5	35.5	68.8	7.85	16.85	25.60	31.20
SPV 393	40.7	43.7	18.5	9.6	54.5**	96.2**	10.42	22.20	38.65**	41.22
SPV 462	48.0	53.2	11.6	8.7	40.1**	52.2	6.75	24.39*	27.55	34.32
SPV 472	30.5	33.4	16.4	12.6	42.5**	61.2	8.90	24.80*	35.68*	38.12
SPV 475	36.5	41.6	9.2	7.1	48.5**	105.2	7.52	19.18	31.23	32.62
SPV 496	48.5	47.5	18.2	10.8	26.2	66.2	9.54	21.02	37.22**	42.22
SPV 544	62.6	60.1	25.4**	19.6	23.0	49.2	10.21	17.52	30.83	36.70
SPV 678	50.2	48.7	13.3	10.5	39.7**	112.2**	8.52	27.05*	32.55	39.20
ICSV 190	25.0	26.7	8.3	6.6	20.5	38.8	7.51	15.16	34.75	41.25
A 3649	31.7	33.3	10.5	9.2	25.6	99.2**	9.56	18.71	18.75	26.75
TNS 31	62.2**	64.4*	17.2	16.1	20.6	92.3**	10.12	21.66	29.71	36.33
KS 7193	71.6**	77.2**	38.8**	31.7**	48.7**	116.6**	10.58	18.64	39.22**	43.13
KS 6312	55.7**	67.3**	20.5	17.9	40.5**	106.1**	9.22	26.40*	42.22**	46.35*
KS 6317	40.5	48.6	14.5	11.5	35.6	86.7**	9.72	18.76	30.11	32.11
KS 7078	80.1**	82.1**	18.3	10.8	28.1	61.2	7.65	17.22	35.61*	37.28
CO 23	68.3**	67.2**	20.5	18.1	19.5	43.2	8.22	15.15	30.75	31.62
CO 25	41.5	44.3	28.5**	21.7*	40.5*	92.2**	11.77*	16.34	36.60*	41.72
K 4	36.5	39.6	10.6	7.6	22.6	43.1	9.67	13.37	26.67	31.67
K 6	61.4**	65.2*	17.5	16.5	29.5	38.6	9.82	17.22	30.72	34.72
K 7	35.6	37.2	14.5	12.2	35.6	79.9	9.75	21.37	18.54	22.12
TMC 120	33.2	35.6	19.5	17.1	25.6	63.3	12.60*	23.79	22.14	31.62
Mean	48.22	51.22	17.37	15.86	33.47	74.88	9.30	19.84	31.19	35.77
SE	1.55	3.65	1.24	1.79	1.53	2.46	0.84	1.85	1.49	2.90
CD (0.05)	4.57	10.76	3.65	5.29	4.51	7.25	2.47	5.45	4.39	8.55
CD (0.01)	6.23	14.68	4.98	7.20	6.15	9.89	3.38	7.44	5.99	11.66

Table 3. Correlation coefficients among ten characters in sorghum types

	Leaf water potential	Green leaf area	Root length	Root volume	Stomatal count	No. of closed stomata	DMP/ plant	Straw yield	Grain yield
Leaf wilting/ rolling score	S 0.095 C 0.281	S 0.283 C 0.081	S-0.154 C 0.052	S 0.035 C-0.112	S 0.057 C 0.183	S 0.583** C 0.281	S 0.245 C 0.581**	S 0.555** C-0.112	S 0.378 C 0.223
Leaf water potential		S 0.119 C 0.143	S 0.094 C 0.021	S 0.421 C 0.377	S-0.104 C-0.081	S 0.109 C 0.134	S 0.526** C 0.761**	S 0.225 C 0.417	S 0.094 C 0.081
Green leaf area			S 0.217 C 0.163	S 0.308 C 0.583**	S 0.084 C 0.041	S 0.342 C 0.223	S 0.434* C 0.183	S 0.329 C-0.01	S 0.173 C 0.193
Root length				S 0.404 C 0.332	S-0.333 C-0.391	S-0.145 C-0.093	S-0.228 C-0.022	S-0.367 C 0.241	S-0.443* C-0.113
Root volume					S-0.015 C-0.141	S 0.248 C-0.086	S 0.033 C 0.117	S 0.434* C 0.221	S 0.039 C 0.187
Stomatal count						S 0.545** C 0.535	S 0.101 C 0.073	S-0.099 C 0.031	S 0.339 C 0.114
No. of closed stomata							S 0.221 C 0.246	S 0.556* C-0.021	S 0.460* C 0.530**
DMP/plant								S-0.007 C 0.561**	S 0.386 C 0.212
Straw yield									S-0.048 C 0.223

S = Stress C = Control (No stress) * - Significant at 5% level ** - Significant at 1% level.

recorded on different physiological characters and yield, *viz.*, leaf wilting/rolling, leaf water potential, green leaf area, root length, volume of roots, stomatal count, number of closed stomata, DMP per plant recorded at the end of stress period and grain yield and straw yield. The data thus obtained were subjected to analysis of variance (Table 2). The mean data of under stress and non stress conditions were correlated (Table3)

RESULTS AND DISCUSSION

The data on ten characters (Table 2) revealed that significant differences existed between treatments. There was a mean reduction for three characters *viz.*, leaf wilting /rolling score, leaf water potential and number of closed stomata while other characters showed increasing trend when comparing stress and nonstress treatments. Under stress condition, the mean straw yield was 9.3 t/ha compared to 19.84 t/ha in control and the mean grain yield was 31.19 q/ha compared to 35.77 of normal. Similar findings were reported by Nageswara Rao *et al.* (1984). Among the entries KS 6312 recorded significantly higher grain yield, under control and KS 6312, SPV 393 , SPV 472, SPV 496, KS 7193, KS 7078 and Co 25 under stress condition. In straw yield, Co 25 (11.77 t/ha) and TWC 120 (12.60 t/ha) showed significant yield under stress and four entries in nonstress conditions. With regard to different physiological characters, SPV 393 (88.12%), SPV 678 (86.20%, A 3649 (85.90%), KS 7193 (87.21%) and KS 6312 (85.16%) were significantly high and belong to tolerant group under stress condition. The same entries also showed tolerance under nonstress condition. With regard to root length and root volume, A3649 and TWC 120 recorded significant root length under stress as well as in control (Table 2). KS 7193 (2.35 cc) K 6 (2.55 cc) and TWC 120 (2.28 cc) showed significant root volumes under stress where as in control, CO 25 and TWC 120 showed root volume of 3.15 cc, and 3.85 cc respectively.

Among the stomatal characters, the number of closed stomata would be advantage for lesser transpiration during drought period. Under stress condition, three varieties recorded significantly higher number of closed stomata *viz.*, SPV 544 (25.4), KS 7193 (38.8) and CO 25 (28.5) than control. Under stress, significant and higher DMP/plant was recorded by SPV 393, SPV 475 and KS 7193 indicating the ability of these varieties to withstand drought in early stages. They also recorded higher DMP/plant under non-stress condition.

The inter correlation studies revealed that the grain yield was significantly correlated with number of closed stomata both under stress and non stress condition. It also recorded significant negative correlation under stress and non significant negative correlation with root length. This indicated that the grain yield is not affected due to drought during early stage of crop growth. Highest non significant correlation was recorded in leaf wilting/rolling score, DMP/plant, and stomatal count under stress condition for grain yield. The straw yield showed significant positive correlation with number of closed stomata, root volume, and leaf wilting score under stress and with DMP/plant under non stress. Number of closed stomata showed significant correlation with green leaf area and leaf water potential under stress and leaf water potential and leaf wilting/rolling score under control. Stomatal count was significantly, positively correlated with number of closed stomata under both condition whereas it is significantly, positively correlated for leaf wilting/rolling score under stress. There was no significant positive or negative correlation between root volume and root length, green leaf area, leaf water potential and leaf wilting/rolling score. Green leaf area wa significant, having positive correlation for roo volume under control but absent under stres condition.

From the study, it was concluded that the wate stress imposed in the early vegetative growt period causes narrow yield reduction compared t control. SPV 393, KS 7193, KS 6312 and TWC 120 were found to be promising for most of th physiological characters studied. The inte correlation among ten characters showed that grai yield was significantly having a positive correlatio for number of closed stomata both in stress and non-stress condition. Highest non-significant correlation was observed for grain yield and leaf wilting/rolling, DMP/plant and stomata coun under stress.

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STABILITY IN YIELD PERFORMANCE OF ERECT LEAF GENOTYPES OF FINGERMILLET

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ABSTRACT

Stability parameters for grain yield were worked out for five erect leaf genotypes of fingermillett (*ragi*) *viz*., IE 252, IE 503, IE 629, IE 798 and TNAU 5 and four normal high yielding varieteies, PR 202, Co.7, Co.13 and Paiyur 1. Significant differences were observed for genotype, environment and genotypes x environment interaction. TNAU 5 and PR 202 recorded above average response for grain yield, low regression coefficient and low mean square deviation from regression indicating their adaptability to unfavourable environments. All other varieties except IE 252 were found to be adaptable for favourable environment. In general, mean square deviation from regression was very low in all the genotypes studied. There was a decline in grain yield of these genotypes when planted at higher plant density levels.

KEY WORDS : Fingermillet, Spacing Levels, Grain Yield, Stability

Finger millet (*ragi*), *Eleusine coracana* (G), a C_4 and short day plant, is an important grain crop in Southern States of India. The wealth of variability in finger millet offers immense scope for rits genetic improvement. Its wide adaptability to rainfed and irrigated situations makes it a potential food crop. The productivity of *ragi* is higher than that of the great millets, sorghum and pearl millet. Plant population is one of the major factors which influences the crop yield. To improve plant production efficiency, optimum plant population has to be maintained which helps in better utilisation of nutrients, moisture and solar light interception.