Paoc. Indian natn. Sci. Acad. B48 No. 2 pp 264-270 (1982)

Desirable Plant Characteristics in Genotypes of Finger Millet (*Eleusine coracana* Gaertn.) for Rainfed Conditions

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(Received 2 November 1981; after revision 7 April 1982)

Varieties of finger millet were grown for the two seasons under rainfed conditions and for one season (Summer) under imposed intermittent stress. Growth and yield analysis revealed that in all the seasons and when grouped according to duration, a significant positive correlation was obtained between shoot dry weight and yield. Even under intermittent stress a similar relationship was observed. Average ear weight per unit area was significantly correlated with yield but not ear number. Under stress the number of late formed tillers enhanced but their contribution to yield was less. It is suggested that high dry matter production, lesser leaf area coupled with higher photosynthetic efficiency and larger average ear weight are desirable features in finger millet genotypes suited to rainfed conditions.

Key Words: Genotypes, *Eleusine coracana* Gaertn, Growth and yield analysis

Introduction

Moisture stress affects adversely several growth and yield parameters resulting in less productivity (Hsiao 1973, Fischer 1975 and Boyer 1975).

Bewley (1979) suggested that one of the critical features of desiccation tolerance is the ability to limit the damage during desiccation. Screening varieties of a species for relative drought tolerance has been based on changes in several physiological characteristics and biochemical components. However, the major limitation has been the lack of a correlation between the field performance and performance in a given test. Screening varieties for drought tolerance based on field performance under induced moisture stress is widely adopted and is directly relevant. In such studies it is necessary to pin-point certain of the growth and yield attributes which are least affected by stress. This would help in imposing selection pressure on such characters, in the process of selecting varieties for rainfed conditions.

Adopting growth and yield analysis

technique in varieties of finger millet, grown under rainfed and under induced moisture stress conditions, characters which are adversely affected, thus reducing productivity were identified.

Material and Methods

Kharif 1977: During kharif (monsoon season) 1977, 28 genotypes of ragi were grown under rainfed conditions. Each variety was sown in three rows of 5.5m length with three replications. The crop was sown on July 20, 1977. Data on dry matter production and yield attributes were collected.

Summer 1978: During summer (dry season) 1978, two experiments were conducted. In one experiment in 21 genotypes (from out of those used in *kharif* 1977) dry matter accumulation and yield attributes under normal and two levels of moisture stress were assessed. Each genotype was sown in three rows of 5.5m length with three replications. In another experiment seven genotypes were grown under normal and two levels of moisture stress and data on dry matter, leaf area, early and late formed tillers and yield attributes were collected periodically. The plot size was 3.3×3.3m, Number of hills per m^2 was 44. Both the summer experiments were sown on 21st January 1978.

Stress Treatments in Summer Experiment

In one treatment the plants were watered to maintain the plots at field capacity. In another treatment, to produce moderate stress, the plots were watered up to field capacity after 75% depletion of available moisture. In the third treatment, for severe stress, the plots were watered up to field capacity five days after 75% depletion of available moisture.

Kharif 1978: During Kharif (monsoon season) 1978, 21 genotypes (same as those used in summer 1978) were grown under rainfed conditions. Each genotype was grown in three rows of 5.5m length with three replications. The crop was sown on 26, July 1978.

The pattern of distribution of rainfall during the crop growth period for Kharif 1977 and 1978 is given in table 1.

Table 1 *Rainfall distribution (mm) monthwise for the crop growth period during the* kharif *season*

	1977	1978
June	97.9	53.2
July	110.6	240.8
August	74.4	128.3
September	120.5	235.7
October	242.0	165.8
November	85.2	44.2

Temperature variation during the period was 22.7–33.4°C for maximum (mean 27.9°C) and 15.5–20.7° (mean 19.3°C) for minimum.

The experiments were conducted on the experimental farm of the University of Agricultural Sciences in Bangalore, India, situated at a latitude of 12°58'N, longitude 77°35'E at an altitude of 930 metres.

Results and Discussion

Leaf growth is a highly sensitive parameter and is adversely affected even under mild stress (Hsiao 1973).

In the experiment conducted during summer 1978, with seven varieties leaf area duration (LAD) decreased due to stress. The treatment differences and differences due to varieties were significant but the interaction was not. Regarding the shoot yield per m^2 which also was reduced due to stress, the differences due to treatment, due to varieties and their interaction was significant (table 2).

Table 2 *LAD, shoot yield and grain yield of seven varieties of finger millet grown under three moisture regimes*

Variety	LAD			Shoot yield g/m²			Grain yield g/m²		
	Control	Moderate stress	Severe stress	Control	Moderate stress	Severe stress	Control	Moderate stress	Severe stress
IE-14-26	304	210	225	789	657	478	530	437	377
HPB-7-6	277	179	161	552	541	495	565	415	411
Purna	242	150	145	680	407	235	436	268	273
CO-1	275	234	237	847	757	733	521	451	457
PR-202	271	207	146	605	525	307	408	343	284
Hullubele	328	240	217	1441	685	623	478	242	213
ROH-2	344	199	290	867	602	710	464	447	461

	F test	CD at 5%	F test	CD at 5%	F test	CD at 5%
Treatment		2.78		135.8		54.9
Variety		39.09		135.8		61.3
T X V	NS	—			NS	—

Regarding grain yield per m² the differences due to treatment and differences due to varieties were significant but the interaction was not. In this set of seven genotypes the reduction in grain yield due to stress followed a common trend, but with regard to shoot yield the varietal response to stress differed significantly.

LAD also decreased due to stress but the interaction between treatment and variety was not significant. Further, less decrease in LAD also resulted in less decrease in shoot weight as in R0H.2 and C0. 1. In an another experiment an attempt was made to see the correlation between LAD and shoot weight per plant under non-stressed conditions. But there was no significant correlation between these parameters (table 3). This is perhaps due to differences in photosynthetic rate amongst the genotypes. That such differences exists amongst the varieties of finger millet was shown by Chandrasekhar (1978).

Shoot yield is an important growth parameter in determining productivity. In the experiments conducted during *kharif* 1977 and 1978 and summer 1978, there was a positive significant correlation between shoot yield and grain weight or ear weight (figures 1&2). In the experiment conducted in *kharif* 1977 significant correlation was observed in genotypes of all duration groups (figure 1A to E). Such a correlation was seen even

Table 3 LAD *and shoot dry weight in finger millet genotypes grown under irrigated conditions*

Genotype	LAD	Shoot dry wt (g/plant)	
IE-14-26	301.8	17.16	
HPB-7-6	246.9	16.73	
Purna	216.1	15.44	
CO-1	246.4	22.76	r-value 0.057 NS
PR-202	221.1	13.91	
Hullubele	313.0	38.81	
ROH-2	330.9	25.55	
C.D. 5%	30.050	3.011	

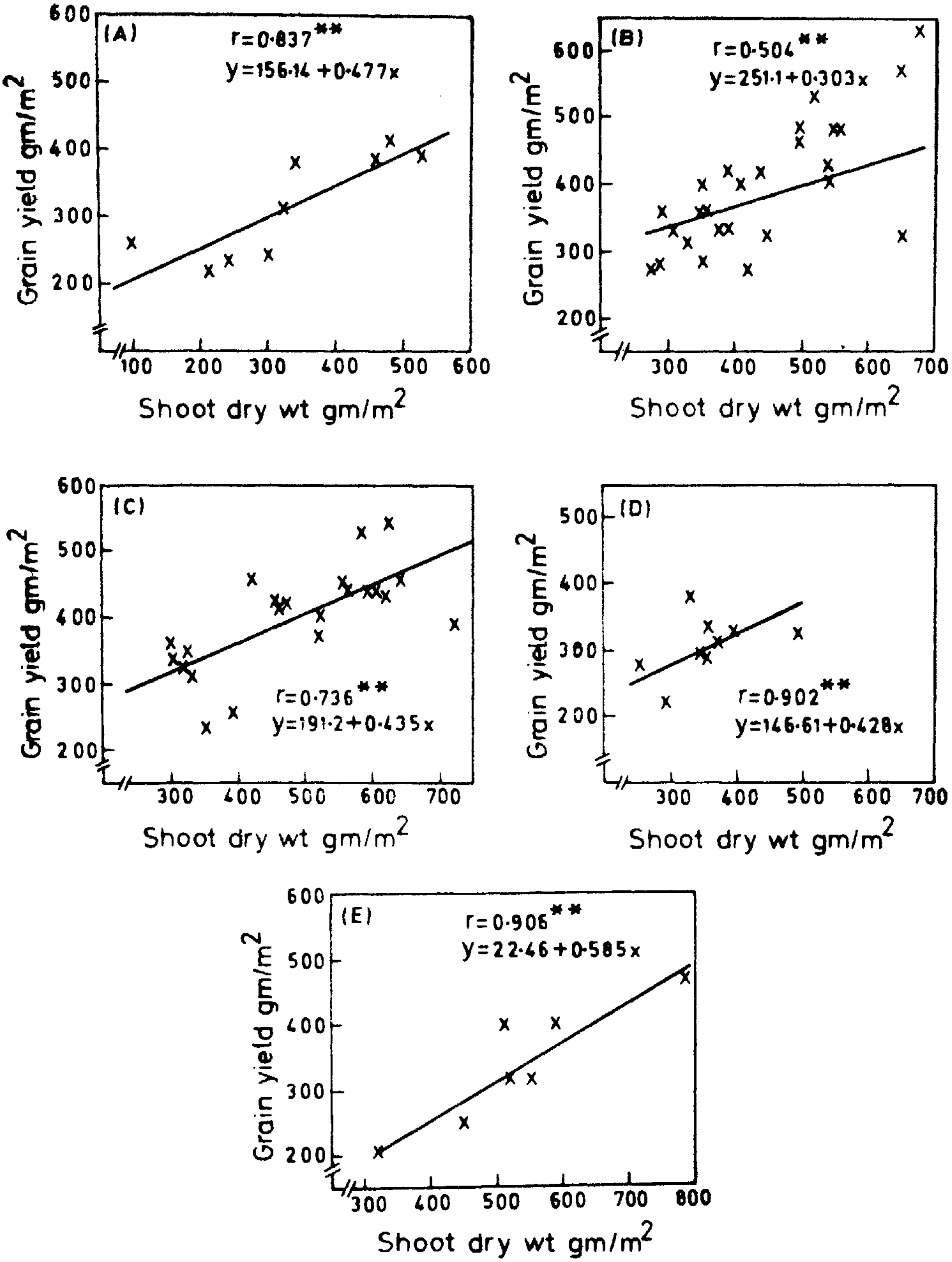

Figure 1 Simple linear regression between shoot dry matter and yield
A,B,C,D,E—Each representing a group of genotypes with different durations
Time taken in days for 50% flowering was:
A—Less than 60 days, B—60–65 days, C—65–70 days, D—70–75 days and E—More than 75 days

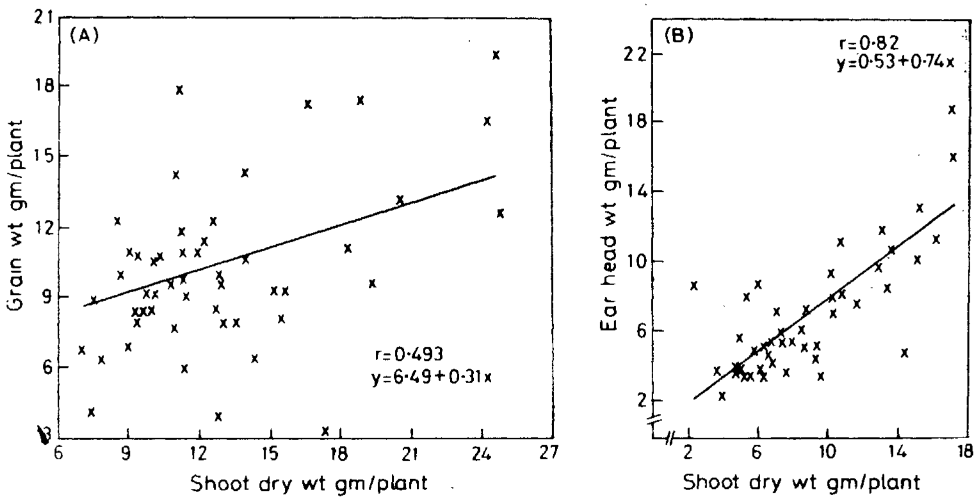

Figure 2 Simple lenier regression between shoot dry matter and yield. *(A) kharif*, 1978; *(B)* summer, 1978

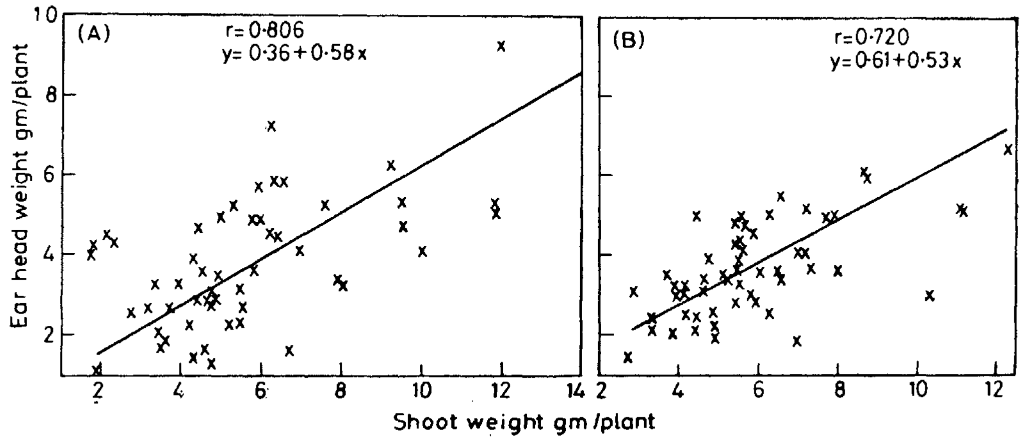

Figure 3 Simple linear regression of shoot weight and ear head weight. *(A)* Moderate stress; *(B)* Severe stress

amongst the set of genotypes grown under induced moisture stress (figure 3). It can be concluded from this data that less reduction in shoot yield due to stress, is desirable. Less reduction in shoot yield is possible either by maintaining high LAD or due to high photosynthetic rate. Since no correlation was observed between LAD and shoot yield, it is essential to select types with high photosynthetic efficiency. Further under rainfed conditions where moisture could be limiting, types with low LAD and high photosynthetic efficiency would possess higher water-use efficiency and hence are desirable.

Another important yield contributing parameter in many tillering cereals is the number of prodctive tillers. Reduction in this parameter under stress conditions has been noticed in wheat, barely and paddy (Aspinall et al. 1964, Fischer 1973 and IRRI 1975). In finger millet contribution to yield by tillers is estimated

Table 4 *Early and late formed tillers (No./m²) in seven varieties grown under three moisture regimes*

	Control		Moderate stress		Severe stress	
	Early formed tillers	Late formed tillers	Early formed tillers	Late formed tillers	Early formed tillers	Late formed tillers
I.E. 14-26	110	143	89	81	79	93
HPB 7-6	118	134	90	58	111	76
Purna	123	135	106	158	83	149
CO.1	129	127	120	53	109	93
PR-202	119	115	98	124	91	105
Hullubele	138	88	101	29	84	48
ROH-2	113	33	99	37	85	61

C.D 5%

Stress — 10.63; Tiller × stress — 15.10; Var. — 36.85; Tiller × var. — 52.12; Stress × var. — 63.83; Stress × Till × var. 90.27.

Table 5 *Number of ears and their grain weight in different tillers in finger millet*

	Total ears per plant	Grain wt. g/plant	Main ear grain wt. (g)	Primary & Secondary tiller ears		Side shoot ears	
				No. of ears	Grain wt./ ear (g)	No. of ears	Grain wt./ ear (g)
Variety I	6.91	22.66	5.51	3.19	3.95	2.72	1.70
Variety II	6.96	15.80	3.43	3.08	2.69	2.88	1.51

to be 37 per cent (Mahadevappa & Ponnaiya 1962). Accordingly it would imply that the number of ears per unit area is another important yield attribute. But in the experiments conducted, there was no correlation between the number of ears and yield (figure 4).

Under stress conditions decrease in yield was due to a decrease in the early formed tillers. But in genotypes where a higher tiller number was primarily due to production of secondary tillers under stress, the yield reduction was more (table 4). The differences due to varieties and the interaction between early and late formed tillers were significant. Further the interaction between treatment, variety and early or late formed tillers was also significant. This showed that the varieties where early formed tillers decreased and late formed ones increased due to treatment resulted in less yield. Further, it is also shown that the ear weight of the successive tillers decreased (table 5). This is particularly pronounced under stress conditions since it is well established that under stress sinks in advanced stages of development are functionally better sinks (Udayakumar et al. 1971 and Udayakumar et al. 1975). From the above the lack of relationship between ear number and yield becomes obvious. On the other hand a significant positive correlation was obtained between mean ear weight and yield (figure 4). It is therefore essential to look for varieties in which the ear weight decreased least when subjected to stress.

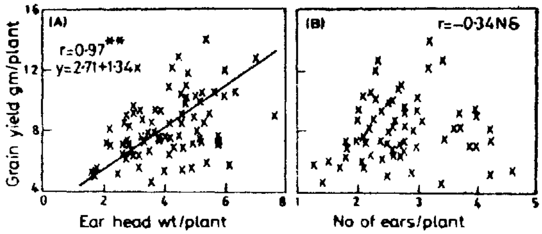

Figure 4 Simple linear regression between mean ear wt., no. of ears/plant and yield. (*A*) average ear head yield; (*B*) no. of ears per plant/yield

Based on this study a projection that could be made is, that high dry matter production coupled with low leaf area and high mean ear weight are important selection indices for identifying genotypes suitable for rainfed conditions.

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