Journal of Genetics, Genomics & Plant Breeding 1(2) 14-19 (November, 2017)

RESEARCH ARTICLE

Stability analysis in finger millet (*Eleusine coracana* (L.) Gaertn.)

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Manuscript received: Oct, 3, 2017; Decision on manuscript: Nov, 3, 2017; Manuscript accepted: Nov, 5, 2017

Abstract

Fourty finger millet genotypes were evaluated for four environments to examine the stability of these genotypes for grain yield and its related traits. Out of forty genotypes two genotype L 48 and MR 34 recorded average stability for number of fingers indicated wide adaptability of these genotypes under all environments. Genotypes showing better performance under favourable environment were DPI 20114, DPI 20132, L 48, MR 34, DM 4, DM 7, GPU 58 and VR 847 for length of finger. General stability for grain yield per plant was found in the genotypes DPI 20132, L 48, L112, DM 4, GPU 58 and VR 849. These genotypes are worthy to be utilized in the future finger millet breeding.

Key words: Finger millet, stability analysis, environment, grain yield

Introduction

Finger millet is widely cultivated crop of tropical and sub tropical region of the world being grown in Africa, Srilanka, Malaysia, China, Japan and India. India is probably the origin home of *Eleusine coracana* (L) Gaertn. In Maharashtra, finger millet occupies an area of about 145 thousand hectare with an average annual grain production of 851 thousand tones. Stability performance is one of the most desired property of genotype which give idea about the adaptation of the genotype in varying environments. Efforts may go futile, if the high yielding variety show unstable nature in varying environments. It is always advocated to have a variety which do not respond for fluctuating environmental conditions and expressed themselves in any kind of situations.

Material and methods

The field experiment was conducted on the field of Department of Agricultural Botany, College of Agriculture, Dapoli by taking three replications in Randomized Block Design during *kharif* season of 2003 and 2004. Forty different finger millet genotypes were evaluated in four different environments. The environments were created by using different sowing dates. The materials was grown in randomize block design with three replications. Seeds of ragi genotypes were sown on raised bed in nursery. The size of raised bed was 10.00 m x 1.00 m. These raised beds were applied with 100 gm of urea for 10.00 m x 1.00 m size bed as basal dose at the time of sowing. After 28 days, seedlings were transplanted in the field. Before transplanting the field was applied with basal dose of fertilizer i.e. 40 kg N and 40 kg P_2O5 per hectare. Remaining 40 kg N per hectare was applied after 30 days of transplanting. 20 cm spacing was kept between the rows while, 10 cm spacing was kept between the plants. The gross plot size was 1.40 m x 1.90 m and net plot size maintained was 1.00 x 1.50 m. All the agronomic practices were performed for better performance of the trial. The observation on number of productive tillers per plant, number of fingers per ear per plant, length of finger, grain yield per plant, 1000-grain weight, grain yield per hector and harvest index were recorded. Stability analysis was carried out using the Eberhart and Russell (1966) model.

Results and discussion

In the present investigation, the analysis of variance revealed that, the differences among the cultures were substantial for all the characters studied. The contribution of the cultures to the genotypes sum of squares was significant for all the characters studied. This indicated that, the choice of the cultures was appropriate and that the cultures were quite distinct in relation to the characters studied and hence, suitable for genetical studies. As indicated by the statistical tests and estimates of genotypic parameters, the cultures exhibited a wide range of variation for almost all the characters studied. However, the degree of variability varied considerably, depending upon the characters. This gives wide scope for selection of the genotypes for a particular character and parent in the breeding programme as well.

Pooled data presented in Table-1 indicated 1.26 population mean for fourty genotypes and over four environments studied for the character number of tillers per plant. The genotypes MR 34, VR 846 and DM 4 showed significant 'b' values, while remaining genotypes showed non significant 'b' values. 'S2d' values for all genotypes were non significant. The genotypes PR 202, JM 1 and DPI 20030 exhibited near about unit 'b' values and least deviation from regression with higher pooled means over population indicated average stability for the character. Genotypes PR 204, VL 149, OEB 22, OEB 71, MR 34,VR 708, OEB101, DM 4,VR 847,VR 849 and VR 768 showed 'b' values greater than one with non significant 'S2d' with higher pooled means over the population mean indicated below average stability and these genotype can perform better for favorable environment, while the genotypes OEB 22 showed 'b' value less than one with non significant 'S2d' with higher pooled means over the population mean indicated above average stability. Suryawanshi *et al.*, (1991) reported that significant G x E (linear) component for number of tillers per plant.

Pooled data indicated that the population mean was found to be 5.87 for fingers per ear for forty genotypes over four environments. Most of the genotypes showed non significant 'b' values except the genotype JM 1. The significance of 'S2d' indicated that the values of all of the genotypes were found to be non significant indicating least deviation from regression and performance was predictable for the character. The genotypes L 48, MR 34 showed near about unit 'b' values and least deviation from regression with non significant 'S2d' higher pooled means over population mean indicated average stability for the character. Genotypes DPI 20114, DPI 20132, ACPR 1, ACPR 2, VL 326, VL 322, VR 855 and OEB 56 recorded 'b' values greater than one with higher pooled mans and non significant 'S2d' indicated below average stability, while the genotypes L 221, VL 149, OEB 22, OEB 65, MR 34, GPU 58, VR 847 and Dapoli 1 showed 'b' values less than one with non significant 'S2d' and higher pooled means over the population mean indicated above average stability. Similar kind of results was also reported by Suryawanshi *et al*., (1989), Rasal (1992) and Anarase *et al*., (2000) in pearl millet.

Pooled data for length of fingers presented in Table 1 indicated that the population mean was found to be 7.00 cm for forty genotypes and over four environments. All the genotypes showed non-significant 'b' values except the genotype L 221 which showed the significant 'b' value indicated much deviation from regression. The significance of 'S2d' indicated that the values of all the genotypes were found to be non significant indicated predictable performance of all genotypes for the character. The genotypes ACPR 2, VL 149, GPU 57, GPU 56, and Dapoli 1 recorded near about unit 'b' values and least deviation from regression with higher pooled means over population mean and non significant 'S2d'indicated average stability for the character. Genotypes DPI 20114, DPI 20132, L 48,MR 34, DM 4, DM 7, GPU 58, and VR 847 recorded 'b' values greater than one with higher pooled means and non significant 'S2d' indicated below average stability and these genotypes can perform better for favorable environment, while the genotypes L 112, VR 846, VR 315, GPU 56, VR 822 and L 84 showed 'b' values less than one and non significant 'S2d' with higher pooled means over the population mean indicate above average stability. Rasal (1992) also noticed similar kind of results.

Pooled data for grain yield per plant presented in Table1 revealed population mean at the tune of 4.90 g grain yield per plant among forty genotypes and over four environments. All the genotypes showed non-significant 'b' values except the genotype JM 1. The significance of 'S2d' indicated that the values of all of the genotypes were found to be non significant indicating least deviation from regression and performance of these genotype was predictable for grain yield per plant. The genotypes DPI 20132 , L 48, L 112, DM 4, GPU and VR 849 recorded near about unit 'b' values and least deviation from regression with non significant 'S2d' and higher pooled means over population mean indicating average stability for the character. Genotypes PR 202, VL149,OEB 22, OEB 71, MR 34, GPU 56, GPU 57,VR 857,VR 849, VR 767 L 84 and OEB 56 recorded 'b' values greater than one with higher pooled means over population mean and non significant 'S2d' indicated below average stability, while the genotypes DPI 20114, VL 326, VR 846 and DM 7 showed 'b' values less than one with non significant 'S2d' with higher pooled means over the population mean indicated above average stability. Similar results were also recorded by Dahiya *et al*. (1987) and Suryawanshi *et al*. (1991) in pearl millet.

For 1000-grain weight pooled data presented in Table1 indicated that the population mean was found to be 2.64 g for forty genotypes and over four environments. Almost all genotypes showed non-significant 'b' values except the genotypes OEB 101, VR 822 and JM 1, which showed the significant 'b' value indicated that these genotypes deviates much from unity. The significance of 'S2d' indicated that the values of all the genotypes were found to be non significant except for the genotypes ACPR 1, VR 846, VR 847, VR 768 and JM 1 which showed significant 'S2d' values indicated unpredictable performance of these genotypes for 1000 grain weight. The genotypes OEB 71, MR 34, VR 708, DM 7, GPU 56, PR 204, PES 110, L 84, OEB 56 and DPI 20030 recorded 'b' values near about unit and least deviation from regression and non significant 'S2d' and higher pooled means over population mean indicated average stability for the character. Genotypes DPI 20114, L 48 and DM 4 recorded 'b' values greater than one with higher pooled means and non significant 'S2d' indicated below average stability. Only one genotype VL 326 showed 'b' values less than one with non significant 'S2d' with higher pooled mean over the population mean indicated above average stability. Suryawanshi *et al*., (1989) reported that genotypes differed significantly for all the characters under different environments in pearl millet. Baviskar (1990) reported that non-linear component was important for 1000-grain weight in pearl millet. For character grain yield per ha. pooled data presented in Table1 indicated that the population mean was found to be 18.8 quintal per hectare for forty genotypes and over four environments. Almost all genotypes showed non-significant 'b' values excepting for the genotypes VL 315, HR 374, RAU 8, VR 708, L 84, JM 1 and MR 33 which had the significant 'b' values indicated that these genotypes deviates largely from unity. The values 'S2d' was significant for most of the genotypes excepting the genotypes DPI 20132, L 112, OEB 22, OEB 65, OEB 71, VR 855, VR 708, DM 7, OEB 101, VR 822, VR 847, VR 849, VR 768, PR 202, PES 110, L 84, JM 1, OEB 56 and DPI 20030 which showed non-significant 'S2d' values indicated performance of these genotypes was predictable.

Data on stability indicated that the genotypes VR 315, JM 1 and OEB 56 showed unit or near about unit 'b' values with least deviation from regression which indicates average stability. However the genotypes DPI 20132, OEB 22, OEB 71 and OEB 56 recorded 'b' values greater than one with higher pooled means over population mean and non significant 'S2d' indicated below average stability and these genotypes can perform better for favorable environment. While the genotypes VR 855, VR 822 and VR 847 showed 'b' values less than one with non significant 'S2d' with higher pooled means over the population mean indicates above average stability and these genotypes can perform better for unfavorable environment. These results are in accordance with the results reported by Kempanna *et al*., (1971) in finger millet, Bhambre (1986) and Dahia *et al*., (1987) in bajra and Hawlador (1991) in foxtail millet.

The genotypes under study responded differently for stability performance for different environments. None of the genotype had given general stability for all the characters studied. The genotypes, VR 315, JM 1 and OEB 56 were found to be more suitable genotypes for grain yield as these exhibited average stability for grain yield quintals per hectare. However the genotypes DPI 20114, DPI 20132, OEB 22, OEB 71, VL 149, OEB 101, L 48 and VR 847 had below average stability and these genotypes could be exploited for favourable conditions of the farm which rich/progressive farmers can afford. The genotypes VL 324, PR 204, VL 322, MR 34, DM 4, VR 708, OEB 65, VR 849 and VR 315 had above average stability and these are the genotypes of poor farmers as these genotypes do well under adverse conditions for most of the yield contributing characters. The general stability was noticed by the genotypes OEB 72, L 48, L 221, OEB 22, DM 4, VR 847, ACPR 2, GPU 56, GPU 58, OEB 56 and Dapoli 1 indicated that these genotypes could perform better under all kinds of environments. Considering overall performance of the genotypes for twenty different characters most desirable genotypes were identified as, DPI 20114, DPI 20132, ACPR 1, ACPR 2, OEB 71, OEB 22, L 48, OEB 101, VR 847, OEB 56, VL 149, OEB 65, DM 4, GPU 56, GPU 57 and GPU 58 for Konkan region. Among forty genotypes, genotype L 48 is the best genotype for almost all characters among the studied population.

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Table1: Average performance of fourty genotypes

	Genotypes	No. of tillers per plant			Fingers per ear			Length of finger			Grain yield per plant			1000-grain weight			Grain yield per hector		
		Mean	bi	S^2di	Mean	bi	S^2di	mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di
1	**DPI 20114**	1.08	-0.21	0.08	7.25	1.85	0.88	7.75	1.42	0.87	5.75	0.15	0.44	2.78	1.34	0.02	23.46	1.95	9.89
2	**DPI 20132**	1.25	4.49	0.06	7.58	1.36	0.40	7.67	1.78	0.25	5.92	0.93	0.51	2.67	0.84	0.02	24.06	1.65	0.43
3	**ACPR 1**	1.00	0.00	0.00	6.42	2.22	0.07	5.67	1.67	0.79	4.83	0.95	0.59	2.85	0.91	0.03	14.40	1.05	8.70
4	**ACPR 2**	1.00	0.00	0.00	6.08	1.73	0.01	8.00	0.80	0.05	4.83	1.21	0.18	3.01	0.27	0.01	18.79	3.3	28.53
5	**VL 326**	1.08	-0.21	0.08*	5.92	1.36	0.18	6.92	3.51	1.61	5.00	0.58	0.33	2.51	0.69	0.02	21.28	2.19	46.75
6	**L 48**	1.25	1.07	0.27	9.17	1.10	1.67	7.00	1.67	0.79	6.67	1.04	0.32	2.70	2.2	0.00	26.75	1.95	3.47
7	**L 112**	1.00	0.00	0.00	5.33	0.49	0.09	7.75	0.13	0.52	5.5	1.10	0.18	2.60	0.64	0.00	21.14	1.61	0.95
8	**L 221**	1.08	-0.21	0.08	6.33	0.57	0.05	6.83	0.66*	0.44	4.50	1.06	0.06	2.67	1.15	0.01	17.52	1.56	4.89
9	**PR 202**	1.40	1.68	0.00	5.75	1.32	1.35	6.08	0.01	0.31	5.50	2.07	1.43	2.76	1.67	0.01	18.75	1.54	2.60
10	**VL 149**	1.65	2.59	0.04	7.33	0.41	2.35	8.75	0.97	0.27	5.83	1.55	0.29	2.36	1.87	0.00	23.49	1.20	7.69
11	**OEB 22**	1.40	-0.03	0.10	6.17	0.20	0.09	6.25	1.11	0.19	6.00	2.15	0.33	2.63	1.87	0.00	27.04	3.17	1.36
12	**OEB 65**	1.33	1.71	0.12	6.50	0.20	0.09	6.33	1.33	0.18	4.33	1.07	0.26	2.47	11.71	0.02	16.36	1.14	0.19
13	**OEB 71**	1.42	3.20	0.18	5.75	0.18	0.07	6.42	0.85	0.11	5.75	2.18	0.43	2.85	0.78	0.00	24.15	3.31	0.08
14	**MR 34**	1.23	-2.55**	0.43**	6.42	0.67	0.06	7.25	1.95	1.48	6.25	1.56	0.61	2.87	0.96	0.02	26.36	2.26	7.26
15	**VR 846**	1.37	-2.23**	0.06	6.33	2.11	0.00	8.35	0.0	0.0	5.42	0.65	0.11	2.96	1.63	0.26	26.53	2.27	6.96
16	**DM 4**	1.15	-1.10*	0.05	5.50	0.61	1.02	9.00	3.73	0.18	5.17	0.91	0.03	2.91	2.08	0.00	19.30	0.79	6.32
17	**VL 315**	1.35	2.20	0.01	5.00	0.98	0.15	5.42	0.80	0.13	3.42	0.11**	0.04	2.58	1.62	0.00	14.57	-0.19	7.19
18	**VL 322**	1.27	4.31	0.09	6.17	2.07	1.54	6.50	1.77	0.59	3.67	0.69	0.06	2.43	0.78	0.01	14.28	0.74	6.49
19	**VR 315**	1.02	-0.18	0.00	6.17	1.91	0.12	8.33	0.63	0.34	4.58	0.16	0.08	2.43	0.47	0.00	20.46	0.69	0.48
20	**HR 374**	1.47	1.65	0.08	4.75	0.75	0.22	6.50	0.31	0.08	3.58	0.77	0.14	2.48	0.54	0.00	16.07	0.04	22.78
21	**RAU 8**	1.18	2.81	0.04	5.00	1.06	0.06	6.00	1.96	0.51	3.92	0.73	0.60	2.72	-0.53	11.69	13.72	-0.53	11.69
22	**VR 708**	1.38	1.86	0.00	4.50	0.77	0.01	5.25	1.11	0.19	3.33	0.97	0.81	2.72	-0.53	1.43	9.09	-0.53	1.43
23	**DM 7**	1.28	2.42	0.00	5.67	0.50	70.05	7.17	2.40	0.32	5.17	0.67	0.27	2.86	0.35	0.60	15.53	0.35	0.60
24	**OEB 101**	1.38	3.57	0.13	4.50	0.47	0.19	6.42	1.30	0.45	3.83	0.22	1.04	2.73	0.39	0.34	10.99	0.39	0.34
25	**DM 1**	1.37	2.04	0.00	5.50	0.85	0.60	6.00	0.48	0.24	4.17	1.10	0.18	2.61	0.36	37.86	13.10	0.36	37.86
26	**GPU 56**	1.12	-0.74	0.06	5.00	1.06	0.06	7.50	0.49	0.05	5.08	1.14	0.03	2.72	1.26	2.58	20.61	1.26	2.58
27	**GPU 57**	1.02	-0.18	0.00	5.50	0.87	0.11	8.17	1.07	0.02	5.42	0.90	0.60	2.78	1.30	0.32	19.10	1.30	6.32
28	**GPU 58**	1.02	-0.18	0.00	6.42	0.18	0.07	7.83	2.62	0.01	5.17	0.91	0.03	2.49	1.53	18.13	22.15	1.53	18.13
29	**VR 822**	1.10	0.39	0.07	5.42	2.30	0.09	8.33	0.00	0.00	4.75	1.01	2.40	2.63	0.68	2.13	20.08	0.68	2.13
30	**VR 847**	1.40	1.68	0.00	6.17	0.20	0.09	9.00	1.38	0.15	5.83	1.15	0.68	2.48	0.25	0.69	19.17	0.25	0.69
31	**VR 849**	1.42	1.50	0.01	5.50	0.94	0.52	5.67	1.03	0.38	5.33	1.03	0.13	2.86	0.84	1.78	17.36	0.84	1.78
32	**VR 768**	1.37	2.04	0.00	5.42	0.83	0.81	6.00	0.30	1.09	5.25	1.36	0.06	2.97	0.56	0.64	19.62	0.56	0.64
33	**PR 204**	1.55	1.28	0.11	5.00	1.54	0.03	6.42	0.14	0.74	4.50	1.05	0.09	2.88	0.35	0.57	16.53	0.35	0.57
34	**PES 110**	1.10	-0.39	0.07	5.50	0.85	0.16	5.92	0.27	0.06	4.00	0.69	0.26	2.80	-0.33	0.80	13.68	-0.33	0.80
35	**L 84**	1.12	-0.74	0.06	5.00	1.10	1.23	7.42	0.44	0.25	5.33	0.66	0.47	2.61	-0.34	1.68	18.09	-0.34	1.68
36	**JM 1**	1.20	0.95	0.5	5.00	0.55	0.59	7.17	0.89	0.34	4.42	0.11**	0.04	2.78	0.97	0.67	21.75	0.97	0.67
37	**OEB 56**	1.32	1.89	0.10	6.17	1.83	0.06	7.08	1.38	0.45	5.92	1.27	0.47	2.50	1.30	1.50	23.93	1.30	1.50
38	**DPI 20030**	1.57	1.09	0.08	5.58	1.61	0.67	6.17	0.26	0.09	4.50	0.86	0.34	2.70	0.39	0.30	15.19	0.39	0.30
39	**MR 33**	1.67	2.41	0.02	4.92	1.04	0.38	5.75	1.77	0.11	4.08	0.80	0.00	2.85	-0.49	3.46	12.85	-0.49	3.46
40	**Dapoli 1**	1.18	2.81	0.04	6.25	0.39	0.00	9.08	1.02	0.02	4.75	0.45	0.01	2.63	0.49	6.43	16.45	0.49	6.43

* Significant at 5% level ** significant at 1% level