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Stability Analysis for Grain Yield Attributing Traits in Finger Millet

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ABSTRACT

Stable performance of genotype in different environments is highly considered for development and release of new high yielding varieties. In the present study, thirteen advanced finger millet genotypes along with one local check were evaluated at three locations to identify stable and high yielding genotypes. None of the genotypes showed stable performance for all the traits studied. Linear component of genotype x environment (G x E) reaction was significant for number of productive tillers and grain yield ha^{-1} revealing the differential reaction of genotypes tested in different environments for these traits. Among the tested genotypes, PPR 1041 recorded average stability for number of productive tillers per plant indicating the wide adoptability of this genotype for number of productive tillers per plant. Average stability for grain yield was found in VR 990 which revealed the wide adaptability of the genotype across different locations.

Keywords: *Finger millet, Grain yield traits, Stability analysis*.

Finger millet (*Eleusine coracana* G. 2n=4x=36) is the third most important millet crop after sorghum and pearl millet in India. It is a hardy crop that can be grown in diverse environments from almost at sea level in South India to high lands of Himalayas and from poor soils to rich soils. It is an important dry land crop and has adaptability to wide range of geographical areas in harsh climatic conditions which makes it an ideal solution to the climatic change. (Vilas A Tanopi *et al.*, 2015). Finger millet is highly nutritious as its grain contains 65-75% carbohydrates, 5.8% protein, 15-20% dietary fibre and 300-350 mg calcium/ 100g grain (Chetan and Malleshi, 2007). It helps in alleviating the problems associated with malnutrition and anaemia (Babu *et al.,* 2006).

In crop improvement programme selection of genotypes for wide adaptability is often limited by the existence of genotype by environment interaction, making the variety development process more complex and expensive. Stability of seed yield is an important consideration in finger millet which is highly influenced by agro-climatic conditions. Stable performance of genotype in different environments is highly considered for development and release of new high yielding varieties (Birhanu Meles *et al.,* 2015). Andhra Pradesh state has a wide environmental variability which can lead to high genotype environment interaction. Wide environmental variability in the state strengthens the importance of multi environment / location experiments in variety development process for identifying high yielding varieties with wide adaptation. Hence the present study was undertaken to evaluate thirteen advanced finger millet genotypes along with one local check in three different agro-climatic locations of Andhra Pradesh for identifying suitable, stable and high yielding finger millet genotypes.

MATERIAL AND METHODS

Thirteen advanced high yielding finger millet genotypes developed from three research stations namely PPR 1012, PPR 1040, PPR 1041, PPR 1044 (developed at ARS, Perumallapalle) VR 989, VR 990, VR 1042, VR 1044 (developed at ARS, Vizianagaram) PR 10-21, PR 10-26, PR 10-30, PR 10-45 (developed at ARS, Peddapuram) and one local check (vakula) were evaluated at three different agro climatic locations (ARS -Perumallapalle, ARS - Vizianagaram and ARS - Peddapuram) during *Kharif* 2016-17. All the experiments were laid out in RBD design with three replications. The plot size was 6.75 sq.m (3 m x 2.25 m) for each entry in each replication. The spacing adopted was 22.5 cm x10 cm between rows and plants, respectively. All the recommended package of practices were followed to raise healthy crop. Observations were recorded for days to maturity, plant height (cm), number of productive tillers per plant, ear length (cm), number of fingers per ear and grain yield (q/ha). Stability analysis was carried out by following Eberhart and Russell (1966) model. Stability parameters namely regression (bi) and deviation from regression (S^2di) were used to identify the stable genotypes.

RESULTS AND DISCUSSSION

Analysis of variance (Table1) for yield attributing traits showed significant genotypic

Table 1. Analysis variance for stability parameters over three environments in finger millet

Source of variation	DF	Mean squares					
		Days to maturity	Plant height (cm)	Number of productive tillers per plant	Ear length (cm)	No. of fingers per ear	Grain yield (q/ha)
Genotype	13	66.81	295.75	0.27**	1.87*	4.54	52.77**
Environment	2	1618.15**	310.91	24.46**	15.32**	7.86*	376.12**
G x E	26	27.17	117.05	0.27**	0.42	3.31	38.89*
E + (G x E)	28	14081*	130.89	2.00**	1.49*	3.64	62.98**
Env. (Linear)	1	3236.29**	621.82**	48.91**	30.63**	15.72**	752.24**
Env. x Genotype (Linear)	13	11.23	94.38	0.50**	0.25	3.87	65.34**
Pooled Deviation	14	40.03**	129.73**	0.04	0.55**	2.56**	11.55**
Pooled Error	78	0.32	9.1	0.07	0.11	0.12	2.79
Total	41	117.35	183.17	1.45	1.61	3.92	59.74

* and ** significant at P = 0.05 and 0.01 respectively.

differences for number of productive tillers per plant, ear length and grain yield revealing the presence of variability for these traits among genotypes. Variety x environment (G X E) interaction was significant only for number of productive tillers per plant and grain yield. Similar type of results were observed in studies of Mahajan *et al.*, (1991). Environment variance was significant for all the characters except plant height. Linear components of G x E interaction were significant only for productive tillers and grain yield, which revealed the differential reaction of genotypes tested in different environments for these traits. The stability of genotypes was measured by three parameters namely; Mean performance of the genotype in tested environments (X), regression coefficient (bi) and mean square deviation from linear regression (S^2di) as per Eberhart and Russell (1966) model.

Mean performance and stability parameters for grain yield attributing traits in fourteen finger millet genotypes were presented in Table 2. Stability performance for different traits among the fourteen finger millet genotypes was presented in Table 3.

Population mean for days to maturity was found to be 115.29 days for fourteen genotypes over three environments. Genotype PPR 1041 matured early (106 days) followed by PPR 1040 (110 days) and PPR 1044 (110.8). None of the genotypes showed stability for days to maturity trait. PPR 1041 showed b value greater than 1 and non significant S^2di with early maturity when compared to population general mean indicating below average stability. These results are in accordance with the results shown by Chavan *et al.*, (2018) and Motowao (1992).

The population mean for plant height in fourteen genotypes over three environments was 98.94 cm. None of the genotypes was stable for this trait. VR 989 and PPR 1012 showed b values greater than 1 and non-significant S^2di with higher pooled means over population general mean indicated below average stability, while genotype Vakula showed b value less than 1 and non-significant S^2di with higher mean value than population general mean indicated above average stability. These results are in accordance with the Harshal E Patil (2007).

Number of productive tillers is one of the important yield contributing trait helps in maximization of yield in finger millet. Population pooled mean for number of effective tillers per plant in fourteen genotypes was 2.35. All genotypes showed non-significant S^2di values. PPR 1041 showed unit b value and non-significant S^2di with higher pooled mean over the general mean indicated average stability for number of productive tillers per plant. Chavan *et al.*, (2018) reported similar significant G x E (linear) component for number of productive tillers per plant.

In finger millet ear length is also an important yield contributing trait for which population general mean of fourteen genotypes over three environments was found to be 8.52 cm. The genotypes PPR 1012, VR 1044, PR 10-14, PR 10-26 and PR 10-30 showed b value greater than 1 and non-significant S^2di with higher pooled means when compared to population general mean indicated below average stability which are suitable for better environment. While the genotype PR-10-21 showed b value less than 1 and non-significant S^2di with higher pooled mean over the general mean indicated above average stability showing better performance in unfavourable environment. Patil (2006) also noticed similar kind of results in finger millet.

Table 2. Mean performance and stability parameters for yield contributing traits in finger millet

S No	Genotypes	Days to maturity			Plant height (cm)			Number of productive tillers per plant			Ear length (cm)			Number of finger per ear			Grain yield (q/ha)		
		Mean	b	S^2_{di}	Mean	b	S^2_{di}	Mean	b	S^2_{di}	Mean	b	S^2_{di}	Mean	b	S^2_{di}	Mean	b	S^2_{di}
1	PPR 1012	114.11	1.27**	12.29**	100.78	4.64**	-9	2.51	0.75**	-0.01	9.6	1.79**	-0.08	7.91	-0.72**	-0.12	32.31	2.02**	22.52**
2	PPR 1040	110.22	1.12*	48.32**	89.00	-0.56	405.61**	1.96	0.90**	-0.07	8.49	0.96	0.13	9.91	3.66	8.33**	28.71	1.55**	-0.12
3	PPR 1041	106.44	1.04**	-0.18	85.89	1.24	-8.75	2.44	1.46	-0.07	8.36	0.79*	-0.07	10.42	3.22**	0.16	30.42	1.54*	26.13**
4	PPR 1044	110.89	1.04**	35.16**	86.67	2.13	-5.89	2.78	1.24**	-0.07	4.43	1.22**	-0.09	11.02	3.03**	0.28	32.42	1.96**	-1.87
5	VR 989	114.44	1.26**	1.54*	109.44	2.21**	5.71	2.47	1.01**	0.15	7.22	0.67**	1.02**	7.51	-0.16	-0.07	30.74	2.38**	-2.04
6	VR 990	111.33	0.6	47.01**	122.56	2.41	373.63**	1.84	0.07	0.03	6.86	0.54	1.61**	7.8	-0.18	-0.12	30.12	0.17	-2.03
7	VR 1042	119.67	0.78**	5.21**	94.33	0.43	82.29**	2.6	1.35**	-0.05	8.1	0.79	-0.10	7.73	0.14**	-0.11	28.72	1.20**	-1.86
8	VR 1044	114.22	1.01**	-0.04	88.56	0.37	-1.81	2.71	1.28**	-0.07	9.34	1.19**	-0.10	7.53	-0.08	0.2	26.63	1.64**	25.49**
9	PR 10-14	117.11	1.88**	10.03**	88.56	0.43	29.92*	2.56	1.38**	-0.06	8.63	1.19**	-0.10	9.69	-0.32	13.08**	23.66	0.01	-2.44
10	PR 10-21	118.11	1.05**	3.63**	97.22	0.88	346.52**	2.24	0.93**	-0.03	9.5	0.90**	0.24	7.87	-0.82	2.92**	25.58	1.53**	-1.86
11	PR 10-26	118.89	1.22**	22.41**	93.89	-0.84**	-8.22	2.33	1.04**	-0.07	0.9	1.13**	-0.08	7.64	0.42	0.10	22.21	-1.03	25.64**
12	PR 10-30	120.11	1.22**	32.68**	97.44	0.2	224.2**	2.02	0.64**	-0.07	8.94	1.04**	0.12	8.64	0.06	2.46**	17.88	-0.64	27.06**
13	PR 10-45	124.22	0.87**	15.09**	92.44	0.88	240.25**	1.98	0.67**	-0.05	8.29	0.51	1.13**	9.24	0.92	0.86**	24.10	-0.18	-1.75
14	Vakula	114.33	0.64	322.72**	96.44	-0.42	14.27	2.47	1.22**	-0.07	8.33	1.29**	0.19	10	4.84*	6.25**	28.81	1.85**	9.74*
Grand mean		115.29			98.94			2.35			8.52			8.78			27.31		

Table 3. Genotypes showing different stability for yield contributing traits in finger millet

Character	Average stability (Non significant b. Non significant S^2di and high mean)	Below average stability (b>1, Non significant S^2di, and high mean)	Above average stability (b<1, Non significant S^2di and high mean)
Days to maturity	-	VR 1044*	-
Plant height (cm)	VR 1044* , Vakula	PPR 1012, PPR 1041*, PPR 1044*, VR 989	PR 10-26*
Number of productive tillers per plant	PPR 1041	PPR 1044, VR 989, VR 1042, V4 1044, PR 10-14, Vakula	PPR 1012
Ear length (cm)	-	PPR 1012, VR 1044, PR 10-14, PR 10-26, PR 10-30	PR 10-21
Number of fingers per ear	-	PPR 1041, PPR 1044	-
Grain yield (q/ha)	VR 990	PPR 1040, PPR 1044, VR 989, VR 1042	-

* Mean values lower than grand mean

Population general mean of fourteen genotypes over three environments for number of fingers per ear was 8.78. None of the genotypes showed average stability for this trait. The genotypes PPR 1044 (11.02) and PPR 1041 (10.42) showed b values greater than 1 and non-significant S^2di with higher pooled mean indicated below average stability suitable for better environment. Similar kind of results was also reported by Anarse *et al.*, (2000) in pearl millet.

Population general mean for grain yield for fourteen genotypes over three environments was 27.3 q/ha. Among fourteen genotypes VR 990 showed unit b value and least deviation from regression with higher pooled mean over population mean indicating average stability for grain yield. However the genotypes PPR 1040, PPR 1044, VR 989 and VR 1042 recorded b values greater than 1 and non-significant S^2di with higher pooled means when compared to population general mean indicated below average stability and found to be promising for favourable environments. These results are in coincidence with the results reported by Jawale *et al.*, (2017) in finger millet.

CONCLUSION

Based on these results it can be concluded that fourteen genotypes exhibited differential reaction for stability parameters. None of the genotypes was stable for all the characters evaluated. Among 14 genotypes, VR 990 exhibited average stability which indicated that this genotype can perform similarly in all kinds of environments.

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