Madras Agric. J., 101 (10-12): 305-307, December 2014
https://doi.org/10.29321/MAJ.10.001203

Stability Analysis in Barnyardmillet (*Echinochloa frumentacea* (Roxb.) Link.) Genotypes

A. Nirmalakumari*, S. Revathi, V. Ulaganathan, C. Priyadharshini and T. Balasubramanian

Department of Millets
Centre for Plant Breeding and Genetics,
Tamil Nadu Agricultural University, Coimbatore - 641 003

Five barnyardmillet genotypes *viz., Sadai kudiraivali*, *Pullu kudiraivali*, CO (KV) 2, VL 29 and VL 172 were evaluated over five different environments to study the stability parameters *viz.,* regression coefficient (bi) and mean square deviations (S^2d_i). Variances due to genotype, environment, genotype x environment, environment (linear) and pooled deviation were significant for days to 50 per cent flowering, days to maturity, plant height and grain yield. Based on the stability analysis, the genotype CO (KV) 2 was found to be stable across five different environments for days to maturity, plant height and grain yield. Hence, it may be recommended for the commercial cultivation in these five environments.

Key words: Barnyardmillet, Stability, Regression coefficient, Grain yield

Barnyardmillet is an important small millet crop well adapted to low and moderate rainfall areas. In India, the cultivation of Barnyard millet is mainly confined to Tamil Nadu, Andhra Pradesh, Karnataka, Uttarakhand and Uttar Pradesh. The grains of barnyardmillet are low in phytic acid an anti-nutrient factor and rich in iron and calcium (Sampath *et al.,* 1986). There are indications that diversity in barnyardmillet is fast eroding and area under barnyardmillet is gradually decreasing in many states (Gupta *et al.,* 2009). In southern parts of Tamil Nadu, farmers are eagerly cultivating the crop in large area. Hence, the research was conducted to identify the stable genotypes for Tamil Nadu. Arunachalam *et al.* (2012) revealed that the performance of barnyardmillet genotypes depends upon the growing environment. It showed that there is a possibility of identifying the high yielding genotypes specific to the given environment.

The main objective of the present investigation was to identify the stable genotype (s) over five locations for different quantitative traits. The stability analysis was carried out by employing linear regression model given by Eberhart and Russell (1966).

Materials and Methods

Field experiments were conducted in five environments *viz.,* M.Kallupatti, Vandapuli, Vitalapatti, P.Thotipatty and S.Kottaipatty villages which belong to Peraiyur block of Madurai district in southern Tamil Nadu during *Kharif,* 2011. In these areas, most of the farmers are cultivating barnyardmillet as a main crop. So the study was conducted only in sole crop area of the Madurai district.

The study consisted of five barnyardmillet genotypes *viz., Sadai kudiraivali, Pullu kudiraivali,* CO (KV) 2, VL 29 and VL 172 and they were sown in a randomized complete block design with two replications in five environments. The plot size was 3 m x 22.5 m and the spacing was 22.5 cm x 7.5 cm. Data were recorded on four characters *viz.,* days to 50 per cent flowering, days to maturity, plant height (cm) and grain yield (kg/ha) from five random normal and healthy plants and the mean values were computed. The mean values for all the traits across the environments were subjected to stability analysis as per Eberhart and Russell (1966) method using GENRES software.

Result and Discussion

Pooled analysis of variance across five environments revealed that there existed highly significant genetic variation among barnyardmillet genotypes for days to 50 per cent flowering, days to maturity, plant height and grain yield (Table 1). The genotypes x environment effects were further partitioned into linear and nonlinear components. The G x E interaction was highly significant for days to 50 per cent flowering, days to maturity, plant height and grain yield per hectare indicating the differential response of the genotypes in different locations for these characters. The genotype x environment (linear) interaction was non -significant for all the characters studied except days to 50 per cent flowering. The linear environment effect was significant indicating the larger macro environmental differences at three locations. The mean sum of squares for pooled deviations was significant

*Corresponding author email: anirmalakumari@yahoo.com

Table 1. Pooled analysis of variance for stability parameters in barnyardmillet

Source of variation	Mean sum of squares				
	Df	Days to 50% flowering	Days to maturity	Plant height	Yield
Genotype	4	36.72 **	12.18	1056.53 **	56737.55 **
Environment	4	47.07 **	136.31**	144.45 **	20809.85 **
Genotype x Environment	16	9.67 **	33.54**	78.85 **	3531.02 **
Environment (Linear)	1	37.35 **	545.23**	577.76**	83239.39**
Genotype x Environment (Linear)	4	19.79 *	52.92	106.23	5573.43
Pooled Deviation	15	5.04 **	21.66*	55.77 **	2280.17 **
Pooled Error	25	1.34	9.15	4.97	17.57

*, **, significant at 5 and 1% probability levels, respectively.

against pooled error for all the characters under study. It indicated the greater role of unpredictable components towards the differences in the stability of the genotypes. The agronomically adapted high yielding variety, CO (KV) 2 recorded higher grain yield in Vandapuli, Vitalapatti, P.Thotipatty and S.Kottaipatty, and genotype *Sadai Kudiraivali* in M.Kallupatti.

Stability analysis was carried out by employing the linear regression model proposed by Eberhart and Russell (1966). An ideal genotype is the one possessing high mean performance, with a regression coefficient around unity (bi = 1) and deviation from regression (S^2d_i) close to zero. The linear regression is regarded as the measure of linear response of a particular genotype to the changing environment. If the regression coefficient (bi) is greater than unity, the genotype is said to be highly sensitive to environmental fluctuations but adapted to high yielding environments. If the regression coefficient (bi) is equal to unity, it indicates the average sensitivity to environmental fluctuations and adaptable to all environments. If the regression coefficient (bi) is less than unity, it indicates less sensitivity to environmental changes and if this is accomplished by a high mean value, then the genotype is said to be better adapted for poor conditions.

In the present study, stability parameters such as mean, regression coefficient (bi) and deviation from regression (S^2d_i), as suggested by Eberhart and Russell (1966) were considered to explain and discuss the stability of different genotypes for various characters under consideration (Table 2). In this analysis, all the genotypes showed non-significant mean square deviation (S^2d_i), but they differed in

Table 2. Mean value, Regression response indices (b_i) and deviation from regression (S^2d) for the various genotypes

Genotypes	Days to 50% flowering			Days to maturity			Plant height			Yield		
	Mean (days)	Response (b_i)	Stability (S^2d_i)	Mean (days)	Response (b_i)	Stability (S^2d_i)	Mean (days)	Response (b_i)	Stability (S^2d_i)	Mean (days)	Response (b_i)	Stability (S^2d_i)
Sadai kudiraivali	63.5	0.74	2.80	95.1	0.29	5.70	140.80	1.40	14.40	1323.25	1.26**	441.33
Pullu kudiraivali	64.0	1.51*	2.36	94.3	0.77	11.17	136.25	2.32	23.53	1215.00	1.79**	1015.23
CO (KV) 2	57.5	-0.16	5.14	94.4	0.82	36.58	149.80	-0.01	119.44	1458.50	1.06	4873.46
VL29	59.7	1.37	5.24	95.0	0.93	1.20	116.78	0.147	34.94	872.00	0.45	1345.47
VL172	61.8	1.52*	2.91	91.3	2.16*	7.90	117.80	1.143	61.67	872.50	0.42	3637.47
Over allMean	61.30		94.02		132.26		1148.25					

*, **, significant at 5 and 1% probability levels, respectively.

mean values and regression coefficients (bi). In days to 50 per cent flowering, *Pullu kudiraivali* showed significant for regression coefficient (bi) and non significant for mean square deviation (S^2d_i).

For days to maturity, the genotypes, which required minimum number of days to mature are more desirable or short duration genotypes are desirable for maturity. Genotype, VL 172 required minimum days to mature (91.30) followed by *Pullu kudiraivali* (94.30), *Sadai Kudiraivali* (94.40) and VL 29 (95). Among the five genotypes, *Sadai kudiraivali*, *Pullu kudiraivali* and VL 29 were stable for maturity characters over five environments as indicated by non significant 'bi' and 'S^2d_i' values.

Genotype, VL 172 exhibited significant 'bi' value leading to the inference that its performance is unpredictable over environments and further suitable for low yielding environments.

For plant height, three genotypes *viz., Pullu kudiraivali, Sadai kudiraivali* and CO (KV) 2 exhibited higher mean value, non significant regression coefficient (bi) and non significant deviation from regression (S^2d_i) except VL 29 and VL 172. High mean value for plant height will impact its influence on high biomass and in turn to more fodder yield. Genotype CO (KV) 2 had bi<1, which indicated less sensitivity to environmental changes. So, this genotype is said to be better adapted for varied conditions.

Genotypes, *Pullu kudiraivali, Sadai kudiraivali* and CO (KV) 2 exhibited higher mean value and non significant deviation from regression for grain yield. But *Sadai kudiraivali* and *Pullu kudiraivali* showed significant regression coefficient. So, these two genotypes are considered as below average in stability. Such genotypes tend to respond favourably to better environments with high inputs, but give poor yield in unfavourable environments. Hence, they are highly suitable for favourable environments only. Hanif Munawwar *et al.* (2007) reported that stability analysis could greatly help in identification of suitable varieties for different environments and in identification of appropriate regional specific recommendations for cultivation of different genotypes to realize the highest potential of that genotypes.

When all the facts are inferred, the genotype, CO (KV) 2 is considered to be superior and stable in its expression and potentiality over all the five environments as indicated by its higher mean value, bi value near to unity (1.06) and non significant deviation from regression coefficient (S_2d_i) for grain yield. So, it is recommended for varied environments in southern Tamil Nadu for stable grain yield and sustained income under south west monsoon rainfed conditions.

Acknowledgement

The authors gratefully express their gratitude to IDRC-CRDI for the financial support and DHAN foundation for their co-ordination in conducting barnyardmillet trials in Peraiyur, Madurai during the year 2011-12.

They sincerely acknowledge the help rendered by Dr.D.Malathi, Professor (FSN), Dr.N.Varadharaju, Professor and Head, PHTC and Dr.P.Veerabadhiran, Professor and Head, Department of Millets, CPBG, TNAU, Coimbatore in terms of valuable suggestions and guidelines.

References

Arunachalam, P., Vanniarajan, C. and Nirmalakumari, A. 2012. Consistency of Barnyard Millet (*Echinochloa frumentacea*) Genotypes for Plant Height, Duration and Grain Yield over Environments. *Madras Agric. J.,* **99** : 11-13.

Eberhart, S.A. and Russell, W.A. 1966. Stability parameters for comparing varieties. *Crop Sci*., **6**: 36-40.

Gupta, A., Mahajan, V., Kumar, M. and Gupta, H.S. 2009. Biodiversity in the barnyard millet (*Echinochloa frumentacea* Link, Poaceae) germplasm in India. *Genet. Resour. Crop Evol.,* **56**: 883-889.

Hanif Munawwar, M., Fateh, J., Javed, H.I.,. Malik, H.N. and Hussain, M. 2007. Stability analysis of millet varieties across diverse environments in Pakistan. *Sarhad J. Agric*., **23**: 645-648.

Sampath, T.V., Razvi, S.M., Singh D.N. and Bondale, K.V. 1990. Small millets in Indian agriculture. *In Small Millets in Global Agriculture*. **Ed.** Seetharam, A .Riley, K.W. and Harinarayana, G., Oxford and IBH Publishing Co. Pvt. New Delhi, p.32.

Received: July 5, 2012; Revised: June 10, 2014; Accepted: June 20, 2014