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Phenotypic stability of grain amaranth (*Amaranthus* spp.) in dry temperate region of north-western Himalaya

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Abstract

Phenotypic stability of 19 genotypes of grain amaranth (*Amaranthus* spp.) grown in 3 different environments was studied for 6 traits, namely, grain yield, days to 50 % flowering, days to maturity, plant height, inflorescence length and seed volume weight. Variances due to genotypes, environments and genotype x environment interaction were significant for all the traits. High and significant mean squares due to environment (linear) indicated considerable differences among environments and their predominant effect on all the traits except inflorescence length. Linear and non-linear components showed predominant genotype x environment interaction for grain yield, days to maturity and plant height, whereas non-linear component was predominant for days to 50 % flowering, inflorescence length and seed volume weight. The most stable genotypes for different traits were 'PRA 9101' for grain yield, 'BDJ 89/245' for days to 50 % flowering, 'BDJ 88/245' for days to maturity and seed volume weight, 'Annapurna' for plant height and 'VL 36' for inflorescence length. 'Annapurna' was found the stable genotype for maximum traits viz., grain yield, plant height and inflorescence length.

Key words: Grain amaranth, *Amaranthus* spp., phenotypic stability and stability parameters.

Introduction

Grain amaranth (*Amaranthus* spp.) has excellent protein quality in terms of essential amino acids unlike many other common cereals which are deficient in lysine content (Joshi and Rana, 1991). It is an important grain crop of Himalayan region and is grown in dry temperate region of Himachal Pradesh during summer season for various uses. Inspite of its great importance, very little efforts have been made to exploit the genetic variability of the crop and also to identify stable genotypes which can perform well under different environments. Hence, a study was carried out to generate information on stability parameters of some indigenous genotypes of grain amaranth for grain yield and contributing traits.

Material and Methods

In the present study, 19 genetically diverse genotypes of grain amaranth were evaluated during the rainy season of 1998-2001. The experiment was laid out in complete randomized block design with 3 replications at Mountain Agricultural Research and Extension Centre, Sangla, at an altitude of 2680 m amsl, $78^0$15.016 N, $31^0$25.941 E. Each plot had 5 rows of 3 m length with row to row and plant to plant distance of 50 cm and 10 cm respectively. The usual agronomic practices were adopted uniformly for raising the crop. The data on grain yield, days to 50 % flowering and days to maturity were recorded on plot basis, whereas 10 competitive random plants in each plot were used to record plant height (cm), inflorescence length (cm) and seed volume weight (10 ml). Stability analysis was carried out as per the model of Eberhart and Russell (1966).

Results and Discussion

Pooled analysis of variance (Table 1) showed significant differences among the genotypes and environments for all the traits studied, indicating the presence of variability, both among the genotypes and the environments. The mean squares for genotype x environment interaction were significant for all the traits, revealing differential response of genotypes to different environments. Though not much such literature is available on grain amaranth, the results confirm the findings of Panwar *et al.* (1996) and Dhiman *et al.* (2002), who also

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Table 1. Pooled analysis of variance (mean squares) for different traits in grain amaranth

Source	d.f.	Grain yield (q/ha)	Days to 50 % flowering	Days to maturity	Plant height (cm)	Inflorescence length (cm)	Seed volume weight (g/10 ml)
Genotypes	18	83.78*	268.32*	684.64*	1640.63*	175.51*	1.88*
Environments	2	120.29*	661.36*	527.33*	1274.68*	36.47*	0.77*
Genotype x environments	36	40.02*	68.49*	121.44*	627.93*	100.31*	1.26*
Environment + (Environ x Genotype)	38	18.97**	56.43**	66.09**	265.38**	33.60	0.44
Environment (linear)	1	240.58**	1322.72**	1054.61**	2548.90**	72.93	1.55**
Genotype x environment (linear)	18	18.75**	25.92	67.25**	311.82**	11.63	0.42
Pooled deviation	19	7.51*	18.69*	12.96*	101.19*	52.34*	0.39*
Pooled error	108	0.42	1.02	0.62	7.49	1.82	0.03

* Significant against pooled error at P=0.05
** Significant against pooled error at P=0.05

reported genotype x environment interaction for grain yield, days to 50 % flowering, days to maturity and plant height in buckwheat.

High and significant mean squares due to environment (linear) indicated considerable differences among environments and their predominant effect on all the traits except inflorescence length, which was due to the variation in weather and temperature during different cropping seasons. Significant pooled deviation for all the traits further indicated that non-linear component was important in the manifestation of G x E interaction. Significant linear component against pooled deviation for grain yield, days to maturity and plant height indicated that the major component for differences in stability was due to linear regression and the performance can be predicted with some reliance under different environments. The non-significance of linear mean square against pooled deviation indicated that a reliable prediction of G x E interaction can not be made for days to 50 % flowering, inflorescence length and seed volume weight. However, for unpredictable traits, prediction can still be made on considering stability parameters of individual genotype (Singh *et al.*,1991).

Assessment of 19 genotypes based on stability parameters revealed that the genotypes, Annapurna and PRA 9101 for grain yield; Annapurna, IC 38269, IC 42255, and PRA 8701 for plant height; Annapurna, BDJ 89/245, PRA 9301 and VL 36 for inflorescence length and BDJ 88/245, BDJ 89/245, IC 35407, IC 38269, PRA 8801, VL 36, VL 37, and VL 38 for seed volume weight were observed having above mean performance, average regression coefficient (b=1) and least deviation from regression ($S^2d=0$), hence identified as stable genotypes in their performance (Table 2). Further, the genotypes, PLP 1 for seed yield; IC 35407 and PLP 1 for plant height and VL 44 for seed volume weight exhibited above mean performance, above average regression coefficient (b>1) and associated with least deviation from regression ($S^2d=0$), which indicated that these genotypes are stable but can be recommended for good environment only. For days to maturity, BDJ 88/245, IC 35407 and IC 38269, and for days to 50 % flowering, BDJ 89/245 and VL 33 were found early with average regression coefficient (b=1) and least deviation from regression coefficient ($S^2d=0$), and thus found to be stable genotypes for these traits.

Table 2. Estimates of stability parameters for different traits in grain amaranth

Genotypes	Grain yield (tonnes/ha)			Days to 50 % flowering			Days to maturity			Plant height (cm)			Inflorescence length (cm)			Seed volume wt (g/10 ml)		
	X_i	b_i	S^2d_i	X_i	bi	S^2d_i	X_i	b_i	S^2d_i	X_i	b_i	S^2d_i	X_i	b_i	S^2d_i	X_i	bi	S^2d_i
Annapurna	1.68	0.76	1.57	81.00	0.90	1.12	142.33	1.56	9.13*	171.38	-018	1.04	56.52	0.35	6.21	8.51	-0.42	0.00
BDJ 88/245	1.50	1.51*	0.00	77.56	1.08	8.07*	131.22	0.01	2.29	152.31	2.58	82.14	50.69	1.58	18.40*	9.14	0.76	0.01
BDJ 89/245	1.28	0.59	3.43*	67.44	0.51	0.26	122.22	0.97	11.62*	131.14	2.89	19.26	54.70	0.66	6.23	8.99	-0.71	0.00
IC 35407	2.20	0.74	1.80*	75.00	0.97	24.78*	135.44	-0.05	2.16	154.34	2.97*	0.64	51.97	0.15	118.85*	8.92	0.19	0.01
IC 38269	1.30	0.57	0.49	78.56	1.48	22.35*	133.56	0.43	2.18	152.54	0.21	22.34	53.76	1.96	36.77*	9.03	0.14	0.02
IC 42255	1.31	2.30	1.01	75.22	1.38	52.86*	131.89	2.94	38.11*	161.04	-0.61	6.56	52.98	4.09	35.47*	8.40	-0.78	0.01
PLP I	1.86	0.66*	0.00	68.56	1.07	12.22*	136.33	0.19	4.82*	160.02	2.59*	2.68	47.30	2.28	13.45	8.50	2.03	0.40*
PRA 8701	1.53	1.45	4.47*	78.56	0.52	8.55*	134.11	1.86	2.96*	170.63	-0.33	2.98	57.82	-1.61	188.77*	8.49	-2.87	0.29*
PRA 8801	1.23	1.22	0.22	80.89	1.18	29.67*	145.56	1.99	3.63*	162.74	1.70	527.86*	52.12	1.75	99.79	8.92	-1.79	0.04
PRA 9101	2.29	-0.13	1.58	80.56	0.52	4.90*	145.33	0.72	1.40	153.86	-1.80	412.50*	48.99	-2.73	87.43*	8.11	4.27	0.92*
PRA 9301	1.43	3.85	33.31*	82.78	1.10	16.11*	149.56	2.12*	-0.07	169.70	1.44	387.91*	56.09	2.24	1.84	7.66	2.32	1.66*
PRA 9401	1.93	-1.62	44.46*	79.00	0.45*	0.16	144.33	0.98	8.22*	160.18	-1.45	276.00*	53.16	0.35	65.25*	7.76	4.22	0.82*
PRA 9402	1.56	-1.46	4.20*	83.11	0.44	0.86	148.11	0.93	2.15	150.62	-0.57	1.64	52.81	-0.89	28.66*	8.17	6.12	0.18*
PRA 9501	1.65	1.13	17.83*	81.00	1.83	6.75*	147.67	0.57	8.92*	141.52	2.68	4.29	49.54	2.36	33.42*	8.33	0.25	1.83*
VL 33	1.56	0.46	2.42*	75.44	0.54	2.31	125.11	-0.11	18.52*	130.38	1.22	163.57*	43.93	2.05	26.33	7.91	3.72	1.10*
VL 36	1.19	0.45	13.24*	83.11	-0.12	21.28*	140.11	-0.22	5.33	150.43	1.98	3.82	56.56	1.91	1.59	9.10	0.67	0.11
VL 37	1.54	1.31	0.54	72.44	0.92	11.52*	131.00	0.47	28.97*	150.60	2.17*	0.51	52.08	1.32	90.92*	8.83	0.74	0.06
VL38	1.48	0.95	7.88*	69.56	2.43	84.18*	130.78	1.32	34.05*	123.03	1.32	0.85	45.87	-1.62	197.56*	8.63	-0.52	0.01
VL 44	1.49	3.25	4.25*	66.33	1.86	47.27*	122.00	3.27	61.70*	144.90	0.19	5.98	41.56	2.79	48.38*	8.79	0.69*	0.00
Grand mean	1.58			76.64			136.67			152.18			51.50			8.54		
SE (m) ±	0.07			1.20			0.95			1.95			1.32			0.08		
CV	7.14			2.28			1.00			3.12			4.54			3.60		

* P, 0.05 X_i, Mean performance of the ith genotype over 4 environments; b_i, Regression coefficient of the ith genotype; S^2d_i, Least deviation from regression of the ith genotype

On the basis of performance and stability parameters, it was concluded that the genotypes, 'Annapurna' and 'PRA 9101' had above mean performance, average regression coefficient (b=1) and least deviation from regression ($S^2d=0$) for grain yield, therefore, these two genotypes may be recommended for large scale cultivation in high hills of dry temperate region of Himachal Pradesh.

References

Eberhart SA and Russell WA 1966. Stability parameters for comparing varieties. Crop Sci. **6**:36-40.

Dhiman KC, Chahota RK, Rana SS and Kapila RK 2002. Stability analysis in common buckwheat (*Fagopyrum esculentum*) in dry temperate region of north-western Himalaya. Indian J. Agric. Sci. **72** (11):679-80.

Joshi BD and Rana RS 1991. Grain Amaranth: The Future Food Crop, pp 60-61. Scientific Monograph 3, NBPGR, Shimla.

Panwar KS, Sood VK, Mittal RK and Sagwal JC 1996. Phenotypic stability in buckwheat (*Fagopyrum esculentum*). Indian J. Agric. Sci. **66** (2): 105-08.

Singh JV, Paroda RS, Arora RN and Saini M 1991. Stability analysis for green and dry fodder yield in cluster bean. Indian J. Genet. **51**:345-48.

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