Indian J. Genet., **67**(2): 153-155 (2007)

Stability analysis for seed yield and component traits in amaranthus [*Amaranthus hypochondriacus* L.] in the high altitude dry temperate regions

N. Kishore, R. K. Dogra, S. R. Thakur and R. K. Chahota

Department of Plant Breeding and Genetics, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur 176 062

(Received: October 2006; Revised: February 2007; Accepted: February 2007)

Abstract

Joint regression analysis over eight environments in 8 genetically diverse amaranth genotypes during *kharif* seasons of 2001-2004 at Sangla (Distt. Kinnaur) and Salooni (Distt. Chamba) indicated the presence of genotype x environment interaction for all the traits studied. Significant pooled deviations for all the traits indicated predominance of the nonlinear component. Estimates of stability parameters revealed that no genotype was stable for the traits studied. Based on the mean performance (x), genotypes Annapurna, Suvarna and PRA-1 showed significantly higher seed yield than the Local check. Suvarna was significantly early in flowering (54 days) and maturity (107 days) than the other genotypes, whereas PRA-1 showed maximum mean plant height and inflorescence length. Significant linear regression coefficient value for seed yield indicated above average (b>1) stability for the genotype Annapurna i.e. suitability for the input responsive environment, whereas for plant height the genotype was significantly least responsive i.e. exhibited below average (b<1) stability showing fitness for the low yielding environment. PRA-1 was also found to be significantly responsive for plant height in comparison to the Local check. Genotypes PRA-2 and the Local check exhibited least responsiveness for days to 50% flowering. Considering the stability parameters in general, genotype Suvarna is by far the best genotype followed by Annapurna and PRA-1 for cultivation in the higher regions of Himachal Pradesh.

Key words: Amaranthus, G × E interaction, stability parameters

Introduction

Grain amaranth (*Amaranthus hypochondriacus* L.) is a traditional crop of Himalayan region generally cultivated as mixed crop as well as a part of subsistence agriculture in the hilly areas with comparatively lower rainfall under neglected agriculture conditions. With the advent of green revolution, the cultivation of this crop has seen a conspicuous decline mainly due to the lack of awareness of its complementary nutritive value and non-availability of suitable high yielding varieties. To reverse this declining trend of cultivation, quick varietal improvement is one of the important criteria. However, cultivation of amaranth has acquired increasing importance among breeders and agronomists and it is being considered as a potential subsidiary food crop as well as crop of future due its excellent quality protein, tolerance to water scarcity and high photosynthetic efficiency, being a C_4 species [1]. Inspite of great importance, systematic efforts have not been made for the improvement of this crop in the recent past in Himachal Pradesh. Therefore, experiments were carried out to identify the stable genotypes for seed yield and component traits suitable for adverse conditions.

Materials and methods

The experimental material consisted of eight diverse amaranth genotypes namely, Annapurna, GA-1, GA-2, Suvarna, PRA-1, PRA-2, PRA-9401 and the Local check raised simultaneously during the rainy (*kharif*) seasons of 2001-2004 at Sangla (2680 metres above mean sea level) in district Kinnaur and at Salooni (1768 metres above mean sea level) in district Chamba. The experiment was conducted in randomized block design comprising of 3 replications and each genotype was grown in plot size of 10 m^2. Data were recorded on ten randomly taken plants for days to 50% flowering, plant height (cm), inflorescence length (cm), days to maturity and seed yield (q/ha). Seed yield was recorded on plot basis. Stability parameters for different characters were computed using the regression approach of Eberhart and Russell [2].

Results and discussion

Analysis of variance (Table 1) revealed significant differences among genotypes and environments for all the traits studied suggesting the presence of variability among genotypes and environments. Significant mean squares for genotype × environment interactions were observed for all the traits indicating differential response of genotypes to different environments. Highly significant mean squares due to environment (linear) indicated

Table 1. Joint regression analysis of variance for different traits over environments

Source	df	Mean sum of squares				
		Days to 50% flowering	Plant height (cm)	Inflorescence length	Days to maturity	Seed yield (q/ha)
Genotypes (G)	7	572.32*	1481.07*	136.93*	1006.67*	49.39*
Environments (E)	7	55.62*	1875.46*	59.03*	394.89*	17.82*
Genotype × Environment	49	50.90*	517.16*	36.94*	133.45*	7.69*
Environment + (G × E)	56	21.80*	385.25*	18.16*	88.29	4.47*
Environment (linear)	1	389.32^{+}	13128.23^{+}	413.18^{+}	2764.28^{+}	124.77^{+}
G × E (linear)	7	40.75^{+}	430.99^{+}	17.63	41.57^{+}	5.03^{+}
Pooled deviation (non-linear)	48	11.38*	113.10*	10.01*	39.35*	1.88*
Pooled error	112	0.50	16.96	0.74	0.43	0.09*

*,**Significant against pooled error m.s. at 5% level; + Significant against pooled deviation m.s. at 5% level

Table 2. Individual regression analysis and estimates of stability parameters for different characters

Genotype	Days to 50% flowering			Plant height (cm)			Inflorescence length (cm)			Days to maturity			Seed yield (q/ha)		
	x	b	S^2d	x	b	S^2d	x	b	S^2d	x	b	S^2d	x	b	S^2d
Annapurna	75.13	1.63 ±0.49	11.24*	186.89	0.19* ±0.30	149.81*	57.28	0.37 ±0.37	6.93*	125.25	0.78 ±0.25	21.94*	15.43	2.07* ±0.34	1.77*
GA-1	78.54	1.31 ±0.45	9.79*	192.55	0.61* ±0.12	25.13	52.96	2.04* ±0.45	10.61*	142.38	0.86 ±0.50	86.13*	10.31	0.73 ±0.32	1.58*
GA-2	76.42	1.40 ±0.37	6.72*	186.71	1.77* ±0.39	247.12*	56.79	0.91 ±0.31	4.89*	139.63	0.65 ±0.47	75.96*	10.90	0.76 ±0.37	2.13*
Suvarna	54.25	0.51 ±0.43	9.16*	154.60	0.81 ±0.30	150.98*	48.16	0.95 ±0.31	4.97*	107.04	1.42 ±0.36	45.04*	15.42	1.35 ±0.28	1.21*
PRA-1	79.46	1.79 ±0.41	7.82*	194.86	1.29* ±0.14	230.29	61.05	0.58 ±0.25	3.17*	125.71	1.14 ±0.17	9.95*	13.83	1.37 ±0.35	1.96*
PRA-2	77.79	-0.15* ±0.39	7.62*	192.75	1.51* ±0.17	48.97*	54.30	0.44 ±0.67	22.56*	128.58	0.62 ±0.23	18.95*	9.34	0.20 ±0.41	2.58*
PRA-9401	77.13	1.97 ±0.76	28.34*	181.26	1.07 ±0.32	168.67*	59.42	1.06 ±0.29	4.27*	124.67	1.00 ±0.21	13.93*	11.72	0.75 ±0.41	2.65*
Local	68.33	-0.45* ±0.46	10.35*	171.52	0.76 ±0.23	83.81*	58.60	1.64 ±0.26	22.64*	118.25	1.55 ±0.35	42.88*	9.70	0.77 ±0.27	1.16*
Grand mean	73.36			182.64			56.07			126.40			12.08		
CD (5%)	3.27			5.69			3.47			3.46			1.28		

*Significant at 5% level

considerable differences among environments and their predominant effects on all the traits. Genotype × environment (linear) interaction was significant for all the traits except for inflorescence length emphasizing the importance of linear regression in the prediction of these significant traits with some reliance under different environments. Significant pooled deviations for all the traits indicated predominance of non-linear component in the manifestation of genotype × environment interaction for the significant traits. The results are in conformity with the findings of earlier workers [3-5]. However, for the unpredictable traits, prediction can be made considering the stability parameters of individual genotypes.

According to Eberhart and Russell model a variety is considered to be stable if it shows high mean performance with unit regression coefficient (b = 1) and minimum deviation (nonsignificant) from the regression line ($S^2d = 0$). Estimates of stability parameters (Table 2) revealed that none of the genotypes were found to be stable as indicated by the significantly high deviation from regression i.e. $S^2d \neq 0$. Based on the mean performance for seed yield, genotypes Annapurna and Suvarna were found to be highest yielding followed by PRA-1. Annapurna also showed above average stability (b>1) for seed yield indicating its suitability to the input responsive or better environment, whereas for plant height, the genotype was significantly least responsive i.e. exhibited below average stability (b<1) indicating its suitability to low yielding environment when compared to the Local check. On the other hand, Suvarna was significantly early in flowering (54 days) and maturity (107 days) in comparison to the other genotypes.

Genotype PRA-1 showed maximum mean plant height and inflorescence length, whereas for the same traits, lowest mean values were observed for Suvarna, although being a high yielding genotype. PRA-1 was also found to be significantly responsive for plant height to superior environment when compared to the Local check. GA-1, though not better than the Local cultivar but was highly responsive for inflorescence length. Genotypes PRA-2 and the Local check exhibited least responsiveness for days to 50% flowering indicating its suitability to low yielding environment.

The results suggest that no single genotype was stable for all the traits studied. On the basis of mean performance and stability parameters, genotype Suvarna was significantly superior with regard to seed yield, days to 50% flowering and days to maturity in comparison to the Local check. Besides Suvarna, genotypes Annapurna and PRA-1 along with one or more yield contributing traits may be recommended for cultivation in the high altitude regions of Himachal Pradesh.

References

1. **Teutonico R. A. and Knorr D.** 1985. Amaranth: Composition, properties and application of rediscovered food crops. Food Tech., **39**: 49-61.
2. **Eberhart S. A. and Russell W. L.** 1966. Stability parameters for comparing varieties. Crop Sci., **6**: 36-40.
3. **Sharma J. K., Lata S. and Sharma R. P.** 2001. Stability for grain yield in amaranthus (*Amaranthus hypocondriacus*). Indian J. Agric. Sci., **71**: 392-394.
4. **Sharma T. R., Bansal G. L. and Chaudhary H. K.** 1998. Seed yield stability of indigenous and exotic genotypes of amaranth in the north-western Himalaya. Indian J. Agric. Sci., **68**: 328-329.
5. **Waghmode B. D., Pawar S. V., Patil S. C. and Jadhav A. S.** 1998. Adaptability under predictable environments in grain amaranthus (*Amaranthus hypocondriacus*). Guj. Agri. Univ. J., **24**: 23-29.