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Variability and association studies for some agro-morphological traits in grain amaranthus (*Amaranthus hypochondriacus* L.) in the high altitude regions of the north-western Himalaya

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, India.

Abstract

Eight diverse grain amaranthus genotypes raised during the rainy seasons of 2001-2004 at Sangla and Salooni showed the highest PCV and GCV values for seed yield/ha. Highest genetic advance coupled with high heritability was also observed for this trait. Plant height showed significant positive association with days to 50% flowering, whereas seed yield showed non-significant negative correlation with days to 50% flowering and maturity. High and positive direct effect of plant height was observed on seed yield indicating better seed yield following increased plant height. The indirect effects of days to 50% flowering and inflorescence length via plant height were positive suggesting plant height to be an important trait for obtaining higher yields in grain amaranthus.

Key words: Amaranthus, variability, correlation, path analysis.

Introduction

Grain amaranthus (*Amaranthus hypochondriacus* L.) is a traditional crop of Himalayan region generally cultivated in the hilly areas under neglected agricultural conditions. There has been a conspicuous decline in the cultivation of this crop mainly due to the lack of awareness of its complementary nutritive value and non-availability of suitable high yielding varieties. 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 to its excellent quality protein, tolerance to water scarcity and high photosynthetic efficiency, being a C_4 species (Teutonico and Knorr, 1985). Being a relatively underexploited crop, information on various genetic parameters is scanty. Therefore, the present study was aimed to generate information on variability and associations among different traits in grain amaranthus in Himachal Pradesh.

Material and Methods

The experimental material consisted of eight diverse grain amaranthus genotypes raised during the rainy (*kharif*) seasons of 2001-2004 at Sangla (2680m above mean sea level) in district Kinnaur and at Salooni (1768m amsl) in district Chamba. The experiments were conducted in randomized block design with of 3 replications and each genotype was grown in $10m^2$ plot. Data were recorded on 10 randomly taken plants for days to 50% flowering, plant height, inflorescence length, days to maturity, whereas seed yield was recorded on plot basis which was converted to q/ha. Coefficients of variability were estimated as per Johnson *et al.* (1955a). Correlation coefficients were calculated according to Johnson *et al.* (1955b) and path coefficient analysis as per Dewey and Lu (1959).

Results and Discussion

To initiate a breeding programme in a particular crop, relevant information on the nature and magnitude of variation and association among different traits is needed. Analysis of variance showed high variability for all the traits studied as indicated by the significant differences among the amaranthus genotypes. In general, magnitude of phenotypic coefficient of variation (PCV) was slightly higher than that of genotypic coefficient of variation (GCV) for all the traits indicated the little influence of environmental factors on these traits (Table 1).

Seed yield showed the highest PCV and GCV values, whereas these were low for the remaining traits suggesting that selection based on grain yield would help in the isolation of the desirable genotypes. High PCV and GCV for seed yield was also observed earlier by Joshi and Rana (1995) and Shukla and Singh (2003).

Table 1. Variance and parameters of variability for different characters in grain amaranthus in pooled over environments

Characters	Variance	Mean ± SE(m)	Range	PCV (%)	GCV (%)	h^2bs (%)	GA (%)
Days to 50% flowering	572.32*	73.38±1.33	54.25-79.46	12.68	12.37	95.20	25.97
Plant height (cm)	1481.07*	182.64±2.05	154.60-194.86	11.30	11.14	97.00	20.25
Inflorescence length(cm)	136.93*	56.07±1.25	48.16-61.05	12.44	11.55	86.30	19.80
Days to maturity	1006.67*	126.44±1.25	107.04-142.38	10.25	10.16	98.20	22.91
Seed yield (q/ha)	49.39*	12.08±0.46	9.34-15.43	32.40	31.90	97.00	62.33

* Significant at 5% level

According to Johnson *et al.* (1955a) high heritability along with high genetic advance (GA) render the selection effective as these characters are under the control of additive gene action. Seed yield showed the highest GA coupled with high heritability, whereas the remaining traits had high heritability estimates accompanied with moderate GA. Lohithaswa *et al.* (1996) also reported high heritability coupled with moderate to high GA for seed yield, plant height and days to 50% flowering.

The correlation coefficients at genotypic level were generally of higher magnitude than the corresponding phenotypic values (Table 2). Plant height showed significant positive association with days to 50% flowering and days to maturity indicating the increase in plant height with late flowering and maturity. Seed yield, however, showed non-significant negative correlation with days to 50% flowering and maturity. Similar finding was also reported earlier by Shukla and Singh (2003).

Table 2. Genotypic (above diagonal) and phenotypic (below diagonal) correlation coefficients among different characters in pooled over environments in grain amaranthus

Characters	Days to 50% flowering	Plant height (cm)	Inflorescence length (cm)	Days to maturity	Seed yield (q/ha)
Days to 50% flowering		0.85	0.35	0.66	-0.28
Plant height (cm)	0.82*		0.06	0.74	-0.10
Inflorescence length(cm)	0.29	0.05		-0.25	0.21
Days to maturity	0.64	0.73*	-0.22		-0.40
Seed yield (q/ha)	-0.26	-0.10	0.17	-0.38	

* Significant at 5% level

The cause and effect relationship as suggested by the path coefficient analysis (Table 3) revealed high and positive direct effect of plant height on seed yield showing better seed yield following increased plant height but the direct effects of days to 50% flowering and inflorescence length were negative indicating that high seed yield may not be necessarily associated with late flowering and long inflorescence.

Table 3. Genotypic (G) and Phenotypic (P) path coefficient analysis for different traits on seed yield in grain amaranthus in pooled over environments

Characters		Days to 50% flowering	Plant height (cm)	Days to maturity	Inflorescence length (cm)
Days to 50% flowering	P	**-0.643**	0.622	0.064	-0.305
	G	**-1.178**	0.962	0.164	-0.229
Plant height (cm)	P	-0.525	**0.761**	0.010	-0.350
	G	-0.997	**1.137**	0.026	-0.261
Days to maturity	P	-0.189	0.037	**0.217**	0.104
	G	-0.414	0.064	**0.467**	0.089
Inflorescence length (cm)	P	-0.410	0.556	-0.047	**-0.479**
	G	-0.771	0.845	-0.118	**-0.350**

Residual effects
Phenotypic (P) = 0.692
Genotypic (G) = 0.543

The indirect effects of plant height and inflorescence length via days to 50% flowering were negative, whereas that of days to 50% flowering and inflorescence length via plant height were positive suggesting plant height to be an important trait for obtaining increased seed yield. The results are in conformity with the findings of Gowda *et al.* (1999) and Shukla and Singh (2003).

Thus, from the overall results it can be inferred that plant height is an important trait based on which high seed yield can be obtained, although simultaneous selection for early flowering genotypes will also be useful in bringing higher yields in grain amaranthus.

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