Genetic Variation, Correlation and Path-Coefficient Analysis for Seed Yield and Quality Characters in Grain Amaranth

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Grain amaranth (*Amaranthus hypochondriacus*) is one of the important under-utilized plants of food and multiple uses. It has potentiality to withstand adverse weather changes, particularly severe moisture stress. Besides, it can be grown in wide range of agro-climatic conditions *viz.*-high rainfall area to low rainfall, from sea-shore to high altitudes and thus, is suitable for sustainable agriculture (Joshi, 1991). It is a crop of poor people who depend for their food on marginal lands. It is the richest source of protein (16%) and three amino acids (lysine, methionine and tryptophan) in comparison to the cereal crops *viz.*-barley, maize, rice, wheat and buckwheat. It is also a rich source of fat (21%), calcium (0.49%), phosphorous (0.60%), iron (17.5%) and total food energy (391 calories) in comparison to other common cereals (Joshi and Rana, 1991). Keeping this in view, the present investigation was carried out under Haryana agro-climatic conditions.

A set of 68 genotypes of indigenous origin grain amaranth germplasm lines procedured from Akola centre of NBPGR were sown in a single row of 2 m length in randomized block design with 2 replications during *rabi* season at the experimental farm of the Department of Plant Breeding. Row-to-row and plant-to-plant spacing were 45 and 10 cm, respectively. Plant height and grain yield/plant were recorded on 5 plants basis in each replication, while quality analysis for protein and phosphorous content were conducted in laboratory as per the standard procedures of AOAC (1985). The data were subjected to correlation and path-coefficient analysis as per the procedures of Miller *et al.* (1958) and Dewey and Lu (1959), respectively. The path-coefficient analysis was based on phenotypic correlation coefficients.

A perusal of results with regard to different parameters of variability correlation and path co-efficient analysis for different traits have been presented in Table 1.

Seed yield/plant: Seed yield being highly complex and environmentally affected character recorded wide range of variability (4.9 to 31.9 g/plant) and the highest phenotypic and genotypic coefficient of variation (PCV and GCV). Accession IC 95453 recorded the highest seed yield/plant (31.9 g), followed by IC 35778 (26.5 g), IC 35634 (25.3 g), IC 35746 (22.3) and IC 35574 (20.4 g) as against 11.4 g of GA-1 (check). The highest heritabilty (98.89%) and genetic advance as per cent of mean or genetic gain (95.76%) in respect of this character revealed better chances of further improvement through selection.

Plant height: It ranged from 33.7 to 113.2cm with overall mean of 68.5 cm. Genotype IC 95453 (113.2cm) was found to be the tallest, followed by IC 35522, IC 35746. IC 35622, IC 95455 and IC 35778. PCV and GCV were comparable, indicating vulnerability to environmental variation in respect of plant height. Heritability (97.64%) and genetic advance as per cent of mean (46.98%) were also quite high, revealing better chances of further improvement for this trait. Plant height had positive and highly significant phenotype correlation with seed yield/plant. Plant height also had maximum and highly significant direct effects on seed yield. Therefore, plant height is an important criterion for selection resulting in increased seed yield.

Protein content: It ranged from 10.9 to 15.7% with population means of 15.0%. Accessions IC 95307, IC 55661 IC 35634, IC 95465, IC 35522, IC 95622 and IC 35595 were the superior genotypes with more than 15% protein content. Low PCV and heritability resulted in poor genetic gain (9.47%). It also had non-significant phenotypic correlation and direct efforts on seed yield, indicating little scope for further improvement with regards to protein content.

Phosphorous content: Wide range of variability was recorded for this character (0.36 to 0.64%) and greater PCV. Accession with high phosphorous content were IC 35719, IC 35584, IC 35681, IC 55145, IC 35735,

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Table 1. Parameters of genetic variation, heritability, genetic gain, phenotypic correlation coefficients and direct effects of different characters on seed yield in grain amaranth

Parameters	Plant Height (cm)	Protein content (%)	Phosphorus content (%)	Seed yield/ plant (g)
Mean	68.5	14.0	0.48	12.00
Range	33.7	10.9	0.36	4.9
	113.2	15.7	0.64	31.9
PCV (%)	23.36	6.10	12.78	47.01
GCV (%)	23.08	5.29	11.68	46.75
Heritability % (Broad sense)	97.64	75.39	83.46	96.89
Genetic gain (%)	46.98	9.47	21.98	95.76
Phenotypic correlation with seed yield/plant	0.405**	0.113	-0.146	—
Direct effects on seed yield	0.408	0.080	-0.154	—
Better genotypes over released variety GA-1	IC 95353	IC 95307	IC 35719	IC 95453
	IC 35522	IC 55661	IC 35584	IC 35778
	IC 35746	IC 35634	IC 35681	IC 35634
	IC 35622	IC 95465	IC 55145	IC 35746
	IC 95455	IC 35422	IC 35735	IC 35574
	IC 35778	IC 95622	IC 35778	
		IC 35595	IC 35453	
			IC 95578	
			IC 35697	
			IC 35686	
Performance of released variety GA-1	58.6	13.6	0.42	11.4

** Highly significant at 1% level of significance

35778, IC 35453, IC 95578, IC 35697, IC 35686 (0.56% and above). Moderately high heritability (83.46%) and genetic gain (21.98%) revealed a little scope for further genetic upgradation for this character. Path coefficient analysis and correlation studies revealed its negative association with seed yield.

In view of the non-significant correlation and low direct effects of quality character (protein and phosphorous contents) with seed yield/plant, it is evident that amaranth seed yield has no effect on protein and phosphorous content. However, plant height and seed yield have been found positively and highly significantly associated; and plant height had high positive direct effects on seed yield. Similar results had been reported earlier by Pandey (1981) and Joshi (1986). Hence, plant height can serve as one of the important criteria to select for higher seed yield, which is further evident from the fact that three accessions, namely, IC 95353 IC 35778 and IC 35746 were tall as well as high seed yielders. On the other hand, accession IC 35634 had suitable combination of high seed yield and protein content; and another line IC 35522 had high plant height and protein content, confirming no significant correlation between the two characters. However, accession IC 35634 is a rare combination of high seed yield and high protein content, which can be used as a donor parent in hybridization programme.

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