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Genetic variability, correlation and path coefficient anlaysis in amaranthus

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Among the various unexploited vegetable crops *Amaranthus* is such a crop which is grown as leafy vegetable during summer and rainy season in India. It is hardy, fast growing and is rich in seed protein, carotene and ascorbic acid. *Amaranthus* seed is a rich source of essential amino acid lysine and produces high quality seed protein up to 160g per Kg seed being much higher than non-legume grain crops. In India, various domesticated forms of *Amaranthus* are grown in the southern states of Tamil Nadu, Andhra Pradesh, Karnataka and Kerala. In the interior areas of North-West hills of India it occupies nearly 60 per cent non-irrigated land of higher hills. *Amaranth* leaves are a rich and inexpensive source of dietary fibre, protein, vitamins and a wide range of minerals. *Amaranthus* has been incorporated into a range of human food products that are primarily targeted at health conscious consumers. It serves as an alternative source of nutrition for vegetarian people in developing countries where the bulk of the population has little access to protein rich food. Through collection and selection programmers a number of strains have been introduced and acclimatized in various parts of the world, but evaluation studies for yield and its contributing quantitative and qualitative traits are scarce in our country, particularly under the north Indian conditions. Hence an experiment was conducted to study genetic variability, correlation and path coefficient among yield and yield components traits in *Amranthus.*

The material consisting of 24 genotypes of *Amaranthus* spp. collected from National Bureau of Plant Genetic Resources (NBPGR), New Delhi and Tamil Nadu was used for the evaluation of economic characters.The 24 genotypes of *Amaranthus* were sown in March 2007 and in June 2007 on raised nursery beds. Transplanting was done on ridges 30 days after sowing in a randomized complete block design with three rows per genotype and eleven plants per row in 3 replications. The planting was done at row to row distance of 60 cm and plant to plant distance of 30 cm. Weeding was done once in 15 days to remove unwanted plants. Irrigation was applied as and when needed. Data ware recorded on growth and yield contributing characters (plant height, number of branches per plant, leaf length, leaf width, number of leaf per plant, days to first harvest, leaf area index, total green yield) quality characters (oxalate content of leaves, protein content of leaves) .Standard statistical procedures were followed for estimating various genetic parameters. Phenotypic and genotypic coefficient of variations, heritability and genetic gain were calculated following Burton and De Vane (1953). The genotypic and phenotypic coefficients were calculated following Dewey and Lu (1959) and path analysis following the method of Fisher and Yates (1963).

The analysis of variance revealed highly significant differences for all the parameters suggesting that experimental material studied possessed sufficient variability. The range of genotypic means provides a rough estimate of diversity within the material under investigation. In the present investigation the values of phenotypic coefficient of variation (PCV) were higher than those of genotypic coefficient of variation (GCV) in both seasons for all the characters in all the cuttings. Similar results were obtained by Rastogi *et al.* (1995) in *Brassics*. The heritability estimates were in general high for all the characters in both the seasons ranging from 89.05 to 99.99 per cent. Similar results were obtained in *Amaranthus* by Revanappa and Madalageri (1998). High values of heritability coupled with high genetic gain for the characters like total green yield and leaf area index were obtained indicating the preponderance of additive gene effect and desired improvement in these characters can be brought through direct selection for these component traits. Similar resulted were earlier reported by Shukla and Singh (2000) in *Amaranthus*. Estimation of correlation coefficients indicated that total green yield was negatively correlated with oxalate content (-0.3347) and leaf blight incidence

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Table 1: Estimation of phenotypic (rp) and genotypic (rg) correlation coefficients among ten characters in Amaranthus (summer season 2007)

Treatment	Type of correlation	Plant height (cm)	Number of branches per plant	Leaf length (cm)	Leaf width (cm)	Number of leaves per plant	Leaf area index	Total green yield (q/ha)	Protein content (%) (Dry Wt. basis)	Oxalate content (%)	Leaf Blight incidence
Plant height (cm)	rg										
	rp										
Number of branches per plant	rg	0.6827									
	rp	0.6491**									
Leaf length (cm)	rg	0.3696	0.5948								
	rp	0.3381**	0.5483**								
Leaf width (cm)	rg	0.4553	0.5973	0.9304							
	rp	0.4195**	0.5581**	0.9071**							
Number of leaves per plant	rg	0.5332	0.8858	0.7514	0.7894						
	rp	0.5254**	0.8465**	0.7136**	0.7452**						
Leaf area index	rg	0.5698	0.8178	0.7872	0.8357	0.9212					
	rp	0.5604**	0.7795**	0.7461**	0.7865**	0.9210**					
Total green yield (q/ha)	rg	0.5720	0.8065	0.8389	0.8785	0.9530	0.9662				
	rp	0.5632**	0.7693**	0.7967**	0.8292**	0.9529**	0.9660**				
Protein content (%) (Dry Wt. basis)	rg	0.4427	0.6451	0.8202	0.8186	0.7914	0.9132	0.8837			
	rp	0.4277**	0.6142**	0.7777**	0.7720**	0.7836**	0.9037**	0.8748**			
Oxalate content (%)	rg	-0.0250	-0.1474	-0.3177	-0.2433	-0.3470	-0.2468	-0.3386	-0.3099		
	rp	-0.0158	-0.1396	-0.2996*	-0.2285	-0.3429**	-0.2440*	-0.3347**	-0.3061**		
Leaf blight incidence	rg	-0.5139	-0.7603	-0.7893	-0.8683	-0.8643	-0.9630	-0.9169	-0.9189	0.1746	
	rp	-0.4989**	-0.7326**	-0.7452**	-0.8211**	-0.8577**	-0.9550**	-0.9097**	-0.9097**	0.1743	

Critical value of 'rp' at 5% = 0.2335 and at 1% = 0.3040

Table 2: Results of path-coefficient analysis showing direct and indirect effect of different characters on total green yield (q/ha) at genotypic (G) and phenotypic (P) levels in Amaranthus (summer season)

Treatment	Type of correlation	Plant height (cm)	Number of branches per plant	Leaf length (cm)	Leaf width (cm)	Number of leaves per plant	Leaf area index	Protein content (%) (Dry Wt. basis)	Oxalate content (%)	Leaf Blight incidence
Plant height (cm)	G	0.0898	-0.1147	0.0301	0.0547	0.2709	0.3245	0.0247	0.0002	-0.1082
	P	0.0915	-0.0942	0.0333	0.0204	0.2592	0.2392	0.0089	0.0005	0.0043
Number of branches per plant	G	0.0613	-0.1680	0.0484	0.0718	0.4500	0.4657	0.0360	0.0013	-0.1601
	P	0.0594	-0.1451	0.0541	0.0272	0.4176	0.3327	0.0128	0.0044	0.0064
Leaf length (cm)	G	0.0332	-0.0999	0.0814	0.1118	0.3818	0.4483	0.0458	0.0028	-0.1662
	P	0.0309	-0.0796	0.0986	0.0441	0.3520	0.3184	0.0162	0.0095	0.0065
Leaf width (cm)	G	0.0409	-0.1003	0.0757	0.1202	0.4011	0.4759	0.0457	0.0021	-0.1828
	P	0.0384	-0.0810	0.0894	0.0487	0.3676	0.3356	0.0161	0.0072	0.0071
Number of leaves per plant	G	0.0479	-0.1488	0.0612	0.0949	0.5081	0.5246	0.0442	0.0030	-0.1820
	P	0.0481	-0.1229	0.0704	0.0363	0.4933	0.3930	0.0163	0.0109	0.0075
Leaf area index	G	0.0511	-0.1374	0.0641	0.1005	0.4680	0.5695	0.0510	0.0021	-0.2028
	P	0.0513	-0.1131	0.0736	0.0383	0.4543	0.4268	0.0188	0.0077	0.0083
Protein content (%) (Dry Wt. basis)	G	0.0397	-0.1084	0.0668	0.0984	0.4021	0.5200	0.0559	0.0027	-0.1935
	P	0.0391	-0.0891	0.0767	0.0376	0.3866	0.3857	0.0208	0.0097	0.0078
Oxalate content (%)	G	-0.0022	0.0248	-0.0259	-0.0292	-0.1763	-0.1405	-0.0173	-0.0087	0.0368
	P	-0.0015	0.0203	-0.0295	-0.0111	-0.1691	-0.1041	-0.0064	-0.0317	-0.0015
Leaf blight incidence	G	-0.0461	0.1277	-0.0642	-0.1044	-0.4391	-0.5484	-0.0513	-0.0015	0.2106
	P	-0.0457	0.1063	-0.0735	-0.0399	-0.4231	-0.4076	-0.0188	-0.0055	-0.020

Unexplained Variation G 0.016, P 0.022

(-0.9097). Plant height was positively correlated with number of branches per plant (0.6491), leaf length (0.3381), leaf width (0.41954), number of leaves per plant (0.5254), leaf area index (0.5604), total green yield (0.5632) and protein content (0.4271). Number of leaves per plant was positively correlated with leaf area index (0.9210), total green yield (0.9529) and protein content (0.7836).Number of leaves was negatively correlated with oxalate content (-0.3429) and leaf blight incidence (-0.8577). It was quite obvious that increase in number of leaves per plant resulted in decreasing the oxalate content and leaf blight incidence. Leaf area index was positively correlated with total green yield (0.9660) and protein content (0.9037). Total green yield was positively correlated with protein content (0.8748). The genotypic coefficients of correlation, in general, were high in magnitude than corresponding phenotypic coefficients of correlation indicating that there is an inherent association among the various characters studied and phenotypic expression of correlation was subduced under the influence of environment. Similar findings in *Amaranthus* were also reported by Varalakshmi and Pratap Reddy (1994). Total green yield exhibited highly significantly and positive correlation with plant height, number of branches per plant, leaf length, leaf width, number of leaves, and leaf area index both at genotypic and phenotypic levels. Similar results were obtained by Campbell and Abbott (1982).

In the present investigations path analysis of phenotypic correlation coefficients reveals that number of leaves per plant had highest (0.4933) positive direct effect on total green yield followed by leaf area index (0.4268), leaf length (0.0986), plant height (0.0915), leaf width (0.0487) and protein content (0.0208). The indirect effect of leaf area index on total green yield was highest (0.4543) in positive direction via number of leaves per plant whereas leaf blight incidence had highest (-0.4231) negative indirect effect via number of leaves per plants.

It was evident that selection based any of these characters was expected to give the desired response. This apparent between total correlation and path coefficient analysis was also observed by several workers viz. Dewey and Lu (1959) in crested wheat grass, Ramanujan and Rai (1963) in *Brassica campestris* and Mujumdar *et al* (1974) in okra.

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