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GENETIC ANALYSIS FOR YIELD AND ITS COMPONENT IN HIMALAYAN CHENOPOD

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A set of 53 genetically diverse genotypes of *Chenopodium album* L. originating from different agro-ecological areas of Himalayas and 3 exotic introductions of *C. quinoa* from South America was tested and analysed for genetic variability, correlation and path coefficient analysis. Phenotypic coefficient of variation and genotypic coefficient of variations were the highest for inflorescence length, number of leaves on main shoot, number of branches/plant and plant height. Heritability and genetic advance (in broad sense) were high for plant height, number of leaves on main shoot and days to mature. Grain yield showed positive association with inflorescence length, days to flower, number of branches/plant and leaf length. Inflorescence length had highest and positive direct effect on grain yield followed by days to flower and number of branches/plant. On the basis of variability and productivity parameters studied, inflorescence length, days to flower and number of branches/plant were observed to be the most potential traits for genetic improvement of Himalayan chenopod. Since late flowering and maturity beyond certain limit are not desirable, greater emphasis is given to inflorescence length and number of branches/plant while making selection or formulating component breeding programme for the genetic improvement of chenopod.

Key Words : *Chenopodium album*, pcv, gcv, heritability, genetic advance, correlation

Yield being the most important and complex quantitative character, is governed by many physiological processes. The out come of the phenotypic selection does not give expected genetic advance mainly due to the presence of genotype x environment interaction, non-allelic interactions and undesirable association between the component characters. In order to identify yield component for defining an ideal plant type, the knowledge of cause and effect relationship of these components on yield, heritability and genetic gain are of great importance to the plant breeders. In chenopod, the literature available on such aspects is very limited on Himalayan chenopod (Joshi, 1991 and Partap, 1987), therefore, an attempt was made to know the nature and magnitude of genetic variability, correlation among yield and its components and their direct and indirect effects.

MATERIALS AND METHODS

Fifty-three genotypes of *Chenopodium album* L. originating from different agro-ecological regions of the Himalayas including 3 exotic introductions of *C. quinoa* from Andean region were grown in the rainy seasons of 1993 and 1994 in an augmented incomplete block design (Federer, 1956). The seeds were drilled in rows 50 cm apart first follwed by thinning and plant to plant distance was kept 20 cm within rows. Five competitive plants of each accession were selected at random. Data were recorded on 10 characters

Table 1. Estimates of various parameters of variability in chenopod

	Characters	Range	Mean	GCV	PCV	Heritability	Genetic advance
1.	Plant height (cm)	77.0-232.5	123.9	30.80	31.00	99.0	78.4
2.	No. of branches	18.5-65.5	35.1	34.50	35.46	94.4	24.2
3.	No. of leaves on main shoot	21.0-92.0	40.0	44.70	45.43	96.8	36.2
4.	Inflorescence length (cm)	4.4-30.3	16.5	48.78	49.93	95.4	16.2
5.	Leaf length (cm)	3.8-8.4	5.7	26.66	27.24	95.7	3.1
6.	Leaf width (cm)	2.7-6.8	4.6	23.72	24.60	93.0	2.2
7.	Days to flower	33.5-66.5	54.7	20.18	20.57	96.2	22.3
8.	Days to mature	54.5-149.5	117.0	15.07	15.25	97.6	35.9
9.	1000 grain weight (g)	0.5-1.70.8	23.17	23.50	97.2	0.4	
10.	Grain yield/plant (g)	4.1-11.5	7.5	21.78	22.29	95.5	3.3

Table 2. Phenotypic (P) and genotypic (G) correlations in chenopod

	Traits	Plant Height	Branches/ plant	Leaves/ main shoot	Inflorescence length	Leaf length	Leaf width	Days to flower	Days to mature	1000 grain weight	Grain yield
		1	2	3	4	5	6	7	8	9	10
1.	P	1.000	–0.005	–0.414**	0.201	–0.313*	–0.253	0.275	0.160	–0.147	0.369**
	G	1.000	–0.007	–0.399**	0.198	–0.311*	–0.242	0.271	0.157	–0.146	0.259
2.	P		1.000	0.774**	0.265	0.575**	0.336*	–0.621**	–0.429**	0.114	0.480**
	G		1.000	0.739**	0.252	0.567**	0.317*	–0.589**	–0.417**	0.107	0.451**
3.	P			1.000	0.210	0.619**	0.640**	–0.427**	–0.299*	–0.027	0.059
	G			1.000	0.206	0.589**	0.612**	–0.411**	–0.296	–0.024	0.062
4.	P				1.000	0.143	–0.064	–0.054	–0.046	0.047	0.648**
	G				1.000	0.132	–0.041	–0.056	–0.048	0.045	0.623**
5.	P					1.000	0.314*	–0.713**	–0.545**	0.214	0.365**
	G					1.000	0.304*	–0.684**	–0.524**	0.208	0.348*
6.	P						1.000	–0.118	–0.080	–0.204	–0.211
	G						1.000	–0.105	–0.069	–0.189	–0.211
7.	P							1.000	0.813**	–0.238	0.477**
	G							1.000	0.791**	–0.235	0.434**
8.	P								1.000	–0.225	0.049
	G								1.000	–0.213	0.042
9.										1.000	0.251
	G									1.000	0.247
10	P										1.000
	G										1.000

*Significant at P0.05 level; **Significant at P 0.01 level

viz. plant height (cm), number of braches, number of leaves on main shoot, inflorescence length (cm), leaf length (cm), days to flower, days to mature, 1000- grain weight (g) and yield/plant (g). The average value of 5 plants for each character were used in the statistical analysis. Genotypic and phenotypic coefficient of variation, heritability and genetic advance were calculated according to Johnson *et al.* (1955) and correlation and path analysis were worked out as per the method described by Dewey and Lu (1959).

RESULTS AND DISCUSSION

Analysis of variance revealed a wide range of variability and significant differences among all the genotypes for all the characters studied (Table 1). Coefficient of variation both at phenotypic (pcv) and genotypic (gcv) was the highest for inflorescence length (Table 2), number of leaves on main shoot and number of branches/plant. In general the differences between the magnitudes of pcv and gcv were very less, indicating little influence of environment for all the traits. Heritability was very high (93 to 99%) for all the traits, indicating the effectiveness of simple selection methods in segregating populations. Genetic advance was high for plant height followed by number of leaves on main shoot, days to mature, number of branches and days to flower. High heritability coupled with high genetic advance was observed for plant height, number of leaves on main shoot, days to mature, number of branches and days to flower indicating the influence of additive genetic variance for these traits. Beru and Mukharjee (1987) also observed variability within wild populations of chenopod while identifying genetic resources for use in improving the cultivated hexaploid used as leaf vegetable and diploid (2n = 18) cytotypes were

Table 3. Direct and indirect effects (direct effects in the main diagonal bold figures)

	Traits	Plant Height	Branches/ plant	Leaves/ main shoot	Inflore-scence length	Leaf length	Leaf width	Days to flower	Days to mature	1000 Grain weight	Correlation with yield
		1	2	3	4	5	6	7	8	9	10
1	P	**0.057**	–0.001	0.020	0.111	–0.70	0.055	0.124	–0.013	–0.014	0.369
	G	**0.085**	–0.001	–0.005	0.108	–0.037	0.054	0.074	–0.003	–0.016	0.259
2	P	0.000	**0.286**	–0.074	0.146	0.129	–0.073	–0.281	0.035	0.011	0.480
	G	–0.001	**0.163**	0.017	0.137	0.068	–0.070	–0.162	0.007	0.012	0.450
3	P	–0.012	0.222	**–0.095**	0.116	0.139	–0.139	–0.193	0.025	–0.003	0.059
	G	–0.018	0.120	**0.070**	0.112	0.071	–0.136	–0.113	0.005	–0.003	0.062
4	P	0.012	0.076	–0.020	**0.551**	0.032	0.014	–0.025	0.004	0.004	0.648
	G	0.017	0.041	0.005	**0.545**	0.016	0.009	–0.015	0.001	0.005	0.623
5	P	–0.018	0.165	–0.059	0.079	**0.125**	–0.068	–0.323	0.045	0.020	0.365
	G	–0.027	0.092	0.014	0.072	**0.120**	–0.067	–0.188	0.009	0.023	0.348
6	P	–0.014	0.096	–0.061	–0.036	0.071	**–0.217**	–0.053	0.007	–0.020	–0.228
	G	–0.021	0.052	0.014	–0.022	0.037	**–0.222**	–0.029	0.001	–0.021	–0.211
7	P	0.016	–0.178	0.041	–0.030	–0.160	0.026	**0.456**	–0.067	–0.023	0.471
	G	0.023	–0.096	–0.009	–0.030	–0.082	0.023	**0.274**	–0.013	–0.026	0.434
8	P	0.009	–0.123	0.029	–0.025	–0.123	0.017	0.368	**–0.083**	–0.022	0.049
	G	0.013	–0.068	–0.007	–0.026	–0.063	0.015	0.217	**–0.016**	–0.024	0.042
9	P	–0.008	0.033	0.003	0.026	0.048	0.044	–0.108	0.019	**0.096**	0.251
	G	–0.012	0.017	–0.001	0.025	0.025	0.042	–0.065	0.004	**0.112**	0.247

Residual (G) 0.1720; (P) 0.1232

investigated. Variation in leaf character was high, one cytotype tended to produce larger plants. Variation was low for protein content of seeds but high for saponin content. Chromosome size and behaviour were generally similar in both cytotypes.

Correlation analysis revealed that grain yield was positively and significantly associated with inflorescence length, number of branches/plant, days to flower, plant height and leaf length. In order to have a clear picture of interrelationship with grain yield of various characters direct andindirect effects at phenotypic and genotypic levels were worked out using path analysis parameter. Considering the direct effects at genotypic level of each character on grain yield, inflorescence length had highest and positive direct effect (0.55) followed by days to flower (0.45) and number of branches per plant (0.28). Days to flower had highest indirect effect on yield via 1000-grain weight. Thus longer vegetative as well as reproductive period may be more conducive for more leaves and bold grain size. Similarly Risi and Galwey (1989) investigated significant correlation between stem diameter, inflorescence length, inflorescence diameter, number of leaf protrusion and saponin content of quinoa.

The results revealed that inflorescence length, days to flower and number of branches per plant showed significant positive correlation and also maximum positive correlation and also maximum positive direct effect on grain yield which should be given attention while making selection or formulating breeding programme for genetic improvement of chenopod. Since late flowering and maturity beyond certain limit are not desirable hence inflorescence length and number of branches per plant be given due consideration while making selections.

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