



Genetic variability and heritability of selected traits during different cuttings of vegetable *Chenopodium*

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Chenopodium album is a winter weed, which is cosmopolitan in distribution in subtropical and temperate parts of the world. This species consists of accessions with three ploidy levels $2n = 18, 36, 54$ [1,2]. The accessions of diploid ($2n = 18$) and hexaploid ($2n = 54$) cytotypes are most commonly used for horticultural purposes as vegetable by humans and for livestock feeding. The leaves constitute an important and inexpensive source of proteins (30-47 g/kg), vitamin A (78-129 mg/kg) and vitamin C (1.9-2.3 g/kg) [3]. The amino acid balance in *C. album* is superior to that of wheat, due to rich content of lysine, methionine and cysteine [4]. Being cheap source of proteins and amino acids, it can compensate for the amino acid deficient food of the poor community.

Thirteen germplasm lines of vegetable *Chenopodium* (*C. album*), maintained at National Botanical Research Institute, Lucknow were sown in a randomized block design with 3 replications during 2002-2003. The germplasm lines selected were of different ploidy levels and from different locations (Table 1). The plot size was 4m² with 6 rows/plot, spaced 30 cm apart. The plant-to-plant distance was maintained at 10 cm. After 3rd week of sowing, first cutting of foliage started and subsequent cuttings were done at the interval of 15 days. Observations were recorded for three cuttings on 10 randomly selected plants in each replication for five characters, namely, plant height (cm), branches/ plant, number of leaves/plant, leaf size (cm²) and stem diameter (cm). Foliage yield was recorded on plot basis for each cutting (3 cuttings) and pooled for total foliage yield. Analysis of variance, phenotypic and genotypic coefficient of variation, heritability in broad sense and genetic advance were estimated.

The analysis of variance revealed significant differences among germplasm lines for all the individual cuttings (Table 2). The total foliage yield/plot ranged between 0.24 to 3.5 kg/plot with an average of 1.80 ± 0.36 . The plant height ranged from 6.73-28.5 cm with an

Table 1. Germplasm lines, their ploidy level, chromosome number and origin

Germplasm line	Ploidy level	Chromosome no.	Country/State
<i>C. album</i> PRC 9802	-	-	India
<i>C. album</i> IC 107297	-	-	India
<i>C. album</i> 'Mexico'	4x	36	Mexico
<i>C. album</i> (local red)	2x	18	India
<i>C. album</i> 'Siliguri'	2x	18	India
<i>C. album</i> amaranticolor	6x	54	India
<i>C. album</i> 'H.P.'	6x	54	India
<i>C. album</i> 605700	6x	54	USDA
<i>C. album</i> CHEN 60/76	6x	54	Gatersleben, Germany
<i>C. album</i> CHEN 95/97	6x	54	Gatersleben, Germany
<i>C. album</i> 'Czech'	6x	54	Czech Republic
<i>C. album</i> 'IOWA'	6x	54	USDA, USA
<i>C. album</i> 'Chandanbathua'	2x	18	India

average height of 14.81 ± 3.98 . The branches/plant ranged from 5.74-15.53 with arithmetic mean 9.85 ± 1.41 . The number of leaves/plant and leaf size ranged from 10.93-34.73 and 2.7-39.27 cm² with average number of leaves/plant and leaf size of 18.34 ± 3.6 and 16.82 ± 3.94 , respectively. Stem diameter was variable between 0.37-0.90 cm with an average value of 0.60 ± 0.04 . The mean of individual cuttings for plant height, branches/plant, stem diameter and foliage yield showed a gradual increase in ascending cuttings and was maximum for 3rd cutting, while leaf size showed gradual decrease up till 3rd cutting (14.45 ± 0.73). The range for stem diameter and foliage yield for individual cuttings gradually increased till the 3rd cutting. The phenotypic coefficient of variation (PCV) had higher estimate than corresponding GCV for all the characters though had small differences. The small differences between PCV and GCV for all the traits in total cuttings indicate that the variability was primarily due to genotypic differences. The coefficient of variability was high for leaf size and foliage yield while it was lowest for stem diameter. Variability alone is of little help in determining the heritable portion of variation. A study of genotypic coefficient of variability gives the amount of gain to be

Table 2. Genetic variability, heritability and genetic advance for different traits in *C. album*

Component of variation	Cuttings	Plant height (cm)	Branches/plant	No. of leaves	Leaf size (cm ²)	Stem dia. (cm)	Foliage yield (kg/plot)
F value	I	13.84	17.86	156.56	105.43	18.75	14.6
	II	89.43	25.54	51.13	174.69	14.58	45.6
	III	137.92	35.91	69.66	350.58	34.44	40.0
	P	-	-	-	-	-	-
Mean \pm S.E.	I	11.37 \pm 1.46	8.00 \pm 0.53	16.78 \pm 0.70	18.55 \pm 1.29	0.52 \pm 0.03	1.33 \pm 0.25
	II	14.44 \pm 0.96	9.85 \pm 0.56	19.63 \pm 1.44	17.47 \pm 1.16	0.60 \pm 0.02	1.99 \pm 0.18
	III	18.62 \pm 0.65	11.69 \pm 0.48	18.61 \pm 0.92	14.45 \pm 0.73	0.68 \pm 0.02	2.1 \pm 0.21
	P	14.81 \pm 3.98	9.85 \pm 1.41	18.34 \pm 3.6	16.82 \pm 3.94	0.60 \pm 0.04	1.8 \pm 0.36
Range	I	6.74-24.38	4.4-13.40	10.6-35.40	4.97-36.57	0.32-0.70	0.14-2.82
	II	8.44-30.40	5.6-13.20	9.8-35.80	3.36-43.87	0.48-0.76	0.24-3.85
	III	6.16-28.74	7.4-15.60	11.8-30.80	2.56-38.59	0.52-0.94	0.52-3.91
	P	6.73-28.50	5.74-15.53	10.93-34.73	2.70-39.27	0.37-0.90	0.24-3.5
σ^2_g	I	13.61	2.41	38.89	87.03	0.0009	0.45
	II	41.56	3.92	52.47	118.69	0.005	0.74
	III	29.66	4.07	29.20	95.55	0.01	0.91
	P	5.0	0.65	21.34	77.67	0.002	0.52
σ^2_p	I	16.79	2.84	39.64	89.53	0.01	0.55
	II	42.97	4.40	55.61	120.74	0.006	0.79
	III	30.31	4.42	30.57	96.37	0.01	0.98
	P	28.87	3.65	40.80	101.04	0.005	0.72
σ^2_e	I	3.18	0.43	0.75	2.50	0.0016	0.10
	II	1.41	0.48	3.14	2.05	0.0012	0.05
	III	0.65	0.35	1.28	0.82	0.0009	0.07
	P	23.87	3.00	19.46	23.37	0.003	0.20
GCV	I	32.44	19.39	37.16	50.29	18.24	50.43
	II	44.64	20.10	36.90	62.36	11.78	43.22
	III	29.24	17.25	29.08	67.64	14.70	45.42
	P	15.09	8.18	25.18	52.39	7.45	40.06
PCV	I	36.03	21.05	37.52	51.00	19.23	55.76
	II	45.39	21.29	37.98	62.89	13.12	44.66
	III	29.56	17.98	29.70	67.93	15.35	47.14
	P	36.28	19.39	34.82	59.76	11.78	47.14
Heritability	I	81.06	84.85	98.10	97.20	90.00	81.81
	II	96.71	89.09	94.35	98.30	80.64	93.67
	III	97.85	92.08	95.81	99.14	91.74	92.85
	P	17.31	17.80	52.30	76.87	40.00	72.22
Genetic gain	I	6.84	2.94	12.72	18.94	0.18	1.24
	II	13.05	3.84	14.49	22.25	0.13	1.71
	III	11.09	3.98	10.91	20.04	0.19	1.89
	P	1.91	0.70	6.88	15.91	0.05	1.26
Genetic gain(%)	I	60.17	36.79	75.82	102.13	35.65	93.97
	II	90.43	39.08	73.83	127.36	21.80	86.18
	III	59.59	34.11	58.63	138.74	29.01	90.16
	P	12.93	7.11	37.52	94.63	9.71	70.13

expected from a selection. The study showed high heritability values ranging from 17.31 to 76.87%. Maximum heritability was observed for leaf size (76.87%) followed by foliage yield (72.22%) and leaves/plant (52.30%). Low heritability was observed for plant height (17.31 %) and branches/plant (17.80%), indicating a major influence of environment. However, high heritability was observed for all the traits in all the three cuttings varying from 80.64-99.14%.

Unless sufficient genetic gain attributable to additive gene action is present, high heritability does not guarantee large gain from selection. In a selection programme where the primary objective is character improvement, a study of genetic gain is more advantageous than heritability studies. In the present study genetic gain was maximum for leaf size (94.63%), followed by foliage yield (70.13%) and number of leaves/plant (37.52%). High heritability coupled with high genetic gain and coefficient of variability was observed

for leaf size, foliage yield and number of leaves/plant indicating a possible role of additive gene effect for the genotypic variance for these characters. Hence, the selection based on phenotypic performance for these characters would be beneficial for achieving the desired gain.

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