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Relative selection efficiency for foliage yield and quality characters in vegetable *Chenopodium* over different cuttings

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Abstract

The present study was undertaken to test the suitability of direct and indirect selection of foliage yield in vegetable *Chenopodium* over successive cuttings through its 7 component characters. High heritability and moderate to high genetic gain was observed for all the characters in all the cuttings except for moisture content. Chlorophyll a exhibited highest correlated response for the Ist and IIIrd cutting while fibre content had highest correlated response for the IInd cutting. A multiple selection index is suggested to enhance foliage yield. The estimates of correlated response and relative selection efficiencies were in proportion with each other though relative selection efficiencies were less than one.

Key words: *Chenopodium*, heritability, genetic gain, correlated response (CRY), Relative selection efficiency (RSE).

Introduction

C. album is a highly polymorphic and widely distributed weed of subtropical and temperate regions of the world and is also being cultivated as a leafy vegetable in the Himalayan region (Risi and Galwey, 1984). *C. album* is gaining importance worldwide as a vegetable due to rich protein content (30-47 gm/kg), vitamin A (78-129 mg/kg), vitamin C (1.9-2.3 gm/kg) (Prakash *et al.,* 1993) and vitamin E (Partap *et al.,* 1998) in its leaves. Its protein has a perfectly balanced amino acid spectrum and is especially rich in sulphur containing amino acids. Keeping in view the economic importance of the crop, genetic improvement in its foliage yield along with quality components is a definite need. To improve the potentiality of the crop through breeding, selection of different contributing traits towards yield is a prerequisite. It is essential to have knowledge of indirect selection to estimate the proximity of component characters favouring or linked to improve foliage yield. Correlated response is a resultant effect of heritability, genetic advance, genotypic correlation and selection intensity. So, it has an added edge in selection of suitable characters over others. So far no study has been performed on relative selection efficiency in different foliage cuttings in *C. album* with reference to the quality characters. Therefore, the present study is an attempt to test the suitability of component characters for making direct and indirect selection for high foliage yield.

Materials and methods

Thirteen promising germplasm lines of *C. album* (Table 1), which are being maintained at National Botanical Research Institute, Lucknow, were evaluated during crop year 2002-2003 in a randomized block design with three replications at the experimental field of N.B.R.I., Lucknow. Plot size for each treatment was 4 m^2 with 6 rows/plot, spaced 30 cm apart. Ist foliage cutting started after 3rd week of sowing and subsequent cuttings were done at an interval of 15 days. Data on foliage yield (kg) was recorded on plot basis for each of the 3 cuttings. A total of three cuttings were done in the season. Seven quality traits *viz.* leaf moisture content, chlorophyll 'a', chlorophyll 'b', carotenoid, fibre, protein and ascorbic acid were also estimated for each individual cutting. The extraction and estimation of carotenoid and chlorophyll 'a' and 'b' were done according to Jensen (1978). Fibre content was estimated using Watson (1994) and protein following the method of Lowry *et al.* (1951). Ascorbic acid was analyzed by the official method (Glick, 1954). Protein and ascorbic acid was estimated on dry weight basis. The moisture content was estimated on the ratio of fresh leaf weight and 100^{o}C dry weight.

Correlated response (CRY) and relative selection efficiency (RSE) were estimated as per procedure suggested by Searle (1965). Heritability (Δh) and genetic advance (ΔG) were calculated according to Johnson *et al.* (1955).

Results and discussion

Different direct and indirect selection parameters like genetic gain, heritability, genotypic correlation and correlated response (CRY) are presented in Table 2. The heritability values for all the characters were high in all the three cuttings. In Ist cutting highest heritability was observed for protein content (0.963), followed by chlorophyll a (0.951) and chlorophyll b (0.950). Ascorbic acid exhibited highest heritability values in IInd and IIIrd cuttings (0.985 and 0.986, respectively). Moderate to high genetic advance was observed in all the three cuttings for all the traits except moisture content. It is interesting to note that both heritability and genetic gain constantly declined in successive cuttings for chlorophyll a and chlorophyll b.

Moisture content was negatively correlated with foliage yield in Ist and IInd cuttings but showed positive correlation in the IIIrd cutting. On the contrary, 4 major quality characters *viz.* carotenoid, fibre, protein and ascorbic acid were positively associated with foliage yield in the first two cuttings but were negatively correlated in the IIIrd cutting indicating that moisture content seems to be inversely proportional to these traits. Chlorophyll a exhibited

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

Germplasm	Ploidy level	Chromosome number	Source
C. album PRC 9802	-	-	India
C. album IC 107297	-	-	India
C. album 'Mexico'	4x	36	Mexico
C. album (local red)	2x	18	India
C. album 'Siliguri'	2x	18	India
C. album amaranticolor	6x	54	India
C. album 'H.P.'	6x	54	India
C. album 605700	6x	54	USDA
C. album CHEN 60/76	6x	54	Gatersleben,Germany
C. album CHEN 95/97	6x	54	Gatersleben,Germany
C. album 'Czech'	6x	54	Czech Republic
C. album 'IOWA'	6x	54	USDA
C. album 'Chandanbathua'	2x	18	India

Table 2. Correlated response and relative selection efficiency of quality characters in different cuttings of vegetable *Chenopodium*

Character	Cuttings	ΔG	Δh	rgh	CRY	RSE
Moisture	I	2.26	0.512	-0.538	-0.530	-0.2348
(%)	II	4.14	0.760	-0.043	-0.066	-0.0160
	III	3.66	0.879	0.232	0.426	0.1165
Chlorophyll a	I	76.59	0.951	0.711	0.956	0.0124
(mg/g)	II	60.14	0.940	-0.466	-0.798	-0.0132
	II	29.97	0.822	0.518	0.920	0.0307
Chlorophyll b	I	126.03	0.950	0.704	0.946	0.0075
(mg/g)	II	78.80	0.925	-0.648	-1.101	-0.0139
	III	20.36	0.592	0.381	0.574	0.0282
Carotenoid	I	75.22	0.920	0.651	0.861	0.0114
(g/100g)	II	37.66	0.828	0.221	0.355	0.0094
	III	49.74	0.943	-0.486	-0.925	-0.0186
Fibre	I	26.69	0.886	0.113	0.146	0.0054
(%)	II	27.71	0.945	0.342	0.588	0.0212
	III	30.72	0.885	-0.163	-0.295	-0.0096
Protein	I	32.07	0.963	0.648	0.877	0.0273
(g/100g)	II	16.30	0.938	0.015	0.025	0.0015
	III	15.02	0.888	-0.550	-1.016	-0.0676
Ascorbic acid	I	55.46	0.889	0.432	0.561	0.0101
(g/100g)	II	41.02	0.985	0.138	0.242	0.0059
	III	45.49	0.986	-0.001	-0.001	-0.0001
Foliage yield	I	93.97	0.818	X	X	X
(kg/plot)	II	86.18	0.936	X	X	X
	III	90.16	0.928	X	X	X

ΔG-Genetic gain (%), Δh- Heritability, rgh-Genotypic correlation
CRY-Correlated response, RSE-Relative selection efficiency

highest correlated response for the Ist and IIIrd cuttings. In the first cutting, protein and carotenoid manifested high correlated response (0.877 and 0.861 respectively) and relative selection efficiency (0.0273 and 0.0114, respectively). However, in IInd cutting, fibre and carotenoid showed maximum correlated response (0.588 and 0.355, respectively), and also had high relative selection efficiency. The results indicated that selection of plants should be exercised during the first two cuttings as higher foliage yield along with high quality components is expected in the initial cuttings. It was concluded that to derive a multiple selection index, selection should be based on high protein and ascorbic acid content in Ist cutting and high fibre and carotenoid content in IInd cutting. The relative selection efficiency of each trait towards foliage yield was less than unity, which might be due to high expected selection response of foliage yield and thus denominator being higher than numerator CRY/ΔG, so the ratio will necessarily be less than one.

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References

Glick, D. 1954. *Methods of Biochemical Analysis.* Vol. 1, Interscience Publishers Inc., New York. pp. 127-132.

Jensen, A. 1978. Chlorophylls and carotenoids. In: *Handbook of physiological methods: Physiological and Biochemical Methods,* eds Hellebust J. A. and Craigie J. S., Cambridge University Press, Cambridge, pp. 5-70.

Johnson, H.W., H.F. Robinson and R.E. Comstock, 1955. Estimation of genetic and environmental variability in soybeans. *Agron. J.*, 47: 314-318.

Lowry, O.H., N.J. Rosebrough, A.L. Farr and R.J. Randall, 1951. Protein measurement with the folin-phenol reagent. *J. Bio. Chem.*, 193: 265-275.

Partap, T., B.D. Joshi and N.W. Galwey, 1998. Chenopods: *Chenopodium* spp. Promoting the conservation and use of underutilized and neglected crops. 22. Institute of Plant Genetics and Crop Plant Research, Gatersleben/International Plant Genetic Resources Institute, Rome, Italy.

Prakash, D., P. Nath and M. Pal, 1993. Composition, variation of nutritional contents in leaves, seed protein, fat and fatty acid profile of *Chenopodium* species. *Intern. J. Food Sci. Agric.*, 62: 203-205.

Risi, J. and N.W. Galwey, 1984. The Chenopodium grains of the Andes: Inca Crops for Modern Agriculture. *Adv. Applied Biology*, 10: 146-206.

Searle, S.R. 1965. The value of indirect selection. I. Mass selection. *Biometrics,* 21: 682-708.

Watson, C.A. 1994. *Official and Standardized Methods of Analysis.* IIIrd Edition, Published by The Royal Society of Chemistry, Thomas Graham House, Science Park, Cambridge CB4 4WF. pp.6.