Himachal Journal of Agricultural Research Vol. 32(2) : 44-51, 2006

Correlation and path coefficient studies in biparental and F_4 progenies of cross PSBK-1 x KT-25 in cauliflower (*Brassica oleracea* var. *botrytis* L.)

R. Halwai, B.N. Korla and S. Aggrawal
Department of Vegetable Crops
Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan - 173 230.

Abstract

Correlation and path analysis with 24 biparental and 70 F_4 progenies (developed by bud pollination/mix pollination) were studied in compact family block design during 2001-2003. In general, the genotypic correlation coefficients were higher than corresponding phenotypic ones for most of the character combinations indicating predominant role of heritable factors. Gross curd weight was positively and significantly associated with net curd weight in the whole materials, while other characters like stalk length in BIP(BP), plant frame, number of leaves per plant, number of leaves per whorl and harvest index in BIP(MP); and plant frame and number of leaves per whorl in F_4(BP) also showed significant and positive correlation with net curd weight. Path analysis explained that maximum direct contribution of gross curd weight on net curd weight followed by harvest index. The direct contribution of other characters with net curd weight was mainly due to indirect effects *via* gross curd weight and harvest index besides partly by other characters.

Introduction

Cauliflower (*Brassica oleracea* var. *botrytis* L.) a member of family Cruciferae, has been rightly described as aristocrat of cole crops. It is grown throughout the country for its tender white curds which are used as vegetables, curies, soups and pickles. Cauliflower has high quality protein and is peculiar in stability of vitamin C after cooking. It is rich in minerals such as potassium, sodium, iron, phosphorus, calcium, magnesium etc. (Chaudhary, 1996). Cauliflower was introduced in India from England by Britishers in 1822 and in such a short period of its introduction, it gained lo of importance. Consequently, a large number of cultivars were developed and available for cultivation in early and mid groups. This may be due to the presence of large variability in both the groups, but there are limited cultivars in snowball/late group and their continuous use is resulting in low production per unit area. The routine breeding procedures like collection and evaluation of germplasm may have yielded satisfactory results, but do not permit the raising of desirable segregants. In this regard, an attempt was made in late cauliflower where the use of biparental mating and normal selfing were adopted in the heterotic cross (Pusa Snowball K-1 X KT-25). The results so obtained are presented in this paper.

Material and Methods

The experimental material comprised of two biparental and five F_3 progenies selected from a heterotic cross PSBK-1 X KT-25 of cauliflower. Different plants were selected on the basis of desirable characters like good curd size, less leaves per plant, large net curd weight and were bud pollinated/ mix pollinated. These were harvested separately and designated as different entries. The materials, thus comprising 24 biparental and 70 F_4 progenies were planted in the field along with the check PSB-1 and PSBK-1 in compact family block design. All the entries were replicated thrice and planted at a spacing of 60x45cm. Each entry was planted in three rows plot having four plants per row. All the plants per row were observed for plant frame (cm), number of leaves per plant, number of leaves per whorl, stalk length (cm), number of days to marketable maturity, gross curd weight (g), net curd weight (g), harvest index (%). Statistical analysis was done for all the traits as described by Panse and Sukhatme (1978). Correlation coefficient among all the characters were estimated as per Al-Jibouri *et al.* (1958) and path coefficients by the method given by Dewey and Lu (1959).

Results and Discussion

The correlation coefficients among different characters, between the progenies of each family are presented in Table 1, 2, 3 and 4. In the present investigation, genotypic correlations in general, were higher than corresponding phenotypic one's in most of the pairs of traits with little difference in magnitude which revealed that there is strong inherent association between various characters studied and the environment has not played much role in the phenotypic expression of the correlation except, few case where it gets reduced under the influence of environment. The results of the present studies indicated that in all the families net curd weight had significant positive correlation with gross curd weight. Similar results were reported by Kumar (2002a). The association of net curd with other characters like harvest index (also by Kumar, 1999; Kumar and Korla, 2001 and Kanwar and Korla, 2002a), net curd weight with harvest index, gross weight with stalk length and number of leaves per plant , curd weight with maturity (Kumar , 2002a), curd weight with number of leaves per plant (Kumar 2002a) and net curd weight with plant frame (Kumar, 1999; Kumar and Korla, 2001, Kumar, 2002 b) were also reported in cauliflower. Net curd weight also showed significant association with harvest index (BIP-BP), with plant frame, number of leaves per plant, number of leaves per whorl in F_4 (BP).

From the above studies, it can be concluded that increase in gross curd weight will result in increase in net curd weight, plant frame, number of leaves per plant, number of leaves per whorl and stalk length in general, showed inter-relationship amongst each other and were responsible for increasing the curd weight.

In the present studies, only those characters were considered for path coefficient analysis which had shown significant association with gross curd weight and net curd weight at genotypic level. Perusal of results (Table 5a & b, 6a&b, 7a & b, 8a & b) indicated that in all the families, gross curd weight had highest direct contribution for net curd weight. Similar results were also reported by Kumar and Korla (2001) and Kanwar & Korla (2002b). Harvest index also showed positive direct effect for net curd weight (also by Kumar and Korla (2001) and Kanwar & Korla (2002), while negative in case of gross curd weight. The direct contribution of other characters like plant frame, number of leaves per plant, number of leaves per whorl, stalk length and number of days to marketable maturity was low in magnitude and their significant association either with net or gross curd weight was largely due to indirect effects of gross curd weight and harvest index barring few exceptions. The path analysis revealed that gross curd weight and harvest index play major role directly or indirectly in increasing the net curd weight, similarly net curd weight & harvest index on gross curd weight. These characters (net and gross curd weight) need emphasis while making improvement. In biological studies, it is not possible to have a completely inclusive path diagram. A residual pathway is always included to cover up other unaccounted factors. Residual effects were negligible for all the families indicating, thereby, that the contribution of characters not included in path analysis was almost nil.

Table 1. Phenotypic (P) and Genotypic (G) correlation between different pairs of traits in BIP (bud pollinated and mix pollinated) progenies

Traits		Plant Frame		Stalk length(cm)		No. of days to marketable maturity		Gross curd weight (g)		Net curd weight (g)		Harvest index (%)	
		BIP-BP	BIP-MP	BIP-BP	BIP-MP	BIP-BP-	BIP-MP	BIP-BP	BIP - MP	BIP-BP	BIP-MP	BIP-BP	BIP - MP
Plant Frame	P	-	-	0.064	0.733*	-0.396	-	0.155	0.518	0.016	0.721*	-0.176	0.548*
	G	-	-	-0.096	1.067*	-0.429	-	0.350	0.683*	-0.054	0.778*	-0.599*	0.860*
Stalk length	P			-	-	-0.289	-	0.413	0.363	0.499	0.618*	0.378	0.619*
	G			-	-	-	-	0.718*	1.136*	0.595*	0.997*	0.236	0.411
						0.630*	-						
No. of days to markt. maturity	P					-	-	-0.195	-	0.072	-	0.072	-
	G					-	-	-0.941	-	-0.564	-	0.184	-
Gross curd weight (g)	P							-	-	0.785*	0.868*	0.191	0.118
	G							-	-	0.896*	0.965*	0.428	0.849*
Net curd weight (g)	P									-	-	0.749*	0.527
	G									-	-	0.789*	0.927
Harvest index (%)	P											-	-
	G											-	-

*significant at 5%level of significance

Table 2. Phenotypic (P) and Genotypic (G) correlation between different pairs of traits in F_4 (bud pollinated and mix pollinated) progenies

Traits		Plant Frame		Stalk length(cm)		No. of days to marketable maturity		Gross curd weight (g)		Net curd weight (g)		Harvest index (%)	
		F_4-BP	F_4-MP	F_4-BP	F_4-MP	F_4-BP	F_4-MP	F_4-BP	F_4 -MP	F_4-BP	F_4 -MP	F_4-BP	F_4 -MP
Plant Frame	P	-	-	0.285	0.011	-0.386*	-0.090	0.641*	0.280	0.603*	0.229	-	0.155
	G	-	-	0.467	-0.086	-0.862	-0.163	0.836*	0.542*	0.621*	0.404*	-	-0.392
Stalk length	P			-	-	-0.253	0.053	0.225	-0.270	0.299	-0.292	-	0.094
	G			-	-	-0.259	0.505*	0.534*	-0.333*	0.743*	-0.801*	-	-0.147
No.of days to	P					-	-	-0.288	0.043	-0.227	-0.006	-	-0.086
mrkt. maturity	G					-	-	0.792*	-0.112	-0.597*	-0.376*	-	-0.364*
Gross curd weight (g)	P							-	-	0.796*	0.908*	-	-0.453*
	G							-	-	0.994*	0.843*	-	-0.875*
Net curd weight (g)	P									-	-	-	-0.164
	G									-	-	-	-0.431*
Harvest index (%)	P											-	-
	G											-	-

*significant at 5%level of significance

Table 3. Estimates of direct and indirect effects on gross curd weight (GCW) and net curd weight (NCW) between BIP (BP) progenies

Traits	Stalk length(cm)	No. of days to marketable maturity	Net curd weight (g)	Correlation with	Stalk length(cm)	No. of days to marketable maturity	Gross curd weight (g)	Harvest index (%)	Correlation with
	GCW	GCW	GCW	GCW	NCW	NCW	NCW	NCW	NCW
Staik length	**-0.008**	0.405	0.320	0.717*	**-0.032**	-0.018	0.533	0.112	0.595*
No.of days to mrkt. maturity	0.005	**-0.643**	-0.303	-0.941*	0.020	**0.028**	-0.699	0.087	-0.564*
Gross curd weight (g)	-	-	-	-	-0.023	-0.027	**0.743**	0.202	0.895*
Net curd weight (g)	-0.004	0.362	**0.538**	0.896*	-	-	-	-	0.788*
Harvest index (%)	-	-	-	0.317	-0.008	0.005	0.317	**0.474**	-

*significant at 5%level of significance, Residual effects on gross curd weight=0.0815, Residual effects on net curd weight)=-0.0038, Underlined and bold figures are direct effects

Table 4a. Estimates of direct and indirect effects on gross curd weight between BIP (MP) progenies

Traits	Plant frame	No. of leaves/ plant	No.of leaves/ whorl	Stalk length	Net curd weight	Harvest index	Correlation with gross curd weight(r_g)
Plant frame	**-0.135**	0.036	0.239	0.055	0.705	-0.217	0.683*
No. of leaves / plant	-0.105	**0.046**	0.134	0.067	0.827	-0.301	0.668*
No. of leaves / whorl	-0.115	0.022	**0.282**	0.068	0.978	-0.271	0.964*
Stalk length	-0.144	0.060	0.370	**-0.052**	0.902	-0.104	1.136*
Net curd weight	-0.105	0.042	0.305	0.051	**0.906**	-0.234	0.965*
Harvest index	-0116	0.055	0.303	0.021	0.839	**-0.253**	0.849*

*significant at 5%level of significance, Residual effects =0.0717, Underlined and bold figures are direct effects

Table 4b. Estimates of direct and indirect effects on net curd weight between BIP (MP) progenies

Traits	Plant frame	No. of leaves/ plant	No.of leaves/ whorl	Stalk length	gross curd weight	Harvest index	Correlation with gross curd weight(r_g)
Plant frame	**0.078**	-0.004	0.052	0.039	0.417	0.196	0.778*
No. of leaves / plant	0.029	**-0.010**	0.058	0.007	0.616	0.213	0.913*
No.of leaves / whorl	0.036	-0.005	**0.213**	0.017	0.679	0.141	1.081*
Stalk length	0.057	-0.001	0.036	**0.053**	0.631	0.221	0.997*
gross curd weight	0.040	-0.006	0.076	0.019	**0.698**	0.138	0.965*
Harvest index	0.043	-0.001	0.112	0.033	0:182	**0.558**	0.927*

*significant at 5%level of significance, Residual effects=0.0804, Underlined and bold figures are direct effects

Table 5a. Estimates of direct and indirect effects on gross curd weight between F_4 (BP) progenies

Traits	Plant frame	No. of leaves/ plant	No.of leaves/ whorl	Stalk length	No. of days to marketable maturity	Net curd weight	Correlation with gross curd weight(r_g)
Plant frame	**-0.039**	-0.205	1.093	-0.177	0.108	0.058	0.838*
No. of leaves / plant	-0.018	**-0.440**	1.053	-0.258	0.096	0.038	0.471*
No.of leaves / whorl	-0.031	-0334	**1.310**	-0.310	0.098	0.165	0.898*
Stalk length	-0.018	-0299	0.069	**-0.380**	0.032	1.130	0.534*
No. of days to marketable maturity	0.034	0.339	1.083	0.099	**-0.125**	-0.056	-0.792
Net curd weight	-0.024	-0.178	0.093	-0.282	0.075	**1.312**	0.996*

*significant at 5%level of significance, Residual effects=0.0068, Underlined and bold figures are direct effects

Table 5b. Estimates of direct and indirect effects on net curd weight between F_4 (BP) progenies

Traits	Plant frame	No. of leaves/ plant	No.of leaves/ whorl	Stalk length	No. of days to marketable maturity	Net curd weight	Correlation with gross curd weight(r_g)
Plant frame	**-0.532**	0.208	0.473	-0.025	-0.312	0.808	0.621*
No. of leaves / plant	-0.258	**-0.338**	0.425	-0.018	0.310	0.284	0.405*
No.of leaves / whorl	-.419	0.245	**0.600**	-0.043	-0282	0.845	0.946*
Stalk length	-0.248	0.200	0.389	**-0.053**	-0.094	-0.549	0.743*
No. of days to marketable maturity	0.231	0.228	-0.469	0.014	**0.361**	-0.962	-0.597*
Net curd weight	-0445	0.220	0.439	-0.028	-0.286	**0.995**	0.994*

*Significant at 5% level of significance, Residual effects=-0.0038, Underlined and bold figures are direct effects

Table 6a. Estimates of direct and indirect effects on gross curd weight between F_4 (MP)

Traits	Plant frame	Stalk length	Net curd weight	Harvest index	Correlation with gross curd weight(r_g)
Plant frame	**0.012**	-0.044	0.452	0.122	0.542*
Stalk length	-0.001	**0.518**	-0.896	0.046	-0.333*
Net curd weight	0.005	-0.415	**1.118**	0.134	0.843*
Harvest index	-0.005	-0.076	-0.482	**-0.482**	-0.875*

Residual effects=0.0497, *significant at 5% level of significance,Underlined and bold figures are direct effects

Table 6b. Estimates of direct and indirect effects on net curd weight between F_4 (MP)

Traits	Plant frame	Stalk length	Number of days to marketable maturity	Gross curd weight	Harvest index	Correlation with net curd weight(r_g)
Plant frame	**0.094**	0.072	0.037	-0.090	0.291	0.404*
Stalk length	-0.008	**-0.845**	-0.113	0.056	0.109	-0.801*
Number of days to marketable maturity	-0.015	-0.426	**0.271**	0.019	-0.225	-0.376*
Gross curd weight	0.051	0.282	0.025	**0.652**	0.167	0.843*
Harvest index	-0.137	0.124	0.082	0.146	**-0.646**	-0.431*

Residual effects=0.0202, *significant at 5% level of significance, Underlined and bold figures are direct effects

References

Al-Jibouri, H.A., Miller, P.A. and Robinson, H.F. 1958. Genotypic and environmental variances and covariances in an upland cotton cross of interspecific origin. *Agronomy Journal* 50: 633-636.

Chaudhry, B. 1996. *Vegetables* (9th ed.). National Book Trust. New Delhi. 230p.

Dewey, D.H. and Lu, K.H. 1959. A correlation and path-coefficient analysis of components of crested wheat grass seed production. *Agronomy Journal* 51: 515-518.

Kanwar, M.S. and Korla, B.N. 2002a. Performanceof biparental progenies in late cauliflower. (*Brassica oleracea* var. *botrytis* L.). *Vegetable Science* 29 (10):13-16.

Kanwar, M.S. and Korla, B.N 2002b. Evaluation of biparental progenies for horticultural and quality traits in late cauliflower (*Brassica oleracea* var. *botrytis* L.).*Indian Journal of Genetics* and *Plant Breeding* 62 (4):328-330.

Kumar, Anshul, 2002 a. Genetic evaluation of some genotypes of cauliflower (*Brassica oleracea* var. *botrytis* L.). *M.Sc. Thesis*, Dr. Y.S. Parmar University of Horticulture & Forestry, Solan (HP), India.

Kumar, Dharminder 1999. Genetic variability for horticultural and quality traits in cauliflower, snowball type (*Brassica oleracea* var. *botrytis* L). *M.Sc. Thesis*, Dr. Y.S Parmar University of Horticulture and Forestry, Solan (H.P.), India.

Kumar, Sanjeev 2002 b. Evaluation of cauliflower genotypes and performance of diallel progeny for resistance to stalk rot and black rot. *Ph.D. Thesis*, Dr. Y.S. Parmar University of Horticulture and Forestry, Solan (H.P.), India.

Kumar, Sanjeev and Korla, B.N. 2001. Correlation and path coefficient studies in late cauliflowers (*Brassica oleracea* var. *botrytis* L.). *Haryana Journal of Horticultural Sciences* 30 (1&2): 79-81.

Panse, V.G. and Sukhatme, P.V. 1978. *Statistical Methods for Agricultural Workers* (3rd ed). Indian Council of Agricultual Research, New Delhi, 347p.

VIR SOFTECH