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Short communication

Genetic variability and character association analysis in cabbage hybrids

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ABSTRACT

The analysis of variance indicated that the difference due to genotypes were highly significant for all the characters. Data further revealed that of the characters under study exhibited high degree of PCV revealing close relationship between phenotypic and genotypic and these characters are not influenced by environment. Maximum heritability was observed in leaves width followed by leaves weight and number of leaves. Leaf length had positive significant correlation with leaf width, leaf weight as well as with head length. Head length had significant correlation with head width. Net head weight expressed significant positive values with leaf length followed by leaf width. Hierarchical cluster analysis showed 2 clusters. Twenty four hybrids divided into 2 clusters with 19 and 5 genotypes respectively. These 19 genotypes further classified into 7 and 12 genotypes, while 7 genotypes further sub-divided in two more stages. The genotypes Kranti, BC-73, Pusa Drum Head and Delhi Ball 65 were different from other hybrids evaluated.

Key words: Variability, combining ability, heritability and genetic advance.

The average yield of cabbage in country is low as compared to other countries (Anon, 1). The reasons for low yield are poor quality of seeds, lack of suitable cultivates for the mild winter and lack of suitable agro-techniques. Traditional cultivars perform poorly both in head formation and yield per unit area (Singh *et al*., 7). To bring about improvement in this crop, the knowledge of magnitude of genetic variability and the extent of heritability of desirable characteristics is essentially important because the phenotypic selection depends upon the range of genetic diversity present in the population. Phenotypically stable varieties, particularly in respect of yield performance, are usually sought for the commercial production. The knowledge of association between yield and its contributing traits will be of great value in planning a breeding programme. Therefore, an attempt was made to study the genetic variability, heritability and genetic advances and character association among various horticultural traits of cabbage hybrids.

The present investigation was carried out at the research farm, Indian Institute of Vegetable Research Varanasi for two years. Twenty four cultivars consisting of hybrids, released/pre released varieties *viz*., Market Ball, Karida, Hybrid No. 415, Questo, Var. No. 11720057, KCH-5, Kranti, Summer Grass, Ramda, Bronco, Delhi Ball 65, BC-73, VIR-333, CH-2200, Green Flash, Sant, Green Kid, Green Emperer, Pride of Asia, Express Mail, Hari Rani Goll, Red Cabbage, Pusa Drum Head, Kranti and Market Ball were taken for the study. Experiment was laid out in randomized block design with three replication. A spacing of 50 cm x 40 cm was given and all the recommended agronomic practices were followed. The observations were recorded, *viz*., number of outer leaf, number of inner leaf, leaves length, width of leaves, head weight, duration of head maturity, head shape, head length, head width, core length, net head weight, yield on five randomly selected plants per replications for each genotype. The analysis of variance was carried out as suggested by Panse and Sukhatme (4). Genotypic coefficient of variation was calculated as per the formula suggested by Burton and deVane (2). Multivariate statistical techniques have been suggested to measure genetic and phenotypic divergence among entries to aid in identifying potential parents for hybridization programme (Peters and Martinalli, 5).

The analysis of variance indicated that the difference due to genotypes were highly significant for all the characters. The extent of variability present in twenty four hybrids of cabbage was measured in term of range, grand mean, phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability (broad sense) and genetic advance. All the hybrids differed significantly with respect to different characters studied. Maximum variability was observed in leaf length (21.04) followed by leaf weight (17.19) while minimum variability was observed in days to maturity (7.01), number of leaves (9.05) and number of inner leaves (9.22). Data further revealed that the characters under study exhibited high degree of PCV revealing close relationship between phenotypic and genotypic and these characters are not influenced by

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environment hence improvement for these characters are not difficult which in inconsance in the present finding.

Heritable variation can be finding out with greater degree of accuracy when heritability is studied in conjunction with genetic advance. Singh *et al.* (6) reported wide range of variability for almost all the characters. Maximum heritability was observed for leaf width (98.7%) followed by leaves weight (95.1%) and number of leaves (91.6%). Selection will be more effective when the characters sowing high heritability while low heritability indicated that the selection will be difficult as the expression of genotypes will be affected by the environmental factors. Same findings were found by Singh *et al.* (7). High heritability values coupled with high percentage of genetic advance were recorded for leaf length, leaf width and leaf weight, which indicated more number of additive factors for this character for which improvement is feasible through selection based on phenotypic observations (Table 1). These results are in close agreement with the findings of Joshi (3).

The genotypic and phenotypic correlations among characters are presented in table 2. In general, the magnitude of the genotypic correlation was higher than the phenotypic correlation coefficient. Head width and days to maturity had significant positive correlation with yield. Net head weight expressed significant positive values with leaf width followed by leaf weight. Maturity day was found highly significant and positive correlated with net head weight.

Path coefficient analysis based on phenotypic correlation was done using yield as dependent factor and ten other characters, *viz.* No. of leaves, no. of inner leaves, leaf length, leaf width, leaf weight, head length, head width, core length, maturity days and net head weight as independent factor at marketable harvesting stage. The total correlation coefficient of each independent character with head yield was partitioned into direct and indirect effects towards head yield. The highest positive direct effect was exerted by net leaf length (0.484) followed by head length (0.345), while highest negative direct effects observed by leaf width followed by number of leaves. Similar results were also reported by Joshi (3).

Hierarchical cluster analysis was conducted for eleven different quantitative characters. Distance between all pairs of genotypes was calculated using squared Euclidean distance method and genotypes were clustered based on Ward's method. Hierarchical cluster analysis showed 2 clusters. Twenty four hybrids divided into 2 clusters with 19 and 5 genotypes respectively. These 19 genotypes further classified into 7 and 12 genotypes, while 7 genotypes further sub divided in two more stages. The genotypes Kranti, BC-73, Pusa Drum Head and Delhi Ball 65 were different form other hybrids. Since these clusters are group of individuals are supposed to exhibit higher external heterogeneity. Genotypes included in the stable clusters with a high order of divergence will be expected to provide the best breeding material from the standpoint of achieving the maximum genetic advance with regard to yield *per se*, provided other factors do not operate to limit the realization of this potential. It is rather encouraging that the divergence revealed in the present genotypes due to these characters will offer a good scope of improving yield through rational selection.

Table 1. Range, mean, variability, heritability and genetic advance.

Trait	Range		Grand mean	PCV (%)	GCV (%)	heritability (%)	Genetic advance (GA)	Genetic advance as % of mean
	Min.	Max.						
No. of leaves	12.0	12.2	11.48	9.05	8.67	91.6	1.96	17.07
No. of inner leaves	30.0	30.4	31.70	9.22	8.69	88.8	5.35	16.88
Leaf length (cm)	29.0	29.8	24.35	21.04	18.93	80.9	8.54	35.07
Leaf width (cm)	25.0	25.4	22.23	17.19	17.08	98.7	7.77	34.95
Leaf weight (cm)	804	830	651.96	19.98	19.49	95.1	255.21	39.15
Head length (cm)	13.0	13.2	13.49	10.24	8.07	62.2	1.77	13.13
Head width (cm)	13.88	14.22	13.49	9.57	8.58	80.5	2.14	15.87
Core length (cm)	4.24	4.90	5.79	10.59	9.24	76.2	0.94	16.23
Net head weight (g)	1206	1264	1210.28	15.79	10.23	41.9	165.10	13.64
Maturity (days)	79.0	81.0	79.11	7.01	6.07	75.1	8.58	10.85
Yield/ ha (q)	603	632	615	12.68	11.09	76.4	122.78	19.96

Table 2. Genotypic and phenotypic correlation coefficients in cabbage.

Trait		No. of inner leaves	Leaf length (cm)	Leaf width (cm)	Leaf wt. (cm)	Head length (cm)	Head width (cm)	Core length (cm)	Net head wt. (g)	Maturity (days)	Yield/ha (q)
No. of inner leaves	(rp)	-0.139	0.131	-0.064	-0.175	0.197	0.174	0.147	-0.117	-0.226	0.205
	(rg)	-0.159	-0.132	-0.064	-0.202	0.292	0.216	0.200	-0.250	-0.274	0.219
Leaf length (cm)	(rp)		0.004	0.092	0.124	0.011	-0.297	0.237	0.308,	-0.019	0.238
	(rg)		-0.018	0.112	0.130	0.155	-0.332*	0.232	0.414*	-0.042	0.278
Leaf width (cm)	(rp)			0.753**	0.381*	0.403*	0.501**	0.305	0.336*	0.117	0.182
	(rg)			0.834**	0.448**	0.494**	0.588**	0.303	0.324*	0.190	0.140
Leaf weight (cm)	(rp)				0.357*	0.376*	0.345*	0.412*	0.298	0.134	0.155
	(rg)				0.372	0.465**	0.390*	0.466**	0.463**	0.152	0.182
Head length (cm)	(rp)					0.122	-0.067	0.237*	0.226	0.233	0.114
	(rg)					0.190	-0.095	0.301	0.279	0.227	0.114
Head width (cm)	(rp)						0.435**	0.337*	0.131	-0.203	0.423*
	(rg)						0.473**	0.449**	0.327*	-0.258	0.505**
Core length (cm)	(rp)							0.127	0.079	0.029	0.113
	(rg)							0.136	0.087	0.007	0.150
Net head weight (g)	(rp)								0.250	0.213	0.278
	(rg)								0.351*	0.271	0.287
Maturity days	(rp)									0.258	0.646**
	(rg)									0.458**	0.893**
Yield/ha (q)	(rp)										0.026
	(rg)										0.297

Note : *(rp) = Phenotypic; *(rg) = Genotypic

Table 3. Direct and indirect effect of traits on yield in cabbage.

Trait	No. of leaves	No. of inner leaves	Leaf length (cm)	Leaf width (cm)	Leaf weight (cm)	Head length (cm)	Head width (cm)	Core length (cm)	Net head wt. (g)	Maturity days	Correlation with yield
No. of leaves	**-0.489**	0.032	-0.064	0.042	0.030	0.101	-0.077	-0.021	-0.309	-0.005	0.205
No. of inner leaves	-0.078	**-0.199**	-0.008	-0.074	-0.020	0.053	0.118	-0.024	0.511	-0.001	0.238
Leaf length (cm)	-0.064	0.003	**0.484**	-0.550	-0.067	0.171	-0.208	-0.031	0.400	0.004	0.182
Leaf width (cm)	-0.031	-0.02	0.404	**-0.660**	-0.056	0.160	-0.138	-0.048	0.571	0.003	0.155
Leaf weight (cm)	-0.099	-0.026	0.217	0.245	**-0.150**	0.066	0.034	-0.031	0.345	0.004	0.114
Head length (cm)	0.143	-0.031	0.239	-0.307	-0.029	**0.345**	-0.168	-0.047	0.403	-0.005	0.423
Head width (cm)	0.160	0.066	0.285	-0.257	0.014	0.163	**-0.355**	-0.014	0.107	0.000	0.113
Core length (cm)	0.098	-0.046	0.147	-0.307	-0.045	0.155	-0.048	**-0.104**	0.434	0.005	0.278
Net head weight (g)	-0.122	-0.083	0.157	-0.305	-0.042	0.113	-0.031	-0.036	**0.234**	0.009	0.646
Maturity day	-0.134	0.008	0.092	-0.100	-0.034	-0.089	-0.002	-0.028	0.565	**0.019**	0.226

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