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*Short communication*

# Correlation studies for quantitative characters in cabbage genotypes

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Cabbage (*Brassica oleracea* var. *capitata* L.) is one the most important cole crop grown under temperate climate for seed production (Singh *et al.*, 7). It is a rich source of minerals, carotene, ascorbic acid and antioxidant and is reported to have anti-carcinogenic properties (Singh *et al.*, 7; Singh *et al.*, 8; Kopsell *et al.*, 6). For selecting superior genotypes, the breeder has to choose from the material on the basis of its phenotypic expression. As most of the traits of economic importance are complex involving several related traits, the knowledge of degree of phenotypic and genotypic correlation of the traits is important. Among the various environmental factors, temperature is the main deciding factor of cabbage seed production. Temperature effects mainly growth of head formation, emergence of flower stalk, pollination and seed setting. Climate of Uttaranchal mid and high hills are more conducive for off season cabbage growing as well as seed production.

Thirty-seven genotypes of cabbage collected from different sources. The seed were sown inside polyhouse and the seedlings were transplanted in Randomised Block Design with three replications. Recommended dose of F.Y.M., fertilizers, insecticides and fungicides were applied and agronomic practices were employed to maintain normal growth of plant. In order to induce early flowering a vertical cross cut was given to genetically true, disease free and good selected heads. Only 1/3 rd top portion of each head was cut with the help of sharp knife without damaging terminal bud. Rouging is done at three different stages of plant growth. Correlation were studied for seed yield per plant and other horticultural traits viz., stalk length, wrapper leaves, non wrapper leaves, core volume, core diameter, head compactness, head shape index, head size, net head weight, days to head maturity, days taken to head bursting, number of floral stalk, length of floral stalk, number of flowers per plant, number of silique per plant, silique length, number of seeds per silique and weight of one thousand seeds. Correlation coefficient was calculated as suggested by Al-Jibouri *et al.* (1).

Indirect selection is desirable for the improvement of yield. Therefore, knowledge of association between yield and its component traits and inter-relationship among themselves may prove fruitful for planning an effective and successful breeding programme. In present study, the phenotypic and genotypic correlation coefficients were worked out in respect of nineteen characters for all possible combinations (Tables 1 & 2). It was found that, in general, genotypic correlation coefficient were higher in magnitude than their corresponding phenotypic values. High genotypic correlation coefficient suggested that there was inherent relationship between trait under study and environment had not played much role in reducing their actual association.

Seed yield per plant had established significant positive correlation with number of silique per plant, silique length, wrapper leaves, weight of one thousand seeds and net head weight and also constituted a significant inverse relation with days to head bursting both at phenotypic and genotypic level. Days to head bursting exhibited negative significant correlation with wrapper leaves, head weight, silique per plant and thousand seed weight. This indicated that an early bursting of head perhaps increased the duration of exposure to favourable climatic condition for better seed production of cultivar, while increasing number of wrapper leaves maintained suitable microclimatic environment (i.e. temperature) at growing tip and made continuous supply of photosynthates and hormone, for the development of reproductive phase of cultivar (Wien and Wurr, 9). The selection for these characters therefore improves the seed yield per plant in cabbage. Similar results on significant positive association was reported between seed yield per plant with number of silique per plant (Gill *et al*., 2 ) as head weight (Kanwar *et al*., 5). Number of silique per plant was significantly positively correlated with number of flowers per plant, silique length, number of seeds per silique, thousand seed weight both at phenotypic and genotypic level. This suggested that physiological efficiency of cultivar at post fertilization period was at most important to increase seed yield though a commensurate increase in silique number, seed number and seed weight. The presence of significant

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**Table 1**. Phenotypic correlation coefficient for different pair of traits in cabbage.

| Trait | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13. | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Stalk length | 1.00 | 0.090 | -0.121 | 0.038 | 0.164 | 0.076 | 0.078 | 0.087 | 0.024 | 0.194 | -0.001 | -0.219 | -0.148 | -0.114 | -0.071 | -0.003 | 0.166 | 0.068 | -0.057 |
| 2. Wrapper leaves | | 1.00 | 0.239 | -0.049 | -0.208 | -0.066 | -0.078 | 0.185 | 0.795** | -0.109 | -0.374 | -0.185 | 0.287 | 0.049 | 0.126 | 0.162 | 0.074 | 0.590** | 0.224 |
| 3. Non wrapper leaves | | | 1.00 | -0.115 | -0.144 | -0.055 | -0.257 | -0.083 | 0.345* | 0.108 | -0.127 | -0.095 | -0.159 | -0.160 | -0.028 | 0.104 | 0.094 | 0.280 | 0.126 |
| 4. Core volume | | | | 1.00 | 0.831** | -0.266 | 0.254 | 0.481** | -0.061 | 0.198 | -0.027 | -0.076 | -0.054 | 0.092 | 0.059 | 0.122 | 0.092 | -0.046 | 0.086 |
| 5. Core diameter | | | | | 1.00 | -0.267 | 0.295 | 0.424** | -0.187 | 0.266 | -0.074 | -.077 | 0.043 | 0.066 | -0.022 | 0.049 | 0.076 | -0.215 | -0.074 |
| 6. Head compactness | | | | | | 1.00 | -0.237 | -0.583** | -0.082 | 0.034 | 0.065 | -0.049 | 0.169 | -0.092 | -0.039 | -0.081 | -0.104 | -0.052 | -0.083 |
| 7. Head shape index | | | | | | | 1.00 | 0.247 | -0.089 | 0.026 | 0.033 | 0.105 | -0.121 | 0.053 | -0.068 | -0.224 | -0.194 | -0.141 | -0.145 |
| 8. Head size | | | | | | | | 1.00 | 0.208 | 0.120 | 0.094 | 0.024 | -0.111 | 0.084 | 0.159 | 0.166 | 0.211 | 0.097 | 0.131 |
| 9. Net head wt. | | | | | | | | | 1.00 | -0.049 | -0.337* | -0.137 | 0-.149 | -0.040 | 0.203 | 0.178 | 0.109 | 0.730** | 0.329* |
| 10. Days to head maturity | | | | | | | | | | 1.00 | 0.081 | 0.101 | 0.004 | 0.083 | 0.221 | 0.232 | 0.269 | 0.119 | 0.254 |
| 11. Head bursting | | | | | | | | | | | 1.00 | 0.101 | 0.004 | -0.288 | -0.389* | -0.260 | -0.089 | -0.360* | -0.357* |
| 12. No. of floral stalk | | | | | | | | | | | | 1.00 | -0.050 | 0.110 | 0.195 | 0.229 | 0.092 | -0.059 | 0.242 |
| 13. Length of floral stalk | | | | | | | | | | | | | 1.00 | 0.673** | 0.092 | 0.003 | -0.121 | -0.216 | -0.148 |
| 14.No. of flower/ plant | | | | | | | | | | | | | | 1.00 | 0.531** | 0.225 | 0.089 | -0.031 | 0.252 |
| 15. No. of Silique / plant | | | | | | | | | | | | | | | 1.00 | 0.771** | 0.577** | 0.395* | 0.860** |
| 16.Silique length | | | | | | | | | | | | | | | | 1.00 | 0.839** | 0.337* | 0.789** |
| 17.No. of seed/ silique | | | | | | | | | | | | | | | | | 1.00 | 0.213 | 0.584** |
| 18.Seed yield | | | | | | | | | | | | | | | | | | 1.00 | 0.490** |
| 19.Weight of 1000 seed | | | | | | | | | | | | | | | | | | | 1.00 |

*, ** Significant at 5 & 1% levels of significance

Table 2. **Genotypic correlation coefficient for different pair of characters in cabbage.**

| Characters | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Stalk length | 1.00 | 0.159 | -0.105 | 0.323* | 0.249 | 0.271 | 0.230 | 0.176 | 0.048 | 0.238 | 0.010 | -0.332* | -0.211 | -0.187 | -0.107 | -0.004 | 0.242 | 0.041 | -0.069 |
| 2. Wrapper leaves | | 1.00 | 0.397* | -0.057 | -0.196 | -0.089 | -0.181 | 0.164 | 0.984** | -0.149 | -0.435** | -0.325* | 0.035 | 0.079 | 0.154 | 0.190 | 0.104 | 0.758** | 0.261 |
| 3. Non wrapper leaves | | | 1.00 | -0.143 | -0.225 | 0.254 | -0.569** | -0.129 | 0.425 | 0.156 | -0.101 | -0.123 | -0.220 | -0.223 | -0.036 | 0.140 | 0.126 | 0.326* | 0.149 |
| 4. Core volume | | | | 1.00 | 0.874** | -0.397* | 0.365* | 0.669** | -0.067 | 0.248 | -0.039 | -0.050 | -0.044 | 0.105 | 0.069 | 0.139 | 0.089 | -0.019 | 0.107 |
| 5. Core diameter | | | | | 1.00 | -0.441** | 0.393* | 0.742** | -0.243 | 0.408** | 0.056 | -0.086 | 0.122 | 0.090 | -0.023 | 0.072 | 0.073 | -0.205 | -0.087 |
| 6. Head compactness | | | | | | 1.00 | -0.382* | -0.612** | -0.097 | 0.039 | 0.114 | -0.051 | 0.289 | -0.0721 | -0.042 | -0.095 | -0.097 | -0.060 | -0.097 |
| 7. Head shape index | | | | | | | 1.00 | 0.614** | -0.068 | 0.033 | 0.138 | 0.065 | -0.209 | -0.042 | -0.106 | -0.368* | -0.398* | -0.263 | -0.214 |
| 8. Head size | | | | | | | | 1.00 | 0.260 | 0.171 | 0.115 | -0.010 | -0.202 | 0.068 | 0.194 | 0.214 | 0.287 | 0.141 | 0.153 |
| 9.Net head wt. | | | | | | | | | 1.00 | -0.047 | -0.398* | -0.188 | -0.159 | -0.037 | 0.210 | 0.188 | 0.128 | 0.869** | 0.337* |
| 10 Days to head maturity | | | | | | | | | | 1.00 | 0.118 | 0.130 | -0.004 | -0.003 | 0.225 | 0.241 | 0.289 | 0.128 | 0.262 |
| 11. head bursting | | | | | | | | | | | 1.00 | -0.071 | -0.054 | -0.308 | -0.411** | -0.275 | -0.088 | -.437** | -0.379* |
| 12.No. of floral stalk | | | | | | | | | | | | 1.00 | -0.023 | 0.354 | 0.251 | 0.284 | 0.104 | -0.128 | 0.301* |
| 13. Length of floral stalk | | | | | | | | | | | | | 1.00 | 0.145 | 0.084 | 0.003 | -0.128 | -0.297 | -0.115 |
| 14 No. of flower/ plant | | | | | | | | | | | | | | 1.00 | 0.534** | 0.267 | 0.107 | -0.067 | 0.258 |
| 15. No. of ilique/plant | | | | | | | | | | | | | | | 1.00 | 0.780** | 0.607** | 0.445** | 0.867** |
| 16. Silique length | | | | | | | | | | | | | | | | 1.00 | 0.860** | 0.380* | 0.799** |
| 17.No. of seed/ silique | | | | | | | | | | | | | | | | | 1.00 | 0.315* | 0.613** |
| 18.Seed yield | | | | | | | | | | | | | | | | | | 1.00 | 0.560** |
| 19.Weight of 1000 seed | | | | | | | | | | | | | | | | | | | 1.00 |

*, ** Significant at 5 & 1% levels of significance

positive correlation between seed yield and number seed per silique at genotypic level suggested that an increase in number of seed per silique would be required to augment seed yield per plant at genotypic level. Hence, relative importance of these characters could not be ignored.

Genotypically significant but phenotypically non-significant relationship was observed between seed yield and non-wrapper leaves. This suggested that relative contribution of non-wrapper leaves to supply the nutrients at growing tip was highly required prior to initiation reproductive phase and at vernalization period toward promoting seed yield effectively (Wien and Wurr, 9). Non-significant association of seed yield per plant with head size, days to head maturity, number of flower per plant, core diameter, head compactness and head shape index indicated that perhaps these traits possessed little or no influence in selection for the improvement of seed yield per plant. Contrary (Joshi, 4) reported that seed yield per plant established significant correlation with head size and head compactness. Seeds per silique established a significant positive correlation with silique length and thousand seed weight. This indicated an increase in number of seeds in side a silique was directly and proportionally related to silique length and thousand seed weight of cabbage cultivars.

It can be concluded that selection of genotypes could be practiced at vegetative stage of crop growth on the basis of head weight, number of wrapper leaves and days to head bursting. Number of silique per plant, greater length of silique and thousand seed weight appeared as the major important selection criterion at reproductive phase of crop growth for improving the genotypes of cabbage for efficient seed production, while an increase number of seeds per silique emerged as the secondary important character.

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