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# Performance and Genetic Evaluation of Some Cauliflower Genotypes in Dry Temperate Ladakh Region of India

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***Author's contribution***

*The sole author designed, analysed, inteprted and prepared the manuscript.*

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## ABSTRACT

Nature has endowed India with many precious gifts, wherein lies its immense potential for the vegetable sector. In dry temperate region of India like Ladakh, cauliflower is grown during summer months. Extreme environmental fluctutaions make the cauliflower cultivation not an easy venture. Cauliflower is thermo-sensitive crop and identification of proper group as well genotype for cultivation in a particular climate and region is of utmost importance. Six genotypes were tried in Randomized Block Design with 4 replications with crop geometry of 45 x 45 cm with the objective to select the proper maturity group and genotype for cultivation in dry temperate Ladakh condition and to study the genetic parameters for further breeding procedures. Results indicated that there are significant differences among all the cultivars for all the characters except stalk length, number of leaves for plant and leaf length. Sweta recorded highest gross plant weight, net curd weight and yield per ha which is superior to all the others cultivars. GCV and PCV as well heritability with genetic advance expressed as percentage of mean were higher in gross plant weight, net curd weight and yield per hectare. Selection on phenotypic performance could be effective for improvement of these traits.

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## 1. INTRODUCTION

Cauliflower (*Brassica oleracea* var. *botrytis* L.) follows cabbage in importance with regard to area and production in the world. Italy and India are the major countries growing cauliflower on large scale. However, in India cauliflower is more widely grown than cabbage. In India, cauliflower is grown both in hills and plains and from 11°N to 35°N. Important cauliflower-growing states in India are UP, Karnataka, West Bengal, Punjab and Bihar. It is also commonly grown in northern Himalayas and in Nilgiri hills in south.

Cauliflower is thought to have been domesticated in the Mediterranean region since the greatest range of variability in the wild types of *B. oleracea* is found there. It originated in the island of Cyprus from where it moved to other areas like Syria, Turkey, Egypt, Italy, Spain and northwestern Europe. Cauliflower has been in cultivation in India since last 150 years. It was introduced from England in 1822 by Dr. Jemson, In-charge of Company Bagh, Saharanpur, U.P. The imported seeds were tested in various parts of India. The growers raised the crop during May to July which corresponded with the growing period in England. However, the climatic conditions of the same period in both the countries varied considerably and this resulted in the adaptation of some introduced varieties to early production during warmer and humid conditions in the country. The growers made selection of such early adapted types and raised their seeds for their own use. The local strains, seeds of which were produced in the country were found to be better adapted and earlier in maturity being ready in November-December as compared to the crops raised from imported seeds. This was the beginning of the development of an entirely new cauliflower now termed as Indian cauliflower.

The cauliflower has a wide range in adaptation to diverse climatic conditions, prevailing in temperate subtropics and tropical parts. The optimum temperature for growth of young plants is around 23$^{o}$C, but in later stages 17-20$^{o}$C are most favourable. The tropical cultivars show growth even at 35$^{o}$C. In temperate regions, the growth of young seedlings may be ceased, when temperatures are slightly about O$^{o}$C, while, the early cultivars grown in plains of north India and other tropical parts can grow even at 35$^{o}$C or still higher temperature. Lower temperatures ranging from 5$^{o}$C to 28-30$^{o}$C are needed for transition from vegetative to curding phase.

Nature has endowed India with many precious gifts, wherein lies its immense potential for the vegetable sector. In dry temperate region of India like Ladakh, cauliflower is grown during summer months. This has been introduced in the region for cultivation during late seventies. Extreme environmental fluctutaions make the cauliflower cultivation not an easy venture. Cauliflower is thermo-sensitive crop and identification of proper group as well genotype for cultivation in a particular climate and region is of utmost importance. Bolting is a common problem faced by the farmers of the region due to the selection of varieties from un-suitable groups. Summer cauliflower of Europe may be the best choice for the region due to same set of season. Hybrids developed by private sector for summer season cultivation may also yield good crop with quality curds. There is also need to evolve cultivars which suits to flutuating enviroment of dry temperate. Before starting any beeding programme, genetic varability must be available in matateriall. Therefore, present study was undertaken with the objective to select the proper maturity group and genotype for cultivation in dry temperate Ladakh condition and to study the genetic parameters for further breeding procedures.

## 2. MATERIALS AND METHODS

The experiment was conducted in open field conditions at Experimental Farm, Stakna (Leh) of High Mountain Arid Agriculture Research Institute (SKUAST-K) which is situated at 3319 m amsl with latitude 33$^{0}$58.551' NS and longitude 77$^{0}$41.995' EW. Climate of the area is typically dry temperate. Soil of experimental site is sandy loam. Nursery was sown in Last week of March. Six genotypes from two maturity groups were transplanted in first week of May in Randomized Block Design with 4 replications with crop geometry of 45 x 45 cm. Due to freezing temperature in winter, main growing season of cauliflower is summer in dry temperate conditions in contrary to Indian plains. Average temperature of experimental site during growing season (March to September) ranged from -6.9$^{0}$C to 27.58$^{0}$C with average humidity range of 25.07-29.23 percent. Crop was transplanted on first week of May. Standard package of practices followed to raise healthy crop. No spray of any

pesticide or fungicide was given. Data were recorded on 9 plants for morphological and yield characters viz. stalk length, number of leaves per plant, leaf length, leaf width, days to maturity, gross plant weight, net curd weight, harvest index and yield per ha in each replication and subjected to statistical analysis as per Panse and Sukhatme [1]. The genotypic and phenotypic variances were estimated according to the formula suggested by Johnson et al. [2]. The genotypic and phenotypic coefficients of variations were estimated according to the formula suggested by Burton and DeVane [3]. Heritability in broad sense was estimated for different traits by the formula suggested by Johnson et al. [2]. The expected genetic advance (GA) for different traits under selection was estimated using the formula suggested by Johnson et al. [2]. The genetic advance in percent of mean was calculated by using formula of Burton and DeVane [3] and Johnson et al. [2].

## 3. RESULTS AND DISCUSSION

Analysis of variance indicated that there are significant differences among all the cultivars for all the characters except stalk length, number of leaves for plant and leaf length.

### 3.1 Performance Evaluation of Cultivars

Stalk length ranged from 0.90 cm to 1.30 cm and number of leaves ranged from 13.00 to 17.00 (Table 1). SB-16 produced maximum number of leaves and shortest stalk. Maximum length of leaves is observed in Sweta and minimum in Pusa Himjyoti. Sweta produced leaves with highest width (21.88 cm) which is statistically superior to all the other cultivars. Sweta and Pusa Himjyoti were found statistically at par in maturity and both were significantly earlier in maturity than other cultivars. All the snow ball group cultivars and Niti showed delayed maturity. That is why snow ball cultivars are called late maturity cultivars. Sweta recorded highest gross plant weight and net curd weight which is superior to all the others cultivars for both of these characters. Harvest index, an important parameter of economic yield, was found highest in PSBK-1 and PSB-1.

Sweta produced highest yield of 552.47 quintal per hectare and found statistically superior to all the other cultivars (Table 1). Minimum yield was recorded in Pusa Himjyoti. Beside Sweta, snow ball group cultivars performed well. Poor performance of Pusa Himjyoti and Niti may be due to the fact that they belong to mid late maturity groups not suited to conditions.

### 3.2 Genetic Parameters

Genetic variability in a crop species is expected to be immense. In cauliflower, plant, leaves and curd vary in shape, size, colour and maturity. Genetic coefficient of variability (GCV) varied from 4.17 in stalk length to 59.22 in gross plant weight (Table 2) showing sufficient genetic diversity among cultivars. GCV helps to measure the range of variability in characters and provides a measure to compare the genetic variability in various quantitative characters. In general, phenotypic values of variation were higher than the genotypic values for all the characters [4-9]. However, differences were small in all the characters except stalk length, number of leaves per plant and leaf length; thus, showing that characters except these are influenced by environmental factors and selections for phenotypic basis will hold good for genotypic basis too. Coefficient of variability varied from character to character indicating thereby that in some characters there was a great diversity while in others it was of low to moderate magnitude. Genetic coefficient of variability and phenotypic coefficient of variability were higher in gross plant weight, net curd weight and yield per hectare whereas it is low for stalk length, number of leaves per plant, leaf length and days to maturity. Higher GCV for gross plant weight, net curd weight and yield per hectare indicated a scope for improvement in these characters by judicious selection. Vivek et al. [10] and Swarna et al. [11] reported appreciable PCV and GCV for gross plant weight, net curd weight and yield per ha in conformity to the present findings but contrary results for stalk length and harvest index.

High heritability (Table 2) was recorded for leaf width, days to maturity, gross plant weight, net curd weight and yield per hectare. In line with present results high heritability for days to maturity and net curd weight yield by Kanwar and Korla [4]; for days to maturity by Kanwar and Korla [5,6,7] for gross plant weight by Sharma et al. [12]; and for whole plant weight and curd weight by Gariya et al. [13]. GCV together with heritability estimates would give a reliable indicator of expected amount of improvement through selection [3]. Selection in the characters with high heritability may be made on phenotypic performance with great reliance.

**Table 1. Mean performance of cauliflower cultivars for yield and horticultural characters**

| Cultivars | Characters | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Stalk length (cm) | No. of leaves | Leaf length (cm) | Leaf width (cm) | Days to maturity | Gross plant weight (g) | Net curd weight (g) | Harvest Index (%) | Yield per ha (Q/ha) |
| Pusa Himjyoti | 0.98 | 13.00 | 24.12 | 10.62 | 58.25 | 287.50 | 140.00 | 49.30 | 69.14 |
| SB-16 | 0.90 | 17.00 | 30.38 | 12.75 | 68.50 | 706.25 | 426.25 | 51.33 | 210.49 |
| PSB-1 | 1.23 | 14.25 | 28.25 | 14.75 | 65.25 | 887.50 | 600.00 | 67.74 | 296.30 |
| PSBK-1 | 1.30 | 14.75 | 28.75 | 14.00 | 63.00 | 937.50 | 650.00 | 69.31 | 320.99 |
| Sweta | 1.25 | 13.00 | 34.92 | 21.88 | 58.50 | 1900.00 | 1118.75 | 59.43 | 552.47 |
| Niti | 1.12 | 13.25 | 29.75 | 14.62 | 67.25 | 481.25 | 287.50 | 59.61 | 166.67 |
| Mean | 1.13 | 14.21 | 29.36 | 14.77 | 63.46 | 866.67 | 537.08 | 60.83 | 269.34 |
| $CD_{0.05}$ | NS | NS | NS | 3.28 | 4.33 | 694.84 | 401.43 | 10.72 | 196.13 |

**Table 2. Genetic parameters for various characters**

| Characters | Coefficients of variation | | Heritability (%) | Genetic advance | Genetic gain (%) |
|---|---|---|---|---|---|
| | Phenotypic | Genotypic | | | |
| Stalk length | 27.55 | 4.17 | 2.30 | 0.01 | 0.88 |
| Number of leaves | 15.88 | 8.57 | 29.10 | 1.35 | 9.50 |
| Leaf length | 17.80 | 9.14 | 26.40 | 2.84 | 9.67 |
| Leaf width | 28.74 | 24.68 | 73.80 | 6.45 | 43.67 |
| Days to maturity | 7.91 | 6.48 | 67.20 | 6.95 | 10.95 |
| Gross plant weight | 79.61 | 59.22 | 55.30 | 786.51 | 90.75 |
| Net curd weight | 76.92 | 58.80 | 58.40 | 497.20 | 92.57 |
| Harvest index | 15.49 | 10.28 | 44.04 | 8.55 | 14.05 |
| Yield/ha | 74.47 | 56.66 | 57.90 | 239.22 | 88.82 |

High heritability estimates were associated with high values of genetic advance expressed as percentage of mean (Table 2) for gross plant weight, net curd weight and yield per hectare. It indicated that additive gene effects were important in determining these characters and a considerable increase could we made in these characters by applying selection pressure. In consonance with the present findings high heritability and genetic advance expressed as percentage of mean for gross plant weight and net curd weight [14,13,10]; and low heritability and genetic advance expressed as percentage of mean for stalk length and leaves per plant [14] were reported earlier. Pramila et al. [15]; Kumar et al. [16]; and Swarna et al. [11] reported similar findings for gross plant weight, net curd weight and yield but results were contrary for number of leaves and harvest index [15]; for stalk length [10]; for number of leaves [11]. Singh et al. [17] reported similar results for gross curd weight and yield and Singh et al. [18] for gross curd weight.

Good Phenotypic and genotypic coefficients of variation, heritability and genetic advance expressed as percent of mean for net curd weight, gross plant weight and curd yield per ha were also reported by Chittora and Singh [19]. In agreement with the findings of Sanjeev [20] and Dharminder [21], the traits viz. gross plant weight and net curd weight exhibited high genetic gain with moderate to high heritability as well as genotypic coefficient of variability which indicated that the selection based on phenotypic performance could be effective for the improvement of these traits as additive gene effects were important in determining these traits [22].

## 4. CONCLUSIONS

It may be summarized that cultivar Sweta as well as late group of cauliflower proved better for summer cultivation in dry temperate Ladakh region. Selection on phenotypic basis for gross plant weight and net curd weight may be made with great reliance and would yield good results.

## COMPETING INTERESTS

Author has declared that no competing interests exist.

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