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Study of varietal performance of coloured cauliflower (*Brassica oleracea* var. *botrytis*) under Prayagraj climatic conditions

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Abstract
The present study was conducted during December 2024 to February 2025 at the Department of Horticulture, SHUATS, Prayagraj, to evaluate the performance of 10 coloured cauliflower varieties under the local agro-climatic conditions. The experiment was laid out in a Randomized Block Design with three replications. Significant variation was observed among the varieties for growth, yield, and quality traits. Variety 2 (Snow Crown) outperformed others in plant height, canopy cover, curd yield, curd diameter, and also recorded the highest gross return, net return, and benefit-cost ratio (3.90). The variety SNOW CROWN showed superiority in weight of the curd, biological yield. These findings suggest SNOW CROWN as the most promising variety for cultivation under Prayagraj conditions.

Keywords: Benefit-cost ratio, cauliflower, performance, varieties

Introduction
In the world of vegetable crops, cauliflower (Brassica oleracea var. botrytis L., 2n = 2X = 18) is one of the most significant crops. There are over 40 species in the genus Brassica, including Brassica oleracea. The well-known class of "Cole" crops or "Cole" vegetables is represented by B. oleracea. One of the most significant crops in this group, cauliflower is grown on 1.42 million hectares of land worldwide and produces 26.90 million tonnes annually. India (33.2%) and China (40.5%) possess the largest shares of this. The glucosinolates found in cauliflower are what give it its flavour, aroma, and pungency as well as its health-promoting qualities.

The economic part of cauliflower is a fleshy apical meristem, commonly referred to as 'curd', which is consumed as a vegetable, in pickles, or in various regional culinary dishes. This curd accounts for approximately 45% of the total plant weight. Cauliflower is a thermo-sensitive crop, and temperature significantly influences the regulation of curd initiation and development through a set of major genes and modifiers.

Cauliflower originated in the Mediterranean region and was introduced to various parts of the world by traders and botanists. Genetic modifications occurred in the introduced genotypes for adaptive traits, including plant types, curding characteristics, and flowering behavior, which may have contributed to the evolution of eight regional morphotypes of cauliflower. These groups are recognized as Italians or Original (Mediterranean), Cornish (England), Northerns (England), Roscoff (France), Angers (France), and Erfurt.

Snowball (Germany and Netherlands) and Indian cauliflower (Northern India) are two distinct varieties. Additionally, cauliflowers are categorized based on their phylogenetic classification into Italian, North-West European biennials, North European annuals, Asian, and Australian types, which underscores the importance of regional influences and cultivation practices. In India, cauliflower is an introduced crop that is divided into two main categories: (i) European (late or snowball) and (ii) Indian (tropical) types, which are determined by their temperature requirements for curding and reproductive stages. The typical Indian cauliflower (group 1a & 1b and group 2) produces curd at higher temperatures (16-27 °C) compared to the snowball group (10-16 °C). An intermediate category, referred to as mid-late (group-3), necessitates temperatures between 12 to 16 °C for the initiation and development of curd.

Moreover, Indian type cauliflower flowers and sets seeds abundantly in the northern plains during the winter season, whereas snowball cauliflower does not flower or produce seeds in these plains due to its extended low-temperature requirements. Specifically, Indian cauliflower is classified into early (group-1), mid-early (group-2), and mid-late (group-3) based on its precise temperature needs for curd initiation and development, which are 20-27 °C, 16-20 °C, and 12-16 °C, respectively.

2. Materials and Methods

The present study entitled "Study on Varietal performance of coloured cauliflower (brassica oleracea var. botrytis) under Prayagraj Agro-climate conditions" was conducted to identify the most suitable variety in terms of growth, yield, and quality of Cauliflower. The experiment was carried out during the autumn season of October 2024 to winter season of December 2024 at the Horticultural Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj.

Experiment Design

The experiment consisted of ten varieties, replicated three folds in randomized design. The details of the layout of experiment are given in (Table 1, 2 and Figure 1).

Table 1: Experiment Layout

1.	Design	RBD
2.	Replications	3
3.	Varieties	10
4.	Crop	Cauliflower
5.	Spacing	60 x 30cm
6.	Plot area	2.40 x 1.5 cm
7.	Main Irrigation channel	50cm
8.	Gross Experimental area	108m

Table 2: List of different varieties of cauliflower and their sources

Sl. No	Variety name	Symbol	Source
1.	Cauliflower F1	V1	Saphirre seeds
2.	Snow Crown	V2	Takii seeds
3.	White Dex	V3	Sakata Seeds
4.	Carotena	V4	Syngenta
5.	F1 Hybrid Yellow	V5	Saphirre seeds
6.	Pili Phool Gobhi	V6	Organic Bazaar
7.	Valentena	V7	Syngenta
8.	F1 Hybrid Purple	V8	Saphirre seeds
9.	Bainganee Phool Gobhi	V9	Organic Bazaar
10.	Poosi	V10	Tycoon seeds

3. Results and Discussion

A) Growth Parameters

Plant Height

As perusal of the data reveals that plant height was significantly varied among different varieties of cauliflower. The plant height of the cauliflower differed significantly at < 0.05 at 30, 60, and 90 days after transplanting (DAT) and the final harvest. The maximum plant height was observed in Snow crown variety of 40 cm and minimum plant height was observed in Poosi variety of 27.19 cm.

Similar results were also published by Amar *et al.*, (2003) [3] The variety Snow Crown gives maximum height at 30, 60 and 90 DAT due to Allahabad Agro-climatic condition is favourable for its growth. Snow Crown showed better performance for early production and the variety was highly preferred by the farmers and consumers. One of the five promising cauliflower variety namely Snow Crown were included in the experiment and has shown the (Yam *et al.*, 2004) [19]. The tallest plant was found with the variety Snow crown (Salim *et al.* 2008) [18].

Number of leaves

As perusal of the data reveals that the number of leaves was significantly varied among different varieties of cauliflower. The number of leaves of the cauliflower differed significantly at < 0.05 at 30, 60, and 90 days after transplanting (DAT) and the final harvest. The maximum number of leaves were observed in Snow crown variety of 14 and minimum number of leaves was observed in Poosi variety of 10.

Similar results were also published by Krishna *et al.* (2017) [3] The average mean for the number of the leaves for both the year shows significant result in Snow crown variety. Basnet *et al.* (2024) [5].

Leaf Area Index (LAI)

As perusal of the data reveals that the leaf area index (LAI) was significantly varied among different varieties of cauliflower. The leaf area index of the cauliflower differed significantly at < 0.05 at 30, 60, and 90 days after transplanting (DAT) and the final harvest (Table 3). The maximum leaf area index (9.23) was found in variety of V2 Snow Crown. Whereas, the minimum leaf area index (7.06) was recorded in V9 Bainganee Phool Gobhi.

Similar results were also published by Basnet *et al.* (2024) [5]. Farmers preferred Snow Crown variety of cauliflower because of its earliness, good taste and high yield potential. Farmers preferred Snow Crown variety because of its good taste, tolerant to frost injury and high yield potential (Subedi *et al.*, 2011) [17].

Table 3: Growth parameters of different varieties of cauliflower grown under Prayagraj Agro climate conditions

Variety	Plant Height (cm)	Number of leaves	Leaf area index (LAI)
Cauliflower F1 hybrid	35.74	13.44	7.23
Snow Crown	40.03	14.33	9.23
White Dex	31.73	11.71	8.16
Carotena	34.02	12.24	8.27
F1 Hybrid Yellow	30.88	12.69	7.52
Pili Phool Gobhi	34.81	11.38	8.10
Valentena	35.28	12.22	8.18
F1 Hybrid Purple	35.40	12.96	8.13
Bainganee Phool Gobhi	33.97	11.87	7.06
Poosi	27.19	10.87	8.26
F-test	S	S	NS
C.D. (5%)	3.13	0.99	1.43
S.E.(d)	1.49	0.47	0.68
C.V.	5.83	4.67	10.41

B) Yield Parameters

Curd Weight (g)

As perusal of the data reveals that the curd weight was significantly varied among different varieties of cauliflower. The cauliflower curd weight significantly differed at < 0.05 at 30, 60, and 90 days after transplanting (DAT) and the final harvest (Table 2). The maximum curd weight (525.63g) was found in the variety of V2 Snow Crown.

Whereas, the minimum curd weight (248.57g) was recorded in V10 Poosi.
Similar results were also published by Marketable curd weight significantly variation were recorded in Snow crown. (Belayet *et al.* 2020) [6]. The variety Snow Crown gives maximum curd weight 90 DAT due to Allahabad Agro-climactic condition is favourable for its growth.

Curd Diameter (mm)
As perusal of the data reveals that the curd diameter was significantly varied among different varieties of cauliflower. The cauliflower curd diameter significantly differed at < 0.05 at 30, 60, and 90 days after transplanting (DAT) and the final harvest (Table 4). The maximum curd diameter (12.04) was found in the variety of V2 Snow Crown. Whereas, the minimum curd diameter (9.85) was recorded in V8 F1 Hybrid Purple.
Similar results were also published the curd diameter was strongest with Snow crown producing the biggest diameter (Salim *et al.*, 2008) [18]. Annual results for yield and percent marketable curds for cauliflower cultivars. Snow Crown with good color and excellent weight. (Marvin *et al.*, 1990) [12]. Farmers preferred Green Coronet variety of cabbage because of its good taste, tolerant to frost injury and high yield potential (Subedi *et al.*, 2011) [17] The variety Snow Crown gives maximum curd diameter at 90 DAT due to Allahabad Agro-climatic condition is favourable for its growth.

Days to Curd Initiation
As perusal of the data reveals that the days to curd initiation was significantly varied among different varieties of cauliflower. The days to curd initiation of the cauliflower differed significantly at < 0.05 at 30, 60, and 90 days after transplanting (DAT) and the final harvest (Table 4). The maximum days to curd initiation (74) was found in the variety of V2 Snow Crown. Whereas, the minimum days to curd initiation (50) was recorded in V10 Poosi
Similar results were also published that the days to curd initiation and Days to curd harvest were earlier in the variety Snow Crown. But the longer duration takes for the variety Kathmandu Local (Asmita *et al.*, 2022) [4]. Significantly shorter period for first curd initiation of 61 days after transplanting (DAT) was recorded in Crown variety than other varieties Giri *et al.*, (2020) [10]

Days from Curd Initiation to harvest
As perusal of the data reveals that the days from curd initiation to harvest was significantly varied among different varieties of cauliflower. The days from curd initiation to harvest of the cauliflower differed significantly at < 0.05 at 30, 60, and 90 days after transplanting (DAT) and the final harvest (Table 4). The maximum days from curd initiation to harvest (16) was found in the variety of V10 Poosi. Whereas, the minimum days from curd initiation to harvest (10) was recorded in V2 Snow Crown.
Similar results were also published by Basnet *et al.* (2024) [5]. Farmer preferred Snow Crown variety of cauliflower because of its earliness, good taste and high yield potential. But the period from seeding to curd harvest was highly affected by the varieties and seeding dates. (Yam *et al.*, 2004) [19].

Curd Yield/ha
As perusal of the data reveals that the days from curd initiation to harvest was significantly varied among different varieties of cauliflower. The curd yield of the cauliflower differed significantly at < 0.05 at 30, 60, and 90 days after transplanting (DAT) and the final harvest (Table 4). The maximum days from curd initiation to harvest (16) was found in the variety of V10 Poosi. Whereas, the minimum days from curd initiation to harvest (10) was recorded in V2 Snow Crown.
Similar results were also published that the Snow crown produced the highest curd yield (Salim *et al.*, 2008) [18] Farmers preferred Green Coronet variety of cabbage because of its good taste, tolerant to frost injury and high yield potential (Subedi *et al.*, 2011) [17] Statistically significant variation was recorded for micronutrients in terms of curd yield per hectare of cauliflower. The highest curd yield was found from Snow crown variety (Rahman *et al.*, 2021) [16] The variety Snow Crown gives maximum curd yield at 90 DAT due to Allahabad Agro-climatic condition is favourable for its growth.

Stalk length
As perusal of the data reveals that the curd yield was significantly varied among different varieties of cauliflower. The stalk length of the cauliflower differed significantly at < 0.05 at 30, 60, and 90 days after transplanting (DAT) and the final harvest (Table 4). The maximum curd yield (7.22cm) was found in the variety of V10 Poosi. Whereas, the minimum curd yield (5.70cm) was recorded in V8 F1 Hybrid Purple.
Similar results were also published by Manpreet *et al.*, (2019) [21] Spacing does not have significant effect on curd count number, curd weight, Curd yield, plant height, number of leaves per plant, spreading diameter and stalk length. Out of eight cultivars, two cultivars viz; RIJK-du and Snow Crown variety Basnet *et al.* (2024) [5].

Table 4: Yield parameters of different varieties of cauliflower grown under Prayagraj Agro climate conditions

Variety	Curd Weight	Curd Diameter	Days to curd initiation	Days from curd initiation to harvest	Curd Yield	Stalk length
Cauliflower F1 hybrid	376.67	10.59	57.27	12.10	21.07	6.02
Snow Crown	525.63	12.04	74.00	10.33	29.17	6.06
White Dex	498	10.16	54.40	13.17	27.54	6.10
Carotena	408.53	10.88	68.73	11.33	22.81	6.12
F1 Hybrid Yellow	299.8	10.26	71.60	12.33	18.66	5.84
Pili Phool Gobhi	370.4	10.34	56.33	15.53	20.66	5.92
Valentena	484.3	11.06	64.80	11.33	25.24	6.64
F1 Hybrid Purple	360.3	9.85	69.4	11.7	13.70	5.70
Bainganee Phool Gobhi	340.73	10.41	72.8	12.1	18.61	5.74
Poosi	248.57	11.44	50.20	16.67	18.93	7.22
F-test	S	S	S	S	S	S
C.D. (5%)	28.17	0.68	3.58	1.4	1.58	0.18
S.E.(d)	13.41	0.32	1.7	0.66	0.75	0.08
C.V.	4.2	3.73	3.26	6.43	4.23	1.68

C) Quality Parameters

TSS (°Brix)

As perusal of the data reveals that the curd yield was significantly varied among different varieties of cauliflower. The TSS of the cauliflower differed significantly at < 0.05 at 30, 60, and 90 days after transplanting (DAT) and the final harvest (Table 5). The maximum TSS (5.10) was found in the variety of V7 Valentena. Whereas, the minimum TSS (1.70) was recorded in V5 F1 Hybrid Yellow.

Similar results were also published by Manoj *et al.*, (2024) [20] Highest leaf dry matter and TSS was found in Super White Top and Snow Crown, Snow Crown cultivar showed the significant results with highest TSS. Basnet *et al.* (2024) [5] Farmers preferred Snow Crown variety of cauliflower because of its earliness, good taste and high yield potential. The horticultural trait i.e. TSS reported positive and highly significant correlation with the trait dry matter suggesting that high TSS values were observed for the heads with greater dry matter. This indicated that both these traits can thus be improved simultaneously.

Compactness

As perusal of the data reveals that the curd yield was significantly varied among different varieties of cauliflower. The compactness of the cauliflower differed significantly at < 0.05 at 30, 60, and 90 days after transplanting (DAT) and the final harvest (Table 5). The maximum TSS (7.34) was found in the variety of V2 Snow Crown. Whereas, the minimum TSS (5.82) was recorded in V10 Poosi

Similar results were also published by (Amar *et al.*, 2004) [3] that the good quality curd (marketable size, compactness and color) was found in Snow Crown and Snow King and these varieties were highly preferred by the farmers and consumers. Observations recorded on days to first harvest, marketable curd yield, unmarketable curd yield, percentage of well developed curd, curd quality (compactness, size, color) and farmers' preferences and were analyzed. Similarly, mean curd compactness was higher in Mid January planting than the Mid December planting of all varieties.

Table 5: Quality parameters of different varieties of cauliflower grown under Prayagraj Agro climate conditions

Variety	TSS content (°Brix)	Compactness
Cauliflower F1 hybrid	5.10	7.10
Snow Crown	5.00	7.34
White Dex	4.50	7.32
Carotena	2.30	6.46
F1 Hybrid Yellow	1.70	6.38
Pili Phool Gobhi	1.90	7.08
Valentena	5.10	6.52
F1 Hybrid Purple	5.10	6.68
Bainganee Phool Gobhi	5.00	6.20
Poosi	4.20	5.82
F-test	S	S
C.D. (5%)	0.58	0.24
S.E.(d)	0.28	0.11
C.V.	8.37	2.07

D). Economic Parameters

The economic performance of all varieties was evaluated by calculating the total cost of cultivation, gross return, net return, and the benefit-cost ratio, based on expenditures from sowing to harvesting.

Among the varieties, V2 Snow Crown proved to be the most economically efficient, achieving the highest gross return of ₹2,73,870/ha, a net return of ₹2,18,050/ha, and an impressive benefit-cost ratio of 3.90.

Table 6: Economics of different varieties of cauliflower grown under Prayagraj Agro climate conditions

Variety	Total cost of Cultivation	Yield (q/ha)	Gross Return (Rs./ha)	Net Return (Rs./ha)	B:C ratio
Cauliflower F1	58,841	215.35	1,29,210	70,369	1.19
Snow Crown	55.820	456.45	2,73,870	2,18,050	3.90
White Dex	57,920	291.28	1,74,768	1,16,848	2.01
Carotena	56,741	305.73	1,83,438	1,26,,697	2.23
F1 Hybrid yellow	59,586	186.60	1,30,620	71,034	1.19
Pili Phool Gobhi	59,286	206.60	1,44,620	85,334	1.43
Valentena	57,341	327.60	1,96,560	1,39,219	2.42
F1 Hybrid purple	57,920	291.28	1,74,768	1,16,848	2.01
Bainganee Phool Gobhi	59,286	186.10	1,30,270	70,984	1.19
Poosi	60,278	279.22	1,67,532	1,07,254	1.77

Table 7: Colour and fruit shape of different varieties of Bitter gourd

Variety name	Symbol	Colour
Cauliflower F1	V1	Light Ivory
Snow Crown	V2	Dutch White
White Dex	V3	Light Ivory
Carotena	V4	Honey Yellow
F1 Hybrid yellow	V5	Golden Yellow
Pili Phool Gobhi	V6	Orange Yellow
Valentena	V7	Purple
F1 Hybrid purple	V8	Old Mauve
Bainganee Phool Gobhi	V9	Violet
Poosi	V10	Creamish White

Conclusion

Based on the results obtained from the present investigation, it is concluded that the highest growth and yield parameters viz., plant height 40.03, Number of leaves 14.33, Leaf area index 9.23, curd weight 525.63, curd diameter 10.59, days to curd initiation 57.27, Days from curd initiation to harvest 10.33, curd yield 29.17, stalk length 6.06, TSS 5.00, Compactness 7.34, yield 456.45, B:C ratio 3.90 was observed with the Variety 2 Snow Crown. So, we can suggest to farmers to use this variety in production of cauliflower.

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