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RESEARCH ARTICLE

Growth, yield and economics of rainy season cauliflower as influenced by the transplanting dates and varieties

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Abstract

Cauliflower is the most widely cultivated cole crop in India and fetches higher returns during rainy-season cultivation. The present study aimed to find out the most suitable time for planting of rainy-season cauliflower and to identify the best-performing variety/varieties under the foothills of the eastern Himalayan region. The experiment was laid out in two-factor factorial RBD with three replications where the first factor comprised five dates of planting (15th July, 30th July, 15th August, 30th August and 15th September) and the second factor was five different varieties (Summer Beauty, Pan 1008, Hybrid Cauliflower No.140, BN 50 and Dawn-175). The field experiment was conducted from July to November of 2022 at UBKV, Pundibari, Cooch Behar, West Bengal. The findings revealed that 15th August transplanting produced maximum curd weight (530.93 g), whereas the variety Hybrid Cauliflower No.140 recorded the highest curd weight (533.93 g) and subsequently maximum curd yield (18.53 t/ha). To obtain a higher curd yield in the rainy season, the hybrid Cauliflower No.140 variety should be transplanted on 15th August to catch the early winter market for better remuneration from the rainy season cauliflower.

Keywords: Cauliflower, curd yield and quality, planting date, variety, rainy season

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Introduction

Cauliflower (*Brassica oleracea* var. *botrytis* L.) is an important cole crop and nutritionally, the curd is rich in protein, vitamins and minerals. The crop is highly thermo-sensitive and variation in temperature significantly influences both vegetative and generative phases of the crop (Chabok and Amoli, 2013; Rahman et al., 2013; Singh et al., 2018). There is a great demand for cauliflower all year round. However, during early winter, the price remains very high, which attracts farmers to cultivate cauliflower during the rainy season. Cauliflower productivity is highly influenced by the genetic characteristics of the cultivar, planting time, growing temperature and nutrient application. Traditionally, cauliflower is grown in the winter season mostly from November to March. However, winter cauliflower cultivation suffers from a market glut and low curd prices. The cauliflower growers are gradually adjusting their planting time to catch the festival market as well as the early winter market. Selection of variety and planting at the proper time are the key elements for high yield and quality of curd production (Islam et al., 2016). Planting time plays a crucial role in curd initiation and development because temperature is one of the primary micro-climatic factors driving rates of growth and development of cauliflower (Bankar et al.,

2018). Improper planting time and faulty selection of variety may drastically affect crop growth and curd yield (Naik et al., 2016). Information on the optimum planting time and suitable variety for rainy season cauliflower is still meager for the foothills of the eastern Himalayan region. Keeping in view, the present experiment was conducted to assess the performance of cauliflower varieties with different planting dates in the rainy season with a view to fetch maximum return during the festival months.

Materials and Methods

The field experiment was conducted at the Instructional Farm of UBKV, Pundibari, Coochbehar, West Bengal, India (89°23'53" E longitude and 26°19'86'' N latitude and at 43 m above mean sea level) during rainy season (July to November) of the year 2022. The soil of the experimental field was sandy loam (66, 23 and 21% sand, silt and clay, respectively) in texture and slightly acidic in reaction (pH 5.74). The initial soil organic carbon was 0.83% and available N, P and K contents were 176.31, 19.28 and 118.63 kg/ha, respectively. The experiment was laid out in two-factor factorial RBD with three replications where the first factor comprised five dates of planting (15th July, 30th July, 15th August, 30th August and 15th September) and the second factor was five different varieties (Summer Beauty, Pan 1008, Hybrid Cauliflower No.140, BN 50 and Dawn-175). Healthy seedlings of 30 days old were transplanted at 45 × 45 cm spacing in a 2.25 × 2.25 m plot area. Farmyard manure (20 t/ha) along with the recommended doses of inorganic fertilizers (120 N: 60 P: 60 K kg/ha) were applied in the form of urea (N- 46%), single super phosphate (P- 16%) and muriate of potash (K-60%). The full dose of P and K, along with half N were applied as basal and the rest of N was top-dressed in two equal splits at 30 and 45 days after transplanting. The crop was raised by adopting standard cultural practices. The observations were recorded for plant height, number of leaves/plant, days to curd initiation, days to curd maturity, curd diameter and individual curd weight, curd yield/plot, curd yield (t/ha), T.S.S.(°Brix) and ascorbic acid content of curd (mg/100 g fresh curd). The vitamin C content was determined titrimetrically, using 2, 6 dichlorophenol indophenol dye as per the method suggested by Ranganna (1986). The observations recorded on different parameters were statistically analyzed as per the method suggested by Panse and Sukhatme (2000).

Results and Discussion

Effect of Planting Dates

The data presented in Tables 1 and 2 revealed that different planting dates showed a significant effect on the growth and yield parameters of cauliflower. Early planting dates significantly increase the plant height and number of leaves/plants but recorded longer duration for curd initiation and curd maturity. Seedling planted on 15th July (P_1) recorded the maximum plant height (48.10 cm) and highest number of leaves/plant (26.60) but took maximum days to curd initiation (62.13) and curd maturity (75.80). The highest curd diameter (14.69 cm) was found for the 30th August planting (P_4), which is 91.42% higher than the curd diameter (13.43 cm) from 15th July planting date (P_1). Data on curd yield showed that the highest curd weight (530.93 g) was found for the 15th August planting (P_3), which is 85.92% more than the curd weight of 30th July planting date (P_2). Transplanting of cauliflower seedlings in mid-August significantly increased the curd diameter and curd yield, which is directly associated with total curd yield. The result revealed that 15th August planting produced the highest curd yield (18.30 t/ha), which was 85.79% higher than the 15th July transplanting (15.70 t/ha). Regarding quality attributes of cauliflower, different planting dates showed a non-significant effect. However, the highest TSS content (5.21°B) and highest ascorbic acid (35.82 mg/100 gm) content were found for the plants transplanted on 15th September. The results clearly indicated that the curd weight of cauliflower gradually increased with planting dates. This may be due to differences in genotypic constituents of the variety and variation in climatic parameters during the growing periods. According to Ara et al. (2009), late planting exposed the plants to a shorter duration for vegetative growth, while the lower night temperature helped the development of curd.

Effect of Varieties

The results in respect of growth and yield attributes of cauliflower varieties are presented in in Table 1 and 2. Significant differences were observed among the varieties in respect of plant height, number of leaves per plant, days to curd initiation, days to curd maturity, curd diameter, curd weight and curd yield. The variety Hybrid Cauliflower No. 140 (V_3) had the maximum plant height (47.27 cm), curd weight (533.93 g), curd yield (13.09 kg/plot and 18.53 t/ha) as well as minimum days for curd initiation (51.83 days) and curd maturity (65.33 days).The total soluble solid and ascorbic acid content of curd was also significantly influenced by different varieties. Among the different varieties, maximum TSS content (5.44°B) and maximum ascorbic acid (37.24 mg/100 gm fresh curd weight) were recorded for the variety Hybrid Cauliflower No.140.

Effect of Interaction of Planting Dates and Varieties

The experimental results indicated a significant interaction between planting dates and varieties for the growth and yield attributes of cauliflower (Tables 1 and 2). The 15th September planting of Hybrid Cauliflower No.140 (P_5V_3) recorded the maximum plant height (56.47 cm), minimum days for curd initiation (46.71 days) and curd maturity (58.67 days). The increase in crop duration in early planting dates might be due to high soil moisture prevailing during the

Table 1: Effect of planting dates, varieties and their interaction on growth characters of cauliflower

Treatments	*Plant height (cm)*	*No. of leaves/plant*	*Days to curd initiation*	*Days to curd maturity*
Factor A (Planting dates)				
P_1 (15th July)	48.10	26.60	62.13	75.80
P_2 (30th July)	43.45	25.56	58.95	72.80
P_3 (15th August)	40.47	24.44	56.88	70.00
P_4 (30th August)	35.18	22.78	54.21	67.46
P_5 (15th September)	31.36	22.20	51.29	64.60
SEm(±)	1.24	0.60	1.07	1.85
CD(P = 0.05)	2.51	1.70	3.06	3.85
Factor B (Varieties)				
V_1(Summer Beauty)	35.52	26.24	58.72	72.04
V_2 (Pan 1008)	43.03	26.62	62.81	76.06
V_3 (Hybrid No.140)	47.27	21.20	51.83	65.33
V_4 (BN 50)	40.56	22.93	53.61	67.40
V_5 (Dawn 175)	32.19	24.59	56.49	69.46
SEm(±)	1.13	0.54	0.98	1.63
CD(P = 0.05)	2.39	1.61	2.87	3.57
Interaction (Factor A x Factor B)				
P_1V_1	28.13	28.17	65.23	78.00
P_1V_2	34.17	29.13	68.00	82.00
P_1V_3	38.50	24.00	57.03	72.00
P_1V_4	31.67	24.73	58.33	73.00
P_1V_5	24.33	26.97	62.07	74.00
P_2V_1	32.07	27.77	62.00	76.00
P_2V_2	37.93	28.00	65.02	79.00
P_2V_3	42.07	22.00	54.00	68.00
P_2V_4	36.33	23.97	55.71	70.00
P_2V_5	27.53	26.07	58.02	71.00
P_3V_1	35.00	27.27	59.00	72.00
P_3V_2	43.40	26.03	63.00	76.00
P_3V_3	48.03	21.00	51.71	65.00
P_3V_4	41.37	22.97	54.02	68.00
P_3V_5	34.57	24.97	56.70	69.00
P_4V_1	37.90	24.00	57.02	70.00
P_4V_2	47.37	24.97	59.37	73.33
P_4V_3	51.30	20.00	49.70	63.00
P_4V_4	45.23	22.00	51.00	64.00
P_4V_5	35.47	22.97	54.00	67.00
P_5V_1	44.50	24.00	50.37	66.00
P_5V_2	52.30	24.97	58.68	70.00
P_5V_3	56.47	19.03	46.71	58.67

P_5V_4	48.20	21.00	49.03	62.00
P_5V_5	39.07	22.00	51.70	66.33
SEm (±)	1.78	1.14	1.40	2.14
CD(P=0.05)	5.24	2.62	3.25	5.42

Table 2: Effect of planting dates, varieties and their interaction on yield and quality characters of cauliflower

Treatments	*Curd diameter (cm)*	*Curd weight (g)*	*Curd yield (kg/ plot)*	*Curd yield (t/ha)*	*TSS (^{0}Brix)*	*Ascorbic acid (mg/100 g)*
Factor A (Planting dates)						
P_1 (15th July)	13.43	456.53	11.31	15.70	4.92	33.45
P_2 (30th July)	13.68	456.20	11.37	16.01	4.96	34.16
P_3 (15th August)	14.80	530.93	12.99	18.30	5.08	34.70
P_4 (30th August)	14.69	524.40	12.94	18.26	5.18	35.19
P_5 (15th September)	14.55	521.26	12.88	18.11	5.21	35.82
SEm (±)	0.37	7.18	0.21	0.46	0.11	0.76
CD (P = 0.05)	NS	19.51	0.53	0.95	NS	NS
Factor B (Varieties)						
V_1(Summer Beauty)	13.25	448.86	11.01	15.42	4.92	33.60
V_2 (Pan 1008)	14.02	487.06	12.24	17.00	5.02	34.54
V_3 (Hybrid No.140)	14.69	533.93	13.09	18.53	5.44	37.24
V_4 (BN 50)	14.84	512.06	12.58	17.79	5.28	35.66
V_5 (Dawn 175)	14.35	507.4	12.57	17.63	4.74	32.28
SEm(±)	0.31	7.39	0.19	0.41	0.09	0.71
CD(P=0.05)	1.05	20.17	0.48	0.96	0.22	2.08
Interaction (Factor A x Factor B)						
P_1V_1	13.06	479.33	11.60	16.23	4.7	32.47
P_1V_2	13.50	452.00	11.30	15.38	4.9	32.90
P_1V_3	13.30	434.66	10.96	15.08	5.3	36.10
P_1V_4	13.18	421.66	10.42	14.60	5.1	34.60
P_1V_5	14.13	495.00	12.27	17.21	4.6	31.20
P_2V_1	13.51	467.00	11.23	16.11	4.8	33.10
P_2V_2	13.43	448.66	11.87	16.57	4.9	34.10
P_2V_3	13.00	406.00	10.07	14.11	5.3	36.80
P_2V_4	13.47	409.66	10.12	14.23	5.2	35.13
P_2V_5	15.00	549.66	13.60	19.03	4.6	31.70
P_3V_1	13.40	449.66	11.10	15.06	5.0	33.70
P_3V_2	13.67	481.66	11.98	16.62	5.0	34.80
P_3V_3	16.03	625.00	15.11	21.69	5.4	37.20
P_3V_4	16.27	576.00	13.84	20.02	5.3	35.70
P_3V_5	14.63	522.33	12.91	18.13	4.7	32.10
P_4V_1	13.20	432.33	10.81	15.29	5.0	34.20
P_4V_2	14.47	510.66	12.63	17.71	5.1	35.20

P_4V_3	15.33	594.00	14.41	20.58	5.5	37.57
P_4V_4	16.30	591.00	14.62	20.54	5.4	36.10
P_4V_5	14.17	494.00	12.26	17.21	4.9	32.90
P_5V_1	13.10	416.00	10.34	14.45	5.1	34.57
P_5V_2	15.03	542.33	13.46	18.76	5.2	35.70
P_5V_3	15.79	610.00	14.92	21.23	5.7	38.53
P_5V_4	15.00	562.00	13.91	19.58	5.4	36.80
P_5V_5	13.83	476.00	11.81	16.57	4.9	33.50
SEm(±)	0.82	12.92	0.34	0.74	0.24	1.82
CD(P=0.05)	NS	36.86	0.97	2.11	NS	NS

Table 3: Economics of rainy season cauliflower cultivation

Treatments	*Curd yield(t/ ha)*	*Curd price(₹/ kg)*	*Gross income (₹/ha)*	*Variable cost(₹)*	*Fixed cost(₹)*	*Cost of cultivation (₹/ha)*	*Net income(₹/ha)*	*B:C ratio*
P_1V_1	16.23	30.00	486990	5000	104000	109000	377990	3.47
P_1V_2	15.38	30.00	461400	7000	104000	111000	350400	3.16
P_1V_3	15.08	25.00	377000	10000	104000	114000	263000	2.31
P_1V_4	14.6	30.00	438000	7000	104000	111000	327000	2.95
P_1V_5	17.21	25.00	430250	12000	104000	116000	314250	2.71
P_2V_1	16.11	25.00	402750	6000	104000	110000	292750	2.66
P_2V_2	16.57	25.00	414250	8000	104000	112000	302250	2.70
P_2V_3	14.11	35.00	493850	12000	104000	116000	377850	3.26
P_2V_4	14.23	30.00	426900	13000	104000	117000	309900	2.65
P_2V_5	19.03	25.00	475750	10000	104000	114000	361750	3.17
P_3V_1	15.06	25.00	376500	7000	104000	111000	265500	2.39
P_3V_2	16.62	30.00	498600	9000	104000	113000	385600	3.41
P_3V_3	21.69	30.00	650700	12000	104000	116000	534700	4.61
P_3V_4	20.02	25.00	500500	14000	104000	118000	382500	3.24
P_3V_5	18.13	25.00	453250	13000	104000	117000	336250	2.87
P_4V_1	15.29	25.00	382325	6000	104000	110000	272325	2.48
P_4V_2	17.71	25.00	442750	8000	104000	112000	330750	2.95
P_4V_3	20.58	25.00	514500	11000	104000	115000	399500	3.47
P_4V_4	20.54	30.00	616200	17000	104000	121000	495200	4.09
P_4V_5	17.21	25.00	430250	12000	104000	116000	314250	2.71
P_5V_1	14.45	30.00	433500	4000	104000	108000	325500	3.01
P_5V_2	18.76	30.00	562800	6000	104000	110000	452800	4.12
P_5V_3	21.23	25.00	530750	8000	104000	112000	418750	3.74
P_5V_4	19.58	30.00	587400	13000	104000	117000	470400	4.02
P_5V_5	16.57	25.00	414250	11000	104000	115000	299250	2.60

early growth stage, which resulted in more vegetative growth for a longer duration. These results are closely in line with the earlier findings of Srivastava et al. (2011). The August 30th planting of the variety BN - 50 (P_4V_4) recorded the maximum curd diameter (16.30 cm), which was statically at par with BN 50 planted on 15th August (P_3V_4)

(16.27 cm). The 15th August planting of Hybrid Cauliflower No.140 (P_3V_3) recorded the maximum curd weight (625.00 g) and subsequently highest curd yield (15.11 kg/plot and 21.69 t/ha), which was 35% more curd yield respectively as compared to 30th July transplanting. The interaction effect on the quality attributes of cauliflower in different planting dates and varieties was found to be statistically non-significant. However, the maximum ascorbic acid content (38.53 mg/100 gm fresh curd weight) as well as the highest total soluble solids content (5.7° Brix**)** was recorded for 15th September planting of Hybrid Cauliflower No. 140 (P_5V_3).

Economics of Production

The economics of cauliflower production (Table 3) revealed that the gross return and net return of cauliflower production were influenced to a great extent by the combination of different planting dates and varieties. The data revealed that the maximum gross income (₹ 650700.00) and maximum net return (₹ 534700.00) were found for 15th August 2022 planting of the variety Hybrid Cauliflower No.140 (P_3V_3). The same treatment combination was also recorded with the highest benefit-cost ratio of 4.61. The second highest benefit: cost ratio (4.12) was recorded by the treatment combination comprising of the 15th September planting of Pan 1008 variety (P_5V_2). The highest net return for the 15th August planting may be due to the coinciding of harvesting time and the festival season when the demand for fresh curd remains very high.

Conclusion

Selection of proper variety and suitable planting dates are very important for better remuneration from rainy season cauliflower cultivation. Seedling planting on 15th August was found most suitable considering the curd yield, quality and higher price due to the coinciding of harvesting of curd and festival season, where supply is less and price remains very high and farmers can expect maximum return from rainy season cauliflower cultivation. Again Hybrid Cauliflower No.140 variety emerged as best and provided stable curd yield for a wide range of planting time under the foothills of the eastern Himalayan region.

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सारांश

फूलगोभी भारत में सबसे व्यापक रूप से उगाई जाने वाली गोभी वर्ग की फसल है और प्रायः बरसात के मौसम में इसकी खेती से अधिक लाभ मिलता है। वर्तमान शोध अध्ययन का उद्देश्य वर्षाकालीन फूलगोभी की रोपाई के लिए सबसे उपयुक्त समय का पता लगाना और पूर्वी हिमालय क्षेत्र की तलहटी में सबसे अच्छा प्रदर्शन करने वाली किस्म/किस्मों की पहचान करना था। प्रयोग को तीन प्रतिकृतियों के साथ दो-कारक फैक्टोरियल आर.बी.डी. में रखा गया था, जहां पहले कारक में रोपण की पांच तारीखें (15 जुलाई, 30 जुलाई, 15 अगस्त, 30 अगस्त और 15 सितंबर) शामिल थीं और दूसरे कारक में पांच अलग-अलग किस्में (ग्रीष्मकालीन) शामिल थीं, (ब्यूटी, पैन 1008, हाइब्रिड फूलगोभी नं.140, बीएन 50 और डॉन-175)। शोध कार्य का क्षेत्रीय प्रयोग जुलाई से नवंबर, 2022 के दौरान यू.बी.के.वी, पुंडीबारी, कूच बिहार, पश्चिम बंगाल में आयोजित किया गया था। निष्कर्षों से पता चला कि 15 अगस्त की रोपाई में अधिकतम कर्ड भार(530.93 ग्राम) का उत्पादन हुआ, जबकि हाइब्रिड फूलगोभी नंबर 140 किस्म में सबसे अधिक कर्ड भार(533.93 ग्राम)और उसके बाद अधिकतम फूलगोभी कर्ड उपज (18.53 टन/हेक्टेयर) दर्ज की गई। बरसात के मौसम में कर्ड की अधिक उपज प्राप्त करने के लिए (हाइब्रिड फूलगोभी नंबर 140) किस्म की रोपाई 15 अगस्त को की जानी चाहिए ताकि किसान बरसात के मौसम की फूलगोभी फसल से बेहतर आय प्राप्त कर सकें और सर्दियां के सुरुआती बाजार में अच्छी पकड़ बना सकें।