



ISSN: 2308-1597 (Print) 3105-4080 (Online)

Journal of the Sylhet Agricultural University

Journal home page: <http://www.jsau.sau.ac.bd>

Research Article

AGRO-ECONOMIC PERFORMANCE OF CAULIFLOWER AND CABBAGE VARIETIES UNDER DIFFERENT PLANTING DATES AT DEKAR HAOR OF BANGLADESH

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Article info

Article history

Received : 12.01.2025

Accepted : 10.06.2025

Published : 30.06.2025

Keywords

Cauliflower, Cabbage, Haor, Planting dates, varieties

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Abstract

Cauliflower (*Brassica oleracea* var. *botrytis* L.) and cabbage (*Brassica oleracea* var. *capitata* L.) are important winter vegetable crops cultivated in Bangladesh. Planting date is crucial for successful production, but the farmers of the *haor* areas generally cultivate cauliflower and cabbage not maintaining proper planting dates. The study aimed to search the suitable varieties and planting dates of cauliflower and cabbage. Two individual experiments were conducted in Naogaon village at Dekar *haor* in Sunamganj district from October 2018 to February 2019. Three planting dates- 5 November, 15 November and 25 November were selected for both the experiments. In experiment one, two hybrid cauliflower varieties- Shira Giko, White Mountain and one OP variety Queen were selected. Atlas 70 and Queen F1 were included in experiment two. The experiments followed two factors randomized complete block design (RCBD) with three farmers' replications. Data were collected on curd diameter, curd yield, gross and marketable yield for cauliflower. The cabbage head diameter, head yield, gross and marketable yield data were also recorded. Economic performance was calculated for the cost of production, gross return, net return and BCR for both the crops. The result showed that the curd diameter (37.56 cm), curd yield (16.36 t ha⁻¹), marketable yield (25.83 t ha⁻¹), gross yield (50.48 t ha⁻¹), and BCR (4.55) were highest on 15th November in the case of cauliflower. Again, head diameter (56.6 cm), head yield (49.17 t ha⁻¹), marketable yield (61.31 t ha⁻¹), gross yield (75.91 t ha⁻¹), and BCR (6.28) were highest on 5th November for cabbage. Cauliflower variety, Shira Giko and cabbage variety, Atlas 70, were the high-yielding varieties compared to others. Mid- November and early November planting were suitable for cauliflower and cabbage cultivation, respectively in the *haor* areas.

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Introduction

Cauliflower and cabbage are the two popular cole crops belonging to the family *Brassicaceae* in Bangladesh and do not tolerate extreme cold or excessive heat (Sani *et al.*, 2018). Due to their delicious taste, rich nutritive value, and high fibre with calcium content, the demand for these vegetable crops occupies a large growing market (Nikzad *et al.*, 2020; Hoq *et al.*, 2014). During the 2022–2023 robi season, cauliflower was cultivated on 22,853.01 ha, yielding a noteworthy 343758.71 metric tons, while cabbage was grown on 21,645.19 ha, yielding 422322.60 metric tons (BBS, 2023). Therefore, 23.58% of the overall winter vegetable production comes from the cultivation of cauliflower and cabbage (Imran, 2021). These crops are sensitive to temperature and light for growth and development, the planting times should be followed properly for successful crop production. Cauliflower, primarily a cool-weather crop,

Cite This Article

Kashem MA, Salwa M and Khan MI. 2025. Agro-economic Performance of Cauliflower and Cabbage Varieties Under Different Planting Dates at Dekar Haor of Bangladesh. J. Sylhet Agril. Univ. 12(1): 84-93, 2025. <https://doi.org/10.3329/jsau.v12i1.85900>

is unable to grow curd at high temperatures and shows tolerance to cold (Din *et al.*, 2007). The selection of suitable varieties and maintaining proper planting times are the key issues for vegetable cultivation (Refai and Hassan, 2019). Planting time is an important factor that significantly influences the proper plant growth (Kumari *et al.*, 2019). Generally, the growing practices of cauliflower and cabbage are followed without maintaining the planting dates in *haor* areas of Sylhet. Therefore, the cumulative yield is lower in the *haor* area. Additionally, the selection of suitable variety of cauliflower and cabbage is another important criteria for successful production. Several researches were conducted to find the adapted varieties of cauliflower and cabbage in the *haor* areas of Sylhet (Hossaina *et al.*, 2020; Salwa and Kashem, 2018; Abed *et al.*, 2015). There exist a great scope to enhance productivity of cauliflower and cabbage through proper planting times. To optimize cauliflower and cabbage production, it is crucial to understand the actual planting dates in the *haor* ecosystem for better growth, development and yield of those two crops. But such studies are very limited so far reviewed. Therefore, the study aimed to see the suitable planting dates and variety for both cauliflower and cabbage to achieve higher yield.

Materials and Methods

Experimental location: The experiments were conducted at Dekar *haor* in Naogaon village areas of South Sunamganj upazila in Sunamganj district from October 2018 to February 2019.

Treatment

Cauliflower

Factor A: Three planting dates - 5 November, 15 November and 25 November

Factor B: Three varieties- Shira Giko (Hybrid), White Mountain (Hybrid), and Queen (OP variety)

The total treatment combination: 9

Cabbage

Factor A: Three planting dates - 5 November, 15 November and 25 November

Factor B: Two variety- Atlas 70 (OP variety) and Queen F1 (Hybrid)

The total treatment combination: 6

Experimental design: Two-factor randomized complete block design (RCBD).

Replication: Three farmers' dispersed replications for each date.

Experimental setup

Cauliflower

The plot size was 5 m × 4 m for cauliflower. After land preparation, the fertilizers were applied at the rate of 391, 388, 391, 12.8, 18.6 kg ha⁻¹ as urea, TSP, MoP, ZnSO₄ and borax (FRG, 2018), respectively. The whole amount of TSP, MoP, ZnSO₄ and borax was applied as basal dose. Urea was applied in the field in three equal splits at 15, 30 and 50 days after planting. Thirty-day-old seedlings were transplanted with three varieties of cauliflower following the dates of planting as assigned in the experiment. The crop was planted following 50 cm × 50 cm spacing for each varieties. Intercultural operations were done as necessary. Harvesting was done at maturity during January 2019. Data were recorded on curd diameter, curd yield, gross yield and marketable yield.

Cabbage

The two varieties- Atlas 70 and Queen F1 were planted in each farmers' field. After plot preparation, the fertilizers were applied at rate of 240, 388, 100, 12.8, 4.5 and 1.5 kg ha⁻¹ as urea, TSP, MoP, gypsum, ZnSO₄ and borax (FRG, 2018), respectively. Urea application was done in three equal splits. Thirty-day-old seedlings were transplanted with two varieties of cabbage following the dates of planting. Intercultural operations were done as when needed properly during the experimentation. During February'2019, the crop was matured and harvesting was done. Data were collected on head diameter and yield, gross yield as well as marketable yield.

Economic analysis

The cost of production was calculated from the prices of inputs at the local price. Gross return was calculated from total income. Net return was measured from gross return by subtracted cost of production. Benefit cost ratio (BCR) was calculated from the gross return divided by the cost of production.

Statistical analysis

The data were analyzed for ANOVA, and mean separation was done by Duncan's Multiple Range Test as guidelines by Gomez and Gomez (1984).

Results and Discussion

Cauliflower

Curd diameter

The effect of planting dates on curd diameter was significant. The largest diameter (37.56 cm) was found on 15th November planting, whereas the smallest curd diameter (32.44 cm) was found on 25th November (Table 1). The significant difference was found in the curd diameters of cauliflower varieties. The hybrid variety Shira Giko produced the largest curd (37.44 cm), followed by Queen (37.11 cm). The smallest curd (32.22 cm) was produced by the White Mountain. The interaction of planting dates with varieties of cauliflower also showed significant variation in curd diameter, ranging from 32 to 40.44 cm. The curd diameter of cauliflower produced from mid-November planting was influenced by exposure to low temperatures, along with sufficient moisture that facilitated curd development. This outcome was supported by the results of Sultana *et al.* (2019). Similarly, the largest curd diameter was observed on 15th November plantation of cauliflower as observed by Rahman *et al.* (2016).

Curd yield

The curd yield of cauliflower was varied with the planting dates. The highest curd yield (16.36 t ha⁻¹) and the lowest curd yield (10.8 t ha⁻¹) were recorded on 15th November and 25th November, respectively (Table 1). The curd yield of cauliflower also differed with different varieties. The highest curd yield (15.09 t ha⁻¹) was found in the Shira Giko variety and the lowest yield (11.88 t ha⁻¹) in the White Mountain variety of cauliflower. Curd production was appreciable in the case of Shira Giko. The reasons may lie in the environmental conditions in the *haor* area. The interaction of planting dates with three varieties showed a significant difference in curd yield, ranging from 9.32 to 19.08 t ha⁻¹. Mid-November planting provides the optimum conditions for the vegetative growth phases of cauliflower plants, which include adequate moisture and low temperatures. Early planting was hindered by excessive moisture, but late planting was adversely impacted by elevated temperatures. Ara *et al.* (2009) indicated that temperature significantly influences all vegetative growth metrics, including marketable curd weight and per hectare yield for cauliflower.

Table 1. Effect of planting times, different varieties and their interactions on the yield of cauliflower in Dekar haor in Sunamganj district

Treatment	Curd diameter (cm)	Curd yield (t ha ⁻¹)	Marketable yield (t ha ⁻¹)	Gross yield (t ha ⁻¹)
Planting dates				
5 th Nov (P ₁)	36.78a	15.57a	22.06b	37.69b
15 th Nov (P ₂)	37.56a	16.36a	25.83a	50.48a
25 th Nov (P ₃)	32.44b	10.8b	16.42c	28.56c
LS	**	**	**	**
Varieties				
Shira Giko (V ₁)	37.44a	15.09a	24.84a	44.90a
White Mountain (V ₂)	32.22b	11.88b	17.79b	31.70b
Queen (V ₃)	37.11a	14.96a	21.88a	40.13a
LS	**	**	**	**
Planting dates × Varieties				
P ₁ V ₁	40.44a	18.43a	27.77a	49.56a
P ₁ V ₂	34bc	14.97b	19.51b	33.03b
P ₁ V ₃	36b	13.31bc	18.91b	30.48b
P ₂ V ₁	40a	19.91a	30.09a	57.08a
P ₂ V ₂	33cd	10.09cd	19.36b	36.93b
P ₂ V ₃	39.67a	19.08a	28.03a	57.41a
P ₃ V ₁	32cd	9.32d	16.67b	28.05b
P ₃ V ₂	29.67d	10.59cd	14.51b	25.15b
P ₃ V ₃	35.67a	12.49bcd	18.09b	32.49b
LS	*	**	*	*
CV%	5.3	14.02	14.8	17.63

‘*’ indicates significant at 5%, ‘***’ indicates significant at 1%, LS for level of significance and CV % for co-efficient of variation

Marketable yield

The marketable yield of cauliflower varied significantly with different planting dates of cauliflower, whereas the highest yield (25.83 t ha⁻¹) and lowest yield (16.42 t ha⁻¹) were recorded on the 15th and 25th of November, respectively. The varieties of cauliflower also significantly affected the marketable yield (Table 1). The interactions of varieties with planting dates showed statistical variation in the case of the marketable yield. The highest marketable yield (30.09 t ha⁻¹) was obtained from P₂V₁, followed by the yield found in P₂V₃. This result was supported by Rahman *et al.* (2016). The mid-November planting caused the highest marketable yield than other planting dates because of favourable temperature and light for curd formation.

Gross yield

The different planting dates showed significant effect on the gross yield of cauliflower, whereas the highest gross yield (50.48 t ha⁻¹) was estimated followed by the gross yield found on 5th November (Table 1). The gross yield of cauliflower showed statistical differences in the case of three varieties of cauliflower in the haor areas. The highest yield (44.90 t ha⁻¹) was recorded in Shira Giko, and the lowest yield (31.70 t ha⁻¹) was

found in White Mountain. Within the same growing conditions, there exists variation among all genotypes. These results from the different characteristics of genotypes regulated by several genes, significantly affected by several environmental-related factors and management approaches (Khanal *et al.*, 2022). Statistical variations in gross yield were recorded in the case of the interactions of varieties with the planting dates ranging from 25.25 to 57.08 t ha⁻¹. The present findings are similar to the outcomes of Sultana *et al.* (2019). As the curd formation was dependent on the light intensity and duration of the temperature, similarly, the gross yield was also affected.

Cost and returns

The cost of production ranged from Tk. 221902 to 222902 ha⁻¹, and the gross return varied from Tk. 991200 to 1148200 ha⁻¹. In term of planting dates, the BCR ranged from 2.57 to 4.55. The varieties of cauliflower showed the highest BCR (4.04) in Shira Giko (Table 2). The similar results correlate with the findings of Salwa and Kashem (2019). The BCR found through interaction of planting dates and varieties ranged from 2.26-5.23.

Table 2. Agro-economic performance of cauliflower in the Noagaon village at Dekar haor of Sumangraj district

Treatment	Cost of production (Tk. ha ⁻¹)	Gross return (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
Planting Dates				
5th Nov (P ₁)	221802	753800	531998	3.39
15th Nov (P ₂)	221802	1009600	787798	4.55
25th Nov (P ₃)	221802	571200	349398	2.57
Varieties				
Shira Giko (V ₁)	222002	898000	675998	4.04
White mountain (V ₂)	224002	634000	409998	2.83
Queen (V ₃)	217002	802600	585598	3.69
Planting dates × Varieties				
P ₁ V ₁	221902	991200	769298	4.46
P ₁ V ₂	222902	561000	338098	2.51
P ₁ V ₃	219402	1141600	922198	5.20
P ₂ V ₁	221902	609600	387698	2.75
P ₂ V ₂	222902	649800	426898	3.92
P ₂ V ₃	219402	1148200	928798	5.23
P ₃ V ₁	221902	660600	438698	2.97
P ₃ V ₂	222902	503000	280098	2.26
P ₃ V ₃	219402	738600	519198	3.37

Note: Local price Tk 20 kg⁻¹

Cabbage**Head diameter**

The planting dates significantly affected the head diameter of cabbage. The largest head diameter (56.6 cm) was recorded on 5th November, followed by 48.4 cm head diameter on 15th November (Table 3). The two varieties of cabbage showed statistically similar results in the head diameter of cabbage. Regarding the interaction of planting dates with cabbage varieties, no variation was found in the head diameter. It might be suggested that planting on 5th November planting was considered to have suitable climatic conditions for cabbage vegetative growth. The head diameter, the head thickness and the head dry matter plant⁻¹ showed significant differences recorded on November planting (Ullah *et al.*, 2013).

Head yield

The planting dates significantly affected the head weight of cabbage, whereas the highest head yield (49.17 t ha⁻¹) was recorded on 5th November, and the lowest (28.77 t ha⁻¹) was found on 25th November (Table 3). The head yield of cabbage was statistically similar in the two varieties. The significant variation was observed in head yield due to the interaction of cabbage varieties with the different planting dates and it ranged from 22.37 to 49.84 t ha⁻¹. High temperatures and excessive moisture content lowered the yield for both very early and late planting of cabbage. These outcomes are supported by the findings of Abed *et al.* (2015), who experimented that the early planting date is more favourable for cabbage cultivation and enhances head yield relative to later planting dates. Previous studies indicated that earlier planting dates resulted in higher total and marketable yields compared to later planting dates. (Thirupal *et al.*, 2014; Tendaj and Sawicki, 2012).

Table 3. Effect of planting times, varieties and their interactions on the yield of cabbage in the Noagaon village at Dekar *haor* in Sunamganj district

Treatment	Head diameter (cm)	Head weight (t ha ⁻¹)	Marketable yield (t ha ⁻¹)	Gross yield (t ha ⁻¹)
Planting dates				
5 th Nov (P ₁)	56.6a	49.17a	61.31a	75.91a
15 th Nov (P ₂)	48.4b	33.15b	52.31ab	64.23ab
25 th Nov (P ₃)	23c	28.77b	41.25b	60.05b
LS	**	**	**	*
Varieties				
Atlas 70 (V ₁)	42.25	38.39	52.71	69.93
Queen F1 (V ₂)	43.08	35.68	50.54	63.52
LS	NS	NS	NS	NS
Planting dates × Varieties				
P ₁ V ₁	58.2	49.84a	68.61a	83.13a
P ₁ V ₂	47.43	48.51a	54abc	68.68a
P ₂ V ₁	55	30.15bc	41.56cd	50.41b
P ₂ V ₂	24.33	36.16b	62.67ab	75.05a
P ₃ V ₁	49.37	35.17b	47.56bcd	76.25a
P ₃ V ₂	21.67	22.37c	34.94d	43.84b
LS	NS	*	*	**
CV (%)	7.44	12.07	17.27	14.01

‘**’ indicates significant at 5%, ‘***’ indicates significant at 1%, LS for level of significance and CV % for co-efficient of variation

Marketable yield

The planting dates were responsible for affecting the marketable yield. The highest yield (61.31 t ha⁻¹) was found on 5th November, followed by the yield (52.31 t ha⁻¹) recorded on 25th November (Table 3). The two varieties of cabbage showed statistically similar marketable yield of cabbage. The interaction of planting dates and cabbage varieties also affected the marketable yield. The highest yield (68.61 t ha⁻¹) was found in P₁V₁ and the lowest yield (34.94 t ha⁻¹) was recorded in P₃V₂. The findings confirm those obtained from the earlier research (Singh *et al.*, 2010; Khan *et al.*, 2015).

Gross yield

The planting dates significantly affected the gross yield of cabbage (Table 3). The highest gross yield (75.91 t ha⁻¹) was observed on 5th November, and the lowest (60.05 t ha⁻¹) was found on 25th November. The gross yield of cabbage was statistically similar solution the two varieties of cabbage. However, the interaction of planting dates with varieties showed significant variation. The earlier planting is likely to be favourable for cabbage head development and enhances the growth as well as yield in comparison to later planting dates. The finding correlates with the outcomes of Abed *et al.* (2015).

Cost and returns

The cost of production ranged from Tk. 180514 -181639 ha⁻¹, and the gross return varied from Tk. 657600 - 1138650 ha⁻¹. The highest BCR for planting dates and varieties were gained from 5th November and Atlas 70, respectively (Table 4). In the case of interactions of planting and varieties, the BCR ranged from 3.62 to 6.86.

Table 4. Agro-economic performance of cabbage in the Noagaon village at Dekar haor of Sumangnaj district

Cabbage	Cost of production (Tk. ha ⁻¹)	Gross return (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	BCR
Planting dates				
5th Nov (P ₁)	181264	1138650	957386	6.28
15th Nov (P ₂)	181264	963450	782186	5.32
25th Nov (P ₃)	181264	900750	719486	4.97
Varieties				
Atlas 70 (V ₁)	182014	1048950	866936	5.76
Queen F1(V ₂)	180514	952800	772286	5.28
Planting dates × Varieties				
P ₁ V ₁	181639	1246950	1065311	6.86
P ₁ V ₂	180889	756150	575261	4.16
P ₂ V ₁	181639	1143750	962111	6.29
P ₂ V ₂	180889	1030200	849311	5.67
P ₃ V ₁	181639	1125750	944111	6.19
P ₃ V ₂	180889	657600	476711	3.62

Note: Local price Tk 15 kg⁻¹

Conclusion

The highest yield of cauliflower and cabbage at Dekar *haor* might be obtained when these crops are transplanted in mid-November and early-November, respectively. Shira Giko variety of cauliflower and Atlas 70 variety of cabbage are suggested to be cultivated in similar agro-ecosystems. Economic returns were also found to be the highest for both cauliflower and cabbage varieties with above mentioned varieties.

Conflict of interest

The authors declare that there are no conflicts of interest related to this research.

Acknowledgement

The authors acknowledged the Krishi Gobeshona Foundation (KGF) for financial support under the project “Farm Productivity Improvement in *Haor* Areas through Integrated Farming Systems Approach”.

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