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IMPACT OF DIFFERENT PLANT SPACINGS AND VARIETIES ON AGRONOMIC PERFORMANCE OF CABBAGE (*BRASSICA OLERACEA VAR. CAPITATA*)

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ABSTRACT

A field study on cabbage was conducted with three different plant spacings: 45 × 60 cm, 45 × 45 cm, and 45 × 30 cm. It included three varieties of cabbage: Golden Acre, Pusa Mukta, and Pusa Drum Head, during October 2023 to February 2024 at Horticulture Research Farm-1, Department of Horticulture, School of Agricultural Sciences and Technology at Babasaheb Bhimrao Ambedkar University, Lucknow. The results showed that maximum vegetative growth was observed in the variety Golden Acre at a spacing of 45 × 60 cm, while notable improvements in yield and yield-attributing parameters were recorded in Golden Acre at 45 × 45 cm spacing. Superior head quality was achieved in the variety Pusa Drum Head with a spacing of 45 × 60 cm.
Keyword **:** Cabbage, Spacing, Varieties, Pusa Mukta, Pusa Drum Head, Golden Acre.

Introduction

Cabbage (*Brassica oleracea V. capitata)* is one of the important vegetable crops in India. It has a chromosome number 2n=2x=18 and is a member of the Cruciferae family. Cabbage is considered one of the top five vegetables in the world (Rashid, 1999). In Bangladesh, it is cultivated as a major winter leafy crop. It was introduced in India from Portugal in 15th century (Singh *et al.* 2005), and it has become a key leafy crop used for salads and cooking. The distinctive flavour of cabbage is attributed to the presence of *sinigrin* glucoside, and it is packed with minerals and vitamins A, B1, B2, and C (Singh *et al.* 2004). Cabbage has an anti-cancer property, it protects against bowel cancer due to the presence of indole-3-carbinol (Thamburaj and Singh, 2013). India ranks second globally in cabbage production after China, with cultivation spanning approximately 397 thousand hectares and yielding about 9.27 million metric tonnes at an average productivity of 19.8 t/ha (Anonymous, 2024-25). The principal cabbage-growing states are Uttar Pradesh, Karnataka, Bihar, West Bengal, Odisha, Gujarat, Punjab, Himachal Pradesh, Haryana, and Rajasthan. Among these, Uttar Pradesh records the largest area (≈401 thousand ha), the highest production (≈9.27 million tonnes), and superior productivity (23.1 t/ha) (Anonymous 2024-25). Growth, yield and quality of crop plants are mainly influenced by two major factors, viz. varieties and spacing. Varieties play a crucial role in the growth and development of crops, and optimum plant spacing also plays a crucial role in influencing crop growth parameters (Thapa *et al.*, 2012). Hence, the present study was undertaken to promote high-value cabbage by evaluating and standardising suitable varieties and spacing levels to achieve improved growth performance of sprouting broccoli under Lucknow conditions.

Material and Methods

The experiment consisted of three varieties, viz. V_1 = Golden Acre, V_2 = Pusa Mukta, and V_3 = Pusa Drum Head, along with three different plant spacings: S_1 = 45 × 60 cm, S_2 = 45 × 45 cm, and S_3 = 45 × 30 cm. These treatments were evaluated using a Factorial Randomized Block Design with three replications

during the rabi season of 2023-24. The experimental crop was sown on November 2, 2023, and transplanting was completed after 25 days. To ensure proper establishment, missing hills were replaced through gap-filling five days after transplanting. Fertiliser was applied at the recommended doses of 180:120:100 kg ha^{-1} NPK using urea, diammonium phosphate, and muriate of potash. The crop was raised following the Package of Practices of Horticulture Research Farm-1, Department of Horticulture, School of Agricultural Sciences and Technology at Babasaheb Bhimrao Ambedkar University, Lucknow. The experimental site is located at 26 ° 46' North latitude, 80 ° 55' East longitude, at an altitude of 125 meters above mean sea level (MSL). Observations were recorded from five plants randomly selected in each plot, focusing on growth parameters such as plant height (cm), plant spread (cm^2), leaf length (cm), leaf width (cm), stem diameter (cm), and days to head maturity (days). Yield parameters, including days to 50% head initiation, plant weight (g), head weight (g), head breadth (cm), head length (cm), and yield (q/ha), were also recorded. Additionally, quality parameters such as dry matter (%), TSS (°Brix), and head volume (cc) were measured. Total soluble solids (°Brix) were determined using a hand refractometer. Vegetative parameters were recorded at the appropriate stage and subjected to statistical analysis.

Table 1: Physical and Chemical qualities of soil.

Parameter	Soil test Value	Method
Texture Class	Sandy Loam	Triangular method (Sigmoid, 1928)
Available Nitrogen (Kg/ha)	115.50	Rapid titration Method (Walkley and Black, 1934)
Available Phosphorus (Kg/ha)	41.50	Olsen's Method (Olsen *et al.*,1954)
Available Potash (Kg/ha)	180.40	Flame Photometer (Jackson,1973
Organic Matter (%)	0.11	Rapid titration Method (Jackson, 1973)
pH	7.85	Glass electrode, pH meter ((Jackson, 1973)
E.C. (1:1)	0.25	Conductivity Meter (Jackson, 1973)
E.S.P.	14.50	Conductivity Meter (Jackson, 1973)

Results and Discussion

Influence of varieties

Significant variations were observed among the varieties for all the parameters studied (Table 2 & 3). The best performing variety is Golden Acre, which is found superior for all the growth parameters, i.e., plant height (15.21 cm), number of leaves (7.07), plant spread (N-S) (12.98 cm), plant spread (E-W) (12.44 cm), length of leaves (13.05), width of leaves (6.48 cm), and stem diameter (3.80 cm). Similar results were observed by Zaki *et al.* (2015) in broccoli and Tejswani *et al.* (2018) in knol khol. The least performing variety for growth parameters is Pusa Drum Head, i.e., plant height (13.64 cm), number of leaves (6.76), plant canopy spread at N-S (11.44 cm), at E-W (10.90 cm), length of leaves (12.59), width of leaves (6.09 cm), and stem diameter (3.57 cm) at 30 DAT. A similar trend was observed, which continued through later growth stages at 60 and 90 DAT across all three varieties for these parameters. These findings are also supported by Bhangre *et al.* (2011), Srivastava *et al.* (2011).

For yield parameters, the best performing variety is also Golden Acre. The maximum days to 50% head initiation was 52.65 in Golden Acre, followed by Pusa Mukta (52.37), and the least in Pusa Drum Head (51.81). The maximum head diameter was (16.00 cm) in Golden Acre, and the least was in Pusa Drum Head (15.04 cm). The largest core length was 6.10 cm in Golden Acre, and the least was in Pusa Mukta (5.93 cm). The maximum head weight was 1.628 kg in Golden Acre, followed by Pusa Drum Head (1.234 kg), and the least in Pusa Mukta (1.212 kg). The maximum head breadth was (14.75 cm) in Golden Acre, followed by Pusa Drum Head (13.92 cm), and the least in Pusa Mukta (13.39 cm). The largest head length was 15.66 cm in Golden Acre, followed by Pusa Drum Head (14.96 cm), and the least in Pusa Mukta (14.03 cm). The highest yield per plot was 20.87 kg in Golden Acre, followed by Pusa Drum Head (16.99 kg), and the least in Pusa Mukta (16.31 kg). These findings are also supported by Bhanghre *et al.* (2011), Prashad *et al.* (2010), Verma *et al.* (2014), and Thirupal *et al.* (2014) in broccoli.

For quality parameters, the best-performing variety is Pusa Drum Head. The maximum dry matter content was 7.91% in Pusa Drum Head, followed by Pusa Mukta (7.83%), and the lowest in Golden Acre (7.59%). The maximum T.S.S. (7.03 °Brix) was in Pusa Drum Head, followed by Pusa Mukta (6.79 °Brix), and the least in Golden Acre (6.59 °Brix). The maximum volume of head (1808.89) was in Pusa Drum Head, followed by Golden Acre (1578.89), and the

least in Pusa Mukta (1533.33). These findings are supported by Upadhyay *et al.* (2012) and Duarte *et al.* (2019) in cabbage.

Effect of spacing

The data (Tables 2 to 5) showed that yield and quality parameters were significantly affected by spacing. The spacing of 45x60 showed higher plant heights of 15.48 cm, 28.87 cm, and 36.6 cm at 30, 60, and 90 DAT, respectively. The highest No. of leaves found in 45 cm × 60 cm (7.38), followed by 45 cm x 45 cm (6.693), with the least being observed spacing 45 cm × 30 cm (6.50 cm), The highest plant spread (N-S) was shown in 45 cm × 60 cm (13.59 cm) and least being observed for spacing 45 cm×30 cm (11.30 cm), The highest plant spread (E-W) was in 45 cm × 60 cm (13. 09 cm), The maximum length of leaves observed in 45 cm × 60 cm (13.42 cm) and minimum spacing 45 cm ×30 cm (12.18 cm), the maximum width of leaves in 45 cm × 60 cm (7.87 cm) which were, significantly higher than other treatments including minimum in spacing 45 cm×30 cm (5.51 cm), The highest stem diameter in 45 cm ×60 cm (4.07 cm) followed by S_3 (3.65) and least being in spacing 45cm× 30cm (3.65cm) at 30 days, a similar finding is observed by Zaki *et al.* (2015) in broccoli, Verma *et al.* (2023) and Mishra (2022) in cabbage.

The highest days to 50% head initiation was counted in 45 cm × 60 cm (52.40days) which were, non-significantly higher than other treatments including least being observed spacing 45 cm ×30 cm (52.17 cm), The Maximum head diameter in 45 cm × 60 cm (16.04 cm) and minimum in spacing 45 cm×30 cm (15.19 cm), The largest core length was found in 45 cm × 45 cm (6.33 cm) and least in spacing 45 cm×30 cm (5.76 cm), The highest weight of head in 45 cm×60 cm (1.453 kg) followed by S_2 (1.384 kg), and minimum in spacing 45 cm×30 cm (1.237kg), The maximum head breadth observed in 45 cm × 60 cm (14.70 cm) followed by 45 cm x 45 cm (13.91 cm), significantly higher than other treatments including least being observed spacing 45 cm×30 cm (13.45cm), The largest head length in 45 cm × 60 cm (15.56 cm) which were followed by 45 cm x 45 cm (14.93 cm), and smallest in spacing 45 cm ×30cm (14.16 cm), The highest yield per plot was found in 45 cm × 30 cm (18.91 kg) which were followed by 45 cm x 45 cm (18.30 kg), lowest in spacing 45 cm×60 cm(16.95kg), The above finding was also in conformity with earlier workers viz., Rahman *et al.* (2007) and Prasad *et al.* (2009) in Chinese cabbage.

The highest dry matter content in 45 cm ×45 cm (7.82 %), which were followed by 45 cm x 30 cm (7.80 %), non-significantly higher than other treatments, including lowest in spacing 45 cm×60 cm (7.69%), The maximum T.S.S. was observed in 45 cm × 60 cm (7.00 °Brix) which were followed by 45 cm x 45 cm (6.95 °Brix), and minimum observed in spacing 45 cm ×30cm (6.46 °Brix) and The highest volume of head was found in 45 cm × 60 cm (1783.33) which were followed by 45 cm×45 cm (1642.22), least being in spacing 45cm × 30cm (1495.55), A similar result was also find by Radovich *et al.* (2004) and Adeniji *et al.* (2010) in cabbage**.**

Combined effect of plant spacing and variety

Significantly, the maximum plant height (16.17 cm) was observed in the variety Golden Acre with a spacing of 45 cm × 60 cm (6.753 cm) at 30 DAT, and a similar trend was observed at later growth stages, *i.e.* at 60 and 90 DAT, supported by Chaudhari *et al.* (2015). The maximum number of leaves, (7.80), was recorded in the variety Golden Acre with a spacing of 45 cm x 60 cm at 30 DAT, with a similar trend at 60 and 90 days. It was followed by the variety Pusa Mukta with the same spacing. The minimum number of leaves was found in effect of Pusa Drum Head with 45 cm x 30 cm spacing (6.300), a finding also reported by Singh *et al.* (2023) in cabbage. The maximum plant spread (N-S) was observed in the variety Golden Acre with 45 cm x 60 cm spacing (14.34 cm), while the minimum was found in Pusa Drum Head with 45 x 30 cm (11.60 cm), supported by Bassiony *et al.* (2014). The maximum plant spread (E-W) was observed in the same variety and spacing (13.95 cm) at 30 DAT, with a similar trend at 60 and 90 DAT. The minimum spread (E-W) was observed in the interaction of Pusa Drum Head with 45 x 30 cm (11.12 cm), also reported by Prasad *et al.* (2010) and Bhangre *et al.* (2011) in broccoli. The maximum leaf length was recorded in the variety Golden Acre with 45 cm x 60 cm spacing (14.12 cm) at 30 DAT, following the same trend at later stages. The minimum leaf length was found in the Pusa Drum Head with 45x30 cm (13.34 cm). The maximum leaf width was also recorded in Golden Acre with 45 cm x 60 cm (8.55 cm) at 30 DAT, with similar trends at 60 and 90 DAT. The maximum stem diameter was observed in Golden Acre with 45 cm x 60 cm (4.24 cm) at 30 DAT and followed the same pattern at later growth stages. The minimum was in the interaction effect of Pusa Drum Head with 45 x 30 cm (3.32 cm). The maximum days to 50% head initiation was noted in Golden Acre with 45 cm x 60 cm (53.48 days), while the minimum was in the interaction of Pusa Mukta with the same spacing (51.17 days), as reported by Hossain *et al.* (2011) and Galate *et al.* (2014) in cauliflower. The maximum head diameter was

observed in Golden Acre with 45 cm x 60 cm (16.22 cm), and the minimum in the interaction of Pusa Drum Head with 45 cm x 30 cm (13.10 cm). The maximum core length was in Golden Acre with 45 cm x 45 cm (6.50 cm), and the minimum in Pusa Mukta with 45 x 30 cm (5.31 cm), supported by Yadav *et al.* (2023). The maximum head weight was in Golden Acre with 45 cm x 45 cm (1.663 kg), followed closely by Pusa Drum Head with 45 cm x 30 cm (1.660 kg). The minimum head weight was in the interaction of Pusa Mukta with 45 cm x 30 cm (0.857 kg). The maximum head breadth was in Golden Acre with 45 cm x 45 cm (15.49 cm), followed by Pusa Drum Head with 45 cm x 30 cm (14.63 cm). The minimum was in Pusa Mukta with 45 cm x 30 cm (11.14 cm). The maximum head length was in Golden Acre with 45 cm x 45 cm (16.20 cm), and the minimum in Pusa Mukta with 45 cm x 30 cm (11.40 cm). The maximum yield per plot was in Golden Acre with 45 cm x 45 cm (23.47 kg), followed by Golden Acre with 45 cm x 60 cm (20.98 kg); the minimum was in the interaction of Pusa Mukta with 45 cm x 60 cm (13.11 kg). The quality parameters also showed significant variance due to the interaction effects. The maximum dry matter content was in Pusa Drum Head with 45 cm x 60 cm (8.18%), followed by Pusa Mukta with 45 cm x 45 cm (7.96%). The minimum was in Golden Acre with 45 cm x 60 cm (7.32%), supported by Yadav *et al.* (2023). The maximum T.S.S. was in Pusa Drum Head with 45 cm x 60 cm (7.24 °Brix), followed by Pusa Mukta with 45 cm x 45 cm (7.14 °Brix). The minimum T.S.S. was in Golden Acre with 45 cm x 30 cm (6.28 °Brix), as reported by Kumar *et al.* (2021). The maximum head volume was in Pusa Drum Head with 45 cm x 45 cm (1980), followed by Pusa Mukta with 45 cm x 45 cm (1886.67); the minimum was in Golden Acre with 45 cm x 45 cm (1060.00), a result supported by Yadav *et al.* (2023).

Table 2 : Effect of varieties, spacing and their interaction on the growth parameters of cabbage.

Treatment	**Plant height**			**Number of leaves**			**Plant spread N-S(cm)**			**Plant spread E-W(cm)**		
DAT	30	60	90	30	60	90	30	60	90	30	60	90
Varieties (V)												
V_1	15.21	28.37	34.89	7.070	11.99	22.00	12.98	22.82	42.39	12.44	22.53	42.16
V_2	13.91	27.26	33.53	6.757	11.47	21.07	12.42	21.85	40.58	11.86	21.47	40.18
V_3	13.64	27.32	33.60	6.753	11.46	21.05	11.44	21.89	40.56	10.90	21.57	37.15
S. Em ±	**0.15**	**0.21**	**0.22**	**0.55**	**0.109**	**0.187**	**0.122**	**0.196**	**0.42**	**0.12**	**0.177**	**0.40**
CD5%	**0.32**	**0.63**	**0.67**	**0.117**	**0.234**	**0.40**	**0.262**	**0.420**	**0.89**	**0.25**	**0.378**	**0.86**
Plant spacing (S)												
S_1	15.48	29.83	36.69	7.380	12.52	22.93	13.59	23.90	44.25	13.09	23.69	44.34
S_2	13.73	26.90	33.09	6.693	11.372	20.87	11.95	21.65	40.23	11.43	21.18	36.43
S_3	13.55	26.22	32.25	6.507	11.04	20.30	11.30	21.02	39.05	10.68	20.69	38.72
S. Em ±	**0.15**	**0.21**	**0.22**	**0.055**	**0.10**	**0.18**	**0.122**	**0.196**	**0.42**	**0.12**	**0.177**	**0.403**
CD5%	**0.32**	**0.63**	**0.67**	**0.117**	**0.23**	**0.40**	**0.260**	**0.420**	**0.89**	**0.25**	**0.378**	**0.861**
Interactions (V×S)												
V_1S_1	16.17	31.50	38.74	7.800	13.22	24.25	14.34	25.22	46.80	13.95	25.25	47.25
V_1S_2	12.97	25.75	31.67	6.500	11.05	20.26	11.89	20.91	38.82	11.24	20.34	38.08
V_1S_3	12.60	27.86	34.28	6.910	11.72	21.48	12.71	22.34	41.55	12.15	22.00	41.17
V_2S_1	15.70	30.58	37.61	7.590	12.90	23.54	13.94	24.52	45.50	13.33	24.12	45.14
V_2S_2	14.94	25.87	31.82	6.360	10.81	19.90	11.79	20.74	38.55	11.23	20.34	38.07
V_2S_3	15.00	25.34	31.17	6.310	10.70	19.71	11.54	20.30	37.71	11.02	19.95	37.33
V_3S_1	14.58	27.42	33.72	6.750	11.44	21.02	12.49	21.97	40.46	12.00	21.71	40.65
V_3S_2	13.28	29.09	35.79	7.220	12.25	22.47	10.23	23.30	43.34	9.58	22.86	33.14
V_3S_3	13.07	25.46	31.31	6.300	10.70	19.71	11.60	20.42	37.90	11.12	20.69	37.67
S. Em ±	**0.55**	**0.36**	**0.38**	**0.095**	**0.190**	**0.324**	**0.211**	**0.340**	**0.728**	**0.209**	**0.307**	**0.69**
CD5%	**0.18**	**1.10**	**1.17**	**0.203**	**0.405**	**0.693**	**0.450**	**0.727**	**1.55**	**0.448**	**0.655**	**1.49**

Table 3 : Effect of varieties, spacing and their interaction on the growth parameters of cabbage.

Treatment	**Length of leaves**			**Leaf width (cm)**			**Stem diameter**		
DAT	30	60	90	30	60	90	30	60	90
Varieties (V)									
V_1	13.05	18.21	25.36	6.48	15.14	25.36	3.80	6.48	8.05
V_2	12.89	18.43	25.02	6.58	15.32	25.02	3.74	6.20	7.72
V_3	12.59	18.21	24.79	6.09	15.12	24.79	3.57	6.24	7.76

S. Em ±	**0.09**	**0.16**	**0.32**	**0.049**	**0.148**	**0.325**	**0.40**	**0.058**	**0.071**
CD5%	**N/A**	**N/A**	**N/A**	**0.106**	**0.317**	**0,694**	**0.085**	**0.125**	**N/A**
Plant spacing (S)									
S_1	13.42	18.94	26.04	7.87	15.73	26.04	4.07	6.818	8.47
S_2	13.24	17.21	24.63	5.77	14.44	24.63	3.38	6.122	7.62
S_3	12.18	18.70	24.50	5.51	15.41	24.50	3.65	5.993	7.44
S. Em ±	**0.09**	**0.166**	**0.32**	**0.049**	**0.148**	**0.325**	**0.04**	**0.058**	**0.071**
CD5%	**0.197**	**0.35**	**0.56**	**0.106**	**0.317**	**0.694**	**0.085**	**0.125**	**0.151**
Interactions (V×S)									
V_1S_1	14.12	19.94	27.62	8.55	16.59	27.62	4.24	7.18	8.92
V_1S_2	11.80	16.67	24.64	5.01	13.96	24.64	3.59	5.88	7.32
V_1S_3	12.77	18.04	23.83	5.90	14.87	23.83	3.63	6.37	7.92
V_2S_1	13.74	19.40	25.75	7.59	15.90	25.75	4.13	6.98	8.68
V_2S_2	11.80	16.67	24.63	6.80	14.22	24.63	3.31	5.86	7.32
V_2S_3	13.61	19.23	24.70	5.35	15.85	24.70	3.79	5.78	7.17
V_3S_1	12.38	17.49	24.77	7.49	14.71	24.77	3.86	6.29	7.82
V_3S_2	12.96	18.30	24.62	5.52	15.14	24.62	3.53	6.62	8.22
V_3S_3	13.34	18.85	24.50	5.28	15.51	24.99	3.32	5.83	7.24
S. Em ±	**0.16**	**0.287**	**0.56**	**0.085**	**0.257**	**0.56**	**0.069**	**0.101**	**0.122**
CD5%	**0.34**	**0.614**	**1.20**	**0.183**	**0.549**	**0.12**	**0.148**	**0.216**	**0.262**

Table 4 : Effect of varieties, spacing and their interaction yield parameters of cabbage

Treatment	Core length (cm)	Weight of Head (kg)	Head Breadth (cm)	Head Length (cm)	Yield /plot (kg)	Yield (q/ha)
Varieties (V)						
V_1	6.47	1.684	14.75	14.96	20.87	590.11
V_2	5.93	1.212	13.39	14.03	16.99	525.71
V_3	6.10	1.234	13.92	15.66	16.31	535.57
S. Em ±	**0.063**	**0.012**	**0.12**	**0.150**	**0.175**	**5.68**
CD5%	**0.134**	**0.026**	**0.25**	**0.321**	**0.374**	**12.14**
Spacing (S)						
S_1	5.99	1.453	14.70	15.56	16.95	536.70
S_2	6.33	1.384	13.91	14.93	18.30	559.91
S_3	5.76	1.237	13.45	14.16	18.91	554.79
S. Em ±	**0.063**	**0.012**	**0.12**	**0.150**	**0.175**	**5.68**
CD5%	**0.134**	**0.026**	**0.25**	**0.321**	**0.374**	**12.14**
INTERACTION (V× S)						
V_1S_1	6.50	1.573	15.37	15.40	20.98	588.28
V_1S_2	6.03	1.663	15.49	16.20	23.47	706.97
V_1S_3	6.15	1.193	14.59	15.69	18.16	624.99
V_2S_1	6.01	1.227	14.57	15.20	13.11	420.31
V_2S_2	6.47	1.620	14.48	15.50	17.59	433.03
V_2S_3	5.31	0.857	11.14	11.40	20.27	424.06
V_3S_1	6.00	1.560	14.18	16.10	16.76	548.71
V_3S_2	6.47	0.870	11.77	13.10	13.86	643.07
V_3S_3	5.82	1.660	14.63	15.40	18.32	564.80
S. Em ±	**0.063**	**0.021**	**0.209**	**0.260**	**0.303**	9.842
CD5%	**0.134**	**0.046**	**0.446**	**0.557**	**0.648**	**21.043**

Table 5 : Effect of varieties, spacing and their interaction on the quality parameters of cabbage

Treatment	Dry Matter (%)	TSS (°Brix).	Volume of Head (cc)
Varieties (V)			
V_1	7.59	6.59	1578.89
V_2	7.83	6.79	1533.33
V_3	7.91	7.03	1808.89
S. Em ±	**0.056**	**0.075**	**13.51**
CD5%	**0.121**	**0.160**	**28.88**

Spacing (S)			
S_1	7.69	7.00	1783.33
S_2	7.82	6.959	1642.22
S_3	7.80	6.469	1495.55
S. Em ±	**0.056**	**0.075**	**13.511**
CD5%	**N/A**	**0.160**	**28.88**
INTERACTION (V× S)			
V_1S_1	7.32	6.87	1836.67
V_1S_2	7.62	6.64	1060.00
V_1S_3	7.85	6.28	1840.00
V_2S_1	7.58	6.89	1786.66
V_2S_2	7.96	7.14	1886.67
V_2S_3	7.95	6.35	926.670
V_3S_1	8.18	7.24	1726.67
V_3S_2	7.90	7.09	1980.00
V_3S_3	7.66	6.77	1720.00
S. Em ±	**0.098**	**0.130**	**23.402**
CD5%	**0.029**	**N/A**	**50.036**

Conclusion

The results indicate that varietal differences and plant spacing exerted a significant influence on the growth, yield, and quality of cabbage. Maximum vegetative growth was observed in the variety Golden Acre at a spacing of 45 × 60 cm, while notable improvements in yield and yield-attributing parameters were recorded in Golden Acre at 45 × 45 cm spacing. Superior head quality, however, was achieved in the variety Pusa Drum Head with a spacing of 45 × 60 cm.

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