



ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(3): 1174-1178
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www.thepharmajournal.com

Received: 20-12-2021

Accepted: 31-01-2022

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Effect of different varieties and spacings on growth and yield attributes of cabbage (*Brassica oleracea* var. *capitata* L.) under Lucknow conditions

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Abstract

The objective of this study was just how different kinds and spacings of cabbage influenced the economic horticultural attributes of the crop. In the trial, different varieties were taken Pusa Mukta, Golden Acre, and Pusa Drum Head, and three spacing viz 60 x 45 cm, 45 x 45 cm, and 45 x 30 cm were used for the study. The layout of the experimental field was laid down in Factorial Randomized Block Design with three replications. The results revealed that the maximum plant height (36.7cm), number of leaves (20.90), leaf length (32.50 cm), leaf width (19.50 cm), and plant spread (58.50 cm) were noted in variety Pusa Drum Head. The stem girth, days to head initiation, and head harvest were not affected non-significant with varieties. The highest values of the weight of the head (830.3 g) and yield (418.1 q ha-1) were noticed in Pusa Mukta In general, the lowest values of growth and yield attributes were noted under Golden Acre. The maximum plant height (36.70 cm), number of leaves (19.10), leaf length (33.07cm), leaf width (19.83 cm), plant spread (59.53cm), and head weight (990 g) were recorded in spacing 60 x45 cm whereas, the maximum yield (418.11 q ha-1) was recorded in 45 x 30 cm spacing.

Keywords: Cabbage, spacing, varieties, growth, and yield

1. Introduction

Cabbage is an important vegetable, extensively cultivated in India and other countries. In India, it was introduced in the 15th century from Portugal (Singh *et al.*, 2004) [17]. It is one of the prominent leafy vegetable crops used for both salad and cooking. Among the cole crops, cabbage is one of the most important commercial vegetable crops in India. It is widely farmed in India and worldwide due to its excellent nutritional content, production, and adaptability. It is a multipurpose vegetable crop that can tolerate rigorous handling, as well as a long-distance sports group of vegetables that are known as cole crops, including cabbage, kale, Brussels sprouts, cauliflower, broccoli, and kohlrabi. The ancestor of all these crops, the wild cabbage was native to the Mediterranean region from which a vast array of varieties have been evolved eg. *B. oleracea* (var. botrytis and var. capitata) Singh and Sharma, 2001: Kochhar, 2010) [16, 8]. Vegetables are essential ingredients of our daily meal. These are rich in nutrients and essential items of a balanced diet. They are also called protective foods as their regular use can prevent several diseases. Vegetables also enhance the palatability and attractiveness of a diet through their color and flavor (Chakraborty, 2000) [3]. The spacing of crops may be varied according to climatic condition, soil fertility, and cultivar suitability to a specific region. The plant was more vigorous in terms of leaf size when the spacing was broader, which could be owing to less competition for light, nutrients, and moisture as compared to when the spacing was closer (Bairwa *et al.* 2017) [2]. Vegetable crop cultivation requires a high population density, which is widely used for a variety of crops. Closer spacing can help to reduce weeds, enhance soil protection, increase fertilizers efficiency, and increase yields (Neto *et al.* 2016) [11]. Proper spacing is an important factor for securing a higher yield of desirable knobs of knol-khol. Dense planting can produce higher head yield owing to the presence of a greater number of plants per unit area although they produce smaller heads or knobs, irrespective of varieties (Rahman *et al.* 2007, Prasad *et al.* 2010 and Moniruzzaman, 2011) [15, 13, 10].

2. Materials and Methods

2.1 Experimental site, soil, and climate: During the rabi season of 2020-21, the experiment was done at Babasaheb Bhimrao Ambedkar University's Horticulture Research Farm, Vidya-Vihar Rae Bareilly Road, Lucknow (UP). Lucknow is located at 26°50' N latitude, 80°52' E longitude, and is at an elevation of 111 meters above sea level. The soil was a light alluvial with a sandy loam texture and a slightly alkaline pH of 8.2. The topography was consistent. The area experiences rainfall that stretches from April to October with many rainy seasons from June to early September. The area receives average rainfall between 800-1000 mm with annual and maximum temperature ranging from 15 to 30 °C.

2.2 Planting materials and seedbed preparation: Three varieties *viz.* Pusa Mukta, Pusa Drum Head, and Golden Acre and three spacing such as 60 x 45 cm, 45 x 45 cm, 45 x 30 cm were used for the study. Were planted on October 15, 2020. A seedbed of 3x2 meters was plowed thoroughly and stubbles were removed. During the bed preparation, well-decomposed cow dung was added.

2.3 Seed treatment, seed sowing, and seedling growth: On October 15, 2020, seeds were treated with Vitavax 200 WP at 2.5 g kg⁻¹ of seeds and sowed in the seedbed. To keep the soil moist, the dry rice straw was used to cover the bed, and sowing was done in thin lines 5 cm apart at a depth of 2 cm, followed by a thin coating of soil and gentle watering. Watering was continued until germination was complete, and the dry straw cover was removed as soon as seedlings emerged. As needed, weeding and mulching were completed. (Firoj Asadul Haque *et al* 2015) ^[5].

2.4 Treatments and the experiment's design: There were three varieties and three spacings. The varieties of cabbage were: Pusa Mukta, Pusa Drum Head, and Golden Acre. The plant spacings were: 60 x 45cm, 45 x 45cm, and 45 x 30 cm as represented by S1, S2, and S3, respectively. With three replications, the experiment was set up as a Factorial Randomized Block Design. Each plot was 1.8 x 1.8 m in size, with a 50 cm spacing between neighboring plots and 1 m between blocks. (Firoj Asadul Haque *et al* 2015) ^[5].

2.5 Seedling transplantation and intercultural work: Only Seedlings in good health were selected for transplantation. The roots of the seedlings were soaked in a solution of Bavistin @ 2 g L⁻¹ of water before transplantation. The 40-day-old seedlings were transplanted in the evening of November 26, 2020, keeping the spacing consistent with the treatments. For optimum crop growth and development, intercultural activities such as gap filling, weeding, earthing-up, and irrigation were provided. (Firoj Asadul Haque *et al* 2015) ^[5].

2.6 Harvesting, data collection, statistical analyses, and economic analyses: The observation was made on the following growth and yield parameters like Plant height (cm), Number of leaves, Plant Spread, leaf length, leaf width Days to 50% head initiation, Days to 50% head maturity, Stem diameter (cm), Weight of untrimmed head (g), Weight of trimmed head (g), Head breadth (cm), Head length (cm), Yield (kg/plot), and Yield (q/ha) All the parameters were collected from three randomly selected plants of each

treatment. Data were collected from randomly selected 5 plants at 30, 45, 60, days, and at harvest. To avoid the border effect outer two lines and the outer plants of the middle lines were excluded. The height of the plants was measured from the ground level to the tip of the highest leaves. The land area covered by the plant was estimated by putting a meter scale on the canopy and was expressed in centimeters. The length and breadth of the largest leaf were measured from the base of the petiole to the tip. To record the diameter, the cabbage heads were sectioned vertically at the middle position and the horizontal distance from one side to another side of the widest part of the sectioned head was measured. The thickness of the head was measured as the vertical distance from the lower to the uppermost leaves of the head. (M.N.A. Naher *et al.* 2014) ^[9].

Symbol	Treatment code	Details of varieties	Details of treatments combination
T ₁	V ₁ S ₁	Pusa Mukta	60X45, Pusa Mukta
T ₂	V ₁ S ₂	Pusa Mukta	45x45, Pusa Mukta
T ₃	V ₁ S ₃	Pusa Mukta	45x30, Pusa Mukta
T ₄	V ₂ S ₁	Golden Acre	60x45, Golden Acre
T ₅	V ₂ S ₂	Golden Acre	45x45, Golden Acre
T ₆	V ₂ S ₃	Golden Acre	45x30, Golden Acre
T ₇	V ₃ S ₁	Pusa Drum Head	60x45, Pusa D Head
T ₈	V ₃ S ₂	Pusa Drum Head	45x45, Pusa D Head
T ₉	V ₃ S ₃	Pusa Drum Head	45x30, Pusa D Head

3. Result and Discussion

3.1 Growth Parameters

3.1.1 Effect of varieties and spacing on plant growth parameters: Growth attributes of cabbage *viz.*, plant height, number of leaves, plant spread, leaves length, leaves width, Days to 50% head initiation, and days to 50% head maturity of the plant were recorded during the present investigation. There was a significant effect of varieties and plant spacing on all the growth parameters. Whereas the combined effect of varieties and plant spacing was found nonsignificant in the case of plant height, the number of leaves, stem diameter, plant spread, etc. Data regarded plant height as an influence by different varieties and spacing levels which clearly indicated that higher plant height improves significantly by the application of different variety and spacing levels. However, the maximum plant height was recorded in the variety Pusa Drum Head (36.7cm) then Pusa Mukta (20.90cm) at 60 days of transplanting at 45cm×60cm spacing levels. The differential growth behaviors of the three varieties might be due to gene be due to genetically characters, which clearly indicated that Pusa Drum Head showed more plant height might be due to upright growth habits compared to other varieties that have spreading growth habits of varieties of good quality and better spacing levels 45cm×60cm and on the increase of plant height in *Brassica olearacea var capitata. L.* has also been reported by Pressmen E & Shakal (1991), Chaubey *et al.* (2001) ^[4] in cabbage, Patil (2003) ^[12], Rehman, *et al* (2007) ^[15], Agarker *et al.* (2010) ^[11], Giri *et al.* (2013) ^[6], and Chaudhari *et al.* (2015) in knol khol and Tejswani *et al.* (2018) ^[18]. The significant increase in plant spread a number of leaves, leaves length, and leaves width were recorded in variety Pusa Drum Head and spacing 45×60cm, the maximum plant spread (46.73), No of leaves (8.30), and width of leaves (15.57), at 30 days being recorded by the variety Pusa Drum Head at 45cm×60cm. Similar observations their also reported by Khatiwada (2001) ^[7] in

cabbage, Patil *et al.* (2003) [12], in cauliflower, Giri *et al.* (2013) [6], and Zaki *et al.* (2015) in broccoli and Tejswani *et al.* (2018) [18]. There was a significant difference in varieties and spacing on a day to 50% head initiation. Maximum days to 50% head initiation were taken by variety Pusa Mukta and Golden Acre at 45cm×45cm had recorded the earliest head initiation. Similar findings have been reported by Khatiwada (2001) [7] in cabbage, Hossain *et al.* (2011), and Gabhale *et al.* (2014) in cauliflower. Maximum number of days to 50% curd maturity was noted with variety Pusa Mukta at 45×45cm. A minimum number of days to 50% curd maturity was taken in case of variety Pusa Drum Head at 45×30cm which was significantly early as compared to Pusa Mukta at 45×45cm. Similar results have been reported by Thapa and Rai (2012) [19], Singh *et al.* (2014).

3.2 Yield Parameters

3.2.1 Effect of varieties and spacing on plant growth parameters: Yield parameters *viz.*, stem diameter, fresh weight of the plant, head length (cm), head breadth (cm), average head weight (g), Total head yield (q/ha) and showed a significant influence of varieties and spacing levels. b The significant effect on head weight, head breadth, head length, and other yield attributing characters played important role in significant improvement of the cabbage yield higher head

breadth (54.80cm), head length (18.10cm), stem diameter (7.32cm) were significantly improved by the application of variety Pusa Mukta at 45cm×60cm spacing level that ultimately contributing in significant enhancement of cabbage yield. The above finding was also in conformity with earlier workers *viz.*, Sharma *et al.* (2004), Rahman *et al.* (2007) [15], Prasad *et al.* (2009) in Chinese cabbage, Bhangre (2011), Prashad, *et al.* (2010) [13] Verma *et al.* (2014), Yanglem and Tumbare (2014) in cauliflower, Verma and Nawange (2015) [20] in cabbage, and Tejswani *et al.* (2018) [18]. The maximum yield has been achieved in the variety Pusa Mukta (418.93q/ha) at spacing (45cm×45cm) level. Among varieties, Pusa Mukta at 45×45cm recorded maximum total head yield. While the lowest total head yield was obtained with the variety Pusa Drum Head at 45×30cm. These findings are supported by those of Choubey *et al.* (2001) [4], Khatiwada (2001) [7] in cabbage, Srivastava *et al.* (2011) in cauliflower, Arin *et al.* (2003), and Tejswani *et al.* (2018) [18]. The present finding obviously showed that interaction effect between different varieties and spacing levels were found significant on increasing number of leaves per plant that ultimately very important role in photosynthetic activity of cabbage yield, that has a significant impact on the improvement of the dietary compound. A similar observation was also reported by Prasad *et al.* 2010 [13], Bhangre 2011, Tejswani 2018 [18].

Table 1: Effect of varieties on growth, and yield of cabbage.

Variety	Plant height (cm)	No. of leaves	Plant spread (N-S) (cm ²)	Plant spread (E-W) (cm ²)	Leaf length (cm)	Leaf width (cm)	Days to 50% head initiation	Days to 50% head maturity	Stem diameter (cm)	Weight of untrimmed head (kg)	Weight of trimmed head (g)	Head breadth (cm)	Head length (cm)	Yield (kg/plot)	Yield (q/ha)
Pusa Mukta	33.70	16.27	52.87	50.23	29.37	17.60	42.819	116.67	6.96	1.19	0.83	46.90	16.57	13.57	418.93
Golden Acre	31.97	17.00	55.70	53.07	30.90	18.57	40.024	110.59	6.52	1.13	0.80	42.20	16.20	12.91	398.40
Pusa Drum Head	36.07	20.90	58.50	55.63	32.50	19.50	37.599	104.24	5.96	1.08	0.76	40.10	14.53	12.36	381.48
CD (%)	0.692	0.386	1.329	1.162	0.728	0.437	1.263	1.215	0.102	0.025	0.013	0.998	0.360	0.273	8.557
SE (m)	2.075	1.158	3.984	3.485	2.182	1.309	3.819	3.675	0.307	0.075	0.039	2.992	1.080	0.820	25.654

Table 2: Effect of spacing on growth, and yield of cabbage.

Spacing	Plant height (cm)	No. of leaves	Plant spread (N-S) (cm ²)	Plant spread (E-W) (cm ²)	Leaf length (cm)	Leaf width (cm)	Days to 50% head initiation	Days to 50% head maturity	Stem diameter (cm)	Weight of untrimmed head (g)	Weight of trimmed head (g)	Head breadth (cm)	Head length (cm)	Yield (kg/plot)	Yield (q/ha)
60x45	36.70	16.53	59.53	56.57	33.07	19.83	43.57	119.21	6.82	1.40	0.99	50.50	16.83	13.45	415.27
45x45	33.23	18.53	55.33	52.60	30.70	18.43	38.87	108.96	6.42	1.20	0.85	42.87	15.57	13.55	418.11
45x30	31.80	19.10	52.20	49.77	29.00	17.40	37.99	103.33	6.20	0.79	0.56	35.83	14.90	11.84	365.43
CD (%)	0.692	0.386	1.329	1.162	0.728	0.437	1.26	1.21	0.102	0.02	0.013	0.99	0.360	0.27	8.55
SE (m)	2.075	1.158	3.984	3.485	2.182	1.309	3.819	3.675	0.307	0.07	0.039	2.99	1.080	0.82	25.65

Table 3: Interaction effect of spacing and different cultivars on growth, and yield of cabbage.

Variety x Spacing	Plant height (cm)	No. of leaves	Plant spread (N-S) (cm ²)	Plant spread (E-W) (cm ²)	Leaf length (cm)	Leaf width (cm)	Days to 50% head initiation	Days to 50% head maturity	Stem diameter (cm)	Weight of untrimmed head (g)	Weight of trimmed head (g)	Head breadth (cm)	Head length (cm)	Yield (kg/plot)	Yield (q/ha)
60X45, Pusa Mukta	36.2	14.6	49.5	47.0	27.5	16.5	46.21	129.36	7.32	1.46	1.02	54.80	18.10	14.40	444.44
45x45, Pusa Mukta	33.5	16.2	52.6	50.0	29.2	17.5	41.15	113.40	6.90	1.25	0.88	46.50	16.10	14.08	434.57
45x30, Pusa Mukta	31.4	18.0	56.5	53.7	31.4	18.8	41.09	107.24	6.66	0.85	0.60	39.40	15.50	12.24	377.78
60x45, Golde	34.4	15.8	52.2	50.0	29.0	17.4	43.61	121.82	6.78	1.40	0.99	49.80	17.00	13.24	408.77

n Acre																
45x45, Golden Acre	31.2	18.4	55.5	52.8	30.7	18.5	38.51	107.33	6.48	1.20	0.85	41.90	16.20	13.60	419.75	
45x30, Golden Acre	30.3	16.8	59.4	56.4	33.0	19.8	37.94	102.64	6.30	0.78	0.55	34.90	15.40	11.88	366.67	
60x45,Pusa D Head	33.7	22.5	62.7	59.6	34.8	20.9	40.90	106.45	6.36	1.35	0.95	46.90	15.40	12.72	352.59	
45x45, Pusa D Head	35.0	21.0	57.9	55.0	32.2	19.3	36.95	106.16	5.88	1.15	0.81	40.20	14.40	12.96	400.00	
45x30, Pusa D Head	39.5	19.2	54.9	52.3	30.5	18.3	34.93	100.12	5.64	0.75	0.53	33.20	13.80	11.40	351.85	
CD (%)	1.19	0.669	2.302	2.013	1.261	0.756	2.18	2.10	0.178	0.043	0.022	1.729	0.624	0.474	14.821	
SE (m)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	

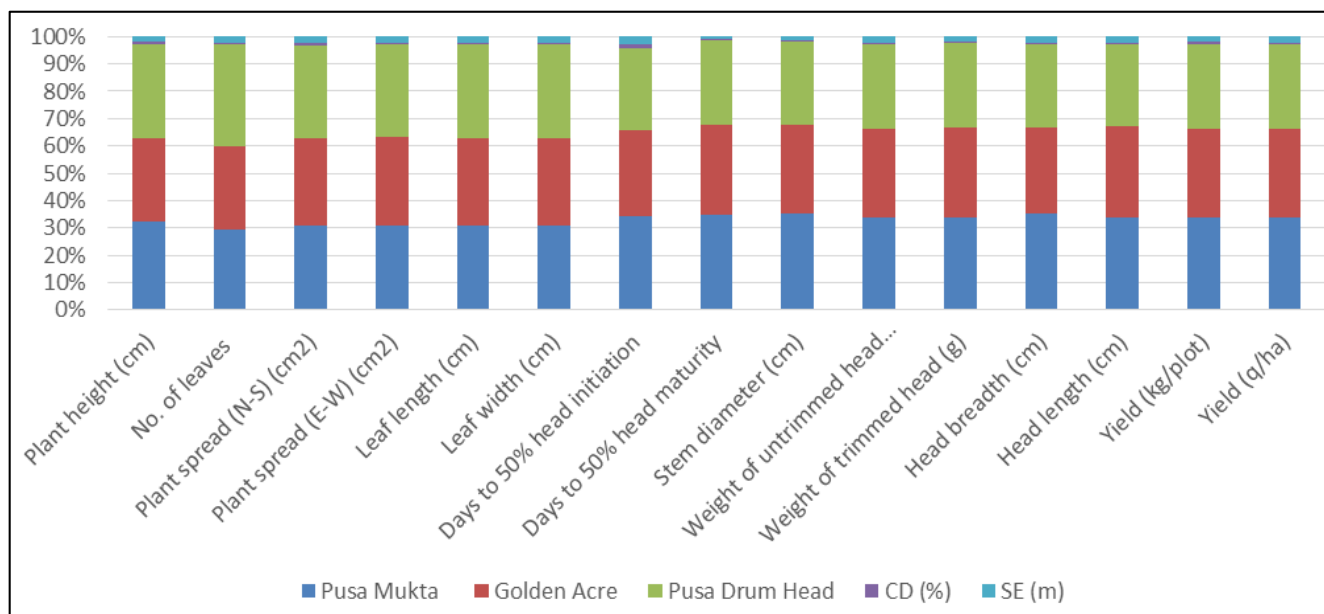


Fig 1: Effect of varieties on growth and yield of cabbage.

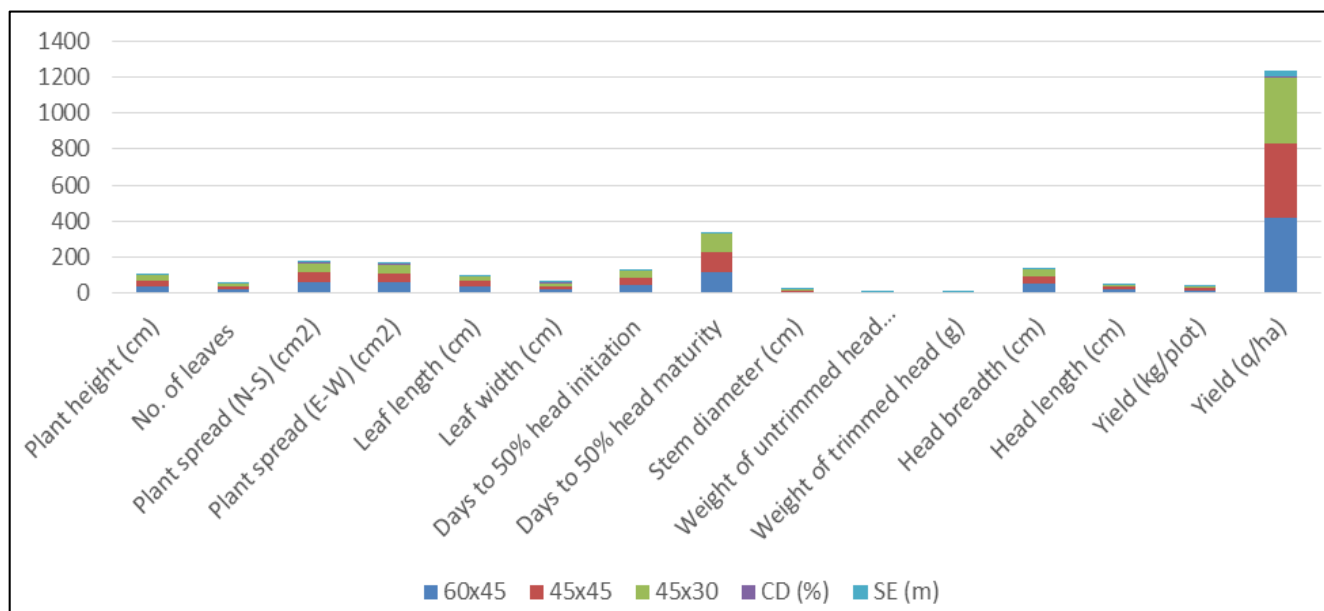


Fig 2: Effect of spacing on growth and yield of cabbage

4. References

1. Agarkar UR, Dadmal KD, Nikas NS, Piwlatkar GK. Effect of nitrogen levels and spacing on growth and yield of broccoli (*Brassica oleracea* var. *Italica* L.). *Green Farming* 2010;1(5):477-479.
2. Bairwa RK, Mahawar AK, Singh SP, Gocher P. Influence of sulfur dose and spacing on quality attributes and economics of knolkhol (*Brassica oleracea* var. *gongylodes* L.) variety early White Vienna. *Chem. Sci. Rev. Lett.* 2017;6(22):933-938

3. Chakrabarty. Importance of vegetable in Textbook of vegetable, tuber crops and spices (Eds. Thamburaj, S and Singh, N.), ICAR, New Delhi, 2000, 35-38.
4. Chaubey T, Srivastava BK, Singh M. Influence of fertility levels on yield and yield components in cabbage. *Veg. Sci.* 2001;28(2):152-156.
5. Firoj Asadul Haque, Islam N, Md. Nazrul Islam, Ahsan Ullah, Md. Dulal Sarkar. Growth, Yield, and Profitability of Cabbage (*Brassica oleracea* L.) as Influenced by Applied Nitrogen and Plant Spacing. *A Scientific Journal of Krishi Foundation*, 2015;13(1):35-45.
6. Giri RK, Sharma MD, Shakya SM, Yubak DGC. Growth and yield responses of broccoli cultivars to different rates of nitrogen in western Chitwan, Nepal. *Agric. Sci.* 2013;4(7):8-12.
7. Khatiwada PP. Plant spacing is a key husbandry practice for season cabbage production. *Nepal Agric. Rec. J* 2000-2001;4(5):48-55.
8. Kochhar SL. *Economic Botany in the Tropics*, Mac Millan India Ltd., Daryaganj, New Delhi, 2010, 604.
9. Naher MNA, Alam MN, Jahan N. Effect of Nutrient Management on the Growth and Yield of Cabbage (*Brassica oleracea* var. capitata L.) in Calcareous Soils of Bangladesh. *A Scientific Journal of Krishi Foundation*. 2014;12(2):24-33
10. Moniruzzaman M. Effect of plant spacings on the performance of hybrid cabbage (*Brassica oleracea* var. capitata) varieties. *Bangladesh Journal of Agricultural Research*. 2011;36(3):495-506.
11. Neto EE, Benett CGS, Santos ECMD, Reboucas TNH, Costa E. Plant spacing and boron (B) topdressing fertilization for purple cabbage crop (*Brassica oleracea* var. capitata) variety purple giant. *Aust. J Crop Sci.* 2016;10(11):1529-1533.
12. Patil BN, Ingle VG, Patil SS. Effect of spacings and nitrogen levels on growth and yield of Knolkhol (*Brassica oleracea* var. caulorapa) cv. White Vienna. *Ann. Plant Physiol.* 2003;17(2):110-113.
13. Prasad PH, Thapa U, Mandal AR, Vishwakarma R. Response of varieties, spacing, and aphid management on growth and yield of sprouting broccoli (*Brassica oleracea* var. italic L.) under West Bengal condition. *Environ. Ecol.* 2010;28(2):779-782.
14. Pressman E, Shaked R. Regulation of stem elongation in Chinese cabbage by inflorescence regulators. *J Plant Growth Regulation.* 1991;10(4):225-228.
15. Rahman MU, Iqbal M, Jilani MS, Waseem K. Effect of different plant spacing on the production of cauliflower (*Brassica oleracea* var. botrytis) under the agro-climatic conditions of D.I. Khan. *Pk. J Biol. Chem. Sci.* 2007;10(24):4531-4534.
16. Singh R, Sharma SR. *Cole crops: In-Text Book of Vegetables, Tuber crops and Spices* (Eds. Thamburaj and Singh, N.), ICAR, New Delhi, 2001, 76-146.
17. Singh SK, Singh T, Singh BN, Verma RB. Response of fertility levels and plant density on growth, yield, and quality of hybrid cabbage. *Veg. Sci.* 2004;31(1):69-72
18. Tejaswini T, Varma LR, Verma P, Thakur DM, Vani FB. Studies on Effect of Different Plant Spacing with Respect to Growth, Yield and Quality of Broccoli (*Brassica oleracea* var. Italica. L) under North Gujarat conditions. *Int. J Curr. Microbiol. App. Sci.* 2018, 7(05).
19. Thapa U, Rai R. Evaluation of sprouting broccoli (*Brassica oleracea* var. Italica) genotypes for growth, yield and quality. *Int. J Agric. Sci.* 2012;4(7):284-286
20. Verma H, Nawange DD. Effect of different levels of nitrogen and sulfur on the growth, yield, and quality of cabbage (*Brassica oleracea* L. var. capitata). *Agric. Sci. Digest.* 2015;35(2):152154.