



Effect of Spacing and Nitrogen Fertilizer on the Growth and Yield of Cabbage (*Brassica oleracea* Var. *Capitata* L.)

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Abstract

To observe the growth and yield attributes of cabbage under different spacing and nitrogen fertilizers, a field experiment was conducted with cabbage (*Brassica oleracea* var. *capitata* L.) variety "BARI Badha kopi-2 (Agradut)". The experiment was carried out at the research field of the Department of Crop Science and Technology, Rajshahi University, Rajshahi during the period from November, 2021 to March, 2022. The experiment consisted of three spacing i.e. 50cmX30cm, 50cmX40cm and 50cmX50cm as well as three levels of nitrogen fertilizers viz. 50kg/ha, 100kg/ha and 150kg/ha. The results revealed that different treatments significantly affected the growth and yield attributes of cabbage. The combination of wider spacing (50cmX50cm) combination with highest level of nitrogen fertilizer (150kg/ha) produced the maximum plant height, no. of leaves per plant, largest leaf length, largest leaf breadth, head diameter, head thickness, individual head weight and yield whereas 50cmX30cm spacing and lowest level of nitrogen fertilizer (50kg/ha) required maximum days required for head maturity. On the other hand, all the studied parameters except days required for head maturity found to be lowest in the treatment combination of 50cmX30cm spacing with lower level of nitrogen fertilizer (50kg/ha). The study concluded that cabbage need to be cultivated at 50cmX50cm spacing and 150kg/ha nitrogen fertilizer is to be applied for getting the targeted yield as well as desired return from cabbage cultivation in "High Ganges River Floodplain zones" of Bangladesh.

Keywords: Cabbage; Spacing; Nitrogen Fertilizer; Growth and Yield

Abbreviations: RCBD: Randomized Complete Block Design; BARI: Bangladesh Agricultural Research Institute; AEZ: Agro Ecological Zone; BBS: Bangladesh Bureau of Statistics.

Introduction

Cabbage (*Brassica oleracea* var. *capitata* L.) is a biannual and herbaceous vegetable crop belonging to the family Brassicaceae. It is one of the most important, high nutritive, palatable leafy popular winter vegetables widely cultivated

in Bangladesh. It is one of the five best vegetables in the world [1]. The taste in cabbage is due to the "Sinigrin glucoside" and it is rich in minerals and vitamin A, B1, B2, and C [2]. It has some medicinal value as it prevents constipation, increases appetite, speeds up digestion and is very useful for diabetic patient. The average yield of cabbage in Bangladesh is very low (8.9t/ha) Bangladesh Bureau of Statistics (BBS) [3] compared to other countries (Japan 40.03 t/ha, South Korea 59.07t/ha, and India 17.88t/ha) of the world [4]. This low yield may be attributed to a great extent on the method of low production management practices adopted

by the farmers. Of the many factors of improved cultivation practices, use of proper spacing for transplantation and proper nutrient management are indeed to influence on the yield contributing characters and consequently on the yield. The use of proper spacing an important factor for securing higher yield of desirable heads of cabbage. There are reports that successful production of cabbage depends on maintenance of optimum plant density in the field [5-8]. They opined that the yield of cabbage depends upon the number of plants per unit area and the size of the harvested portion of each plant.

Besides spacing, nitrogen fertilizer plays a great role for higher yield of cabbage. There is a wide scope of increasing cabbage production with the proper utilization of nitrogen fertilizer. Fertilizer enhances plant growth by providing amendments to the soil via various macro and micronutrients. The fertilizer application for cabbage should ensure adequate levels of all nutrients. Optimum nitrogen fertilization is required to produce top quality and high yields while a lack of essential fertilizers will stunt its growth, leading to undersized and poorly developed heads. Cabbage is well known to be an exhaustive crop and has the capacity to absorb higher amount of nutrient from soil. The supply of proper nutrient must be ensured during its cultivation, which is related to the judicious application of fertilizer. The nitrogen is essentially required nutrients for plant growth and head development and their recommendation for cabbage may differ with the soil type and availability of these essential nutrients in the soil [9]. The positive effect of N on the growth and yield of cabbage is well documented. A very few research have so far been done with combined application of spacing and nitrogen fertilizer in cabbage. Keeping in view, the present experiment was conducted to find out the suitable spacing and level of nitrogen fertilizer on the growth and yield of cabbage.

Materials and Methods

The experiment was carried out at the research field of Department of Crop Science and Technology, University of Rajshahi, Rajshahi, during the period from November, 2021 to March, 2022 with cabbage (*Brassica oleracea* var. *capitata* L.) variety "BARI Badha kopi-2 (Agradut)". The study area is located at 24. 3700 N and 88.6370 E latitude and 200 cm from the sea level and was belonging to the Agro Ecological Zone (AEZ-11) "High Ganges River Floodplain". The soil was sandy loam in texture with pH 5.47. The experimental area is under the sub-tropical climate that is characterized by less rainfall associated with moderately low temperature during rabi season, (October-March) and high temperature, high humidity and heavy rainfall with occasional gusty winds during kharif season (April-September). The two factors Randomized Complete Block Design (RCBD) with three

replications was followed to carried out the study. The study consisted three spacing (factor A) i.e. S1=50cm X 30cm, S2=50cm X 40cm and S3=50cm X 50cm as well as three levels of nitrogen fertilizers (factor B) viz. N1:50kg/ha, N2:100kg/ha and N3:150kg/ha. The unit plot size was 2.5m X 2.5m. The seed of cabbage was collected from the Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur. Seeds of variety BARI Badha kopi-2 (Agradut) were sown in the nursery beds at 30th September, 2021. Beds were immediately irrigated with the help of watering cane. After germination, when the seedlings were attained at a height of 3 cm then the seedlings were transplanted in the other nursery beds 10cm apart for proper growth and development of the seedlings. Thirty days old seedlings were transplanted in the evening time in the experimental plot according to the treatment. Healthy seedlings of uniform size were selected for planting. Before transplantation, the nursery beds were irrigated so that the seedlings could be easily uprooted from the beds without any damage of the root. After one week of transplantation, dead seedlings were replaced by planting fresh seedlings to obtain a uniform stand. Fertilizers were applied following the guidelines of Rashid MM [10]. Intercultural operations were done as and when necessary. Data were recorded for desired parameters from the sample plants at harvest. Ten (10) plants were randomly selected from each unit plot for the collection of data. The collected data were analyzed using computer package MSTAT and mean differences were adjudged by using Duncan's Multiple Range Test following [11].

Results and Discussion

Effect of Spacing

Observations on growth and yield attributes of cabbage revealed that spacing differed significantly in respect of plant height, no. of leaves per plant, largest leaf length, largest leaf breadth, head diameter, head thickness, individual head weight and yield (Table 1). The highest values of all the above parameters (35.70cm, 10.60, 34.27cm, 24.37cm, 19.27cm, 13.07cm, 2.01kg and 51.54t/ha) were found in the wider spacing of 50cmX50cm whereas the lowest values (33.57cm, 9.40, 32.90cm, 23.17cm, 17.50cm, 10.33cm, 1.43kg and 36.69t/ha) of those parameters were observed in spacing of 50cmX30cm. Maximum days required for head maturity (87.33) was found in closer spacing of 50cmX30cm whereas the minimum (85.97) was in the wider spacing of 50cmX50cm. The plants grown under wider spacing received more nutrients, light and moisture around compared to plants of closer spacing, which was probably the cause of better performance in yield attributes and yield of individual cabbage head. Similar findings in cabbage production were also reported by Farooqe AM, et al. [12], Rahman A, et al. [6], Hossain MF et al. [13] and Nahar J, et al. [7].

Treatments	Plant Height (cm)	No. of Leaves/ Plant	Largest Leaf Length (cm)	Largest Leaf Breadth (cm)	Days Required for Head Maturity	Head Diameter (cm)	Head thickness (cm)	Individual Head Weight (kg)	Yield (t/ha)
Spacing									
S ₁	33.57c	9.40b	32.90c	23.17c	87.33a	17.50c	10.33b	1.43c	36.69c
S ₂	34.83b	9.80b	33.60b	23.63b	87.06ab	18.33b	12.79a	1.76b	45.22b
S ₃	35.70a	10.60a	34.27a	24.37a	85.97b	19.27a	13.07a	2.01a	51.54a
CV (%)	1.07	4.67	0.84	1.92	1.26	2.9	5.51	6.66	0.63
LSD (5%)	0.37	0.47	0.28	0.46	1.09	0.53	0.66	0.11	0.28
Nitrogen Fertilizer									
N ₁	30.43c	8.43b	27.77c	19.87c	88.89a	13.93c	10.12c	1.41c	36.26c
N ₂	35.67b	10.50a	35.80b	22.57b	87.47b	17.00b	12.50b	1.75b	44.80b
N ₃	38.00a	10.87a	37.20a	28.73a	84.00c	24.17a	13.57a	2.04a	52.39a
CV (%)	1.07	4.67	0.84	1.92	1.26	2.9	5.51	6.66	0.63
LSD (5%)	0.37	0.47	0.28	0.46	1.09	0.53	0.66	0.11	0.28

Means followed by the same letter(s) do not statistically differ at 5% level tested by DMRT.

Table 1: Main effect of spacing and nitrogen fertilizer on the growth, yield attributes and yield of cabbage.

Effect of Nitrogen Fertilizer

Plant characters and yield varied significantly in response to different levels of nitrogen fertilizer (Table 1). The higher level of nitrogen (150kg/ha) showed superiority in respect of plant height (38.00cm), no. of leaves/plant (10.87), largest leaf length (37.20cm), largest leaf breadth (28.73cm), head diameter (24.17cm), head thickness (13.57cm), individual head weight (2.04kg) and yield (52.39t/ha). Except days required for head maturity, the lowest values of all the above parameters (30.43cm, 8.43, 27.77cm, 19.87cm, 13.93cm, 10.12cm, 1.41kg and 36.26t/ha) were recorded from 50kg nitrogen/ha. Nitrogen at the rate of 50kg/ha required maximum days (88.89) for head maturity whereas 150kg nitrogen/ha required the minimum days (84.00) for head maturity. The results showed similarity to Farooq et al. who reported that plant height, leaf length and yield of cabbage were maximum at higher nitrogen level. Westerveld SM, et al. [14,15] also recorded the higher yield contributing characters and yields by high nitrogen fertilizer management in cabbage. The results are in partial agreement with the findings of Wang-Xiude D, et al. [16].

Combined Effect of Spacing and Nitrogen Fertilizer

All the recorded parameters show the significant variations due to combined effect of spacing and nitrogen fertilizer level (Table 2). Higher plant height (39.00cm); no. of leaves per plant (12.00); largest leaf length (38.70cm);

largest leaf breadth (30.00cm); head diameter (25.00cm); head thickness (15.00cm); individual dead weight (2.49kg) and yield (63.74t/ha) of cabbage were obtained from wider spacing S₃(50cm X 50cm) with higher level of nitrogen fertilizer N₃(150kg/ha) which were significantly different from all other treatments. Only highest value of head thickness was statistically identical with treatments S₂N₃ and S₃N₂. On the other hand, cabbage cultivated with closer spacing S₁ (50cm X 30cm) combination with lower nitrogen fertilizer level N₁ (50kg/ha) produced the lower plant height (29.50cm); largest leaf length (27.20cm); largest leaf breadth (19.50cm); head diameter (13.00cm); individual head weight (1.10kg) and yield (28.10t/ha) which were statistically different from all other treatments. Treatment S₁N₁ also produced the lowest no. of leaves per plant (8.00) and head thickness (9.50cm) which was statistically similar with treatments S₁N₂, S₂N₁ and S₃N₁. In case of days required for head maturity, the highest value (90.00) was found in treatment S₁N₁ which was statistically similar with treatment S₂N₁ whereas the lowest value of above parameter (82.00) was observed in treatment S₃N₃ Table 2 which was significantly different from all other treatments. The results obtained in the present study were supported by various authors. The higher yield in above treatment is due to better plant survival owing to the favorable conditions for growth and development of plant and the closer spacing accommodates more number of plants per unit area. Similar results were reported by Azizur Rehman A, et al. [17]. Rahman M, et al. [18], Farzana L, et al. [19] conducted an experiment on cabbage with spacing and reported that the

maximum yield of cabbage was found where the plants were spaced 45×50cm apart. The results were also supported in the term of nitrogen by Islam MH, et al. [20] who showed the

maximum amount of nitrogen gives the high production of cabbage.

Treatments	Plant Height (cm)	No. of Leaves/Plant	Largest Leaf Length (cm)	Largest Leaf Breadth (cm)	Days Required for Head Maturity	Head Diameter (cm)	Head Thickness (cm)	Individual Head Weight (kg)	Yield (t/ha)
S ₁ N ₁	29.50g	8.00f	27.20e	19.50e	90.00a	13.00g	9.50d	1.10f	28.16i
S ₁ N ₂	34.20e	10.70bc	35.50c	22.00d	87.00b	16.00e	10.00d	1.55e	39.68g
S ₁ N ₃	37.00c	9.50de	36.00c	28.00b	85.00c	23.50b	11.50c	1.64de	42.24e
S ₂ N ₁	30.80f	8.50f	28.00d	20.00e	88.67ab	14.00f	10.67cd	1.52e	38.91h
S ₂ N ₂	35.70d	10.90b	35.90c	22.70cd	87.50b	17.00d	13.50b	1.78cd	45.56d
S ₂ N ₃	38.00b	10.00cd	36.90b	28.20b	85.00c	24.00b	14.20ab	2.00b	51.20b
S ₃ N ₁	31.00f	8.80ef	28.10d	20.10e	88.00b	14.80f	10.20d	1.63de	41.72f
S ₃ N ₂	37.10c	11.00b	36.00c	23.00c	87.92b	18.00c	14.00ab	1.92bc	49.15c
S ₃ N ₃	39.00a	12.00a	38.70a	30.00a	82.00d	25.00a	15.00a	2.49a	63.74a
CV (%)	1.08	4.67	0.84	1.92	1.26	2.9	5.51	6.66	0.63
LSD (5%)	0.65	0.27	0.49	0.79	1.89	0.92	1.15	0.2	0.48

Means followed by the same letter(s) do not statistically differ at 5% level tested by DMRT.

Table 2: Combined effect of spacing and nitrogen fertilizer on the growth, yield attributes and yield of cabbage.

Conclusion

The study concluded that cabbage need to be cultivated at the spacing of 50cm X 50cm with 150kg/ha nitrogen is to be provided for getting the targeted yield as well as desired return from cabbage cultivation in “High Ganges River Floodplain zones” of Bangladesh. The study may be continued further to find out the yield potentiality of cabbage under different spacing and levels of nitrogen.

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