Annual Research & Review in Biology

37(10): 111-118, 2022; Article no.ARRB.91952
ISSN: 2347-565X, NLM ID: 101632869

Effect of Sowing Dates and Varieties on Growth and Yield of Broccoli under Acidic Soil Condition of Sylhet

Mukta Sarker [aω], Md. Shahidul Islam [b], Biswojit Debnath [b*], Dwipok Deb Nath [b], Jannatul Ferdousi [b] and Masuma Zahan Akhi [b]

[a] Department of Agriculture Extension (DAE), Sylhet Sadar, Sylhet, Bangladesh.
[b] Department of Horticulture, Sylhet Agricultural University, Sylhet, Bangladesh.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/ARRB/2022/v37i1030542

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/91952

Original Research Article

Received 17 July 2022
Accepted 24 September 2022
Published 21 October 2022

ABSTRACT

This experiment was conducted during October, 2013 to March, 2014 in the experimental field of Department of Horticulture, Sylhet Agricultural University (SAU), Bangladesh. The objective was to evaluate the effect of three planting dates (30 October, 15 November and 1 December) on growth, yield and yield attributes of three broccoli varieties (Premium, BR001 and BR002) under acidic soil condition of Sylhet. The two factors field experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. Broccoli planted on 30 October recorded the minimum number of days to first curd harvest (64.77), the tallest plants at harvest (62.76 cm) with denser leaves (17.90), the highest primary curd weight (142.75 g) with increased curd length (11.93 cm), the maximum curd yield of both primary (5.29 t/ha) and secondary (5.24 t/ha). Variety Premium was the earliest in curd initiation (50.33 days) and curd harvest (64.44 days). Premium had the highest number of leaves at harvest (16.07), the maximum primary curd weight (207.59 g) with increased curd length (12.18 cm) and curd diameter (14.28 cm). The highest primary curd yield (7.70 t/ha) and secondary curd yield (4.02 t/ha) of Premium variety out yielded the other two varieties in this experiment. Interaction effect showed that the variety Premium planted on 30 October showed the

[ω] Upazila Agriculture Officer;
**Corresponding author: E-mail: biswo26765@yahoo.com;*

best performance in primary curd weight (274.13 g), primary curd yield (10.17 t/ha) and secondary curd yield (8.43 t/ha). Therefore, the variety Premium can be recommended to cultivate at 30 October planting date under acidic soil condition of Sylhet.

Keywords: Secondary curd yield; acidic soil condition; broccoli; organoleptic properties.

1. INTRODUCTION

Broccoli (*Brassica oleracea* var. italica L.) is an important member of "Cole" crops, belongs to the family Brassicaceae. It is one of the most prominent vegetables originated from west Europe [1]. At present, broccoli is widely cultivated in many European, American and Asian Countries [2]. Among different nationalities, broccoli is considered as an important and popular vegetable due to its good organoleptic properties and high nutritive value [3]. This highly nutritious vegetable has been considered as an anti-cancerous food by the American Cancer society [2].

In Bangladesh, broccoli was introduced about two decade ago. Although its popularity to the consumers of urban areas are increasing day by day in our country, but its cultivation has not spread much beyond the farms of different agricultural organizations due to the unawareness among the people and lack of available information regarding production technology [4]. Moreover, the farmers who are cultivating broccoli often harvests a lower yield compare to the most other broccoli growing countries [5]. However, considering its better environmental adaptability and less risk of crop failure than other Cole crops, promotional efforts can be taken for increasing the production [4].

One of the factors that could lead to a lower yield is planting date. According to Hafiz et al. [4], the planting dates have significant effect on growth, yield and other yield contributing characters of broccoli. Delay plantings could lead to a linear decrease in curd yield of broccoli [6]. Early planting produced healthy and taller plants with increased leaves size as well as number, higher plant spread and less number of abnormal heads than late planted crops. All of which attributed to higher curd yield of early planted broccoli [7]. So, there is an opportunity to maximize head yield of broccoli by finding optimum planting date.

Another factor that could lead to a lower yield is the selection of broccoli varieties. Different varieties are cultivated in our country those differ in yield [4]. Sometimes only vegetative growth is happened and ended up the lifecycle with a very small unmarketable curd [8]. So it is essential to identify high yielding varieties to maximize broccoli yield.

Sylhet is a special agro ecological zone in Bangladesh with acidic soils. Production of broccoli in Sylhet region can also be possible since broccoli prefer slightly acidic soil with a sandy texture and full sun exposure [9]. Moreover, this region has got huge fallow land during rabi season could be brought under cultivation [10]. Therefore, selection of suitable varieties and optimization of plating dates could be crucial for broccoli cultivation in this region. Research based information on the production of this crop under Sylhet conditions are almost absent. So the aim of this work was to evaluate three broccoli varieties in three planting dates under acidic soil conditions of Sylhet.

2. MATERIALS AND METHODS

The experiment was conducted at the experimental field of Horticulture Department, Sylhet Agricultural University (SAU), Sylhet, during the period of October, 2013 to March, 2014. The location of the experimental site was north-east corner of the Bangladesh lying between 23º57′ to 25º13′ North latitude and 90º56′to 92º21′ East longitude. The site falls under the Agro-ecological Zone-20: Eastern Surma-Kusiyara Flood Plain [11]. The land was situated just below some tillas of the southern part of the SAU campus. The soil of the experimental site was grey, sandy loams in texture and belongs to the 'Noncalcareous Grey' soils under Eastern Surma-Kusiyara Flood Plain. The reaction of soils ranges from strongly acidic to neutral (4.7-6.9), [11]. Chemical characteristics of the soil measured during the experiment is given in Table 1. There were three planting dates viz. 30 October, 15 November and 1 December and three varieties viz. Premium, BR001 and BR002. The two factors field experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. The unit plot size was 3.2 m x 1.0 m. The plants were spaced with 60 cm × 40 cm spacing. The seeds of these varieties were collected from the Department of

Horticulture, SAU. The seeds were sown in ideal seedbed and seedlings were nursed until they were ready for transplanting. The land was manured and fertilized with cowdung, urea, TSP and MOP @ 15 t, 240 kg, 150kg and 200 kg per hectare, respectively. The whole amount of cowdung, TSP and MOP were applied at final land preparation. About one third of the urea was applied during pit preparation. The remaining urea was applied in three equal installments at 15, 30 and 45 days after transplanting. Healthy and uniform thirty days old seedlings at each sowing date were transplanted in the experimental field. Light irrigation of seedling was given just after transplanting for better establishment of the plants. Weeding, irrigation and other intercultural operations were done as required. Five plants were randomly selected from each replication for data collection. Data on different growth parameters, yield and yield attributes were recorded and statistically analyzed using MSTATC software for interpretation of result.

3. RESULTS AND DISCUSSION

3.1 Effect of Planting Dates on Growth, Yield and Yield Attributes of Broccoli

Significant variations were observed among the planting dates in respect to growth parameters, curd yield and yield attributes of broccoli (Table 2). It was revealed that the maximum number of days (59.22) for the first curd initiation was required in 1 December planting. The lowest and statistically similar number of days to curd initiation required for both 30 October and 15 November plantings. The differences in days required to curd initiation might be due to the fact that planting date determines the time available for vegetative phase before onset of flowering, which is principally regulated by the photoperiod [12]. Days to curd harvest (64.77) was the lowest for 30 October plantings, while for both 15 November and 1 December plantings were required the highest and statistically similar number of days to harvest. The highest plant height (62.76 cm) and leaves number (17.90) at harvest were obtained from 30 October planting while both of them were decreased significantly with advancement of planting date. This result was in agreement with the result obtained by Ahmed and Abdullah [13] who found taller plant with the maximum number of leaves from earlier planting of broccoli than late planting. Hafiz et al. [4] also observed a decreasing trend in plant height with the advancement of planting date. The superiority of the early planting (30 October) over the other planting dates may be due to the warmer temperature which favored the plant to attain maximum height and leaf production [14,15]. Late planting had the minimum leaf size (length and breadth) in comparison to both the early planting. This may be due to the less favorable environment for the growth of broccoli during the late planting. Similar result with leaf size has previously been observed due to late planting of broccoli variety Green Mountains by Ahmed and Siddique, [16]. The curd length (11.93 cm) and the curd diameter (11.11 cm) of the 30 October planting were significantly higher than the other two planting dates, therefore, 30 October planting had the highest individual curd weight (142.75 g). Not only individual curd but also the highest secondary curd weight from each plant (141.29 g) was harvested from 30 October planting. This is mainly due to the maximum number of secondary curd obtained from each plant for this planting (15.23). The highest number of secondary curd per plant contributed to the highest per plant secondary curd yield was previously reported by Hafiz et al. [4]. Broccoli of 30 October planting produced the highest primary curd yield (5.29 t/ha) and secondary curd yield (5.24 t/ha) followed by the 15 November planting (3.28 and 1.90 t/ha, respectively). On the other hand, the minimum yield of both primary and secondary curd yield (1.71 and 0.46 t/ha) was obtained from 1 December planting. The reason for obtaining increased yield during 30 October planting might be due to the favorable temperature. Abou El-Magd and Zaki [2] reported that the superiority in performance of broccoli during early planting is the narrow difference between day and night temperatures. In addition, suitable temperature allows more absorption and translocation of water and soil solution by the root system. These moderate conditions then allow more photosynthesis and more metabolites reflecting better vegetative growth and yield during 30 October planting. The higher vegetative growth and yield of the early planted broccoli might be due to the suitable environment.

3.2 Effect of Varieties on Growth, Yield and Yield Attributes of Broccoli

Effect of broccoli varieties on curd yield and yield attributes was presented in Table 3. Significant variations were observed among the varieties in respect to all parameters except plant height and biggest leaf length at harvest. Days to first curd initiation (50.33) and days to first harvest (64.44) of Premium variety were significantly lower than

that of two other varieties BR001 and BR002. Similar result were previously reported by Debnath et al. [8] while working with the same three varieties as of the current experiment. Refai et al. [17] suggested that the differences in genetic make-up among the varieties could be the factor determines the number of days required for harvesting. The variety Premium had the highest primary curd weight (207.59 g) which was more than 4.5 times of the other two varieties. The variety Premium produced the highest primary curd weight might be due to producing higher number of leaves (16.07), leaf breadth (19.06), curd length (12.18 cm) and curd diameter (14.29 cm). Srivastava [18] reported that better curd size depends on the number of leaves, their size and ability to store carbohydrates and other nutrients within a particular temperature range. The results also revealed that there was a variation in number and weight of secondary curds per plant among the genotypes. The maximum number of secondary curds (11.37) and weight of secondary curds (108.42 g) per plant were recorded in variety Premium. The yield of both primary curd (7.70 t/ha) and secondary curd (4.02 t/ha) were recorded significantly higher for the variety Premium. The lowest and statistically similar curd yield (primary and secondary) were recorded from BR001 and BR002. Debnath et al. [8] also observed the similar yield differences while working with the three different varieties and suggested that these variations might be attributed due to genotypic variations. The superiority of Premium plants in their vegetative growth and yield might be owing to its potential heredity. This hybrid cultivar allows more benefits from the natural resources, higher potentiality for absorbing water and nutrients through soil solution and translocation to the aerial parts. Consequently, higher photosynthetic activity and higher potentiality for condensation of metabolites which in turn reflects higher vegetative growth rate and both primary and secondary curd yield.

3.3 Interaction Effect between Planting Dates and Varieties

Interaction effect between planting dates and varieties was presented in Table 4. Some of the parameters had significantly influenced by the interaction between planting dates and varieties. Significant interaction effect was observed for the biggest leaf breadth. The highest and statistically similar leaf breadth was recorded from the variety Premium for the first two planting dates (30 October and 15 November). The lowest leaf breadth at harvest was recorded from genotype BR001 planting at 15 November. Due to combined effect of planting times and varieties primary curd weight and curd length differed significantly, where primary curd weight and curd length were ranging from 9.88 to 274.13 g and from 7.61 to 14.74 cm, respectively. The maximum primary curd weight (274.13 g) was recorded from V1T1 (Premium planted on 30 October) followed by V1T2 (Premium planted on 15 November), V1T3 (Premium planted on 1 December). The minimum primary curd weight (9.88 g) was obtained from V3T3 (BR002 planted on 1 December). The highest curd length (14.74 cm) was also recorded from Premium when planted at 30 October and the lowest (7.61 cm) was recorded from BR002 planted at 1 December. The plants of Premium variety when planted on 30 October performed better might be due to prevailing suitable temperature for vigorous vegetative growth resulting in higher primary curd weight. Similar results were obtained by Bianco et al. [6] who reported that primary curd yield was higher when crop planted earlier. The highest primary and secondary curd yield per hectare was obtained by the combined effect of 30 October planting date and Premium variety. Planting Premium in the 30 October in this experiment out yielded the other interaction treatments. These results indicate the dependency of 30 October planting date and Premium cultivar on each other. The lowest primary and secondary curd yield per hectare was recorded from both BR001 and BR002 planted at 1 December. The highest individual primary curd weight and both the maximum number and weight of per plant secondary curd of premium variety planted during the 30 October contributed to both the highest per hectare primary and secondary yield. Some investigators reported that the combined effect of planting date and varieties affected broccoli growth and curd yield [19,20,21]. Similar result with both primary and secondary curd yield as of the current experiment due to the combined effect of ‘Decathlon’ variety and 15 October planting was previously reported by Hanaa et al. [22] and Hanaa [23].

Table 1. Chemical characteristics of the soil (1-15 cm)

Soil properties	Analytical data
Soil pH	4.98
Organic matter (%)	1.79
Total N (%)	0.09
Exchangeable K (meq 100 g^{-1} soil)	0.13
Available P (µg g^{-1} soil)	14.98
Available S (µg g^{-1} soil)	27.01

Table 2. Main effect of planting dates on morphological characteristics, yield and yield attributes of broccoli

Planting dates	Days to first curd initiation	Days to first curd harvest	Plant height at harvest (cm)	Number of leaf at harvest	Biggest leaf length at harvest (cm)	Biggest leaf breadth at harvest (cm)	Primary curd weight (g)	Curd length (cm)	Curd diameter (cm)	Primary curd yield (t/ha)	Number of secondary curd per plant	Weight of secondary curd per plant (g)	Secondary curd yield (t/ha)
T1	53.88b	64.77b	62.76a	17.90a	41.13a	19.57a	142.75a	11.93a	11.11a	5.29a	15.23a	141.29a	5.24a
T2	55.77b	68.39a	57.99b	14.86b	37.95a	18.33a	107.50b	9.45b	9.88 a	3.28b	8.80b	51.45b	1.90b
T3	59.22a	69.44a	42.08c	9.88c	26.27b	13.18b	46.19c	8.40b	6.80 b	1.71c	4.91c	0.46c	0. 46c
F-test	**	**	**	**	**	**	**	**	**	**	**	**	**
CV%	**2.81**	**2.49**	**3.86**	**12.67**	**8.52**	**9.66**	**14.36**	**7.88**	**15.90**	**14.36**	**17.95**	**13.60**	**13.60**

*** indicates significant at 1% level of probability, T1= 30 October planting, T2= 15 November planting and T3= 1 December planting*

Table 3. Main effect of varieties on morphological characteristics, yield and yield attributes of broccoli

Varieties	Days to first curd initiation	Days to first curd harvest	Plant height at harvest (cm)	Number of leaf at harvest	Biggest leaf length at harvest (cm)	Biggest leaf breadth at harvest (cm)	Primary curd weight (g)	Curd length (cm)	Curd diameter (cm)	Primary curd yield (t/ha)	Number of secondary curd per plant	Weight of secondary curd per plant (g)	Secondary curd yield (t/ha)
V1	50.33b	64.44b	55.15	16.07a	37.03	19.06a	207.59a	12.18a	14.29a	7.7a	11.37a	108.42a	4.02a
V2	59.00a	69.22a	54.37	13.42b	33.02	16.11b	45.34b	9.22b	6.70b	1.68b	8.73b	49.18b	1.82b
V3	59.55a	68.88a	53.30	13.16b	34.69	15.90b	43.51b	8.38b	6.79b	1.61b	8.83b	47.54b	1.76b
F-test	**	**	**NS**	**	**NS**	**	**	**	**	**	**	**	**
CV%	**2.81**	**2.49**	**3.86**	**12.67**	**8.52**	**9.66**	**14.36**	**7.88**	**15.90**	**14.36**	**17.95**	**13.6**	**13.6**

*NS indicates non-significant, ** indicates significant at 1% level of probability, V1= Premium, V2= BR001 and V3= BR002*

Table 4. Interaction effect of planting dates on morphological characteristics, yield and yield attributes of broccoli

Planting dates × Varieties	Days to first curd initiation	Days to first curd harvest	Plant height at harvest (cm)	Number of leaf at harvest	Biggest leaf length at harvest (cm)	Biggest leaf breadth at harvest (cm)	Primary curd weight (g)	Curd length (cm)	Curd diameter (cm)	Primary curd yield (t/ha)	Number of secondary curd per plant	Weight of secondary curd per plant (g)	Secondary curd yield (t/ha)
V1T1	48.33	62.66	61.22	20.59	42.64	20.57 ab	274.13 a	14.74a	16.20	10.17a	16.90 a	227.19 a	8. 43a
V2T1	56.66	66.00	64.60	16.56	39.24	19.94 b	77.64 d	11.46bc	8.44	2.88d	14.26 ab	99.65 b	3.69b
V3T1	56.66	65.66	62.46	16.56	41.51	18.20 bc	76.47 d	9.60cd	8.68	2.83d	14.53 ab	97.03 bc	3.59bc
V1T2	50.33	64.66	60.78	16.62	42.11	22.85 a	230.00 b	12.52b	13.81	8.53b	12.66 b	75.48 c	2.80c
V2T2	58.33	70.33	56.17	14.54	34.80	15.87 cde	48.34 d	8.09de	7.58	1.79	6.63 c	40.68 d	1.51d
V3T2	58.66	70.00	57.01	13.43	36.35	16.27 cd	44.18 d	7.74e	8.26	1.63	7.10 c	38.17 d	1. 41d
V1T3	52.33	66.00	43.46	11.00	27.75	13.76 def	118.65 c	9.27de	12.86	4. 4c	4.56 c	22.60 de	0.84de
V2T3	62.00	71.33	42.34	9.16	26.83	12.54 f	10.04 e	8.11de	4.10	0.37e	5.30 c	7.20 e	0.26e
V3T3	63.33	71.00	40.43	9.50	26.22	13.25 ef	9.88 e	7.61de	3.44	0.37e	4.86 c	7.43 e	0.27e
F-test	**NS**	**NS**	**NS**	**NS**	**NS**	*****	******	******	**NS**	******	*****	******	******
CV%	**2.81**	**2.49**	**3.86**	**12.67**	**8.52**	**9.66**	**14.36**	**7.88**	**15.9**	**14.36**	**17.95**	**13.87**	**13.60**

*NS indicates non-significant, * indicates significant at 5% level of probability, ** indicates significant at 1% level of probability,*
V1= Premium, V2= BR001, V3= BR002 and T1= 30 October planting, T2= 15 November planting, T3= 1 December planting

4. CONCLUSION

It could be concluded from the current experiment that performance of broccoli declined gradually in each successive delay of planting date. Among the three varieties used in this experiment, the Premium is the best adapted to acidic soil condition of Sylhet and out yielded the other two varieties. BR001 and BR002 only formed small sized unmarketable curd after completion of vegetative growth in each planting dates. Therefore, the genotype Premium could be taken under consideration for early planting (30 October) in Sylhet.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Prasad S, Kumar U. Principles of horticulture. Agrobotanica. 4E 176. J.N. Vyas Nagar India. 1999;6.
2. Abou El-Magd MM, Zaki MF. Productivity and quality of some broccoli cultivars in eastern Egypt under different planting dates. Middle East Journal of Applied Sciences. 2017;7(4):848-856.
3. Dhillon BS, Tyagi RK, Saxena S, Randhaw GJ. Plant Genetic Resources: Horticultural Crops. 1st Edn., Narosa, New Delhi. 2005;332.
   ISBN-10: 8173195811
4. Hafiz MA, Biswas A, Zakaria M, Hassan J, Ivy NA. Effect of planting dates on the yield of broccoli genotypes. Bangladesh Journal of Agricultural Research. 2015;40(3): 465-478.
5. Anonymous. Annnual Report, Bangladesh Agricultural Rsearch Institute. Joydebpur, Gazipur. 2011;353.
6. Bianco VV, Darnato G, Pomarici R, Dias JS, Crute I, Monteiro AA. Sowing and transplanting date in four Cima de rapa (*Brassica rapa* L.) cultivars. I. sowing dates. Acta Horticulture. 1996;407: 293-298.
7. Gautam BP, Shadeque A, Saikia L. Effect of sowing dates and varieties on growth and yield of early cauliflower. Journal of Vegetable Science.1998;25(1):1-4.
8. Debnath D, Islam MS, Debnath B. Performance of broccoli under inorganic and organic culture system, J. Sylhet Agril. Univ. 2015;2(1):55-58.
9. Nagraj GS, Chouksey A, Jaiswal S, Jaiswal AK. Broccoli. In Nutritional Composition and Antioxidant Properties of Fruits and Vegetables. 2020;5-17.
10. BARC. Crop production planning in fallow land of Sylhet Region (in Bengali). Bangladesh Agricultural Research Council, Farmgate, Dhaka. 2011;35.
11. UNDP and FAO. Land resource appraisal of bangladesh for agricultural development report No. 2. agro-ecological regions of Bangladesh. United Nations Development Programme and Food and Agriculture Organization. 1988;212-221.
12. Bankar DS, Pawar SB, Kadam YE. Thermal utilization and heat use efficiency of green gram varieties under different sowing dates. Int. J. Curr. Microbiol. App. Sci. 2018;7(10):2270-2276.
13. Ahmed MS, Abdullah AM. Effect of time of planting on the yield of sprouting broccoli. Bangladesh Hort. 1986;14(2):47-48.
14. Nowbuth RD. The effect of temperature on curd initiation of cauliflower. In Second Annual Meeting of Agricultural Scientists. 1998;225.
15. Islam S. Performance of cauliflower (*Brassica oleracea var. botrytis* L.) genotypes under different planting dates. M.Sc. Thesis, Fac. Hort., Uttarbanga Krishi Viswavidyalaya Pundibari, Coochbehar, West Bengal; 2013.
16. Ahmed MJ, Siddique W. Effect of sowing dates on growth and yield of broccoli (*Brassica oleracea* L.) under Rawalakot conditions. Asian Journal of Plant Sciences. 2004;3(2):167-169.
17. Refai EFS, Hassan AMA. Response of some genotypes of cauliflower to different planting dates under Assiut conditions. Sciences. 2019;9(01):231-240.
18. Srivastava RC. Three steps to a bumper cauliflower crops. Indian Farming. 1960;9 (11):8-9.
19. Diputado Jr MT, Nichols MA. The effect of sowing date and cultivar on the maturity characteristics of broccoli (*brassica oleraceae* var. *italica*). In Research and Development Conference on Vegetables, the Market and the Producer. 1988;247: 59-66.
20. El-Hifny IM, Abdallah MMF, Gomaa SS. Influence of sowing date, production method and cultivars on broccoli transplants production. Arab Universities Journal of Agricultural Science. 2002;10 (3):867-877.

21. Vagen IM, Shjelvag AO, Bonesmo H. Growth analysis of broccoli in relation to fertilizer nitrogen application. Journal of Horticultural Science and Biotechnology. 2004;79(3):484- 492.
22. Hanaa A, El-Rahman A, Zaki MF, El-Behairy OA, Abou El-Magd MM. Effect of planting dates on productivity and heads quality of some broccoli cultivars under sandy soil conditions. Egypt J. Appl. Sci. 2010;25(2A):52-65.
23. Hannaa A, Abdel-Rahman. Effect of planting dates and potassium fertilization on growth and productivity of some broccoli cultivars in sandy soils. A.sc. Thesis, Fac. Of Agric. Ain shams University; 2011.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/91952