

ORIGINAL ARTICLE

Effect of sowing time and spacing on the growth, yield and quality attributes of broccoli (*Brassica oleracea* var. *italica*) under Punjab condition

Mohit Malik¹, Saurabh Tomar¹, Sapna Devi², Rajkumari Asha Devi³, S.K. Jawla⁴, and Alka Sahrawat⁵

¹Department of Horticulture, C.S. Azad university of agriculture and technology, Kanpur (U.P.) 208002. India

^{2&3}Dept. of Horticulture, Lovely Professional University, Jalandhar (144411), Punjab (INDIA)

⁴Dept. of Agricultural Economics and extension, Lovely Professional University, Jalandhar (144411), Punjab (INDIA)

⁵Department of Biotechnology, Shobhit Institute of Engineering and Technology (Deemed to be University), Meerut (U.P.) 250110 India

Corresponding author's email: - rajkumari.22847@lpu.co.in

ABSTRACT

A field experiment entitled 'Effect of sowing time and spacing on the growth, yield and quality attributes of broccoli (*Brassica oleracea* var. *italica*) was conducted during the rabi season in 2019-2020 at Agriculture Research Farm, School of Agriculture, Lovely Professional University, Phagwara, Punjab. 20th October sowing was observed to be recorded maximum plant height, number of leaves, plant spread, leaf area, weight of curd, curd diameter, total yield/plot, total yield, vitamin - C and chlorophyll content. Whereas, 1st November sowing resulted in maximum leaf area index, SPAD value, number of days to harvesting, harvest index, dry matter content and total soluble solids. Among the different spacing adopted in 20th October sowing, 60 cm X 60 cm show superior result in terms of plant height, plant spread, leaf area, fresh weight of plant, dry weight of plant, weight of curd, curd diameter and vitamin - C whereas, number of leaves was observed maximum in 60 cm X 45 cm. But the important factor viz. highest total yield per plot and total yield per hectare were observed maximum under 60 cm X 30 cm. Among the different interactions effect, 20th October sowing with 60 cm X 30 cm spacing was showing superior result over others in terms of plant height, plant spread, leaf area, dry weight of plant, weight of curd, curd diameter and vitamin - C. But the SPAD value, maximum number of days to harvesting and maximum TSS were relatively better in 1st November sowing with 60 cm X 30 cm spacing interaction, respectively.

Key words: broccoli, sowing time, spacing, Vitamin-C, Chlorophyll content.

Received 28.06.2021

Revised 16.07.2021

Accepted 11.08.2021

How to cite this article:

S M Gejage, A G Wale, S R Shinde, S R Zine, S S Walvekar, S S Kadam. *In-Vitro* Calcium Oxalate Stone Reducing Potential of Selected Commercial Samples From Indian Market. Adv. Biores. Vol 12 [5] September 2021. 175-178

INTRODUCTION

Broccoli (*Brassica oleracea* var. *italica*) is a cole crops which is attaining status everywhere throughout the world in light of its high nutritional content. It is a popular Italian vegetable which is cultivated most profoundly in Italy from ancient times. Sulforaphane is one of the richest and widely examined plant compound in broccoli, known for decreasing the threat of tumour. The specific time of planting of seed in nursery and transplanting in the field is fundamental for getting more yield with quality of vegetables [2]. Broccoli is delicate to high temperature, it directly influences the head quality and makes it heat threat crop. Delay in planting diminishes the crop yield. Yield is higher when crop is planted before the onset of high temperature and show a straight diminishing pattern with delay in planting dates [1]. From quality point of view broccoli are formed when the day temperature is between 25 °C to 26 °C and night temperature is between 15-16 °C [12]. Therefore, the present study was undertaken to identify the best sowing time and plant spacing as no research work has been taken under Punjab condition.

MATERIAL AND METHODS

A field experiment was conducted during the rabi season in 2019-2020 at Agriculture Research Farm, School of Agriculture, Lovely Professional University, Phagwara, Punjab. The experiment consisted of six treatment combinations with two levels of sowing date viz. (i) D₁ i.e. October 20, 2019, (ii) D₂ i.e. November 1, 2019 and three plant spacing viz. (i) S₁ i.e. 60 cm x 30 cm (ii) S₂ i.e. 60 cm x 45 cm and (iii) S₃ i.e. 60 cm x 60 cm were included in the study in Factorial Randomized Block Design with three replications. The unit plot size was 2.5m x 6m. The amounts of fertilizer applied for our experimental fields are as follows: Nitrogen was applied through urea @ 5.67 kg. Urea was applied in two split doses. Half dose of urea was applied at the time of transplanting and remaining half dose of urea was again split into two parts, first was given at 30 days after transplanting and the remaining second was given 45 days after transplanting since urea is highly sensitive to leaching loss. Phosphorus was applied through DAP (3.52 kg) and Potassium was applied through MOP (2.7 kg) as basal dose at the time of transplanting. After 30 days, transplanting was done and observations on height of plant, number of leaves per plant, days to flower bud initiation, days to harvesting, total yield (q/ha), Vitamin-C content (mg/100g) and chlorophyll content (mg/g) were recorded.

Table 1: Effect of sowing time and spacing on plant height, Number of leaves per plant, Leaf area (cm²) in broccoli.

Treatment	Plant height (cm)				Number of leaves per plant				Leaf area (cm ²)			
	S ₁	S ₂	S ₃	Mean	S ₁	S ₂	S ₃	Mean	S ₁	S ₂	S ₃	Mean
D ₁	31.5	31.7	33.9	32.37	6.60	6.60	6.07	6.43	110.2	116.27	128.15	118.21
D ₂	19.98	19.24	20.77	19.99	5.27	5.33	5.20	5.27	99.4	110.87	107.73	106
Mean	25.74	25.47	27.34		5.94	5.97	5.64		104.8	113.57	117.94	
Source	D	S	D×S		D	S	D×S		D	S	D×S	
S.E.m ±	0.33	0.41	0.57		0.05	0.06	0.08		0.91	1.12	1.58	
CD _{5%}	1.05	1.29	N/S		0.15	0.19	0.27		2.91	3.56	5.04	

Note: D₁ (20th October sowing) and D₂ (1st November sowing)

S₁ (60 cm X 30 cm spacing), S₂ (60 cm X 45 cm spacing) and S₃ (60 cm X 60 cm spacing)

N/S (Non-significant).

RESULT AND DISCUSSION

The outcomes got from the current investigation as well as relevant discussion have been summed up under following heads:

Effect of sowing time on growth, yield and quality of broccoli:

Plant height, Number of leaves per plant, plant spread and leaf area was found significantly superior. Maximum plant height (32.37 cm) was recorded at 60 DAT during the D₁ sowing i.e. 20th October maybe due to availability of favourable conditions to the plants and early planting too. Maximum number of leaves per plant (8.99), plant spread (1,617.03 cm²) and leaf area (118.21 cm²) was observed during D₁ sowing i.e. 20th October. Maximum number of days to floral bud initiation (68.49) and number of days to harvesting (103.84) was observed during the D₂ sowing i.e. 1st November. These findings are in close conventionality with the findings of Solunke *et al.* [11], Saikia *et al.* [8] and Sigal *et al.* [10] in broccoli.

Maximum weight of curd (85.72 g), highest total yield (33.62 q/ha) was observed during the D₁ sowing i.e. 20th October sowing. In D₂ sowing, S₁ i.e. 60 cm X 30 cm plays a significant role in increasing the highest SPAD value (65.35), maximum number of days to harvesting (95.66) and maximum total soluble solids (9.78 °Brix), respectively. Similar results obtained by Yoldas and Esiyok [14], Gogoi *et al.* [3] and Solunke *et al.* [11].

Effect of spacing on growth, yield and quality of broccoli:

The maximum plant height (27.34 cm) and maximum leaf area (117.94 cm²) was recorded at 60 DAT with in increasing spacing at S₃ i.e. 60 cm X 60 cm and minimum (27.34 cm) was recorded at spacing S₂ i.e. 60 cm X 30 cm. Maximum number of leaves (8.65) was recorded at spacing S₂ i.e. 60 cm X 45 cm, maximum number of days to floral bud initiation (65.53) and days to harvesting (95.66) was recorded at spacing S₁ i.e. 60 cm X 30 cm. These findings are in close conformity with the findings of Hossian *et al.* [4] and Kumar *et al.* [5].

Maximum weight of curd (85.03 g) was recorded at spacing S₃ i.e. 60 cm X 60 cm and lowest (69.09 g) was recorded at spacing S₁ i.e. 60 cm X 30 cm. Highest total yield (38.39 q/ha) was recorded at spacing S₁ i.e. 60 cm X 30 cm and lowest (23.62 q/ha) at spacing S₃ i.e. 60 cm X 60 cm. Maximum VITAMIN - C was observed at spacing S₃ (76.33 mg/100g) and lowest (66 mg/100g) at spacing S₂. Maximum chlorophyll content (0.61 mg/g) was observed at spacing S₁ i.e. 60 cm X 30 cm and lowest (0.57 mg/g) at spacing S₃ i.e. 60 cm X 60 cm. D₁ sowing (20th October sowing) with plant spacing S₁ (60 cm X 30 cm) resulted in

maximum gross income (255240Rs./ha), net income (195680Rs./ha) and B: C ratio (3.28) D₁S₁ (1,95,680.00 Rs./ha). These findings are in line with Roni et al. [7] and Suthar et al. [12], Hossain et al. [4], Prasad et al. [6] in their study.

Effect of interaction (sowing time and spacing) on growth, yield and quality of broccoli:

Among the interactions, D₁S₃ was showing superior result over others in terms of plant height (33.9 cm), plant spread (1,671.13 cm²), leaf area (128.15 cm²), dry weight of plant (61.67 g), weight of curd (92.33 g), curd diameter (76.63 mm) and vitamin - C (89.00 mg/100g), respectively. But the SPAD value (72.27), maximum number of days to harvesting (105.16) and maximum total soluble solids (11.67 °Brix) were relatively better in D₂S₁ interaction, respectively. With the above findings, we can conclude that for better yield it is recommended to adopt D₁ sowing i.e. 20th October with spacing S₁ i.e. 60 cm X 30 cm. While for better quality D₁S₃ can be adopted. For getting continuous yield staggered planting can be adopted as D₂ which compensate the high perishability problem in broccoli.

Table 2: Effect of sowing time and spacing on days to floral bud initiation, days to harvesting, weight of curd (g) in broccoli.

Treatment	days to floral bud initiation				days to harvesting				weight of curd (g)			
	S ₁	S ₂	S ₃	Mean	S ₁	S ₂	S ₃	Mean	S ₁	S ₂	S ₃	Mean
D ₁	62.11	59.16	57.16	59.48	86.17	84.25	82.29	84.23	76.59	88.23	92.33	85.72
D ₂	69.15	69.17	67.14	68.49	105.16	104.16	102.19	103.84	61.6	73.34	77.73	70.89
Mean	65.63	64.16	62.15		95.66	94.21	92.24		69.09	80.78	85.03	
Source	D	S	D×S		D	S	D×S		D	S	D×S	
S.Em ±	0.57	0.70	0.98		0.03	0.03	0.04		0.7	0.86	1.21	
CD _{5%}	1.81	2.22	N/S		0.07	0.09	0.12		2.24	2.74	N/S	

Note: D₁ (20th October sowing) and D₂ (1st November sowing)

S₁ (60 cm X 30 cm spacing), S₂ (60 cm X 45 cm spacing) and S₃ (60 cm X 60 cm spacing)

N/S (Non-significant).

Table 3: Effect of sowing time and spacing on total yield (q/ha), Vitamin- C content (mg/100g), Chlorophyll content (mg/g) in broccoli.

Treatment	total yield (q/ha)				Vitamin- C content (mg/100g)				Chlorophyll content (mg/g)			
	S ₁	S ₂	S ₃	Mean	S ₁	S ₂	S ₃	Mean	S ₁	S ₂	S ₃	Mean
D ₁	42.55	32.67	25.64	33.62	81.00	70.00	89.00	80	0.90	0.59	0.78	0.76
D ₂	34.22	27.15	21.59	27.65	62.67	62.00	63.67	62.78	0.32	0.29	0.35	0.32
Mean	38.39	29.91	23.62		71.83	66.00	76.33		0.61	0.44	0.57	
Source	D	S	D×S		D	S	D×S		D	S	D×S	
S.Em ±	0.18	0.22	0.31		0.62	0.76	1.08		0.01	0.01	0.01	
CD _{5%}	0.57	0.70	0.99		1.99	2.43	3.44		0.02	0.03	0.04	

Note: D₁ (20th October sowing) and D₂ (1st November sowing)

S₁ (60 cm X 30 cm spacing), S₂ (60 cm X 45 cm spacing) and S₃ (60 cm X 60 cm spacing)

REFERENCES

- Bianco, V.V., Darnato G., Pomarici R., Dias J.S., Crute I. and Montiro A.A. (1996). Sowing and transplanting date in four Cima di rapa (*Brassica rapa* L.) cultivars. I. Sowing dates. *Acta Horticulturae*. **407**: 293-298.
- Csizinsky, A.A. (1996). Optimum planting time, spacing and nitrogen and potassium rates to maximize yield of green cauliflower. *American Society for Horticultural Science*. **31(6)**:930-933.
- Gogoi, S., Das M.R., Bora P., Mazumdar N., Das B.K. (2016). Effect of sowing dates and spacing on broccoli (*Brassica oleracea* var. *italica*) seed production. *Indian Journal of Agricultural Research*. **50(4)**: 350-353.
- Hossain, M.F., Ara N., Uddin M.R., Islam M.R., Azam M.G. (2015). Effect of sowing date and plant spacing on seed production of cauliflower. *Bangladesh Journal of Agricultural Research*. **40(3)**: 491-500.
- Kumar, N., Chaudhary V.P., Srivastva A.K. (2007). Effect of transplanting dates and geometries on broccoli under mid-hills conditions of north-west Himalaya. *Indian Journal of Agricultural Sciences*. **77(7)**: 448-450.
- Prasad, P.H., Thapa U., Mandal A.R., Vishwakarma R. (2010). Response of varieties, spacing and aphid management on growth and yield of sprouting broccoli (*Brassica oleracea* var. *italica* L.) under West Bengal condition. *Environment and Ecology*. **28(2)**: 779-782.
- Roni, M.S., Zakaria M., Hossain M.M., Siddiqui M.M. (2014). Effect of plant spacing and nitrogen levels on nutritional quality of broccoli (*Brassica oleracea* L.). *Bangladesh Journal of Agricultural Research*. **39(3)**: 491-504.
- Saikia, B.R., Phookan D.B., Brahma S. (2010). Effect of time of planting and planting densities on growth, yield and economic production of broccoli [*Brassica oleracea* (L.) var. *italica* Plenck] cv. Pusa broccoli KTS-1. *Journal of Hill Agriculture*. **1(2)**: 135-139.
- Sermenli, T., Mavi K., Yilmaz S. (2011). Determination of transplanting dates of broccoli (*Brassica oleracea* L. var. *italica* Plenck) under Antakya condition. *Journal of Animal and Plant Sciences*. **21(4)**: 638-641.

10. Singhal, P., Srivastava B.K., Singh M.P., Singh P.K. (2009). Effect of date of planting and spacing on the performance of broccoli. *Indian Journal of Horticulture*. **66(1)**: 137-140.
11. Solunke, B.G., Wagh A.P., Dod V.N., Nagre P.K. (2011). Effect of dates of planting and spacing on growth and yield of broccoli. *Asian Journal of Horticulture*. **6(2)**: 294-296.
12. Suthar, V., Aravindakshan K., Bola P.K. (2017). Effect of sowing date and spacing on growth, yield and quality of broccoli (*Brassica oleracea* var. italica).var. Green Head. *Chemical Science Review and Letters*.
13. Thirupal, D., Madhumathi C., SyamSundar Reddy P. (2014). Effect of planting dates and plant spacings on growth, yield and quality of broccoli under Rayalaseema zone of Andhra Pradesh, India. *Plant Archives*. **14(2)**: 1095-1098.
14. Yoldas, F. and Esiyok D. (2004). Effect of plant spacing, sowing and planting date on yield and some quality parameters of broccoli. *The Journal of Agricultural Faculty of Ege University (Turkey)*.

Copyright: © 2021 Society of Education. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.