

Influence of varieties and spacing on growth characters of sprouting broccoli (*Brassica oleracea* L.)

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ABSTRACT

The investigation was undertaken at B.B.A. University, Lucknow (UP) during rabi season of 2017-18 and 2018-19 to study the influence of varieties and spacing on growth characters of sprouting broccoli (*Brassica oleracea* L. var. *italic* Plenck). Four varieties viz. V₁- Pusa Broccoli KTS-1, V₂-Palam Kanchan, V₃-Palam Vichitra, V₄-Palam Samridhi and four spacings viz.- S₁- 60x45 cm, S₂- 60x30 cm, S₃- 45x45 cm, S₄- 45x30 cm were evaluated in factorial randomized block design with three replications. The results revealed that the variety Pusa Broccoli KTS-1 showed the highest plant height (66.7 and 66.2 cm), stem diameter (3.5 and 3.5 cm), plant spreading (E-W and N-S) (61.3, 62.5 and 54.2, 55.3 cm), leaves per plant (23.7 and 23.9), length of leaves (51.1 and 51.1 cm) and width of leaves (30.3 and 30.6 cm). Spacing of 60x45 cm produced significantly highest values of plant height (67.3 and 68.4 cm), stem diameter (3.4 and 3.4 cm), leaves per plant (24.3 and 24.5), length of leaves (51.9 and 52.0 cm) and width of leaves (31.0 and 31.2 cm). The lowest values of these growth characters were recorded under spacing of 45x30 cm. The interaction effect between variety Palam Vichitra and spacing of 60x45 cm showed significant beneficial effect on growth parameters viz.- plant height (68.3 and 68.8 cm), stem diameter (3.5 and 3.6 cm), plant spreading (E-W and N-S) (64.1 and 68.1 and 54.5 and 55.6 cm), leaves per plant (24.7 and 24.9), length of leaves (52.7 and 52.5 cm) and width of leaves (31.3 and 31.3 cm) in sprouting broccoli.

Keywords: Broccoli, varieties, spacing, growth characters

INTRODUCTION

Broccoli (*Brassica oleracea* L. var. *italica*) is a member of the Brassicaceae family. Morphologically, sprouting broccoli resembles cauliflower. The plant forms a sort of head, comprising of green buds and thick beefy blossom stalks. The terminal head is fairly free, green in shading and blossom stalks are longer than cauliflower (Thamburaj and Singh, 2013). It is utilized as plate of mixed greens, half bubbled vegetables, blended in soup with juice of different vegetables and cooked as single or blended vegetables in with potato. It is appreciated for its delectable taste, season and nutritive worth and has been accounted for to forestall disease. It is additionally favored via cardiovascular patients. Broccoli contains around 2500 IU nutrient A, 103 mg calcium, 78 mg phosphorus, 382 mg potassium and 113 mg nutrient C for every 100 g palatable bit. It is additionally rich in sulphoraphane which is known to have against malignancy properties. Being a cool season crop, it requires 15-20° C temperature for head creation. Temperature above 25° C isn't favorable for its development

and can cause slackening and darting of heads. The head is collected alongside a couple of leaves and stem (Singh *et al.* 2014). Varieties play a crucial role in growth and development of crop. In broccoli, very few cultivars such as Pusa KTS-1, Palam Samridhi, Palam Vichitra, Palam Kanchan and Punjab Broccoli-1, which are developed for very cool winter of North India. Optimum plant spacing is one of the important factors in growth parameters of crops. Therefore, present studies were aimed at promotion of high valued broccoli by identifying and standardization of different varieties and optimum plant spacing to obtain better growth characters of sprouting broccoli is important for Lucknow condition. Keeping in view the above facts, the present investigation was planned using broccoli as test crop.

MATERIALS AND METHODS

The field experiment was conducted at Babasaheb Bhimrao Ambedkar University, Lucknow (UP), during rabi seasons of 2017-18 and 2018-19. The experimental site is situated at 26°50' N latitude, 80°52' E longitude and altitude

of 111 meter above mean sea level (MSL). The area experiences rainfall from April to October with many rains from June to early September. The area receives average rainfall between 800 and 1000 mm with annual temperature ranging from 15 to 30°C. Transplanting was done when the seedlings were 30 days old. The transplanting was done on 24th Nov. 2017 and 26th Nov. 2018 in first and second year, respectively. Four varieties viz. V₁- Pusa Broccoli KTS-1, V₂-Palam Kanchan, V₃-Palam Vichitra, V₄-Palam Samridhi with four spacing's viz.- S₁- 60x45 cm, S₂- 60x30 cm, S₃- 45x45 cm, S₄- 45x30 cm were evaluated in factorial randomized block design with three replications. Recommended dose of N, P₂O₅ and K₂O was supplied through urea, single superphosphate and muriate of potash, respectively. Appropriate management practices were adopted to raise the crop. The observations were recorded on growth

parameters viz.-Plant height, stem diameter, plant spreading (E-W direction), plant spreading (N-S direction), leaves per plant, length and, width of leaves and dry weight of plant. All the parameters were collected from randomly selected plants of each treatment. Observations on vegetative parameters were recorded at proper stage and statistically analyzed.

RESULTS AND DISCUSSION

Influence of varieties

Variety Pusa Broccoli KTS-1 recorded (66.7 and 67.2 cm, respectively) the highest plant height during first and second year, respectively, which was followed by variety Palam Kanchan (66.7 and 67.1 cm) in both years. While minimum plant height were obtained in variety Palam Vichitra (66.0 and 66.0 cm).

Table 1: Influence of varieties and spacing's on growth characters of sprouting broccoli

Treatment	Plant height (cm)		Stem diameter (cm)		Plant spreading (E-W direction) (cm)		Plant spreading (N-S direction) (cm)	
	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19
Varieties (V)								
V ₁ (Pusa Broccoli KTS-1)	66.7	67.2	3.5	3.5	61.3	62.5	54.2	55.3
V ₂ (Palam Kanchan)	66.7	67.1	3.3	3.4	61.3	61.9	54.0	54.5
V ₃ (Palam Vichitra)	66.0	66.0	3.1	3.1	58.4	56.9	50.3	49.4
V ₄ (Palam Samridhi)	66.5	66.6	3.1	3.2	58.6	57.0	50.4	49.4
CD(P=0.05)	0.38	0.41	0.34	0.33	1.25	1.33	0.41	0.49
Spacing (S)								
S ₁ (60x45 cm)	67.3	68.4	3.4	3.4	62.5	64.0	52.8	53.2
S ₂ (60x30 cm)	67.3	67.4	3.2	3.3	60.4	60.5	52.4	52.8
S ₃ (45x45 cm)	65.8	65.9	3.2	3.2	59.4	59.3	52.0	52.0
S ₄ (45x30 cm)	64.6	65.1	3.2	3.2	57.3	54.5	51.7	50.7
CD(P=0.05)	0.38	0.41	0.34	0.33	1.25	1.73	0.41	0.49
Interaction (VxS)								
V ₁ S ₁	68.3	68.8	3.5	3.6	64.1	68.1	54.5	55.6
V ₁ S ₂	67.8	68.1	3.5	3.5	63.8	64.1	54.2	55.4
V ₁ S ₃	66.2	66.3	3.4	3.5	61.3	63.1	54.2	55.3
V ₁ S ₄	64.9	65.5	3.4	3.4	56.3	54.6	54.0	55.0
V ₂ S ₁	67.4	68.7	3.5	3.5	62.0	63.9	54.4	55.3
V ₂ S ₂	67.6	67.6	3.3	3.4	61.2	63.6	54.1	50.0
V ₂ S ₃	65.9	65.2	3.3	3.3	61.0	62.4	54.0	54.2
V ₂ S ₄	65.1	65.2	3.2	3.3	60.9	57.5	53.4	51.6
V ₃ S ₁	67.5	68.2	3.2	3.2	63.6	63.6	51.0	50.4
V ₃ S ₂	66.7	67.4	3.1	3.1	57.2	57.3	50.8	49.9
V ₃ S ₃	65.6	65.4	3.1	3.1	56.9	55.8	49.9	48.8
V ₃ S ₄	64.3	64.4	3.1	3.1	55.9	51.0	48.5	48.4
V ₄ S ₁	65.5	66.8	3.2	3.2	60.3	60.3	51.4	50.4
V ₄ S ₂	67.0	66.6	3.1	3.1	59.4	57.2	50.6	49.9
V ₄ S ₃	65.4	65.3	3.1	3.1	58.3	55.8	49.9	49.6
V ₄ S ₄	64.6	65.1	3.1	3.1	56.3	54.9	49.5	47.7
CD (P=0.05)	0.76	0.82	0.68	0.66	2.50	2.46	0.82	0.98

Maximum stem diameter (3.5 and 3.5 cm), plant canopy spreading (E-W direction) (61.3 and 62.5 cm) and plant canopy spreading (N-S direction), (54.27 and 55.38 cm,) were recorded in variety Pusa Broccoli KTS-1 during individual year, which was consequently pursued by variety Palam Kanchan, whereas, minimum values were recorded in Palam Vichitra. Variety Pusa Broccoli KTS-1 recorded maximum number of leaves per plant (23.7 and 23.9), length (51.1 and 51.1 cm) and width of leaves (30.3 and 30.6 cm) during first and second year, respectively. Minimum values were recorded in variety Palam Vichitra. These results are in close conformity with the results of Bhangre *et al.* (2011). Pusa KTS-1 recorded essentially most elevated qualities for growth parameters. Varieties Palam Kanchan recorded the highest dry weight of plant pursued by Palam Vichitra. Thus, there appeared to be very wide differences among these four varieties with respect to growth characters. This may be attributed to variation in the genetic variability among the varieties against growth characters as well as due to changing in the agroclimatic condition. These results are close conformity with the finding of Thakur *et al.* (2016) and Ngullie and Biswas (2014).

Influence of spacing

Table 1&2 revealed that the growth parameters were significantly affected by different spacings. Plant spacing (60x45 cm) had recorded maximum plant height (67.3 and 68.4 cm) during first and second year, respectively followed by spacing of 60x30 cm (67.3 and 67.4 cm,) whereas, minimum values were obtained in spacing of 45x30 cm (64.6 and 65.1 cm). At the end of experiment, maximum stem diameter (3.4 and 3.4 cm), plant canopy spreading (E-W direction), (62.5 and 64.0 cm) and plant canopy spreading (N-S direction), (52.8 and 53.2 cm) were recorded in spacing of 60x45 cm during individual year, respectively which was followed by spacing of 45x30 cm. Minimum values were recorded in spacing of 45x30 cm. These results are in close conformity with the findings of Solunkeet

al. (2011). Spacing of 60x45 cm recorded maximum number of leaves per plant (24.3 and 24.5), length of leaves (51.9 and 52.0 cm) and width of leaves (31.0 and 31.2 cm) during first and second year, respectively, while minimum values were recorded in spacing of 45x30 cm. These findings are in accordance with the findings of Munro *et al.* (2007), Kumar *et al.* (2007), (Saikia and Sanchita Brahma (2010) and Bhangre *et al.* (2001) in broccoli. Plant spacing (60x45 cm) had recorded maximum dry weight of plant (164.8 and 169.2 g) during first and second year, respectively. The higher values of growth parameters at higher plant spacing might mainly due to increased intra-row plant competition for light, moisture, nutrients and other environmental resources under this treatment. Similar results were reported by Agarkar *et al.* (2010), Kumar *et al.* (2007) and Vinod Sutar *et al.* (2017).

Interaction

Table- 1&2 showed that the growth parameters were significantly influenced by interaction between varieties and spacing's. The maximum plant height was recorded under V_1S_1 treatment (68.3 and 68.8 cm) during first and second year, respectively. Significantly maximum stem diameter during first and second year (3.5 and 3.4 cm, respectively), plant canopy spreading (E-W and N-S), (64.1, 68.1 and 54.5, 55.6 cm,) was recorded under $V_1 \times S_1$ treatment. Interaction V_1S_1 produced maximum leaves per plant (24.7 and 24.9), length of leaves (52.7 and 52.5 cm) and width of leaves (31.3 and 31.3 cm,) followed by interaction V_2S_1 . Similar results were also observed by (Saikia and Sanchita Brahma, 2010). The minimum leaves per plant, length of leaves and width of leaves was observed under V_3S_4 . Maximum dry weight of plant was observed in V_2S_4 (201.3 and 206.1 g) during first and second year, respectively followed by V_2S_3 (194.3 and 204.3 g) during first and second year, respectively, whereas, minimum dry weight of plant was obtained in V_1S_1 . These results are in close conformity with the results of Bhangre *et al.* (2011).

Table 2: Influence of varieties and spacing on growth characters of sprouting broccoli

Treatment	Number of leaves per plant		Length of leaves (cm)		Width of leaves (cm)		Dry weight of plant (g)	
	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19
Varieties (V)								
V ₁ (Pusa Broccoli KTS-1)	23.7	23.9	51.1	51.1	30.3	30.6	109.1	115.6
V ₂ (PalamKanchan)	23.6	23.7	50.8	50.9	29.8	30.1	190.3	198.0
V ₃ (PalanVichitra)	23.2	23.2	49.1	49.0	29.4	29.6	176.0	179.5
V ₄ (PalamSamridhi)	23.5	23.7	50.6	50.7	29.8	30.0	114.8	121.7
CD(P=0.05)	0.37	0.43	0.31	0.38	1.01	0.90	5.17	9.91
Spacing (S)								
S ₁ (60x45 cm)	24.3	24.5	51.9	52.0	31.0	31.2	133.4	137.8
S ₂ (60x30 cm)	24.0	24.0	50.8	50.9	30.5	30.8	143.9	148.5
S ₃ (45x45 cm)	23.1	23.2	50.2	50.2	29.4	29.8	150.8	159.3
S ₄ (45x30 cm)	22.8	22.8	48.7	48.6	28.6	28.5	164.8	169.2
CD (P=0.05)	0.37	0.43	0.31	0.38	1.01	0.90	5.17	9.91
Interaction (VxS)								
V ₁ S ₁	24.7	24.9	52.7	52.5	31.3	31.3	99.4	101.7
V ₁ S ₂	24.2	24.3	51.4	51.9	30.7	31.1	107.7	110.3
V ₁ S ₃	23.1	23.4	51.0	50.7	30.0	30.4	110.9	120.1
V ₁ S ₄	23.0	23.0	49.3	49.3	29.1	29.8	119.3	130.3
V ₂ S ₁	24.5	24.7	52.4	52.3	31.1	31.2	176.4	184.7
V ₂ S ₂	24.1	24.2	51.1	51.4	30.5	30.8	189.3	196.8
V ₂ S ₃	23.0	23.1	57.0	50.8	29.3	29.7	194.3	204.3
V ₂ S ₄	23.0	22.9	48.8	49.0	29.1	28.8	201.3	206.1
V ₃ S ₁	23.9	24.0	50.4	51.0	30.4	31.0	156.3	162.3
V ₃ S ₂	23.5	23.4	49.8	49.0	30.0	30.4	174.1	175.3
V ₃ S ₃	23.3	23.1	48.3	48.7	29.4	29.8	183.2	188.4
V ₃ S ₄	22.1	22.4	47.7	47.3	28.0	27.1	190.2	192.1
V ₄ S ₁	24.1	24.4	52.1	52.2	31.1	31.1	101.3	102.3
V ₄ S ₂	24.0	24.1	51.0	51.3	30.8	30.9	104.5	111.7
V ₄ S ₃	23.0	23.9	50.4	50.7	29.0	29.4	114.8	124.3
V ₄ S ₄	22.9	23.0	49.1	48.8	28.4	28.4	138.4	148.5
CD(P=0.05)	0.74	0.86	0.62	0.76	2.02	1.80	10.34	19.82

It may be concluded from the results that the varieties and spacing's showed significant variation among the different growth parameters. Generally, the wider plant spacing performed better for broccoli. Thus, variety Pusa Broccoli

KTS-1 and spacing of 60x45cm and their interaction significantly showed the maximum plant height, stem diameter, plant canopy spreading, leaves per plant, length of leaves and width of leaves.

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