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T Tejaswini
Department of Vegetable Science, College of Horticulture, SD Agricultural University, Sardarkrushinagar, Gujarat, India

LR Varma
Department of Vegetable Science, College of Horticulture, SD Agricultural University, Sardarkrushinagar, Gujarat, India

P Verma
Department of Vegetable Science, College of Horticulture, SD Agricultural University, Sardarkrushinagar, Gujarat, India

P Arun Kumar
Department of Horticulture Agricultural College, Jagtial Telangana, India

RI Prajapati
Department of Vegetable Science, College of Horticulture, SD Agricultural University, Sardarkrushinagar, Gujarat, India

Correspondence
T Tejaswini
Department of Vegetable Science, College of Horticulture, SD Agricultural University, Sardarkrushinagar, Gujarat, India

Studies on interaction effect of plant spacing on different varieties with respect to growth and yield of broccoli (*Brassica oleracea var. italica.* L)

T Tejaswini, LR Varma, P Verma, P Arun Kumar and RI Prajapati

Abstract
Present investigation was carried out during *Rabi*, 2015-16 at Horticulture Instructional Farm, CP College of Agriculture, SD Agricultural University, Sardarkrushinagar, Gujarat with 12 treatments replicated thrice in Split Plot Design. The treatment combinations were three plant spacings *viz*., S_1: 30 cm × 30 cm, S_2: 45 cm × 30 cm and S_3: 45 cm × 45 cm with four varieties *viz*., Palam Samridhi (V_1), Palam Vichitra (V_2), Pusa Broccoli KTS-1 (V_3) and Palam Haritika (V_4). Results revealed that S_1V_3 recorded maximum plant height at transplanting (23.92 cm), while S_1V_2 recorded maximum plant height at 45 DAT (43.52 cm) while S_1V_4 recorded maximum at harvest (69.50 cm). Number of leaves at harvest (23.70), plant spread at 45DAT [E-W 55.09 cm N-S 53.27 cm] and at harvest [E-W 65.91 cm N-S 65.67 cm] were recorded maximum with treatment combination S_3V_4. The minimum number of days taken for head initiation and head harvesting were recorded with treatment combination S_1V_1 whereas maximum head diameter with highest yield per plant were observed with S_3V_2.

Keywords: Broccoli, spacings, varieties, growth and yield parameters

1. Introduction
Broccoli (*Brassica oleracea* var. *italica* L.), an important fancy and nutritive exotic vegetable of cruciferous family also known as winter broccoli or heading broccoli or Italian broccoli is considered to be originated from wild cabbage, *Brassica oleracea* var. *Sylvestris* L. which is found growing wild along the Mediterranean Sea. It is rich source of sulphoraphane associated with reducing the risk of cancer (Guo *et al*. 2001) [2]. Nutritionally, it is rich in vitamin-A, C, protein, carbohydrates and minerals (Rana, 2008) [7]. After harvesting the head, its green leaves are also a good source of nutritious green fodder and serves in acute shortage in winter season (Kumar *et al*. 2007) [4].

Plant spacing is an important factor that will influence the plant population per unit area plays an important role in growth and development of the crop. Optimum plant spacing is one of the important factors in increasing the yield and quality of crops. Therefore, present studies were aimed at promotion of high valued broccoli by identifying and standardization of optimum plant spacing to obtain better growth, yield and quality of broccoli is important for North Gujarat. There are no any recommendation has been available with respect to suitability of specific variety for certain region. So, there is a research need to make a certain recommendations to generate research evidences with respect to suitability of certain varieties in a specific season to benefit the growers of North Gujarat region.

2. Materials and Methods
The present investigation was executed at Horticulture Instructional Farm, CP College of Agriculture, Dantiwada Agricultural University, Sardarkrushinagar, Gujarat during 2015-16. The experiment was laid out in a split plot design with three replications with plots of 2.70 m x 1.80 m size. The experiment was carried out with three different plant spacing (S_1 30 cm × 30cm, S_2 45 cm × 30 cm and S_3 45 cm × 45 cm) and four varieties (Palam Samridhi, Palam Vichitra, Pusa broccoli KTS-1 and Palam Haritika) (table. 1). Recommended package of practices were followed to keep good crop stand. The mean data were subjected to statistical analysis following analysis of variance technique suggested by Panse and Sukhatme, 1985 [6].

Table 1: Details of treatments combinations

S. No	Treatment Notations	Treatment Combinations
1.	S_1V_1	Plant spacing (30 cm × 30 cm) with variety Palam Samridhi
2.	S_1V_2	Plant spacing (30 cm × 30 cm) with variety Palam Vichitra
3.	S_1V_3	Plant spacing (30 cm × 30 cm) with variety Pusa broccoli KTS-1
4.	S_1V_4	Plant spacing (30 cm × 30 cm) with variety Palam Haritika
5.	S_2V_1	Plant spacing (45 cm × 30 cm) with variety Palam Samridhi
6.	S_2V_2	Plant spacing (45 cm × 30 cm) with variety Palam Vichitra
7.	S_2V_3	Plant spacing (45 cm × 30 cm) with variety Pusa broccoli KTS-1
8.	S_2V_4	Plant spacing (45 cm × 30 cm) with variety Palam Haritika
9.	S_3V_1	Plant spacing (45 cm × 45 cm) with variety Palam Samridhi
10.	S_3V_2	Plant spacing (45 cm × 45 cm) with variety Palam Vichitra
11.	S_3V_3	Plant spacing (45 cm × 45 cm) with variety Pusa broccoli KTS-1
12.	S_3V_4	Plant spacing (45 cm × 45 cm) with variety Palam Haritika

3. Results and Discussion

The interaction effect between different plant spacing and varieties with respect to days taken for germination was found non-significant (table 2).

The significantly maximum plant height of seedling (23.92 cm) at the time of transplanting was found with the treatment combination S_1V_3 and found to be statistically at par with S_3V_1 (22.54 cm) and S_1V_2 (22.47 cm) (table 2). The minimum plant height (18.62 cm) was recorded with S_3V_4. The significantly maximum plant height (43.52 cm) at 45 DAT was found with treatment S_1V_2 found to be statistically at par with S_1V_4 and S_3V_2 (40.31 cm). The minimum plant height (30.32 cm) was observed with treatment combination S_3V_1 at 45 DAT. The significantly maximum plant height at the stage of head harvest (69.50 cm) was found with treatment combination S_1V_4. The minimum plant height at the stage of head harvest (46.47 cm) was recorded with the treatment combination S_3V_2. These findings are in accordance with the findings of Bhangre *et al*. (2011) [1] and Gurjeet (2016) [3] in broccoli and Moniruzzaman *et al*. (2011) [5] in cabbage.

The highest number of leaves at 45 DAT 12.60 was recorded with treatment combination S_3V_2. The lowest number of leaves at 45 DAT was observed with treatment combination S_1V_4 (table. 3). These findings are in accordance with the findings of Bhangre *et al*. (2011) [1], Solunke *et al.* (2011) [8] and Vinod *et al.* (2017) [9] in broccoli. The highest number of leaves at harvest (23.70) was recorded with treatment combination S_3V_4. The lowest number of leaves at harvest was observed with treatment combination S_1V_1. These findings are in accordance with the findings of Bhangre *et al*. (2011) [1], Solunke *et al.* (2011) [8] and Vinod *et al.* (2017) [9] in broccoli.

The maximum plant spread at 45 DAT was recorded [E-W & N-S (55.09 cm) & (53.27cm)] with treatment combination S_3V_4 and was found to be statistically at par with treatment combination S_3V_1. The minimum plant spread [E-W (38.33 cm) N-S (38.57 cm] was observed with treatment combination S_1V_3 (table 3.). The maximum plant spread at Harvest [E-W & N-S (65.91 cm) & (65.67 cm)] was recorded with treatment combination S_3V_4 which was found statistically at par with the treatment combination S_3V_4. These findings are in accordance with the findings of Bhangre *et al*. (2011) [1], Solunke *et al.* (2011) [8] and Vinod *et al.* (2017) [9] in broccoli.

The minimum number of days taken for head initiation was recorded with treatment combination S_1V_1 (48.33 days) which was found statistically at par with the treatment combination S_2V_1 (52.40 days). The maximum number of days taken for head initiation (89.27days) was recorded with treatment combination S_3V_4 (table 4).

The interaction effect of different plant spacing and varieties for no of days taken for first head harvest was found significant. The minimum number of days taken for head harvest (68.40 days) was recorded with treatment combination S_1V_1 which was found statistically at par with the treatment combination S_1V_3 (table 4). The maximum number of days taken for head harvest (105.07 days) was recorded with treatment combination S_3V_4. These results are in accordance with the findings of Bhangre *et al*. (2011) [1], Solunke *et al.* (2011) [8] and Vinod *et al.* (2017) [9] in broccoli.

The interaction effect between different plant spacing and varieties with respect to fresh weight of head and head diameter was found non-significant. The maximum fresh weight of head was recorded with treatment combination S_3V_2 (338.00 g) (table 4). While the minimum fresh weight of head was recorded with treatment combination S_1V_4. The maximum fresh weight of height might be due wider plant spacing and also due to genetic makeup of the variety.

The interaction effect between different plant spacing and varieties with respect to head diameter was found non-significant (table 4). The maximum head diameter was observed with treatment combination S_3V_2 (16.60 cm) while the minimum head diameter was recorded with treatment combination S_1V_4 (9.78 cm). The maximum fresh weight of height might be due wider plant spacing and also due to genetic inheriting character of the variety.

4. Conclusion

From the above study, it is concluded that among the different plant spacing and varieties interaction with respect to growth parameters S_3V_4 recorded maximum number of leaves at harvest, plant spread (E-W & N-S) at 45 DAT and at harvest while the minimum number of days for head initiation and head harvesting was recorded with treatment combination S_1V_1. With respect to yield parameters maximum head diameter with highest yield per plant was recorded with S_3V_2.

Table 2: Interaction effect of plant spacings on different varieties with respect to days taken for germination and plant height at transplanting, 45 DAT and at harvest

Treatment combinations	Days taken for germination	Plant height (cm)		
		At Transplanting	45 DAT	At Harvest
		22.47	43.52	55.83
S_1V_3	3.00	23.92	34.33	49.23
S_1V_4	3.00	20.02	42.19	69.50
S_2V_1	3.00	22.10	36.11	53.07
S_2V_2	6.00	20.43	38.48	59.63
S_2V_3	3.00	21.23	31.35	49.90
S_2V_4	3.00	20.02	33.90	61.67
S_3V_1	3.00	22.54	30.32	51.30
S_3V_2	6.00	20.26	40.31	46.47
S_3V_3	3.00	21.07	30.67	48.97
S_3V_4	3.00	18.62	34.67	58.03
S.Em±	0.096	0.546	1.190	1.928
C.D. at 5%	NS	1.624	3.537	5.727
CV %	4.41	4.47	5.71	6.07

Table 3: Interaction effect of plant spacing on different varieties with respect to number of leaves per plant and plant spread at 45 DAT & harvesting

Treatment combinations	Number of leaves/ plant		Plant spread (cm)			
	45 DAT	At Harvest	45 DAT		At Harvest	
			(E-W)	(N-S)	(E-W)	(N-S)
S_1V_1	10.00	17.55	38.81	38.03	52.88	53.63
S_1V_2	10.27	20.72	44.04	40.15	61.08	55.17
S_1V_3	9.93	18.92	38.33	38.57	58.85	50.03
S_1V_4	9.87	21.52	50.50	41.73	56.66	57.15
S_2V_1	10.67	18.72	41.79	43.91	55.66	57.61
S_2V_2	10.47	21.32	46.66	45.65	55.69	59.87
S_2V_3	10.27	17.59	45.05	43.40	58.85	56.14
S_2V_4	10.07	22.92	43.00	45.64	60.25	60.01
S_3V_1	11.01	19.76	51.65	49.26	59.19	59.78
S_3V_2	12.60	22.36	47.01	52.45	62.49	62.91
S_3V_3	11.53	19.38	47.69	44.67	61.30	60.11
S_3V_4	10.53	23.70	55.09	53.27	65.91	65.67
S.Em±	0.481	0.758	1.256	2.078	1.402	2.128
C.D. at 5%	NS	NS	3.730	NS	4.165	NS
CV %	7.85	6.45	4.75	8.05	4.11	6.34

Table 4: Interaction effect of plant spacing on different varieties with respect to days taken for head initiation, days taken for head harvesting, head diameter and yield per plant (gm)

Treatment combinations	Days taken for head initiation	Days taken for head harvesting	Head diameter (cm)	Yield/plant (gm)
S_1V_1	48.33	68.40	11.43	256.47
S_1V_2	64.73	84.27	13.87	297.60
S_1V_3	51.07	70.80	12.22	226.33
S_1V_4	81.08	102.00	9.78	102.67
S_2V_1	50.73	73.07	13.62	271.00
S_2V_2	71.87	92.33	14.53	300.00
S_2V_3	55.00	75.73	12.89	246.20
S_2V_4	84.53	103.93	10.01	127.87
S_3V_1	52.40	71.87	15.22	313.37
S_3V_2	75.40	95.40	16.60	338.00
S_3V_3	58.67	79.07	13.91	282.13
S_3V_4	89.27	105.07	10.69	168.60
S.Em±	0.799	1.073	0.748	20.543
C.D. at 5%	2.373	3.187	NS	NS
CV %	2.12	2.18	10.05	14.57

5. References

1. Bhangre KK, Sonawane PC, Warade SD. Effect of different varieties and spacing on growth and yield parameters of broccoli (*Brassica oleracea* var. *italica*) under Pune conditions, Asian Journal of Horticulture. 2011; 6(1):74-76.
2. Guo JH, Lee S, Chiang F, Chang, C. Antioxidant properties of the extracts from different parts of broccoli in Taiwan. Journal of Food and Dry Analysis. 2001; 9:96-101.
3. Gurjeet K. Growth, yield and quality of broccoli (*Brassica oleracea var. italica*). As influenced by nitrogen and plant population under different dates of sowing. M.Sc. Thesis. Punjab Agricultural university, Ludhiana. (India), 2016.

4. Kumar N, Praskash V, Srivastva AK. Effect of transplanting dates and geometries on broccoli (*Brassica oleracea var. italica*) under mid hill conditions of North-West Himalaya. Indian Journal of Agricultural Sciences. 2007; 77(7):448-450.
5. Moniruzzaman M. Effect of plant spacings on the performance of hybrid cabbage (*Brassica oleracea* var. *capitata*) varieties. Bangladesh Journal of Agriculture Research. 2011; 36(3):495-506.
6. Panse VG, Sukhatme PV. Statistical methods for agricultural workers, ICAR. Pub., New Delhi, 1985.
7. Rana, MK. Olericulture in India. Kalyani Publishers, New Delhi. 2008, 301p.
8. Solunke BG, Wagh AP, Dod VN, Nagre PK. Effect of dates of planting and spacing on performance of different cultivars on growth and yield of broccoli. The Asian Journal of Horticulture. 2011; 6(2):294-296.
9. Vinod Sutar, Aravindakshan K, Bola PK. Effect of sowing date and spacing on growth, yield and quality of broccoli (*Brassica oleracea* var. *italica*) cultivar. Green head. Chemical science review and letters. 2017. 6(21):209-212.