

Effect of different plant spacings and varieties on growth yield and quality attribute characters of sprouting broccoli (*Brassica oleracea* var. *italica* Plenck)

Abstract

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To investigate the effect of different plant spacing (S_1 (45x45 cm), S_2 (60x45 cm), and S_3 (50x45 cm) and varieties (V_2 Pusa KTS-1, V_3 Ganesh, and V_1 Broccoli Green) on different quality attributes in sprouting broccoli (*Brassica oleracea* var. *italica* Plenck) with nine treatments. The field experiment was conducted at the Horticulture Research farm of the Department of Horticulture, BabasahebBhimraoAmbedkar University (A Central University), Vidya-Vihar, Rae-Bareilly Road, Lucknow-226025 (U P), India during the Kharif season of 2019-2020 in a Randomized Block Design. On November 16th, 2019, week 2nd, seedlings of three different cultivars (V_2 Pusa KTS-1, V_3 Ganesh, and V_1 Broccoli Green) were transplanted in the field at three different plant spacing. S_1 (45 x 45 cm), S_2 (60 x 45 cm), and S_3 (50 x 45 cm) were transplanted. They investigated different parameters such as growth parameters, plant height, number of leaves, length of leaves (cm), days to 50% curd initiation and 50% curd maturity, and in the case of yield parameters such as number of auxiliary branches in broccoli, weight of curd, as well as in quality parameters such as curd colour, shape of curd, curd compactness, etc. I have found that significant performance of varieties with spacing and varieties at a given parameter (S_2 60 x 45 cm) is performed better with Pusa KTS-1 as compared to (S_3 50 x 45 cm) with variety Ganesh, and at a lower recorded at (S_1 45 x 45 cm) with variety Green Broccoli.

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Keys words:-Broccoli, Spacing, Varieties.

Introduction:-

Broccoli (*Brassica oleracea* var. *italica* Plenck) is a member of the Cole group of crops. It is a native place in the Mediterranean region. The word "cole" is abbreviated from "caulis", which means stem. Broccoli belongs to the family Brassicaceae. All the Cole group of crops originated from a common ancestor, wild cabbage/colewort's (*Brassica oleracea* var. *Sylvestris*). Broccoli is an Italian word derived from the Latin word brachium, meaning an arm or branch (Thamburaj and Singh 2013). Morphologically, broccoli resembles cauliflower, but the major difference between cauliflower and broccoli is cauliflower's lack of an auxiliary branching habit. The edible parts of the broccoli crop are the modified inflorescence and the flower stalk terminal head. Broccoli grown in India is commonly known as green sprouting broccoli or Calabrese. In the case of broccoli, after the completion of the growth of the primary inflorescence (terminal head), a small secondary inflorescence (sprout) appears in the axils of the lower leaves. They are used for salads with half-boiled vegetables. It is also used in soups with other vegetable juices or as a single vegetable mixed with potatoes. It has been found that delicious taste and good flavour, as well as nutritive

values, are very high and are easily preferred by cardiac patients. Broccoli is an important, fancy, and highly nutritive exotic vegetable. Broccoli is a rich source of sulphoraphane, which is associated with reducing the risk of cancer (Guo *et al.*, 2001), also found carcinogenic and antioxidant. The primary inflorescence was characterised by higher levels of dry matter, total nitrogen, vitamin-C, chlorophylls, beta-carotene, and carotenoids, and by lower levels of nitrates.

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The growth, yield, and quality of crop plants are mainly influenced by two principal factors, viz., genetically and cultural or management factors. The first factor deals with the various breeding techniques for the improvement of crop varieties. The second factor deals with horticultural practices, viz., plant population, date of planting, fertiliser dose, irrigation, weed control, etc. Among them, the plant population per unit area is very important. They are high-demand Chinese cabbage, red cabbage, Brussels sprout, and broccoli crops. In its edible portion, broccoli has the highest nutritive value of vitamin A (9000 IU/100g), thiamine (33mg/100g), vitamin C (137mg/100g), calcium (103mg/100g), phosphorus (78mg/100g), and potassium (382mg/100g). Sprouting broccoli has 130 times more vitamin A than cauliflower and 22 times more than cabbage. Heading broccoli is highly nutritive and it contains 3.3% protein.

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Materials and methods:-

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The present experiment was conducted during rabi season October to February on Horticulture Research farm Department of Horticulture, Babasaheb Bhimrao Ambedkar University (A Central University) Vidya Vihar Rae Bareilly Road Lucknow-226025 (UP), India during of 2019-2020. Geographically, Lucknow is situated at 26°50' North latitude, and 80°52' East longitude, and altitude of 123 meter above mean sea level (MSL). Lucknow has sub-tropical climate with an average annual rainfall of about 1000 mm. The winters are severing and summer is dry and hot. The maximum temperature generally goes to 43°C in summer, and minimum up to 3°C in winter. Monsoon generally sets in during third week of June, and recedes by the end of September with heavy rainfall during monsoon season. Meteorological observation taken by IISR Lucknow, and soil type of field was sandy clay loam with slightly alkaline while pH is near about 6.5 to 8.5. The experiment is done in RBD design with two factors (factor-1-variety and factor 2- spacing in 9 treatments with 3 replication, and 27 numbers of plot and net plot size 2.40m x 1.80m (3 meter length and 1 meter width) and Grass cultivated area 24.1 meter X 7.9 meter. The seedling become ready for transplanting 28 days after sowing (4 to 5 leaf stage). The treatments comprised of three varieties (Pusa KTS-1, broccoli green, Ganesh) and three planting spacing (60 x 45cm, 50x45cm, and 45 x 45 cm). The recorded observations recorded were growth parameters, plant height, number of leaves, length of leaves (cm), days to 50% curd initiation, and days to 50% curd maturity, and in case of yield parameter such as number of auxiliary branch in

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broccoli, as well as in quality parameter curd colour, shape of curd, curd compactness, etc. ~~Statistical analysis of data obtained in different set of experiments was calculated following the standard procedure.~~ Application of fertilizer in field at the recommended dose of our crop in the field, 100kg of N₂ and 80 kg of P₂O₅ and as well as 60 kg of K₂O kg/ha. The fertiliser is applied with a half dose of N, a full dose of P, and a full dose of K at the time of transplanting as per recommended. The half doses of N are given twice in the experiment field, one of them at 30 days and another at 45 days after transplanting. Statistical analysis of data obtained in different set of experiments was calculated following the standard procedure.

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Results and Discussion

Effect of varieties:-

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The data was collected on a daily basis for the first few days after transplantation. The data presented in the Table reveals a significant effect of variety. Among the varieties, with respect to plant height, number of leaves, and length of leaves (cm), we recorded that V₂ (Pusa KTS-1) showed maximum plant height superior to that of V₃ (Genesh), while V₁ (Broccoli Green) recorded a lesser plant height, number of leaves, and number of leaves than that recorded by **Singh et al. (2014)**. While in the case of days after 50% curd initiation, it was recorded that varieties V₂ (Pusa KTS 1) take more days for 50% curd initiation than V₃ (Ganesh), while the fewer days taken for 50% curd initiation were found in variety V₁ (Broccoli Green) reported by **Thapa et al. (2013) and Thapa and Rai (2012)**. As well as days after 50% curd maturity Varieties expressed significant effects on days of 50% curd maturity as per data recorded. According to **Singh et al. (2014) and Thapa and Rai (2012)**, variety V₂ (Pusa KTS-1) takes the most days to reach 50% curd maturity, followed by variety V₃ (Ganesh) and variety V₁ (Broccoli Green). In the case of yield parameters such as number of auxiliary branches in broccoli and curd weight, they found among the varieties, number of auxiliary showed a significant effect. V₂ (Pusa KTS-1) provides the maximum number of auxiliary inflorescence as compared to V₃ (Genesh). **Ngullie and Biswas (2014)** report that V₁ (Broccoli Green) has fewer auxiliary genes. In the case of quality parameters such as curd colour, shape of curd, and curd compactness, they have found In the case of Pusa KTS-1, the green colour is flat and slightly loose; in the case of Ganesh, the dark green colour is domic and compact; and in the case of Broccoli Green, the green colour curd and head shape curd and slightly loose similar result found **Bhangreet al. (2011)**.

Effect of spacing:-

The data was collected on a regular basis for several days after the broccoli crop was planted. The data presented in the table reveals a significant effect of spacing. With respect to the spacing, with respect to plant height, number of leaves, and length of leaves (cm), we have recorded that S₂ (60x45cm) is the maximum as compared to S₃ (50x45cm), where minimum plant height is recorded at spacing S₁ (45x45cm) observed by **Singh et al. (2006), Bhangreet al. (2011), and Yadav et al. (2016)**. Among the plant spacing, the maximum number of leaves is observed at spacing S₂ (60x45cm) at a maximum as compared to S₃ (50x45cm), where the minimum number of leaves is recorded at spacing S₁ (45x45cm). The same result is found by **Singh et al. (2006), Gariya et al. (2016), and Yadav et al. (2016)**. While in the case of the

length of leaves (cm) and width of leaves (cm), there is a significant effect of plant spacing on leaf length. Maximum leaf length spacing S₂ (60x45cm) is recorded as maximum as compared to S₃ (50x45cm), while minimum leaf length is also recorded. S₁ spacing (45 x 45 cm). Plant spacing exerted a significant effect on the number of days to 50% curd initiation. Plant spacing S₂ (60x45cm) takes more days as compared to S₃ (50x45cm), where minimum days are recorded at spacing S₁ (45x45cm). Similar results have been reported by **Thapa and Rai (2012) and Rhaeta et al. (2013) in broccoli**. as well as days after 50% curd maturity Plant spacing S₂ (60x45cm) takes more days to reach 50% curd maturity as compared to S₃ (50x45cm), where minimum days are recorded at spacing S₁ (45x45cm). Plant spacing showed a significant effect on the number of days to 50% curd maturity on the broccoli crop. Similar results have been reported by **Singh et al. (2014)**. In the case of yield parameters such as number of auxiliary branches in broccoli and curd weight, they have found that at plant spacing, maximum weight of curd and number of auxiliary branches are observed at spacing S₂ (60x45cm) as compared to S₃ (50x45cm), where minimum weight of curd is recorded at spacing S₁ (45x45cm). They have found a significant effect of the weight of curd on spacing. These results are in agreement with **Prasad et al. (2010) and Bhangreet et al.(2011)**. In terms of quality parameters, curd color, curd shape, and curd compactness, they found that Pusa KTS-1 in all spacing, where they revealed green colour curd, flat shape, and slightly loose curd; Ganesh in all spacing, where they found that dark green colour curd, domic shape, and compact of the curd; and Broccoli Green varieties in all spacing, where they found that green colour curd, head shape, and slightly loose compact of curd. Similar results are found by **Bhangreet et al. (2011)**.

Interaction effect of varieties and spacing:-

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Among varieties and spacing interaction effects, significant for growth parameters such as plant height, number of leaves, length of leaves (cm) and quality parameters such as weight of curd and number of auxiliary branches, while in the case of quality parameters, curd colour, curd shape, and curd compactness are influenced by varieties but not influenced by spacing.

Conclusion:-

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Finally, after our experiment, we found that the combined effect of varieties and spacing on the growth parameters such as plant height, number of leaves, length of leaves (cm), days to 50% curd initiation and days to 50% curd maturity was significant, and yield parameters such as curd weight and number of auxiliary branches were also significant. The variety V₂ (Pusa KTS-1) with a wider spacing S₂(60 x 45 cm) is shown to be most effective in growing the vegetative growth attributes over V₃ (Ganesh) with a wide spacing S₃ (50 x 45 cm) and the minimum vegetative growth obtained at V₁(Broccoli Green) with a wide spacing S₁ (45 x 45 cm). While in the case of days to 50% curd initiation and days to 50% curd maturity, they found that varieties V₂ (Pusa KTS 1) with a wide spacing S₂ (60 x 45 cm) take more days for curd initiation and curd maturity as compared to V₃ (Ganesh) with a wide spacing S₃ (50x45cm), while minimum days are taken by V₁ (Broccoli Green) with a wide spacing S₁ (45x45cm). While in the case of quality parameters such as weight of curd and number of auxiliary branches, while in the case of quality parameters, curd colour, curd shape, and curd compactness are influenced by varieties but not influenced by spacing. So this significant result is recommended for commercial cultivation under Lucknow conditions.

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V2S2	17.9	26.9	39.1	9.3	12.3	15.3	9.2	17.6	22.5	75.3	81.3	259.5	13:3	Formatted: Centered, Space After: 0 pt
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V3S1	15.5	23.5	35.7	7.3	10.3	11.7	7.3	14.4	19.7	59.6	64.7	122.1	7:7	Formatted: Centered, Space After: 0 pt
V3S2	15.4	23.6	36.9	6.7	9.7	12.7	7.7	15.7	20.6	65.3	69.7	148.8	10:2	Formatted: Centered, Space After: 0 pt
V3S3	16.8	25.2	37.3	8.3	11.3	14.3	8.1	16.4	21.2	63.4	72.3	178.5	9:5	Formatted: Centered, Space After: 0 pt
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Table no-3 Effect of different spacing and varieties on quality parameter of broccoli crop.

Treatment		Colour	Shape	Compactness
Varieties	Spacing			
Ganesh broccoli	S₁(45x45cm)	Dark green	Domic	Compact
	S₂(60x45cm)	Dark green	Domic	Compact
	S₃(50x45cm)	Dark green	Domic	Compact
Pusa KTS 1	S₁(45x45cm)	Green	Flat	Slightly loose
	S₂(60x45cm)	Green	Flat	Slightly loose
	S₃(50x45cm)	Green	Flat	Slightly loose
Broccoli Green	S₁(45x45cm)	Green	Head	Slightly loose
	S₂(60x45cm)	Green	Head	Slightly loose
	S₃(50x45cm)	Green	Head	Slightly loose

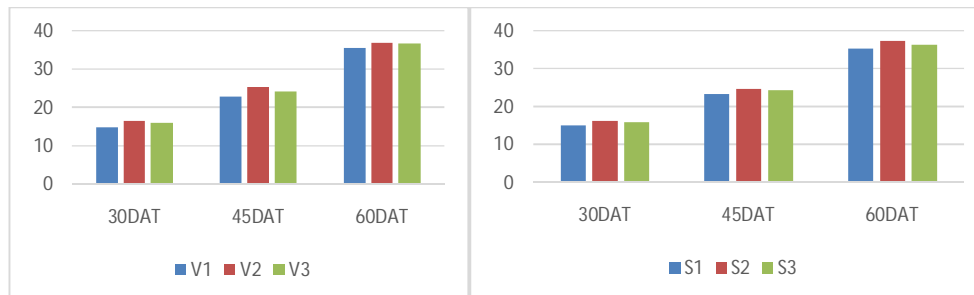
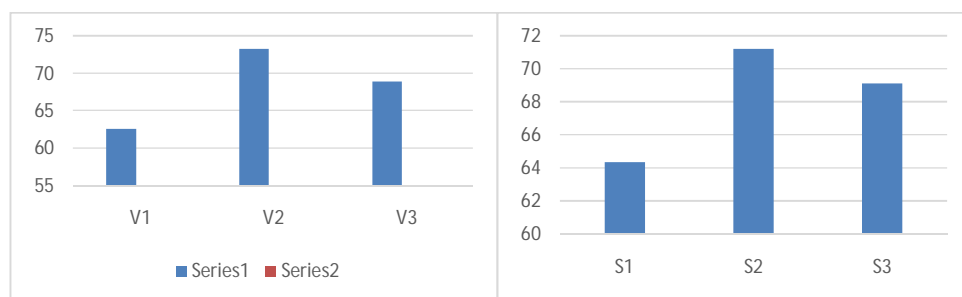


Fig.1 Effect of variety and spacing on plant height 30,45, 60 DAT(days after transplanting)



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Fig.2 Effect of variety and spacing on 50% curd maturity

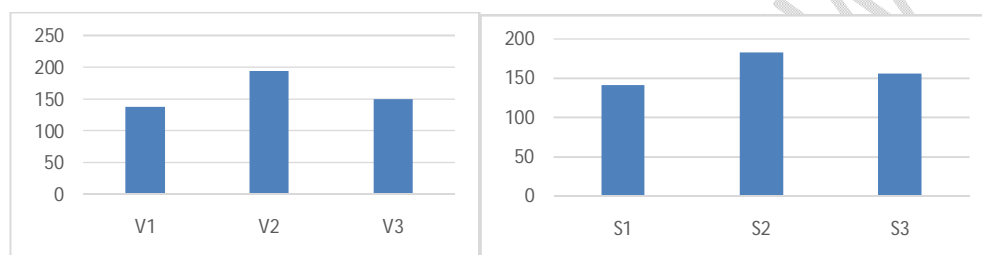


Fig.3 Effect of variety and spacing on weight of curd

References:-

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