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Effect of spacing and mulching on growth, yield and quality of sprouting Broccoli (*Brassica oleracea var. italica*)

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Abstract

A field experiment was conducted to study the effect of spacing and mulching on growth, yield and quality of sprouting broccoli. The broccoli cultivar Palam Samridhi comprised the plant material for investigation. The experiment was laid out in factorial randomized block design with three replications. The experiments were consisted three spacing (45 x 30 cm, 45 x 45 cm, 45 x 60 cm) and four mulching (FYM, Black polythene mulch, White polythene mulch and no mulch). The data were recorded on various growth, yield and quality parameters. Results revealed that the application of black polythene mulch with wider spacing (45 x 60 cm) proved to be most effective in increasing the vegetative growth and quality characters of sprouting broccoli while, narrow spacing (45 x 30 cm) with black polythene mulch induces the higher yield of sprouting broccoli under Punjab conditions in terms of growth, yield and biochemical characters.

Keywords: Sprouting broccoli, spacing, mulching, yield, quality

Introduction

Sprouting broccoli (*Brassica oleracea var. italica* L.), belongs to family Cruciferae, is a member of Cole group. Broccoli closely resembling cauliflower but differs from same in being green. In India, it is mainly grown in hilly areas of Himachal Pradesh, Jammu and Kashmir, Nilgiri Hills, Uttar Pradesh and Northern plains^[1, 2]. The curd of broccoli is formed from a compact flower head and produces a green curd that rapidly develops into a mass of fertile flower buds^[2]. Broccoli has high nutritive value and many health benefits. It contains carbohydrates (5.5 %), protein (3.3 %), vitamin-A (3500 IU), vitamin-C (137 mg), vitamin-B1 (0.05 mg), vitamin-B2 (0.12 mg), calcium (0.80 mg) and phosphorus (0.79 mg)^[1, 2]. Broccoli has 4.0, 2.5 and 2.0 times more riboflavin, calcium and ascorbic acid content respectively as compared to cauliflower^[3]. It is also rich source of sulphoraphane which is associated with reducing the risk of cancer. Broccoli is used as curries, soups, and pickles and also eaten as salad and cooked as sole or mixed vegetable with potato^[4].

In the cultivation of broccoli, weed causes the serious problem. It reduces the yield, quality and increases the cost maintenance. Weeds compete with crops for water, nutrients and light. In order to prevent the problem of weed growth, evaporation from soil surface, to protect the soil surface from the influence of unfavorable factors and to improve the growing conditions for the crop plant, the practice of mulching is beneficial^[5]. Mulches influence on weed growth by blocking the daylight, which suppress their emergence and growth. It acts as surface barrier to check evaporation to water from soil surface. Black polyethylene is popular for vegetable production in cool season because it warms the soil by contact^[6]. Mulches significantly enhanced root growth and facilitated higher nutrient uptake, thereby, promoting growth and development of plants^[7].

Plant spacing plays a significant role on growth, development and yield of plant. Closer spacing hampers intercultural operations and as such more competition arises among the plants for nutrients, air, and light whereas, wider spacing produces larger plants with more vigorous growth and better quality produce. It helps to increase the number of leaves, branches and healthy foliage. Plant population is directly related to spacing, with more spacing, number of plants per unit area is decreased. So, it provides more area for plant establishment. Hence, keeping in view the above facts in mind present investigation is framed to study the effect of spacing and mulching on growth, yield and quality sprouting broccoli (*Brassica oleracea var. italica*).

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Materials and Methods

The present work was conducted at Research Farm, Department of Agriculture, Khalsa College, Amritsar during 2019-20. The experiment consists of twelve treatment combinations with three spacing namely 45 x 30 cm, 45 x 45 cm, 45 x 60 cm and four mulches namely FYM, Black polythene sheet, White polythene mulch and no- mulch in Factorial Randomized Block Design with three replications. The unit plot size was 3m x 3m. A basal dose of half of the nitrogen @ 150 kg ha⁻¹, full dose of phosphorous @ 120 kg ha⁻¹ and potash @ 100 kg ha⁻¹ was applied at the time of land preparation. Nitrogen was applied into two splits, at the time of transplanting and remaining half after 45 days of transplanting. Mulching was done before transplanting of seedling. Seedlings were transplanted after one month of seed sowing and irrigations were done when necessary. Three weeding was also done after planting. Five plants were selected randomly for data collection. Immature and developed broccoli heads from each treatment were harvested at 7-10 day interval throughout the harvesting season. The plant height, number of leaves per plant and leaf area, days taken to curd initiation, weight of primary curd, number of secondary curds, weight of secondary curds, total yield per plant, total yield per plot, total yield per hectare, chlorophyll content in leaves, vitamin C content in head and TSS were recorded following earlier reported methods [1, 2].

Result and discussion

Effect of spacing

As evident from table 1, 2 and 3 the maximum plant height was obtained in narrow spacing (45 x 30 cm) at 30, 60 and 75 days after transplanting. This observation is primal attributed due to less availability of space around the growing plant and subsequently plant growth was upward. These findings are in close accordance with earlier findings [8, 9]. The maximum number of leaves per plant at 30, 60 and 75 days after transplanting was recorded in wider spacing (45 x 60 cm). The leaf area, minimum days taken to curd initiation, weight of primary curd, number of secondary curds, weight of secondary curds and total weight of plant were found maximum under wider spacing (45 x 60 cm). Plants planted in wider spacing experience less competition for space, nutrients and light between the plants and thus have maximum food

accumulation ability. This led to luxurious vegetative growth and maximum weight of curd. These results are in conformity with those of earlier reports in cauliflower [10, 11] and broccoli [12, 13].

Total yield per plot and per hectare were recorded maximum under narrow spacing (45 x 30 cm). The main reason for maximum yield per plot and per hectare in closer plant spacing was due to higher plant population per unit area. These findings are in close accordance with findings of in broccoli [14]. Quality characters such as maximum chlorophyll content in leaves and maximum vitamin C content in head were found in wider spacing (45 x 60 cm). Plants grown at wider spacing, receive more sunlight resulting increased photosynthesis and dry matter content. Similar results have been report earlier in broccoli [15]. There was no effect of spacing on TSS of sprouting Broccoli.

Effect of mulching

Maximum plant height, number of leaves per plant at 30, 60 and 75 DAT, leaf area, weight of primary curd, number of secondary curds, weight of secondary curd, total yield per plant, total yield per plot, yield per hectare, chlorophyll content in leaves, vitamin C content in head and TSS were obtained with application of black polythene mulch treatment (Table 1, 2 and 3). Mulching showed non-significant effect on days taken in curd initiation. This might be due to the fact that use of black polythene mulch efficiently controlled weed growth by inhibiting photosynthesis conserved more soil moisture in rhizosphere, created etiolated conditions in plant rhizosphere there by increased root growth and more uptake of nutrients from the soil by the plants. This situation ultimately resulted in increased yield and produce better quality of curds [16]. Black polythene mulch also provides extremes in the absorbance of short wave radiations [17].

Interaction effect of spacing and mulching

Interaction between various factors under study was found to be non-significant for most of the parameters. An interaction between spacing and mulching revealed the maximum leaf area of 439.66 cm², weight of primary curd 245 g and weight of secondary curds 167 g were obtained with the combination of wider spacing (45 x 60 cm) and black polythene mulch.

Table 1: Effect of spacing and mulching on growth characters of sprouting broccoli

Treatments	Plant height (cm)			Number of leaves per plant			Leaf area (cm ²)	Days taken to curd initiation
	30DAP	60DAP	75DAP	30DAP	60DAP	75DAP		
Spacing								
45 x 30 cm	24.61	44.79	55.65	5.3	12.9	18.6	326.16	53.72
45 x 45 cm	22.01	43.06	53.52	6.0	13.2	19.8	388.33	57.42
45 x 60 cm	21.08	41.21	51.72	6.9	15.5	21.1	423.82	60.09
CD at 5%	1.77	1.96	2.10	0.68	1.18	0.96	9.28	2.51
Mulching								
FYM	21.38	42.17	52.49	5.5	13.9	19.7	371.11	57.53
Black polythene mulch	25.42	45.44	56.68	7.7	15.2	21.6	402.33	55.76
White polythene mulch	23.10	43.16	53.86	6.2	14.3	20.0	388.98	56.47
No mulch	20.27	41.30	51.50	4.9	12.7	18.1	355.33	58.55
CD at 5%	2.04	2.26	2.42	0.78	1.37	1.10	10.28	NS

Table 2: Effect of spacing and mulching on yield characters of sprouting broccoli

Treatments	Weight of primary curd (g)	Number of secondary curds	Weight of secondary curds (g)	Total weight per plant (g)	Yield per plot (kg)	Yield per hectare (q)
Spacing						
45 x 30 cm	161.65	3.6	104.50	266.15	17.56	193.10
45 x 45 cm	223.15	4.4	123.50	346.65	15.24	169.35
45 x 60 cm	240.41	5.5	151.50	391.91	12.92	143.61
CD at 5%	3.65	0.50	2.93	6.42	1.03	8.10
Mulching						
FYM	205.33	4.3	123.33	328.66	14.93	165.86
Black polythene mulch	217.66	5.0	137.66	355.33	16.22	180.23
White polythene mulch	210.86	4.7	128.66	339.53	15.47	169.29
No mulch	199.75	3.8	116.33	316.08	14.34	159.37
CD at 5%	4.22	0.58	3.38	7.41	1.19	9.35

Table 3: Effect of spacing and mulching on quality characters of sprouting broccoli.

Treatments	Chlorophyll content in leaves (mg/100g)	Vitamin C content in head (mg/100g)	Total soluble solids (°Brix)
Spacing			
45 x 30 cm	0.38	102.96	6.2
45 x 45 cm	0.45	115.39	6.6
45 x 60 cm	0.51	122.27	7.5
CD at 5%	0.01	1.9	NS
Mulching			
FYM	0.42	112.94	6.7
Black polythene mulch	0.48	116.11	7.4
White polythene mulch	0.45	114.97	6.9
No mulch	0.39	110.14	5.8
CD at 5%	0.02	2.2	0.70

Conclusion

It can be concluded from the present investigation that the influence of spacing and mulching on the growth, yield and quality traits of sprouting broccoli was significant. The application of black polythene mulch with wider spacing (45 x 30 cm) proved to be most effective in increasing the vegetative growth and quality characters of sprouting broccoli while, narrow spacing (45 x 30 cm) with black polythene mulch induces the higher yield of sprouting broccoli under Punjab conditions in terms of growth, yield and biochemical characters.

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