

Research Article

Effect of Sowing Date and Spacing on Growth, Yield and Quality of Broccoli (*Brassica oleracea* var. *italica*) var. Green Head

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Abstract

A field experiment entitled 'Effect of sowing date and spacing on growth, yield and quality of broccoli (*Brassica oleracea* var. *italica*) var. Green head' was conducted during the *rabi* season in 2013-14 at the Department of Vegetable Science, College of Horticulture & Forestry, Jhalawar. The experiment consisted of twelve treatment combinations with four levels of sowing date viz. (i) October 01, 2013, (ii) October 15, 2013, (iii) November 01, 2013, (iv) November 15, 2013 and three plant spacing viz. (i) 30 x 30cm, (ii) 30 x 45cm and (iii) 45 x 45cm were included in the study in Randomized Block Design with three replications. The growth, yield and quality contributing all characters were significantly influenced by the treatments. October 01, 2013 sowing produced the highest yield (9.97 kg/plot and 221.73 t/ha) and November 15, 2013 sowing produced the lowest yield (2.40 kg plot⁻¹ and 53.41 q hac.⁻¹) of broccoli. On the other hand, closer spacing (30 x 30cm) produced the highest yield (9.97 kg/plot and 221.73 t/ha) which was statistically similar to 30 x 45cm (8.01 kg plot⁻¹ and 178.07 q hac.⁻¹) and lowest yield (5.73 kg plot⁻¹ and 127.24 q hac.⁻¹) was obtained from 45 x 45 cm spacing.

The growth contributing characters were significantly increased by the treatments of wider spacing than the closer spacing. October 01, 2013 sowing and 30 x 30cm plant spacing combination produced the highest yield and lowest yield (2.40 kg plot⁻¹ and 53.40 q hac.⁻¹) was produced from November 15, 2013 sowing and 45 x 45cm plant spacing combination.

Keywords: *Brassica oleracea*, head, broccoli, sowing date, spacing

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Introduction

Broccoli (*Brassica oleracea* var. *italica*) is an herbaceous winter vegetable and commercial cultivated in India [1]. Broccoli is the most prominent vegetables grown all over the world. 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]. In India, its cultivation is negligible but now it is becoming increasingly popular in hotels in Mumbai, Kolkata, Delhi and Chennai. It prefers cool moist climate for quality heads. Broccoli has high nutritive value and many health benefits. The American Cancer Society (ACS) indicated that it has several anti-carcinogenic effects [3]. Higher plant population reduced head size, lower average marketable head weight and delay maturity [4]. Best quality of broccoli heads are produced when the day temperature is between 25°C to 26°C and night temperature is between 15-16°C. India is endowed with a wide range of agro climatic conditions and so can grow broccoli in winter season. Therefore, the present study was undertaken to identify the best sowing time and plant spacing as no research work has been taken under Jhalawar condition.

Materials and Methods

A field experiment was conducted during the *rabi* season in 2013-14 at the College of Horticulture & Forestry, Jhalawar as a study in Randomized Block Design with three replications (**Table 1**). The unit plot size was 3.0m x 1.5m. The amounts of fertilizer applied (kg/ha) as follows: Nitrogen was applied @ 150 kg ha⁻¹ as per recommendation. As per the treatments combinations nitrogen was supplied through urea. Urea was applied in two split doses. Half dose of urea was applied at the time of transplanting and remaining half after 45 days of transplanting. As per the treatments phosphorus was applied through SSP (60 % P₂O₅), 120 kg ha⁻¹ as basal dose of at the time of transplanting. Potassium was applied through MOP (60 % K₂O) according to treatment @ 100 kg ha⁻¹ as

basal dose of at the time of transplanting. Transplanting will be done after one month and irrigations were done when necessary. Three weeding was also done after planting.

Table 1 Treatments tested

| Factor A | Factor B |
|-----------------------|----------------------|
| Time of sowing | Plant spacing |
| October 01, 2013 | 30x30 cm |
| October 15, 2013 | 30x45 cm |
| November 01, 2013 | 45x45 cm |
| November 15, 2013 | |

Ten 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, plant spread, days to first initiation and harvest, head diameter, length and fresh weight of head, total yield per plot and hectare, chlorophyll, TSS, ascorbic acid, crude protein, dry matter and carotene were recorded.

Result and Discussion

The sowing date and spacing had significantly effect on plant height, number of leaves per plant and Plant spread (EW-NS) on both 30 and 60 DAT recorded the maximum 33.23 cm and 50.40 cm, 10.47 and 24.93, 57.60 and 68.27 cm and 58.40 and 70.93 cm under the treatment combination 01 October sowing and 45 x 45cm spacing. There was significant increase chlorophyll content in the leaves at 60 DAT. The maximum chlorophyll content was under 01 October sowing and 30 x 30 cm spacing 0.57 mg/g (**Table 2**).

The growth attributes of plant is maximum might be due to fact that the plant under in favorable climate and the late sowing of seedling was not congenial for normal growth of plant [5-7]. This effect might to be due to wider spacing plant get more better light, better availability of space, aeration and soil moisture as well as better nutrient for the growth and development of the plant [8-10]. The chlorophyll concentration significantly decreased with every delay in the sowing date [11]. The sowing date and spacing had significantly effect on 15th November sowing and 45 x 45cm spacing recorded the minimum days to first head initiation and harvest 66.97 and 79.70 days. The head diameter, length of head and Fresh weight of head was maximum under 01 October sowing and 45 x 45cm spacing recorded at 14.72 cm, 16.80 cm and 204.50 gm and the yield was maximum recorded at 9.97 kg plot⁻¹ and 221.73 q hac.⁻¹ under the treatment combination 01 October sowing and 30 x 30 cm spacing (Table 2).

Table 2 Effect of sowing date and spacing on growth, yield and quality attributes of broccoli

| Treatment | Plant height (cm) | | Plant spread E-W (cm) | | Plant spread N-S (cm) | | No. of leaves | | first head initiation DAT | first head harvest DAT |
|-----------------|-------------------|-------------|-----------------------|-------------|-----------------------|-------------|---------------|-------------|---------------------------|------------------------|
| | 30 DAT | 60 DAT | 30 DAT | 60 DAT | 30 DAT | 60 DAT | 30 DAT | 60 DAT | | |
| T ₀ | 26.47 | 41.40 | 53.77 | 68.20 | 57.37 | 68.57 | 10.33 | 22.13 | 82.87 | 102.33 |
| T ₁ | 32.37 | 50.07 | 56.17 | 66.40 | 56.13 | 66.63 | 10.40 | 23.23 | 82.00 | 101.77 |
| T ₂ | 33.23 | 50.40 | 57.60 | 68.27 | 58.40 | 70.93 | 10.47 | 24.93 | 81.17 | 99.57 |
| T ₃ | 24.20 | 43.17 | 44.70 | 58.60 | 42.10 | 56.10 | 9.63 | 22.93 | 77.30 | 94.50 |
| T ₄ | 24.40 | 44.67 | 44.03 | 59.63 | 43.60 | 59.33 | 9.97 | 22.07 | 76.97 | 94.43 |
| T ₅ | 24.67 | 46.30 | 46.67 | 61.00 | 45.57 | 59.13 | 10.37 | 24.30 | 75.80 | 92.60 |
| T ₆ | 19.97 | 38.90 | 32.60 | 47.13 | 31.90 | 45.37 | 8.77 | 14.63 | 72.47 | 87.10 |
| T ₇ | 19.63 | 38.47 | 31.73 | 45.07 | 32.37 | 42.53 | 8.27 | 13.97 | 69.10 | 85.40 |
| T ₈ | 19.17 | 40.30 | 33.37 | 44.57 | 32.77 | 43.73 | 8.90 | 14.73 | 71.97 | 87.00 |
| T ₉ | 17.70 | 30.53 | 26.63 | 34.40 | 24.37 | 32.83 | 7.20 | 13.90 | 67.13 | 80.20 |
| T ₁₀ | 17.20 | 29.63 | 27.73 | 35.13 | 26.73 | 36.23 | 7.57 | 14.73 | 67.13 | 79.93 |
| T ₁₁ | 17.60 | 30.37 | 30.37 | 39.17 | 29.80 | 38.57 | 8.00 | 14.83 | 66.97 | 79.70 |
| S.Em± | 2.09 | 2.54 | 1.86 | 2.04 | 1.86 | 1.82 | 0.57 | 2.04 | 0.86 | 0.73 |
| CD at 5 % | 6.17 | 7.51 | 5.59 | 6.03 | 5.48 | 5.37 | 1.69 | 6.03 | 2.52 | 2.16 |

| Treatment | Head diameter (cm) | Length of head (cm) | Fresh weight (g) | Yield per plot (kg) | Yield per hectare (q) | Chlorophyll on leaves (mg/g) | TSS (%) | protein % | Ascorbic acid (mg/100 g) | DRY MATTER (%) |
|-----------------|--------------------|---------------------|------------------|---------------------|-----------------------|------------------------------|--------------|--------------|--------------------------|----------------|
| T ₀ | 14.30 | 15.47 | 199.57 | 9.97 | 221.73 | 0.57 | 6.00 | 20.69 | 80.34 | 9.43 |
| T ₁ | 14.25 | 16.63 | 200.33 | 8.00 | 178.07 | 0.56 | 5.82 | 20.53 | 79.31 | 8.73 |
| T ₂ | 14.72 | 16.80 | 204.50 | 5.77 | 127.23 | 0.54 | 5.85 | 20.14 | 80.23 | 9.40 |
| T ₃ | 14.20 | 14.97 | 163.00 | 8.17 | 181.13 | 0.53 | 5.74 | 20.29 | 78.88 | 9.00 |
| T ₄ | 13.75 | 14.60 | 170.00 | 6.80 | 151.1 | 0.54 | 5.87 | 19.89 | 78.83 | 9.00 |
| T ₅ | 14.50 | 16.17 | 180.67 | 5.07 | 122.43 | 0.52 | 5.72 | 19.89 | 78.99 | 8.40 |
| T ₆ | 14.18 | 13.70 | 126.83 | 6.33 | 140.93 | 0.54 | 5.80 | 13.75 | 68.65 | 7.87 |
| T ₇ | 12.90 | 13.03 | 136.03 | 5.43 | 120.93 | 0.52 | 5.80 | 12.81 | 68.47 | 8.80 |
| T ₈ | 13.02 | 15.10 | 143.17 | 4.00 | 89.07 | 0.51 | 5.78 | 13.90 | 68.48 | 9.17 |
| T ₉ | 11.52 | 11.50 | 86.67 | 4.33 | 96.3 | 0.48 | 5.54 | 14.37 | 62.07 | 8.40 |
| T ₁₀ | 11.93 | 10.97 | 91.67 | 3.67 | 81.47 | 0.48 | 5.63 | 13.22 | 62.07 | 7.83 |
| T ₁₁ | 11.95 | 11.67 | 85.83 | 2.40 | 53.4 | 0.47 | 5.53 | 13.64 | 62.21 | 8.23 |
| S.Em± | 0.44 | 0.80 | 7.54 | 0.27 | 5.33 | 0.013 | 0.084 | 0.486 | 0.233 | 0.528 |
| CD at 5 % | 1.31 | 2.36 | 22.26 | 0.80 | 15.74 | 0.039 | 0.248 | 1.436 | 0.689 | NS |

The wider spacing produced heavier head than closer spacing but maximum yield per plot and hectare obtained in closer spacing this might be due to fact that the significant increases in number of marketable heads with increasing plant density [12-17].

The sowing date and spacing had significantly effect on 01 October sowing and 30 x 30 cm spacing recorded the maximum TSS, Ascorbic acid content in head, Crude protein and Dry matter were recorded maximum TSS (6.07 %), Ascorbic acid content (80.34 mg/100g), Crude protein (20.69 %) and Dry matter (9.43%) respectively as compared to other quality attributes (Table 2).

These quality attributes concentration significantly decreased with every delay in the planting date and they were affected by closer plant spacing and some condition effect might to be due to wider spacing plant get more better light, better availability of space, aeration and soil moisture as well as better nutrient for the growth [18-21].

Conclusion

Results of the present study revealed that 1 October seed sowing is the optimum time for broccoli production in Jhalawar condition. Before 1 October, seed sowing decreases the yield of broccoli. Besides, 30cm x 30cm plant spacing increased statistically similar yield of broccoli. Further studies are needed to optimize the specific time and plant spacing for the highest yield of broccoli.

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