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Full Length Research Paper

Effect of planting density and transplanting time on growth and curd yield of broccoli

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A field experiment was conducted to study the effect of planting density (50 x 30cm, 45 x 45cm and 60 x 45cm) with four transplanting dates (20th November, 10th December, 31st December and 20th January) in factorial randomized block design with three replications. The data revealed that significantly higher growth parameters viz., plant height (43.13cm), plant spread (86.66 cm), number of leaves per plant (27.50 cm), stalk stem diameter (48.10mm), curd weight (834.66g), curd length (21.12cm), curd width (24.87cm), harvest index (41.83%) and yield per hectare (37.04t) were recorded in December 10th planting (D2). Among the different spacings, wider spacing of 60 x 45 cm (S3) significantly recorded higher values for growth and yield parameters under study except plant height (39.01 cm) and yield per hectare (27.03 t). Interaction effect of different spacing and transplanting dates D2S1 (December 10th and 50x30 cm) was found to be non-significant for various parameters except plant height, harvest index and yield per hectare.

Keywords: Broccoli, transplanting, planting density, growth, yield.

INTRODUCTION

Broccoli (*Brassica oleracea* var. *italica* L.) is an important cool season vegetable crop after cabbage and cauliflower from the family Brassicaceae. It is cherished for its delicious taste, flavor and nutritive value and is reported to prevent cancer. Since this crop has been introduced recently in Andhra Pradesh, there is a dire need to standardize the dates of transplanting as well as planting density to suit the local conditions. The planting dates have directly affecting yield and quality parameters in broccoli (Kunicki *et al.,* 1999). The study of production practices is a pre-requisite for any new crop assessment with respect to optimum time of planting and planting density to achieve more returns per unit area. The response may differ in growth and quality parameters of broccoli. Keeping this in view, the present investigation was planned.

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MATERIAL AND METHODS

The present investigation was carried out during winter season of 2013-14 at Horticulture College & Research Institute, Anantharajupet, Andhra Pradesh. The soil of the experimental plot was sandy loamy with good water holding capacity. A field experiment was laid out in factorial randomized block design with three spacings *viz*., 50 x 30cm, 45 x 45cm and 60 x 45cm and four planting dates *viz*., 20th November, 10th December, 31st December and 20th January. Fantasy-F_1 hybrid was used in this experiment and it is a single head type. The twelve treatment combinations were formed thus replicated thrice. Well-rotten farm yard manure @15-20 t ha^{-1} was incorporated at the time of final ploughing. A basal dose of half of the nitrogen @ 70 kg ha^{-1}, full dose of phosphorous @ 100 kg ha^{-1} and potash @ 100 kg ha^{-1} was applied at the time of land preparation. The remaining dose of nitrogen was top dressed in 2 equal

Table 1. Effect of planting density and dates of transplanting on plant height, plant spread, number of leaves plant^{-1} and stalk stem diameterin broccoli.

Dates of transplanting	Plant height (cm)				Plant spread (cm)				Number of leaves plant^{-1}				Stalk stem diameter (mm)			
	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean
D_1	43.10	42.31	41.31	42.24	84.83	85.40	86.90	85.71	24.47	26.13	27.43	26.01	45.93	46.58	47.94	46.81
D_2	44.16	43.05	42.16	43.13	85.26	86.06	88.66	86.66	26.26	27.71	28.53	27.50	47.23	48.10	48.96	48.10
D_3	40.13	37.62	36.69	38.15	80.83	81.90	82.06	81.60	24.31	25.23	26.40	25.31	43.88	44.29	46.56	44.91
D_4	37.30	36.73	35.90	36.64	78.60	79.40	79.90	79.30	23.37	24.12	24.71	24.06	42.62	43.85	46.87	44.45
Mean	41.17	39.93	39.01		82.38	83.19	84.38		24.60	25.80	26.77		44.91	45.70	47.58	
Source	D	S	D x S		D	S	D x S		D	S	D x S		D	S	D x S	
S. Em ±	0.13	0.12	0.24		0.42	0.36	0.73		0.11	0.10	0.20		0.36	0.31	0.63	
CD at 5%	0.40	0.35	0.70		1.25	1.08	NS		0.34	0.30	0.60		107	0.93	NS	

Dates of transplanting (D): D_1- November 20th, D_2- December 10th, D_3- December 31st and D_4- January 20th
Plant spacing (S): S_1- 50x30 cm, S_2- 45x45 cm and S_3- 60x45 cm NS- Non-significant

Table 2. Effect of planting density and dates of transplanting on curd weight, length, width and yield ha^{-1} in broccoli.

Dates of transplanting	Curd weight (g)				Curd length (cm)				Curd width (cm)			
	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean
D_1	725.66	787.83	838.53	784.01	16.20	17.30	19.56	17.68	21.93	22.83	24.26	23.01
D_2	733.00	844.66	926.33	834.66	20.23	21.10	22.03	21.12	24.13	25.06	25.43	24.87
D_3	621.16	721.50	810.83	717.83	15.33	16.30	17.46	16.36	19.96	22.30	23.16	21.81
D_4	522.80	635.20	720.66	626.22	14.86	15.36	16.53	15.58	18.73	19.06	20.86	19.55
Mean	650.65	747.30	824.09		16.65	17.51	18.90		21.19	22.31	23.43	
Source	D	S	D x S		D	S	D x S		D	S	D x S	
S. Em ±	4.89	4.23	8.47		0.14	0.12	0.24		0.19	0.16	0.32	
CD at 5%	14.43	12.50	25.00		0.41	0.36	0.72		0.56	0.48	0.97	

Dates of transplanting (D): D_1- November 20th, D_2- December 10th, D_3- December 31st and D_4- January 20th
Plant spacing (S): S_1- 50x30 cm, S_2- 45x45 cm and S_3- 60x45 cm, NS- Non-significant

splits, one at 30 days after transplanting and another at curd initiation stage. Healthy seedlings of 30 days old were transplanted in evening hours as per the treatments and observations on plant height, plant spread, number of leaves per plant (cm), stalk stem diameter (mm), curd weight (g), length (cm), width (cm) and yield per hectare (t) were subjected to statistical analysis as per procedure suggested by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Effect of planting density

Data presented in Table 1 showed significant effect on growth contributing characters. The highest plant height (41.17cm) recorded from 50 x 30 cm spacing, this might be due to more terminal increase in closer spaced plants than wider spaced plants, where lateral growth is more. Similar findings were reported by Saikia *et al.* (2010) in broccoli. Maximum plant spread (84.38cm), number of leaves per plant (26.77) and stalk stem diameter (47.58mm) were noticed from 60 x 45 cm spacing (S_3) whereas curd weight (824.09g), length (18.90cm) and width (23.43 cm) were recorded from 60 x 45 cm spacing (Table 2). This might be due to maximum food accumulation due to increased vegetative growth (no. of leaves) in wider spacing and also less competition for

Table 3. Effect of planting density and dates of transplanting on harvest index and yield hectare^{-1} in broccoli.

Dates of transplanting	Harvest index (%)				Yield hectare^{-1}			
	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean
D_1	41.11	40.37	42.11	41.19	43.07	34.45	27.50	35.01
D_2	41.54	41.18	42.78	41.83	43.51	37.24	30.38	37.04
D_3	41.39	40.68	41.30	41.15	36.87	31.55	26.60	31.67
D_4	35.23	38.10	39.76	37.03	31.02	27.78	23.64	27.48
Mean	39.81	40.08	41.48		38.62	32.75	27.03	
Source	D	S	D x S		D	S	D x S	
S. Em ±	0.43	0.37	0.74		0.22	0.19	0.39	
CD at 5%	1.27	NS	2.20		0.67	0.58	1.17	

nutrients, space and light between the plants. These results are in conformity with those of Khatun *et al.* (2011) in broccoli. Spacing showed non-significant effect on harvest index and significant effect for yield per hectare (Table 3). Highest yield per hectare (27.03t) was recorded in closer spacing of 50 x 3 cm (S_1) probably due to the closer spacing of 50 x 30 cm accommodated more number of plants per unit area.

Effect of transplanting time

Data presented in Table 1 showed that significantly maximum growth parameters like plant height (43.13cm), plant spread (86.66cm), number of leaves per plant (27.50) and stalk stem diameter (48.10mm) were noticed from December 10th transplanting (D_2). Similar results were reported by Saikia *et al*. (2010) in broccoli. Among the yield parameters, highest curd weight (834.66 g), length (21.12cm), width (24.87cm), harvest index (41.83%) and yield per hectare (37.04t) were obtained when planted on December 10th transplanting (Table 2 & 3). The fact that due to optimum temperatures that prevailed during vegetative growth period which resulted in greater photosynthetic activity and higher mobilization of assimilates. Similar results were quoted by Sighal *et al.* (2009), Saikia *et al*. (2010) and Sharma and Narayan(1995) in broccoli. January 20th transplanting recorded lowest values for all growth and yield characters in broccoli.

Interaction effect of planting density and transplanting time

Maximum plant height (44.16cm) and yield per hectare (43.51t) were recorded in a treatment combination of December 10th planting with a spacing of 50 x 30 cm (D2S1) whereas December 10th planting with a spacing of 60 x 45 cm (D2S3) was recorded highest number of leaves per plant (28.53), curd weight (926.33 g), length (22.03cm), width (25.43cm) and harvest index (42.78%). Interaction effects of transplanting dates and spacing on yield were also reported by Saikia et al. (2010), Hossain et al. (2011) and Solunke et al. (2011) in broccoli.

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