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Standardization of planting time and spacing in broccoli cv Green Head for lower hills of Northern India

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ABSTRACT

The 45 days old healthy seedlings of broccoli cv Green Head were transplanted on four planting times at ten days interval viz P1: 5 Oct, P2: 15 Oct, P3: 25 Oct and P4: 5 Nov at three spacings viz S1: 60 x 30 cm, S2: 60 x 45 cm and S3: 60 x 60 cm during two consecutive Rabi seasons of 2005-06 and 2006-07 at the experimental farm of Regional Horticultural and Forestry Research Station, Bhota, District Hamirpur, HP in a Randomized Block Design with three replications in the plots of size 3.00 x 1.80 m. The recommended doses of manures and fertilizers and all agronomic practices were adopted for raising a healthy and normal crop. The data on gross yield (q/ha), yield per plant (g), primary head weight (g), secondary head weight (g), secondary heads per plant (number), plant height (cm) and days to head initiation, maturity and harvest duration were recorded. Significant differences were observed for all the traits studied except days to head initiation, maturity and harvest duration during both the years. The broccoli seedlings transplanted during the first fortnight of October at a spacing of 60 x 60 cm produced maximum gross yield. The delayed planting markedly reduced the yield whereas days to head initiation, maturity and harvest duration were least influenced by the planting time and spacing.

Keywords: Planting time, spacing, broccoli, head initiation, maturity, harvest duration

INTRODUCTION

Broccoli (*Brassica oleracea* var *italica* Plenck) is one of the important members of the cole group of vegetables and is considered to be the first to originate from wild cabbage ie *Brassica oleracea* var *oleracea* (syn *sylvestris*) which is found growing wild along the Mediterranean Sea. It is mainly of two types green sprouting and purple heading broccoli. The head consists of closely packed mature differentiated flower buds in sprouting broccoli, immature differentiated flower buds in heading broccoli ie winter cauliflower and immature undifferentiated floral primordia in cauliflower. In world USA is the largest producer of broccoli followed by European countries. In India it was introduced during the second half

of 20th century and now its popularity is increasing steadily on account of awareness among the educated masses about its nutritive value and developing tourism industry as a novelty crop. It is well established amongst amateur gardeners and its commercial production has also picked near metropolises. It ranks at fourth place after cauliflower, cabbage and knol-khol among the cole crops. It is emerging as a new cash crop in temperate hilly regions where it is grown as an off-season vegetable and fetches very high price in plains. It is eaten cooked or raw as salad and can also be served as mixed vegetable and in soups. Broccoli is known for its better taste, flavor and higher nutritive value especially with respect to proteins, vitamins and minerals among the cole crops. It is also rich in organoleptic and anti-cancerous properties and has antioxidant and anticancer compounds. The typical broccoli phytochemicals are sulphur containing compounds including isothiocyanates, dithiolthiones and indoles. Several isothiocyanates have been shown to inhibit tumours induced by chemical carcinogens. Indoles also play a role in cancer prevention. Realizing the importance of this crop present investigations were conducted to standardize the planting time and spacing of broccoli cv Green Head for lower hills of Northern India.

MATERIAL AND METHODS

The present investigations were carried out on broccoli cv Green Head during two consecutive Rabi seasons of 2005-06 and 2006-07 at the experimental farm of Regional Horticultural and Forestry Research Station, Bhota, District Hamirpur, HP. The 45 days old healthy seedlings were transplanted at four planting times at ten days interval viz P1: 5 Oct, P2: 15 Oct, P3: 25 Oct and P4: 5 Nov at three spacings viz S1: 60 x 30 cm, S2: 60 x 45 cm and S3: 60 x 60 cm. These 12 treatment combinations were laid out in a Randomized Block Design with three replications in the plots of size 3.00 x 1.80 m during both the years. The sandy loam soil of well prepared field was incorporated with recommended doses of manures and fertilizers and all agronomic practices were adopted as per package of practices for raising a healthy and normal crop. The data on gross yield (q/ha) was recorded on plot basis whereas that of yield per plant (g), primary head weight (g), secondary head weight (g), secondary heads per plant (number) and plant height (cm) were recorded on ten randomly selected plants. Days to head initiation and maturity were counted from transplanting to initiation of heads and start of harvesting respectively. The harvest duration was also counted from start of harvesting to last harvesting.

RESULTS AND DISCUSSION

Data on gross yield, yield per plant, primary head weight, secondary head weight, secondary heads per plant and plant height besides days to head initiation, maturity and harvest duration were

statistically analyzed and the mean values for two years along with the pooled means are presented in Table 1 for planting time and spacing and in Table 2 for interaction of planting time and spacing.

Effect of planting time

All the characters were significantly influenced by planting time during both the years except days to head initiation, maturity and harvest duration (Table 1). The highest gross yields of 196.4 q/ha and 180.8 q/ha obtained by planting the crop on 5 Oct during 2005-06 and 2006-07 respectively were significantly superior to the late planting times. The yield per plant (619.0 and 588.9 g), primary head weight (300.6 and 283.9 g), secondary head weight (318.4 and 305.0 g), secondary heads per plant (20.1 and 17.8 g) and plant height (48.7 and 46.5 cm) were also recorded maximum at 5 Oct planting time during 2005-06 and 2006-07 respectively. The every delay in transplanting after 5 Oct resulted in continuous decrease in yield and its attributes. However days to head initiation, maturity and harvest duration were not influenced by the planting time. This might be attributed to the warmer and longer growth period of the early planted crop than the later ones before the initiation of head development. Singhal et al (2009) also found 1 October, Sharma et al (1995) 15 September and Kumar et al (2007) 30 September to 15 October as the best time for transplanting broccoli under the hilly conditions. Singh et al (1999) studied the effect of transplanting dates in low hills from 20 October to 22 December and recorded maximum gross yield, yield per plant and plant height from the transplanting on 27 October which was at par with that of 20 October and 3 November. The decrease in yield with the delay in sowing was also reported by Yoldas and Esiyok (2004) and Wlazo and Kunicki (2003).

Effect of spacing of plants

The variation in plant spacing significantly influenced yield and its attributes except plant height and days to head initiation, maturity and harvest duration during both the years (Table 1). The yield per plant, primary head weight, secondary head weight and secondary heads per plant showed an increasing trend with increase in plant spacing and the highest values were recorded at the widest spacing of 60 x 60 cm. Such response must have been due to the availability of more space providing more nutrients, air and sun light per plant which led to vigorous growth of the plants. However plant height, days to head initiation, maturity and harvest duration did not show significant response to spacing levels. On the other hand maximum gross yields of 154.8 and 142.7 q/ha during 2005-06 and 2006-07 respectively were produced at the closest spacing of 60 x 30 cm which may be due to the higher plant density at this spacing. It reveals that the maximum yield per plant under 60 x 60 cm spacing did not compensate the reduction in per hectare yield caused by decreased

Table 1. Effect of planting time and spacing on yield and its attributes in broccoli cv Green Head

Treatments/ Traits	Year	Planting time						Spacing				
		Oct 05	Oct 15	Oct 25	Nov 05	Mean	CD (5%)	60x30 cm	60x45 cm	60x60 cm	Mean	$CD_{0.05}$
Gross yield (q/ha)	2k5-6	196.4	158.8	96.4	71.4	130.8	17.6	154.8	125.5	112.0	130.8	16.8
	2k6-7	180.8	150.1	86.6	66.7	121.1	14.4	142.7	117.3	103.2	121.1	13.4
	Pooled	188.6	154.5	91.5	69.1	125.9		148.8	121.4	107.6	125.9	
Yield/plant (g)	2k5-6	619.0	441.3	302.3	200.4	390.8	36.5	319.4	387.6	465.3	390.8	33.6
	2k6-7	588.9	424.0	279.2	180.7	368.2	31.3	305.3	364.4	334.9	368.2	29.5
	Pooled	604.0	432.7	290.8	190.6	379.5		312.4	376.0	450.1	379.5	
Primary head Weight (g)	2k5-6	300.6	223.3	157.7	107.7	197.3	22.4	166.5	190.9	234.5	197.3	24.1
	2k6-7	283.9	209.3	143.9	97.6	183.7	18.1	155.0	178.9	217.1	183.7	19.9
	Pooled	292.3	216.3	150.8	102.7	190.5		160.8	184.9	225.8	190.5	
Secondary heads Weight (g)	2k5-6	318.4	228.1	144.7	92.7	196.0	17.2	160.4	196.8	230.8	196.0	16.7
	2k6-7	305.0	214.7	135.3	83.1	184.5	12.9	150.3	185.5	217.7	184.5	13.4
	Pooled	311.7	221.4	140.0	87.9	190.3		155.4	191.2	224.3	190.3	
Secondary heads/ plant (no)	2k5-6	20.1	19.7	15.3	10.4	16.4	2.3	13.7	16.4	19.1	16.4	1.9
	2k6-7	17.8	17.4	13.6	8.3	14.3	1.9	12.2	14.1	16.6	14.3	1.5
	Pooled	19.0	18.6	14.5	9.4	15.3		13.0	15.3	17.9	15.3	
Plant height (cm)	2k5-6	48.7	46.4	40.8	28.9	41.2	5.7	41.5	41.0	41.1	41.2	NS
	2k6-7	46.5	46.2	38.7	27.3	39.6	5.1	38.0	39.8	41.2	39.6	NS
	Pooled	47.6	46.3	39.8	28.1	40.5		39.8	40.4	41.2	40.5	
Days to head initiation	2k5-7	55	55	55	55	55	-	55	55	55	55	-
Days to maturity	2k5-7	90	90	90	90	90	-	90	90	90	90	-
Harvest Duration	2k5-7	50	50	50	50	50	-	50	50	50	50	-

Table 2. Effect of interaction of planting time and spacing on yield and its attributes in broccoli cv Green Head

Treatments / Traits	Year	Oct 05 & 60x30	Oct 05 & 60x45	Oct 05 & 60x60	Oct 15 & 60x30	Oct 15 & 60x45	Oct 15 & 60x60	Oct 25 & 60x30	Oct 25 & 60x45	Oct 25 & 60x60	Nov 05 & 60x30	Nov 05 & 60x45	Nov 05 & 60x60	Mean	$CD_{0.05}$
Gross yield	2k5-6	235.0	187.5	166.7	198.2	152.9	125.3	98.4	93.2	97.7	87.5	68.3	58.4	130.8	39.6
(q/ha)	2k6-7	216.8	171.4	154.3	184.6	147.4	118.3	89.5	84.1	86.2	79.9	66.4	53.8	121.1	31.6
Pooled		225.9	179.5	160.5	191.4	150.2	121.8	94.0	88.7	92.0	83.7	67.4	56.1	125.9	35.6
Yield/plant (g)	2k5-6	520.6	624.3	712.1	381.4	437.1	505.5	202.3	291.9	412.8	173.3	197.2	230.7	390.8	74.8
	2k6-7	496.6	594.0	676.0	384.7	410.2	477.1	181.0	277.3	379.2	158.8	176.2	207.1	368.2	65.2
Pooled		508.6	609.2	694.1	383.1	423.7	491.3	191.7	284.6	396.0	166.1	186.7	218.9	379.5	70.0
Primary head	2k5-6	252.4	307.2	342.1	208.7	212.8	248.3	112.9	140.7	219.4	92.1	102.8	128.2	197.3	32.3
Weight (g)	2k6-7	241.7	291.4	318.6	192.9	199.7	235.4	101.1	131.7	198.8	84.2	92.9	115.7	183.7	26.7
Pooled		247.1	299.3	330.4	200.8	206.3	241.9	107.0	136.2	209.1	88.2	97.9	122.0	190.5	29.5
Secondary heads	2k5-6	268.2	317.1	370.0	202.7	224.3	257.2	89.4	151.2	193.4	81.2	94.4	102.5	196.0	21.7
Weight (g)	2k6-7	254.9	302.6	357.4	191.8	210.5	241.7	79.9	145.6	180.4	74.6	83.3	91.4	184.5	16.6
Pooled		261.6	309.9	363.7	197.3	217.4	249.5	84.7	148.4	186.9	77.9	88.9	97.0	190.3	19.2
Secondary heads/	2k5-6	17.4	20.7	22.1	16.2	19.0	23.8	12.3	15.4	18.3	8.7	10.4	12.1	16.4	2.3
plant (no)	2k6-7	14.3	17.5	21.6	15.9	16.8	19.4	11.8	13.1	15.8	6.7	8.8	9.5	14	
Pooled		15.9	19.1	21.9	16.1	17.9	21.6	12.1	14.3	17.1	7.7	9.6	10.8	15.3	2.2
Plant height (cm)	2k5-6	47.4	48.9	49.9	47.5	45.6	46.2	42.8	40.4	39.2	28.4	29.2	29.2	41.2	2.8
	2k6-7	45.4	46.9	47.1	45.4	47.0	46.2	36.1	38.8	41.1	25.1	26.5	30.2	39.6	2.5
Pooled		46.4	47.9	48.5	46.5	46.5	46.2	39.5	39.5	40.2	26.8	27.9	29.7	40.5	2.7
Days to head initiation	2k5-7	55	55	55	55	55	55	55	55	55	55	55	55	55	-
Days to maturity	2k5-7	90	90	90	90	90	90	90	90	90	90	90	90	90	-
Harvest Duration	2k5-7	50	50	50	50	50	50	50	50	50	50	50	50	50	-

plant density at this wider spacing. The decrease in head weight with the increase in plant density due to closer spacing and increase in the head yield due to higher number of plants per unit area were also observed by Singhal et al (2009), Kumar et al (2007), Agarwal et al (2007), Kona (2004), Rekowska (2002) and Gorski and Armstrong (1985).

Effect of planting time and spacing interaction

The interaction effect of planting time and spacing was found to be significant for all the characters during both the years (Table 2). The maximum gross yield (225.9 q/ha) was recorded by planting the crop on 5 Oct at the closest spacing of 60 x 30 cm closely followed by planting on 15 Oct at the same spacing whereas maximum yield per plant, primary head weight, secondary head weight, secondary heads per plant and plant height were also recorded by planting the crop on 5 Oct at the widest spacing of 60 x 60 cm. The delayed planting markedly reduced the gross yield. However days to head initiation, maturity and harvest duration were observed to be least influenced by the planting time and spacing.

On the basis of above results it may be concluded that planting during first fortnight of October at a spacing of 60 x 30 cm is most suitable for the highest gross yield of broccoli cv Green Head under lower hills of Northern India.

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