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Effect of sowing dates on growth, curd initiation and curd maturity of broccoli

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Abstract
Field experiment were conducted during the year 2015 on planting dates and different varieties of broccoli in Vidarbha region, at Main Garden, Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (MH). The experiment was laid out in Factorial Randomized Block Design with four dates of planting (P_1 - 15th September, P_2 - 30th September, P_3 - 15th October, P_4 - 30th October) as a main factor and three varieties of broccoli (V_1 - Ganesh Broccoli, V_2 – Palam Vichitra, V_3- Palam Samridhi). The data of present investigation revealed that, the vegetative growth contributing characters i.e. plant height, curd initiation and curd maturity found to be significantly earliest in variety Palam Vichitra. As regard to the effect of dates of planting, significantly superior plant height, days required for curd initiation and curd maturity were found in 15th September planting date.

Keywords: Broccoli, dates of planting, varieties of broccoli, curd initiation, curd maturity.

Introduction
Amongst the various exotic vegetable grown in India, broccoli is one of the commercial vegetable, grown on a now a day large scale. Broccoli (*Brassica oleracea* var. italica) is a cole crop from the family Brassicaceae. It is native to the Mediterranean region and cultivated in Italy in ancient Roman times and was introduced in England during 1720 known as "*Italian asparagus"* or "sprout cauliflower". Basically broccoli is a cool season exotic vegetable crop. Best quality of broccoli curds are produced when the day temperature is between 25 ^{0}C to 26 ^{0}C and night temperature is between 15-16 ^{0}C. India is endowed with a wide range of agro-climatic conditions and so can grow broccoli in winter season.

Broccoli has good organoleptic properties and is a very delicious vegetable. An hundred gram raw broccoli provides carbohydrates 6.64 g, fat 0.37 g, protein 2.82 g, water 89.30 g, vitamin A equivalent 31 mg, carotene 361 mg, vitamin B-0.071 mg, vit. B2 – 0.117 mg, Vit. B3- 0.639 mg, Vit. B5- 0.573 mg, Vit. C- 8.92 mg, calcium 47 mg. Broccoli contains Indole-3-carbinol which helps to fight breast and lung cancer (Anon., 2006) [1]. Broccoli soup is a delicacy in big hotels and resorts, which is more nutritious than other coles, such as cabbage, cauliflower (Thompson and Kelly, 1985) [11].

Time of sowing and transplanting are important factor especially in Vidarbha Region influencing vegetable production to pinpoint the exact time of sowing of seed in nursery and transplanted in field is essential for obtaining maximum yield along with quality of vegetable.

As this crop gaining the importance due to its high nutritive value and anticancer properties, it is very necessary to cope up with demand to increase the production of broccoli and this can be achieved by using proper date of planting and find out the suitable variety for this region.

Material and Methods
The field were conducted at Main Garden, Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (MH) during *Rabi* season of the year 2014-2015.

Akola is situated in sub-tropical region between 22^{0}42'N latitude and 77^0 02' E longitudes. The altitude of the place is 307.42 m above mean sea level. The climate of Akola is semi-arid and characterized by three distinct season viz., hot and dry summer from March to May, warm humid and rainy season from June to October and mild cold winter from November to February. The soil of experimental plot was black cotton with moderate fertility and good drainage.

The experiment was laid out in Factorial Randomized Block Design with three varieties V_1 - Ganesh Broccoli, V_2 – Palam Vichitra, V_3- Palam Samridhi and four dates of planting P_1 - 15th

September, P_2 - 30th September, P_3 - 15th October, P_4 - 30th October with 12 treatment combinations replicated thrice.

For the record of pre harvest and post-harvest observation, five plants were selected randomly from each plot. The details of pre and post-harvest observations recorded are height of plant, leaves per plant, leaf length, leaf area, diameter of steam, days required for curd Initiation from transplanting, days required for curd maturity, curd weight (kg), curd length (cm), curd diameter (cm), curd yield per plot (kg), curd yield per hectare, percentage of marketable curd, compactness, days to 50% harvest and days to last harvest.

For the statistical analysis of data a method of analysis of variance was used and Factorial Randomized Block Design was used to test the significance of means between treatments (Panse and Sukhatme, 1985) [6].

Results and Discussion

Effect of varieties and planting dates on height of plant

At the stage of 15th, 30th, 45th and 60th DAT, all treatments showed significant differences. The significantly maximum plant height (17.66 cm), (24.41 cm), (32.41 cm) and (37.38 cm) respectively was recorded in variety Palam Vichitra. While minimum plant height was recorded in Ganesh Broccoli (14.24 cm), (18.44 cm), (22.92 cm) and (29.03 cm) at the stage of 15th, 30th, 45th and 60th DAT respectively. Variety Palam Vichitra showed the maximum height at all growth stages amongst the varieties under study. The above results are in close conformity with the findings of Thapa and Rai (2012) [10], Singh *et al*. (2014) [8] who recorded maximum plant height in Palam Samridhi followed by Palam Kanchan in broccoli.

At the stage of 15th, 30th, 45th and 60th DAT all treatments showed significant difference. The significantly maximum plant height (17.28 cm), (23.08 cm), (29.94 cm) and (35.37 cm) respectively was recorded in P_1 (15th September). The height of plant was maximum when the transplanting was done in the middle of September as compared to the October transplanting. Similar results have been reported by Ahmed and Siddique (2004) [2] in broccoli.

Interaction effect due to varieties and dates of planting on plant height were found to be non-significant at all the stages of plant growth.

Table 1.

Treatment	Plant Height (cm)			
	15th DAT	30th DAT	45th DAT	60th DAT
Varieties				
V_1 (Ganesh Broccoli)	14.24	18.44	22.92	29.03
V_2 (Palam Vichitra)	17.66	24.41	32.41	37.38
V_3 (Palam Samridhi)	15.91	22.61	30.96	34.30
`F' test	Sig	Sig	Sig	Sig
SE(m)+	0.25	0.32	0.43	0.52
CD at 5%	0.74	0.94	1.27	1.52
Planting Dates				
P_1 (15th September)	17.28	23.08	29.94	35.37
P_2 (30th September)	16.32	21.74	28.97	34.15
P_3 (15th October)	15.17	21.65	28.47	32.94
P_4 (30th October)	14.98	20.81	27.67	31.81
`F' test	Sig	Sig	Sig	Sig
SE(m)+	0.29	0.37	0.50	0.60
CD at 5%	0.86	1.09	1.47	1.76

Effect of varieties and planting dates on days required to curd initiation

The days required to curd initiation was significantly influenced by different varieties. Variety Ganesh Broccoli recorded minimum days for curd initiation (56.22 days), followed by Palam Samridhi (61.30), while maximum days (71.03 days) required in Palam Vichitra.

In broccoli temperature play very important role specially in curd initiation and it's development. As variety Ganesh Broccoli comes under early group of broccoli varieties which required 15-20 ºC temperature for curd initiation and in the present experimentation it was recorded during 44th meteorological week (29th October to 4th November). Which reflect in this might be the reason for early curd initiation recorded in Ganesh Broccoli as compared to other varieties under study. These results are in conformity with those of Gabhale (2011) [3] in cauliflower and Thapa and Rai (2012) [10] in broccoli.

The days required for curd initiation were significantly affected by the different dates of planting. The treatment P_1 (15th September) recorded significantly minimum days for curd initiation (60.75), which was significantly superior than rest of all the treatments it was followed by treatment P_2 (62.10 days). However, significantly maximum (64.76) days required for curd initiation were recorded with treatment P_4 (30th October) which was at par with treatment P_3 (15th October).

In broccoli curd initiation was correlated with temperature. In treatment P_1- 15th September curd initiation occurs in minimum days. This might be due to fact that, at 30th October temperature was increase due to October heat and hence curd initiation starts late. The results in the conformity with those of Solunke (2010) in broccoli, Gabhale. (2011) [3] in cauliflower.

Table 2.

Treatment	Days Required to Curd Initiation	Days to Curd Maturity
Varieties		
V_1 (Ganesh Broccoli)	56.22	70.88
V_2 (Palam Vichitra)	71.03	83.88
V_3 (Palam Samridhi)	61.30	74.49
`F' test	Sig	Sig
SE(m)+	0.43	0.60
CD at 5%	1.28	1.77
Planting Dates		
P_1 (15th September)	60.75	74.72
P_2 (30th September)	62.10	76.17
P_3 (15th October)	63.79	77.13
P_4 (30th October)	64.76	77.64
`F' test	Sig	Sig
SE(m)+	0.50	0.700
CD at 5%	1.48	2.054

Effect of varieties and planting dates on days to curd maturity

The number of days required for maturity of curds exhibited significant variations due to varieties. The variety Ganesh Broccoli took significantly minimum days for curd maturity (70.88 days), followed by Palam Samridhi (74.49 days) while, Palam Vichitra took maximum days for curd maturity (83.88 days).

Early maturity was found in Ganesh Broccoli due to early curd initiation and varietal character i.e. earliness. The length of curd maturity period of crop was also related to the length of their curd initiation periods and prevailing environmental conditions specially temperature before curd initiation can influenced the maturity characteristics of crop. The results of findings are in agreement with the findings of Larsen (1988) [4] in broccoli and Prasad (1992) [7] in cauliflower.

The days required for curd maturity were significantly influenced by the dates of planting. The minimum days required for curd maturity (74.72) were recorded in the treatment P_1 (15th September) followed by P_2 -30th September (76.17 days) and P_3 -15th October (77.13 days). While, treatment P_1 and P_2 more at par with each other, P_4 (30th October) required maximum days for curd maturity (77.64).

The broccoli varieties are very responsive to the temperature and photoperiod. It is therefore, very important to choose right variety to be sown at right time for proper vegetative and reproductive growth. In present investigation, varieties transplanted on 15th September showed early maturity, this might be due to fact that, plant transplanted on this date received longer congenial environmental condition, which resulted in early maturity. The results of the present study are in accordance with the findings of Solanke (2010) [9] in broccoli.

V_1 (Ganesh Broccoli) P_1 (15th September)

V_1 (Ganesh Broccoli) P_4 (30th October)

V_2 (Palam Vichitra) P_1 (15th September)

V_2 (Palam Vichitra) P_4 (30th October)

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