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Full Research Article

Influence of Planting Date on Performance of Cauliflower (*Brassica oleracea* var. *botrytis* L.) Varieties at Terai Region of West Bengal, India

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Abstract

An experiment was undertaken to find out the most suitable time for planting of mid late season cauliflower and to identify the best performing variety/varieties under terai zone of West Bengal. The experiment was laid out in split plot design with three replications. Sub plot consists of five cauliflower varieties viz. Girija, White Excell, Remi, Pushpa and White Marvel and main plot covered three planting dates viz. 15th November, 30th November and 15th December. The pooled results indicated that duration for curd initiation as well as days to curd maturity differ significantly for different varieties as well as different planting dates. Significantly highest curding percentage (75.67%) was observed from 2nd planting date (30th November) whereas among the varieties, Remi gave significantly highest curding percentage (83.97%). The highest net curd weight (620.67 g) was produced by the 15th November planting where White Excell recorded highest net curd weight (820.22 g). Maximum curd yield was recorded by White Excell (26.39 t ha^{-1}) followed by Remi (16.13 t ha^{-1}) and Girija (15.06 t ha^{-1}). White Excell also performed best in all the planting date, whereas Remi performed best in 30th November planting date. The vitamin-A content and ascorbic acid content of cauliflower curd did not differ with the changes of planting dates. Considering the yield and quality parameters it may be concluded that first planting date (15th November) was most suitable for cultivation of the cauliflower varieties viz. Girija, White Excell, Remi, Pushpa and White Marvel except Remi.

1. Introduction

Cauliflower (*Brassica oleracea* var. *botrytis* L) is an important cole crop and nutritionally the curd is rich in protein, vitamin C and minerals. The crop is highly thermo sensitive and variation in temperature significantly influences both vegetative and generative phases of the crop (Chabok and Amoli, 2013; Rahman et al., 2013). Planting time plays crucial role for curd initiation and development. Improper planting time and faulty selection of variety may drastically affects the crop growth and curd yield. With the development of tropical Indian cauliflowers and introduction of F_1 hybrids, cultivation of cauliflower is possible throughout the year. However, selection of varieties and planting at optimum time are the key factors for high yield and quality curd production. Every year cauliflower grower suffers from button curd, excessive vegetative growth of plant and poor curd yield following improper planting time and varietal selection. Information on the performance of the mid late season cauliflower varieties and their optimum planting time is still meager for this region. Keeping in view this experiment was conducted with the objectives of to select the optimum planting time and to identify the most suitable variety of the mid late season cauliflower.

2. Materials and Methods

The experiment was conducted at the experimental farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal, India situated under Terai agro climatic region of West Bengal during the year 2011−12 and 2012−13. The experimental soil was sandy clay loam having pH 5.96, 0.83% organic carbon, 172.79 kg ha^{-1} available nitrogen, 22.15 kg ha^{-1} available phosphorus and 123.25 kg ha^{-1} potash. The climatic condition of this region is sub-tropical humid

in nature. The experiment was laid out in split plot design with three replications. Sub plot consists of five cauliflower varieties and main plot included three planting dates viz. 15th November, 30th November and 15th December. There was two types of varieties viz. F_1 hybrid and improved variety. Three F_1 hybrid varieties namely Girija (Source:Namdhari Seeds Pvt. Ltd., Bangalore), White Excell (Source:Bharat Nursery Pvt. Ltd., Kolkata) and Remi (Source:Bharat Nursery Pvt. Ltd., Kolkata) and two improved varieties Pushpa (Source:Sungro Seeds Ltd., Delhi) and White Marvel (Source:Sungro Seeds Ltd., Delhi) were included in this experiment. The plot size was 2.25×2.25 m^2 with a spacing of 45×45 cm^2. Farmyard manure at the rate of 15 t ha^{-1} was applied during field preparation. Inorganic fertilizers were applied as 120:60:60 N, P_2O_5 and K_2O kg ha^{-1}. The full dose of P_2O_5, and K_2O and half dose of N were applied at land preparation. Remaining half dose of N was applied at 30 days after transplanting as top dressing. Observation on different growth, yield and yield attributing characters were recorded from ten randomly selected plants from each replication. Curd compactness (g cm^{-1}) was calculated as the average curd weight divided by average circumference of ten curds of the individual plot. Vitamin A (IU 100 g^{-1} fresh weight) content of curd was estimated following the method suggested by Ranganna (2001. Ascorbic acid (mg 100 g^{-1} fresh weight) of the cauliflower curd was determined by colorimetric method (Ranganna, 2001). Data on different growth, yield and quality parameters were analyzed statistically as per method described by Gomez and Gomez (1984).

3. Results and Discussion

3.1. Growth parameters

A perusal of the data (Table 1 and Table 2) revealed that the highest number of leaves (17.67 plant^{-1}) was obtained in 15th November planting whereas the lowest (15.37 plant^{-1}) was found at 15th December planting date. Among the different

Table 1: Vegetative attributes of different cauliflower varieties under different planting dates (pooled mean of 2011−12 and 2012−13)

Variety	Number of leaves plant^{-1}				Leaf length (cm)				Leaf width (cm)			
	15th Nov	30th Nov	15th Dec	Mean	15th Nov	30th Nov	15th Dec	Mean	15th Nov	30th Nov	15th Dec	Mean
Girija	17.80	16.78	15.14	16.57	47.97	44.97	40.05	44.33	25.17	22.79	20.64	22.67
White Excell	18.18	17.62	16.06	17.29	41.78	40.55	40.05	40.79	20.93	19.56	20.40	20.30
Remi	17.76	15.84	15.30	16.3	40.43	42.37	40.84	41.21	18.55	19.32	18.95	18.94
Pushpa	19.55	16.50	15.39	17.15	38.99	38.34	36.69	38.01	17.91	16.46	14.89	16.42
White Marvel	15.08	16.06	14.95	15.36	31.53	33.38	32.22	32.37	14.78	14.66	13.00	14.15
Mean	17.67	16.56	15.37		40.14	39.92	37.97		19.46	18.56	17.58	
	Season	Variety	S×V*		Season	Variety	S×V*		Season	Variety	S×V*	
SEm±	0.08	0.17	0.30		0.52	0.39	0.67		0.21	0.31	0.54	
CD (*p*=0.05)	0.27	0.50	0.86		0.82	1.10	1.91		0.68	0.89	1.54	

*S×V: Season×Variety

varieties, White Excell produced the highest numbers of leaves (17.29 plant^{-1}) which was statically at par with Pushpa (17.15 plant^{-1}) and Girija (16.57 plant^{-1}). On the basis of pooled data the interaction effect showed that the variety Pushpa planted in 15th November produced the highest numbers of leaves (19.55 plant^{-1}). The findings indicated that a warmer temperature encourages more vegetative growth which may be the reason for more leaves in early planting (15th November). The result is in conformity with the earlier findings of Kumar et al. (2002). The highest leaf length (40.14 cm) and width (19.47 cm) was produced for the 15th November planting which was statically at par with the leaf length (39.92 cm) and width (18.56 cm) of 30th November planting respectively. Kumar et al. (2002) also recorded that the vegetative characters such as stalk length and leaf number of cauliflower significantly differ with the changes in planting dates. Among the varieties Girija produced significantly highest leaf length (44.33 cm) and width (22.67 cm). The findings further showed that duration for curd initiation as well as curd maturity gradually decreased from first planting (15th November) to 3rd planting date (15th December) and the minimum time for curd initiation and marketable curd maturity (52.07 days and 59.30 days, respectively) were found in 3rd planting date. According to Ara et al. (2009), late planting exposed the plants to shorter duration to favourable climate for vegetative growth while the lower temperature

helped on set of reproductive phase which may be the cause for quick curd initiation in delayed planting. The increase in crop duration in early sowing dates might be due to high temperature prevailing during the early growth stage which resulted in more vegetative growth for longer duration. These results are closely in line with the earlier finding of Srivastava et al. (2011). Irrespective of planting dates, the variety White Marvel recorded significantly lowest duration for curd initiation (37 days) as well as marketable curd maturity (44.62 days) whereas, maximum duration for the same was recorded by the variety Pushpa (71.61 days and 78.95 days, respectively).

3.2. Yield and yield parameters

The observation on different yield and yield parameters have been presented in Table 2, Table 3, Table 4 and Table 5. The highest curd diameter (14.55 cm) was recorded in 30th November planting which was statistically at par with 15th November planting (14.25 cm). However, the variety White Excell produced significantly highest curd diameter (18.33 cm) irrespective of planting dates. Hossain et al. (2011) opined that early planting received comparatively low temperature during vegetative growth which encouraged bigger size with larger diameter head development in broccoli.

The data on curding percentage depicted that among the different planting dates, highest curding percentage (75.67%) was obtained from 2nd planting (30th November) whereas, it was found lowest (70.29%) when planted at 15th December). However, curding percentage (70.84%) of the 1st planting date (15th November) was statically at par with it. Formation of curd mainly depends upon genetic constituents of the variety, however temperature difference under different planting date also modify the curding percentage in different varieties (Pearson et al., 1994; Muhammad et al., 2007). Irrespective of planting dates, the variety Remi recorded significantly highest curding percentage (83.97%) among all the varieties.

The data on curd compactness showed that, irrespective of the varieties, the highest curd compactness (13.69 g cm^{-1}) was obtained in 15th November and lowest in 15th December (9.62 g cm^{-1}) planting. Among the different varieties, the highest curd compactness was recorded in White Excell (14.44 g cm^{-1}) followed by Remi (13.52 g cm^{-1}) and Pushpa (13.11 g cm^{-1}). The interaction effect showed that significantly highest curd compactness was recorded by the variety Pushpa (19.47 g cm^{-1}) in 15th November planting and lowest in White Marvel (4.76 g cm^{-1}) for 15th December planting date.

Pooled data on curd weight revealed that significantly highest

Table 2: Days to curd initiation and curd maturity and curd diameter of different cauliflower varieties under different planting dates (pooled mean of 2011−12 and 2012−13)

Variety	Days to curd initiation (days)				Days to marketable curd maturity (days)				Curd diameter (cm)			
	15th Nov	30th Nov	15th Dec	Mean	15th Nov	30th Nov	15th Dec	Mean	15th Nov	30th Nov	15th Dec	Mean
Girija	74.34	68.00	63.84	68.72	80.50	73.84	69.34	74.56	15.00	16.12	16.59	15.90
White Excell	76.17	63.83	57.83	65.95	82.84	71.00	65.83	73.23	19.15	18.47	17.37	18.33
Remi	65.84	54.67	52.33	57.61	75.17	63.84	60.00	66.34	13.91	11.81	10.12	11.95
Pushpa	83.67	73.17	58.00	71.61	89.67	79.34	67.84	78.95	12.86	14.80	11.47	13.05
White Marvel	43.67	39.00	28.34	37.00	55.00	45.34	33.50	44.62	10.20	11.53	9.88	10.58
Mean	68.74	59.73	52.07		76.66	66.67	59.30		14.25	14.55	13.09	
	Season	Variety	S×V*		Season	Variety	S×V*		Season	Variety	S×V*	
SEm±	0.26	0.23	0.39		0.23	0.25	0.44		0.31	0.28	0.48	
CD (*p*=0.05)	0.86	0.46	1.11		0.74	0.72	1.24		1.01	0.79	1.37	

*S×V: Season×Variety

net curd weight (620.67 g) was produced by the 15th November planting and it was lowest (392.59 g) in 15th December planting. The data clearly indicated that net curd weight of cauliflower gradually decreased with delay in planting dates. This may be due to differences in genotypic constituents of the variety and variation in climatic parameters during the growing periods. Among the varieties, White Excell produced significantly highest net curd weight (820.22 g) followed by Pushpa (534.34 g), Remi (487.59 g) and Girija (480.34 g). The interaction effect showed that hybrid variety White Excell produced significantly highest net curd weight (958.28 g) in 15th November planting. Researchers like, Chatterjee (2006) and Muhammad et al. (2007) also observed higher curd weight in early planting dates compared to late planting

Table 3: Individual curd weight of different cauliflower varieties under different planting dates

Variety	Curd weight (g)											
	2011−12				2012−13				Pooled			
	15th Nov	30th Nov	15th Dec	Mean	15th Nov	30th Nov	15th Dec	Mean	15th Nov	30th Nov	15th Dec	Mean
Girija	610.28	448.86	280.71	446.62	651.08	519.85	371.22	514.05	630.68	484.36	325.97	480.34
White Excell	1050.00	889.18	736.10	891.76	866.55	772.83	606.61	748.67	958.28	831.10	671.36	820.22
Remi	378.49	543.79	454.23	458.84	468.72	624.97	455.30	516.33	423.61	584.38	454.77	487.59
Pushpa	743.31	396.83	394.04	511.39	838.74	501.64	331.45	557.28	791.03	449.24	362.75	534.34
White Marvel	307.84	247.36	156.46	237.22	291.69	231.91	139.73	221.11	299.77	239.64	148.10	229.17
Mean	617.98	505.20	404.31		623.36	530.24	380.86		620.67	517.72	392.59	
	Season	Variety	S×V*		Season	Variety	S×V*		Season	Variety	S×V*	
SEm±	4.33	25.11	43.49		13.60	23.76	41.15		7.14	17.28	29.94	
CD (*p*=0.05)	17.01	73.28	126.93		53.39	69.35	120.11		23.27	49.14	85.14	

*S×V : Season × Variety

Table 4: Curd yield of different cauliflower varieties under different planting dates

Variety	Curd yield (t ha^{-1})											
	2011−12				2012−13				Pooled			
	15th Nov	30th Nov	15th Dec	Mean	15th Nov	30th Nov	15th Dec	Mean	15th Nov	30th Nov	15th Dec	Mean
Girija	18.73	13.92	8.39	13.68	20.79	16.84	11.68	16.44	19.76	15.38	10.04	15.06
White Excell	33.20	29.79	22.74	28.58	28.70	25.11	18.77	24.20	30.95	27.45	20.76	26.39
Remi	12.72	17.68	15.08	15.16	15.51	20.89	14.89	17.10	14.12	19.29	14.99	16.13
Pushpa	11.05	7.40	6.15	8.20	12.21	9.17	5.30	8.89	11.63	8.29	5.73	8.55
White Marvel	8.61	8.19	4.35	7.05	8.03	7.69	3.90	6.53	8.32	7.94	4.13	6.79
Mean	16.86	15.39	11.34		17.05	15.94	10.91		16.96	15.67	11.13	
	Season	Variety	S×V*		Season	Variety	S×V*		Season	Variety	S×V*	
SEm±	0.15	0.49	0.85		0.14	0.52	0.89		0.10	0.36	0.62	
CD (*p*=0.05)	0.61	1.43	2.48		0.54	1.50	2.61		0.33	1.10	1.75	

*S×V: Season×Variety

for mid late season cauliflower.

On the basis of pooled value among the different planting dates significantly highest curd yield (16.96 t ha^{-1}) was recorded in first planting date (15th November) and it was gradually decreases with subsequent planting and the lowest yield (11.13 t ha^{-1}) was recorded in third planting date (15th December). Among the varieties White Excell produced significantly highest curd yield (26.39 t ha^{-1}) and significantly lowest (6.79 t ha^{-1}) was recorded in White Marvel. Gautam et al. (1998) pointed that the reduction in total yield in the late shown crop might be due to the transition in weather towards lowering down the average maximum and minimum temperature whereas higher yield in the early sown crop might also be due to the fact that the crop remained in the field for longer period and hereby accumulated more photosynthates for higher curd production. In case of interaction effect pooled value showed that among the varieties in each planting dates highest curd yield was recorded only by the White Excell (30.95, 27.45 and 20.76 t ha^{-1} in 15th November, 30th November and 15th December, respectively). Ara et al. (2009) also observed similar results with their experiment on planting dates of cauliflower.

3.3. Quality parameters

The data on different quality parameters of the curd (Table 6) depicted that vitamin-A and ascorbic acid content of the curd did not differ significantly with the changes in planting dates. Among the different varieties, the highest vitamin-A content (55.38 IU 100 g^{-1} fresh weight) was observed in Remi which was statically at par with the White Excell (54.52 IU 100 g^{-1} fresh weight). The first and third planting dates showed non significant for vitamin A content of the curd among the varieties. The maximum ascorbic acid content (61.10 mg 100 g^{-1} fresh weight) was recorded by the variety White Excell whereas the lowest ascorbic acid was recorded by White Marvel (36.22 mg 100 g^{-1} fresh weight). The first and third planting dates also recorded non significant effect for ascorbic acid content of the curd among the varieties. Kumar et al. (2010) observed that the highest ascorbic acid content for the genotype DC-98-10 (103.23 mg 100 g^{-1} of fresh weight) and lowest in the genotype CC-12 (17.68 mg 100 g^{-1} of fresh weight) of cauliflower curd. Variation in quality attributes for 30th November planting may be due to the differences in genetic constituents of the variety.

Table 5: Curd attributes of different cauliflower varieties under different planting dates (pooled mean of 2011−12 and 2012−13)

Variety	Curding percentage (%)				Curd compactness (g cm^{-1})			
	15th Nov	30th Nov	15th Dec	Mean	15th Nov	30th Nov	15th Dec	Mean
Girija	79.39	80.32	77.76	79.16	13.44	9.59	6.25	9.76
White Excell	82.00	83.63	78.52	81.38	16.17	14.49	12.52	14.44
Remi	84.72	83.54	83.67	83.97	9.91	16.29	14.37	13.52
Pushpa	37.52	47.02	40.50	41.68	19.47	9.65	10.2	13.11
White Marvel	70.46	83.87	71.00	75.11	9.305	6.7	4.76	6.92
Mean	70.84	75.67	70.29		13.69	11.34	9.62	
	Season	Variety	S×V*		Season	Variety	S×V*	
SEm±	0.71	0.89	1.54		0.29	0.44	0.77	
CD (*p*=0.05)	2.31	2.53	4.38		0.97	1.26	2.19	

*S×V: Season×Variety

Table 6: Quality attributes of different cauliflower varieties under different planting dates (pooled mean of 2011−12 and 2012−13)

Variety	Vitamin-A (IU 100 g^{-1} fresh weight)				Ascorbic acid (mg 100 g^{-1} fresh weight)			
	15th Nov	30th Nov	15th Dec	Mean	15th Nov	30th Nov	15th Dec	Mean
Girija	49.07	46.87	46.20	47.38	42.44	40.40	39.45	40.76
White Excell	54.21	55.13	54.23	54.52	60.94	62.13	60.25	61.10
Remi	55.38	55.91	54.86	55.38	43.57	42.35	41.37	42.43
Pushpa	31.65	32.40	31.10	31.72	40.19	40.62	39.81	40.21
White Marvel	39.12	37.92	35.99	37.68	35.90	36.92	35.86	36.22
Mean	45.18	45.65	44.48		44.61	44.49	43.35	
	Season	Variety	S×V*		Season	Variety	S×V*	
SEm±	0.38	0.38	0.66		0.35	0.43	0.75	
CD (*p*=0.05)	N.S.	1.09	N.S.		N.S	1.23	N.S	

*S×V: Season×Variety

4. Conclusion

First planting date (15th November) was most suitable for cultivtion of most of the varieties except Remi. However, delayed planting decreases curd yield. White Excell emerged as best for all the three planting dates (viz. 15th November, 30th November and 15th December) and adoption of such variety will provide stable curd yield for a wide range planting time under terai zone of West Bengal.

5. References

Ara, N., Kaisar, M.O., Khalequzzaman, K.M., Kohinoor, H., Ahamed, K.U., 2009. Effect of different dates of planting and lines on the growth, yield and yield

contributing characteristics of cauliflower. Journal of Soil and Nature 3(1), 16−19.

Bose, T.K., Som, M.G., 1986. Vegetable crops in India,. First Edition. Nayaprakash, Calcutta, India, 192.

Chatterjee, R., 2006. Effect of transplanting dates and spacing on seed yield and quality of cauliflower (*Brassica oleracea* var. *botrytis* L.) cv. Pusa Early Synthetic. Seed Research 34(1), 104−106.

Dhakre, D.S., Bhattacharya, D., 2013. Growth and Instability Analysis of Vegetables in West Bengal, India. International Journal of Bio-resource and Stress Management 4(3), 456−459

Gautam, B.P., Shadeque, A., Saikia, L., 1998. Effect of sowing dates and varieties on growth and yield of early cauliflower. Vegetable Science 25(1), 1−4.

Gomez, K.A., Gomez, A.A. 1984. Statistical Procedure for Agricultural Research, 2nd Edition. A John Wiley Inter Science Publication (John Wiley and Sons), New York, 20−30.

Hossain, M.F., Ara, N., Uddin, M.R., Dey, S., Islam, M.R., 2011. Effect of time of sowing and plant spacing on broccoli production. Tropical Agricultural Research and Extension 14(4), 90−92.

Kumar, M., Sharma, S.R., Kalia, P., and Saha, P., 2010. Genetic variability and character association for quantitative and quality traits in early maturing Indian cauliflowers. Indian Journal of Horticulture 67, 218−223.

Kumar, P.T., Babu, S.D., Aipe, K.C., 2002. Adaptability of cauliflower genotypes in the high ranges of Kerala. Journal of Tropical Agriculture 40, 45−47.

Muhammad, D., Muhammad, Q., Jan, N.E., Faridullah, 2007. Response of sowing dates on the growth and yield of cauliflower. Sarad Journal Agriculture 23(2), 289−292.

Pearson, S., Hadley, P.,Wheldon, A., 1994. A model of the effects of temperature on the growth and development of cauliflower (*Brassica oleracea* L. *botrytis*). Scientia Horticulturae 59, 91−106.

Rahman, H., Hadley, P., Pearson, S., Khan, M.J., 2013. Response of cauliflower (*Brassica oleracea* var *botrytis*) growth and development after curd initiation to different day and night temperatures. Pakisthan Journal of Botany 45(2), 411−420.

Ranganna, S., 2001. Analysis and Quality Control for Fruits and Vegetable Products, 2nd Edition, Tata Mc Grawhill Publication., New Delhi, 110−112.

Srivastava, B.K., Singh, M.P., Singh Pradeep, K., Singh, P.K., 2011. Performance of early cauliflower (*Brassica oleracea* var. *botrytis*) under naturally ventilated poly house. Progressive Horticulture 43(2), 228−230.