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Performance of Off-season Cauliflower (*Brassica oleracea* var. *botrytis* L.) under Agro Shade Net as influenced by Planting Dates and Nutrient Source

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Abstract
Off-season cauliflower during summer months inside shade net offers great potential and fetches higher remuneration as compared to winter season crop. Summer King cultivar is gaining popularity among the farmers during summer months but lack of standard planting time and indiscriminate chemical fertilizers results in fluctuating yield and economic return. The present work was aimed to identify optimum planting time and proper nutrient source of summer season cauliflower to make production system economically viable and remunerative. Four different planting dates (1st May, 7th May, 14th May and 21st May) and four nutrients sources (100% recommended inorganic fertilizers plus 10 t/ha farmyard manure; 75% recommended inorganic fertilizers plus 10 t/ha farmyard manure plus biofertilizer; 75% recommended inorganic fertilizers plus 5 t/ha vermicompost plus biofertilizer and 75% recommended inorganic fertilizers plus 5 t/ha farmyard manure plus 2.5 t/ha vermicompost plus biofertilizer) were laid out in two factor factorial RBD with three replications inside shade net house. The findings revealed that planting dates and nutrient source have significant effect on off-season cauliflower production and 14th May planting was found best considering the plant grwoth, curd yield and quality. Again 75% recommended inorganic fertilizers along with vermicompost (5 t/ha) and biofertilizer seedling inoculation emerged as best nutrient source for off-season cauliflower production. The finding established that 14th May planting coupled with 75% recommended inorganic fertilizers, vermicompost (5 t/ha) and biofertilizer seedling inoculation will bring desirable growth, yield and quality attributes of off-season cauliflower under agro shade net.

Key words: Off-season cauliflower, planting dates, inorganic fertilizers, organic manure and biofertilizer

Introduction
Cauliflower is one of the popular winter season vegetable grown throughout the world. The edible curd is a rich source of protein, minerals and vitamins which protects human from certain cancers and heart diseases (Keck, 2004). There is a great demand of cauliflower all year round. Off-season cauliflower during summer months fetches higher remuneration as compared to winter season crop. Cauliflower productivity is highly influenced by the genetic characteristics of the cultivar, planting time, growing temperature and applied nutrients. Normal crop production under open field condition is not possible during summer months. With the introduction of shade net which partially controls the temperature and light and creates a favourable

environment for crop growth that enables the growers to raise the crop during intense summer months? The local farmers are gradually practicing summer cauliflower production under agro shade net. Summer King cultivar is gaining popularity among the farmers during summer months but lack of standard planting time and indiscriminate chemical fertilizers results in fluctuating yield and poor return. Selection of optimum planting time and proper nutrient sources have direct bearing on the economic viability of the production system and may bring higher return from off-season cauliflower. Significant role of planting dates on the performance of vegetables have been reported by different researchers (Pandey, 2007; Dilruba *et al.*, 2009; Gautam *et al.*, 2006). The present work was formulated to identify the most suitable planting time and best possible nutrient source for summer cauliflower under agro shade net.

Materials and methods

The field experiment was conducted at the Instructional Farm of UBKV, Pundibari, Coochbehar, West Bengal, India during summer months of 2012. The site is located at 89°23′53″ E longitude and 26°19′86″ N latitude and at 43 m above mean sea level. The soil was sandy loam (66%, 23% and 21% sand, silt and clay respectively) in texture and slight acidic in reaction (pH 5.74). The initial soil organic carbon was 0.83% and available N, P and K contents were 176.31, 19.28 and 118.63 kg/ha respectively. Four different planting dates (1st May, 7th May, 14th May and 21st May) and four nutrients sources (100% recommended inorganic fertilizers plus 10 t/ha farmyard manure ; 75% recommended inorganic fertilizers plus 10 t/ha farmyard manure plus biofertilizer ; 75% recommended inorganic fertilizers plus 5 t/ha vermicompost plus biofertilizer and 75% recommended inorganic fertilizers plus 5 t/ha farmyard manure plus 2.5 t/ha vermicompost plus biofertilizer). Thus 16 treatment combinations (Table 1) were laid out in two factor factorial Randomized Block Design with three replications. Cauliflower was grown in a UV stabilized HDPE naturally ventilated shade net house of 20 m x 10m dimension with 50 per cent shade intensity. Healthy seedlings of 30 days old of the cultivar Summer King were transplanted at 45 cm x 45 cm spacing in 2.25 m x 2.25 m plots area. Vermicompost and farmyard manure were applied to the respective plots at the time of transplanting. The recommended doses of inorganic fertilizers (120 N: 60 P: 60 K kg/ha) were applied in the form of urea (N-46%), single super phosphate (P-16%) and muriate of potash (K-60%). Full dose of P and K along with half N were applied as basal and rest N was top dressed in two equal splits at 30 and 45 days after transplanting. *Azophos*, *Azotobacter* and phosphate solubilizing bacteria containing biofertilizer was applied as seedling dipping (250 g litre^{-1} water) just before transplanting. The crop was raised adopting standard cultural practices. The observation were recorded for plant height (cm), number of leaves/plant, days to curd initiation and maturity, curd weight (g), curd yield (kg/m^2) and vitamin C content of the curd (mg/100 g fresh curd). The vitamin C content was determined titrimetrically, using 2, 6 dichlorophenol indophenol dye as per method suggested by Ranganna (1986). The observations recorded on different parameters were statistically analyzed as per method suggested by Panse and Sukhatme (2000).

Results and discussion

Effect of planting dates

The result showed that planting dates have significant effect on vegetative and yield attributes of cauliflower (Table 1). Among the different planting dates, 14th May planting recorded the highest plant height (37.28 cm), maximum number of leaves (17.31 /plant), curd weight (314.53 g), curd yield (1.55 kg/m^2) and vitamin C content of curd (35.59 mg/100g). The curd weight was lowest at first planting then gradually increased and again decreased on subsequent planting. Although, 1st May planting resulted in minimum days for curd initiation and curd maturity but recorded the lowest curd weight (263.14 g) among all planting dates. Saikia *et al*., (1998) also found significant differences on the performance of cauliflower varieties planted at different dates. Vitamin C content of curd showed non significant difference upon planting dates. The improvement of curd yield on 14th May planting may be due to favourable environmental condition (Fig. 1) for optimum growth of the plants. Higher marketable yield and better quality of vegetables under protected structures have been reported earlier by Palada and Ali (2002), Dixit (2007) and Lawwa and Singh (2011).

Table1.Effect of planting dates and nutrient source on growth, yield and quality of cauliflower

Treatments	Plant height (cm)	No. of leaves /plant	Days to curd initiation	Days to curd maturity	Curd weight (g)	Yield (kg/m^2)	Vitamin C (mg/100 g)
Planting dates							
P_1	34.87	14.24	39.47	57.59	263.14	1.30	34.58
P_2	35.23	15.12	40.82	58.84	281.64	1.39	34.91
P_3	37.28	17.31	43.71	61.24	314.53	1.55	35.59
P_4	35.82	16.53	46.29	63.32	306.59	1.51	35.12
CD(P=0.05)	1.41	0.73	1.13	1.21	5.83	0.05	NS
Nutrient source							
N_1	37.83	17.17	43.21	61.74	317.28	1.57	36.28
N_2	36.52	16.21	44.87	62.81	298.34	1.47	33.57
N_3	39.47	18.41	45.27	62.37	324.19	1.60	37.28
N_4	35.89	15.39	47.19	64.12	311.49	1.54	35.19
CD(P=0.05)	1.38	0.78	1.24	1.29	6.03	0.05	0.98

Treatments : P_1-1st May planting,P_2-7th May planting,P_3-14th May planting, P_4-21st May planting; N_1-100% recommended inorganic fertilizers plus 10 t/ha farmyard manure,N_2-75% recommended inorganic fertilizers plus 10 t/ha farmyard manure plus biofertilizer,N_3-75% recommended inorganic fertilizers plus 5 t/ha vermicompost plus biofertilizer,N_4-75% recommended inorganic fertilizers plus 5 t/ha farmyard manure plus 2.5 t/ha vermicompost plus biofertilizer.

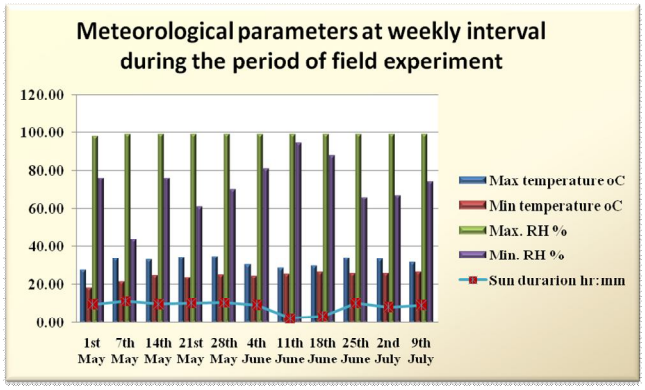

Figure 1: Meteorological parameters during the experiment period (1st May to 9th July, 2012)

Effect of nutrient source

A perusal data indicated that different nutrient source have significantly influenced the growth and yield attributes of cauliflower (Table 1). Results revealed that plant received 75% recommended inorganic fertilizers plus 5 t/ha vermicompost plus biofertilizer recorded the maximum plant height (39.47 cm) and number of leaves (18.41). The same treatment not only improved the growth attributes but also increased the curd weight (324.19 g) and finally maximum curd yield (1.60 kg/m^2). The vitamin C content of curd (37.28 mg/100g curd) was also found highest under same nutrient combination. This could be attributed to enhanced plant growth coupled with adequate reserved food material which facilitated adequate vegetative growth and subsequent higher curd weight and finally led to highest curd yield. 100% recommended inorganic fertilizers plus 10 t/ha farmyard manure stood as second best nutrient combination considering the growth and yield attributes of cauliflower.

Table 2: Effect of interaction of planting dates and nutrients source on growth, yield and quality of cauliflower

Treatments	Plant height (cm)	No. of leaves /plant	Days to curd initiation	Days to curd maturity	Curd weight (g)	Yield (kg/m^2)	Vitamin C (mg/100 g)
P_1N_1	35.16	15.03	40.68	58.17	271.82	1.34	34.62
P_1N_2	34.93	14.82	40.53	57.84	265.24	1.31	34.43
P_1N_3	35.38	15.16	41.12	58.37	279.28	1.38	34.87
P_1N_4	35.07	14.89	39.83	57.69	268.51	1.33	36.52
P_2N_1	36.22	16.07	42.24	59.81	290.12	1.43	34.36
P_2N_2	35.68	15.79	41.34	59.54	285.27	1.41	35.11
P_2N_3	36.42	16.17	43.59	60.24	292.32	1.44	34.53
P_2N_4	36.02	15.74	43.17	59.53	293.11	1.45	34.87

P_3N_1	40.21	18.57	43.52	60.27	330.21	1.63	37.08
P_3N_2	37.91	17.36	41.17	58.29	311.38	1.54	36.78
P_3N_3	41.58	19.28	44.37	62.11	337.42	1.67	38.56
P_3N_4	39.78	18.23	42.91	59.83	319.52	1.58	36.82
P_4N_1	37.69	16.81	45.39	62.58	302.61	1.49	35.53
P_4N_2	37.06	16.09	45.19	62.87	293.52	1.45	34.61
P_4N_3	38.29	17.11	43.28	63.71	307.31	1.52	35.81
P_4N_4	37.31	16.14	46.21	63.52	297.38	1.47	34.96
CD(P=0.05)	1.43	0.81	1.18	1.41	6.08	0.08	1.22

Treatment details in Table 1.

Effect of Interaction of planting dates and nutrient source

The result indicated a significant interaction between planting dates and nutrient source for the growth and yield attributes of cauliflower (Table 2). Seedling planted on 14th May and received 75% recommended inorganic fertilizers along with vermicompost (5 t/ha) and biofertilizer seedling inoculation had recorded the maximum plant height (41.58 cm) and maximum number of leaves (19.28). The same combination also recorded highest curd weight (337.42 g) and curd yield (1.67 kg/m^2) as well as maximum vitamin C content of the curd (38.56 mg/100g curd). Seedling planted at optimum time coupled with suitable nutrient level might have provided favourable environment for greater vegetative growth and development. Again combined use of higher amount of vermicompost and reduced level of inorganic fertilizers in presence of biofertilizer might have increased the concentration of essential nutrients in soil solution resulted in steady uptake of major nutrients, sturdy plant growth and subsequently higher curd yield and quality (Chatterjee, 2009).

Conclusion

The findings revealed that planting dates and nutrient source have significant effect on off-season cauliflower production. Seedling planted on 14th May was found best considering the plant growth, curd yield and quality. Again 75% recommended inorganic fertilizers along with vermicompost (5 t/ha) and biofertilizer seedling inoculation emerged as best nutrient source for off-season cauliflower production. The finding established that 14th May planting coupled with 75% recommended inorganic fertilizers, vermicompost (5 t/ha) and biofertilizer seedling inoculation will bring desirable growth, yield and quality attributes of off-season cauliflower under agro shade net.

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