Asian Australas. J. Biosci. Biotechnol. 2020, 5 (1), 1-5

Asian-Australasian Journal of Bioscience and Biotechnology
ISSN 2414-1283 (Print) 2414-6293 (Online)
www.ebupress.com/journal/aajbb

Article

Fertilizer recommendation for cauliflower production in the Bogura region of Bangladesh

Most. Arzuman Akther[1*], Selina Hasan[2], Shamima Akhter[3] and Md. Rahmat Ali Mollah[1]

[1]On-Farm Research Division, BARI, Chalopara, Bogura, Bangladesh
[2]On-Farm Research Division, BARI, Alamnagor, Rangpur, Bangladesh
[3]Pulse Research Sub-Centre, BARI, Joydebpur, Gazipur, Bangladesh

*Corresponding author: Most. Arzuman Akther, On-Farm Research Division, BARI, Chalopara, Bogura, Bangladesh. E-mail: arzumanagst@gmail.com

Received: 27 February 2020/Accepted: 02 April 2020/ Published: 30 April 2020

Abstract: An experiment was conducted to detect fertilizer doses in cauliflower (*Brassica oleracea* var. *botryitis,* L. Family: Cruciferae) during *rabi* season of 2016-17. The location for the study was at the Multi location Testing (MLT) site, (medium highland under AEZ-03) Goneshpur of Shibganj upazilla under Bogura district. The experiment was laid out in randomized complete block design (RCBD) with eight dispersed replications. There were eight nutrient packages viz. T_1 = 100% NPKSZnB (STB), T_2 = T_1+ 25% N, T_3 = T_1+ 25% NP, T_4 = T_1+ 25% NK, T_5 = T_1+ 25% PK, T_6 = T_1+ 25% NPK T_7 = 75% of T_1 and T_8 = Control. The highest yield (42.11t $ha^{-1)}$ was obtained from the treatment T_6 which was statistically similar with the rest treatments except T_7 (35.89 t ha^{-1}) and T_8 (18.36 t ha^{-1}). In case of gross margin, the highest value, (824607) was also obtained from the treatment T_6 followed by T_3, T_1 and T_4. The treatment T_6 (T_1+ 25% higher NPK), fertilizer management practices produced higher in terms of cauliflower yield, gross return, gross margin over the other treatments. Therefore, the result revealed that recommended fertilizer dose $N_{138.25}$ P_{50} $K_{143.75}$ $s_{4.5}$ $Zn_{3.22}$ $B_{0.51}$ Kg ha^{-1} was optimum for maximizing the yield as well as economically and environmentally viable for cauliflower cultivation in Bogura region.

Keyword: fertilizer; recommendation; cauliflower; FRG 2012

1. Introduction

Cauliflower (*Brassica oleracea* var. *botryitis* L.*)* is the most popular vegetable crop among cole crops belong to the family Cruciferae. It is being grown round the year for its white and tender curd. It is a fair source of vitamin A (51 IU), vitamin-C (56 mg), riboflavin (0.10 mg), thiamin (0.04 mg), nicotinic acid (1.0 mg), calcium (33 mg), phosphorus (57 mg), potassium (138 mg), moisture (90.8 g), carbohydrates (4.0 g), protein (2.6 g), fat (0.4 g), fiber (1.2 g), and iron (1.5 mg) per 100 g of edible portion of cauliflower (Fageria *et al.*, 2012). Cauliflower is grown commercially on an area of about 19332 hectares with an annual production of average 13.88 MT/ha. In Bangladesh (BBS, 2016). Bangladesh is an agro-based country. But it is a densely populated country of the word. Now a days, the scarcities of foods are increasing day by day due to over population. The present population of Bangladesh is about 170 million and the rate of population (about 1.42% annually) is higher than other developing countries (BBS, 2016). In this situation, the major challenges for agriculture sector of Bangladesh are to increase and sustain crop production. It can be possible to overcome this problem through high yielding variety and used balanced fertilizer so that increase properly**.** Cauliflower important vegetables but have lacking and divergent information about potassium (K) fertilization in soil with a high K content. Fertilizing agricultural soils is one of the most expensive agricultural practices, although its economic return is

usually high due to its effects on productivity, product uniformity and quality (Ricci *et al.*, 1995). In horticulture, because fertilization has a high economic return, farmers usually do not economize when applying fertilizers to the plants. Cauliflower crop is among those with the highest demand for potassium; it is the second most absorbed nutrient by plants of these species (Castoldi *et al.*, 2009). According to Islam *et al*. (2010), K is the most important nutrient for cauliflower productivity. On the other hand, Nitrogen is an essential plant nutrient, which is involved in physiological processes and enzyme activities. Farmers use urea excessively as a nitrogen fertilizer to enhance curd initiation and increase curd size in cauliflower. Nitrogen could increase production of cauliflower, but the curd quality is affected. High nitrogen contents with deficits of other nutrients could reduce the storage life of cauliflower and buttoning (Kirthisinghe, 2006). Mineral nutrition does play an important role in influencing the quality of crops and it is fact that the soil health deteriorates due to continuous use of chemical fertilizers (Savci, 2012). Bangladesh Agricultural Research Council published fertilizer recommendation guide in 2012, which was found to be very useful for the extension agents and farmers. But with the progress of time there have been considerable changes in crops and cropping patterns including soil physical and chemical characteristics, some new crops and cropping patterns are emerged as promising, many areas became deficient in Zinc, Boron and other nutrients and farmers are growing those crops without any fertilizer recommendation. Determination of fertilizer for those crops and cropping patterns are very important for sustainable crop production and it should be included in the new national fertilizer recommendation guide. Location specific AEZ based fertilizer management for crops and cropping patterns are very useful in this regard. The present study was undertaken to find out optimum fertilizer dose for Cauliflower in AEZ-3.

2. Materials and Methods

The experiment was conducted to detect the ideal fertilizer doses in cauliflower (*Brassica oleracea* var. *botryitis,* L. Family: Cruciferae) during *rabi* season of 2016-17. The location for the study was at the Multi location Testing (MLT) site, (medium highland under AEZ-03) Goneshpur of Shibganj upazilla under Bogura district. In the study, to evaluate the response of cauliflower to different nutrient management practices under farmer's field condition. The experiment was laid out in randomized complete block design (RCBD) with six replications. The crop was accommodated in 8 m × 4 m. There were eight treatments viz. T_1 = 100% NPKSZnB (STB), T_2 = T_1+ 25% N, T_3 = T_1+ 25% NP, T_4 = T_1+ 25% NK, T_5 = T_1+ 25% PK, T_6 = T_1+ 25% NPK, T_7 = 75% of T_1 and T_8 = Control. The unit plot size was 8m x 4m. Seedlings (variety 3S) were planted on 18-30 October 2016. The climatic condition was cold and humid at the vegetative stage and moderately hot & high humid with frequent rain during fruiting and harvesting phase Table 1. The fertilizers were used in treatment wise. Before conducting the experiment soil samples were collected from the experimental fields, and then sent to the Soil Resources Development Institute, Bogura for analysis to know the level of nutrient status. Chemical analysis of soil's results has been presented in Table 2. Weeding, mulching, irrigation and removal of dried leaves were done as and when necessary. The crop was harvested treatment wise during 6 to 20 December, 2016 irrespective of farmers. At harvest, 10 randomly selected plants from each plot were carefully uprooted to record number of leaves per plant, length & diameter curd and yield. The yield of potato per plot was recorded and converted into yield per hectare according to treatment. At maturity, different data were collected in different parameter wise.

2.1. Data analysis

The data obtained for yield contributing character and yield were statistically analyzed to find out the significance of differences among the treatments. The mean values of all the characters were evaluated and analysis of variance was performed by MSTAT-C software package and the mean differences were adjudged by Duncans Multiple Range Test (Gomez and Gomez, 1984). The gross economic return was calculated on the basis of prevailing market price of the commodities. Economic analysis was done on the basis of existing market prices of input and output (Reddy and Reddy, 1992).

Table 1. Meteorological data recorded at the experimental site during the study period 2016-17.

Months	During 2016-17			
	Average Temperature (^{0}C)		Average Relative Humidity (%)	Average Rainfall (mm)
	Maxi.	Min.		
January	24.50	12.02	92.89	0.20
February	28.83	16.20	91.76	0.0
March	32.45	20.77	85.56	0.4
April	-	-	-	-
May	-	-	-	-
June	-	-	-	-
July	32.90	26.86	91.31	1.64
August	32.41	26.17	94.42	1.43
September	33.48	24.96	94.53	1.05
October	33.50	23.42	93.72	0.09
November	31.16	18.95	93.99	0.0
December	25.75	14.01	93.21	0.0

Table 2. Soil analysis values of different samples collected from the MLT site, Shibganj, Bogura.

Sample	Analysis results							
	PH	OM %	Total N (%)	(meq/100 g soil)	(mg/g soil)			
				k	P	S	Zn	B
Value	5.8-0.4	154	0.07	0.10	6.99	15.00	0.64	0.29
	Slightly acidic	L	VL	L	L	M	L	L
Critical level	-	-	0.12	0.12	7.0	10.0	0.60	0.20

3. Results and Discussion

The yield and yield attributes of cauliflower have been presented in Table 3.There was significant different among the treatments all characters. The highest no of leaves plant^{-1} was observed in T_6 (21.95) which was statistically similar with the rest treatments except T_7 (17.40) and control plot T_8 (15.47). The highest weight of leaves per plant (1.13kg) was found in treatment T_6 which was statistically similar in all characters except T_7 (0.78 kg) and T_8 (0.45kg). The maximum length of curd (20.45cm) was obtained from treatment T_6 and it was followed by all other treatments except T_7 (15.50cm) and T_8 (11.83cm). The highest diameter and weight of curd was observed in treatments T_6 (18.43cm and 1.14 kg) and lowest in control plot (10.15cm and 0.51kg) and which was followed by T_7 (12.92cm and 0.86kg). More or less similar observations in characters. Hasan *et al*. (2013) also verified that the application of phosphorus fertilizer affected broccoli and cauliflower in vegetative growth parameters (plant height leaf number and area fresh and dry weights of whole plants) as well as diameter and weight of the head. Therefore, the response of NPK fertilization improved overall crop growth in terms of number of leaves per plant, weight of leaves per plant, length of curd and diameter of curd quality attributes *viz.* chlorophyll content in leaves. Similar observation was found in yield per hectare. The highest yield was obtained from the treatment T_6 (42.11tha^{-1}) which was followed by treatments T_3 (41.62. tha^{-1}) T_1 (40.94 tha^{-1}), and T_4 (40.60tha^{-1}). The lowest yield was obtained from T_8 (18.36 tha^{-1}) and T_7 (35.89 tha^{-1}). Potassium helps in the protein and chlorophyll formation ultimately the NPK are used for better vegetative growth. The results are close conformity with the finding of (Abd el-All and EL-Shabrawy, 2013). The similar trend of the results were found by several scientists (Bhagatagoudra and Rokhde, 2001; Gautum, 2012).

Table 3. Performance of cauliflower at different nutrient combinations in the MLT site, Shibganj, Bogura during 2016-17.

Treatments	No. of leaves/plant	Wt of leaves/plant (kg)	Length of curd (cm)	Diameter of curd (cm)	Wt of curd (kg)	Yield (tha^{-1})
T_1 = 100% NPKSZn B	20.82 a	1.04 a	19.27 a	17.77 a	1.10 a	40.94 a
T_2 = T_1+ 25% N	21.47 a	1.09 a	19.27 a	17.90 a	1.12 a	39.80 ab
T_3 = T_1+ 25% NP	21.32 a	1.07 a	19.57 a	18.22a	1.05 a	41.62 a
T_4 = T_1+ 25% NK	21.55 a	1.10 a	19.02 a	18.22 a	1.08 a	40.60 a
T_5 = T_1+ 25% PK	21.50 a	1.09 a	18.97 a	17.80 a	1.08 a	39.96 ab
T_6 = T_1+ 25% NPK	21.95 a	1.13 a	20.45 a	18.43 a	1.14 a	42.11 a
T_7 = 75% of T_1	17.40 b	0.78 b	15.50 b	12.92 b	0.86 b	35.89 b
T_8 = Control.	15.47 c	0.45 c	11.83 c	10.15 c	0.51 c	18.36 c
CV (%)	7.08	8.37	7.85	9.15	9.93	10.06

$T_{1=}$ 100% NPKSZnB(110.6-40-115-4.5-3.22-0.51 NPKSZnB)
$T_{2=}$ T_1+ 25% N (138.2-40-115-4.5-3.22-0.51 NPKSZnB)
$T_{3=}$ T_1+ 25% NP (138.25-50-115-4.5-3.22-0.51 NPKSZnB)
$T_{4=}$ T_1+ 25% NK (138.25-40-143.75-4.5-3.22-0.51 NPKSZnB)
$T_{5=}$ T_1+ 25% PK (110.6-50-143.75-4.5-3.22-0.51NPKSZnB)
$T_{6=}$ T_1+ 25% NPK (138.25-50-143.75-4.5-3.22-0.51NPKSZnB)
$T_{7=}$ 75% of T_1 (82.95-30-86.25-3.37-2.42-0.38 NPKSZnB)
$T_{8=}$ Control

3.1. Economic performance of cauliflower

The results of economic performance of cauliflower were presented in Table 4.The highest gross return was obtained from treatment T_6 (Tk. 842200 ha^{-1}) followed by T_3 (Tk. 832400ha^{-1}), T_1 (Tk. 818800 ha^{-1}), T_4 (Tk. 812000ha^{-1}), T_2 (Tk. 796000 ha^{-1}), T_5 (Tk.787200 ha^{-1}), T_7 (Tk. 717800 ha^{-1}) and T_8 (Tk. 367200 ha^{-1}). In case of gross margin, the highest value was also obtained from the treatment T_6 (Tk. 824607 ha^{-1}) followed by T_3 (Tk. 815670 ha^{-1}), T_1 (Tk. 804370 ha^{-1}), T_4 (Tk. 795507 ha^{-1}), T_2 (Tk. 780370 ha^{-1}), T_5 (Tk. 770807 ha^{-1}), T_7 (Tk. 706877 ha^{-1}) and T_8 (Tk. 367200 ha^{-1}). From the experiment it was observed that all the treatment offered statistically similar yield except T_7 and control plot. The highest value was obtained from the treatment T_6 followed by T_3, T_1 and T_4. So it can be concluded that treatment T_6 is the best treatment for cauliflower in AEZ-3. (Karim *et al.*, 1994) reported that farmers always try to maximize their returns up to the point where returns to investment are the highest as the capital is scarce. Thus farmers of the area may be advised to go to for treatment T_6. The marginal farmers who are unable to afford necessary cost may choose T_1. Considering, treatment T_6 was found economically profitable and viable among the nutrient management treatments for the cultivation of cauliflower in the Medium highland under AEZ-03.

Table 4. Economic analysis of cauliflower under different nutrient combinations at Shibganj, Bogura during 2016-17.

Treatment	Gross return (Tk./ha)	Cost of treatment (Tk./ha)	Gross margin (Tk./ha)
T_1 = 100% NPKSZnB	818800	14430	804370
T_2 = T_1+ 25% N	796000	15630	780370
T_3 = T_1+ 25% NP	832400	16730	815670
T_4 = T_1+ 25% NK	812000	16493	795507
T_5 = T_1+ 25% PK	787200	16393	770807
T_6 = T_1+ 25% NPK	842200	17593	824607
T_7 = 75% of T_1	717800	10923	706877
T_8 = Control.	367200	-	367200

Market price of cauliflower @ 20 TK. /kg

4. Conclusions

From the above result, it may be concluded that the treatment T_6 was found economically profitable and viable for cauliflower production in the (Medium High land under *AEZ-03)* soil. So, the fertilizer dose $N_{138.25}$-P_{50}-$K_{143.75}$-$S_{4.5}$- Zn $_{3.22}$- $^{B}{}_{0.51}$ Kg ha^{-1} was optimum for growing cauliflower.

Acknowledgements
We gratefully acknowledge the financial support of Soil Fertility and Fertilizer Management for Crops and Cropping patterns BARI Gazipur to conduct the research. We also want to thank for nice co-operation of farmers and Md. Shifur Rahman, Scientific Assistant of Multiplications Testing Site (MLTS), Shibjanj, Bogura, Bangladesh.

Conflict of interest
None to declare.

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