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Growth and yield response of cauliflower in different doses of zinc

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ABSTRACT

A field experiment was conducted at Horticultural farm, Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka-1207 during October 2016 to February 2017 with micronutrient zinc (Zn). Zn was applied to investigate the growth, curd size and yield contributing characters of cauliflower cultivar, 'F_1 hybrid'. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. There were three concentrations of Zn_0: Control, Zn_1: 1.5 kg zinc ha^{-1}, Zn_2: 2 kg zinc ha^{-1}, Zn_3: 2.5 kg zinc ha^{-1}. Application of Zn_3 showed maximum (42.13 cm) plant height at harvest while minimum (37.03 cm) was recorded from control treatment. Number of leaves per plant (19.23), length of the largest leaf (42.15 cm), breadth of the largest leaf (12.97 cm) at harvest, curd diameter at harvest (14.5 cm) was highest in Zn_3 treatment whereas, lowest (17.24, 40.26 cm, 11.19 cm and 13.6 cm respectively) was recorded from control treatment.

Key Words: *Zinc, Cauliflower, Growth, Curd and Yield characteristics*

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I. Introduction

Cauliflower (*Brassica oleracea var. botrytis sub var. cauliflora*) is a major cultivated vegetable in Bangladesh of *Brassicaceae* family. The leading cauliflower producing countries of the world are China, India, France, Italy, Spain, United States of America and United Kingdom (FAO 2011). It is nutritionally rich and has medicinal value. It contains good amount of vitamins like riboflavin, thiamine, nicotinic acid and high quality of proteins and minerals like calcium and magnesium. Only 32gm per person per day in Bangladesh against the minimum recommended quantity of 200 g per day (FAO 2014). Cauliflower covered in an area of 40,970 hectares with a total production of 21,1585 metric tons (BBS 2015). The average yield per hectare of cauliflower is below than its actual yield potentiality. It can be grown in all

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types of soil with good soil fertility. Because of over mining of the plant food elements by the crops, most of the micronutrients become in short supply to the crops and some disorder appears resulting in low yields (Joshi 1997). From production aspect, it requires balanced dose of plant nutrients particularly nitrogen, phosphorus, potassium, molybdenum, zinc and boron (Mengelm et al. 1999). Balanced fertilizer requirement of crops have been discussed by Sultana et al. (2015). However, the productivity of cauliflower is not satisfactory due to poor soil fertility, degraded soil quality and imbalanced fertilization in Bangladesh (Siddique et al. 2017; Sultana et al. 2015; Siddique et al. 2014). Micronutrients deficiency is more prevalent in acidic soils (Fujimoto et al. 2000). In the recent past, much emphasis has been given to the use of NPK fertilizers but application of micronutrients especially zinc has been largely neglected. There is great scope for increasing the curd yield per unit area by rational and optimum use of nutrients coupled with better management practices. Cauliflower is a heavy feeder and it requires large amount of macronutrients as well as micronutrient for better development of curd quality (Chhonkar et al. 2005). In addition, of checking the various diseases and physiological disorders, the use of chemical fertilizer is one kind of barrier for maximization of crop yield through their proper utilization. The application of optimum dose of nitrogenous, phosphates and potash fertilizers along with some micronutrient such as zinc, boron and molybdenum are also essential for higher production, better quality and control of nutritional disorders in cauliflower. Plant grown on micronutrient deficient soils can exhibit a similar reduction in plant growth and yield as macro-nutrients.

Zinc is vital for various enzymatic reactions, metabolic processes and oxidation-reduction reactions. In addition, Zn is also essential for many enzymes which are needed for nitrogen metabolism, energy transfer and protein synthesis in plants. Saini et al. (1985) observed that yields of *Brassica juncea* were increased by zinc application. Plant root absorb zinc as zinc ions, soluble zinc salts and zinc complexes can also enter the plant through leaves. Its deficiency results in shorter internodes, chlorate areas in older leaves or may appear in younger plant too. Banuelos et al. (2000) observed that application of zinc increases yield in rapeseed. Effect of supplemental Zinc on vegetative growth and yield related character as well as suitable dose for cauliflower cultivation was studied in this field experiment.

II. Materials and Methods

The experiment was done in research fields of Sher-e-Bangla Agricultural University, Dhaka, during the period of October 2016 to February 2017. The climate of the experimental site is subtropical, characterized by heavy rainfall for the time it lasts the months from April to September (Kharif season) and the soil belongs to the Madhupur Tract (AEZ No. 28) with pH ranging from 5.8-6.5 (Haider 1991). This research work was carried out to evaluate the effect of Zn on growth and yield of cauliflower with four treatments: Zn_0: Control, Zn_1: 1.5 kg ha^{-1}, Zn_2: 2 kg ha^{-1}, Zn_3: 2.5 kg ha^{-1} in Randomized Complete Block Design (RCBD) with three replications. Twenty-five days old seedlings, which were collected from Bangladesh Agricultural Research Institute, Gazipur, were transplanted into the main field (plot size 3m×1m) maintaining a required spacing of 60cm×30cm. Manure and fertilizer was applied according to BARI recommended dose (BARC 2006). Plants in each plot were selected randomly and tagged. The tagged plants were used for recording data for the following characters: Plant height, Number of leaves $plant^{-1}$, Leaf area, Days to curd initiation, Days to 50% curd initiation, Days from curd initiation to harvest, Curd diameter, and individual curd weight, Curd weight with leaf at harvest, Curd yield $plot^{-1}$, and Curd yield ha^{-1}. The recorded data for different characters were analyzed statistically using "MSTAT-C" to find out the significance of variation among the treatments. Difference between treatments was evaluated by Duncan's Multiple Range Test (DMRT) test at 5% level of probability (Gomez and Gomez, 1984).

III. Results and Discussion

Plant height

Due to zinc application, significant differences were observed in plant height at 30 and 50DAT and at harvest. Maximum plant height (14.70 cm, 25.03 cm and 42.13 cm) was obtained from Zn_3 (2.5 kg ha^{-1}) treatment. On the other hand, lowest plant height (11.20 cm, 20.86 cm and 37.03 cm respectively) was recorded from Zn_0 (control) treatment (Figure 01). Mokhlikar et al. (2015) stated that plant height increased gradually at the early stages and decreased at the later stages of the plant growth.

Number of leaves plant^{-1}

Application of zinc caused significance increased in number of leaves per plant (Figure 01). At 30 DAT and at harvest, maximum number of leaves per plant (6.50 and 19.23) was produced by treatment Zn_3 (2.5 kg ha^{-1}) while, minimum number of leaves per plant (4.05 and 17.24) was obtained from control (Zn_0) treatment. Duraishami et al. (2005) also found similar result.

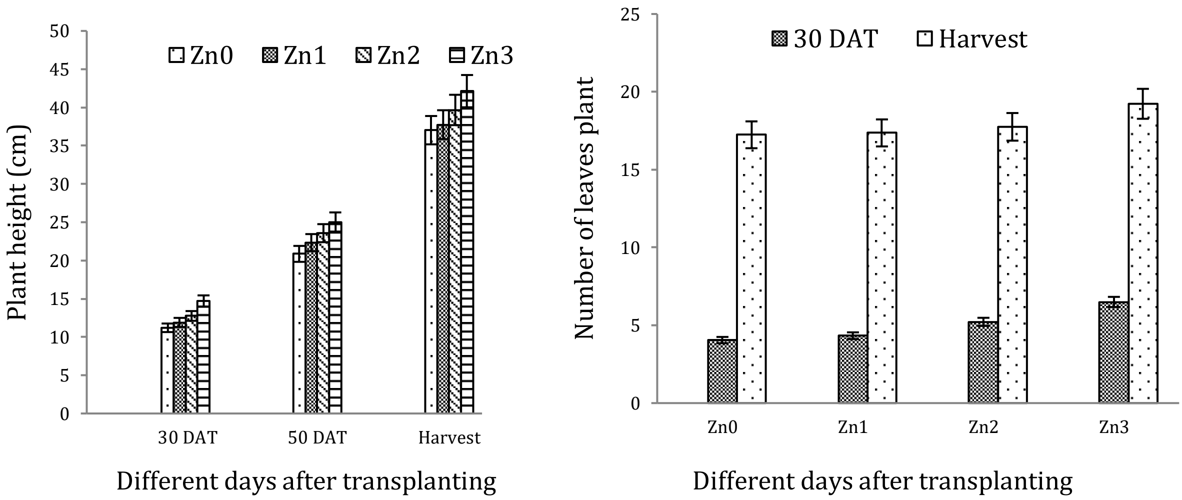

Figure 01. Effect of zinc on plant height and number of leaves of cauliflower.
Zn_0: Control, Zn_1:1.5 kg zinc ha^{-1}, Zn_2: 2 kg zinc ha^{-1}, Zn_3: 2.5 kg zinc ha^{-1}

Leaf length

Leaf length (20.14 cm) was highest in Zn_3 treatment (2.5 kg zinc ha^{-1}) while minimum leaf length (15.66cm) was found in (control) Zn_0 treatment (Table 01). Andrejiova et al. (2011) conducted a field trial and found the similar results.

Leaf Breadth

A significant variation was observed in cauliflower leaf breadth due to the application of zinc. Leaf breadth (11.81 cm) was recorded highest from the Zn_3 (2.5 kg zinc ha^{-1}) treatment while the lowest (6.83cm) was found in (Zn_0) control treatment (Table 01).

Leaf area

Maximum (203.75 cm^2) leaf area was found in Zn_3 (2.5 kg zinc ha^{-1}) treatment followed by (160.41 cm^2) Zn_2 treatment and minimum (107.06 cm^2) area was obtained from (control) Zn_0 treatment (Table 01).

Days to curd initiation

Significant differences were noted on days required from transplanting to curd initiation by different concentrations of zinc. In Zn_3 (2.5 kg zinc ha^{-1}) treatment, cauliflower required lowest days (43.83) for curd initiation. On the other hand, maximum days (47.17) were required in where no zinc was applied (Zn_0 treatment) (Table 01). This result was similar to those of Duraisami et al. (2005).

Days to 50% curd initiation

Days from transplanting to 50% curd initiation were highest (50.17) in control treatment (Zn_0) whereas, minimum number of days (47.42) was required in Zn_3 (2.5 kg zinc ha^{-1}) treatment (Table 01).

Days to harvest

A significant effect was recorded on days from curd initiation to harvest for the application of zinc. Maximum (12.03) days from curd initiation to harvest was recorded from control (Zn_0) treatment and it needed minimum (10.21) days from curd initiation to harvest in Zn_3 (2.5 kg zinc ha^{-1}) treatment (Table 01).

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Table 01. Effect of zinc on leaf length, leaf breadth, leaf area, Days to curd initiation, 50% Curd initiation and Days to curd harvest of cauliflower[x]

Treatment	Leaf length (cm)		Leaf breadth (cm)		Leaf area (cm^2)		Days to curd initiation		50% Curd initiation		Days to curd harvest	
Zn_0	15.66	c	6.83	c	107.06	c	47.17	d	50.17	d	12.03	c
Zn_1	16.44	c	7.57	c	118.23	c	44.45	c	49.53	c	11.23	c
Zn_2	18.43	b	9.26	b	160.41	b	44.4	b	48.81	b	10.77	b
Zn_3	20.14	a	11.81	a	203.75	a	43.83	a	47.42	a	10.21	a
$LSD_{(0.05)}$	0.784		0.430		11.17		0.572		0.640		0.560	
CV %	3.98		4.72		6.48		1.12		1.07		0.48	

[x]In a column, means with similar letter (s) are not significantly different by LSD at 5% level of significance.
[y]Zn_0: Control, Zn_1:1 kg zinc ha^{-1}, Zn_2: 1.5 kg zinc ha^{-1}, Zn_3: 2 kg zinc ha^{-1}.

Curd diameter

The maximum (14.5cm) curd diameter was recorded from treatment Zn_3 (2.5 kg zinc ha^{-1}) and the minimum (13.60 cm) curd diameter was found from the control (Zn_0) treatment (Table 02). This result was similar to that of Pizetta et al. (2005).

Pure Curd weight

The curd weight varied significantly due to the application of different concentration of zinc. The maximum (705.30 gm) curd weight was recorded from Zn_3 treatment (2.5 kg zinc ha^{-1}) and the minimum (443.50 gm) from the control treatment (Zn_0) (Table 02).

Curd weight with leaf

Curd weight with leaf at harvest was also found to differ significantly by the application of zinc at different concentrations. The maximum curd weight (1.55 kg) with leaf was recorded from the treatment Zn_3 (2.5 kg zinc ha^{-1}) and the minimum (0.68 kg) was from the control (Zn_0) treatment at final harvest of the crop (Table 02).

Table 02. Effect of zinc on Curd diameter (cm), Pure curd weight (kg), Curd weight with leaf (kg), Curd yield $plot^{-1}$ (kg) and Curd yield ha^{-1} (ton) of cauliflower[x]

Treatment[y]	Curd diameter (cm)		Pure curd weight (kg)		Curd weight with leaf (kg)		Curd yield $plot^{-1}$ (kg)		Curd yield ha^{-1} (ton)	
Zn_0	13.60	c	443.50	c	0.68	d	9.28	d	9.28	d
Zn_1	13.65	c	498.80	c	1.02	c	9.80	c	9.80	c
Zn_2	13.92	b	597.20	b	1.29	b	11.9	b	11.9	b
Zn_3	14.53	a	705.37	a	1.55	a	15.2	a	15.2	a
$LSD_{(0.05)}$	0.050		55.3		0.260		0.180		0.180	
C.V. %	0.59		7.97		2.71		5.75		5.75	

[x]In a column, means with similar letter (s) are not significantly different by LSD at 5% level of significance
[y]Zn_0: Control, Zn_1:1 kg zinc ha^{-1}, Zn_2: 1.5 kg zinc ha^{-1}, Zn_3: 2 kg zinc ha^{-1}

Curd yield $plot^{-1}$

A significant variation was found due to the application of Zn at different levels on the curd yield. The maximum (1.52 kg) curd yield per plot was recorded from Zn_3 (zinc 2.5 kg ha^{-1}) treatment and the minimum (0.93 kg) was found from the control (Zn_0) treatment (Table 02).

Curd yield ha^{-1}

A significant variation was found due to the application of zinc at different levels. Maximum (15.20 ton ha^{-1}) curd yield was recorded from Zn_3 (zinc 2.5 kg ha^{-1}) treatment and the minimum (9.28 ton) from the control (Zn_0) treatment (Table 02).

IV. Conclusion

Zinc application had significant effects on growth, yield and quality of cauliflower. Among the various treatments of zinc, application of $ZnSO_4$ 2kg/ha markedly enhanced the vegetative growth and produced highest yield of quality curd.

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