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EFFECT OF NUTRIENT MANAGEMENT ON GROWTH AND YIELD OF CAULIFLOWER HYBRIDS IN *HAOR* AREA

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Abstract

The experiment was conducted in the Dekar*haor* of Noagaon village under South Sunamganj Upazila of Sunamganj district during November 2017 to February 2018 to observe the effect of nutrients management on growth and yield of cauliflower hybrids. Two Hybrids namely ShiraGiku (V1) and Rupali (V2), and four combinations of nutrients, viz. (i) recommended rate of N-P-K-S-Zn-B @ 180-80-180-28-4.5-2.1 kg ha^{-1}(F1), (ii) F1 + 25% N-P-K- S-Zn-B of F1 (F2), (iii) F1 – 25% N-P-K-S-Zn-B of F1 (F3), and (iv) cow dung @ 10 t ha^{-1} (F4) was conducted in a factorial randomized complete block design (RCBD) and replicated thrice. Plant height (cm), numbers of leaves $plant^{-1}$, leaf length (cm) and leaf breadth (cm), and spreading diameter (cm) were collected at 15 days intervals, while the yield data were recorded at harvest. The parameters were significantly varied due to hybrids and fertilizers packages. Higher gross yield (42.52tha^{-1}) was found in Shira Giku and lower (42.12 t ha^{-1}) from Rupali. Higher curd yield of 25.17 t ha^{-1} was obtained in Shira Giku than Rupali (9.61 t ha^{-1}). The highest gross yield of 44.45 t ha^{-1} was obtained when the crop was treated with cowdung @ 10 t ha^{-1} followed by recommended fertilizer rate (F1). The curd yield of 18.19 t ha^{-1} was obtained with 25% less than recommended fertilizer rate of application (F3). The highest gross yield of 52.93 t ha^{-1} was obtained in V1F1 combination and the lowest of 30.10t ha^{-1}in V2 F1. Results revealed that the Hybrid ShiraGiku with recommended dose of fertilizer (180-80-180-28-4.5-2.1 kg ha^{-1}N-P-K-S-Zn-B) performed the best in comparison to other treatment combinations.

Introduction

Cauliflower (*Brassica oleracea* Lin.) is one of the popular cole crops (*botrytis* Group) belonging Brassicaceae family (or Cruciferae) in Bangladesh. The optimum temperature for cauliflower withstands is 10 to 15° C (Din *et al.,* 2007). The yield of cauliflower is low due to lack of proper management practices and nutrients deficiency in the soil. National production of cauliflower was 268.48 thousand MT from 19.424 thousand ha (BBS, 2016). *Haor* with their unique hydro-ecological characteristics are large bowl shaped floodplain depressions. The *haor* goes under flooding (5-10 m) from late April to October in Sunamganj district. In *haor* areas of north-eastern districts of Bangladesh only one crop i.e. *boro* rice is widely practiced. Due to flash flood and longtime inundation of low land of *haor* areas it is almost impossible to cultivate more than one crop. Short duration vegetables can be introduced in that region of medium high land (*kanda* land). There is a huge scope in *haor* areas for vegetable cultivation through intensification and diversification of technology in the medium high land during winter. As the *haor* areas remain under water upto late October,

cauliflower would be a promising crop for that region. After recession of flood water, cauliflower and other winter vegetables could be grown easily.

Appropriate fertilizer management would play an important role in plant growth and curd formation especially in *haor* soil. Ali *et al.* (2009) reported that fertilizer manure enhanced curd yield and yield attributes substantially. Utilization of organic matter has been well documented to improve physical, chemical and biological properties of soil (Whalen *et al.,* 2000; Tejada and Gonzalez, 2003). But the farmers of *haor* area are not habituated of cauliflower cultivation with proper fertilizer management of the crop. Hence, an experiment was undertaken to select asuitable hybrid of cauliflower and appropriate nutrient management package for increasing productivity of the crop in the *haor* areas of Sunamganj.

Materials and Methods

The experiment was conducted in the Dekar *haor*areas of South Sunamganj Upazila in Sunamganj district, during November 2017 to February 2018. Two hybrids viz. ShiraGiku (V1) and Rupali (V2), and four combinations of nutrients viz. (i) recommended dose of fertilizer (FRG, 2012) (F1) (391:388:391:156:12.8:18.6 kg ha^{-1} as urea, TSP, MoP, Gypsum, $ZnSO_4$, borax), (ii) F1 + 25% of F1 (F2), (iii) F1 - 25 % of F1 (F3), and (iv) cowdung @ 10 t ha^{-1} (F4) was conducted in *haor* area. The experiment was laid out in a Factorial Randomized Complete Block Design (RCBD) with three dispersed replications. The soil of the area was silt-loam in texture having pH 4.9 - 5.2. Experimental fields were medium high land with well drained condition. The unit plot size was 5 m 4 m with 50 cm 50 cm plant spacing. The seedlings were transplanted in the nursery bed from seed bed at a height of 3 cm for proper growth and development. Afterwards thirty-day old seedlings were transplanted in the main field on 11th November 2017. The whole amount of TSP, Zn and B was applied as basal during the final land preparation. Urea and MoP were applied in three equal splits at 15, 30 and 45 DAT in ring method under moist soil condition and mixed thoroughly with the soil. Irrigations were done after fertilizer application and when necessary. Three weeding were done to control weeds at 20, 40 and 50 days after planting (DAP). Insects were controlled successfully by hand picking, removal of damaged leaves and spraying Malathion 57 EC @ 2ml L^{-1} water. Yield related data on curd diameter (cm), gross yield (t ha^{-1}) and curd yield (t ha^{-1}) were recorded during harvesting. Cauliflower was harvested when attained marketable maturity. Harvesting was done at 2-3 days interval up to second week of January 2018. Data were converted into t ha^{-1}. The data were analyzed using R software and means separation were adjudged by using DMRT (Gomez and Gomez, 1984).

Results and Discussion

Growth performance

Plant height

Cauliflower hybrids showed significant variation in plant height at 30, 45 and 60 days after planting (DAP) (Table 1). Shira Giku attained higher plant height of 21.33, 22.83 and 29.34 cm at 30, 45 and 60 DAT, respectively. Rupali produced shorter plant of 18.67, 18.75 and 24.58 cm at corresponding DAP. Significant variation of plant height was found due to application of different nutrients packages. At 15 and 30 DAT, the highest plant height of 22.00 and 22.83 cm, respectively, was observed when the plants received recommended dose (F_1) of nutrients. At 60 DAT, the longest plant (30.03 cm) was found in F_2 treatment. The main causes of above result may be the presence of available N and B in chemical fertilizer comparing sole application of cowdung. In combination, the highest plant height of 27.33 cm at 30 DAT was recorded in V_1F^4 and the lowest of 16.33 cm in V_2F_3. Plant height of cauliflower and broccoli showed a significant variation with increasing concentrations of N and P (Sharma *et al.*, 2002).

Number of leaves plant^{-1}

Number of leaves plant^{-1} was higher (6.06) in ShiraGiku and lower (5.17) in Rupali at 30 DAP (Table 1). Ara *et al.* (2009) reported similar results in respect of plant height. At 30 DAP, the highest leaves plant^{-1} (6.45) was produced from recommended fertilizer package. Interaction effect of hybrid and fertilizer showed non-significant variations in leaf number.

Leaf length

Hybrids showed significant variations in leaf length at 30, 45 and 60 DAP (Table 2). Hybrid ShiraGiku showed longer leaves of 26.37, 36.00 and 38.99 cm at 30, 45 and 60 DAP, respectively. Rupali produced the shorter length of 17.48, 24.27 and 27.87 cm at the corresponding dates. Significant variation on leaf length was found due to application of different fertilizer packages. The maximum length of 24.87 cm at 30 DAP was due to recommended fertilizer treatment (F_1) which was statistically similar to F_2 and F_3 packages. Similar pattern was also showed at 45 DAP. The biggest leaf was of17.73 cm given by V_2F_2 at 15 DAP and the smallest in V_2F_4. According to Farahzety and Aishah (2013), leaf area was increased up to 33 % by using chemical fertilizer. Due to fertilizer application the increased cell elongation and cell division probably influenced the leaf growth of cauliflower.

Leaf breadth

Significant variations were observed in leaf breadth at 30 and 45 DAP. Hybrid ShiraGiku produced wider leaf breadth of 12.75 and 17.65 cm at 30 and 45 DAP, respectively while the narrower leaves of 9.67 and 13.54 cm were observed in Rupali in the corresponding DAP (Table 2). Statistically significant variations on leaf width were observed due to different packages of nutrients application. The treatment F_2 produced the maximum leaf of 8.40 cm at 15 DAP and the minimum was of 5.57 cm in F_4. Recommended fertilizer treatment (F_1) produced the highest leaf breadth of 13.40, 17.78 and 21.98 cm at 30, 45 and 60 DAP, respectively. Interaction effects showed the significant response of 21.83 cm at 45 DAP due to V_1F_1 combination.

Spreading diameter

Higher spreading diameter was reported in case of ShiraGiku of 17.24, 42.39, 56.28 and 62.10 cm and lower in Rupali of 15.93, 34.31, 47.25 and 52.92 cm at 15, 30, 45 and 60 DAP, respectively (Table 3). At 15 DAP, spreading diameter was found significant variation. The highest diameter (17.75 cm) was found due to recommended fertilizer (F_1) application and the lowest (15.23 cm) in F_4 treatment. Significant variation in spreading diameter was also recorded at 30 DAP where the highest value (45.47 cm) was showed due to F_2 package and the lowest (32.03 cm) was reported in F_4 package. The results were corroboratory towards the *haor* soil condition and nutrient availability due to different fertilizer packages. The interaction effects of hybrids and fertilizers showed non-significant variation in spreading diameter.

Yield contributing characters of cauliflower

Curd diameter

Higher curd diameter (48.33 cm) was produced in ShiraGiku, while lower (38.46 cm) in Rupali (Table 4) and the difference in the response was probably due to genetically improved, nutrients uptake capacity and adaptive nature of the hybrids. Fertilizer packages had significant variation on curd diameter. The maximum curd diameter (46.67 cm) was recorded with the recommended nutrient application, (F_1) which was at par with F_4 (43.42 cm), while the lowest diameter (41.33 cm) in F_3. The largest curd diameter (59.00 cm) was observed in V_1F_1 and the smallest one (34.33 cm) in V_2F_1 (Table 4). Curd size has a positive response towards the proper fertilizer application (Rikiand Kristian, 1997).

Gross yield

Gross yield was non-significant between the hybrids as well as different fertilizers packages (Table 4). It was probably caused due to profuse vegetative growth with seasonal effects as well as fertility. The highest gross yield of 52.93 t ha^{-1} was obtained in V_1F_1 and the lowest 30.10 t ha^{-1}in V_2F_1. According to Stanislaw and Jan (1998) gross yield of cauliflower increased with nitrogen rates up to 600 kg ha^{-1}.

Curd yield

Higher curd yield of 27.17 t $ha^{-1}$was observed in ShiraGiku and the lower of 9.61 t ha^{-1} in Rupali (Table 4). The results assumed that ShiraGiku might be adapted to that area while Rupali may be the early hybrid but it was planted during late season which reflected the low yield. The highest curd yield of 18.19 t ha^{-1} was found in F_3 and the lowest (15.05 t ha^{-1}) in F_4 treatment. Significant difference in curd yield was found due to interaction effects of hybrids and fertilizer combination. The highest curd yield (33.20 t ha^{-1}) was produced by V_1F_1. The lowest curd yield of 2.87 t ha^{-1} was recorded from V_2F_1 combination. Similar result was reported by Das *et al.* (2000) where curd yield was higher due to higher inorganic fertilizers application.

Cost and returns

The cost of production varied from Tk.177005 to Tk. 203673 ha^{-1}. The gross return ranged from Tk. 57400 to Tk. 664000 for different treatments (Table 5). BCR was recorded higher in ShiraGiku where showed negative in Rupali because of small size and deformed curd formation, which might be due to seasonal effect (probably early hybrid).

Table 1. Effect of hybrids, fertilizer packages and their interactions on plant height and number of leaves plant^{-1} of cauliflower in the *haor* are

Treatments	Plant height (cm)				Number of leaves plant^{-1}			
	15 DAP	30 DAP	45 DAP	60 DAP	15 DAP	30 DAP	45 DAP	60 DAP
Hybrids								
Shira Giku	20.75	12.33a	22.83a	29.34a	5.83	6.06a	14.00	19.25
Rupali	17.75	17.67b	18.75b	24.58b	5.33	5.17b	13.17	16.42
Level of significance	NS	**	*	**	NS	*	NS	NS
CV%	18.78	10.51	16.85	13.62	18.18	16.82	22.81	19.09
Fertilizer packages								
F1 (FGR, 2012)	22.00a	22.83a	21.33	28.73a	6.00	6.45a	15.17	19.83
F2 (F1 + 25% of F1)	18.67ab	18.38b	20.50	30.03a	6.00	4.89c	12.83	18.33
F3 (F1 - 25% of F1)	18.83ab	19.38b	21.00	25.58ab	4.67	6.11ab	13.33	18.00
F4 (Cowdung @ 10 t ha^{-1})	17.56b	18.33b	20.33	23.50b	5.67	5.00bc	13.00	15.67
Level of significance	*	**	NS	*	NS	*	NS	NS
CV (%)	18.78	10.51	18.78	10.51	18.18	16.82	18.18	16.82
Hybrids ЧFertilizer								
V1F1	21.33	20.43bc	26.67	33.80	5.67	5.56	15.67	20.33
V1F2	21.00	19.10bcd	20.67	33.40	6.33	4.67	13.00	19.67
V1F3	20.33	22.43b	23.33	27.17	5.00	6.67	13.67	21.00
V1F4	20.33	27.33a	20.67	23.00	6.33	7.33	13.67	16.00
V2F1	22.67	16.33d	16.00	23.67	6.33	4.44	14.67	19.33
V2F2	16.33	17.67cd	20.33	26.67	5.67	5.11	12.47	17.00
V2F3	17.33	16.33d	18.67	24.00	4.33	5.56	13.00	15.00
V2F4	14.67	18.33cd	20.00	24.00	5.00	5.56	12.33	14.33
Level of significance	NS	*	NS	NS	NS	NS	NS	NS
CV (%)	18.78	10.51	18.78	10.51	18.18	16.82	18.18	16.82

'*' significant at 0.5 %,'**' significant at 1 %, 'NS' non-significant, V1=Shira Giku, V2=Rupali, F1 -=Recommended dose of NPKSZnS, F2 -= Recommended dose + 25% NPKSZnS, F3 -= Recommended dose- 25% NPKSZnS, F4 -=Cowdung @ 10 t ha^{-1}, DAP = Days After Planting, CV – Coefficient of Variance

Table 2. Effect of hybrids, fertilizer packages and their interactions on leaf length and breadth (cm) of cauliflower in *haor* area

Treatments	Leaf length (cm)				Leaf breadth (cm)			
	15 DAP	30 DAP	45 DAP	60 DAP	15 DAP	30 DAP	45 DAP	60 DAP
Hybrids								
Shira Giku	15.32	26.37a	36.00a	38.99a	7.12	12.75a	17.65a	20.11
Rupali	14.97	17.48b	24.27b	27.87b	7.04	9.67b	13.54b	17.74
Level of significance	NS	**	**	**	NS	**	**	NS
CV%	10.33	18.81	17.91	15.75	12.22	17.91	15.44	14.98
Fertilizer packages								
F1 (FGR, 2012)	16.38	24.87a	33.92	37.02	7.00b	13.40a	17.78a	21.98a
F2 (F1 + 25% of F1)	17.45	23.58a	32.41	34.38	8.40a	12.37ab	15.92ab	19.57a
F3 (F1 - 25% of F1)	16.13	22.20a	28.86	33.10	7.37ab	10.87b	15.72ab	19.30a
F4 (Cowdung @ 10 t ha^{-1})	10.60	17.07b	25.38	29.22	5.57c	8.20c	12.96b	14.85b
Level of significance	NS	*	NS	NS	**	**	*	**
CV (%)	10.33	18.81	10.33	18.81	12.22	17.91	12.22	17.91
Hybrids ч Fertilizer								
V1F1	16.00a	29.20	41.67	42.33	7.37	16.40	21.83a	25.13
V1F2	17.17a	26.53	38.37	39.17	7.67	13.87	17.83ab	21.17
V1F3	16.43a	29.37	36.67	37.67	7.23	12.53	17.83ab	20.37
V1F4	11.67b	20.40	27.33	29.05	6.23	8.20	13.10c	13.77
V2F1	16.77a	20.53	26.17	27.10	6.63	10.40	13.72bc	18.83
V2F2	17.73a	20.63	26.45	26.16	9.13	10.87	14.00bc	17.97
V2F3	15.83a	15.03	21.05	20.67	7.50	9.20	13.61c	18.23
V2F4	9.53b	13.73	23.42	22.45	4.90	8.20	12.81c	15.93
Level of significance	**	NS	NS	NS	NS	NS	*	NS
CV (%)	10.33	18.81	10.33	18.81	12.22	17.91	12.22	17.91

'*' significant at 0.5 %, '**' significant at 1 %, 'NS' non-significant,

V1-=Shira Giku, V2- Rupali, F1 = Recommended dose of NPKSZnS, F2 = Recommended dose + 25% NPKSZnS, F3 = Recommended dose - 25% NPKSZnS, F4 = Cowdung @ 10 t ha^{-1}, DAP = Days After Planting, CV = Coefficient of Variance

Table 3. Effect of hybrids, fertilizer packages and their interactions on spreading area (cm) of cauliflower in *haor* area

Treatments	Spreading diameter(cm)			
	15 DAP	30 DAP	45 DAP	60 DAP
Hybrids				
ShiraGiku	17.24a	42.39a	56.28a	62.10a
Rupali	15.93b	34.31b	47.25b	52.92b
Level of significance	**	*	*	**
CV%	5.09	22.31	16.28	12.77
Fertilizer packages				
F1 (FGR, 2012)	17.75a	33.72b	51.95	60.75
F2 (F1 + 25% of F1)	17.48a	45.47a	55.97	60.58
F3 (F1 - 25% of F1)	15.88b	42.18ab	53.68	57.90
F4 (Cowdung @ 10 t ha^{-1})	15.23b	32.03b	45.45	50.80
Level of significance	**	*	NS	NS
CV (%)	5.09	22.31	5.09	22.31
Hybrids x Fertilizer				
V1F1	17.60	37.47	58.83	71.97
V1F2	18.27	51.87	59.87	63.87
V1F3	16.57	48.07	59.60	61.50
V1F4	16.53	32.17	46.80	51.07
V2F1	17.90	29.97	45.07	49.53
V2F2	16.70	39.07	52.07	57.30
V2F3	15.20	36.30b	47.77	54.30
V2F4	13.93	31.90	44.10	50.53
Level of significance	NS	NS	NS	NS
CV (%)	5.09	22.31	5.09	22.31

'*' significant at 0.5 %, '**' significant at 1 %, 'NS' non-significant,
V1= ShiraGiku, V2= Rupali, F1 = Recommended dose of NPKSZnS, F2 = Recommended dose + 25% NPKSZnS, F3 - Recommended dose - 25% NPKSZnS, F4 - Cowdung @ 10 t ha^{-1}, DAP – Days After Planting, CV – Coefficient of Variance

Table 4. Effect of hybrids, fertilizer packages and their interactions on yield of cauliflower in *haor* area

Treatments	Yield parameters		
	Curd diameter (cm)	Gross yield (t ha^{-1})	Curd yield (t ha^{-1})
Hybrids			
ShiraGiku	48.33a	42.52	25.17a
Rupali	38.46b	42.12	9.61b
Level of significance	**	NS	**
CV%	4.17	19.13	23.52
Fertilizer packages			
F1 (FGR, 2012)	46.67a	41.52	18.03
F2 (F1 + 25% of F1)	42.17b	39.58	17.83
F3 (F1 - 25% of F1)	41.33b	43.75	18.19
F4 (Cowdung @ 10 t ha^{-1})	43.42ab	44.45	15.05
Level of significance	*	NS	NS
CV (%)	4.17	19.13	23.52
Hybrids x Fertilizer			
V1F1	59.00a	52.93a	33.20a
V1F2	46.00b	41.44abc	25.04b
V1F3	43.83bc	37.32bc	21.63bc
V1F4	44.50bc	38.40abc	20.80bc
V2F1	34.33e	30.10c	2.87e
V2F2	38.83d	50.17ab	14.75cd
V2F3	38.33d	37.72bc	10.64d
V2F4	42.33c	50.49ab	10.20d
Level of significance	**	**	**
CV (%)	4.17	18.76	23.52

'*' significant at 0.5 %, '**' significant at 1 %, 'NS' non-significant, V1= ShiraGiku, V2= Rupali, F1 = Recommended dose of NPKSZnS, F2 = Recommended dose + 25% NPKSZnS, F3 - =Recommended dose - 25% NPKSZnS, F4 = Cowdung @ 10 t ha^{-1}, CV = Coefficient of Variance

Table 5. Cost of production, gross return, net return and BCR of cauliflower in *haor* areas

Treatments	Cost of production (Tk. ha^{-1})	Gross return (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})	BCR
Hybrids				
ShiraGiku	203673	503400	299727	2.47
Rupali	202283	183200	-19083	-1.10
Fertilizer packages				
F1 (FGR, 2012)	212562	360600	148038	1.70
F2 (F1 + 25% of F1)	265703	356600	90897	1.34
F3 (F1 - 25% of F1)	159422	363800	204378	2.28
F4 (Cowdung @ 10 t ha^{-1})	177005	301000	123995	1.70
Hybrids x Fertilizer				
V1F1	208118	664000	455882	3.19
V1F2	243688	500800	257112	2.06
V1F3	181548	432600	251052	2.38
V1F4	190339	416000	225661	2.19
V2F1	207423	57400	-150023	-3.61
V2F2	233993	295000	61007	1.26
V2F3	180853	212800	31947	1.18
V2F4	189644	204000	14356	1.08

Note: Market price of Cauliflower was Tk. 20 kg^{-1}, V1- ShiraGiku, V2- Rupali, F1 = Recommended dose of NPKSZnS, F2 = Recommended dose + 25% NPKSZnS, F3 = Recommended dose - 25% NPKSZnS, F4 - Cowdung@ 10 t ha^{-1}, BCR = Benefit Cost Ratio

Conclusion

Results revealed that the cauliflower var. hybrid Shira Giku performed better with recommended doses of fertilizer (180-80-180-28-4.5-2.1 kg ha^{-1}N-P-K-S-Zn-B) during late season. Research with more number of short duration late hybrids/ varieties is needed to conduct in *haor* area for higher production of cauliflower.

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