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RESPONSE OF CORIANDER (*Coriandrum sativum* L.) FOLIAGE TO DIFFERENT RATES AND METHODS OF NITROGEN APPLICATION

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Abstract

The experiment was conducted at Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur during January 2009 to February 2009 taking two coriander (*Coriandrum sativum* L.) lines, CS001 and CS003 to determine the nitrogen requirement of coriander foliage crop and to select the best method of nitrogen application for maximizing foliage yield. The experiment was laid out in randomized complete block design with three replications having five nitrogen doses (0, 20, 40, 60, and 80 kg/ha) and four methods of N application (entire N dose as basal, ½ N as basal, and ½ N at 30 days after sowing as top dressing, ½ N as basal and ½ N at 30 DAS as foliar spray and 2/3 N at 20 DAS, 1/3 N at 30 DAS, and 1/3 N at 40 DAS as foliar spray). The nitrogen dose of 80 kg/ha and ½ N as basal and ½ N at 30 days after sowing as top dressing independently gave the maximum plant height, number of leaves/plant, single plant weight, plant weight/m^2, and foliage yield/ha. Nitrogen @ 80 kg/ha applied half as basal and half at 30 DAS as top dress produced maximum foliage yield/ha closely followed by 60 kg and 40 kg N/ha with the same application method. The highest gross margin was recorded from 80 kg N/ha applied half as basal and half at 30 DAS as top dress (Tk. 262.705 thousand/ha) followed by 60 kg N/ha with the same application method (Tk. 259.529 and Tk. 254.342 thousand/ha, respectively) and these two combinations also gave the highest benefit-cost ratio of 6.90.

Keywords: Nitrogen rate, application method, foliage production, *Coriandrum sativum* L.

Introduction

Coriander (*Coriandrum sativum* L.) is an important culinary herb grown throughout the country for the leaves. For successful crop production, all necessary nutrients must be supplied to the plants judiciously in a sufficient amount. Among different major plant nutrients, nitrogen is required in large amounts by plants because it is a constituent of macromolecules, such as protein. Nitrogen encourages cell elongation, above ground vegetative growth, and imparts green colour of plant leaves (Brady, 1990) and this macronutrient makes the plant leaves succulent and soft. Being a leafy crop, it has a great demand to

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nitrogenous fertilizer. It is a short duration crop and is generally harvested within 35 to 50 days after sowing (Badgujar *et al*., 1987; Dhanasekar *et al.*, 2000; Oliveira *et al.*, 2003). Moreover, the nutrients like nitrogen should be applied in optimum dose and proper method in order to reduce nitrogen loss and increase yield and nitrogen use efficiency of the crop (BARC, 2005). The requirement of nitrogen, which varies according to environmental conditions, has to be determined by actual field trial for any particular soil and climate. Side by side method of application of nitrogenous fertilizer has great impact on nitrogen utilization by the crop. Therefore, the present study was undertaken with the following objectives:

1. to determine the nitrogen requirement of coriander foliage crop.
2. to find out the best method of nitrogen application for maximizing foliage yield of coriander.

Materials and Method

The experiment was conducted at the research farm of the Department of Horticulture, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur during January 2009 to February 2009. The experiment was conducted taking two previously selected coriander genotypes CS001 and CS003. The soil was clay loam having soil pH of 5.90 contained 1.91% organic matter. The total nitrogen, available phosphorus, exchangeable potassium, and exchangeable calcium were 0.0795%, 30.77 ppm, 0.35 meq/100 g soil, and 5.33 meq/100 g soil. The experiment was laid out in RCB design with three replications having five nitrogen doses viz., 0 (N_0), 20 (N_1), 40 (N_2), 60 (N_3), and 80 (N_4) kg/ha and four methods of N application viz., entire N dose as basal (M_1), ½ N as basal, and ½ N at 30 days after sowing (DAS) as top dressing (M_2), ½ N as basal and ½ N at 30 DAS as foliar spray (M_3) and1/3 N at 20 DAS, 1/3 N at 30 DAS, and 1/3 N at 40 DAS as foliar spray (M_4). The unit plot size was 3m ×1m (3 m^2). Total sub-plots were 60 for each genotype (CS001 or CS003). The land was fertilized with 5 tons cowdung, 11 kg P, and 25 kg K/ha. The entire amount of cowdung, phosphorus from TSP, and potassium from MoP, and N from urea according to treatment was applied to the soil. The seeds (fruits) were rubbed for separating the two mericarps (seeds) and were soaked in water for 24 hours to enhance germination. Seeds were also treated with Bavistin @ 2g per kg of seeds before sowing.

Seeds were sown on 3 January 2009 @ 40 kg/ha seed. The field was kept weed free. One weeding was done once at 25 days after sowing (DAS). Plant thinning was not done. Two irrigations were given at 20 and 30 DAS. To ensure proper germination and crop stand, small amount of water was applied by watering can just after sowing and continued at three-day intervals upto first irrigation. Harvesting of plants was done by cutting just beneath the soil when a few plants were seen to bolt depending upon the genotypes.

Relative efficiency of different methods was worked out by polynomial function $y = a + b_1x_1 + b_2x_2 ..... + b_ix_i$ after working out response curve ($y = a + bx$) for each method (Rajput and Singh, 1975).

Data were collected from the inner rows of each plot to avoid the border effect. In each unit plot, 10 plants were selected randomly for recording data on different foliage yield contributing characters viz., plant height (cm), leaves/plant (no.), single plant weight (g) for foliage yield. Plants/m^2 (no.) and plant weight/m^2 were also recorded. Plot yield was converted to per hectare yield.

The gross return, gross margin, and benefit cost ratio (BCR) were calculated on the basis of the market price of coriander and input cost. The data were compiled properly and analyzed statistically by MSTAT Program and mean comparison was done by Duncan's Multiple Range Test (DMRT) at 5% level of probability.

Results and Discussion

The data have been explained on the basis of individual genotypic response. Under this chapter, only those characters are discussed which were found significant. The non-significant parameters are not discussed although these are incorporated in tables.

All the yield contributing characters except number of plants/m^2 and foliage yield of coriander were significantly affected by various levels of N and its methods of application (Table 1). Interactions between N levels and methods of its application had significant positive effect on plant height, single plant weight, foliage weight/m^2, and fresh foliage yield except number of leaves/plant and number of plants/m^2 (Table 1).

Plant height: Plant height of the genotype CS001 increased significantly with the increase of N up to 80 kg/ha, while in CS003 plant height significantly increased up to 60 kg N/ha (Table 1). The maximum plant height (21.06 cm and 22.51 cm for CS001 and CS003, respectively) was recorded from the application of 80 kg N/ha, being closely followed by 60 kg N/ha in CS003 only. The results are in close conformity with the results of Oliveira *et al.* (2003).

One-half N applied at basal and the rest one-half at 30 days after sowing (DAS) (M_2) maintained a lead over other methods of application in respect of plant height (Table 2). The application of one half of N at basal and one-half at 30 DAS as top dress (M_2) gave maximum plant height for CS001 (17.92 cm and 19.87 cm) followed by the application of entire N as basal (M_1) (17.34 cm and 18.92 cm for CS001 and CS002, respectively). The lowest plant height in both the genotypes was obtained from the application of N one-third at 20 DAS, one-third at 30 DAS, and one-third at 40 DAS as foliar application (M_4).

Table 1. Effect of rates and methods of nitrogen application on the yield components and foliage yield of coriander.

Treatments	Plant height (cm)		Leaves/plant		Plants/m^2	
	CS001	CS003	CS001	CS003	CS001	CS003
Nitrogen (N)						
N_0	10.65 e	11.51 d	5.43 c	5.80 c	464.0	420.0
N_1	14.69 d	16.40 c	6.34 b	8.10 b	463.0	421.0
N_2	17.39 c	19.47 b	8.06 a	8.42 a	465.0	420.0
N_3	19.99 b	22.16 a	8.06 a	8.61 a	460.0	423.0
N_4	21.06 a	22.51 a	8.21 a	8.72 a	464.0	419.0
Method of N application (M)						
M_1	17.34 b	18.92 b	7.39 a	8.04 a	463.0	419.0
M_2	17.92 a	19.87 a	7.45 a	8.22 a	464.0	420.0
M_3	16.51 c	18.17 b	7.33 a	7.75 b	465.0	422.0
M_4	15.26 d	16.69 c	6.78 b	7.73 b	462.0	423.0
CV (%)	4.01	5.52	3.58	5.63	3.01	3.52

Table 1. Cont'd.

Treatment	Plant wt (g)		Foliage wt/m^2 (kg)		Foliage yield (t/ha)	
	CS001	CS003	CS001	CS003	CS001	CS003
Nitrogen (N)						
N_0	1.01 c	1.24 c	0.51 c	0.49 c	4.90 c	4.75 c
N_1	1.38 b	1.51 b	0.64 b	0.64 b	6.15 b	6.05 b
N_2	1.90 a	2.54 a	0.88 a	1..05 a	8.45 a	10.12 a
N_3	1.93 a	2.57 a	0.89 a	1.07 a	8.59 a	10.29 a
N_4	1.96 a	2.58 a	0.91 a	1.07a	8.77 a	10.34 a
Method of N application (M)						
M_1	1.85 b	2.11 b	0.86 b	0.86 b	8.27 b	8.27 b
M_2	2.05 a	2.53a	0.95 a	1.06 a	9.14 a	9.62 a
M_3	1.41 c	1.95 c	0.65 c	0.81 b	6.18 c	6.90 c
M_4	1.33 c	1.77 d	0.62 c	0.74 c	5.93 c	6.51 d
CV (%)	8.14	4.43	7.04	9.48	7.30	4.50

Means showing different letters in a column are significantly different at 5% level of probability by DMRT.

N_0 = 0 kg/ha N_1 = 20 kg/ha N_2 = 40 kg/ha N_3 = 60 kg/ha N_4 = 80 kg/ha

M_1 = Entire N as basal

M_2 = ½ N as basal and ½ N at 30 DAS as top dressing

M_3 = ½ N as basal and ½ N at 30 DAS as foliar application

M_4 = 1/3 N at 20 DAS, 1/3 N at 30 DAS and 1/3 N at 40 DAS as foliar application

The maximum plant height in CS001 was recorded from $N_4 \times M_2$ (22.84 cm). However, plant height in $N_4 \times M_1$ (21.80 cm), $N_2 \times M_2$ (21.76 cm), and $N_3 \times M_2$ (21.75 cm) were similar to that of $N_4 \times M_2$ (Table 3). CS003 exhibited similar behaviour as that of CS001 regarding plant height. The tallest plant was recorded in $N_4 \times M_2$ (24.62 cm), which was similar to $N_2 \times M_2$ (24.18 cm), $N_3 \times M_2$ (24.14 cm), $N_4 \times M_1$ (23.10 cm) and $N_3 \times M_1$ (22.99 cm). It was clear that M_2 method produced the maximum plant height irrespective of nitrogen doses except control. The minimum plant height was noticed in plots where no N was applied.

Leaves/plant: Number of leaves/plant increased with the increase of N application dose up to 80 kg/ha in both the genotypes (Table 1). The maximum leaves/plant (8.21 for CS001 and 8.72 for CS003) was observed in 80 kg N/ha, being at par with 40 and 60 kg N/ha in all cases. The minimum number of leaves/plant was found in control (N_0) treatment in all cases (CS001 and CS003). The results are in agreement with that of Moniruzzaman *et al*. (2009) where maximum number of leaves/plant was found at the highest dose of N in 'Bangladhonia' (*Eryngium foetidum* L.). The maximum leaves/plant (7.45/plant and 8.22/plant) was recorded from two applications of N, one half at basal and the remaining half at 30 DAS as top dress (M_2), which was similar to the application of entire N applied as basal (M_1) and one-half N applied at basal and the rest one-half at 30 DAS as foliar spray (M_3) in the genotype CS001 and CS003, respectively (Table 1). In CS001 and CS003, the lowest leaves/plant was observed in M_4. The interaction effect on number of leaves/plant was insignificant (Table 2).

Single plant weight: Plant weight increased with increasing rate of N application up to 80 kg/ha in CS001 and CS003 (Table 1). The genotypes CS001 and CS003 produced the mean maximum plant weight, 1.96 and 2.58 g, respectively, when nitrogen was applied @ 80 kg/ha, which was similar to 40 and 60 kg N/ha in both the genotypes. This result is in consonance with that of BARI (2010) where maximum individual plant weight (fresh weight/plant) of 'Batishak' was recorded at 80 kg N/ha. Moniruzzaman *et al*. (2009) also obtained maximum fresh weight/plant from the highest dose of nitrogen in 'Bangladhonia' (*Eryngium foetidum* L.). In CS001 and CS003, one-half N at basal and the rest one-half at 30 DAS as top dress (M_2) gave the maximum single plant weight (2.05 g/plant and 2.53 g/plant, respectively) followed by the application of entire N applied as basal (M_1) and the lowest plant weight (1.33 g/plant) was recorded from the application of one-third N at 20 DAS, one-third at 30 DAS, and the rest one-third at 40 DAS as foliar application (M_4) (Table 2).

Table 2. Effect of interaction of rates and methods of nitrogen application on the yield components and foliage yield in coriander.

Treatment comb.		Plant height (cm)		Leaves/plant		Plants/m^2	
Nitrogen (N)	Method (M)	CS001	CS003	CS001	CS003	CS001	CS003
N_0	M_1	11.03i	11.53i	5.33	5.67	464.0	418.0
	M_2	10.65i	11.61i	5.19	5.80	460.0	420.0
	M_3	10.50i	11.62i	5.20	5.73	465.0	424.0
	M_4	10.43i	11.28i	5.33	5.99	464.0	420.0
N_1	M_1	15.05g	16.95g	6.30	8.02	464.0	421.0
	M_2	15.45g	17.80fg	6.70	8.30	465.0	420.0
	M_3	14.48gh	18.10fg	6.32	8.07	461.0	424.0
	M_4	13.75h	14.76h	6.00	8.00	464.0	420.0
N_2	M_1	10.00ef	20.00de	8.30	8.50	462.0	418.0
	M_2	21.76ab	24.18a	8.50	8.91	466.0	422.0
	M_3	17.17f	19.00ef	8.17	8.20	464.0	420.0
	M_4	15.44g	17.70fg	7.67	8.16	460.0	423.0
N_3	M_1	20.70dc	22.99abc	8.00	9.00	464.0	422.0
	M_2	21.75ab	24.14a	8.33	9.02	460.0	426.0
	M_3	19.72cd	21.84bc	8.50	8.25	465.0	423.0
	M_4	17.75ef	19.65de	7.40	8.19	464.0	420.0
N_4	M_1	21.80ab	23.10ab	8.33	9.00	461.0	425.0
	M_2	22.84a	24.62a	8.53	9.08	464.0	428.0
	M_3	10.70bc	22.27bc	8.47	8.50	464.0	418.0
	M_4	18.91de	20.04de	7.50	8.30	464.0	425.0
CV (%)		4.01	5.52	5.63	4.74	3.01	3.52

Means showing different letters in a column are significantly different at 5% level of probability by DMRT.

N_0 = 0 kg/ha N_1 = 20 kg/ha N_2 = 40 kg/ha N_3 = 60 kg/ha N_4 = 80 kg/ha

M_1 = Entire N as basal

M_2 = ½ N as basal and ½ N at 30 DAS as top dressing

M_3 = ½ N as basal and ½ N at 30 DAS as foliar application

M_4 = 1/3 N at 20 DAS, 1/3 N at 30 DAS and 1/3 N at 40 DAS as foliar application

Table 2. Cont'd.

Treatment comb.		Plant wt (g)		Foliage wt/m^2 (kg)		Foliage yield (t/ha)	
Nitrogen (N)	Method (M)	CS001*	CS003	CS001	CS003	CS001	CS003
N_0	M_1	0.97g	1.45gh	0.45e	0.51fg	4.32e	4.90h
	M_2	1.14fg	1.15i	0.53de	0.48g	5.05de	4.61h
	M_3	1.15fg	1.17i	0.54de	0.49fg	5.15de	4.70h
	M_4	1.14fg	1.19i	0.53de	0.50fg	5.08de	4.80h
N_1	M_1	1.43de	1.53g	0.67c	0.64ef	5.57c	6.14f
	M_2	1.56d	1.77f	0.71c	0.77de	6.82c	7.10e
	M_3	1.31def	1.43gh	0.61cd	0.60fg	5.85cd	5.76fg
	M_4	1.21efg	1.29hi	0.56d	0.54fg	5.38d	5.18gh
N_2	M_1	2.22c	2.46bcd	1.03b	1.03bc	9.89b	9.89bc
	M_2	2.48ab	3.18a	1.15a	1.33a	11.07a	12.77a
	M_3	1.48d	2.41bcd	0.69c	0.98bc	6.63c	9.41c
	M_4	1.43de	2.10e	0.66c	0.88cd	6.37c	8.42d
N_3	M_1	2.27bc	2.54bc	1.05b	1.06b	10.11b	10.18b
	M_2	2.54a	3.25a	1.18a	1.36a	11.33a	12.94a
	M_3	1.49d	2.37cd	0.69c	0.99bc	6.56c	9.50c
	M_4	1.44de	2.13e	0.67a	0.89cd	6.37c	8.54d
N_4	M_1	2.36abc	2.56b	1.09ab	1.07b	10.50ab	10.27b
	M_2	2.54a	3.27a	1.18a	1.37a	11.43a	13.15a
	M_3	1.51d	2.36d	0.70c	0.99bc	6.72c	9.47c
	M_4	1.44de	2.11e	0.67c	0.88cd	6.43c	8.48d
CV (%)		8.14	4.43	7.04	9.48	7.30	4.25

Means showing different letters in a column are significantly different at 5% level of probability by DMRT.

N_0 = 0 kg/ha N_1 = 20 kg/ha N_2 = 40 kg/ha N_3 = 60 kg/ha N_4 = 80 kg/ha

M_1 = Entire N as basal

M_2 = ½ N as basal and ½ N at 30 DAS as top dressing

M_3 = ½ N as basal and ½ N at 30 DAS as foliar application

M_4 = 1/3 N at 20 DAS, 1/3 N at 30 DAS and 1/3 N at 40 DAS as foliar application

Maximum plant weight was recorded from $N_4 \times M_2$ (2.54 g/plant) and $N_3 \times M_2$ (2.54 g/plant), which was similar to $N_2 \times M_2$ (2.48 g/plant) and $N_4 \times M_1$ (2.36 g/plant) in CS001 whereas, in CS002 $N_4 \times M_2$ combination gave the maximum individual plant weight (3.27 g/plant), which was at par with those of $N_3 \times M_2$

(3.25 g/plant) and $N_2 \times M_2$ (3.18 g/plant) (Table 2). The least single plant weight was observed in $N_0 \times M_1$, which was similar to other methods of application with no nitrogen. In respect of individual plant weight, M_2 method produced the highest individual plant weight irrespective of different N rates except control in both the genotypes.

Foliage weight per square meter: The maximum weight of foliage/m^2 was 0.91 kg for CS001 and 1.07 kg for CS003 that was recorded from 80 kg N/ha, which was similar to 40 and 60 kg N/ha for both the genotypes (Table 1). The lowest weight of foliage/m^2 was found from control. This result corroborates the results of Moniruzzaman *et al*. (2006) and Oliveira *et al.* (2003). One-half N applied at basal and the rest one-half at 30 DAS as top dress (M_2) produced the maximum foliage weight, 0.95 kg/m^2 for CS001 and 1.06 kg/m^2 for CS003, respectively, and the lowest (0.62 kg) was recorded from the application of one-third N at 20 DAS, one-third at 30 DAS, and the rest one-third at 40 DAS as foliar application (M_4) (Table 1).

The treatment $N_4 \times M_2$, $N_3 \times M_2$, and $N_2 \times M_2$ exhibited the best performance in respect of the foliage weight/m^2 of coriander (Table 2). In CS003, the maximum foliage weight/m^2 was obtained from both $N_4 \times M_2$ and $N_3 \times M_2$, which was similar to $N_2 \times M_2$ whereas, in CS003 $N_4 \times M_2$ produced the highest weight of foliage/m^2 (1.37 kg), which was statistically identical to that of $N_3 \times M_2$ (1.36 kg) and $N_2 \times M_2$ (1.33 kg). The subsequent weight of foliage/m^2 was observed in $N_4 \times M_1$, $N_3 \times M_1$, and $N_2 \times M_1$ in both the genotypes. The least weight of foliage/m^2 was noticed in control N treatment irrespective of application methods.

Foliage yield: Fresh foliage yield increased significantly with the increase in nitrogen up to 40 kg N/ha (Table 1). The maximum foliage yield (8.77 t/ha for CS001 and 10.74 t/ha for CS003) was recorded at 80 kg N/ha, which was similar to 60 and 40 kg N/ha in both the genotypes. The minimum foliage yield was found in control treatment in all the cases. Application of N at 80 and 60 kg N/ha increased foliage yield by only 2.71% compared to 40 kg N/ha. It has been suggested to apply N @ 45 kg ha for foliage yield of coriander (http://www.indianspices.com/html/spicesspfarmcori.html). The result is in agreement with the result of BARI (2010) where it was reported that the maximum fresh yield of Batishak was obtained at 80 kg N/ha and no significant difference was observed among 40 and 80 kg N/ha. The result is in partial agreement with Moniruzzaman *et al*. (2009) who found the highest fresh yield of Bangladhonia with the application of the highest dose of nitrogen.

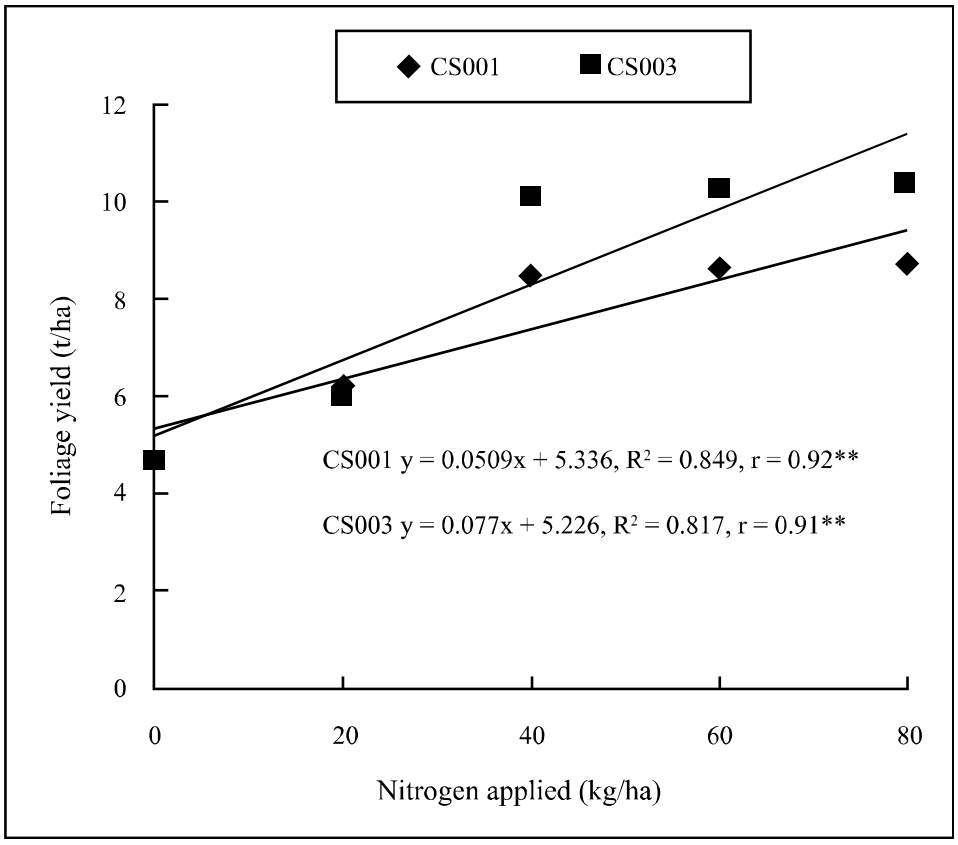

Fig. 1. Relationship between foliage yield and nitrogen levels in coriander.

The foliage yield showed a linear response with increasing levels of nitrogen (Fig. 1). The linear relationships as estimated were y = 0.0509x + 5.336, R^2 = 0.85, r = 0.92** for CS001, and y = 0.0777x + 5.226, R^2 = 0.82, r = 0.91** for CS003. The positive relationship indicated that foliage yield increased with the increasing of N doses for each genotype. The two linear equations stated that for every increased application of 1kg N/ha about 50.9 and 77.1 kg foliage for CS001 and CS003, respectively, were increased per hectare. The R^2 values for two genotypes indicated that the 85 and 82% increase in foliage yield for CS001 and CS003, respectively, was attributed to applied nitrogen. This is in agreement with that of Ullah *et al*. (1999) who showed that yield response of leafy vegetable, cabbage to applied N (0, 60, 120, 180, and 240 kg/ha) was linear (y = 0.26 N + 31.5, r = 0.96**). Moniruzzaman *et al*. (2007) obtained the linear yield response of Kangkong to N application (y = 0.1195N + 40.932, r = 0.97**). The beneficial effect of N might be due to the fact that it increases the production of green leaves and the size and chlorophyll content of the leaves which help in the

synthesis of carbohydrate, protein etc. for building up of new tissues. Eventually, there is an increase in the growth and yield of coriander.

The application of one-half N at basal and one-half at 30 DAS as top dress (M_2) gave maximum foliage yield (9.14 t/ha for CS001 and 9.62 t/ha for CS003 and the lowest foliage yield was recorded from M_4 (5.93 t/ha for CS001 and 6.51 t/ha for CS003) (Table 2). This is in partial agreement with the report of Moniruzzaman *et al.* (2005) who found the highest yield of lettuce leaf with split application of nitrogen. The application of entire N as basal (M_1) failed to give better result than that of N one-half at basal and one-half at 30 DAS as top dress (M_2) due to the fact that coriander was slow in growth in early stage and then rapid growth takes place towards the end of cycle for leaf purpose crop (Oliveira *et al.*, 2003). When N was applied as basal after 30 days of sowing, effective utilization of N and rapid vegetative growth took place i.e., maximum plant height and number of leaves/plant are produced. Marked effect of adequate supply of N by split application at 30 DAS as top dress helped in more and continuous absorption of the same by coriander plants. However, in the present investigation, foliar application of N by M_3 and M_4 method might not give fruitful result compared to M_1 and M_2 due to the fact that leaves of coriander are variously lobed, shiny, and waxy and thus spray N solution did not stay long enough for activity on the surface of the leaves. In addition, no surfactant was used in spray solution of N. Therefore, split application of N as top dress showed better performances over basal application (M_1) and other two methods (M_3 and M_4).

The interactions of N doses and application methods on foliage yield of coriander were significant and the maximum yield in CS001 was recorded from $N_4 \times M_2$ (11.43 t/ha), which was similar to $N_2 \times M_2$ (11.07 t/ha), $N_3 \times M_2$ (11.33 t/ha), and $N_4 \times M_1$ (10.50 t/ha) (Table 3). The genotype CS003 gave identical foliage yield, the highest was obtained from $N_4 \times M_2$ (13.15 t/ha), which was similar to $N_3 \times M_2$ (12.94 t/ha) and $N_2 \times M_2$ (11.91 t/ha). The M_I method showed the performance next to M_2 method when interacted with N_1, N_2, N_3, and N_4. The minimum foliage yield was obtained from N_0M_1. This result corroborates with the report of Moniruzzaman *et al*. (2007) in kangkong. Based on foliage yield data, the treatment $N_3 \times M_2$ (with 33% less N requirement compared to $N_4 \times M_2$) seemed to be the best combination of N dose and method of its application for getting the maximum yield of the crop.

Relative efficiency of different methods of nitrogen application: Relative efficiency of different methods of nitrogen application was worked out and M_2 was found to be highly superior to all the methods (Table 3). It was closely followed by M_1 method in CS001, but in CS003, it is not very close. The least efficient method was M_4 in both the genotypes.

Table 3. Efficiency (%) of different methods of nitrogen application.

Method	Genotype	
	CS001	CS003
M_1	456.76	137.87
M_2	467.03	212.69
M_3	104.32	123.88
M_4	100.00	100.00

M_1 = Entire N as basal; M_2 = ½ N as basal and ½ N at 30 DAS as top dressing; M_3 = ½ N as basal and ½ N at 30 DAS as foliar application; M_4 = 1/3 N at 20 DAS, 1/3 N at 30 DAS and 1/3 N at 40 DAS as foliar application

Table 4. Cost-return analysis of coriander production in different levels of nitrogen and its method of application.

Treatment combination		Average foliage yield (t/ha)	Gross return (000 Tk./ha)	Cost of cultivation (000 Tk./ ha)	Gross margin (000 Tk./ ha)	Benefit-cost ratio (BCR)
Nitrogen (N)	Method (M)					
N_0	M_1	4.61	115.250	41.677	73.573	2.76
	M_2	4.82	120.500	42.260	78.240	2.85
	M_3	4.92	123.000	42.109	80.891	2.92
	M_4	4.94	123.500	42.390	81.110	2.91
N_1	M_1	6.27	156.750	42.240	114.51	3.71
	M_2	6.96	174.000	42.845	131.155	4.06
	M_3	5.82	145.500	42.694	102.806	3.41
	M_4	5.28	132.000	42.974	89.026	3.07
N_2	M_1	9.89	247.25	42.803	204.447	5.78
	M_2	11.91	297.750	43.408	254.342	6.86
	M_3	8.02	200.500	43.257	157.243	4.63
	M_4	7.39	184.750	43.538	141.21	4.24
N_3	M_1	10.15	253.750	43.367	210.383	5.85
	M_2	12.14	303.500	43.971	259.529	6.90
	M_3	8.06	201.500	43.820	157.68	4.60
	M_4	7.49	187.250	44.101	143.149	4.24
N_4	M_1	10.38	259.500	43.930	215.570	5.90
	M_2	12.29	307.250	44.535	262.705	6.90
	M_3	8.09	202.250	44.384	158.116	4.56
	M_4	7.46	186.500	44.664	141.836	4.17

N_0 = 0 kg/ha; N_1 = 20/kg ha; N_2 = 40 kg/ha; N_3 = 60 kg/ha; N_4 = 80 kg/ha

M_1 = Entire N as basal; M_2 = ½ N as basal and ½ N at 30 DAS as top dressing; M_3 = ½ N as basal and ½ N at 30 DAS as foliar application; M_4 = 1/3 N at 20 DAS, 1/3 N at 30 DAS and 1/3 N at 40 DAS as foliar application

Produce (foliage): Tk. 25000.00/t (Tk. 25.00/kg); Urea: Tk. 26.08 kg -N

Economics: The maximum gross return (Tk. 307.25 thousand/ha) was obtained from $N_4 \times M_2$ combination followed by $N_3 \times M_2$ combination (Tk.303.5 thousand/ha) and $N_2 \times M_2$ (Tk.297.75 thousand/ha) (Table 4). The highest gross margin was also recorded from $N_4 \times M_4$ combination (Tk. 262.705 thousand/ha) followed by $N_3 \times M_2$ combination (Tk. 259.529 thousand/ha) and $N_2 \times M_2$ (Tk.254.342 thousand/ha). Minimum gross margin was recorded in $N_0 \times M_1$ combination. The highest benefit-cost ratio (6.90) was recorded from both $N_4 \times M_2$ and $N_3 \times M_2$ combinations and the lowest for the same from $N_0 \times M_1$. Although $N_4 \times M_2$ gave higher gross margin than $N_3 \times M_2$, both the combinations gave the same BCR (6.90).The cost of cultivation in $N_4 \times M_2$ was Tk. 44.535 thousand/ha while it was Tk. 43.971 thousand/ha, in $N_3 \times M_2$. Since the $N_3 \times M_2$ incurred less cost compared to $N_4 \times M_2$, $N_3 \times M_2$ was the most profitable combination for foliage yield of coriander.

Based on the results, it could be concluded that coriander should be cultivated with 60 kg N/ha applied one- half as basal and the rest one-half at 30 days after sowing for maximum yield of foliage with the highest economic benefit for the genotypes CS001 and CS003.

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