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EFFECT OF FERTILIZER ON CORIANDER SEED PRODUCTION

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Abstract

A field experiment on coriander (*Coriandrum sativum* L.) was carried out during *rabi* seasons of 2011-12 and 2012-13 in Low Ganges River Flood Plain Soil under AEZ-12 at Farming System Research and Development Site, Hatgobindapur, Faridpur to find out optimum and economic doses of fertilizers for coriander (var. BARI Dhania 1) for sustainable higher yield and to update balanced fertilizer recommendation for target yield. The experiment was laid out in a randomized complete block design with 8 treatments viz. T_1=$N_{118}P_{47}K_{26}S_{10}Zn_{2.2}B_{0.8}$ Kgha^{-1}, T_2= $N_{147}P_{47}K_{26}S_{10}Zn_{2.2}B_{0.8}$ Kg ha^{-1}, T_3= $N_{147}P_{59}K_{26}S_{10}Zn_{2.2}B_{0.8}$ Kg ha^{-1}, T_4= $N_{147}P_{47}K_{32}S_{10}Zn_{2.2}B_{0.8}$ Kgha^{-1}, T_5= $N_{118}P_{59}K_{32}S_{10}Zn_{2.2}B_{0.8}$ Kgha^{-1}, T_6= $N_{147}P_{59}K_{32}S_{10}Zn_{2.2}B_{0.8}$ Kgha^{-1}, T_7= $N_{88}P_{35}K_{19}S_8Zn_{1.6}B_{0.6}$ Kgha^{-1} and T_8= Native nutrient (Control). The highest seed yield (1373 kg ha^{-1}) was obtained from the treatment T_3 which was statistically similar with T_1, T_2, T_3, T_4, T_5 and T_6 treatments. The soil test based treatment T_1 produced 1311 kg yield ha^{-1} and yield difference of ther added fertilizer treatment with T_1 was only 5%. The fertilizer added treatments didn't exert the significant difference with soil based treatment (T_1) on yield and yield contributing characters. However, T_1 treatment appeared to be the best suited combination because of its higher gross margin Tk 41,769 ha^{-1}, capability in reducing nutrient cost Tk 13106 ha^{-1} and the highest marginal rate of return (MRR) (108%) whereas treatment T_3 covered 21% MRR and the highest nutrient cost among the treatments and hence treatment, $N_{118}P_{47}K_{26}S_{10}Zn_{2.2}B_{0.8}$ Kg ha^{-1} (100% NPKSZnB from STB dose) may be recommended for coriander seed production in the study area.

Introduction

Coriander (*Coriandrum sativum* L.) is one of the important spices in Bangladesh. Seeds of the crops are used as spice, while its tender green leaves are used as culinary herbs. In Bangladesh, the average area of coriander is around 0.33 lakh hectares of land and production 0.38 lakh metric tons in 2013-14 (DAE, 2015). Faridpur district stands first in terms of area (2573 ha) and production (2433 tons) among other districts of Bangladesh. Bangladesh imported coriander seed about 93 tons expending 3000 US dollar in 2006 and 190 tons in 2008-09 (Anon., 2011). The average yield (825 kg ha^{-1}) of coriander is low whereas the research yield is 1.5 tha^{-1} (SAARC Ag. centre, 2006). One of the most important reasons for low yield is the application of imbalanced and improper fertilization. Fertilizer is the vital input that plays a significant role in exploring the highest

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yielding capacity of any crop. The requirement of fertilizer for any crop varies with the cultivars and soil types in agro-ecological zones (Mitra *et al.,* 1990). An adequate supply of plant nutrients is required in order to ensure proper development and potential yield for a particular crop. Judicious application of fertilizer has positive impact on growth and yield of crop. In order to obtain satisfactory results the nutrients should be applied in optimum dose. It was reported that the application of macronutrients (NPKS) markedly increased yield of coriander seed (Anon., 2008). Among different major plant nutrients, nitrogen is required in large amounts by plants because it is a constituent of macromolecules such as protein, encourages cell elongation and vegetative growth. The coriander absorbs most of phosphorous in early growth stages and increases seed yield (Gosh *et al,* 1986). Potassium is responsible for chlorophyll formation which plays an important part in the strength of cells and encourages flower and fruit formation. Tripathi *et al.*, (2009) reported that the seed yield increases with the application of sulphur and potassium. In Bangladesh, soil nutrient is diminishing day by day due to intensive cropping and the soil C and N status in Bangladesh has decreased considerably (Ali *et al.,* 1997). A judicial application of fertilizer must be followed for reducing soil nutrient. Research information regarding the suitable dose of NPKSZnB for the satisfactory production of coriander in Bangladesh is very meagre although some fertilizer based research has accomplished by scientists of BARI. Considering the above facts, the present study was undertaken to assess the appropriate combination of N, P, K, S, Zn and B for obtaining satisfactory yield of coriander seed in AEZ-12 and also to evaluate the economic return of coriander.

Materials and Method

The study was conducted at Farming System Research and Development Site, Hatgobindapur, Sadar Faridpur during *rabi* season of 2011-12 and 2012-13. Soil samples were collected from the experimental fields from a depth of 0-15 cm prior to application of fertilizers in both the years. Results of soil analysis are presented in Table 1. The soil of experimental field was clay to clay loam and slightly alkaline in nature. The average soil nutrient level of N and P was very low, K and S was medium and Zn & B was low (Table 1).

The experiment was set up in a randomized complete block design with six dispersed replications. The recommended fertilizer dose for coriander was computed on average data of soil test base (STB) value for high yield goal.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 = Native nutrient (Control). The treatments with full amounts of nutrients were shown in below:

T_1=$N_{118}P_{47}K_{26}S_{10}Zn_{2.2}B_{0.8}$ Kg ha^{-1}

T_2= $N_{147}P_{47}K_{26}S_{10}Zn_{2.2}B_{0.8}$ Kg ha^{-1}

T_3= $N_{147}P_{59}K_{26}S_{10}Zn_{2.2}B_{0.8}$ Kg ha^{-1}

T_4= $N_{147}P_{47}K_{32}S_{10}Zn_{2.2}B_{0.8}$ Kg ha^{-1}

T_5= $N_{118}P_{59}K_{32}S_{10}Zn_{2.2}B_{0.8}$ Kg ha^{-1}

T_6= $N_{147}P_{59}K_{32}S_{10}Zn_{2.2}B_{0.8}$ Kg ha^{-1}

T_7= $N_{88}P_{35}K_{19}S_8Zn_{1.6}B_{0.6}$ Kg ha^{-1}

T_8= Native nutrient (Control)

Table 1. Initial properties of the soil samples (average of two years)

	Texture	pH	OM (%)	Total N (%)	Available P (µg/g soil)	K (meq/ 100g soil)	S (µg/g soil)	Zn (µg/g soil)	B (µg/g soil)
Average	Clay, Clay loam		1.32	0.073	6.06	0.25	16.66	0.90	0.21
Interpretation			L	VL	VL	M	M	L	L
Range		7.7-8.2	0.58-1.98	0.03-0.11	1.80-13.00	0.20-0.39	4.1-34.0	0.11-1.33	0.15-0.26
Interpre-tation		Slightly Alkaline	Very Low to Medium	Very Low to Low	Very Low to Low	Medium to High	Very Low to High	Very Low to Mediu m	Very Low to Low
Critical limit				0.12	10	0.12	10	0.6	0.2

The unit plot size was 5m X 4m. The variety was BARI Dhania 1and seeds were collected from Spices Research Centre, BARI, Faridpur. Coriander seeds were sown in 4 November to 5 December, 2011 and 30 November to 7 December, 2012 providing spacing of row to row 30 cm and seed to seed 15 cm. Half of nitrogen and whole amount of phosphorus, potassium, sulphur, zinc and boron were applied as basal in the form of urea, TSP, MoP, gypsum, zinc sulphate monohydrate and boric acid, respectively. The remaining nitrogen was top dressed at 30 days after sowing (DAS) of seeds followed by irrigation. Weeding cum thinning was done at 25 and 50 DAS. Mulching was done after irrigation. Sevin powder was sprayed around the plot at initial stage to protect the seeds against ant. Malathion @ 1.5 ml/L was sprayed against aphid. The spray was done at an interval of 15 days up to 45 days. Harvesting was done when the seeds reached at right stage of maturity. The harvesting was done from 1 to 19 March, 2012 and 18 to 23 March, 2013. Data on yield and yield attributes along with other parameters were collected and subjected to statistical analysis by Least Significant Test (LSD) test. Partial budget and marginal analysis of undominated fertilizer responses on coriander were done following the method suggested by Elias and Karim (1984).

Results and Discussion

The result obtained from two years was almost similar in yield and yield attributes and therefore pooled analysis was done.

Plant population

The effect of applied fertilizer on plant population m^{-2} of coriander was non-significant (Table 2). However, plant population m^{-2} varied from 79 to 88. The highest number of plants m^{-2} (88) was observed in T_4 (T_1+ 25%NK) treatment followed by 100% STB (T_1) and the lowest (79) in control (T_8) but this variation was statistically non-significant.

Table 2. Effect of different fertilizer dose on yield and yield contributing characters of coriander (Pooled data of 2011-2012 and 2012-2013)

Treatment	Plants m^{-2} (no.)	Plant height (cm)	Seeds $plant^{-1}$ (no.)	1000 seed weight (g)	Seed yield (Kg ha^{-1})	Straw yield (Kg ha^{-1})
T_1- 100% NPKSZnB (STB)	86	73.94	215	4.95	1311	1613
T_2 = T_1+ 25% N	85	73.44	215	5.06	1342	1795
T_3 = T_1+ 25% NP	84	74.44	229	5.10	1373	1877
T_4 = T_1+ 25% NK	88	73.45	216	5.06	1261	1820
T_5 = T_1+ 25% PK	81	72.80	223	4.96	1263	1932
T_6 = T_1+ 25% NPK	84	74.25	222	4.93	1312	1866
T_7 = 75% of T_1	84	69.80	191	4.96	1137	1719
T_8 = Native nutrient	79	54.55	111	5.15	728	929
CV(%)	12.77	8.63	10.93	6.99	11.84	11.38
LSD ($_{0.05}$)	NS	6	40	NS	143	275

STB = Soil test base; NS = Not significant.

Plant height

Application of fertilizer significantly influenced the plant height of coriander. But there was no significant variation among the treatments in respect of plant height of coriander (Table 2). However, the plant height among the added fertilizer treatments varied from 69.80 – 73.44 cm, where all the treatments showed similar except T_8 treatment which produced the shortest plant height. The above results showed that fertilizer virtually had no significant effect on the plant height of coriander plant but Oliveira *et al.* (2003) evaluated that N fertilizer plays an important role to increase plant height.

Seeds $plant^{-1}$

The effect of different nutrient combinations was significant on the number of seeds $plant^{-1}$ (Table 2). Fertilizer application increased seeds $plant^{-1}$ from 111 to

229. Maximum seeds plant^{-1} (229) was observed in T_3 (T_1+25%NP) treatment and it was identical with rest of the treatments except T_8 treatment. The lowest number of seeds plant^{-1} was obtained from control treatment. The present results are close to the findings of Channabasavanna *et al.* (2002) who reported that application of 60 kg N ha^{-1} + 60 kg P ha^{-1} produced the maximum number of seeds plant^{-1}.

Thousand seed weight

There was no significant effect of fertilizer among the treatments in terms of 1000 seed weight of coriander (Table 2). However, the 1000 seed weight among the fertilizer treatments varied from 4.93 to 5.15 g.

Seed Yield

Seed yield ha^{-1} was significantly influenced by the application of different fertilizer treatments (Table 2). Fertilizer application increased seed yield from 728 to 1373 kg ha^{-1}. The maximum seed yield (1373 kg ha^{-1}) was obtained from the treatment T_3 due to higher number of seeds plant^{-1} (229) and thousand seed weight (5.10 g). The experimental soil was deficient in different nutrients. So the application of different nutrients to the soil resulted in the higher uptake by plants which ultimately helped increase production of assimilates that causes higher seeds plant^{-1} and seed size. Response on the yield of coriander to higher doses of fertilizers was observed. Seed yield of coriander was higher when 100% fertilizer dose was used but yield decreased when 25% less fertilizer applied. On the other hand, variation in seed yield was found in different combinations of fertilizer treatments (from T_3 to T_6) although it was statistically similar. The maximum yield was observed in T_3 treatment where N and P combination was used. The treatment of T_4 (combination of NK) and T_5 (combination of PK) showed the lower seed yield. Gosh *et al.* (1986) also reported that yield was greatly influenced by interaction of N and P at 60 and 40 kg ha^{-1}. Channabasavanna (2002) reported that application of K_2O did not show any beneficial effect on seed yield of coriander. The treatment T_6 (T_1+25%NPK) also showed the lower yield than treatment T_3 due to excess use of K perhaps which created nutrient imbalance in the soil (soil inherently belongs to medium to high amount of K (Table 1). The lowest yield (728 Kg ha^{-1}) was obtained from native nutrient (T_8) where no fertilizer was used.

Stover yield

The straw yield ha^{-1} varied significantly with different fertilizer treatments (Table 2). The treatment T_5 produced the maximum straw yield (1932 kg ha^{-1}), which was statistically similar with all fertilizer added treatments except T_1 (1613 kg ha^{-1}). The lowest straw yield (929 kg ha^{-1}) was obtained from control treatment (T_8).

Economic performance

Gross return was calculated from the price of coriander. Costs that vary were calculated from the cost involved for fertilizer nutrients used for the experimental treatments. The partial budget analysis of fertilizer showed that the highest gross return (Tk. 57922 ha^{-1}) and gross margin (Tk. 42244 ha^{-1}) was accounted for T_3 treatment because of higher yield though higher cost was involved (Table 3). The dominance analysis of various treatments showed that treatments T_4,T_5 and T_6 were cost dominated due to obtain lower net return against increase of investment (Table 4). Marginal increase in gross margin, marginal increase in cost and marginal rate or return (MRR) of cost undominated treatments were shown in Table 5. The highest MRR (108%) was obtained from T_1 (Soil test based treatment, 100% NPKSZn) followed by T_7 (75% of T_1) treatment. Higher doses of fertilizer treated plots in T_2 and T_3 provided the highest gross margin but showed lower MRR among the cost undominated treatments and hence, they may not be economic. However, application of only chemical fertilizers at the rate of soil test based treatment (T_1) was appeared at the most suitable treatment for coriander cultivation due to its yield performance (1311 t ha^{-1}), satisfactory gross margin (Tk 41769 ha^{-1}) and higher marginal rate of return (108%). On the contrary, the second highest MRR (79%) was received from the treatment T_7 reduced nutrient cost 33% than T_1 treatment which could be suitable for the poor resource farmers.

Table 3. Cost and return analysis of coriander production as influenced by different fertilizer doses (Pooled data of 2011-2012 and 2012-2013)

Treatment	Gross return (Tk. ha^{-1})	Nutrient cost (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})
T_1=100% NPKSZnB (STB)	54875	13106	41769
T_2 = T_1+ 25% N	56355	14386	41969
T_3 = T_1+ 25% NP	57922	15678	42244
T_4 = T_1+ 25% NK	53169	13301	39868
T_5 = T_1+ 25% PK	53434	14594	38840
T_6 = T_1+ 25% NPK	55269	**15874**	39395
T_7 = 75% of T_1	48069	9830	38239
T_8 = Native nutrient	30525	-	30525

Price of input (Tk. kg^{-1}):

Urea: Tk. 20.00, TSP: Tk. 22.00, MoP: Tk. 15.00, Gypsum: Tk 8.00, Boric acid: Tk. 160.00,

Zinc sulphate monohydrate Tk 160.00

Labor Cost (Tk. $labor^{-1}$): 300.00

No. of labor required for 1 ha fertilizer application (2 times): 3 (2 labor needed for basal application and remaining 1 for top dressing in 1 ha.)

Price of output (Tk. kg^{-1}): Seed: Tk. 40.00 and Straw: Tk. 1.50 (average of years)

Table 4. Dominance analysis of various treatments applied in coriander (Pooled data of 2011-2012 and 2012-2013)

Treatments	Gross margin (Tk. ha^{-1})	Nutrient cost (Tk. ha^{-1})	Inference
$T_3 = T_1$+ 25% NP	42244	15678	CUD
$T_2 = T_1$+ 25% N	41969	14386	CUD
T_1- 100% NPKSZnB (STB)	41769	13106	CUD
$T_4 = T_1$+ 25% NK	39868	13301	CD
$T_6 = T_1$+ 25% NPK	39395	**15874**	CD
$T_5 = T_1$+ 25% PK	38840	14594	CD
T_7 = 75% of T_1	38239	9830	CUD
T_8 = Native nutrient	30525	0.00	CUD

CUD: Cost undominated and CD: Cost dominated

Table 5. Marginal analysis of cost undominated treatments applied in coriander at FSRD site, Faridpur (Pooled data of 2011-2012 and 2012-2013)

Cost undominated treatments	Gross margin (Tk ha^{-1})	Nutrient cost (Tk ha^{-1})	Marginal increase in gross margin (Tk ha^{-1})	Marginal increase in variable cost of fertilizer as nutrient (Tk ha^{-1})	Marginal rate of return (%)
T_1= 100% NPKSZn (STB)	41769	13106	3530	3276	108
$T_2 = T_1$+ 25% N	41969	14386	200	1280	16
$T_3 = T_1$+ 25% NP	42244	15678	275	1292	21
T_7 = 75% of T_1	38239	9830	7714	9830	79
T_8 = Native nutrient	30525	0	30525	--	--

Conclusion

Two years study revealed that a package of 100% soil test based dose of chemical fertilizer ($N_{118}P_{47}K_{26}S_{10}Zn_{2.2}B_{0.8}$ Kg ha^{-1}) may be recommended for the cultivation of coriander in low Ganges river flood plain soil for higher yield with economic profitability.

References

Anonymous, 2011. SAARC Centre. Quality Seed in SAARC countries. Production, processing, legal & quality control and marketing system. P.112.

Anonymous. 2008. Annual Report for 2007-2008. Spices Research Centre, BARI, Shibganj, Bogra. Pp.104-107.

Ali, M.M., S.M. Shaeed., D. Kubota., T. Masunaga and T. Wakatsuki. 1997. Soil degeration during the period 1967-1995 in Bangladesh. J. Carbon and nitrogen. Soil Sci. and Plant nutr. **43:** 863-878.

Channabasavanna, A. S., S. G. Yalamali and D.P. Biradar. 2002. Nutrient requirment of coriander in Tungabhadra project area of Karnataka. J. MoharastraAgril. Univ. **27**(1): 38-39

DAE. 2015. Department of Agricultural Extension. Kreshe Diary 2015. Agriculture Information Service, Khamarbari, Farmgate, Dhaka-1215. P. 15.

Elias,S.M. and Karim M.R. 1984. Application of partial budget technique on cropping system research at Chittagong Division of Agril. Economics, Bangladesh Agril. Res. Institute, Gazipur,Bangladesh. Pp.151-152

Gosh, D., T.K.Maiti., M.G.Som and T.K. Bose. 1986. Effect of row spacing and levels of nitrogen growth and seed yield of coriander. Indian Cocoa Arecanut and Spices Journal, **9**(2): 44-46.

Mitra, R.S.K., M.L. Sadhu and T.K. Bose. 1990. Nutrition of Vegetable Crops. Naya prokash, Calcutta, 700006, India. Pp. 157-159.

Oliveira, A.P. de., de S. Paiva-Sobrinho., J.K.A. Barbosa., C.I. Ramalho., A.L.P. Oliveira., A.P. de-Oliveira and S.de. Paiva Sobrinho. 2003. Rendimento de coentro cultivado com doses crescentes de N (Yield of coriander cultivated with increasing nitrogen levels). *Hortic. Bras.* **21**(1): 81-83.

SAARC Agriculture Centre 2006. Statistical data book for Agriicultural res. & Dev. in SAARC countries. 2006/07. vol.5, P. 112.

Tripathy, M.L., S.K. Trivedi and R.P. Yadav. 2009. Effect of irrigation and nutrient levels on growth and yield of coriander. *Indian J. Agron*. **45**(4): 25-28