The Pharma Innovation Journal 2023; 12(4): 2135-2138

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(4): 2135-2138

www.thepharmajournal.com
Received: 08-01-2023
Accepted: 13-02-2023

Srishti Singh Parihar
Department of Vegetable Science, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Neeraj Shukla
Department of Vegetable Science, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Karuna Sahu
Department of Vegetable Science, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Gulab Das Barman
Department of Vegetable Science, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Corresponding Author:
Srishti Singh Parihar
Department of Vegetable Science, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Assessment of economic for integrated nutrient management of coriander (*Coriandrum sativum* L.) var. Pant Haritima in the Kabirdham district of Chhattisgarh, India

Srishti Singh Parihar, Neeraj Shukla, Karuna Sahu and Gulab Das Barman

Abstract
An experiment was conducted to evaluate the "Assessment of economic for integrated nutrient management of coriander (*Coriandrum sativum* L.) var. Pant Haritima in the Kabirdham District of Chhattisgarh, India" using Randomized Block Design (RBD) with three replications and 10 treatments at Krishi Vigyan Kendra farm Newari, Kabirdham under Indira Gandhi Krishi Vishwavidyalaya, Raipur, and Chhattisgarh. The treatments used under experimentation are T_1 (Absolute control), T_2 (100% RDF 60:40:30 kg NPK/ha), T_3 (VC @ 3 t/ha), T_4 (FYM @ 10 t/ha), T_5 (30:20:15 kg NPK/ha + VC @ 1.5 t/ha), T_6 (30:20:15 kg NPK/ha + FYM@ 5t/ha), T_7 (VC @ 1.5 t/ha + FYM @ 5 t/ha), T_8 (60:40:30 kg NPK/ha + Azotobacter + PSB), T_9 (VC @ 3 t/ha + Azotobacter + PSB), T_{10} (FYM @ 10 t/ha + Azotobacter + PSB). Findings revealed that the treatment T_5 (30:20:15 kg NPK/ha + VC @ 1.5 t/ha) emerged superior in respected of growth attributes as well as yield of coriander and gave maximum seed yield (23.00 q ha^{-1}) while treatment T_8 (60:40:30 kg NPK/ha + Azotobacter + PSB), with seed yield (21.83 q ha^{-1}). In terms of economics, maximum B: C ratio (3.34) was found with T_8 (60:40:30 kg NPK/ha + Azotobacter + PSB) and looking to the B: C ratio, the application of 60:40:30 kg NPK/ha + Azotobacter + PSB was found superior among all the organic and inorganic fertilizers, which will be useful for farming of coriander.

Keywords: Coriander, FYM, vermicompost, yield, economics, B: C ratio

Introduction
Coriander (*Coriandrum sativum* L.) is an annual herb and is known for its both green leaves and dried seeds. It belongs to family Apiaceae and is native to Southern Europe and Mediterranean region. Coriander is used as a natural flavoring agent in food industry and is rich source of vitamin C (12 mg/100 g), vitamin A (10,460 I.U./100 g) and dietary fibre (10.40 mg/100 g). India is one of the largest producers as well as consumer of coriander in the world. Coriander crop is mainly cultivated in Rajasthan, Madhya Pradesh, Gujarat, Andhra Pradesh, Odisha, Assam and Tamil Nadu. Rajasthan and Madhya Pradesh are the two largest coriander producing states contributing about 80% of total production. In India total area under coriander cultivation is 7,04,000 ha with the production of 9,00,000 metric tonnes. The average productivity of coriander in India is around 0.9 metric tonnes/ha. Coriander is the important vegetable, spice crop of the Chhattisgarh state total production of coriander is 314 thousand million tonnes from 13,374 ha area. Anonymous, (1). Production of coriander plays an important role in improving the economic condition of farmer's specially marginal and small farmers at one side and help to meet out the nutritional requirements of the people on the others side. The present study was undertaken to analyze economics and constraints of coriander cultivation in Kabirdham district of Chhattisgarh state.

The demand of various medicinal, aromatic and spice crops is increasing in the national and international markets. The large deficit in the availability of quality material of these crops can be met only through their organized and scientific cultivation. The productivity of coriander is influenced by several factors such as soil, variety, fertilizer management and various agro-techniques. Nutrients play a vital role in functioning of normal physiological processes during growth and development of plants. However, for obtaining economic yield, balanced supply of nutrients is one of the key factors. The inadequate and imbalanced application of nutrients is one of the major factors for low yield and poor quality.

The conjunctive application of organics with inorganic source of nutrients reduces dependence on chemical inputs and provides micronutrients as well as modifies soil physical behaviour and efficiency of applied nutrients. Integrated supply of nutrients through combination of organic and inorganic sources is becoming increasingly important to protect the environment, quality of soil and human health. Adequate soil nitrogen availability is necessary to achieve better plant growth and yield. However, excessive levels can decrease plant growth and development. Hence, accurate nitrogen application is required. To have consistently higher yield of quality produce of the seed type coriander varieties, standardization of nitrogen requirement is very much pertinent, which can be achieved by use of both organic and inorganic fertilizers.

Materials and Methods

The field investigation was conducted during *Rabi* season 2020-21 at Krishi Vigyan Kendra farm Newari, Kawardha under Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh. The Kawardha has the tropical climate. It comes under the CG Plains agro-climatic zone. It is located at North latitude of 22.32 ° to 22.28° and 80.48° to 81.25° East longitude and an altitude of 353 meters above mean sea level (MSL). The soil of experimental field is clayey in texture, with soil ph 7.88, low in availability of nitrogen (277.5 kg/ha), medium in Phosphorus (10.72 kg/ha) and high in potassium status (595.9 kg/ha). The experiment was conducted in a RBD with 10 treatments and replicated thrice. Total numbers of plots were 30, each with plot size of: 2.0 m × 1.8 m = 3.6 m^2 .planting was made at a spacing of 30 cm × 10 cm. The economics of different cultural practices, inputs and returns for coriander under each treatment was worked out to find the most effective and economical treatment. The experimental data was analyzed statistically by the method of analysis of variance as out lined by (Panse and Sukhatme) [5].

Table 1: Treatment Details

S. No.	Treatment no.	Description
1	T_1	Absolute control
2	T_2	100% RDF(60:40:30 kg NPK /ha)
3	T_3	VC @ 3 t/ha
4	T_4	FYM @10 t/ha
5	T_5	(30:20:15 kg NPK/ha) + VC @ 1.5 t/ha
6	T_6	(30:20:15 kg NKP/ha) + FYM @ 5 t/ha
7	T_7	VC @ 1.5 t/ha + FYM @ 5 t/ha
8	T_8	(60:40:30 kg NPK/ha) + Azotobacter + PSB
9	T_9	VC @ 3 t/ha + Azotobacter + PSB
10	T_{10}	FYM @ 10 t/ha + Azotobacter + PSB

- RDF- Recommended dose of fertilizers.
- VC- Vermi compost.
- FYM- Farm yard manure.
- PSB- Phosphate solubilizing bacteria (5 gm/kg seed as seed inoculation + 5 kg/ha as soil application).
- Azotobacter- (5 gm/kg seed as seed inoculation + 5kg/ha as soil application).

Gross Returns (Rs./ha): Gross returns are the total monetary value of economic produce and by products obtained from the crop.

Net return (Rs. /ha): Net return = Gross return - Cost of cultivation

B:C ratio: Cost Benefit Ratio = [Net return (Rs. /ha)] / [Cost of cultivation (Rs. /ha)]

Results and Discussion

In the present investigation yield of coriander (q ha^{-1}), cost of cultivation (Rs. /ha.), gross return (Rs. /ha.), net profit (Rs. /ha) and cost: benefit ratio were calculated under the various treatments during the experimental year 2020-2021. (Table 4) and (Fig 1).

1. Cost of cultivation (Rs./ha)

The highest cost of cultivation (Rs. 46020/ha) was calculated under T_9 (VC @ 3 t/ha + Azotobacter + PSB) followed by T_3 (VC @ 3 t/ha) (Rs. 45930/ha). While the minimum cost of cultivation (Rs. 21930/ha.) was recorded in T_1 (absolute control).

2. Gross return (Rs./ha)

The maximum gross return (Rs. 115000.00/ha.) was calculated in the treatment T_5 (30:20:15 kg NPK/ha + VC @ 1.5 t/ha) followed by T_6 (30:20:15 kg NPK/ha + FYM@ 5 t/ha) with (Rs. 111650.00/ha). Whereas the variable cost of cultivation is common to both the treatments and the treatment cost is (Rs. 13541.29/ha) and (Rs. 5541.29/ha) respectively. While the minimum gross return (Rs. 75000.00/ha) was found in the treatment T_1 (absolute control).

3. Net profit (Rs. /ha)

The maximum net profit (Rs. 84178.71/ha) was obtained in T_6 (30:20:15 kg NPK/ha + FYM @ 5 t/ha) followed by T_8 (60:40:30 kg NPK/ha + Azotobacter + PSB) (Rs. 84047.42/ha). Whereas the variable cost of cultivation is common to both the treatments and the treatment cost is (Rs. 5541.29/ha) and (Rs. 3172.58/ha) respectively. The minimum net profit (Rs. 42220.00/ha) was obtained in treatment T_3 (VC @ 3 t/ha).

4. Cost: Benefit ratio

The maximum cost: benefit ratio **(**3.34) was recorded under the treatment T_8 (60:40:30 kg NPK/ha + Azotobacter + PSB) followed by T_2 100% RDF (60:40:30 kg NPK/ha) (3.1). Whereas the variable cost of cultivation is common to both the treatments but the difference in net profit was (Rs. 84047.42/ha) and (Rs. 77787.42/ha) respectively, which affect the B: C ratio. The minimum cost: benefit ratio (0.91) was recorded in T_3 (VC @3t/ha).

Looking to the B: C ratio, Treatment (T_8) was found superior among all the treatments, which will be useful for farming of

coriander. The results were in accordance with the reported of Choudhary *et al.* [2], Godara *et al.* [3] and Nisarata *et al.* [4] in coriander.

Table 2: Cost of Cultivation

S. No.	Particulars	Unit	Quantity	Rate/Unit	Cost(Rs/ha)
A.	**Field preparation**				
1.	Preparatory tillage	hrs	4	520	2080
B.	**Sowing**				
1.	Cost of seed	Kg	15	200	3000
2.	Labour for seed treatment	Labour	1	170	170
3.	Sowing (by seed drill)	hrs	2	520	1040
C.	**After care**				
1.	Thinning and Gap Filling	Labour	5	170	850
2.	Weeding	Labour	12	170	2040
D.	Irrigation	Days	7	450	3150
E.	**Plant protection**				
1.	Insecticide (Cypermethrin + Profenofos)	L	1	600	600
2.	Fungicide (Dithane M-45)	Kg	1	600	600
3.	Labour for application	Labour	5	170	850
F.	Harvesting and Drying	Labour	25	170	4250
G.	Threshing and Cleaning	Labour	10	170	1700
H.	Transportation			1000/ha	1000
I.	Other Expenses			600	600
	Total				21930

Table 3: Treatment wise cost of fertilizers

Treatment	Urea			SSP			MOP			Vermicompost			FYM			Azotobacter			PSB	Total cost
	Qty. Kg ha^{-1}	Rate Rs kg^{-1}	Amt. Rs	Qty. Kg ha^{-1}	Rate Rs kg^{-1}	Amt. Rs	Qty. Kg ha^{-1}	Rate Rs kg	Amt. Rs	Qty. q ha^{-1}	Rate Rs q^{-1}	Amt. Rs	Qty. q ha^{-1}	Rate Rs q^{-1}	Amt. Rs	Qty. Kg ha^{-1}	Amt. Rs	Qty. Kg ha^{-1}	Amt. Rs	
Absolute control	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
100% RDF (60:40:30 kg NPK /ha)	130.43	6	782.58	250	6	1500	50	16	800											3082.58
VC @ 3 t/ha										30	800	24000								24000
FYM @ 10 t/ha													100	80	8000					8000
(30:20:15 kg NPK/ha) + VC @ 1.5 t/ha	65.21	6	391.26	125	6	750	25	16	400	15	800	12000								13541.29
(30:20:15 kg NPK/ha) + FYM @ 5 t/ha	65.21	6	391.26	125	6	750	25	16	400				50	80	4000					5541.29
VC @ 1.5 t/ha + FYM @ 5 t/ha										15	800	12000	50	80	4000					16000
(60:40:30 kg NPK/ha) + Azotobacter + PSB	130.43	6	782.58	250	6	1500	50	16	800							5.075	45	5.075	45	3172.58
VC @ 3 t/ha + Azotobacter + PSB										30	800	24000				5.075	45	5.075	45	24090
FYM @ 10 t/ha + Azotobacter+ PSB													100	80	8000	5.075	45	5.075	45	8090

Table 4: Effect of integrated nutrient management on economics of various treatments of coriander

Treatments		Variable cost of cultivation (Rs/ha)	Treatment cost (Rs/ha)	Total cost (Rs/ha)	Gross return (Rs/ha)	Net profit (Rs/ha)	B:C ratio
T_1	Absolute control	21930	0	21930	75000	53070	2.41
T_2	100% RDF (60:40:30 kg NPK/ha)	21930	3082.58	25012.58	102800	77787.42	3.1
T_3	VC @ 3 t/ha	21930	24000	45930	88150	42220	0.91
T_4	FYM @ 10 t/ha	21930	8000	29930	94550	64620	2.15
T_5	(30:20:15 kg NPK/ha) + VC @ 1.5 t/ha	21930	13541.29	35471.29	115000	79528.71	2.24
T_6	(30:20:15 kg NPK/ha) + FYM @ 5 t/ha	21930	5541.29	27471.29	111650	84178.71	3.06
T_7	VC @ 1.5 t/ha + FYM @ 5 t/ha	21930	16000	37930	105000	67070	1.76
T_8	(60:40:30 kg NPK/ha) + Azotobacter + PSB	21930	3172.58	25102.58	109150	84047.42	3.34
T_9	VC @ 3 t/ha + Azotobacter + PSB	21930	24090	46020	95800	49780	1.08
T10	FYM @ 10 t/ha + Azotobacter + PSB	21930	8090	30020	93300	63280	2.10

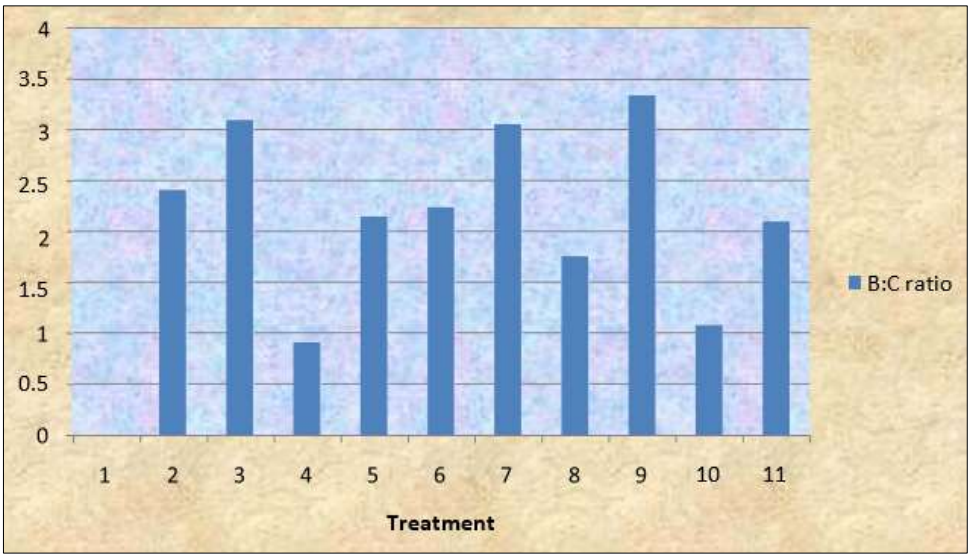

Fig 1: Effect of integrated nutrient management on economics of various treatments of coriander

Conclusions

Finding of the above experiment concluded that, among ten treatment combination, treatment T8 (60:40:30 kg NPK/ha + Azotobacter + PSB) was found to be the most suitable in terms of seed yield (21.83 q ha^{-1}), cost benefit ratio (3.34) and other aspects. Therefore application of RDF, Azotobacter and PSB in the above recommended dose will be emerged best in terms of higher return as well as other benefits and recommended for cultivation of coriander in Kawardha climatic condition.

Author's Contribution

Conceptualization of research (NS, SSP); Designing of the experiments (NS); Contribution of experimental materials (SSP, KS, GSB); Execution of field/lab experiments and data collection (SSP, KS, GDB); Analysis of data and interpretation (SSP); Preparation of manuscript (SSP, NS).

Declaration

The authors declare that they have no conflict of interest.

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