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Effect of micronutrients and biofrtilizer on quality parameters of coriander (*Coriandrum sativum* L.) *cv.* RCR-41

Avinash Sharma, PK Gupta, Palak Dongre, Nikhil Parihar and Jagat Pratap Singh Dangi

Abstract
"The present investigation entitled "Effect of micronutrients and biofrtilizer on quality parameters of coriander (*Coriandrum sativum* L.) *cv*. RCR-41" proposed to be undertaken at Research Field, Department of Horticulture, College of Agriculture, Gwalior M.P. during Rabi 2020-21 and 2021-22. The experiment was laid out in the Randomized Block Design with three replications. The following treatment combinations involving RDF dose of fertilizers and biofertilizers i.e. *Azotobactor* and PSB were applied at sowing time of coriander (*Coriandrum sativum* L.). Result concluded that among in micronutrient levels, treatment M_1 ($ZnSo_4$ @ 0.5%) was found the best treatment for quality of coriander. Among in biofertilizer levels, treatment B_2 (*Azotobacter*) was found the best treatment for quality of coriander. The treatment combination M_1B_2 ($ZnSo_4$ @ 0.5% x *Azotobacter*) was found significantly superior among all treatment combinations and it gave the maximum quality parameters of coriander."

Keywords: Quality, biofertilizers, micronutrients, coriander, fertilizers

Introduction
Coriander (*Coriandrum sativum* L.) is an annual herb. Believe that it is one of the first seed spice to be used by mankind. Coriander which belongs to the family *Apiaceae* (Umbelliferae) is mainly cultivated from its seeds throughout the year (Mhemdi *et al*. 2011) [8]. It is also known as '*Dhaniya* in Hindi, Seeds are round to oval in shape, golden brown or brown in colour with vertical ridges and have a distinct flavour. The seeds are important ingredient of curry powder (Ramadan *et al.* 2002) [5]. *Coriandrum sativum* is an ayurvedic medicinal herb, which is widely used as flavoring agent for its unique smell and flavour. Coriander is an important source of chemicals of a-pinene, a-terpinene, limonene and ncymene together with various non-linalool alcohols and esters (Verma *et al*. 2011) [6].
Coriander leaves and seeds are valued as food mainly for its high vitamin A and C. Its fresh leaves contain 87.9 percent moisture, 3.3 percent protein, 6.5 percent carbohydrates, 1.7 percent total ash, 0.4 percent calcium, 0.06 percent phosphorus, 0.01 percent iron, 60mg/100g vitaminsB2, 0.8mg/100g niacin, 35mg/100g vitamin C and 10,460 International units (IU)/100g vitamin A. 100g of coriander seed contains nearly 11g of starch, 20 g of fat, 11g of protein, and nearly 30g of crude fiber (Peter, 2004) [9].
For adequate plant growth and production, micronutrients are needed in small quantities; however, their deficiencies cause a great disturbance in the physiological and metabolic processes in the plant. Micronutrients application plays an important role in the production of good quality and high yield of crops (Amjad *et al*. 2014) [10]. The role of micronutrients in photosynthesis, N-fixation, respiration and other metabolic processes of the plant is well documented (Naga *et al.* 2013) [7]. The effect of micronutrient foliar fertilizer on the promotion of growth and production of some medicinal and aromatic plants were observed by several researchers (Mazaheri *et al.*, 2013) [1]. Application of micronutrients significantly influenced the number of branches, umbels per plant, seeds per umbel and seed yield of coriander (Kalidasu *et al.* 2008) [3].
Biofertilzers are less expensive, eco-friendly, sustainable and likely to assume greater significance as a compliment or supplement to inorganic fertilizers (Malhotra *et al*. 2006) [11]. Using biofertilizers that contain different microbial strains has led to decrease in the use of chemical fertilizers and has provided high quality products free of harmful agrochemicals for human safety (Mahfouz and Sharaf-Eldin 2007) [2].

The bio-fertilizers benefiting the crop production are *Azotobacter*, *Azospirillium*, blue green algae, *Azolla*, PSB, KSB, *mycorrhizae*. However the bio-fertilizers despite of their tremendous potential and benefits are unpredictable and inconsistent in their performance under field condition. *Azotobacter*, PSB and KSB are the widely used biofertilizers that significantly contribute N and P to plants besides providing tolerance to water stressed situations (Maheshwari *et al*. 1991) [12].

Material and Methods

The experiment was conducted at Experimental Field, Department of Horticulture, College of Agriculture, Gwalior M.P.

Experimental details

Crop - Coriander (*Coriandrum sativum* L.)
Variety - RCR-41
Design - Factorial Randomized Block Design
No. of treatments - 20
No. of replications - 03
Total no. of plots - 60
Plot size - 3×2 m^2
Net Experimental area - 360 m^2
Gross Experimental area - 420 m^2
Seed rate - 12 kg/ha
Date of sowing - 15/10/2020 & 15/10/2021

Treatments details

Micronutrients

M_0 = Control
M_1 = $ZnSo_4$ (0.5%)
M_2 = $FeSo_4$ (0.5%)
M_3 = $CuSo_4$ (0.5%)
M_4 = $MnSo_4$ (0.5%)

Biofertilizers

B_0 = Control
B_1 = PSB
B_2 = *Azotobacter*
B_3 = KSB

Treatment combinations

T_1 – Control
T_2 – PSB
T_3 – *Azotobacter*
T_4 – KSB
T_5 – $ZnSo_4$ (0.5%)
T_6 – $ZnSo_4$ (0.5%) + PSB
T_7 – $ZnSo_4$ (0.5%) + *Azotobacter*
T_8 – $ZnSo_4$ (0.5%) + KSB
T_9 – $FeSo_4$ (0.5%)
T_{10} – $FeSo_4$ (0.5%) + PSB
T_{11} – $FeSo_4$ (0.5%) + *Azotobacter*
T_{12} – $FeSo_4$ (0.5%) + KSB
T_{13} – $CuSo_4$ (0.5%)
T_{14} – $CuSo_4$ (0.5%) + PSB
T_{15} – $CuSo_4$ (0.5%) + *Azotobacter*
T_{16} – $CuSo_4$ (0.5%) + KSB
T_{17} – $MnSo_4$ (0.5%)
T_{18} – $MnSo_4$ (0.5%) + PSB
T_{19} – $MnSo_4$ (0.5%) + *Azotobacter*
T_{20} – $MnSo_4$ (0.5%) + KSB

Variety RCr-41: It is a tall and erect type with longer juvenile period (germination to shoot formation), having round and small seeds. The variety is highly resistant against wilt and stem gall diseases under field condition. It matures in 130-140 days and produces an average seed yield of 920 kg/ha.

Fertilizer application

A uniform dose of 60 kg N, 40 kg P and 20 kg/ha through urea, DAP (diammonium phosphate) and MOP (murate of potash) was given. A basal dose of 30 kg N/ha and full dose of phosphorus and potassium was drilled about 5-7 cm deep through hand plough at sowing. Remaining dose of nitrogen through urea was applied in two equal splits with irrigation.

Observations Recorded

Total chlorophyll (A and B) content of leaf (mg/100g)

The chlorophyll content was estimated spectrophotometrically by the method of Sadasivan and Manicham (1991) [12].

Essential oil content (%)

100 g of seeds sample was dried and cleaned initially and then oil eg. Linalool content were estimated by using essential oil distillation assembly (A. O. A. C., 1995).

Volatile oil content (%)

Volatile oil (Oleoresin) content in coriander seed were determined by using clevanger assembly.

Total carbohydrate (g/100 g)

Carbohydrates were estimated by methods suggested by Nelson (1941).

Results

Total chlorophyll content of leaf (mg/100g)

Total chlorophyll content of leaf (mg/100g) is presented in Table 1.

The maximum total chlorophyll content of leaf (2.22, 2.16 and 2.22 mg) in first year, second year and in pooled was found in treatment M_2 ($FeSo_4$ 0.5%) and the minimum total chlorophyll content of leaf (1.59, 1.59 and 1.59 mg) in first year, second year and in pooled was noted under treatment M_0 (Control), among in micronutrient levels.

The maximum total chlorophyll content of leaf (2.04, 2.07 and 2.05 mg) in first year, second year and in pooled was recorded under treatment B_2 (*Azotobacter*) and the minimum total chlorophyll content of leaf (1.72, 1.75 and 1.74 mg) in first year, second year and in pooled was noted under treatment B_0 (Control), among in biofertilizer levels.

The interaction effect between micronutrient and biofertilizer levels was found no-significant influence on total chlorophyll content (mg/100g) of coriander leaf.

Table 1: Effect of micronutrients and bio-fertilizers on total chlorophyll content of leaf (mg/100g) of coriander

Total chlorophyll content of leaf (mg/100g)					
I^{st} Year					
	B_0	B_1	B_2	B_3	MEAN
M_0	1.50	1.62	1.71	1.55	1.59
M_1	1.79	2.23	2.32	2.20	2.14
M_2	1.83	2.37	2.42	2.25	2.22
M_3	1.76	2.06	2.16	1.99	1.99
M_4	1.73	1.90	1.98	1.87	1.87
MEAN	1.72	2.04	2.12	1.97	
	M	B	M*B		
SE(m)	0.031	0.028	0.062		
CD(5%)	0.089	0.079	NS		
II^{nd} Year					
M_0	1.49	1.64	1.70	1.55	1.59
M_1	1.83	2.26	2.32	2.23	2.16
M_2	1.85	2.37	2.42	2.28	2.23
M_3	1.81	2.13	2.21	2.08	2.06
M_4	1.78	1.94	2.05	1.88	1.91
MEAN	1.75	2.07	2.14	2.00	
	M	B	M*B		
SE(m)	0.030	0.027	0.061		
CD(5%)	0.087	0.078	NS		
Pooled					
M_0	1.49	1.63	1.70	1.55	1.59
M_1	1.81	2.25	2.32	2.21	2.15
M_2	1.84	2.37	2.42	2.27	2.22
M_3	1.79	2.09	2.18	2.04	2.02
M_4	1.76	1.92	2.02	1.88	1.89
MEAN	1.74	2.05	2.13	1.99	
	M	B	M*B		
SE(m)	0.031	0.027	0.061		
CD(5%)	0.088	0.079	NS		

Chlorophyll A content of leaf (mg/100g)

Glance of data on chlorophyll A content of leaf (mg/100g) is presented in Table 2.

Data revealed that among in micronutrient levels, the maximum chlorophyll A content of leaf (1.56, 1.57 and 1.56 mg) in first year, second year and in pooled was found in treatment M_2 ($FeSo_4$ 0.5%) and the minimum chlorophyll A content of leaf (1.16, 1.15 and 1.16 mg) in first year, second year and in pooled was noted under treatment M_0 (Control).

Among in biofertilizer levels, the maximum chlorophyll A content of leaf (1.50, 1.50 and 1.50 mg) in first year, second year and in pooled was recorded under treatment B_2 (*Azotobacter*) and the minimum chlorophyll A content of leaf (1.24, 1.26 and 1.25 mg) in first year, second year and in pooled was noted under treatment B_0 (Control).

The combined effect between micronutrient and biofertilizer levels was found no-significant influence on chlorophyll A content (mg/100 g) of coriander leaf.

Table 2: Effect of micronutrients and bio-fertilizers on chlorophyll A content of leaf (mg/100g) of coriander

Chlorophyll A content of leaf (mg/100g)					
I^{st} Year					
	B_0	B_1	B_2	B_3	MEAN
M_0	1.10	1.18	1.24	1.12	1.16
M_1	1.28	1.58	1.63	1.55	1.51
M_2	1.31	1.65	1.69	1.58	1.56
M_3	1.27	1.45	1.54	1.42	1.42
M_4	1.25	1.34	1.41	1.32	1.33
MEAN	1.24	1.44	1.50	1.40	
	M	B	M*B		
SE(m)	0.021	0.019	0.042		
CD(5%)	0.061	0.054	NS		
II^{nd} Year					
M_0	1.08	1.20	1.21	1.13	1.15
M_1	1.33	1.59	1.62	1.57	1.53
M_2	1.33	1.66	1.67	1.60	1.57
M_3	1.30	1.48	1.55	1.47	1.45
M_4	1.28	1.37	1.47	1.34	1.36
MEAN	1.26	1.46	1.50	1.42	
	M	B	M*B		

SE(m)	0.022	0.020	0.045		
CD(5%)	0.064	0.057	NS		
Pooled					
M_0	1.09	1.19	1.23	1.13	1.16
M_1	1.30	1.58	1.62	1.56	1.52
M_2	1.32	1.66	1.68	1.59	1.56
M_3	1.29	1.46	1.55	1.44	1.43
M_4	1.27	1.36	1.44	1.33	1.35
MEAN	1.25	1.45	1.50	1.41	
	M	B	M*B		
SE(m)	0.022	0.019	0.044		
CD(5%)	0.063	0.056	NS		

Chlorophyll B content of leaf (mg/100g)

Glance of data on chlorophyll B content of leaf (mg/100g) is presented in Table 3.

The maximum chlorophyll B content of leaf (0.66, 0.63 and 0.66 mg) in first year, second year and in pooled was found in treatment M_2 ($FeSo_4$ 0.5%) and the minimum chlorophyll B content of leaf (0.43, 0.44 and 0.44 mg) in first year, second year and in pooled was noted under treatment M_0 (Control), among in micronutrient levels.

The maximum chlorophyll B content of leaf (0.61, 0.64 and 0.62 mg) in first year, second year and in pooled was recorded under treatment B_2 (*Azotobacter*) and the minimum chlorophyll B content of leaf (0.48, 0.49 and 0.48 mg) in first year, second year and in pooled was noted under treatment B_0 (Control), among in biofertilizer levels.

The interaction effect between micronutrient and biofertilizer levels was found no-significant influence on chlorophyll B content (mg/100 g) of coriander leaf.

Table 3: Effect of micronutrients and bio-fertilizers on chlorophyll B content of leaf (mg/100g) of coriander

Chlorophyll B content of leaf (mg/100g)					
Ist Year					
	B_0	**B_1**	**B_2**	**B_3**	**MEAN**
M_0	0.40	0.44	0.46	0.43	0.43
M_1	0.51	0.66	0.69	0.65	0.63
M_2	0.52	0.72	0.73	0.67	0.66
M_3	0.49	0.61	0.62	0.57	0.57
M_4	0.48	0.56	0.57	0.55	0.54
MEAN	0.48	0.60	0.61	0.58	
	M	B	M*B		
SE(m)	0.018	0.016	0.036		
CD(5%)	0.052	0.046	NS		
IInd Year					
M_0	0.41	0.45	0.49	0.42	0.44
M_1	0.50	0.67	0.70	0.66	0.63
M_2	0.51	0.71	0.75	0.68	0.66
M_3	0.50	0.65	0.65	0.62	0.61
M_4	0.50	0.57	0.59	0.54	0.55
MEAN	0.49	0.61	0.64	0.58	
	M	B	M*B		
SE(m)	0.019	0.017	0.038		
CD(5%)	0.055	0.049	NS		
Pooled					
M_0	0.41	0.44	0.48	0.43	0.44
M_1	0.51	0.66	0.69	0.66	0.63
M_2	0.52	0.71	0.74	0.68	0.66
M_3	0.50	0.63	0.64	0.60	0.59
M_4	0.49	0.57	0.58	0.55	0.55
MEAN	0.48	0.60	0.62	0.58	
	M	B	M*B		
SE(m)	0.019	0.017	0.037		
CD(5%)	0.053	0.048	NS		

Essential oil content (%)

Data on essential oil (Linalool) content (%) is presented in Table 4.

Among in micronutrient levels, the maximum essential oil (Linalool) content (0.367, 0.370 and 0.368%) in first year, second year and in pooled was found in treatment M_2 ($FeSo_4$ 0.5%) and the minimum essential oil (Linalool) content (0.331, 0.335 and 0.333%) in first year, second year and in pooled was recorded in treatment M_0 (Control).

Among in biofertilizer levels, the maximum essential oil (Linalool) content (0.357, 0.359 and 0.358%) in first year, second year and in pooled was noted in treatment B_2 (*Azotobacter*) and the minimum essential oil (Linalool) content (0.343, 0.346 and 0.344%) in first year, second year and in pooled was found in treatment B_0 (Control).

The combination effect of micronutrient and biofertilizer levels was found no-significant influence on essential oil (Linalool) content (%) in coriander.

Table 4: Effect of micronutrients and bio-fertilizers on essential oil content (%) of coriander

Essential oil content (%)					
Ist Year					
	B_0	**B_1**	**B_2**	**B_3**	**MEAN**
M_0	0.33	0.33	0.33	0.33	0.33
M_1	0.35	0.37	0.37	0.36	0.36
M_2	0.35	0.37	0.38	0.37	0.37
M_3	0.34	0.36	0.36	0.36	0.36
M_4	0.34	0.35	0.35	0.35	0.35
MEAN	0.34	0.36	0.36	0.35	
	M	B	M*B		
SE(m)	0.002	0.001	0.003		
CD(5%)	0.005	0.004	NS		
IInd Year					
M_0	0.33	0.34	0.34	0.33	0.33
M_1	0.35	0.37	0.37	0.37	0.36
M_2	0.35	0.37	0.38	0.37	0.37
M_3	0.35	0.36	0.37	0.36	0.36
M_4	0.35	0.35	0.36	0.35	0.35
MEAN	0.35	0.36	0.36	0.36	
	M	B	M*B		
SE(m)	0.002	0.002	0.004		
CD(5%)	0.005	0.005	NS		
Pooled					
M_0	0.33	0.33	0.34	0.33	0.33
M_1	0.35	0.37	0.37	0.37	0.36
M_2	0.35	0.37	0.38	0.37	0.37
M_3	0.35	0.36	0.36	0.36	0.36
M_4	0.35	0.35	0.35	0.35	0.35
MEAN	0.34	0.36	0.36	0.35	
	M	B	M*B		
SE(m)	0.002	0.002	0.003		
CD(5%)	0.005	0.004	NS		

Volatile oil content (%)

The data pertaining to volatile oil (Oleoresin) content (%) is presented in Table 5.

Among in micronutrient levels, the maximum volatile oil (Oleoresin) content (0.07 and 0.08%) in first year and second year was found in treatment M_1 ($ZnSo_4$ @ 0.5%), while (0.07%) in pooled was found in treatment M_1 ($ZnSo_4$ @ 0.5%) and M_2 ($FeSo_4$ @ 0.5%). However, the minimum volatile oil (Oleoresin) content (0.05, 0.05 and 0.05%) in first year, second year and in pooled was recorded in treatment M_0 (Control).

Among in biofertilizer levels, the maximum volatile oil (Oleoresin) content (0.07, 0.07 and 0.07%) in first year and in pooled was noted in treatment B_2 (*Azotobacter*), while (0.07%) in second year was noted in treatment B_1 (PSB), B_2 (*Azotobacter*) and B_3 (KSB). However, the minimum volatile oil (Oleoresin) content (0.05, 0.05 and 0.05%) in first year, second year and in pooled was found in treatment B_0 (Control).

The combination effect of micronutrient and biofertilizer levels was found no-significant influence on volatile oil (Oleoresin) content (%) in coriander.

Table 5: Effect of micronutrients and bio-fertilizers on volatile oil content (%) of coriander

Volatile oil content (%)					
Ist Year					
	B_0	**B_1**	**B_2**	**B_3**	**MEAN**
M_0	0.04	0.05	0.05	0.04	0.05
M_1	0.06	0.07	0.08	0.07	0.07
M_2	0.05	0.07	0.07	0.06	0.06
M_3	0.05	0.06	0.06	0.06	0.06
M_4	0.05	0.06	0.06	0.06	0.06
MEAN	0.05	0.06	0.07	0.06	
	M	B	M*B		
SE(m)	0.004	0.004	0.009		
CD(5%)	0.012	0.011	NS		
IInd Year					
M_0	0.04	0.05	0.05	0.05	**0.05**
M_1	0.06	0.08	0.09	0.08	**0.08**
M_2	0.05	0.07	0.08	0.07	**0.07**
M_3	0.05	0.07	0.07	0.06	**0.06**
M_4	0.05	0.06	0.06	0.06	**0.06**

MEAN	0.05	0.07	0.07	0.07	
	M	B	M*B		
SE(m)	0.005	0.005	0.010		
CD(5%)	0.015	0.013	NS		
Pooled					
M_0	0.04	0.05	0.05	0.05	0.05
M_1	0.06	0.08	0.09	0.08	0.07
M_2	0.05	0.07	0.08	0.07	0.07
M_3	0.05	0.07	0.07	0.06	0.06
M_4	0.05	0.06	0.06	0.06	0.06
MEAN	0.05	0.06	0.07	0.06	
	M	B	M*B		
SE(m)	0.005	0.004	0.009		
CD(5%)	0.014	0.012	NS		

Total carbohydrate (mg/100g)

The data pertaining to total carbohydrate (mg/100g) is presented in Table 6.

Among in micronutrient levels, the maximum total carbohydrate (4.32, 4.33 and 4.33 mg) in first year, second year and pooled was found in treatment M_1 ($ZnSo_4$ @ 0.5%). However, the minimum total carbohydrate (4.12, 4.15 and 4.14 mg) in first year, second year and in pooled was recorded in treatment M_0 (Control).

Among in biofertilizer levels, the maximum total carbohydrate (4.28, 4.30 and 4.29 mg) in first year and in pooled was noted in treatment B_2 (*Azotobacter*), while (0.07%) in second year was noted in treatment B_1 (PSB), B_2 (*Azotobacter*) and B_3 (KSB). However, the minimum total carbohydrate (4.16, 4.18 and 4.17 mg) in first year, second year and in pooled was found in treatment B_0 (Control).

The interaction effect of micronutrient and biofertilizer levels was found no-significant influence on total carbohydrate (mg/100 g) in coriander.

Table 6: Effect of micronutrients and bio-fertilizers on total carbohydrate (mg/100g) of coriander

Total carbohydrate (mg/100g)					
I^st^ Year					
	B_0	**B_1**	**B_2**	**B_3**	**MEAN**
M_0	4.10	4.14	4.14	4.11	4.12
M_1	4.21	4.37	4.39	4.32	4.32
M_2	4.20	4.31	4.33	4.28	4.28
M_3	4.16	4.26	4.28	4.25	4.24
M_4	4.15	4.22	4.23	4.21	4.20
MEAN	4.16	4.26	4.28	4.23	
	M	B	M*B		
SE(m)	0.021	0.019	0.042		
CD(5%)	0.061	0.054	NS		
II^nd^ Year					
M_0	4.14	4.15	4.17	4.15	4.15
M_1	4.20	4.38	4.42	4.32	4.33
M_2	4.19	4.31	4.34	4.31	4.29
M_3	4.19	4.27	4.30	4.25	4.25
M_4	4.17	4.24	4.24	4.22	4.22
MEAN	4.18	4.27	4.30	4.25	
	M	B	M*B		
SE(m)	0.014	0.012	0.028		
CD(5%)	0.040	0.036	NS		
Pooled					
M_0	4.12	4.15	4.16	4.13	4.14
M_1	4.21	4.38	4.41	4.32	4.33
M_2	4.20	4.31	4.34	4.30	4.28
M_3	4.17	4.27	4.29	4.25	4.25
M_4	4.16	4.23	4.24	4.21	4.21
MEAN	4.17	4.27	4.29	4.24	
	M	B	M*B		
SE(m)	0.018	0.016	0.036		
CD(5%)	0.051	0.046	NS		

Discussion

Data revealed that among in micronutrient levels, the maximum chlorophyll A, B, total chlorophyll content of leaf (mg/100g) and essential oil (Linalool) in first year, second year and in pooled was found in treatment M_2 ($FeSo_4$ 0.5%) and the minimum chlorophyll A, B, total chlorophyll content of leaf (mg/100 g) and essential oil (Linalool) in first year, second year and in pooled was noted under treatment M_0 (Control). The micronutrients act as an important catalytic in the enzymatic reactions of the metabolism and would have

helped in larger biosynthesis of photo assimilates. Higher concentration of micronutrients in the leaves and leaf tips resulted in increased photosynthesis and more chlorophyll formation. Similar results for most of the characters were also reported by Lal *et al.* (2014) [13] and Diana *et al*. (2015) [14].
Among in micronutrient levels, the maximum volatile oil (Oleoresin) content (%) in first year, second year and in pooled was found in treatment M_1 ($ZnSo_4$ @ 0.5%) and the minimum volatile oil (Oleoresin) content (%) in first year, second year and in pooled was recorded in treatment M_0 (Control). This effect of micronutrients on oil percentage may be attributed to their effect on enzymes activity and metabolism improvement. Zinc is an essential micronutrient that acts either as a metal component of various enzymes or as a functional, structural or regulatory cofactor associated with saccharide metabolism, photosynthesis, and protein synthesis. Carbon dioxide and glucose are precursors of monoterpene biosynthesis. Saccharides are also a source of energy and reducing power for terpenoid synthesis. These results are supported by the findings of Diana *et al*. (2015) [14] and Kumawat *et al*. (2015) [15].
Among in micronutrient levels, the maximum total carbohydrate (mg/100g) in first year, second year and pooled was found in treatment M_1 ($ZnSo_4$ @ 0.5%). However, the minimum total carbohydrate (4.12, 4.15 and 4.14 mg) in first year, second year and in pooled was recorded in treatment M_0 (Control). The results are in confirmation with the results achieved by Lal *et al.* (2014) [13] and Diana *et al*. (2015) [14].

Effect of bio-fertilizers on quality parameters of coriander
Among in biofertilizer levels, the maximum chlorophyll A, B and total chlorophyll content of leaf (mg/100 g) in first year, second year and in pooled was recorded under treatment B_2 (*Azotobacter*) and the minimum chlorophyll A, B and total chlorophyll content of leaf (mg/100 g) in first year, second year and in pooled was noted under treatment B_0 (Control). Biofertilizers helps in producing growth promoting substances such as indole acetic acid, gibberellins and cytokinins resulting in more efficient absorption of nutrients, which use the main components of photosynthetic pigments and consequently the chlorophyll content was increased. More chlorophyll content in leaves might be due to the micronutrients supplied by the biofertilizers which would retard leaf senescence and improving the photosynthates assimilation and increases nitrogen availability for seed biomass. These results are supported by the findings of Peerzada *et al.* (2016) [16], Patidar *et al*. (2016) [17], Mounika *et al.* (2017) [18] and Fikadu-Lebeta *et al*. (2019) [20].
Among in biofertilizer levels, the maximum essential oil (Linalool) and volatile oil (Oleoresin) content (%) in first year, second year and in pooled was noted in treatment B_2 (*Azotobacter*) and the minimum essential oil (Linalool) and volatile oil (Oleoresin) (%) in first year, second year and in pooled was found in treatment B_0 (Control). Application of biofertilizers enhances oil content in coriander plant. The results are in confirmation with the results achieved by Abdoolahi *et al.* (2016) [21], Kalasare *et al.* (2016) [4], Patidar *et al*. (2016) [17] and Suman *et al.* (2018) [22].
Among in biofertilizer levels, the maximum total carbohydrate (mg/100g) in first year and in pooled was noted in treatment B_2 (*Azotobacter*), while in second year was noted in treatment B_1 (PSB), B_2 (*Azotobacter*) and B_3 (KSB). However, the minimum total carbohydrate (mg/100g) in first year, second year and in pooled was found in treatment B_0 (Control). Findings are in agreement with those of Kalasare *et al.* (2016) [4], Mounika *et al.* (2017) [18] and Fikadu-Lebeta *et al*. (2019) [20].

Interaction effect of micronutrients and bio-fertilizers on quality parameters of coriander
The combined effect between micronutrient and biofertilizer levels was found no-significant influence on chlorophyll A, B and total chlorophyll content (mg/100 g) of coriander leaf.
The combination effect of micronutrient and biofertilizer levels was found no-significant influence on essential oil (Linalool) content (%) in coriander.
The combination effect of micronutrient and biofertilizer levels was found no-significant influence on volatile oil (Oleoresin) content (%) in coriander.
The interaction effect of micronutrient and biofertilizer levels was found no-significant influence on total carbohydrate (mg/100g) in coriander. Findings are in agreement with those of Chanchan *et al.* (2013) [23], Diana *et al*. (2015) [14] and Mounika *et al.* (2018) [19].

Conclusion
Result concluded that among in micronutrient levels, treatment M_1 ($ZnSo_4$ @ 0.5%) was found the best treatment for growth and yield of coriander. Among in biofertilizer levels, treatment B_2 (*Azotobacter*) was found the best treatment for growth, yield and quality of coriander. The treatment combination M_1B_2 ($ZnSo_4$ @ 0.5% x *Azotobacter*) was found significantly superior among all treatment combinations and it gave the maximum growth, yield and quality parameters of coriander.

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