

Original Research Article

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Influence of Sulphur and Zinc Fertilization on Yield Attributes, Yield and Economics of Coriander Varieties

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ABSTRACT

Keywords

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The present study was aimed to examine the effect of two varieties, four levels of sulphur (0, 20, 40 and 60 kg S/ha) and four levels of zinc (0, 2.5, 5.0 and 7.5 kg Zn/ha) making 32 treatment combination under split plot design with three replications. Results showed that significantly increased umbels/plant, umbellets/umbel, seeds/umbel, seed (1409 kg/ha), stover and biological yields, and net returns (Rs 39396/ha) were obtained with coriander variety RCr-436 as compared to variety RCr-435. The variety RCr-436 recorded 13.1 and 24.2% higher seed yield and net returns as compared to RCr-435. Sulphur application at 40 kg/ha significantly increased umbels/plant, umbellets/umbel, seeds/umbel and test weight, seed (1406 kg/ha), stover and biological yields, and net returns (39175/ha) over control and 20 kg S/ha. The sulphur at 40 kg/ha register 20.8 and 7.5 % higher seed yield, 39.0 and 12.7% more net return over control and 20 kg/ha, respectively. Significantly increased umbels/plant, umbellets/umbel, seeds/umbel and test weight, seed (1436 kg/ha), stover and biological yields, and net returns (Rs. 39309/ha) were obtained with 5.0 kg Zn/ha over control and 2.5 kg Zn/ha. Zinc application @ 5.0 kg/ha recorded significantly more seed yield by 30.3 and 10.5 % and net returns by 35.2 and 10.4 %, respectively.

Introduction

Coriander (*Coriandrum sativum* L.) popularly known as “dhanian” is one of the oldest seed spice used by the mankind. It is the most widely used condiment throughout the world. It is mainly grown for its aromatic and fragrant seed which is botanically a cremocarpic fruit. The fresh green stem, leaves and fruits of coriander have a pleasant aromatic odour. The pleasant aroma in the plant is due to an essential oil called “coriandrol” ranges from 0.1 to 1.3 per cent in dry seeds. The oil of coriander seeds is a valuable ingredient in perfumes, cosmetic products, soup, candy, cocoa, chocolate, meat products, soft drinks and alcoholic beverages.

Good quality oleoresin can be extracted from coriander seed which is used for flavouring beverages, sweets pickles, sausages, shacks etc. Coriander bark oil has high germicidal activity and can be used as fungicides (Krishna, 1999). The entire young plant is used for flavouring curried dishes of all sorts and chutney. Coriander leaves are also rich source of vitamin C (125-250 mg/100 g) and vitamin A (5200 IU/100g). In medicines, its seed is used as a carminative, refrigerant and diuretic. The dry seeds of coriander contain 0.3 per cent essential oil, 19.6 per cent non-volatile oil, 24 per cent carbohydrates, 5.3 per cent mineral matter and 175 IU/100 vitamin A

Recently sulphur deficiency has been aggravated in soils due to continuous crop removal under intensive cropping system and use of sulphur free high analysis NPK fertilizers. Sulphur which has now emerged as the third most important plant nutrient for crop plays a multiple role in nutrition. It helps in chlorophyll formation and also a constituent of amino acids like cystine, cysteine and methionine. Sulphur is also responsible for synthesis of certain vitamins (biotin and thiamine), proteins, fats and metabolism of carbohydrates (Tondon, 1991). Zinc is most deficient among all the micronutrients in Indian soils. In many parts of India, zinc as a plant nutrient now stands third in importance next to nitrogen and phosphorus (Takkur and Randhawa, 1980). It is a constituent of several enzyme systems which regulates various metabolic reactions in plant, for example oxidation reduction reactions in the formation of chlorophyll etc. It acts as an activator of dehydrogenase and proteinase enzymes directly or indirectly in the synthesis of carbohydrates and protein. Therefore, the present investigation carried out to study the effect of sulphur and zinc on yield, nutrient uptake and quality of coriander varieties.

Materials and Methods

The two year field experiment comprising 32 treatment combinations replicated three times, was laid out in split split design with two varieties (RCr-435 and RCr-436) and four levels of sulphur (0, 20, 40 and 60 kg/ha) in main plots and four level of zinc (0, 2.5, 5.0 and 7.5 kg/ha) in sub plots. It was conducted at S.K.N. College of Agriculture, Jobner (Rajasthan) during *rabi* seasons of 2012-13 and 2013-14 situated at latitude of 27° 05' N, longitude of 75° 28' E and at an altitude of 427 m above mean sea level. The soil of experimental field was loamy sand, low in organic carbon (0.18%), available N

(128.4 kg/ha), phosphorus (17.18 kg/ha), zinc (0.43 ppm) and medium in potassium (173.40 kg/ha) with alkaline (pH 8.4) in reaction having 1.60 Mg/m³ bulk density, 2.63 Mg/m³ particle density, 11.95% field capacity and 42.35% porosity at the beginning of the experiment. The crop variety RCr-436 and RCr-435 were sown in rows 30 cm apart with seed rate of 12 kg/ha. Uniform dose of nitrogen (60 kg/ha) through urea and phosphorus (40 kg/ha), potassium (20 kg/ha) and soil application of zinc and sulphur as per treatments through MOP, DAP, zinc chloride and gypsum, respectively were drilled at the time of sowing. During the crop season need based cultural and plant protection operations were taken up to harvest good crop during both the years of experimentation. Five random plants were selected from each plot for taking observations on yield attributes and for yield, the net plots were harvested. To ascertain the economic feasibility of different treatments, economics of treatments was worked out on the basis of prevailing market prices of inputs and outputs and expressed in terms of net profit per hectare so that most remunerative treatment could be recommended. Regular analysis of variance was performed for each trait for both the seasons and the pooled analysis over seasons after testing error variance homogeneity was carried out according to the procedure outlined by (Gomez and Gomez, 1984).

Results and Discussion

Yield attributes and yield

Coriander variety RCr-436 recorded significantly higher umbels/plant, umbellets/umbel, seeds/umbel over variety RCr-435 during both the years of experimentation and in pooled data (Table 1). The per cent increase in umbels/plant, umbellets/umbel and seeds/umbel was 9.1, 8.5 and 10.4% by RCr-435, respectively on pooled mean basis. The

marked increase in yield attributes under RCr-436 might be due to its genetic potential when grown under semi-arid conditions and improved growth of plants at successive stages as reflected by higher production of dry matter per plant at harvest. This subscribes to the view that there was adequate supply of metabolites in RCr-436 as compared to RCr-435 for growth and development of reproductive structures (AICRPS, 2008). The variety of RCr-436 produced significantly higher seed (1409 kg/ha), stover (2061 kg/ha) and biological (3469 kg/ha) yields during both the years of experimentation and in pooled analysis and registered an increase of 13.1, 8.3 and 10.2% higher seed, stover and biological yield over RCr-435, respectively on pooled mean basis. Since coriander yield formation is a complex process and governed by interaction between source (photosynthesis and availability of assimilates in leaves etc.) and sink component (storage organs). Thus, as a consequence of marked improvement in both these regulative processes as evidenced from higher accumulation of biomass and nutrients as well as yield components in varieties RCr-436 led to significant increase in seed, stover and biological yields (Balai and Keshwa, 2010).

Increasing levels of sulphur at 40 kg/ha recorded significant improved yield attributes of coriander *viz.*, umbels/plant, umbellets/umbel, seeds/umbel in individual years of experiment as well as in pooled analysed data (Table 1). Application of sulphur at 40 kg/ha during 2012-13 and 60 kg/ha during 2013-14 significantly enhanced the test weight of coriander over control. On pooled basis, the application of 40 kg S/ha increased umbels/plant by 23.2, 8.2%, umbellets/umbel by 20.1, 6.8% and seeds/umbel by 21.7, 7.3%, respectively over control and 20 kg S/ha. The test weight was increased by 3.2% with application of 40 kg S/ha over control in pooled data. Supply of

sulphur in adequate and appropriate amount helps in flower primordial initiation for its reproductive part. When supply of sulphur is optimum, greater translocation of photosynthates occurs from leaves towards sink *i.e.*, yield attributes (Nawange *et al.*, 2011). Application of sulphur @ 40 kg/ha increased seed (1406 kg/ha), stover (2075 kg/ha) and biological (3481 kg/ha) yields of coriander during both the year and in pooled data. The per cent increase in seed, stover and biological due to 40 kg S/ha was recorded to the tune of 20.8, 16.5 and 18.2% over control and 7.5, 6.3 and 6.8 % over 20 kg/ha, respectively. The seed, stover and biological yields primarily being a function of cumulative response of growth and yield attributing characters increased remarkably with increase in sulphur levels (Patel *et al.*, 2013).

Application of successive dose of zinc upto 5 kg/ha significantly increased the yield attributes *viz.*, umbels/plant, umbellets/umbel and seeds/umbel during both the year as well as in pooled analysed data (Table 1). Application of zinc upto 2.5 kg/ha recorded significantly enhanced test weight of coriander over control during both the years and in pooled mean. On pooled basis, the application of 5 kg Zn/ha increased umbels/plant by 25.8, 9.2%, umbellets/umbel by 28.4, 9.5%, seeds/umbel by 25.4, 8.8% over control and 2.5 kg Zn/ha and the increase in test weight due to 2.5 kg/ha was to the tune of 4.8% over control on pooled data, respectively. The increase in yield attributes might be due to role of zinc in biosynthesis of indole acetic acid (IAA) and especially due to its role in initiation of primordial for reproductive parts and partitioning of photosynthates towards them. Zinc is also an essential component of enzymes that are responsible for assimilation of nitrogen leading to higher growth and yield contributing parameters.

Table.1 Effect of variety, sulphur and zinc fertilization on yield attributes of coriander

Treatments	Umbels/plant			Umbellets/umbel			Seeds/umbel			Test weight (g)		
	2012-13	2013-14	Pooled	2012-13	2013-14	Pooled	2012-13	2013-14	Pooled	2012-13	2013-14	Pooled
Variety												
RCr-435	20.27	18.50	19.38	5.41	4.89	5.15	24.85	24.41	24.63	9.81	9.92	9.87
RCr-436	22.07	20.21	21.14	5.88	5.30	5.59	27.58	26.79	27.19	10.07	10.16	10.11
SEm±	0.23	0.25	0.17	0.06	0.06	0.04	0.33	0.34	0.23	0.12	0.12	0.08
CD (P=0.05)	0.71	0.75	0.52	0.19	0.21	0.14	0.99	1.02	0.72	NS	NS	NS
Sulphur levels (kg/ha)												
0	18.32	16.69	17.51	4.96	4.48	4.72	22.73	22.42	22.58	9.56	9.67	9.62
20	20.86	19.05	19.95	5.59	5.03	5.31	25.89	25.28	25.59	9.90	9.96	9.93
40	22.52	20.63	21.58	5.94	5.40	5.67	27.88	27.06	27.47	10.10	10.23	10.17
60	22.97	21.04	22.01	6.09	5.48	5.79	28.36	27.65	28.00	10.19	10.30	10.25
SEm±	0.33	0.35	0.24	0.09	0.09	0.06	0.46	0.48	0.33	0.17	0.17	0.12
CD (P=0.05)	1.01	1.06	0.74	0.26	0.27	0.19	1.39	1.44	1.02	0.51	0.51	0.37
Zinc levels (kg/ha)												
0	18.00	16.50	17.25	4.72	4.29	4.51	22.32	21.97	22.15	9.42	9.63	9.53
2.5	20.77	18.97	19.87	5.57	5.01	5.29	25.78	25.27	25.53	9.90	10.07	9.99
5.0	22.66	20.74	21.70	6.09	5.48	5.79	28.07	27.47	27.77	10.17	10.20	10.19
7.5	23.24	21.21	22.23	6.21	5.61	5.91	28.69	27.70	28.20	10.26	10.26	10.26
SEm±	0.30	0.31	0.22	0.08	0.09	0.06	0.39	0.40	0.28	0.13	0.13	0.09
CD (P=0.05)	0.87	0.89	0.61	0.24	0.25	0.17	1.11	1.14	0.78	0.37	0.37	0.26

Table.2 Effect of variety, sulphur and zinc fertilization on yield and economics of coriander

Treatments	Seed yield (kg/ha)			Stover yield (kg/ha)			Biological yield (kg/ha)			Net returns (Rs/ha)		
	2012-13	2013-14	Pooled	2012-13	2013-14	Pooled	2012-13	2013-14	Pooled	2012-13	2013-14	Pooled
Variety												
RCr-435	1298	1193	1245	1960	1845	1902	3258	3038	3148	34211	29235	31723
RCr-436	1465	1352	1409	2107	2015	2061	3572	3367	3469	42020	36772	39396
SEm±	17	15	11	25	23	17	44	41	30	496	516	358
CD (P=0.05)	53	45	35	75	71	52	135	125	94	1506	1566	1104
Sulphur levels (kg/ha)												
0	1210	1118	1164	1831	1731	1781	3041	2850	2945	30347	26007	28177
20	1362	1254	1308	2007	1897	1952	3369	3152	3260	37310	32230	34770
40	1464	1347	1406	2132	2018	2075	3597	3365	3481	41923	36428	39175
60	1489	1370	1430	2162	2074	2118	3652	3444	3548	42882	37349	40116
SEm±	25	21	16.08	35	34	25	63	58	43	702	730	506
CD (P=0.05)	74	63	50	106	100	74	191	177	132	2129	2215	1561
Zinc levels (kg/ha)												
0	1156	1048	1102	1759	1657	1708	2915	2705	2810	31601	26537	29069
2.5	1351	1246	1299	1994	1892	1943	3345	3138	3242	38058	33129	35594
5.0	1490	1381	1436	2168	2056	2112	3658	3437	3548	41874	36745	39309
7.5	1529	1415	1472	2212	2115	2164	3741	3530	3636	40929	35605	38267
SEm±	23	19	15.40	33	32	23	53	53	38	619	602	432
CD (P=0.05)	67	55	43	99	93	67	150	151	105	1760	1711	1211

These findings of present investigation are supported by Yousuf *et al.*, (2014) in coriander. The further pooled data analysis of present experiment indicated that application of 5 kg Zn/ha significantly increased seed (1436 kg/ha), stover (2112 kg/ha) and biological (3548 kg/ha) yields of coriander during both the years as well as in pooled analysis and represented an increased seed by 30.3 and 10.5 per cent in seed, 23.3 and 8.7 per cent in stover and 26.3 and 9.4 per cent in biological yields over control and 2.5 kg Zn/ha, respectively. The applied as well as native zinc helped to improve overall availability in the rhizosphere resulting into greater uptake by the plant consequently leading to a favourable stimulus effect on physiological and metabolic processes of the plant (Chauhan *et al.*, 2013).

Economics

The data (Table 2) indicated that variety RCr-436 recorded higher net returns of Rs. 39396/ha, representing an increase of Rs. 7673/ha over RCr-435 (Rs 31723/ha). Despite the same cost of cultivation for both the varieties, the higher seed yield recorded under variety RCr-436 have led to increased net returns as compared to RCr-435. These results are also supported by the findings of Balai and Keshwa (2010). The net returns (Rs.39175/ha) were increased significantly with increasing levels of sulphur upto 40 kg/ha by `10998 and 4405/ha over control and 20 kg S/ha, respectively (Table 2). This was mainly due to the increased seed yield with comparatively lesser cost of sulphur under this treatment. Similar results were also reported by Lal *et al.*, (2014). The economic evolution (Table 2) shows that in coriander, the application of zinc at the rate of 5.0 kg/ha exhibited maximum net returns (Rs.39309/ha) which was significantly higher by Rs. 10240 and Rs. 3715 over control and 2.5 kg Zn/ha, respectively. The cost involved under the

treatment was comparatively lower than its additional income due to high yield, which led to more returns under these treatments. These results also substantiated by Lal *et al.*, (2014).

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