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Studies on different organic modules for yield and quality of coriander (*Coriandrum sativum* L.)

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ABSTRACT

A field experiment on effects of different organic modules and varieties on the yield attributes, yield and quality parameters of coriander was conducted at National Research Center on Seed Spices, Ajmer, Rajasthan during Rabi season of 2010-11. The experiment comprising of three organic modules (M_1, M_2 and M_3) and two varieties (ACr-1 and RCr-41) was laid in factorial RBD with four replications. The results of present study demonstrated that cultivation of ACr-1 with the application of organic Module-1 comprising of soil application of vermicompost, *Trichoderma* and neem cake as well as seed treatment of *Azotobacter,* PSB and *Trichoderma* with the foliar spray of garlic extract and neem oil exhibited maximum values for all the yield attributing characters and quality parameters like days to 50 per cent flowering, number of umbels per plant, number of umbellets per umbel, number of seeds per umbellate, seed yield per hectare, test weight, chlorophyll content in leaves at 60 and 90 DAS, grain colour, aroma and essential oil and Net returns (Rs 105518.25) with B:C ratio (3.92 : 1) over ACr-1 and RCr-41 grown under Module-2 and Module-3.

Key words : Benefit cost ratio, coriander, net return, organic cultivation, seed spices, varieties.

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INTRODUCTION

Current trends in agriculture are centered on reducing the use of inorganic fertilizers by organic manure and the application of biofertilizers (Gyaneshwar *et al.,* 13 and Darzi *et al*., 11). It is a well documented fact that increased dependence on agro-chemicals including fertilizers has led to several ill effects on the environment. Moreover, people are becoming more conscious of the health problems due to consumption of agricultural products contaminated with pesticide residue and of the adverse impact of the modern agriculture on the environment throughout the world. Organic products are highly remunerative because of higher demand in domestic market in metro cities and for export earnings. Its quality is comparatively higher. Fertility status of the soil maintained over a longer period of time. It helps in enhancing availability of nutrients to plant. According to Lampkin (16), organic farming practices are near to nature hence dependency on external inputs is reduced. It is believed that organically produced crops may be more resistant to pests and disease compared to conventional farming.

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India is the largest producer of coriander (*Coriandrum sativum* L.) in the world. It is mainly cultivated in Rajasthan, Andhra Pradesh, Gujarat and Madhya Pradesh with scattered pockets in Tamil Nadu, Orissa, Karnataka, Haryana, Uttar Pradesh and Bihar. Rajasthan occupies the first position in production and acreage, contributes about 40 per cent of total production of coriander in India. The tender leaves stem and fruits of coriander have a pleasant aromatic flavour and thus is indispensable food adjunction in Indian cookery. The seeds are also used as condiment. The medicinal properties of coriander are many used in Indian Ayurvedic and Unani medicinal preparation. Coriander seed contains 18.21 per cent fatty oil which is used in the cosmetic industries. Coriander crop responds well to the application of both organic manures and inorganic fertilizers. There is greater demand in the domestic and international market for organically produced coriander. Organic manures supply the major nutrients, micronutrients, besides improving soil health (Palaniappan and Anndurai, 19).

Several studies showed that organic nutrients could increase the growth and yield of some medicinal plants and other crops such as turmeric (Vadiraj *et al*., 26), basil (Anwar *et al*., 3), garlic (Arguello *et al*., 5), geranium (Chand *et al*., 7), *Vigna radiata* (Mathur, 17), *Vigna unguiculata* (Karmegam and Daniel, 15), sunflower (Devi and Agarwal, 12), fennel (Darzi *et al*., 9, 10), chamomile (Azizi *et al*., 6), plantain (Sanchez *et al*., 23), strawberry (Arancon *et al*., 4) and barley (Roy and Singh, 21).

By using correct nutritional sources through biofertilizers, quantitative and qualitative yield of coriander can be maximized. However, information in this aspect for coriander crop is very limited. Keeping in view the nutritional properties, medicinal importance, and common use of coriander and its chemical constituents, the present study was designed to investigate the effects of different organic modules on the yield and quality attributes of coriander crop.

MATERIALS AND METHODS

A field experiment on effect of different organic modules on yield and quality of coriander was conducted at research farm of National Research Center on Seed Spices, Ajmer, Rajasthan, during '*rabi*' season of 2010-11. The soil of research farm is sandy loam, poor in fertility and water holding capacity, having pH 8 to 8.3, EC 0.07 to 0.12 and organic carbon 0.15 to 0.23%, available N 178.5 kg ha^{-1} (low), P_2O_5 12 kg ha^{-1} (medium), K_2O 85 kg ha^{-1} (low), Ca 214.7 kg ha^{-1} (high), Mg 258 kg ha^{-1} (medium), S 27 kg ha^{-1} (high).

The experiment comprising of three organic modules *viz*., M_1 [Vermicompost (5t/ha), foliar spray of garlic extract (5% @ 2 kg ha^{-1}) + neem oil (2% @ 5 litre ha^{-1})], M_2 [FYM (10 t/ ha^{-1}), foliar spray of garlic extract (5% @ 2 kg ha^{-1}) alone], and M_3 [Sheep manure (10t ha^{-1}), foliar spray of karanj oil (2% @ 5 litres ha^{-1})] and two varieties *viz.*, ACr-1 and RCr-41 was laid in factorial RBD with four replications. Prior to sowing, seeds were cleaned and splited to two halves. Soil application of *Trichoderma* (2.5 kg ha^{-1}) and neem cake 150 kg ha^{-1}were common in all the modules and seeds were universally treated with *Azotobacter* (100 ml kg^{-1} seeds), PSB (100 ml kg^{-1} seeds) and *Trichoderma* (10 g kg^{-1} seeds) and then sown in furrows opened at 30 cm row spacing and covered with soil properly. Irrigations and inter cultural operations were taken as per existing recommendations for the crop.

Observation on days to 50% flowering, number of umbels per plant, number of umbellets per umbel, number of seeds per umbellate, seed yield per ha and weight of 1000 seeds were taken. The chlorophyll content of leaves was also determined at 60 and 90 days after sowing. The organoleptic evaluation of grain was conducted on the basis of colours and aroma by a panel of five judges on the basis of grain colour using Hedonic rating test (Amerine *et al.* 1). To ascertain the economic feasibility of different treatments, economics of treatments was worked out in terms of net profit per hectare so that most remunerative treatment could be recommended. The net return was calculated by subtracting cost of cultivation of each treatment from gross return. The B:C ratio was computed by dividing gross return with cost of cultivation of each treatment.

Statistical analysis of data was done as per standard procedure prescribed by Cochran and Cox (8). Whereas, the variance ratios (F–values) were found significant at 5 per cent level of probability, the critical difference (CD) values were computed for making comparison among treatment means.

RESULTS AND DISCUSSION

Yield attributes and yield of coriander

Number of umbels per plant was significantly influenced by the application of different organic modules and the varieties of coriander (Table 1). The maximum number of umbels per plant (65.55) was recorded in Module-1 (M_1) in comparison to minimum number of umbels per plant (42.65) under Module-2 (M_2). Likewise, maximum number of umbels per plant (55.96) was recorded in ACr-1 (V_1) in comparison to the minimum (49.72) under RCr-41 (V_2). Similarly, number of umbellets per umbel and number of seeds per umbellets significantly affected by application of different organic modules and maximum values of these parameters (6.31 and 11.17) were recorded in Module-1 (M_1) as against minimum (5.68 and 8.41) under Module-2 (M_2). It is further revealed from the results that the number of umbellets per umbel was significantly varied between the varieties of coriander. The maximum number of seeds per umbellate (9.77) was recorded in ACr-1 (V_1) as against the maximum number of seeds per umbellate (8.86) under RCr-41 (V_2). However, the interaction of M x V was nonsignificant in respect to seeds per umbellate.

The data showed that the test weight of the grain was significantly influenced with the application of different organics modules as well as varieties of coriander. The maximum test weight (8.99 g) was recorded in Module-1 (M_1) as against minimum (7.96 g) under Module-2 (M_2) whereas in varieties, the maximum test weight (8.66 g) was recorded in ACr-1 (V_1) as against the minimum test weight (8.24 g) recorded under RCr-41 (V_2). The statistical analysis of data further revealed that the interaction M x V did not affect significantly the test weight. Due to these biofertilizers crop got higher test weight which might have produced more number of heavier and bolder seeds contributing to better seed quality. These results are in confirmation with the reports of Shashidhara (24) and Amrithalingam (2) in chilli and Rahman *et al*, (20) in tomato.

It is obvious from the results that the application of different organic modules to the coriander crop influenced significantly the seed yield per ha. The maximum seed yield (1546.66 kg ha^{-1}) was recorded in Module-1 (M_1) as against to the minimum seed yield (1288.33 kg ha^{-1}) recorded under Module-2 (M_2). The data further revealed that the seed yield per ha non-significantly varied between the varieties of coriander. Similarly, under interaction effects, it was recorded that M x V interaction had no significant effect on coriander.

It is evident from results that application of vermicompost at 5t ha^{-1} significantly increased the value of yield contributing characters and their by seed yield per ha over FYM and sheep manure. It is established fact that vermicompost improves the physical and biological properties of soil including supply of almost all the essential plant nutrients for the growth and development of plants. Thus, balance nutrients under favourable environment might have helped in production of new tissue and development of new shoot might have ultimately increased the yield attributes and yield. The results of present investigation corroborate the findings of Mba (18) and Singh *et al.*, (25). In this study, application of vermicompost at 5 t ha^{-1} enhanced the seed yield over other modules.

The increase in yield may be attributed to better utilization of organic N, greater biological N fixation, higher synthesis of plant growth hormones and enhanced availability of P in the presence of biofertilizers. *Azotobacter* and PSB play an important role in the development of meristematic tissues at growing points for promoting growth and also aid in formation of seeds in plants. Increase in seed yield due to inoculation by *Azotobacter* and PSB has been observed in other crops like soybean, tomato and chilli (Hamedunnisa and Begum 14; Sajan *et al*. 22)

Quality parameters of coriander

An examination of data presented in Table 2 revealed that the chlorophyll content in leaves at 60 and 90 DAS differs significantly with the application of different organic modules. The maximum chlorophyll content (12.34 and 8.52 ppm) in leaves at 60 and 90 DAS, respectively was recorded in Module-1 (M_1). However, varieties did not significant influenced the chlorophyll content.

Organoleptic rating of grain colour was affected significantly with the application of organic modules as well as varieties. The maximum score (8.00) with respect to colours was recorded in Module-1 as compared to Module-2. The varieties influenced significantly the organoleptic score of grain colour. The highest score (7.50) was obtained with the grains of ACr-1 (V_1) over grains of RCr-41.

Similarly grain aroma was significantly influenced with various modules. The highest score (8.25) for aroma was recorded in Module-1 (M_1) as against the Module-2. Moreover, the grain aroma was significantly varied between the varieties of coriander, i.e., maximum organoleptic score (7.50) for aroma was recorded in grains of ACr-1 (V_1) over RCr-41 (V_2).

Application of different organic modules influenced significantly the essential oil content of coriander grains. The maximum essential oil content (0.41 g kg^{-1}) was recorded in coriander produced with the application of organic Module-1 as against with Module-2. A critical examination of data revealed that the essential oil content was significantly varied between the varieties of coriander. The maximum essential oil content (0.54 g kg^{-1}) was recorded in the grains ACr-1 (V_1) as compare to the minimum essential oil content (0.21 g kg^{-1}) recorded in the grain of RCr-41 (V_2). Interestingly, interaction of M x V significantly enhanced the essential oil content. The maximum essential oil content (0.59 g kg^{-1}) was recorded in the grains of variety ACr-1 (V_1) grown under Module-1 over variety RCr-41 (V_2) grown under Module-2 (M_2).

Economics

Data on economics evaluation of treatments in terms of monetary returns and B:C ratio realized for coriander are presented in Table 3. The application of different organic modules to the coriander crop influenced significantly the net return and B:C ratio. The maximum net return (Rs. 107780.90) with BC ratio of 3.82 was recorded in Module-1 as against in Module 3. However, net return and B:C ratio were non-significantly varied between the varieties of coriander.

CONCLUSION

Thus it is inferred that application of various organic *viz.*, Vermicompost, *Trichoderma*, neem cake, seed treatment with *Azotobacter*, PSB and *Trichoderma* and foliar spray of garlic extract under Module 1 in ACr-1 variety of coriander is better for higher yield, net return anf profit.

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Table 1. Effect of different organic module and variety on yield attributes of coriander

Treatments	Days to 50% flowering	No. of umbels/ plant	No of umbellets /imbel	No of seeds /umbellet	Seed yield kg ha^{-1}	Test weight (g)
Organic modules						
M_1	72.50	65.55	6.31	11.17	1546.66	8.99
M_2	80.87	42.65	5.68	8.37	1288.33	7.96
M_3	77.87	50.33	5.96	8.41	1341.87	8.40
SEm±	0.49	1.93	0.15	0.40	6.59	0.16
CD at 5%	1.48	5.82	0.44	1.20	182.60	0.49
Varieties						
V_1	76.58	55.96	6.07	9.77	1414.30	8.24
V_2	77.58	49.72	5.90	8.86	1370.27	8.66
SEm±	0.40	1.58	0.12	0.33	49.47	0.13
CD at 5%	NS	4.75	NS	0.98	NS	0.40
M x V Interaction						
M_1V_1	72.00	67.62	6.37	12.04	1577.08	8.68
M_1V_2	73.00	63.47	6.25	10.30	1516.25	9.31
M_2V_1	81.75	49.40	5.82	8.45	1295.00	7.86
M_2V_2	80.00	35.90	5.55	8.30	1281.66	8.06
M_3V_1	76.00	50.87	6.02	8.82	1370.83	8.20
M_3V_2	79.75	49.80	5.90	8.00	1312.91	8.61
SEm±	0.69	2.73	0.21	0.56	85.68	0.23
CD at 5%	2.09	8.23	0.63	1.70	258.24	0.69
CV %	NS	8.91	NS	NS	NS	NS

Table 2. Effect of different organic module and variety on quality attributes of coriander

Treatments	Chlorophyll content at 60 DAS	Chlorophyll content at 60 DAS	Grain colour	Grain aroma	Essential oil content
Organic modules					
M_1	12.34	8.52	8.00	8.25	0.41
M_2	9.79	6.87	6.25	6.12	0.35
M_3	10.72	7.41	7.00	7.00	0.37
SEm±	0.53	0.40	0.10	0.14	0.01
CD at 5%	1.58	1.22	0.29	0.43	0.03
Varieties	11.51	8.09	6.50	7.50	0.54
V_1	10.39	7.11	6.66	6.75	0.21
V_2	0.43	0.33	0.08	0.12	0.01
SEm±	NS	NS	0.24	0.35	0.02
CD at 5%					
M x V Interaction					
M_1V_1	10.15	8.25	8.50	8.75	0.59
M_1V_2	9.20	8.00	7.50	7.75	0.23
M_2V_1	9.10	7.32	6.50	6.25	0.50
M_2V_2	9.04	7.22	6.00	6.00	0.19
M_3V_1	8.95	7.07	7.50	7.50	0.53
M_3V_2	8.18	6.95	6.50	6.50	0.21
SEm±	0.74	0.57	0.14	0.20	0.01
CD at 5%	2.24	1.73	0.41	0.60	0.04
CV %	NS	NS	NS	NS	NS

Table 3. Effect of organic module and variety on net returns and B : C ratio

Treatments	Net return	B:C ratio
Organic module:		
M_1	107780.90	3.82
M_2	94530.72	3.48
M_3	84638.90	2.34
SEm±	8375.25	0.28
CD at 5%	25241.92	0.85
Variety:		
V1	97631.63	3.27
V2	93668.68	3.15
S.Em±	6838.37	0.23
CD at 5%	20609.94	0.70
M*V Interaction		
M_1V_1	110518.25	3.92
M_1V_2	105043.55	3.72
M_2V_1	95131.00	3.50
M_2V_2	93930.45	3.46
M_3V_1	87245.75	2.41
M_3V_2	82032.05	2.27
SEm±	11844.40	0.40
CD at 5%	35697.47	1.21
CV %	21.64	21.84

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