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RESEARCH ARTICLE :

Interaction effect of organic manures and fertilizers levels on growth and yield of coriander (*Coriander sativum* L.)

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SUMMARY : The experiment was carried out at during the *Rabi* season at Horticulture complex, Department of Horticulture, JNKVV, Jabalpur (M.P.) during the year 2012-2013. The experiments were laid out in Asymmetrical Factorial RCBD with three replications. To assess the effect of different organic manures (Poultry manure and Vermicompost) and inorganic fertilizer levels (50 % and 100 % RDF) on growth and yield of coriander (*coriandrum sativam*). Among the organic manures and fertilizer levels, variation for all characters were found to be significant. The maximum values were recorded with Poultry manure @ 5 t ha^{-1} and 100 % RDF repectively. Variation in treatment combinations due to interaction effect were non-significant (except for plant height at 30, 60 number of umbels per plant seed yield per plant) however, maximum values were recorded with Poultry manure @ 5 t ha^{-1} + 100 % RDF recorded the maximum seed yield (19.16 q per ha) of coriander variety JD-1. The maximum seed yield of 19.16 q ha^{-1} was recorded in coriander variety JD – 1 in treatment combination T_5 (Poultry manure @ 5 t ha^{-1} + 100 % RDF) along with cost benefit ratio 1:2.98. However, the minimum cost benefit ratio (1.95) was obtained in the treatment combination T_{12}(Vermicompost @ 2.5 t ha^{-1} + 50% RDF) due to higher expenditure and comparatively lower seed yield of 13.77 q ha^{-1} as compared to the other treatments.

KEY WORDS :
Coriander, Growth, Inorganic fertilizer, Organic manure, RDF, Seed yield

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BACKGROUND AND OBJECTIVES

Coriander is one of the important spice crop grown through out the world and botanically known as *Coriandrum sativum* Linn. It belongs to the family Apiaceae. Coriander is an annual herb and the name of coriander is derived from the Greek word 'koris' meaning "bad bug" because of the unpleasant odour of green and unripened fruits. Among the spices, it is known to mankind since time immemorial. Organic sources which are directly or indirectly helpful in providing the nutrients as well as increases the availability of nutrients to the plant from the soil and enhance the yield and quality of coriander without detrimental effects on

physiochemical properties of the soil. There is large number of organic manure such as FYM, town compost, horse manure, sewage sludge, press mud, goat and sheep manure, poultry manure, cattle manure and vermicompost along with the chemical fertilizers tend to reduce the total cost of cultivation and crops are also supplemented with the essential nutrients for growth and development of the plant. Organic manures like Poultry litter and Vermicompost are available in plenty in locality and can be effectively utilized for vegetable production. Since Poultry litter applied to agricultural lands serves as a source of macro nutrients such as N, and P for major crops (Nyakatawa and Reddy, 2002; Pederson *et al.*2002). Poultry litter also contains high concentrations of some trace elements such as Cu, Zn, and As (van der Watt *et al.*1994; Moore *et al.*1998). The high nitrogen and balanced nutrients is the reason that chicken manure compost is the best kind of manure to use.Vermicompost supply all the nutrients in readily available form, it also enhances uptake of nutrients by plants (Rai and Pandey, 2007). Vermicompost influences the physico-chemical and biological proportion of the soil, which, in turn improves its fertility. It is cost effective and renewable source of plant nutrients to supplements the chemical fertilizers. Therefore, present study was taken to develop a suitable nutrient management practice for coriander crop adopting organic farming.

RESOURCES AND METHODS

The present investigation was carried out during winter season of 2012-13 at Horticulture Research Farm, Department of Horticulture, JNKVV, Jabalpur (Madhya Pradesh).To study the influence of organic manure and inorganic fertilizer doses of nutrients on growth parameters and yield of coriander. Among the eight treatments (T_1- Poultry manure @ 5 t/ha +100% RDF, T_2- Poultry manure 5 t/ha+50 % RDF, T_3- Poultry manure @ 2.5 t/ha + 100 % RDF, T_4- Poultry manure @ 2.5 t/ha + 50 % RDF, T_5 -Vermicompost @ 5 t/ha+100% RDF, T_6- Vermicompost @ 5t/ha + 50 % RDF, T_7- Vermicompost @ 2.5 t/ha +100% RDF, T_8 – Vermicompost @ 2.5 t/ha+50% RDF) was laid out in asymmetrical factorial RCBD with three replications. Manually applications of organic sources viz., Poultry manure and Vermicompost were applied in required plots prior sowing of seeds and chemical fertilizers were applied at the time of sowing in furrows, nitrogen was applied through Urea, Phosphorus through SSP and Potash through Muriate of potash @ 50:30:60 kg/ha in plots of RDF @ 100% and 25:15:30 in plots of RDF @ 50% were also applied. Half amount of N with full amount of P and K were given per plot as basal dose and reaming amount of N was given as top dressing after 40 days of sowing. The coriander variety JD-1 was sown in furrows opened at 30 cm spacing. Standard agronomic and plant protection practices were adopted for raising healthy crop, data on growth and yield attributes were taken from ten tagged plants. Biological and economic yields were taken from net plot. Statistical analysis was performed as per methods suggested by Panse and Sukhatme (1985).

OBSERVATIONS AND ANALYSIS

The results obtained from the present study as well as discussions have been summarized under following heads :

Effect of organic manures and fertilizers growth parameters :

The nutrient supplementation through organic manures and fertilizer levels significantly increased various growth parameters *viz.*, plant height at various crop growth stages, number of primary branches per and secondary branches per plant. The height of coriander plant at 30, 60 and 90 DAS was influenced significantly by the use of various organic manures. Among the organic manures, Vermicompost @ 5 t ha^{-1} (14.55, 70.97 and 93.17 cm, respectively) recorded the maximum plant height followed by Poultry manure 5 @ t ha^{-1} (13.37, 70.30 and 91.92 cm, respectively). However, the minimum height was recorded with Poultry manure @ 2.5 t/ ha (11.34, 69.24 and 88.90 cm, respectively). Vermicompost @ 5 t ha^{-1} was significant over poultry manure. The result might be due to the high water-holding capacity of vermicompost @ and proper supply of macro- and micro-nutrients. Similarly (Edwards and Burrows, 1988; Atiyeh *et al.*, 2002; Arancon *et al.*, 2004) reported that vermicompost has a positive effect on biomass production which subsequently enhanced the plant height. The present findings are in conformity to Moslemi *et al.* (2012), Darzi *et al.* (2012) in anise and Asgharipour (2012) in cumin. Increase in plant height at 30, 60 and 90 DAS with regard to fertilizer levels was observed significant and the maximum height was found with 100 % RDF (14.26,70.94 and 93.44 cm, respectively) and

the minimum with 50 % RDF (11.86,69.06 and 88.49 cm, respectively). 100 % RDF was found to be significant over 50 % RDF. The present finding is in agreement with the findings of Singh and Jat (2002); Kumar *et al.* (2007); Nagar et al. (2009) and Khalid (2012.). The plant height measured at 30 DAS due to various treatments interactions was found to be significant but at 60 and 90 DAS was non significant. However, among treatment combinations, the maximum height was recorded with Vermicompost @ 5 t ha $^{-1}$ + 100 % RDF (15.98, 72.23 and 95.69 cm, respectively) followed by Poultry manure @ 5 t ha $^{-1}$ + 100 % RDF (14.78, 71.22 and 94.70 cm, respectively) the minimum height of plant was recorded with Poultry manure @ 2.5 t ha $^{-1}$ + 50 % RDF (10.20, 68.39 and 86.48 cm, respectively). The higher plant height achieved might be owing due to combined application of major and minor nutrients, through different organic and inorganic fertilizers levels which resulted in fast cell division, multiplication and cell elongation in meristematic region of the plant. Due to the production of plant growth substances and other growth promoting substances by Vermicompost applications the metabolic process of the plant gets stimulated (including increased uptake of nutrients through insoluble nutrient like P gets converted in to soluble nutrients by the activation of desirable enzymes. The present finding is in conformity to Singh (2011). Number of primary and secondary branches per plant of coriander plants were influenced significantly with regard to organic manures. It was observed that among the organic manures, the maximum number of primary and secondary branches was recorded by the application of Vermicompost @ 5 t ha $^{-1}$ (9.07 and 21.86, respectively) followed by Poultry manure 5 t ha $^{-1}$ (8.63 and 20.17, respectively). While, the lowest number of primary and secondary branches were recorded with Poultry manure @ 2.5 t ha $^{-1}$ (8.25 and 18.52 espectively). The effect of fertilizer levels on number of primary and secondary branches was observed to be significant. The maximum number of primary and secondary branches were found in the treatment of plants with 100 % RDF (9.017 and 21.59) and the minimum in 50 % RDF (8.192 and 18.39). 100 % RDF was found to be significant over

Table 1 : Effect of organic manures and fertilizers on plant height (cm) of coriander at 30, 60 and 90 DAS

Organic manures	Plant height (cm) 30 DAS			Plant height (cm) 60 DAS			Plant height (cm) 90 DAS		
	RDF 100%	RDF 50%	Mean	RDF 100%	RDF 50%	Mean	RDF 100 %	RDF 50 %	Mean
Poultry manure @5 t/ha	14.78	11.96	13.37	71.22	69.48	70.30	94.70	89.16	91.92
Poultry manure @ 2.5 t/ha	12.48	10.20	11.34	70.09	68.39	69.24	91.32	86.48	88.90
Vermicompost @ 5 t/ ha	15.98	13.12	14.55	72.23	69.72	70.97	95.69	90.64	93.17
Vermicompost @ 2.5 t/ha	13.81	12.14	12.97	70.13	68.64	69.38	92.05	87.68	89.87
Mean	14.26	11.86		70.94	69.06		93.44	88.49	
	OM	RDF	OM×RDF	OM	RDF	OM×RDF	OM	RDF	OM×RDF
S.E. ±	0.15	0.11	0.21	0.19	0.14	-	0.23	0.17	-
C.D. (P=0.05)	0.457	0.323	958	0.586	0.414	NS	0.711	0.503	NS

NS=Non-significant

Table 2 : Effect of organic manures and fertilizers on number of primary and secondary branches per plant of coriander

Organic manures	Number of primary branches/plant			Number of secondary branches /plant		
	RDF 100 %	RDF 50 %	Mean	RDF 100 %	RDF 50 %	Mean
Poultry manure @ 5 t/ha	9.13	8.13	8.63	21.80	18.53	20.17
Poultry manure @ 2.5 t/ha	8.53	7.97	8.25	19.57	17.43	18.52
Vermicompost @ 5 t/ ha	9.67	8.47	9.07	23.60	20.13	21.86
Vermicompost 2.5@ t/ha	8.73	8.20	8.47	21.40	17.47	19.42
Mean	9.017	8.192		21.59	18.39	
	OM	RDF	OM × RDF	OM	RDF	OM × RDF
S.E. ±	0.091	0.065	-	0.22	0.16	-
C.D. (P=0.05)	0.277	0.196	NS	0.669	0.473	NS

NS=Non-significant

50 % RDF. The present finding is in conformity to Singh and Jat (2002); Channabasavanna *et al.* (2002); Kumar *et al.* (2007); Nayak *et al.* (2009) and Khalid (2012). Variation in the number of primary and secondary branches per plant was non significant with regard to interaction effects. However, Vermicompost @ 5 t ha $^{-1}$ + 100 % RDF (9.67 and 23.60) recorded the maximum number of primary and secondary branches followed by Poultry manure @ 5 t ha $^{-1}$ + 100 % RDF (9.13 and 21.80). However, the minimum number of primary and secondary branches were found with the application of Poultry manure @ 2.5 t ha $^{-1}$ + 50% RDF (7.97 and 17.43). These results corroborated the results of Singh (2011). Probable reason for increased number of branches might be due to the increased rates of photosynthesis and photosynthates. This character is also found to be related with endogenous hormonal level and apical dominance in the plant. The findings are in close harmony with the results of Singh and Prasad (2006).

Effect of organic manures and fertilizers on the phonological characters of coriander :

A Day to first flowering and for 50 % flowering was significantly influenced by the use of various organic manures. Early first flowering and 50 % flowering was observed in Vermicompost 2.5@ t/ha (52 and 59.83 days) comparitively delayed flowering was observed in Poultry manure @ 5 t ha $^{-1}$ (55 and 64 days). With regard to fertilizer levels, variation in days taken to first flowering and 50 % flowering was observed to be significant. Early first flowering and 50 % flowering was observed in 50 % RDF (52 and60.42) and delayed flowering in 100 % RDF (55.17 and 63.67). Further it was observed that variation in days taken to first flowering and 50 % flowering by various treatment combinations was non significant though early first flowering and 50 % flowering was observed in Vermicompost 2.5@ t/ha+ 50% RDF (50.67 and 58.33) followed by Vermicompost @ 5 t/ ha (51.33 and 59.33) while, late flowering was observed with Poultry manure @ 5 t ha $^{-1}$ +100 % RDF (56.67 and 65.33). The variation in number of days to flowering might be due to the fact that nitrogen in plants increased

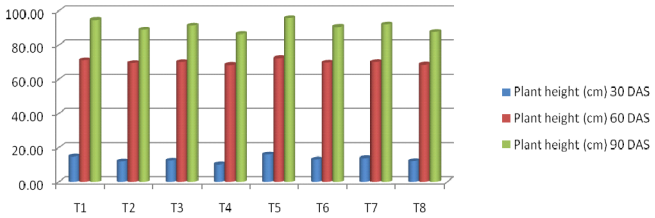

Fig. 1 : Bar graph for plant height at 30, 60 and 90 DAS

Table 3 : Response of organic manures and fertilizers days taken to first and 50 % flowering of coriander

Organic manures	Days taken to first flowering			Days taken to 50 % flowering		
	RDF 100 %	RDF 50 %	Mean	RDF 100 %	RDF 50 %	Mean
Poultry manure @ 5 t/ha	56.67	53.33	55.00	65.33	62.67	64.00
Poultry manure @ 2.5 t/ha	56.33	52.67	54.67	64.33	61.33	62.83
Vermicompost @ 5 t/ ha	54.33	51.33	52.83	63.67	59.33	61.50
Vermicompost 2.5@ t/ha	53.33	50.67	52.00	61.33	58.33	59.83
Mean	55.17	52.00		63.67	60.42	
	OM	RDF	OM × RDF	OM	RDF	OM × RDF
S.E. ±	0.21	0.15	-	0.24	0.17	-
C.D. (P=0.05)	0.641	0.453	NS	0.721	0.510	NS

NS=Non-significant

Table 4 : Effect of organic manures and fertilizer on number of umbels per plant and seed yield per plant (g) of coriander

Organic manures	Number of umbels per plant			Seed yield per plant (g)		
	RDF 100 %	RDF 50 %	Mean	RDF 100 %	RDF 50 %	Mean
Poultry manure @ 5 t/ha	36.27	31.07	33.67	7.14	5.04	6.09
Poultry manure @ 2.5 t/ha	33.33	30.73	32.03	6.27	4.13	5.20
Vermicompost @ 5 t/ ha	34.13	30.53	32.33	6.72	4.34	5.53
Vermicompost 2.5@ t/ha	32.07	29.77	30.92	5.23	3.88	4.56
Mean	33.95	30.53		5.341	3.343	
	OM	RDF	OM × RDF	OM	RDF	OM × RDF
S.E. ±	0.28	0.20	0.39	0.108	0.077	0.153
C.D. (P=0.05)	0.840	0.594	1.761	0.328	0.232	0.689

cell division and cell differentiation. Thus, plant remains in vegetative phase and results in imbalance between C: N ration there by leading to delayed flowering at higher nitrogen levels. The findings are in agreement with findings of Verma *et al.* (1991); Data Ram and Verma (2000) and Subramanian and Vijayakumar (2001) in fenugreek.

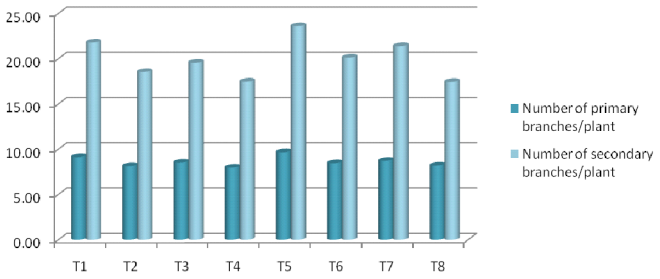

Fig. 2 : Bar graph for number of primary and secondary branches per plant of coriander

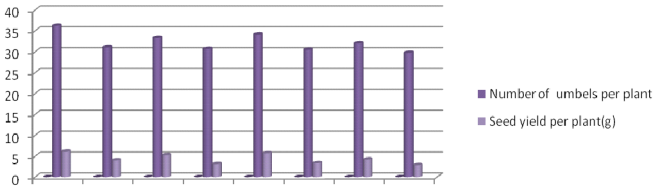

Fig. 3 : Bar graph for number of umbels per plant and seed yield per plant (g) of coriander

Effect of organic manures and fertilizers on yield and yield parameters :

The application of organic manures significantly improves the various yield parameters and consequently yield *viz*., number of umbels per plant, seed yield per plant (g), seed yield per plot (kg) and seed yield per hectare (q) of coriander. Number of umbels per plant of coriander were significantly affected by various organic manures. Among the organic manures, Poultry manure @ 5 t ha $^{-1}$ (33.67) produced the maximum number of umbels per plant followed by Vermicompost @ 5 t ha $^{-1}$ (32.33). The least number of umbels per plant was recorded in. vermicompost 2.5@ t/ha (30.92).The present findings are in accordance with Ibrahim *et al.* (2006) and El- Mekawey *et al.* (2010).

Number of umbels per plant were significantly influenced with regard to fertilizer levels. The maximum number of umbels per plant were observed in the application of 100 % RDF (33.95) and the minimum in the application of 50 % RDF (30.53). The present findings are in accordance with Singh and Jat (2002) ; Okut and Ydrm (2005); Kumar *et al.* (2007) Nagar *et al.* (2009 a&b); Nayak *et al.* (2009); Jan *et al.* (2011) and Khalid (2012). In case of interaction effects, number of umbels per plant was significantly influenced by the treatment combinations. The maximum number of umbels per plant were recorded with the application of poultry manure @ 5 t ha $^{-1}$ + 100 % RDF (36.27) followed by vermicompost @ 5 t ha $^{-1}$ + 100 % RDF. 34.13.The least number of umbels per plant were recorded in Vermicompost 2.5 t ha $^{-1}$ + 50% RDF (29.77).The present findings corroborated the results of Choudhary *et al* (2011) for number of pods per plant in fenugreek. The increase in number umbels per plant might be due to increased supply of major plant nutrients that are required in larger quantities for growth and development of plants. Nitrogen accelerates the growth, development reproductive phases and protein synthesis in plants, thereby promoting higher number of umbels per plant. Seed yield per plant (g) was influenced significantly by the use of various organic manures. Among the organic manures, poultry manure @ 5 t ha $^{-1}$ (6.09)produced the maximum seed yield per plant followed by vermicompost @ 5 t ha $^{-1}$ (5.53). Whereas, the minimum seed yield per plant was recorded in Vermicompost 2.5 t ha $^{-1}$ + 50% (4.56)The present findings are in accordance with El- Mekawey *et al.*

Table 5 : Effect of various levels of organic manures and fertilizers on seed yield per plot (kg) and seed yield per hectare (q) of coriander

Organic manures	Seed yield per plot (kg)			Seed yield per hectare (q)		
	RDF 100 %	RDF 50 %	Mean	RDF 100 %	RDF 50 %	Mean
Poultry manure @ 5 t/ha	2.04	1.65	1.85	19.16	15.43	17.30
Poultry manure @ 2.5 t/ha	1.82	1.52	1.67	17.08	14.20	15.64
Vermicompost @ 5 t/ ha	1.98	1.67	1.82	18.53	15.61	17.07
Vermicompost 2.5@ t/ha	1.75	1.47	1.61	16.43	13.77	15.10
Mean	1.9	1.574		17.80	14.76	
	OM	RDF	OM × RDF	OM	RDF	OM × RDF
S.E. ±	0.021	0.015	-	0.018	0.013	-
C.D. (P=0.05)	0.030	0.021	NS	0.56	0.39	NS

NS=Non-significant

(2010). Seeds yield per plant (g) was significantly influenced by fertilizer levels. The highest seed yield per plant were recorded in 100 % RDF (5.341) and mimimum in 50 % RDF. (3.343). The present findings are in accordance with Manure *et al.* (2000) ; Kumar *et al.* (2007); Nayak *et al.* (2009) and Khalid (2012).The interaction effect on seed yield per plant (g) was found significant. In case of interaction, the maximum seed yield per plant (g) was recorded in poultry manure @ 5 t ha $^{-1}$ + 100 % RDF (7.14) followed by vermicompost @ 5 t ha $^{-1}$ + 100 % RDF(6.72) and the minimum seed yield per plant was recorded in FYM @ 10 t ha $^{-1}$ + 50% RDF. However, critical difference between poultry manure @ 5 t ha $^{-1}$+ 100 % RDF and vermicompost @ 5 t ha $^{-1}$ + 100 % RDF was found at par. Seed yield per plot (kg) and seed yield per hectare (q) was influenced significantly by the use of various organic manures. It was observed that among the organic manures, poultry manure @ 5 t ha $^{-1}$ produced the maximum seed yield per plot (1.85kg) and seed yield per hectare (17.30q ha^{-1}) followed by vermicompost @ 5 t ha $^{-1}$. (1.82 kg) and (17.07 q ha^{-1})

The least seed yield per plot (kg) and seed yield (q ha^{-1}) was noted in Vermicompost 2.5@ t/ha (1.161) and (15.10) However, difference in between poultry manure and vermicompost was non significant and which was at par. Variation in seed yield per plot (kg) and seed yield per hectare(q) was significantly influenced with regard to fertilizer levels. The maximum seed yield was found in 100 % RDF 1.9 and 17.8 and the minimum in RDF 50 % (1.54 and 14.76). Similar results are reported by Manure *et al.* (2000); Naghera *et al.* (2000); Singh *et al.* (2000); Singh and Jat (2002); Channabasavanna (2002); Kumar *et al.* (2002); Garg *et al.* (2004); Gujar *et al.* (2005); Tripathi (2006 a&b); Akbarinia *et al.* (2006); Oliveira *et al.* (2006) Kumar *et al.* (2008) and Nagar *et al.* (2009). Based on the interaction effects on the maximum seed yield per plot (kg) and seed yield (q) were recorded with poultry manure @ 5 t ha $^{-1}$ + 100 % RDF(2.04 and 19.16 followed by vermicompost @ 5 t ha $^{-1}$ + 100 % RDF. 1.98 and 18.53 While the minimum seed yield per plot (kg) and seed yield per hectare (q) was recorded in Vermicompost 2.5@ t/ha + 50% RDF. (1.47 and 13.77). However, difference in between poultry manure 5 t ha $^{-1}$ and vermicompost @ 5 t ha $^{-1}$ was not found to be significant and values were at par. Similar results have also been reported by Mohamed and Abdu (2004); Sadanandan and Hamza (2006) in black pepper. Aishwath *et al.* (2010); Choudhary *et al.* (2011) in fenugreek and Jan *et al.* (2011). The probable reason for enhanced seed yield might be due to cumulative effects of nutrient (macro and micro) on vegetative growth which ultimately led to more photosynthetic activities while, application of organic, inorganic and bio-fertilizers enhance carbohydrate and nitrogen metabolism of pectic substances, as well as improve the water metabolism and water relation in the plants.

Economics of various treatments :

The economics of crop production is a very important part of cultivation of any crop. The cost of cultivation was directly associated with various inputs *viz*. cost of chemical fertilizers, FYM, poultry manure and vermicompost. Gross income was found directly associated with the seed yield under various treatments. The maximum seed yield of 19.16 q ha^{-1} was recorded in coriander variety JD – 1 in treatment combination T_5 (Poultry manure @ 5 t ha $^{-1}$ + 100 % RDF) along with cost benefit ratio 1 :2.98.However, the minimum cost benefit ratio (1.95) was obtained in the treatment combination T_{12} (Vermicompost @ 2.5 t ha $^{-1}$ + 50% RDF) due to higher expenditure and comparatively lower seed yield of 13.77 q ha^{-1} as compared to the other treatments.

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