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Comparative study of conventional and organic farming of coriander (*Coriandrum sativum*) -radish (*Raphanus sativus*) cropping sequence

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Abstract

An experiment was conducted to compare performance of organic and conventional management practices in coriander (*Coriandrum sativum* L.) and radish (*Raphanus sativus* L.) cropping system at Rajasthan Agricultural Research Institute, Durgapura, Jaipur, Rajasthan during 2017–18, 2018-19 and 2019–20. The conventional practices comprising integrated use of organic amendments, nutrients through chemical fertilizers and plant-protection chemicals were compared with organic management practices which comprised nutrient and pest management through organic amendments and practices. Experiment consisted of 7 treatments laid out in randomized block design. Pooled analysis revealed that, safe production practices (recommended FYM + fertilizer + plant protection with organic methods) + IIHR microbial consortium @ 12.5 kg/ha (T_7) resulted in significantly higher coriander fresh green leaves yield (94.03 q/ha) and radish root yield (237.61 q/ha). It was followed by conventional practices (recommended FYM + fertilizer + plant protection with chemicals) + IIHR microbial consortium @ 12.5 kg/ha (T_4) in coriander, while T_6 (FYM equivalent to 100 % N recommended for each of the crop + IIHR microbial consortium @ 12.5 kg/ha (plant protection with organic methods) in case of radish. Return per rupee invested (4.00) and net return (₹.2.55 lakh/ha.) in the sequence were also maximum with treatment T_7.

Key words: Cropping sequence, Microbial consortium, Organic, Radish-coriander, Vermicompost

Radish (*Raphanus Sativus* L.) is an important vegetable crop. It is consumed as raw or as a salad. It is rich in calcium, potash, phosphorus and Vitamin C. Coriander (*Coriandrum sativum* L.), a member of the family Apiaceae, is one of the important spice crops grown throughout the world. It is an annual herb. Its plant characterization is based on morphological, chemical, biochemical and molecular traits. Morphological characterization of a variety is based on morphological traits such as plant growth, stem, leaves, flower seed, etc (Kumar *et al.*, 2022). It is mainly grown in Rajasthan, Gujarat, Madhya Pradesh, Tamilnadu and Uttar Pradesh. Coriander is an important seed spice crop of Rajasthan which is mostly grown in Kota, Bundi, Jhalawar and Baran.

The productivity of radish and coriander in India is very less which may be due to unavailability of quality water in arid and semi-arid regions. It is influenced by several factors such as soil, varieties, fertilizer management and various agro-techniques used for growing crop. Nutrients play a vital role in functioning of normal physiological processes during growth and development of plants. However, for obtaining higher economic yield, balanced supply of nutrients is one of the key factors (Kumar *et al.,* 2015). Ahlawat and Gangaiah (2010) reported higher system productivity in chickpea intercropped with linseed over sole chickpea. Mustard and chickpea intercropping have exhibited higher land equivalent ratio (1.41) over in sole crops (Thomas *et al.,* 2010). Shortages of vegetables in the country have focused the attention on intercropping systems which have capacity to improve the physical, biological and chemical properties of soil (Mehta *et al.* 2010). Thus, productivity of system can be enhanced with change in crop configuration for inclusion of other crops in the existing cropping system. Organic farming is the old method of farming, which maintains the natural potential of the land. With organic farming, the environment remains pure, water holding capacity of the soil increases. It is bulky in nature and containing small quantity of nutrients which are required in large quantities; however it also contains trace or micronutrients (Yawalkar *et al.,* 2002) in sufficient amount, the deficiency of which cannot be supplemented by others. Since vermicomposting supply all the nutrients in readily available form, it enhances uptake of nutrients by plants (Rai and Pandey, 2007). Vermicomposting influences the physio-chemical and biological properties of the soil, which, in turn improves the fertility. It is cost effective and renewable source of plant nutrients to supplement the chemical fertilizers. Biofertilizers in combination with organic manures found as effective component in organic farming for reliable and cheap supply of nutrients. These combinations were

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ecologically safe and improve soil fertility by improving the soil physical, chemical and biological condition. Microbial consortium is a carrier based microbial product that contains N fixing, P and Zn solubilizing and plant growth promoting microbes in single carrier. Azospirillum is a micro-europhilic nitrogen fixer. Keeping in view, comparative study of conventional and organic farming of coriander-radish cropping sequence was carried out.

MATERIALS AND METHODS

The field experiment was conducted at Rajasthan Agricultural Research Institute (SKN Agriculture University), Durgapura, Jaipur, Rajasthan, during winter (*rabi*) seasons of 2017–18, 2018-19 and 2019–20. The randomized block design with seven treatments and three replications was used. There were 21plots each of 10 m x 0.75 m size. The variety Mahak of coriander and Ivory White of radish were used. The sowing of seeds was done on 22, 20 and 24 November of 2017, 2018 and 2019 respectively. All recommended package of practices were followed. The treatment combinations were T_1: conventional practices (recommended FYM + fertilizer + plant-protection chemicals), T_2: vermicompost equivalent to 100% N recommended for each of the crop + plant protection with organic methods, T_3:FYM equivalent to 100% N recommended for each of the crop + plant protection with organic methods, T_4: conventional practices (recommended FYM + fertilizer + plant-protection chemicals) + IIHR microbial consortium @ 12.5 kg/ha, T_5:vermicompost equivalent to 100 % N recommended for each of the crop+ IIHR microbial consortium @ 12.5 kg/ha (plant protection with organic methods), T_6:FYM equivalent to 100%N recommended for each of the crop + IIHR microbial consortium @ 12.5 kg/ha (plant protection with organic methods) and T_7: safe production practices (recommended FYM + fertilizer + plant protection with organic methods) + IIHR microbial consortium @ 12.5 kg/ha. The five plants from each plot were selected randomly. The observations were taken on their yield attributes. The observations were analyzed by using standard statistical techniques (Panse and Sukhatme, 1985). On the basis of total variable cost and gross returns, net returns and B:C ratio were calculated as per Devasenapathy *et al.* (2008). The critical difference at 5% probability level was also calculated to draw the valid conclusion.

The soil was sandy loam, having pH of 8.0-8.2, low in organic carbon (0.18%), available N (156.0 kg/ha), medium in phosphorus (26.02 kg/ha) and potassium (184.0 kg/ha). The available N, P and K contents in vermicompost were 1.46, 0.45 and 1.38% and in FYM, these were 0.46,0.25 and 0.53% respectively. Coriander crop was grownfor fresh green leaves. Organic manures and IIHR microbial consortium were applied at the time of field preparation of coriander as per treatment. Microbial consortium contained nitrogen fixing, phosphorus and zinc solubilizing and plant growth-promoting microbes in single formation and is used to increase the nutrient-use efficiency as well as yield.

Results and Discussion

Yield parameters

The results revealed that fresh green leaves yield of coriander was influenced significantly by different treatments during all the three years (Table 1). Application of safe production practices (recommended dose of FYM+ fertilizer + plant protection with organic methods) + IIHR microbial consortium @ 12.5 kg/ha (T_7) resulted in significantly highest yield of fresh green leaves of 94.03 q/ha. It was followed by conventional practices (recommended + fertilizer + plant-protection chemicals) +IIHR microbial consortium @ 12.5 kg/ha (T_4) with production of 79.07 q/ha. While FYM equivalent to 100%N recommended for each of the crop + IIHR microbial consortium @ 12.5 kg/ha plant protection with organic methods (T_6) and vermicompost equivalent to 100% N recommended for each of the crop + consortium @12.5 kg / ha plant protection with organic methods (T_5) gave the yield of 71.58 q/ha and 66.39 q/ha respectively. The increase in yield was highest(28.92q/ha) or 44.42 % in treatment T_7, whereas lowest (0.96q/ha) or 1.47 % in T_5.The yield of coriander leaves reduced inT_2 and T_3. Yield was increasedin safe production practices (recommended dose of FYM+ fertilizer + plant protection with organic methods) + IIHR microbial consortium @ 12.5 kg/ha (T_7) as compared to conventional practices. It might be attributed to the availability of nutrients for crop use (Meena *et al.*, 2013). Organic manures are not only the good source of major and micronutrients but also improve physico-chemical properties of soil (Reust and Neyround, 2003). These results corroborate with the findings of Narayan *et al.* (2014).

Different treatments significantly influenced the radish yield. Application of safe production practices (recommended FYM+ fertilizer + plant protection with organic methods) + IIHR microbial consortium @ 12.5 kg/ha (T_7) proved better for yield (237.37q/ha)among all the treatments followed by treatment T_6 (FYM equivalent to 100%N recommended for each of the crop + IIHR microbial consortium @ 12.5 kg/ha (plant protection with organic methods) and treatment T_4 (conventional practices (recommended FYM+ fertilizer + plant protection with chemicals) + IIHR microbial consortium @ 12.5 kg/ha.)

Table1. Effect of management practices on coriander green leaves yield (pooled data over 3 years)

Treatment	Details	Yield (q/ ha)	Increase/decrease in yield from conventional practices	
			(q/ha)	(%)
T_1	Conventional practices (FYM+ Fertilizer +P.P.	65.11	-	-
T_2	Vermicompost + P.P. with organic method	54.56	(-) 10.55	(-) 16.20
T_3	FYM + P.P. with organic method	55.89	(-) 9.22	(-) 14.16
T_4	Conventional practices (FYM + fertilizer +P.P. chemicals+ IIHR microbial consortium @12.5 kg / ha	79.07	(+) 13.96	(+) 21.44
T_5	Vermicompost + consortium @12.5 kg / ha P.P. with organic method	66.39	(+) 0.96	(+) 1.47
T_6	FYM + IIHR microbial consortium @12.5 kg / ha P.P. with organic matter	71.58	(+) 6.45	(+) 9.91
T_7	Safe production practices (FYM +Fertilizer+ P.P. with organic method + IIHR microbial consortium @12.5 kg	94.03	(+) 28.92	(+) 44.42
	SEm (±)	**2.26**	-	-
	CD at (5 %)	**6.86**	-	-
	CV(%)	**5.90**	**-**	**-**

with the yield of 221.39 q/ha and 214.80 q/ha respectively (Table 2). Kumar *et al.* (2014) also found that adding vermicomposting with poultry manure significantly increased growth parameters, yield characteristics and yield in radish *cv.* Japanese White. Jadhav *et al.* (2014) found that vermicompost and microbial consortia enhances the growth and yield of radish. Application of safe production practices (recommended FYM+ fertilizer + plant protection with organic methods) + IIHR microbial consortium @ 12.5 kg/ha (T_7) resulted in higher yield. This might be owing to increased availability of nutrients to plants. Yadav *et al.* (2017) observed that inoculation of biofertilizers resulted in higher weight of tubers/plant over without inoculated treatment with same level of organic manure in potato. Kumar *et al.* (2013) also reported similar results in rainfed potato.

Economics

The treatment T_4: conventional practices (recommended FYM+ fertilizer + plant-protection chemicals) required highest cultivation cost(₹ 0.71 lakh/ ha) compared to other treatments. It might be attributed to higher cost of FYM and NPK fertilizers. Among other treatments,application of vermicompost + IIHR microbial consortium required higher cost perhaps because of vermicompost cost(Table 3, Fig. 1). The similar findings were also reported by Narayan *et al.* (2014) in respect to cost of cultivation being higher in FYM or vermicompost application in potato cultivation. The net returns (₹ 2.55 lakh/ha) and B:C ratio (4.0) were significantly higher with treatment T_7 (safe production practices (recommended FYM + fertilizer + plant protection with organic methods) + IIHR microbial consortium @ 12.5 kg/ha),followed by

Table2. Effect of management practices on radish yield (pooled data over 3 years)

Treatment	Details	Yield (q/ ha)	Increase/decrease in yield from conventional practices	
			(q/ha)	(%)
T_1	Conventional practices (FYM+ Fertilizer +P.P.	180.27	-	-
T_2	Vermicompost + P.P. with organic method	174.77	(-) 5.50	(-) 3.05
T_3	FYM + P.P with organic method	164.96	(-) 15.31	(-) 8.49
T_4	Conventional practices (FYM+ Fertilizer +P.P. chemicals+ IIHR microbial consortium @12.5 kg /ha	214.80	(+) 34.53	(+) 19.16
T_5	Vermicompost + consortium @12.5 kg / ha P.P. with organic method.	195.67	(+) 15.40	(+) 8.54
T_6	FYM + IIHR microbial consortium @12.5 kg / ha P.P. with organic matter	221.39	(+) 6.45	(+) 3.58
T_7	Safe production practices (FYM +Fertilizer + P.P. with organic method + IIHR microbial consortium @12.5 kg	237.61	(+) 41.12	(+) 22.81
	SEm (±)	**3.84**	-	-
	CD at (5 %)	**11.64**	-	-
	CV(%)	**3.44**	**-**	**-**

treatment T_4 (conventional practices (recommended FYM+ fertilizer + plant-protection chemicals) + IIHR microbial consortium @ 12.5 kg/ha) . Application of FYM + IIHRmicrobial consortium resulted in lower net returns than vermicompost + IIHR microbial consortium. It showed the superiority of vermicompost to FYM among organics. Net return is the resultant of gross income and cost of cultivation where gross income dominated over cultivation cost in present study. Return per rupee invested and per day return (PDR) were also remarkably higher with vermicompost + IIHR microbial consortium than other treatments. It might be owing to higher gross income in vermicompost + IIHR microbial consortium. These results are in close agreement to those of Sarkar *et al.* (2011) and Narayan *et al.* (2014).

CONCLUSION

It can be concluded that, application of safe production practices (recommended FYM + fertilizer+ plant protection with organic methods) + IIHR microbial consortium @ 12.5 kg/ha for each of the crop are profitable alternatives of conventional practices in coriander *cv.*Mahak and radish *cv.* Ivory White system for agroclimatic condition of Rajasthan. It alsoensures the sustainability in production and soil health along with pollution free environment.

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Table 3. Economic analysis for organic farming in coriander – radish sequence (2017–18, 2018-19 and 2019–20)

Treatment	Details	Cost of Cultivation (₹ lakh/ha)	Gross income (₹)	Net income (₹)	B.C. ratio
T_1	Conventional practices (FYM+ fertilizer +P.P.	0.50	1.81	1.31	2.6
T_2	Vermicompost + P.P. with organic method	0.54	2.09	1.55	2.8
T_3	FYM + P.P. with organic method	0.55	1.95	1.40	2.5
T_4	Conventional practices (FYM + fertilizer +P.P. chemicals+ IIHR microbial consortium @12.5 kg / ha	0.71	2.97	2.26	3.1
T_5	Vermicompost + consortium @12.5 kg / ha P.P. with organic method	0.56	2.23	1.67	3.0
T_6	FYM + IIHR microbial consortium @12.5 kg / ha P.P. with organic matter	0.61	2.44	1.83	2.9
T_7	Safe production practices (FYM + fertilizer+ P.P.with organic method + IIHR microbial consortium @12.5 kg	0.63	3.18	2.55	4.0

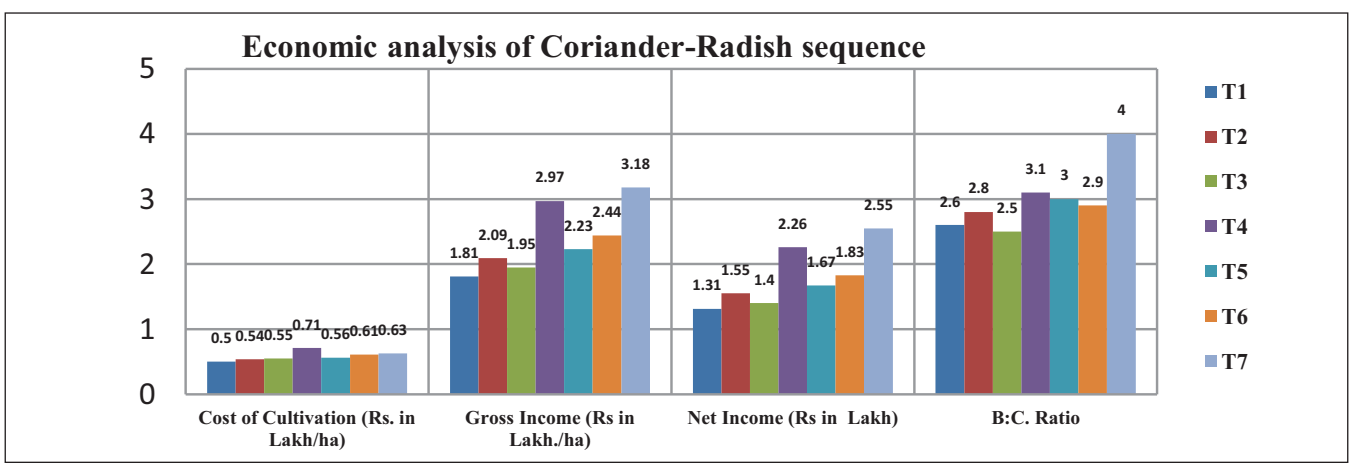

Fig. 1: Economic analysis of Coriander-Radish sequence

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