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Effect of different inter cropping systems on nutrient uptake, yield and profitability in coriander (*Coriandrum sativum* L.) production

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Abstract

A field experiment comprising 10 treatments viz., sole coriander, sole french radish, sole knolkhol, sole fenugreek, coriander intercropping with french radish, knolkhol and fenugreek in 1:1 and 2:2 row ratio was conducted in Randomized Block Design with four replications during *rabi* season, 2016-17 at research farm of ICAR-NRCSS, Ajmer. Intercropping of coriander with french radish in 1:1 row ratio resulted significantly higher land equivalent ratio (1.83), coriander equivalent yield (4272 kg/ha), gross return (Rs.341728/- ha), net return (Rs.283228/- ha) and BCR (4.84) followed by intercropping of coriander with french radish in 2:2 paired row ratio. Inclusion of legumes in intercropping system has impacted residual availability of nutrients after harvesting of coriander. Intercropping of coriander with fenugreek in 1:1 and 2:2 recorded significantly higher residual availability of N, P, and K after harvesting of crop. Thus, it is inferred that intercropping of coriander with french radish in 1:1 row ratio is better for realizing higher yield and profitability but residual availability of N, P and K after harvesting of crop can be realized in inter cropping of coriander with fenugreek in 1:1 ratio

Keywords: Coriander, intercropping, NPK fertilizer, net returns, LER, yield

Introduction

Coriander (*Coriander sativum*) generally called as ‘‘Dhania’’ belongs to the Apiaceae family. 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. Area, production and productivity of coriander in Rajasthan is 2.48 lakh hectares, 1.98 lakh M tonnes and 680 kg/ha, respectively (Anon - 2015). Ahlawat and Gangaiah (2010) [1] 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) [8]. 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) [5]. Thus, productivity of system can be enhanced with change in crop configuration for inclusion of other crops in the existing cropping system. Hence the study on effect of coriander based inter-cropping system with vegetable crops was undertaken with an objective to find most efficient inter cropping system for realizing higher system productivity and improving residual nutrient availability in the soil.

Material and Methods

The experiment was laid out at Research farm of ICAR-National Research Center on Seed Spices, Ajmer, Rajasthan, during ‘Rabi’ season of 2016-17. The soil of research farm is sandy loam, poor in fertility and water holding capacity, having pH 8.3, and organic carbon 0.23%, available N 68.49 kg/ha, P₂O₅ 7.05 kg/ha, K₂O 230.16 kg/ha. The experiment comprising of 10 treatments viz., sole coriander, sole French radish, sole knolkhol, sole fenugreek, coriander intercropping with French radish, knolkhol and fenugreek in 1:1 and 2:2 row ratio was laid in randomized block design with four replications. As per technical programme one row of radish, knolkhol and fenugreek was added between two rows of coriander in 1:1 intercropping ratio and two rows of vegetable crops were added in a pair of two rows of coriander (paired row having 25/35 cm). A uniform recommended dose of 60 Kg N and 40 kg P₂O₅ ha⁻¹ and 30 kg K₂O for sole coriander, 120 kg N, 60kg P₂O₅ and 40 kg K₂O for sole knolkhol, 100 kg N, 50 kg P₂O₅ and 40 kg K₂O for french radish and 20 kg N, 40 kg P₂O₅ and 30 kg K₂O for fenugreek was applied. In intercropping of coriander and vegetables 100% NPK requirement

of sole coriander and 50% NPK requirement of respective vegetables were applied. 1/3 N and full dose of phosphorus and potash were applied at the time of sowing and remaining 2/3 N was applied with low pressure drip irrigation through urea at an interval of 8 days. The standard agronomic practices were applied for raising healthy coriander crop as well as French radish, knolkhol and fenugreek. Immediately after sowing irrigation was provided with low pressure drip irrigation having normal operating pressure of 0.1 kg sq cm⁻¹. Available residual N in soil was determined by alkaline potassium permanganate method (Jackson, 1973) [4], available P₂O₅ by Olsen *et al.* (1954) [6] and available potassium by flame photometric method (Jackson, 1973) [4]. The yield of coriander, french radish, knolkhol and fenugreek was converted into coriander equivalent yield as per prevailing rates in market and treatment evaluation was done accordingly. Economic analysis of the different treatment was done for drawing conclusion.

Results and Discussion

Effect of intercropping system on residual NPK availability in soil after harvesting of crop

Different intercropping system significantly influenced the N, P and K availability in soil after harvesting of crops. Available N, P and K after harvesting of crops is less in all treatments as compared to initial value. Among different intercropping system available N, P and K after harvesting is more in intercropping of coriander with fenugreek in both 1:1 and 2:2 ratio followed by intercropping of coriander with knolkhol in both the ratio. Available N, P and K in all sole crops is higher compared to intercropping with respective vegetable crops. In comparison to respective sole crops, N, P and K availability after harvesting is less under different intercropping system which might be due to more extraction and utilization of these nutrients combinedly by coriander and respective intercrops. Among intercropping systems, higher N, P and K availability in intercropping of coriander with fenugreek in both 1:1 row ratio and 2:2 paired row ratio might be due to more nitrogen fixation in nodules of fenugreek

which after utilizing by fenugreek and coriander, remain soil. Similar result has also been reported by Tanwar *et al.* (2011) [7].

Table 1: Effect of intercropping system on availability of residual NPK in soil after harvesting of crop

Treatments	Available N	Available P ₂ O ₅	Available K ₂ O
Sole Coriander	90.00	6.72	267.65
Sole French radish	89.98	6.65	256.28
Sole Knolkhol	89.61	6.59	251.47
Sole Fenugreek	92.51	6.81	273.03
Coriander + French radish 1:1	89.56	6.63	252.50
Coriander + French radish 2:2	89.38	6.61	250.90
Coriander + Knolkhol 1:1	88.51	6.58	246.20
Coriander + Knolkhol 2:2	88.44	6.56	243.66
Coriander + Fenugreek 1:1	90.47	6.75	268.60
Coriander + Fenugreek 2:2	90.36	6.72	267.85
Initial value	100.57	7.60	354.74
SEm + ₋	3.32	0.33	8.59
CD (P=0.05)	9.62	0.94	24.92

Yield of main crop and intercrops

Seed yield of coriander was recorded higher when grown as sole compared to inter cropping. Among intercropping systems, the higher seed yield of coriander was obtained in intercropping of coriander with french radish in both 1:1 and 2:2 ratio. The higher yield of coriander in sole crop might be due to no competition with other crops resulting in better growth, yield attributes and yield. In inter cropping of coriander with french radish, higher seed yield of coriander over inter cropping with other crops might be due to less competition of coriander with french radish compared to other crops. Yield of intercrops was recorded higher in respective sole crops as compared to intercropping with coriander. Further, perusal of data in Table 2 reveals that among different inter cropping ratios, the higher yield of intercrops was exhibited in 1:1 ratio. Intercropping of coriander + french radish in all the ratios resulted higher economic yield of french radish as compared to knolkhol and fenugreek. The higher yield of all the intercrops crops in 1:1 ratio was on account of higher plant population due to accommodation of a greater number of rows in between interspaces as compared to 2:2 ratio. Mehta *et al.* (2012 and 2015) also reported higher yield of intercrops in 1:1 intercropping ratio over 2:2 and 1:2 intercropping ratio.

Table 2: Effect of intercropping systems on yield of coriander, inter-crops and coriander equivalent yield

Treatments	Seed yield of Coriander (q/ha)	Seed yield of intercrops (q/ha)	Coriander equivalent yield (q/ha)
Sole Coriander	18.90	-	18.90
Sole French radish	-	273.62	27.36
Sole Knolkhol	-	137.22	17.15
Sole Fenugreek	-	276.64	27.67
Coriander + French radish 1:1	16.98	257.36	42.72
Coriander + French radish 2:2	15.60	253.72	40.98
Coriander + Knolkhol 1:1	16.83	117.75	31.56
Coriander + Knolkhol 2:2	15.42	113.75	29.65
Coriander + Fenugreek 1:1	16.49	246.57	41.15
Coriander + Fenugreek 2:2	15.10	238.28	38.94
SEm + ₋	0.59	7.98	1.15
CD (P=0.05)	16.98	23.3	18.90

Table 3: Effect of intercropping systems on gross return, net return and land equivalent ratio

Treatments	Cost of cultivation (Rs/ha)	Gross returns (RS/ha)	Net returns (Rs/ha)	B:C ratio	LER
Sole Coriander	55300	151200	95900	1.73	1.00
Sole French radish	61750	218896	157146	2.54	1.00
Sole Knolkhol	64500	137220	72720	1.12	1.00
Sole Fenugreek	66250	221312	155062	2.34	1.00
Coriander + French radish 1:1	58500	341728	283228	4.84	1.83
Coriander + French radish 2:2	58500	327776	269276	4.60	1.74
Coriander + Knolkhol 1:1	59700	252390	192690	3.22	1.74
Coriander + Knolkhol 2:2	59700	237110	267876	2.97	1.63
Coriander + Fenugreek 1:1	61300	329176	250124	4.36	1.76
Coriander + Fenugreek 2:2	61300	311424	280376	4.08	1.65
SEm + ₋	-	-	-	-	0.05
CD (P=0.05)	-	-	-	-	0.15

Coriander equivalent yield and Land Equivalent Ratio

Coriander equivalent yield (CEY) and land equivalent ratio (LER) were significantly influenced with different intercropping system. Significantly higher coriander equivalent yield and land equivalent ratio was recorded in intercropping systems as compared to sole cropping (Table 3). Coriander + french radish in all ratios resulted higher CEY and LER as compared to its intercropping with knolkhol and fenugreek. Further analysis showed that intercropping of coriander with all intercrops in 1:1 ratio proved superior resulting in higher CEY and LER over 2:2 ratio. Inter cropping of coriander + french radish in 1:1 ratio exhibited 126 and 83% higher CEY and LER, respectively over sole coriander. The higher CEY and LER in intercropping system was on account of additional yield of intercrops without much reduction in yield of base crop. The highest CEY and LER in 1:1 ratio with french radish, knolkhol and fenugreek was due to proportionately less reduction in coriander yield as compared with 2:2 ratio resulting in better yield of intercrop. Ahlawat and Gangaiah (2010) ^[1] reported higher system productivity in chickpea intercropped with linseed over sole chickpea. Thomas *et al.* (2010) ^[8] reported the highest LER of 1.41 in mustard and chickpea Bhati (1992) ^[2] reported higher fennel equivalent yield in intercropping as compared to sole crops. intercropping over sole crops. Mehta *et al.* (2015) also reported higher fennel equivalent yield and LER in intercropping system over sole cropping.

Economics

Gross return, net return and BCR are affected by different intercropping system. Intercropping of coriander + french radish in 1:1 ratio exhibited significantly higher net return (Rs 283228/ha) and B: C ratio (4.84) which was 195 and 179 per cent higher, respectively over sole coriander. Inter cropping of coriander + french radish/knolkhol/fenugreek in 1:1 ratio proved superior which resulted in higher net return and B: C ratio over 2:2 ratio. Similar benefits of inter-cropping on economics in fenugreek + mustard was reported by Yadav *et al.*, (2003) ^[9]. Khurana and Bhatia (1995) ^[3] in intercropping of onion and potato with fennel and Ahlawat and Gangaiah (2010) ^[1] in chickpea +linseed reported similar results. It is concluded that intercropping of coriander and french radish in 1:1 ratio is promising for higher productivity and profitability. Thus, it is inferred that intercropping of coriander with french radish in 1:1 row ratio is better for realizing higher yield and profitability but for higher residual availability of N,P and K after harvesting of crop can be realized with inter cropping of coriander and fenugreek in 1:1.

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