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Production potential and impact on soil health as influenced by chickpea-spices based intercropping system

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ABSTRACT

To find out the suitable intercropping system and its' impact on soil nutrient status, a field experiment was carried out with chickpea along with three intercrop i.e. coriander, fenugreek and fennel in randomized block design at CCS Haryana Agricultural University. The result reveals that Chickpea + fennel (4:2) row ratios provide the best system in terms of economics benefit but was not so much significant variation were observed in respect of different soil physico-chemical properties due to different intercropping system. Highest nutrient uptake was noticed in sole cultivation of chickpea than cultivated in intercropping system.

Keywords : Chickpea, coriander, fenugreek, fennel, intercropping, nutrient

Intercropping is an advanced agro-technique and is used basically for increasing land use efficiency per unit area and time, particularly for marginal and small holdings farmers. Diversification of the cropping systems helps in efficient utilization of natural resources, decreases the risk potential and improves soil fertility through adding nutrient to the system besides improving yield and quality (Singh *et al*., 2012). Chickpea is the most common winter pulse grown in India providing 8.88 m tonnes in 8.70 m ha with the productivity of 1020 kg ha^{-1} (Anon., 2012-13). Chickpea + cereal or chickpea + oilseed are generally practiced in India but chickpea + spices based intercropping in the new one. The present study was undertaken to find out optimum row ratio of chickpea and suitable intercrop in respects of production potential and soil nutrient balance.

The field experiment was carried out at research farm of CCS, Haryana Agricultural University, Hisar, Haryana during *rabi* season of 2010-11. The experiment was conducted in randomized block design replicated thrice. It involved thirteen treatments, had four sole crops (Chickpea, coriander, fenugreek and fennel) and nine combinations of chickpea intercropping with other three crops in 2:1, 3:1 and 4:2 row ratio. The variety was used in the experiment were HC-5 (chickpea), DH-36 (coriander), HM-57 (fenugreek) and HF-33 (fennel). The crops were sown on 25 November, 2010 in the plot of 7.2 × 5 m^2. The soil was sandy loam in texture, well drained, poor in organic carbon (0.17%) with pH 7.9. The initial available N was 185 kg ha^{-1}, available P_2O_5 was 35.6 kg ha^{-1} and available K_2O 256.9 kg ha^{-1}. Row to row and plant to plant distances of 30 x 10 cm for all crops were maintained. A basal dose of 100 kg di-ammonium phosphate ha^{-1} was applied at the time of sowing. All other plant protection measure was carried out as and when required. Soil fertility analysis under different intercropping systems was carried out by using standard methodology described by Jackson, 1973. Statistical analysis of data was carried out using standard analysis of variance (Gomez and Gomez, 1984).

Nodulation

Nodule numbers $plant^{-1}$ increased in intercropping system as compared to sole chickpea (Table 1). Among the intercropping treatments, highest number of nodules (41.9) in chickpea was recorded in chickpea + fennel at 4:2 row ratio which was statistically *at par* with 2:1 row ratio of the same intercropping and chickpea + fenugreek intercropping system. Dry weight of nodules also followed the same trends (Table 1). Numbers of nodule $plant^{-1}$ vary in intercropping of chickpea also reported by Banik *et al.* (2006).

Crop yield and economics

Sole stand of chickpea recorded higher grain yield as compared to intercropping system. This might be due to more plant population in sole stand. Similar results were reported by Chand *et al*. (2004). Among the different intercropping system, the higher yield of chickpea grain was recorded from 3:1 row ratio irrespective of intercrops, however, it was significantly superior than 4:2 and 2:1 row ratio. This might be due to higher plant population of chickpea in 3:1 row ratio as compared to rest of the row ratios 4:2 and 2:1. Among the different intercropping systems, chickpea + fennel with 4:2 row ratio was recorded higher B: C ratio (2.52) and it was found *at par* with 2:1 row ratio of chickpea + fennel. Variation in B:C ratio due to different intercropping systems had also been reported by Tanwar *et al.* (2011).

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Table 1: Nodulation, yield, nutrient uptake of chickpea and physiochemical properties as influenced by different treatments in chickpea-spices based intercropping systems

Treatments	Nodules plant^{-1} at flowering		Chick pea yield (kg ha^{-1})		B:C ratio	Nutrient uptake (kg ha^{-1})			Physico-chemical properties of soil after harvest					
	Number	Dry wt. (mg)	Grain	Stover		N	P	K density (%)	Bulk	pH Carbon (%)	Organic (kg ha^{-1})	N (kg ha^{-1})	P_2O_5 (kg ha^{-1})	K_2O
T_1	19.2	88.3	1503	3176	1.76	126.48	24.47	55.68	1.53	7.35	0.22	191.6	39.0	248.7
T_2	18.7	81.9	924	1973	1.94	88.64	14.75	41.14	1.60	7.42	0.19	193.3	37.7	257.3
T_3	17.2	79.8	1112	2232	1.93	112.36	18.36	44.75	1.58	7.51	0.21	194.7	33.8	241.3
T_4	19.1	82.3	938	2071	1.91	89.72	16.12	42.37	1.54	7.62	0.20	203.3	35.3	255.4
T_5	16.4	59.4	1014	2095	1.85	78.83	19.22	43.78	1.59	7.58	0.19	205.3	33.6	256.7
T_6	17.3	62.6	1228	2593	1.99	94.75	20.58	48.16	1.61	7.64	0.22	199.2	35.8	236.0
T_7	16.5	65.7	994	1953	1.86	90.12	15.64	44.73	1.47	7.46	0.18	200.8	33.9	248.0
T_8	16.6	60.2	1081	2109	2.45	97.06	14.53	42.89	1.52	7.77	0.23	195.6	36.2	259.3
T_9	17.4	61.7	1297	2614	2.36	107.33	19.85	47.57	1.55	7.66	0.22	202.3	37.8	237.2
T_{10}	18.3	70.6	1096	2146	2.52	99.54	15.27	43.63	1.58	7.52	0.21	201.8	36.1	253.3
LSD (0.05)	**1.31**	**6.14**	**59.2**	**143.0**	-	**12.36**	**4.20**	**6.14**	**0.24**	**N S**	**N S**	**15.2**	**N S**	**N S**
Initial soil	-	-	-	-	-	-	-	-	**1.57**	**7.9**	**0.17**	**185.0**	**35.6**	**256.9**

Notes : *T_1= Chickpea Sole, T_2= Chickpea+ Coriander (2:1), T_3= Chickpea+ Coriander (3:1), T_4= Chickpea+ Coriander (4:2), T_5= Chickpea+ Fenugreek (2:1), T_6= Chickpea+ Fenugreek (3:1), T_7= Chickpea+ Fenugreek (4:2), T_8= Chickpea+ Fennel (2:1), T_9= Chickpea+ Fennel (3:1), T_{10}= Chickpea+ Fennel (4:2)*

Nutrient uptake

Irrespective of the different row ratios along with sole cultivation, highest N, P and K uptake of chickpea was recorded with sole stand (Table 1). The higher removal of these nutrients by sole chickpea as compared to intercropping treatments probably happened due to vigorous growth and better root system under optimum spacing which had helped in adequate supply of these nutrients resulting in higher biological yield coupled with their effective transfer to the ultimate sink *i.e.* the grains thus leading to numerically higher chickpea grain nutrient contents of N, P and K. These results confirm the findings of Kour *et al*. (2013) who also reported higher nutrient uptake in sole cultivation of chickpea as compared with the intercropping one.

Physico-chemical properties of soil

The bulk density and pH, organic carbon, total nitrogen content, available phosphorus (P_2O_5) and potash (K_2O) contents of the initial and after harvest soil of the experimental field are presented in table 1. The bulk density, soil pH and organic carbon of soil did not vary after harvesting of the crops though the pH of the experimental soil after harvest of the crop reduced to some extent where as organic carbon increased. Sole chickpea recorded higher nitrogen content after harvest as compared to the initial nitrogen status which may be due to their leguminous in nature and fixation of atmospheric nitrogen by the formation of nodules. Coriander and fennel being non leguminous depleted more nitrogen from soil thus resulted in less nitrogen content. No significant differences were observed in available phosphorus and potassium content before sowing and after harvest due to different intercropping system.

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