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Effect of Integrated Nutrient Management on Nutrient Uptake, Yield and Soil Fertility in Late Sown Sesame-Chickpea Sequence Cropping under Rainfed Conditions

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ABSTRACT

Field experiment was conducted during *kharif* and *rabi* seasons of 2004-05 at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad (Karnataka) under rainfed conditions to study the effect of integrated nutrient management on nutrient uptake, yield and soil fertility in late sown sesame-chickpea sequence cropping. The results of the experiment revealed that maximum productivity, net returns in addition to improvement in soil fertility status could be possible with application of 40 kg N through FYM + Copper ore tailing (COT) @ 0.5 t ha^{-1}. Integrated use of organics and inorganic sources showed significantly higher available nutrients at harvest of crops as compared to recommended dose of nitrogen in the form of urea alone.

Key words : Copper ore tailing (COT), Nutrient Uptake and Sequence Cropping

Sesame (*Sesamum indicum* L.) is one of the important oilseed crops in India. The production of oilseed crops in our country including sesame is not enough to meet the domestic demand of the large Indian population. Low production of sesame is attributed to the fact that the crop is usually grown during rainy season on marginal and less fertile soils. Further, lack of proper nutrient management is one of the major causes for low yields of sesame.

Excessive use of agrochemicals has raised concern regarding depleting soil productivity and overall nutrient imbalance. Integrated use of organic and inorganic fertilizers in a balanced proportion for sustainable production of sesame was therefore emphasized by Hegde (1998) and Deshmukh *et al.* (2002).

The balanced application of both organic and inorganic sources in ideal proportion appears to meet the nutrient requirements of crops rather than application of either of the two. Integrated nutrient management may play a vital role in sustaining both soil health and crop production on long-term basis. Keeping these aspects in view, the present study was conducted during *kharif* and *rabi* seasons of 2004-05 under rainfed conditions at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad.

MATERIAL AND METHODS

The field experiment was laid out in randomized block design with ten treatments, replicated thrice T_1 - 40 kg N ha^{-1} through urea, T_2 - 10 kg N ha^{-1} through FYM + 30 kg N ha^{-1} through urea, T_3 - 20 kg N ha^{-1} through FYM +20 kg N ha^{-1} through urea, T4 - 30 kg N ha^{-1} through FYM +10 kg N ha^{-1} through urea, T5 - 40 kg N ha^{-1} through FYM, T6 - 50 kg N ha^{-1} through FYM, T_7 - 60 kg N ha^{-1} through FYM, T_8 - 40 kg N ha^{-1} through FYM + 0.5 t COT , T_9 - 40 kg N ha^{-1} through FYM + 25 kg S ha^{-1} and T_{10} - Control (No FYM and fertilizer). The soil of the experimental site was black clayey, low in available nitrogen (220.7 kg ha^{-1}), medium in available phosphorus (31.6 kg ha^{-1}) and high in available potassium (324.5 kg ha^{-1}). Sowing of sesame was done on 19-07-2004 (late sown) at 30 cm row spacing by mixing the seeds with sand in 1:4 proportion. Chickpea was sown on 08.11.2004 after the harvest of sesame at 30 cm x 10 cm spacing in the plough line and was harvested for table purpose (80 DAS). Soil and plant samples were collected and analyzed for N, P, K and S content using the method described by Subbaiah and Asija (1956) and Jackson (1967). All the parameters are statistically analyzed by adopting procedure, as outlined by Gomez and Gomez (1984).

Table 1. Yield components, yield, nutrient uptake and soil nutrient status as influenced by integrated nutrient managment in sesame

Tr.No.	Treatments	Total dry matter production at harvest	Number of seeds capsule^{-1}	Seed yield (kg)	Stalk yield (kg)	Total uptake (kg ha^{-1})				Soil nutrient status			
						N	P	K	S	Nitrogen (kg)	Phosphorus (kg)	Potassium (kg)	Sulphur (ppm)
T_1	40 kg N ha^{-1} through urea	18.34	49	298	1414	35.38	4.92	35.76	2.80	215	33.22	322	10.90
T_2	10 kg N ha^{-1} through FYM+30 kg N ha^{-1} through urea	16.77	47	259	1249	28.03	4.18	30.33	2.58	220	35.42	325	11.60
T_3	20 kg N ha^{-1} through FYM+20kg N ha^{-1} through urea	16.43	44	256	1216	26.88	4.02	29.08	2.56	219	38.44	329	11.70
T_4	30 kg N ha^{-1} through FYM+10 kg N ha^{-1} through urea	16.14	42	238	1144	24.57	3.68	26.88	2.60	225	39.40	332	11.73
T_5	40 kg N ha^{-1} through FYM	15.72	41	220	1058	22.18	3.27	24.36	2.48	227	40.36	335	12.00
T_6	50 kg N ha^{-1} through FYM	15.92	42	229	1122	23.39	3.53	25.80	2.68	232	44.20	347	12.25
T_7	60 kg N ha^{-1} through FYM	16.37	44	240	1154	24.58	3.73	27.14	2.86	240	48.27	361	12.70
T_8	40 kg N ha^{-1} through FYM+0.5 t COT	17.07	48	262	1256	28.31	4.40	30.37	3.28	237	43.12	342	13.33
T_9	40 kg N ha^{-1} through FYM 25kg S ha^{-1}	16.63	46	257	1228	27.00	4.09	29.54	3.30	235	42.54	339	15.30
T_{10}	Control (No FYM and fertilizer)	13.15	39	212	1012	19.57	2.81	20.50	1.83	209	28.41	312	9.84
	S.Em±	0.55	1.45	14	44	1.26	0.18	1.34	0.12	7	3.11	9	0.55
	C.D (0.05)	1.62	4.29	41	131	3.74	0.55	3.99	0.34	19	9.23	26	1.64

Note: FYM = Farmyard manure, COT = Copper ore tailings, DAS = Days after sowing

RESULTS AND DISCUSSION

Sesame Yield:

Significantly superior seed yield (298 kg ha^{-1}) and stalk yield (1414 kg ha^{-1}) of sesame were recorded with application of 40 kg N ha^{-1} through urea (T_1) over absolute control (T_{10}) and the improvement was to the tune of 41 and 40 per cent, respectively. However, the seed yield obtained with the application of 10 kg N ha^{-1} through FYM + 30 kg N ha^{-1} through urea (T_2), 20 kg N ha^{-1} through FYM + 20 kg N ha^{-1} through urea (T_3), 40 kg N ha^{-1} through FYM + COT @ 0.5 t ha^{-1} (T_8) and 40 kg N ha^{-1} through FYM + 25 kg S per ha (T_9) were comparable to that of T_1 (Table 1). The higher yields in these treatments could be attributed to higher total dry matter and number of seeds capsule^{-1}. The higher total dry matter was due to the availability of nutrients throughout the crop growth and its higher uptake by the crop (Table 1).

Nutrient Uptake

Statistically detectable differences were noticed with respect to total uptake of nutrients among the treatments. Significantly higher total uptake of N (35.38 kg ha^{-1}) was recorded with the application of 40 kg N ha^{-1} through urea (T_1) as compared to absolute control (19.57 kg ha^{-1}). Due to integrated use of nutrients, increased uptake of N by sesame was observed in T_2, T_3, T_8 and T_9 over absolute control (T_{10}) (Table 1). Similar trend was observed with P and K uptake also. These findings were in corroboration with Tomar (1990) and Mandal *et al.* (1992). Sulphur uptake by sesame was significantly higher with the application of 40 kg N ha^{-1} through FYM along with 25 kg S ha^{-1}(T_9). The increased uptake of S by the crop could be attributed to increased availability of S in the treated soil. Similar results were observed by Sangale and Sonar (2004).

Soil fertility status

Post harvest soil available N, P, K and S of sesame differed significantly among the treatments (Table 2). All the treatments which received N in the form of urea/FYM or in combination (T_1 to T_9) recorded significantly higher soil available N over absolute control (T_{10}). With regard to availability of P in soil, significantly higher P was recorded with FYM

Table 2. Fodder Yield, uptake and soil nutrient status after harvest of chickpea as influenced by the residual effect of integrated nutrient management applied to preceeding sesame crop

Tr.No.	Treatments	Total green matter yield (q)*	Total uptake (kg ha^{-1})				Soil nutrient status			
			N	P	K	S	Nitrogen (kg)	Phosphorus (kg)	Potassium (kg)	Sulphur (ppm)
T_1	40 kg N ha^{-1} through urea	45	27.58	2.44	12.65	2.17	206	29.10	312	9.74
T_2	10 kg N ha^{-1} through FYM+30 kg N ha^{-1} through urea	47	29.06	2.70	13.86	2.27	212	31.63	315	10.20
T_3	20 kg N ha^{-1} through FYM+20kg N ha^{-1} through urea	51	32.07	3.13	15.83	2.60	212	34.76	319	10.27
T_4	30 kg N ha^{-1} through FYM+10 kg N ha^{-1} through urea	52	33.21	3.30	16.62	2.80	219	35.85	321	10.37
T_5	40 kg N ha^{-1} through FYM	55	35.45	3.65	17.90	3.05	222	36.55	326	10.54
T_6	50 kg N ha^{-1} through FYM	57	37.06	3.88	18.98	3.28	226	39.66	337	10.77
T_7	60 kg N ha^{-1} through FYM	58	37.85	4.04	20.12	3.52	230	41.81	343	
T_8	40 kg N ha^{-1} through FYM+0.5 t COT	60	38.80	4.18	20.65	3.64	232	38.66	332	
T_9	40 kg N ha^{-1} through FYM 25kg S ha^{-1}	55	36.54	3.61	18.58	3.95	229	37.59	329	
T_{10}	Control (No FYM and fertilizer)	41	23.55	2.03	11.12	1.87	198	25.50	302	
	S.Em±	2	1.72	0.15	0.80	0.18	7	1.18	9	
	C.D (0.05)	7	5.09	0.45	2.37	0.53	20	3.50	26	

Note: FYM = Farmyard manure, COT = Copper ore tailings, DAS = Days after sowing *= harvested for green purpose

+ COT (T_8). The available P recorded in T_3, T_4, T_5, T_6, T_7 and T_9 was however, comparable with T_1. The maximum available K content was recorded with T_5, T_6, T_7, T_8 and T_9 compared to absolute control (T_{10}). Significantly higher available S was recorded with application of 40 kg FYM + 25 kg S ha^{-1} (T_9). The increase in available nutrients in soil could be attributed to residual effects of organic matter/COT/S applied to the soil. Similar increase in soil available nutrients due to integrated application of organic and inorganic nutrients had been reported by several workers (Thakkar *et al.*, 1975; Nimje and Seth, 1988 and Dwivedi *et al.*, 1990).

Chickpea Yield:

Total green matter yield of chickpea (harvested for green / table purpose hence individual seed yield was not taken) differed significantly due to the residual effect of integrated nutrient management. Application of recommended dose of nitrogen (40 kg N ha^{-1}) through FYM along with 0.5 t ha^{-1} COT (T_8) during *kharif* season for sesame exerted significantly higher residual effect on total green matter yield of succeeding chickpea (Table 2). The extent of increase was by 33 per cent when compared to application of recommended dose of N through urea (T_1). The total green matter yield obtained with the residual effect of 40 kg N ha^{-1} through FYM (T_5), 50 kg N ha^{-1} through FYM (T_6), 60 kg N ha^{-1} through FYM (T_7) and 40 kg N ha^{-1} through FYM + 25 kg S ha^{-1} (T_9) were however, comparable with T_8. This improvement could be attributed to the combined effect of nutrients present in COT besides residual effect of FYM (Rajasekhar, 1995).

Nutrient Uptake

Total uptake of nutrients differed significantly among the treatments (Table 2). The total uptake of N with FYM + COT (T_8) was 41 per cent higher than urea alone (27.58 kg ha^{-1}) (T_1). The total uptake of N in T_4, T_5, T_6, T_7 and T_9 were comparable with T_8. Similar trend was noticed with P and K uptake also. These results were in agreement with Sherell (1989). The increase in N uptake was due to synergistic effect of Cu with N (Antil *et al.,* 1988). The uptake of S was significantly more with the residual effect of FYM + S (T_9). S

uptake in T_8 and T_7 was however, comparable with T_9. Increase in SO_4 concentration and uptake due to application of S was reported by Pathak and Pathak, 1972.

Soil fertility status

The availability of different nutrients in soil at harvest of chickpea were also found significant with application of FYM along with COT (Table 2). Available N in soil was maximum with the residual effect of 40 kg N ha^{-1} through FYM + COT @ 0.5 t ha^{-1} (T_8). While available P and K were more with the residual effect of 60 kg N per ha through FYM (T_7) and sulphur was maximum with combined application of FYM along with S (T_9). The other treatments (T_2, T_3, T_4, T_5 and T_6) receiving FYM alone or in combination with N in the form of urea recorded higher availability of N, P, K and S when compared to recommended dose of nitrogen through urea. Similar such increase in soil available nutrients due to the residual effect of FYM/COT/S had been reported by Das *et al.* (2004) in wheat, Rajasekhar (1995) in chickpea.

Integrated use of organic and inorganic sources showed significantly higher available nutrients at harvest of crops as compared to RDN in the form of urea alone. The data clearly indicated that integrated nutrient management practices in sesame-chickpea cropping sequence were to be profitable and also help to maintain the productivity of soil.

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