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Nutrient uptake, quality and economics of sesame as influenced by Vermicompost and moisture conservation practices

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Abstract
A field experiment was conducted during *kharif* season of 2016 at S.K.N. College of Agriculture, Jobner to study the "Response of Sesame (*Sesamum indicum* L.) to vermicompost and moisture conservation practices. The experiment comprising of four levels of vermicompost (Control, 1.5, 3.0 and 4.5 t/ha) and four moisture conservation practices (control, dust mulch, straw mulch and plastic mulch), thereby making 16 treatment combinations was laid out in factorial randomized block design and replicated thrice. Nitrogen, phosphorus and potash concentration in seed and straw as well as oil content in seeds were significantly higher with vermicompost @ 3.0 t/ha but it was found at par with vermicompost @ 4.5 t/ha. The uptake of N, P and K by crop increased significantly up to vermicompost @ 3.0 t/ha. Application of vermicompost @ 3.0 t/ha fetched net returns of 43964₹/ha, which were significantly higher over lower levels of vermicompost and at par with vermicompost @ 4.5 t/ha. Application of straw mulch recorded significantly higher protein content in seed (20.63%) and nitrogen content in both seed (3.30%) and stalk (1.34%), whereas, total N uptake (54.6 kg/ha) was significantly higher due to straw mulch over control and dust mulch. Application of straw mulch fetched the net returns of Rs 45979₹/ha, which was significantly higher over control, dust and plastic mulch.

Keywords: Moisture conservation practices, Mulches, Sesame and Vermicompost

Introduction
Oilseeds are the main source of fat and protein, particularly for vegetarians. In Indian economy, oilseeds occupy an important place and contribute to about 15 per cent of the gross cropped area, nearly 6 per cent of gross domestic product and 7 per cent of world edible oil consumption (Anonymous, 2015) [1]. Sesame is an important edible oilseed crop next to groundnut and rapeseed-mustard. Its oil content generally varies from 46 to 52 per cent and protein from 18 to 20 per cent. The crop is grown in wide range of environments extending from semi-arid tropics and sub-tropics to temperate regions. Due to soil and climatic adversities in rainfed ecosystems, the crop suffers from several biotic and abiotic stresses, particularly moisture stress and multi-nutrients deficiency, resulting in poor and unpredictable crop yields. Vermicompost is a prime source of macro and micro nutrients in chelated form and fulfills the balanced nutrient requirement of crops for longer period. Organic mulch has been found to attribute to the reduction in soil temperature and improved moisture holding capacity of the soil (Lal, 1974) [2]. Looking to the above facts, an experiment entitled "Nutrient uptake, quality and economics of sesame as influenced by vermicompost and moisture conservation practices'' was under taken.

Materials and Methods
A field experiment was conducted at experimental farm of Department of Agronomy, S.K.N. College of Agriculture, Jobner (Rajasthan) during *Kharif* season of 2016. Soil of the experimental site was loamy sand in texture, poor in organic carbon content, available N as well as S and medium in available P and K. Soil was slightly alkaline in reaction with pH 8.2. The field had an even topography and good drainage system. The total rainfall received during crop growing period (*Kharif*, 2016) was 353 mm. The experiment was conducted in fixed layout of factorial RBD. The field experiment comprised of four levels of vermicompost viz. 0, 1.5, 3 and 4.5 tonne/ha and four levels of moisture conservation practices viz.

control, dust mulch, straw mulch and plastic mulch, replicated thrice. Sesame variety 'RT-346' was sown manually in rows spaced 30 cm apart at a depth of 3 cm following the seed rate of 4kg seed/ha. Vermicompost (Composition N-1.8-2.5, P-1.0 and K-1.5) was applied as per treatment at the time of sowing and was thoroughly incorporated in soil with the help of spade. Dust mulching was done twice at 20 and 55 DAS manually by hoeing with the help of *khassi*. Strip of 30 cm wide and 4 metre long black plastic was placed in between the rows 20 DAS in the ear marked plots and their corners were put under bund of the bed. Similarly, straw mulch of mustard @ 5 t/ha was applied at 20 DAS. One weeding cum hoeing was done manually at 25 DAS to facilitate aeration and removal of weeds. One irrigation was given at capsule development stage. Dusting of methyl parathion 2% @ 25 kg/ha was done to protect the crop from damage of sucking insects. Nitrogen was estimated by colorimetric method. Phosphorus concentration in seed and staw were determined by "Vanadomolybdo phosphate" Yellow colour method. Potassium concentration in the samples was estimated by flame photometric method. The total uptake of nitrogen, phosphorus and Potassium was computed from N, P and K concentration in seed and staw at harvest using following relationship:

$$\text{Total nutrient uptake (kg/ha)} = \frac{\text{Nutrient conc. in seed (\%)} \times \text{Seed yield (kg/ha)} + \text{Nutrient conc. in straw (\%)} \times \text{Straw yield (kg/ha)}}{100}$$

Protein content in seed was calculated from the per cent nitrogen in the seed multiplied by the factor 6.25 (A.O.A.C., 1960) and expressed as per cent protein content. Oil content in the seed was determined by "Soxhlet's apparatus using petroleum ether (60-80 ^{0}C) as an extractant (A.O.A.C., 1960). The regression equations were also fitted and tested for significance. The experimental data were statistically analysed by Fisher's'Analysis of Variance' technique (Fisher, 1950). Economics was calculated using prevailing prices of inputs and outputs.

Result and Discussion

Effect of Vermicompost: There was significant increase in N, P and K content in seed and straw and their uptake and protein content (Table1) in seed due to application of vermicompost to the sesame. The higher concentration of nutrients in plant under vermicompost is due to adequate supply of nutrients. Thus crop manure with higher dose of vermicompost had utilized more nutrients as compared to lower doses resulted in increased N, P and K content in seed and straw. Since nutrient uptake is function of its content in grain and straw and their yield, the increase in these parameters due to vermicompost led to an increased uptake of these nutrients in present study. Significant increase in protein content from 16.63 in control to 21.63% in @3.0 vermicompost t/ha but at par with @ 4.5 vermicompost t/ha has been observed in the present study because of increased nitrogen content in seed which might be the result of increased availability of nitrogen to plants. Higher N content in seed is directly responsible for higher protein content because it is primary component of amino acid which constitutes the basis of protein. It is evident from the data that increasing level of vermicompost up to @ 3.0 t/ha significantly increased the net return and thereafter decreased. The highest net return (Rs.43964/ha) was obtained when vermicompost applied @ 4 t/ha and minimum with @1.5 t/ha vermicompost (Table 2). The net returns decrease with the each increasing dose of vermicompost, because of the fact the cost involved in each addition of higher dose of vermicompost increase the cost of cultivation whereas the addition in term of returns was low.

Effect of moisture conservation practices: The mulching practices remarkably increased the N content in seed and stover as well as their uptake by fennel crop (Table 1). The maximum content and uptake of nutrients were obtained under straw mulch followed by plastic and dust mulches. The increase in content of N might be due to the fact that greater moisture content in rhizosphere under mulching led to faster solubilization of nutrients and promoting optimum hydrothermal regimes for better root growth which results in more exploitation/extraction of N from soil. The increased uptake of N under these mulching practices could be attributed to the increased content of N in seed and stover. Further, since the uptake is the function of nutrient content and biomass production, the increased uptake of nutrients under various mulching practices could be assigned to the higher seed and stalk yield of sesame under these treatments. Significant increase in protein content from 18.06 per cent in control to 20.63 per cent with straw mulch has been observed in the present investigation (Table 2). The increase in protein content in seed was due to higher N content in seed. These findings are in consonance with results of Yadav (2005) [4] in mustard and Saren *et al*. (2008) [3] in Niger. There was marginal increase in oil content due to mulching practices (Table 2). This might be ascribed to the fact that the marginal increase in oil content due to mulching practices was due to bolder seeds of mustard produced by increasing moisture availability under mulching as evident from increased test weight with mulching practices. Application of straw mulch fetched the net returns of Rs 45979/ha, which was significantly higher over control, dust and plastic mulch.

On the basis of one year experimentation, it may be concluded that application of vermicompost @ 3.0 t/ha along with use of straw mulch proved to be the superior treatment in dependently with regard to yield, quality and net returns of sesame.

Table 1: Effect of vermicompost and moisture conservation practices on macronutrients concentration and total uptake

Treatments	N concentration (%)		Total N uptake (kg/ha)	P concentration (%)		Total P uptake (kg/ha)	K concentration (%)		Total K uptake (kg/ha)
	Seed	Stalk		Seed	Stalk		Seed	Stalk	
Vermicompost (t/ha)									
Control	2.66	1.08	31.3	0.582	0.252	7.077	1.060	0.546	14.22
1.5	3.17	1.22	44.5	0.602	0.265	9.039	1.120	0.572	18.24
3.0	3.27	1.29	54.2	0.640	0.280	11.174	1.180	0.600	22.36
4.5	3.46	1.33	61.9	0.645	0.284	12.346	1.220	0.636	25.62
SEm±	0.09	0.03	1.4	0.017	0.008	0.297	0.033	0.017	0.61
Cd (P = 0.05)	0.26	0.10	4.2	0.050	0.022	0.856	0.094	0.049	1.76

Treatments	N concentration (%) Seed	N concentration (%) Stalk	Total N uptake (kg/ha)	P concentration (%) Seed	P concentration (%) Stalk	Total P uptake (kg/ha)	K concentration (%) Seed	K concentration (%) Stalk	Total K uptake (kg/ha)
Moisture conservation practices									
Control	2.89	1.10	38.1	0.580	0.256	8.204	1.062	0.546	16.36
Dust mulch	3.12	1.22	47.7	0.605	0.262	9.690	1.112	0.573	19.60
Straw mulch	3.30	1.34	54.6	0.644	0.283	11.012	1.213	0.640	22.96
Plastic mulch	3.25	1.26	51.6	0.640	0.280	10.729	1.193	0.596	21.53
SEm+	0.09	0.03	1.4	0.017	0.008	0.297	0.033	0.017	0.61
Cd (P = 0.05)	0.26	0.10	4.2	0.050	0.022	0.856	0.094	0.049	1.76

Table 2: Effect of vermicompost and moisture conservation practices on quality parameters and economic of sesame

Treatments	N concentration (%)		Total N uptake	P concentration (%)		Total P uptake	K concentration (%)		Total K uptake
	Seed	Stalk	(kg/ha)	Seed	Stalk	(kg/ha)	Seed	Stalk	(kg/ha)
Vermicompost (t/ha)									
Control	2.66	1.08	31.3	0.582	0.252	7.077	1.060	0.546	14.22
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