Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2017; 6(3): 263-265
Received: 18-03-2017
Accepted: 19-04-2017

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Effect of organic manures and mineral nutrients on quality parameters and economics of sesame (*Sesamum indicum* L.)

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Abstract
A field experiment entitled "Effect of Organic Manures and Mineral nutrients on Quality Parameters and Economics of sesame (*Sesamum indicum* L.)" was conducted during *kharif* season of 2015 at Agronomy farm, S.K.N. College of agriculture, Jobner, Jaipur (Rajasthan). The experiment composed of 16 treatments combination comprising four levels of organic manures (control, FYM @ 10 t ha^{-1}, Vermicompost @ 5 t ha^{-1} and FYM @ 5 t ha^{-1} + Vermicompost @ 2.5 t ha^{-1}) and four levels of Mineral nutrients (control, S @ 20 kg ha^{-1}, S @ 20 kg ha^{-1} + Fe @ 10 kg ha^{-1} and S @ 20 kg ha^{-1}+ Fe @ 10 kg ha^{-1} + Zn @ 5 kg ha^{-1}) was laid out in randomized block design and replicated thrice. Sesame variety RT-46 was taken as a test crop. Results showed that application of organic manures FYM @ 5 t ha^{-1} + vermicompost @ 2.5 t ha^{-1} and mineral nutrients S @ 20 kg + Fe @ 10 kg + Zn @ 5 kg ha^{-1} significantly increased protein content, oil content and oil yield and net returns (₹ 45531 M_3) and (₹ 47646 T_3) over rest of the treatments.

Keywords: Organic manures, mineral nutrients, quality and economics

1. Introduction

Sesamum indicum L. (Syn. *Sesamum orientale* L.), which is known variously as sesamum, *til, gingelly, simsim, gergelim* etc. is one of the most important oilseed crop grown extensively in India. Sesamum is quality food, nutrition, edible oil, biomedicine and health care, all in one. Sesamum has remarkable antioxidant due to the presence of lignin and tocopherol. The seed of sesame are highly rich in quality proteins and essential amino acids, especially methionine is considered rejuvenate anti-aging for human body. Sesamum seeds are rich source of fatty acids (linoleic, oleic, palmitic and stearic acids), vitamins (E, A, B_1, B_2), niacin and minerals including calcium and phosphorus.

The seeds are used in preparation of baby foods, considered as the substitute for mother milk to compensate the breast-feeding. The oil of the crop consisted 85% unsaturated fatty acid is highly stable and has reducing effect on cholesterol and prevent coronary heart diseases. Sesame is called as 'the queen of oils' because of extra ordinary cosmetic and skin care qualities. It is grown in all seasons of the year and being a short duration crop, fit well into various cropping sequences/systems.

The oil of the sesame is highly resistant to oxidative rancidity and is characterized for its stability and quality. Because of its excellent quality characters, sesame oil is also referred to as "poor man's substitute for ghee". Sesame cake or meal obtained as a byproduct of oil milling industry is rich in protein, carbohydrate, vitamins (Niacin) and minerals (Ca and P) and considered as it is eaten mixed with sugar by poor people and sometimes also added to bread to improve palatability and nutritive value. Sesame cake is also a valuable nutrition's feed for cattle especially for milch animals and is ingredient of poultry feed because of its high methionine content. The cake content 6.0-6.2 per cent N, 2.0-2.2 per cent P and 1.0-1.2 per cent K and can also be used as manure.

A proper and economically justified recycling of crop residues in the form of FYM, compost, vermicompost, green manure etc. (Tandon, 1992) [18] and the use of bio-fertilizers may provide a substantial supply of nutrients to the soil plant system (Dixit and Gupta, 2000) [3]. In present scenario of agriculture where limited availability of FYM, vermicompost may be a another potential source of organic matter in the cultivated soils, which not only supply macronutrients and plant growth promoting hormones but also take care of micronutrients which are otherwise limiting the growth and yields of the crop in many intensively cultivated areas (Singh, 1999, Massod Ali and Mishra, 2000) [15, 8].

It is well known fact that the incorporation of organic residual in the soil plant system directly or indirectly improves the physical, chemical and biological properties of soil and helps in sustaining the crop production and soil fertility (Swarup and Wanjari, 2000) [16].

2. Materials and methods

Sesame variety RT-46 was taken as a test crop. The analysis of experimental soil showed that experimental soil was loamy sand in texture with high infiltration rate (22.46 cm hr^{-1}) and saturated hydraulic conductivity 10.20 cm hr^{-1}. The soil was low in organic carbon (0.21%), low available nitrogen (125.64 kg N ha^{-1}), medium in available phosphorus (18.43 kg P_2O_5 ha^{-1}) and in available potassium (141.05 kg K_2O ha^{-1}) while the soil was deficient in available sulphur (7.95 mg kg^{-1}), available iron (3.34 mg kg^{-1}) and available zinc (0.42 mg kg^{-1}). The soil was saline with a p^H 8.2.

Oil content in seed was determined by Nuclear Magnetic Resonance (NMR) method as suggested by Tiwari *et al*. (1974) [19]. The oil yield was calculated by using following expression:

Oil yield (kg ha^{-1}) = Seed yield (kg ha^{-1}) x Oil content (%) / 100

The protein content of the seed was worked out by multiplying nitrogen content in the seed (per cent) with the factor 6.25 as reported by Angelo and Mann (1973).

The gross realization in term of rupees per hectare was worked out separately for each treatment considering the yields of seed and stalk and their respective prices prevailed during the month of November 2015. Likewise, the cost of cultivation was worked out by considering the expenses incurred on routine operations from preparatory tillage to harvesting including threshing, cleaning as well as the cost of inputs viz., seeds, fertilizers etc. The total cost of cultivation was deducted from the gross realization to work out the net income for each treatment combinations and was recorded accordingly.

Net return (₹ ha^{-1}) = Gross return (₹ ha^{-1}) – Cost of cultivation (₹ ha^{-1}).

3. Results and Discussion

3.1 Quality parameters

Oil and protein content in sesame has a great bearing and it determines market price for farmers. The oil and protein content of the crop were significantly influenced with the application of organic manures. The significantly maximum oil and protein content in seed of the crop. Were observed with the application of FYM @ 5 t ha^{-1} + Vermicompost @ 2.5 t ha^{-1} over control. The increase in oil yield and protein content with the application of organic manures is consequence of the increase in oil content and protein content and grain yield (Saxena *et al.,* 2001).

The better supply of Nitrogen might have helped in better absorption and utilization of all plant nutrients and a large proportion of photo synthates may have diverted to protein formation (Sharma *et al.,* 2014) [14]. The nitrogen is an integral part of protein and phosphorus is an integral part of certain co-enzymes involved in protein synthesis. This might be due to more production of carbohydrate under better and balance supply of nutrient which are degrade to acetyl co-enzyme-A for the synthesis of fatty acid (Tripathi *et al.,* 2011) [21].

The significant increase in oil content of seed with application of vermicompost may also be due to enhanced availability of all nutrients to plant, favorable physical condition of the soil and better proliferation of roots, might have helped in better utilization and translocation of nutrients in to plant parts and resulted in higher uptake of nutrients that in turn may have resulted in higher synthesis of essential metabolites responsible for increased oil content in seed Ola *et al.,* 2013) [10]. It might be because of the fact that sulphur is recognized as an integral part of oil, the increased availability of S due to its application to the soil low in sulphur might have favorably affected to the synthesis of essential metabolites responsible for higher oil content. Such increase in oil content of the crop may also be due to role of sulphur in synthesis of oil sulphur is involved in the formation of glucocides, glucocynoates and sulphidril linkage and activation of enzymes which add in bio chemical reaction within the plant (Ravi *et al*., 2008) [11].

The increase in oil content with the application of sulphur and other micronutrients may be due to direct involvement in the synthesis of oil and an increase in oil content of the crop due to application of sulphur along with iron and zinc in the sulphur, Fe and Zn deficient soils is expected (Jena *et al.,* 2006) [6]. Similar results have also been reported on mustard by Misra *et al*., (2002) [9], Kumawat and Aswal (2005) [7], and Ghatei *et al.,* (2013) [5] and Debnath and Basu (2013) [2] and Tahir *et al*., (2014) [17].

3.2 Economics

The increase in net return might be due to the direct result of higher sesame yield. There are many criteria for the evaluation of treatments with each one having its own significance. For, the farmers, growing the crops for his livelihood and profit making by sale of produce, monetary return per unit of land or per rupee invested of foremost importance rather than growth, soil properties etc. The application of FYM @ 5 t ha^{-1} + vermicompost @ 2.5 t ha^{-1} to sesame crop obtained significantly maximum net return as ₹45531 ha^{-1} under the treatment M_3. The application of mineral nutrients at increasing level significantly influenced the net return. The application of S @ 20 kg ha^{-1} + Fe @ 10 kg ha^{-1} + Zn @ 5 kg ha^{-1} obtained significantly highest net return ₹ 47646 ha^{-1} under the treatment T_3 over control. The increasing nutrient demand may be fulfilled by integrated use of bio organics and mineral nutrients in most of the crops (Masood Ali and Mishra, 2000) [8]. Similar results have also been reported by Tiwari *et al.,* (2000) [20] and Dixit *et al.,* (2012) [4].

Table 1: Effect of organic manures and mineral nutrients on protein content, oil content oil yield and net returns of sesame

Treatments	Protein content (%)	Oil content (%)	Oil yield (kg ha^{-1})	Net returns (□ ha^{-1})
Organic manures				
M_0	18.01	42.17	224.88	25467
M_1	21.74	44.89	349.12	39913
M_2	23.26	47.36	422.02	29094
M_3	24.51	49.71	482.97	45531
SEm$\pm$	0.43	0.80	8.16	980.57
CD (P = 0.05)	1.23	2.32	23.57	2831.71
Mineral nutrients				
T_0	17.99	42.23	223.92	15305
T_1	21.74	44.92	348.17	34343
T_2	23.22	47.32	418.58	42711
T_3	24.56	49.66	488.54	47646
SEm$\pm$	0.43	0.80	8.16	980.57
CD (P = 0.05)	1.23	2.32	23.57	2831.71

4. Conclusion

Application of FYM @ 5 t ha^{-1} + Vermicompost @ 2.5 t ha^{-1} recorded significantly maximum quantity of quality parameters and net returns proved superiority over rest of the treatments. In mineral nutrients, application of S @ 20 kg ha^{-1} + Fe @ 10 kg ha^{-1} + Zn @ 5 kg ha^{-1} recorded significantly maximum quantity of quality parameters and net returns proved superiority over rest of the treatments.

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