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Effect of organic manures and mineral nutrients on growth, yield attributes and yield of sesame (*Sesamum indicum* L.)

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Abstract
A field experiment entitled "Effect of Organic Manures and Mineral nutrients on growth, yield attributes and yield 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 FYM @ 5 t ha^{-1} + Vermicompost @ 2.5 t ha^{-1} was significantly increased plant height, number of capsules per plant, number of seeds per capsule, seed and stalk yield over rest of the treatments. Results increasing levels of the mineral nutrient treatments revealed that the application of S @ 20 kg + Fe @ 10 kg + Zn @ 5 kg ha^{-1} significantly increased the growth parameter (plant height), yield attributes (number of capsules per plant and number of seeds per capsule), yield (seed and stalk yield) over rest of the treatments.

Keywords: Organic manures, mineral nutrients, growth, yield attributes and yield

Introduction
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.

Sulphur is a vital part of the ferrodoxins, which has a significant role in NO_2^- and SO_4^- reduction. On the other hand, sulphur deficiency may be responsible for poor flowering and fruiting of leaves, reddening of stems and petiole and stunted growth and adverse effect on yield of sesame crop. The iron is a structural component of porphyrin molecucles, cytochromes, heams, hematin, ferrichrome and leg- haemoglobin involved in oxidation-reduction reactions in respiration and photosynthesis. It is an important part of the enzyme nitrogenase which is essential for nitrogen fixation through nitrating bacteria. Iron in chloroplast reflects the presence of cytochromes performing various photosynthetic reduction processes. The ferrodoxin are Fe-S proteins and are the first stable redox compound of the photosynthetic electron transport chain.

Zinc being one of the essential micronutrient, plays significant role in various enzymatic and physiological activities of the plant body. It is also essential component of synthetic and natural organic complexes in plants. It promotes synthesis of growth hormone, seed maturation, starch synthesis, chlorophyll synthesis and regulates water absorption.

It is an important element for the stability of cytoplasmic ribosome, cell division, dehydrogenase, proteinase and peptidase enzymes and also help in the synthesis of protein and carotene.

Materials and methods

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.

The plant height of five selected plants at harvest of the crop was measured by tape from the base of plants (ground level) to the top of main stem in cm. Average value of plant height for each plot at harvest stage was computed and recorded separately. Average number of capsules per plant was recorded at harvest on the basis of five randomly selected plants from each net plot. Average number of seeds per capsule was recorded at harvest on the basis of five randomly selected plants from each net plot. The produce of each net plot was threshed out separately, cleaned and weighted separately and the seed yield was recorded and it was converted into kilogram per hectare (kg ha^{-1}).Stalk yield was obtained by subtracting the seed yield of each net plot from respective total dry matter and converted into kilogram per hectare (kg ha^{-1}).

Results and Discussion

Effect of organic manure and mineral nutrients on growth attributes:

Effect of organic manures on growth attributes:

Data presented in the table- 1 revealed that plant height of the crop significantly increased with increasing number of organic manure. The highest significant increase in growth attributes were recorded with the application of FYM @ 5 t ha^{-1} + vermicompost @ 2.5 t ha^{-1} (M_3) over control. Such significant increase in growth attributes with the application of FYM @ 5 t ha^{-1} + vermicompost @ 2.5 t ha^{-1} (M_3) not only might be due to improved physical, chemical and biological properties like water holding capacity, hydraulic conductivity, buffering effect, improved soil aggregation, aeration but may be due to balanced fertilization and availability of nutrients throughout the growth period specially at critical growth periods resulting in better uptakes. Deshmukh *et al.,* 2010, also reported increase in plant height, number of branches per plant of sesame was also recorded with application of FYM @ 10 t ha^{-1}+ vermicompost @ 5 t ha^{-1} coupled with seed treatment of Azospirillum. The Similar were also observed by Yadav *et al*. (2013) [18], Dahama *et al.* (2007) [17].

Table 1: Effect of organic manures and mineral nutrients on plant growth, yield attributes and yield of sesame

Treatments	Plant height(cm)	Capsules per plant	Number of seeds per capsule	Seed yield (kg ha^{-1})	Stalk yield (kg ha^{-1})
Organic manures					
M_0	82.85	33.51	47.13	533.28	1384.25
M_1	90.25	37.12	52.79	776.35	1901.73
M_2	97.35	40.01	57.14	891.11	2215.48
M_3	104.36	42.39	61.31	971.58	2405.88
SEm±	2.42	0.80	1.42	16.12	31.55
CD (P = 0.05)	6.99	2.31	4.10	46.56	91.10
Mineral nutrients					
T_0	81.98	33.31	47.17	530.25	1426.54
T_1	90.37	37.22	52.87	773.73	1839.89
T_2	97.74	40.07	57.14	884.58	2191.97
T_3	104.73	42.44	61.19	983.77	2448.94
SEm±	2.42	0.80	1.42	16.12	31.55
CD (P = 0.05)	6.99	2.31	4.10	46.56	91.10

Effect of mineral nutrients on growth attributes

The application of mineral nutrients *viz*. S, Fe and Zn as soil application resulted in significant in increase growth attributes and each additional supplementation of nutrients resulted in higher growth attributes, with minimum when no mineral nutrient was applied and maximum where all four nutrients were applied. The significantly better growth of plant in terms of plant height with the application of S + Fe + Zn (T_3) could be attributed to enhanced controlled release of nutrients from the added sources like S, Fe and Zn. Enhanced dry matter production might be due to improvement in nutrient uptake particularly iron and zinc along with N,P that have favourably influenced on carbohydrate metabolism and favourable sustained availability of nutrients that increased transformation of photosynthetic activity towards growing plant parts (Rahevar *et al*., 2015) [10]. The crop growth significantly increased with the use of micronutrients like Fe, Zn the result finding of Mousavi *et al.,* (2013) [9]; Chaudhari and Patel (2007) [2], Mavarkar *et al*., (2008) [7].

Effect of organic manures and mineral nutrients on yield attributes and yield

Effect of organic manures

The application of organic manures significantly increased the total number of capsules per plant, number of seeds per capsule, seed and stalk yield of sesame (Table 1). The significantly highest total number of capsules per plant, number of seeds per capsule, seed and stalk yield were recorded with the application of FYM @ 5 t ha^{-1} + Vermicompost @ 2.5 t ha^{-1} (M_3). Such increase in yield and have been reported to be associated with the release of macro and micro nutrients during the course of decomposition (Singh and Ram, 1992) [16].

The greater production of metabolites and their translocation to various sinks specially the reproductive structures (capsules, seeds and stalk) might have in increasing number of capsules per plant, seeds per capsule besides increasing the overall growth. Organic matter also function as sources of energy for soil micro flora which bring about the transformation of inorganic nutrients held in soil or applied in

the form fertilization in a form that is readily utilized by growing plants. The beneficial effects of organic manures are also related to improvement in soil physical properties (kofoed, 1987) [6]. Thus application of FYM could be owing to higher availability of plant nutrients which is conductive for physical environment leading to enhanced moisture holding capacity, better aeration, root activity and nutrient absorption which consequently in complementary effect and finally would have resulted in higher growth and yield of the crop (Rahevar *et al.,* 2015 and Fulmali *et al*., 2011) [10, 5].Application of FYM @ 5 t ha^{-1} significantly increased yield attributes viz. seed yield, straw yield over FYM @ 2.5 t ha^{-1} and control have also been reported by Singh and sinsinwar, (2006) [15]. The results are in agreement with those of Singh *et al.* (2011) [14], Dixit *et al.* (2012) [4].

Effect of mineral nutrition

The application of multi nutrients combination significantly increased the yield attributes and yield of sesame crop. The highly significant improvement in sesame was noticed under the treatment level T_3 (S + Fe + Zn). The application of mineral fertilizers alone might supply one or two nutrients only but conjoint use of macro and micro nutrient fertilizers and organic manure would provide all the essential nutrients in proper ratio to plant and soil and also reduces the possibilities of multiple micronutrients deficiency in particular. Iron is a structural component of porphyrin molecules: cytochromes, hemes, hematin, ferrichrome and leghemoglobin. These substances are involved in oxidation reductions in respiration and photosynthesis. It performs an essential role in nucleic acid metabolism. It is essential for many of the enzymatic transformations. Thus iron helps indirectly in crop production.

Likewise zinc is also involved in many enzymatic activities. It is important in the synthesis of tryptophan, a component of some proteins and a compound needed for the production of growth hormones like indole acetic acid (Meena *et al*., 2007, Bharti *et al*., 2010) [8, 1]. The similar findings corroborates were also reported by Shinde *et al*., (2011) [13], Raja *et al*. (2007) [11]. Ravi *et al*. (2008) [12] observed that combined application of sulphur with micronutrient (Fe, Zn) significant increase the growth, seed yield and straw yield.

Conclusion

In organic manures, application of FYM @ 5 t ha^{-1} + Vermicompost @ 2.5 t ha^{-1} recorded significantly maximum plant height, number of capsules per plant, number of seeds per capsule, seed yield and stalk yield of sesame 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 plant height, number of capsules per plant, number of seeds per capsule, seed yield and stalk yield of sesame proved superiority over rest of the treatments.

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