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Influence of Different Tree Born Oil Seed Cakes on Nutrition of Tomato (*Solanum lycopersicum* L.)

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Abstract A field experiment on different biofuel de-oiled cakes on productivity of tomato was carried out during *kharif* season of 2014 using randomized complete block design with 3 replications. The experiment included seven treatments of which five were de-oiled cakes of pongamia, neem, mahua, calophyllum and simarouba at 50% recommended N equivalent basis and supplementation of remaining NPK through inorganic fertilizers. The results revealed that application of neem cake at 50% N equivalent basis registered significantly higher yield, followed by pongamia cake at 50% N equivalent. Application of neem seed cakes at 50% N equivalent resulted in 107.38% of higher yield per hectare followed by pongamia cake (95.75%), than the control treatment. However, simarouba and calophyllum cakes, at 50% N equivalent failed to show tangible influence on growth and yield of tomato. Nutrient supply through oil-based cakes which is a form of organic manure will increase the productivity of the crop and also reduce the dependence on chemical fertilizers.

Keywords De-oiled cakes, Tree born oil seeds, Biodiesel, Tomato.

Introduction

Tomato (*Solanum lycopersicum* L.) is the world's largest grown vegetable crop after potato and onion. Tomato represents an essential part human diet, it is a good nutritional resource rich in vitamin C and antioxidants mainly lycopene, carotene, organic acids and phenols [1]. Nutrient management practices are important in tomato production, tomato responds well in integrated nutrient management system using organic manures. Supplementation of secondary and micro-nutrient through amendment and fertilizers depending on the soil condition can substantially increase the yield in tomato.

Farmers in the tropics have adopted the use of inorganic fertilizers, but intensive use of this over time have been reported to constitute a setback to soil, since it pollutes the underground water resources and increases soil acidity. However, vegetables cultivation by using organic manures are getting more important because of less chemical residues, better taste as well as their effect on soil health and environ-

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ment [2]. Nutrient supply through oil-based cakes which is a form of organic manure will not only reduce the dependence on chemical fertilizers but also improve the soil structure, encourage the growth and activity of beneficial organisms in the soil, alleviate the deficiency of secondary and micronutrients and sustain higher productivity due to improved soil health [3].

There has been growing interest in commercial plantations of biofuel crops, because of their ability to produce green fuel which can be used as an alternate for petroleum fuel. A substantial portion of the by-product of the biodiesel extraction process is the de-oiled cake [4]. Plants like pongamia *(Pongamia pinnata)*, neem *(Azadiricta indica)*, mahua *(Madhuca indica),* calophyllum *(Calophyllum inophyllum)* and simarouba *(Simarouba glauca)* have been identified as potential feedstock shrub/tree species for bio-diesel production. These bio-energy species yield non-edible oil seeds which are raw materials for bio-diesel production. The by-products obtained during the oil extraction process such as de-oiled cake and biomass can be used for organic farming as nutrients sources. The utility of neem oil seed cake as a fertilizer as well as a pesticide on economically important crops are well established. However, the studies on the manurial values of other biofuel crops on productivity of different crops and the impact of the application of these sources of plant nutrients on soil nutrient status are scanty [5]. Exploring the alternative uses of these organic by-products will go a long way in attracting biofuel industry, as it is the most important determinant factor for economic viability of bio-diesel production [6]. Considering the above facts, the present study was under taken to evaluate efficacy and effect of different biofuel oil seed cakes on yield of tomato.

Materials and Methods

A field experiment was conducted following randomized complete block design (RCBD) with seven treatments and three replications at the Biofuel Park, Madenur- Hassan during *kharif* season of 2014. The location is situated at an altitude of 423.7 m above mean sea level, and latitude of 13.00^0 North and Longitude of 76.09^0 East. The soil of the experiment site was red sandy loam soil with pH of 7.75, medium in available nitrogen (279.44 kg ha^{-1}), medium in available phosphorus (51.29 kg ha^{-1}) and medium in available potassium (260.467 kg ha^{-1}).

The drought tolerant tomato variety, Arka vikas developed by IIHR Bengaluru, was used as material for present study. The treatment plants were grown by application of different de-oiled cakes along with inorganic fertilizers as plant nutrients (Table 1). Different de-oiled cakes were obtained from the bio-diesel extraction and expeller unit of Biofuel Park, Hassan. These cakes were analyzed for their nutrients (NPK) content and are presented in Table 2. The seedlings of Arka vikas variety were transplanted at a spacing of 0.6 m × 0.6 m, after the spot application of nutrient combinations (Table 1). Recommended dose of NPK (115 : 100: 60 kg ha^{-1}) was applied inorganically using Urea, D.A.P and M.O.P for treatment T_6 along with Farm Yard Manure (FYM), for control treatment (T_7) no fertilizers were applied. The plants were well irrigated through drip irrigation. All other standard crop protection and production management practices were followed to raise healthy crop. The data on growth

Table 1. Description of treatments as different combination of organic and inorganic sources of nutrients applied.

Treatments	Treatments details
T_1	50% Recommended N through pongamia cake + supplementation of remaining NPK through inorganic fertilizers
T_2	50% Recommended N through neem cake+supplementation of remaining NPK through inorganic fertilizers
T_3	50% Recommended N through mahua cake+supplementation of remaining NPK through inorganic fertilizers
T_4	50% Recommended N through simarouba cake+supplementation of remaining NPK through inorganic fertilizers
T_5	50% Recommended N through calophyllum cake+ supplementation of remaining NPK through inorganic fertilizers
T_6	Recommended dose of nutrients (FYM and NPK fertilizers)
T_7	Absolute control (no fertilizer application)

Table 2. Nutrient content of different de-oiled cakes.

Sl. no.	Oil cake	pH	EC (ds/m)	OC (%)	Total N (%)	Total P (%)	Total K (%)
1	Pongamia	5.8	1.0	51.5	3.9	0.60	0.88
2	Neem	5.7	1.0	20.6	3.9	0.36	1.0
3	Mahua	4.7	1.6	51.9	1.5	0.29	0.36
4	Simarouba	5.6	0.9	53.9	7.1	0.38	0.5
5	Calophyllum	4.5	1.1	42.4	2.1	0.29	0.11

and yield parameters were recorded during the crop growth period and subjected to statistical analysis using analysis of variance (ANOVA). The weight of fruits harvested from each picking was recorded and total yield per plant was worked out by adding the yield of all harvests.

Results and Discussion

Different growth parameters like plant height, number of branches and number of leaves were recorded after 90 days of planting and the values are furnished in Table 3. The height of the plant varied from 52.27-63.30 cm and did not show any significant difference between the treatments. Highest numbers of branches were found in plants treated with neem cake (17.09), which was on par with pongamia cake application (15.98), whereas least number of branches was recorded in control plants (7.37). The value for total number of leaves showed significant variation with

Table 3. Effect of de-oiled cakes on growth parameters of tomato.

Treatments	Plant height (cm)	Total number of branches per plant	No. of leaves per plant	Days to first harvesting	Days to last harvesting
T_1	55.75	15.98*	62.91*	81.67	134.07*
T_2	63.30	17.09*	68.01*	77.67*	131.47*
T_3	53.10	12.87	52.80	81.80	132.27*
T_4	52.42	9.55	36.87	85.47	127.07*
T_5	56.56	9.00	37.32	87.47	127.07*
T_6	55.60	13.04	52.17	75.87*	114.00*
T_7	52.27	7.37	30.13	77.27*	113.93
SEm ±	17.57	1.40	9.19	6.77	34.47
CD (*p*= 0.05)	NS	2.1	5.39	4.627	10.44

Table 4. Effect of de-oiled cakes on yield and yield parameters of tomato.

Treatment	No. of fruits per	Fruit yield per plant (g)	Avg weight of fruit (g)	Yield (kg/ha)	% Change in yield over control
T_1	41.93	2.61	75.21*	76.38*	95.75
T_2	49.20*	3.14*	75.95*	80.92*	107.38
T_3	37.27	2.21	72.79*	61.54	57.71
T_4	27.33	1.45	60.19	40.28	3.23
T_5	27.53	1.41	59.26	39.11	0.23
T_6	39.80	2.31	72.73*	64.16	64.43
T_7	29.13	1.41	62.82	39.02	0.00
SEm ±	15.39	0.03	14.77	8.49	-
CD (*p*= 0.05)	6.98	0.35	6.83	5.18	-

maximum in neem cake treatment (68.01), which were at par with pongamia (T_1) i.e. 62.91. The number of days taken for first harvest was significantly lower in treatment T_6, T_7 and T_2, which was 75.87, 77.27, 77.67 days respectively, whereas delay in first harvest was observed in plants treated with calophyllum cake (87.47) followed by simarouba cake (85.47). Surprisingly all cake treated plants lasted for long time and significantly increased the days taken for the last harvest. This may be mainly because of slow and steady releasing of nutrients and inhibition of nitrification which makes the availability of nitrogen for longer period. The nitrification inhibition property of neem and pongamiz cakes has been emphasized by several workers [3, 7].

The application of de-oiled cakes on tomato registered yield of 1.41– 3.14 kg plant^{-1}. The yield of tomato was tangibly influenced by the application of neem and pongamiz cakes. Neem cake registered significantly higher number of fruits and yield per plant than all other treatments with yield of 3.14 kg plant^{-1} from 49 fruits, followed by pongamia cake which recorded yield of 2.61 kg plant^{-1} from 42 fruits. Significantly higher yield of 80.92 t ha^{-1} was recorded in neem cake applied plot which was on par with pongamia cake treatment (76.38 t ha^{-1}). Application of neem cakes at 50% N equivalent resulted in 107.38% of higher yield ha^{-1} followed by pongamia cake (95.75%) than the control treatment (Table 4). Moreover, they were in the field for longer period than other treated plants. There exist synergistic effect of

Azadirachtin and karinjin on release of nitrogen and yield of crop [8, 9]. Since, during application of basal dose fertilizers, they were mixed with cakes which would have increased the use efficiency of nitrogen. Moreover, significantly higher yield in neem cake treated plants indicate the profound influence of neem cake on yield of tomato. In okra application of neem seed cake significantly influenced the growth and yield, resulting in 75.81% higher yield over the control [10]. Replacement of 50% basal N through Jatropha cake recorded up to 8% increase in maize grain yield and 27% increase in soybean grain yield over sole use of chemical fertilizers [11].

However, mahua cake did not show any tangible influence on growth and yield of tomato. Mahua cake takes two months for decomposition [12], and this long duration for release of nutrient might be responsible for lesser yield than plants treated with recommended dose of nutrients (T_6). Application of simarouba and calophyllum cakes recorded yield of 1.41 and 1.45 kg plant^{-1} which is similar to yield obtained in control plants (T_7), which is a matter of concern. Simarouba cake did not perform well even though it has good quantity of nutrients (higher than any other cakes). Most of the oilcakes possess certain bioactive compounds specific to the particular plant species. These compounds act as an allelopathic agent, which restricts it to use as a fertilizer agent. In fact, several studies have reported phytotoxic and antimicrobial effects of different oil cakes due to its phenol, organic acids and other complex constituents [13, 14]. This might be the reason for poor growth in simarouba and calophyllum treated plants. However, report on effect of simarouba and calophyllum cakes on growth and yield is very scanty and further study in this aspect is required.

References

1. Giovanelli G, Paradiso A (2002) Stability of dried and intermediate moisture tomato pulp during storage. J Agric Food Chem 50 : 277—281.
2. Rani SN, Mallareddy M (2007) Effects of different organic manures and inorganic fertilizers on growth, yield and quality of carror. Karnataka J Agric Sci 20 : 686—688.
3. Elnasikh MH, Osman AG, Sherif AM (2011) Impact of neem seed cake on soil microflora and some soil properties. J Sci Tech 12 : 144—150.
4. Chaturvedi S (2011) Influence of composted biodiesel cake on growth, yield and micronutrient composition of tomato. Communications in Soil Sci and Pl Analysis 42 : 642—653.
5. Ramesh S, Balakrishnagowda, Raghu HB, Shivakumar BC (2009) Manurial value of by products of bio-fuel feed stocks on finger millet grain and dry fodder produity. J Appl and Natural Sci 1 : 241—249.
6. Parikh J, Walia A (2002) Techno-economic assessment of bio-energy in India. Technology Information Forecasting and Assessment Council (TIFAC), Ministry of Science and Technology, Government of India, New Delhi.
7. Majumdar D (2008) Un exploited botanical nitrification inhibitors prepared from Karanja plant. Natural Product Radiance 7 : 58—67.
8. Usha K, Patra DD (2003) Medicinal and aromatic plant materials as nitrification inhibitors for augmenting yield and nitrogen uptake of Japanese mint (*Mentha arvensis* L. var piperascens). Bioresour Technol 86 : 267—277.
9. Chaturvedi S, Kumar V, Satya S (2009) Composting effects of *Pongamia pinnata* on tomato fertilization. Arch Agro Soil Sci 55 : 535—546.
10. Eifediyi EK, Mohammed KO, Remison SU (2015) Effects of neem (*Azadirachta indica* L.) Moench). Poljoprivreda 21 : 46—52.
11. Wani SP, Chander G, Sahrawat KL, Rao NP (2014) Integrated nutrient management using de-oiled Jatropha cake for sustained and economic food production. Int J Pl Prod 8 : 549—562.
12. Gill PS, Singh H (1960) A note on the effect of mahua cake on the chemical properties of soil and yield and quality of sugarcane. Ind J Sugarcane Res and Develop 4 : 181—182.
13. Linares JM, Caba F, Ligero T, Rubia D, Martinez J (2003) Detoxification of semisolid olive-mill wastes and pine-chip mixtures using *Phanerochaete flavidoalba.* Chemosphere 51 : 887—891.
14. Martin J, Sampedro I, Garcia RI, Garrido JM, Ocampo JA (2002) Arbuscular mycorrhizal colonization and growth of soybean *(Glycine max)* and lettuce *(Lactuc sativa)* and phytotoxic effects of olive mill residues. Soil Biol Biochem 34 : 69—75.