J Krishi Vigyan 2022, 11 (1) : 352-356 DOI : 10.5958/2349-4433.2022.00159.3

Use of Organic Nano NPK Affects Yield and Profitability in Seasame

A S Sruthi[1], M Indira[2] and Atul Jayapal[3]

Onattukara Regional Agricultural Research Station, Kayamkulam- 690502, Alappuzha
Kerala Agricultural University, Vellanikkara, Thrissur, 680656 (Kerala)

ABSTRACT

Nano fertilizers are gaining much importance in agriculture as they are required only in lower quantity which will help farmers to reduce the cost incurred for cultivation and improve the crop output. An experiment was carried out during December 2020 to March 2021 to investigate the profitability in sesame cultivation due to soil application of organic nano NPK at Onattukara region in Kerala. Ten treatments were arranged in randomized block design and were replicated thrice. The treatments consisted of 2 levels of organic nano NPK (25 kg/ha and 50 kg/ha) with FYM and without FYM, combination of organic nano NPK (25 kg/ha and 50 kg/ha) and 50 per cent recommended dose of NPK with FYM and without FYM, soil test based recommendation of NPK and FYM along with absolute control. It was found that the soil application of organic nano NPK 50 kg/ha and FYM 5t/ha (T_6) had significantly produced higher seed yield (712.5 kg/ha). Subsequently, higher gross returns (Rs. 2,13,750/-), net returns (Rs. 1,06,554/-) and BC ratio (1.99) for sesame was obtained for T_6 treatment.

Key Words: BC ratio, Gross returns, Organic nano NPK, Sesame, Yield.

INTRODUCTION

This century is turning out to be an era of nanotechnology in almost every aspects including agriculture. In the agricultural production sector, nano fertilizer is an important contribution of nanotechnology. The use of conventional fertilizers is limited by their low nutrient use efficiencies and high environmental impacts. Thus, the farmers are forced to use more productive, economical, environment friendly and sustainable source of fertilizers. Nano fertilizers can be the best alternative for traditional fertilizers and have the potential to revolutionize the agricultural sector (Shukla *et al,* 2019). Nano fertilizers are fertilizers whose particles are present in nanoscale dimension (1-100 nm). This nano size enables the faster translocation of nutrients into the targeted sites (Qureshi *et al,* 2018). Thus, nano fertilizers can improve the yield and profitability of the crops (Nibin, 2019; El-Azeim *et al*, 2020). Organic nano NPK is a commercial product of nano NPK marketed by Tropical Agrosystems Pvt. Ltd.

Sesame is a major oil seed crop in India. India ranks first in sesame production in the world with 8.66 Lakh tonne production and 19.47 lakh ha area. Average productivity of sesame is 413 kg/ ha (Evangilin *et al,* 2020). In Kerala, Onattukara is the major sesame producing tract which cultivates sesame in the garden lands as well as in the summer rice fallows. Apart from its higher oil content, sesame is a source of various nutritional components like vitamins, minerals, phytosterols and lignans, which provides numerous health benefits to humans. Presence of antioxidants, lignans (sesamin and sesaminol) and tocopherol homologues in oil reduce the activity of reactive oxygen species and

[1]Corresponding Author's Email : sruthias8600@gmail.com

[1]M. Sc. Scholar, Deptt of Soil Science and Agricultural Chemistry, College of Agriculture, Vellayani-695522, Thiruvananthapuram, Kerala.

[2]Professor and Head (Rtd), Soil Science and Agricultural Chemistry, Agricultural Research Station, Thiruvalla, Pathanamthitta, Kerala

[3]Assistant Professor (Agronomy), On Farm Research Centre, Kayamkulam- 690502, Alappuzha, Kerala

prevents the oxidative rancidity, which improves the keeping quality of the oil (Pathak *et al,* 2014). Onattukara sandy plain falling in the agro ecological unit 3, is a special agro ecological zone delineated for the sandy plains of Alappuzha, Kollam and Pathanamthitta districts which is inherently limited by low organic matter and low nutrient status of the soil. The present study was undertaken to improve the yield and profitability in sesame cultivation with soil application of organic NPK in Onattukara.

MATERIALS AND METHODS

The field experiment was conducted at Onattukara Regional Agricultural Research Station, Kayamkulam, Kerala from December, 2020 to March, 2021. The sesame variety Thilak which was released from Onattukara Regional Agricultural Research Station, Kayamkulam was used for the experiment. It has an average yield is 600-650 kg/ ha. Initial analysis of soil indicated that the soil had a low N (154.71 kg/ha), high P (44.60 kg/ha) and low K (125.84 kg/ha) status. The soil was also found deficient in secondary nutrients (exchangeable Ca- 80.37 mg/kg, exchangeable Mg- 7.74 mg/kg, available sulphur -0.98 mg/kg) and boron (0.39 mg/kg). The remaining micronutrients were found sufficient with respect to the available nutrient status (Fe- 44.79 mg/kg, Mn- 1.48 mg/ kg, Zn- 3.90 mg / kg and Cu-1.75 mg/ kg). The seeds were dibbled at spacing of 0.25 m x 0.15 m. The experiment was laid out in Randomized Block Design (RBD) with 10 treatments and 3 replications. The general recommended dose of organic nano NPK was 25 kg/ha. Therefore, a blanket recommendation of fertilizers was given to the plots. The treatments applied were T_1- Soil application of organic nano NPK formulation 25 kg/ha, T_2 – Soil application of organic nano NPK formulation 25 kg/ha + FYM 5 t/ha, T_3 - Soil application of organic nano NPK formulation 25 kg/ha + 50 per cent of recommended dose of NPK, T_4 - Soil application of organic nano NPK formulation 25 kg/ha + FYM 5 t/ ha + 50 per cent of recommended dose of NPK, T_5 - Soil application of organic nano NPK formulation 50 kg/ ha, T_6 - Soil application of organic nano NPK formulation 50 kg/ha + FYM 5 t/ha, T_7 - Soil application of organic nano NPK formulation 50 kg/ ha + 50 per cent of recommended dose of NPK, T_8 - Soil application of organic nano NPK formulation 50 kg/ha + FYM 5 t/ ha + 50 per cent of recommended dose of NPK, T_9 - Soil test based recommendation of NPK + FYM 5 t/ha and T_{10} - Absolute control. The recommended dose of NPK for sesame was 30:15:30 kg NPK/ha (KAU, 2016). The seed yield and straw yield from the observational plants were recorded at harvest and were expressed in kg/ha. Economic parameters like cost of cultivation and gross returns were calculated and net returns and BC ratio were worked out as follows.

Net returns (Rs./ha) = Gross returns (Rs./ha) - Cost of cultivation (Rs./ha)

BC ratio = Gross returns (Rs./ha) / Cost of cultivation (Rs./ha)

RESULTS AND DISCUSSION

Seed yield

The organic nano NPK treatments showed significant improvements in the yield of sesame (Fig. 1). Soil application of organic nano NPK (T_6) produced significantly higher seed yield (712.5 kg/ ha) among the treatments, which was followed by treatment T_8. The absolute control (T_{10}) recorded the lowest seed yield (499 kg/ha). Even though the nutrients applied in T_8, were higher than that of T_6, the reduction in yield might be due to the loss of chemical fertilizers by leaching or run off from the soil by the rain that received during the experimental period. A 42 per cent increase in seed yield was obtained in treatment T_6 than absolute control. This increase in yield might be due to the availability of sufficient amount of nutrients at the critical growth stages of crop growth. Addition of FYM might have also increased the nutrient availability by its decomposition and binding of nutrients. The reduced size of the nano formulation would have enhanced the nutrient uptake and its translocation. This is in agreement with the findings

of Merghany *et al* (2019) who had reported that the foliar application of 6 ml of nano NPK resulted in 53.42 per cent yield increase in cucumber. El-Karamity *et al* (2020) found that replacing 50 per cent recommended dose of N through nano N resulted in highest yield in sesame when grown as an intercrop with maize. Similar results were also obtained by Kumar *et al* (2022) in sesame. Earlier, Manikandan and Subramanian (2016) had also reported 38 per cent higher yield than conventional urea fertilization in maize due to the application of nanozeourea [nanozeolite and urea (1:1 ratio) in intercalated form].

Straw yield

Fig. 2 depicts the influence of organic nano NPK on the fresh straw yield of sesame. The highest straw yield (9287.01 kg/ha) was registered in treatment T_5 (organic nano NPK formulation 50 kg/ha) which was found to be on a par with treatment T_6 (organic nano NPK formulation 50 kg/ha + FYM 5 t/ha) with 9055.52 kg/ha. All the treatments yielded significantly higher straw than absolute control. The increased nutrient uptake might have enhanced photosynthesis and subsequently the straw yield. This result was in line with the findings of Kandil and Marie (2017) who had reported that amino mineral nano fertilizer application improved the straw yield in wheat.

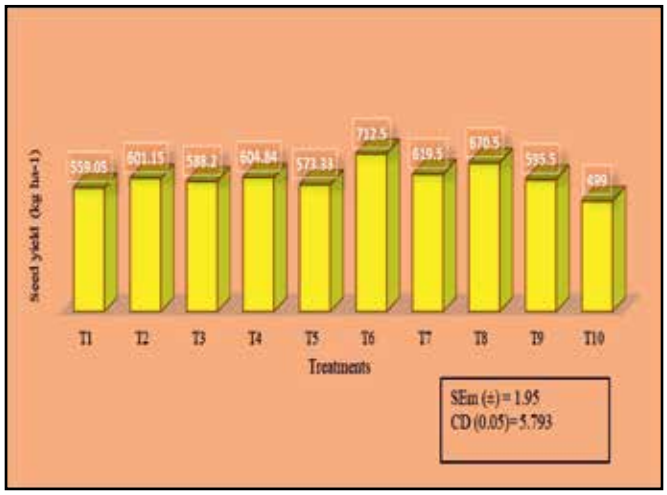

Fig. 1. Influence of organic nano NPK formulation on seed yield of sesame (kg ha^{-1})

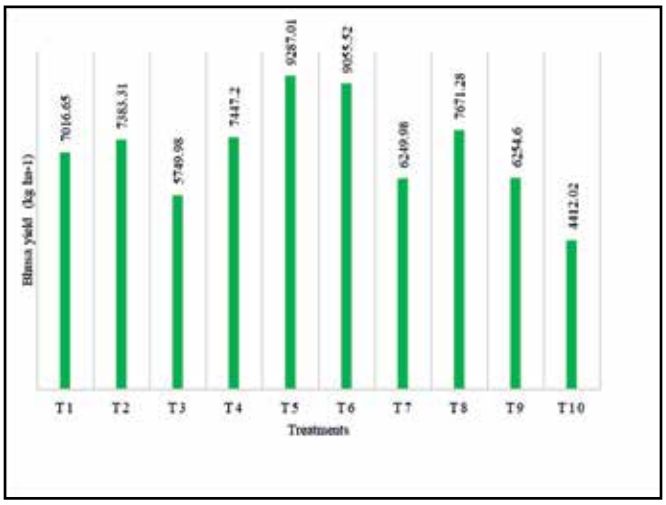

Fig. 2. Influence of organic nano NPK formulation on straw yield of sesame (kg ha^{-1})

Economics of cultivation

Cost of cultivation

The cost of cultivation was found to be significantly highest (Rs. 109978/-) in the treatment T_8 followed by treatment T_6 (Rs. 107196/-) as indicated in Table 1. This was due to the higher input cost and labour charge prevalent in Kerala. The treatments containing organic nano NPK and FYM have resulted in higher cost of cultivation because of the higher cost of organic nano NPK (Rs 130/Kg) and the higher requirement of FYM. The cost of chemical fertilizers were comparatively lower and available on subsidized amount. The increased cost of cultivation was counter balanced by the improved yield and higher market price of sesame (Rs.300/ ha). Similar results were obtained by Sankar *et al* (2020) in baby corn.

Gross returns

Table 1 depicts the gross returns obtained from sesame cultivation due to soil application of organic nano NPK. Significantly higher gross returns (Rs. 213750/-) were obtained from the treatment T_6 since it had produced the highest seed yield. Absolute control (T_{10}) recorded lowest gross returns (Rs. 149700/-). This result was in line with Nibin (2019) who reported that application of organic nano NPK formulations improved the returns in Okra.

Table 1. Cost of cultivation, gross returns, net returns and BC ratio of sesame by the application of organic nano NPK.

Treatment	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	BC ratio
T_1: Organic nano NPK (25 kg ha^{-1})	92865	167715	74850	1.81
T_2: Organic nano NPK (25 kg ha^{-1}) + FYM (5 t ha^{-1})	104005	180345	76340	1.73
T_3: Organic nano NPK (25 kg ha^{-1}) + 50 per cent recommended dose of NPK	95075	176460	81385	1.86
T_4:Organic nano NPK (25 kg/ha) + FYM (5 t/ha) + 50 per cent recommended dose of NPK	104885	181452	76567	1.73
T_5: Organic nano NPK (50 kg/ha)	98341	171999	73658	1.75
T_6: Organic nano NPK (50 kg/ha) + FYM (5 t/ha)	107196	213750	106554	1.99
T_7: Organic nano NPK (50 kg/ha) + 50 per cent recommended dose of NPK	98541	185850	87309	1.89
T_8: Organic nano NPK (50 kg/ha) + FYM (5 t/ha) + 50 per cent recommended dose of NPK	109978	201150	91172	1.83
T_9: Soil test based recommendation of NPK + FYM (5 t/ha)	93828	178650	84822	1.90
T_{10}: Absolute control	89426	149700	60274	1.67
SEm (±)	-	584.52	584.52	0.01
CD (0.05)	-	1736.706	1736.706	0.034

Net returns

The net returns (Table 1) were found to be significantly higher for the treatment T_6 (Rs. 106554). This might be due to the higher yield produced from the treatment. In the case of absolute control (T_{10}), a net return of only Rs. 60274/- was produced which was due to the lower seed yield. Even though the yield of soil test based recommendation of NPK and FYM (T_9) was not much pronounced among various organic nano NPK treatments, it provided a much higher net returns (Rs. 84821/-) as the cost incurred for cultivation was low. Similar results were obtained by Spruogis *et al* (2013) in spring barley.

Benefit Cost ratio

The significantly higher yield produced from the treatment T_6 had resulted in the highest BC ratio (1.99) which was followed by the application of soil test based recommendation of NPK and FYM (T_9 -1.90). The range of BC ratio of the treatments were narrow (1.67-1.99) which might be due to the higher cost of cultivation in organic nano NPK and FYM applied treatments. The application of organic nano NPK had improved the profit for sesame cultivation by increasing the yield of the crop. This result was in agreement with Panda *et al* (2020) who reported that the application of nano

NPK improved the BC ratio of tomato. El-Azeim *et al* (2020) also got similar results by the foliar spray of nano NPK fertilizer in potato.

CONCLUSION

The present study to improve the profitability in sesame cultivation with soil application of organic NPK in Onattukara revealed that the soil application of organic nano NPK had produced higher seed yield and straw yield in sesame. This increased yield had subsequently enhanced the gross returns, net returns and BC ratio. Even though, the cost of cultivation for treatments with organic nano NPK was higher than the soil test based recommendation, the higher yield for the organic nano NPK treatments have justified its use by giving a higher profit. Hence, it was concluded that the soil application of organic nano NPK formulation (50 kg/ha) along with FYM (5 t/ha) was sufficient for profitable sesame cultivation in the constrained sandy soils of Onattukara.

REFERENCES

El-Azeim M M A, Sherif M A, Hussien M S, Tantawy I A A and Bashandy S O (2020). Impacts of nano and non-nanofertilizers on potato quality and productivity. *Acta Ecol Sin* **40** (5): 388-397.

El-Karamity A H, Ahmed N and Mohamad A N (2020). Effect of intercropping of some oil summer crops with maize under levels of mineral N and nano N fertilizers. *Scientific J Agril Sci* **2** (2): 90-103.

Evangilin N P, Murthy B R, Naidu M and Aparna B (2020). Statistical model for forecasting area, production and productivity of Sesame crop (*Sesamum indicum* L.) in Andra Pradesh, India. *Int J Curr Microbiol App Sci* **9** (7): 1156-1166.

Kandil E E and Marie E A (2017). Response of some wheat cultivars to nano, mineral fertilizers and amino acids foliar application. *Alex Sci Exch J* **38**: 53-68.

KAU [Kerala Agricultural University] (2016). *Package of Practices Recommendations: Crops* (15th Ed.). Kerala Agricultural University, Thrissur, 392p.

Kumar A, Singh K, Verma P, Singh O, Panwar A, Singh T, Kumar Y and Raliya R (2022). Effect of nitrogen and zinc nanofertilizer with the organic farming practices on cereal and oil seed crops. *Sci Rep* **12**, 6938.

Manikandan A and Subramanian K S (2016). Evaluation of zeolite based nitrogen nano-fertilizers on maize growth, yield and quality on inceptisols and alfisols. *Int J Plant Soil Sci* **9** (4): 1-9.

Merghany M, Shahein M M, Sliem M A, Abdelgawad K F and Radwan A F (2019). Effect of nano-fertilizers on cucumber plant growth, fruit yield and its quality. *Plant Arch* **19** (2): 165-172.

Nibin P M (2019). Organic nano NPK formulations for enhancing soil health and productivity. Ph. D. Thesis, Kerala Agricultural university, Thrissur, 276p.

Panda J, Nandi N, Mishra S P, Pal A K, Pattnaik A K and Jena N K (2020). Effects of nano fertilizer on yield, yield attributes and economics in tomato (*Solanum lycopersicum* L.). *Int J Curr Microbiol Appl Sci* **9** (5): 2583-2591.

Pathak N, Rai A K, Kumari R and Bhat K V (2014). Value addition in sesame: A perspective on bioactive components for enhancing utility and profitability**.** *Pharmacogn Rev* **8** (16): 147–155.

Qureshi A, Singh D K and Dwivedi S (2018). Nano-fertilizers: a novel way for enhancing nutrient use efficiency and crop productivity. *Int J Curr Microbiol Appl Sci* **7** (2): 3325-3336.

Sankar L R, Mishra G C, Maitra S and Barman S (2020). Effect of nano NPK and straight fertilizers on yield, economics and agronomic indices in baby corn (*Zea mays* L.). *Int J Chem Stud* **8** (2): 614-618.

Shukla P, Chaurasia P, Younis K, Qadri O S, Faridi S A and Srivastava G (2019). Nanotechnology in sustainable agriculture: Studies from seed priming to post-harvest management. *Nanotechnol Environ Eng* **4** (1): 11-26.

Spruogis V, Dautarte A, Gavenauskas A and Bartkevicius E (2013). The Influence of universal bioorganic nano fertilizer NAGRO on spring barley crop productivity. In: *Proceeding of the International Scientific Conference on Rural Development* **6**: 441-445.

Received on 20/02/2022 *Accepted on 15/07/2022*