Int.J.Curr.Microbiol.App.Sci (2019) *8*(4): 1814-1819

EXCELLENT PUBLISHERS

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 8 Number 04 (2019)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2019.804.210

Organic Nano NPK Formulations on Soil Microbial and Enzymatic Activities on Post-harvest Soil of Bhindi

P.M. Nibin[1*], K. Ushakumari[1] and P.K. Ishrath[2]

[1]Department of Soil Science and Agricultural Chemistry, College of Agriculture, Vellayani - 695 522, Kerala Agricultural University, Dist. Thiruvananthapuram (Kerala), India
[2]Department of Agronomy, College of Agriculture, Vellayani - 695 522, Kerala Agricultural University, Dist. Thiruvananthapuram (Kerala), India

**Corresponding author*

Keywords

Organic nano NPK, Microbial load and enzymatic activities

Article Info

Accepted:
15 March 2019
Available Online:
10 April 2019

A B S T R A C T

Nano-fertilizer technology is designed to deliver nutrients in a regulated pattern in correspondence with the crop demand thereby nutrient use efficiency can be improved without associated ill-effects. The present investigation was conducted to study the effect of soil and foliar application of organic nano NPK formulations on microbial load (bacteria, fungi and fungi) and their role in improving the enzymatic activities (dehydrogenase, acid phosphatase, alkaline phosphatase and urease) of the experimental soil. The field experiment was carried out during the year 2017-18 at College of Agriculture, vellayani. Fertilizer samples were analysed and particle size of granular organic nano NPK and liquid organic nano NPK were 89.26 nm and 67.30 nm respectively. Zeta potential of the organic nano NPK formulations was -14.4 mV means the organic nano NPK formulations was considered to be highly stable. The soil samples were collected at the final harvest of the crop for calculating the microbial load and enzymatic activities of the soil. From the result it was indicated that among the different treatment combinations, application of FYM (12 t ha^{-1}) + Soil application of nano NPK (12.5 kg ha^{-1}) + Foliar application of nano NPK (0.4%) recorded the highest bacterial count, dehydrogenase, urease and acid phosphatase content in the post harvest status of the soil.

Introduction

Nanotechnology encompasses a range of technologies related to the manipulation of matter at the length scale of 1–100 nm. Each nanometre is one-billionth of a metre or one-millionth of a milli-metre. Particles on the scale of less than 100 nm fall in a transitional zone between individual atoms or molecules and corresponding bulk material, which can lead to dramatic modifications in the physical and chemical properties of the material. Nanotechnology has already been extensively exploited in the fields of energy, environment, electronics and health sciences and rarely studied in agricultural sciences. While nanotechnology applications in agriculture have been somewhat slower to develop, industrial and academic interest in this field is growing. A series of reviews released over the past several years have focused on the prospects for nanotechnology in fertilizer and plant protection products suggesting an increased awareness of the field's potential (Gogos *et al.,* 2012; Ghormade *et al.,* 2011; Hong *et al.*, 2013; Nair *et al.*, 2010).

Nano-fertilizers are known to improve the nutrient use efficiencies as a result of the large surface area and small size of the nano-materials that allow sustained release, enhanced interaction and efficient uptake of nutrients for crop fertilization (DeRosa *et al.*, 2010; Subramanian *et al.*, 2015). The integration of nanotechnology in fertilizer products may improve release profiles and increase uptake efficiency, leading to significant economic and environmental benefits.

Materials and Methods

Okra [*Abelmoschus esculentus* (L.) Moench] is one of the warm season vegetables having high nutritive value as well as foreign exchange potential. Varshauphar is the most acceptable and widely cultivated variety in India. A field experiment was conducted with bhindi crop (VarshaUphar) in sandy clay loam soil at College of Agriculture, Vellayani during 2017-18 by using Lattice Design with sixteen treatments including control plot with three replications. The treatments are as follows:

T_1: Soil application of nano NPK (12.5 kg ha^{-1}),
T_2: FYM (12 t ha^{-1}) + Soil application of nano NPK (12.5 kg ha^{-1}),
T_3: Soil application of nano NPK (25 kg ha^{-1}),
T_4: FYM (12 t ha^{-1}) + Soil application of nano NPK (25 kg ha^{-1}),
T_5: Soil application of nano NPK (50 kg ha^{-1}),
T_6: FYM (12 t ha^{-1}) + Soil application of nanoNPK (50 kg ha^{-1}),
T_7: Foliar application of nano NPK (0.2%),
T_8: FYM (12 t ha^{-1}) + Foliar application of nano NPK (0.2%),
T_9: Foliar application of nano NPK (0.4%),
T_{10}: FYM (12 t ha^{-1}) + Foliar application of nano NPK (0.4%),
T_{11}: Soil application of nano NPK (12.5 kg ha^{-1}) + Foliar application of nano NPK (0.4%),
T_{12}:.FYM (12 t ha^{-1}) + Soil application of nano NPK (12.5 kg ha^{-1}) + Foliar application of nano NPK (0.4%),
T_{13}: Soil application of nano NPK (25 kg ha^{-1}) + Foliar application of nano NPK (0.2%), T_{14}: FYM (12 t ha^{-1}) + Soil application of nano NPK (25 kg ha^{-1}) + Foliar application of nano NPK (0.2%),
T_{15}: KAUPOP (FYM 12 t ha^{-1} NPK 110:35:70 kg ha^{-1}) and
T_{16}: Absolute control.

Granular organic nano NPK formulation have applied as basal dose. Foliar application of liquid organic nano NPK formulations were applied at 15 days interval. The data collected from the experiment were subjected to statistical analysis as per standard procedures using R package.

Using zeta sizer analyser, size of organic nano NPK fertilizers were recorded. Size of granular organic nano NPK was 89.26 nm and liquid nano NPK was 67.30 nm. The zeta potential of supernatant solution was determined using and zeta potential analyzer. Zeta potential of granular organic nano NPK was -14 mV and from the result it was clear that the organic nano NPK formulations were highly stable (Fig. 1–3).

Results and Discussion

Effect of organic nano NPK formulations on soil enzymatic activities

The treatment which received FYM (12 t ha^{-1}) + Soil application of nano NPK (12.5 kg ha^{-1})

+ Foliar application of nano.NPK.(0.4%) was registered the highest enzyme activities *viz.*, dehydrogenase (31.14 µg of TPF g^{-1} soil 24 h^{-1}), acid phosphatase activities (92.76 µg of p- nitrophenol g^{-1} soil h^{-1}) and urease activities (33.75 ppm urea g^{-1}soil h^{-1}). Absolute control plot showed the lowest enzymatic activities of the experimental soil. Presence of microbial activity increased the content of enzyme activities.Soil enzymes are considered as the best indicator of microbial diversity of a soil as they are secreted by the microorganisms extracellularly and help in nutrient recycling and microbial propagation (Pandey *et al.,* 2010). The level of soil enzymes indicates the change in microbial activities due to their sensitivity for changes in soil. These phosphorous mobilizing enzymes help in the mobilization of native phosphorous existing in rhizosphere in the complex form with calcium, iron, or aluminum. Which suggests the enhancement in microbial population and activity in the rhizosphere that may also add in enhancement of nutrient mobilization and availability of nutrients for plants uptake (Table 1).

Effect of organic nano NPK formulations on soil microbial population of post harvest soil

The influence of organic nano NPK formulations on soil microbial populations in post harvest soil varied significantly and the mean values ranged from 6.41 to 7.77 log cfu g^{-1} soil [FYM (12 t ha^{-1}) + Soil application of nano NPK (12.5 kg ha^{-1}) + Foliar application of nano. NPK (0.4%)] recorded the highest total bacterial count. The lowest count was noticed in T_{16} (Absolute control) 6.41 log cfu g $soil^{-1}$.

Table.1 Influence of organic nano NPK formulations on soil enzyme activity

Treatments	Dehydrogenase (µg of TPF g^{-1} soil 24 h^{-1})	Urease (ppm urea g^{-1}soil h^{-1})	Acid phosphatase (µg of p-nitrophenol g^{-1} soil h^{-1})	Alkaline phosphatase (µgof p- nitrophenolg^{-1} soil h^{-1})
T1	11.32 de	31.78 cd	44.26 f	3.23abcd
T2	14.08 d	32.08 c	64.89 cd	**4.09 a**
T3	13.12 de	30.75 d	51.29 def	3.41abc
T4	16.78 cd	32.39 bc	81.41ab	4.23 a
T5	13.95 d	31.88 c	53.77 def	3.55abc
T6	15.65 d	33.59 a	84.99 ab	3.45 abc
T7	14.52 d	33.44 ab	57.83 cdef	3.82ab
T8	17.66 cd	31.99 c	53.93 def	2.86 abcde
T9	27.83 ab	32.47 bc	54.79def	2.45bcde
T10	15.29 d	32.07 c	53.80def	2.77 abcde
T11	15.48 d	31.98 c	61.37cde	2.18 cde
T12	31.14 a	33.75 a	92.76 a	1.77 de
T13	22.26 bc	32.82abc	70.95bc	2.40 bcde
T14	27.06 ab	33.68 a	90.39 a	3.95 ab
T15	11.38 de	31.97 c	51.76 def	2.68 abcde
T16	7.42 e	29.40e	48.65 ef	1.54 e

Table.2 Influence of organic nano NPK formulations on soil microbial population of post harvest soil, log cfu g soil^{-1}

Treatments	Bacteria	Fungi	Actinomyctes
T1	6.78 g	4.02 cd	3.64 h
T2	6.88 e	4.04 cd	3.88 b
T3	7.49 b	4.30 a	3.81 de
T4	6.58 i	4.14 bc	3.70 g
T5	6.31 k	4.04 cd	3.72 fg
T6	7.73 a	4.18 b	3.84 c
T7	7.16 c	3.97 de	3.73 f
T8	6.97 d	4.23 ab	3.79 e
T9	6.74 h	4.12 bc	3.74 f
T10	6.83 f	4.06 cd	3.84 c
T11	6.61 i	4.19 ab	3.74 f
T12	7.77 a	3.95 de	3.83 cd
T13	6.84 ef	4.21 ab	3.80 e
T14	6.27 k	4.21 ab	3.96 a
T15	6.72 h	3.88 e	3.75 f
T16	6.41 j	3.96 de	3.56 i

Fig.1 Particle size analysis of Organic nano NPK (Granular)

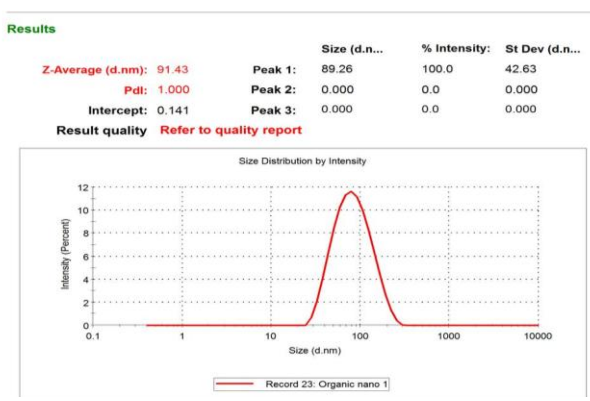
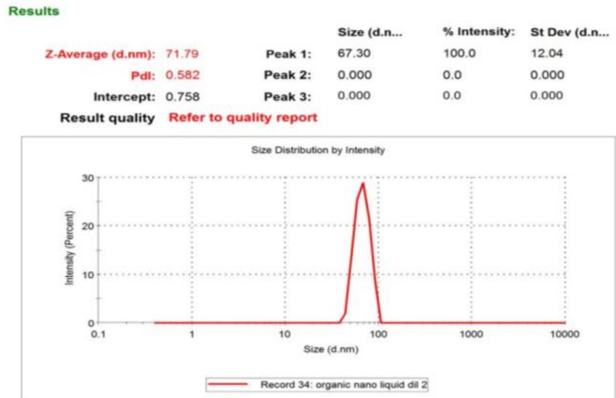


Fig.2 Zeta potential of organic nano NPK

Fig.3 Particle size analysis of organic nano NPK (Liquid)



The analysis of the data (Table 2) inferred that the different treatments effects were significant and the mean values ranged from 3.96 to 4.30 log cfu g soil^{-1}. Absolute control with mean of 3.96 log cfu g soil^{-1} recorded the lowest fungal population. Critical appraisal of the data shows that the different treatments have significant effect for the actinomycetes count. The highest mean value for different treatments effect was recorded by the T14 (FYM (12 t ha^{-1}) + Soil application of nano NPK (25 kg ha^{-1}) + Foliar application of nano NPK (0.2%)) with mean population of 3.96 log cfu g soil^{-1} (Absolute control) recorded the lowest count of 3.56 log cfu g soil^{-1}.Nano-composite slow release fertilizer stimulated the growth of microbes by providing nutrients and directly increased the population. An increased availability of N, P, K and Zn which is preferentially assimilated by microorganisms (Paul and Clark, 1996), but normally rather limited in soil, enables an increase in activity of the microbial biomass. Microbial activity of a soil system is directly affected by anthropogenic activities and by introduction of contaminants (Elliott *et al.*, 1993). Soil enzymes are considered as the best indicator of microbial diversity of a soil as they are secreted by the microorganisms extracellularly and help in nutrient recycling and microbial propagation.

From the study it was concluded that among the different treatment combinations, application of FYM (12 t ha^{-1}) + Soil application of nano NPK (12.5 kg ha^{-1}) + Foliar application of nano NPK (0.4%) was found to be recorded highest bacterial count, dehydrogenase, urease and acid phosphatase content in the post harvest status of the soil. Nano fertilizers can serve as an efficient nutrient delivery system thereby reduces the quantity of nutrient required, soil enzymes are considered as the best indicator of microbial diversity of a soil and increase the effectiveness of applied nutrients as well as nutrients in the labile pool.

References

DeRosa, M.C., C. Monreal., M. Schnitzer., R. Walsh and Y. Sultan. 2010. Nanotechnology in fertilizers. *Nature nanotechnology*, 5.

Elliott, E, T., Cambardella, C, A and Cole, C, V. 1993. Modification of ecosystem processes by management and the mediation of soil organic matter dynamics. *Plant Soil*. 22: 129-138.

Ghormade, V., M.V. Deshpande and K.M. Paknikar. 2011. Perspectives for nanobiotechnology

Enabled protection and nutrition of plants. *Biotechnology Advances*. 29: 792–803.

Gogos, A., K. Knauer and T.D. Bucheli. 2012. Nano materials in plant protection and fertilization: current state, foreseen applications, and research priorities. *J. Agri.lFood.Chem*.60: 9781–9792.

Hong, J., J.R. Peralta-Videa., J.L. Gardea-Torresdey. 2013. Nano materials in agricultural production: benefits and possible threats. In: Shamin N (ed) Ch. 5. Sustainable nanotechnology and the environment: advances and achievements. ACS symposium series, 73–90.

Nair, R., S. H. Varghese., B. G. Nair., T. Maekawa., Y. Yoshida and D. S. Kumar. 2010. Nano particulate material delivery to plants. *Plant Sci*. 179: 154–163.

Pandey, A, C., Sanjay, S, S., and Yadav, R, S. 2010. Application of ZnO nanoparticles in influencing the growth rate of Cicerarietinum. *J Exp Nanosci*. 6:488–497

Paul, E.A. and Clark, F.E. 1996. Soil Microbiology and Biochemistry; Academic Press: San Diego, California, 188.

Subramanian, K.S., A. Manikandan, M. Thirunavukkarasu and C.S. Rahale. 2015. Nano fertilizers for Balanced Crop Nutrition (Eds) Rai, M *et al.*, Springer International Publishing Switzerland. pp 69-80.

How to cite this article:

Nibin, P.M., K. Ushakumari and Ishrath, P.K. 2019. Organic Nano NPK Formulations on Soil Microbial and Enzymatic Activities on Post-harvest Soil of Bhindi. *Int.J.Curr.Microbiol.App.Sci.* 8(04): 1814-1819. doi: https://doi.org/10.20546/ijcmas.2019.804.210