REVIEW ARTICLE

NANO-FERTILIZERS A TECHNOLOGY TO INCREASE CROP PRODUCTION

K.K. Sharma[1]*, R. Paliwal[1], Jitendra Singh[1], A.R.K. Pathan[1], Rahul Kumar[2], Probhoo Singh[3], S.S. Sharma[3] and P.C. Bairwa[3]

[1]SKN College of Agri-Business Management, Jobner,
[2]College of Agriculture, Bharatpur
[3]Department of Soil Science,SKN Agriculture University, Jobner, India-303329
Email; kksharma.soils@sknau.ac.in

Received-01.04.2021, Revised-17.04.2021, Accepted-26.04.2021

Abstract: Recently the Nano-fertilizers are getting importance in sustainable agriculture in increasing crop production, enhancing nutrient use efficiency and reduction in wastage of chemical fertilizers and cost of cultivation. The new developments on application of nano-fertilizer in agriculture, plant mineral nutrition, soil health, and interactions with soil microorganism directed to sustainable way by replacing conventional fertilizers with their nano-particulate counterparts possessing superior properties to overcome the current challenges of availability and uptake of nutrients , increasing crop yield and protecting the environment. Nano-fertilizers are very effective tool for precise nutrient management in precision agriculture with matching the crop growth stage for nutrient and may provide nutrient throughout the crop growth period. Several studies showed that nano-particles of essential minerals and non-essential elements affected plant growth, physiology and development, depending on their size, composition, concentration, and mode of application, Nano-fertilizers provide more surface area for different metabolic reactions in the plant system which increase rate of photosynthesis and produce more dry matter and yield of the crop. Nano-fertilizers are applied either to soil and / or leaves. Foliar application can be done during unfavorable soil and weather conditions. In addition to this, it promotes the direct entry of nutrients into the plant system, foliar application of nano fertilizer leads to higher nutrient use efficiency (NUE) and has given a rapid response to the growth of crops. Nano fertilizers are more reactive and can penetrate through cuticle, ensuring controlled release and targeted delivery. Hence, nanotechnology has a high potential for achieving sustainable agriculture, especially in developing countries.

Keywords: Crop, Nano-Fertilizers, Production, Technology

REFERENCES

Abdel-Aziz, H.M.M., Hassaneen, M.N.A. and Omer, A.M. (2016). Nano-chitosan-NPK fertilize enhances the growth and productivity of wheat plants grown in sandy soil. *Spanish Journal of Agricultural Research.* 14, 1-9.

Abdel-Aziz, H.M.M., Mohammed, N.A.H. and Aya, M.O. (2018). Effect of Foliar Application of Nano-Chitosan NPK Fertilizer on the Chemical Composition of Wheat Grains. *Egypt. Journal Botany.* 58 (1), 87-95.

Agrawal, S. and Rathore, P. (2014). Nanotechnology pros and cons to agriculture: a review. *International journal of Current Microbiology and Applied Sciences*3, 43-55.

Ail, N.S. and Al-Juthery, H. W. A. (2017). The application of nanotechnology for micronutrient in agricultural production (review article). *The lraqi Journal of Agricultural Sciences.* (9) 48, 489-441.

Biswal, S.K., Nayak, A.K., Parida, U.K. and Nayak, P.L. (2012).Applications of nanotechnology in agriculture and food sciences. *International Journal of Science Innovations and Discoveries*2(1), 21-36.

Chinnamuthu, C. R. and Boopathi, P. M. (2009). Nano-technology and Agroecosystem. *Madras Agricultural Journal,* 96: 17-31.

DeRosa, M.C., Monreal, C., Schnitzer, M., Walsh, R. and Sultan, Y. (2010). Nanotechnology in fertilizers. *Nature Nanotechnology* 5, 91. doi: 10.1038/nnano.2010.2.

Dimkpa, C.O., McLean, J.E., Britt, D.W. and Anderson, A.J. (2015). Nano-CuO and interaction with nano-ZnO or soil bacterium provide evidence for the interference of nanoparticles in metal nutrition of plants. *Ecotoxicology*, 24,119-129.

Ditta, A. (2012). How helpful is nanotechnology in agriculture? *Advances in Natural Sciences, Nanoscience and Nanotechnology 3*(3).033002.

Frewer, L.J., Norde, W., Fischer, A.R.H. and Kampers, F.W.H. (2011). Nanotechnology in the Agri-Food Sector*:Implications for the Future.*Wiley-VCH, Weinheim, Germany.

Gosavi, A.B., Deolankar, K.P., Chaure, J.S. and Gadekar, D.A. (2017). Response of wheat for NPK foliar sprays under water stress condition. *International Journal of Chemical Studies*. 5(4), 766-768.

Gruere, G., Narrod, C. and Abbott, L. (2011). Agriculture, Food, and Water Nanotechnologies for the poor: Opportunities and Constraints.*Policy Brief 19*. IFPRI, Washington, DC. Available from http://www.ifpri.org/sites/default/files/publications/bp019.pdf.

Gutierrez, F.J., Mussons, M.L., Gaton, P. and Rojo, R. (2011). Nanotechnology and Food Industry. Scientific, Health and Social Aspects of the Food Industry, *In Technical, Croatia,* BookChapter

*Corresponding Author

Jinghua, G. (2004). Synchrotron radiation, soft X-ray spectroscopy and nano-materials**.** *International Journal of Nano-technology*1, 193-225.

Joseph, T. and Morrison, M. (2006). Nanotechnology in Agriculture and Food: A Nanoforum Report. Institute of nanotechnology may 2006, www.nanoforum.org.

Lal, R. (2008). Promise and limitations of soils to minimize climate change. *Journal of Soil Water Conservation*, 63: 113-118.

Lin, D. and Xing, B. (2007). Root uptake and phytotoxicity of ZnO nanoparticles. *Environmental Science and Technology.* 42(2): 5580-5585.

Liu, X., Feng, Z., Zhang, S., Zhang, J., Xiao, Q. and Wang, Y. (2006). Preparation and testing of cementing nano-subnano composites of slow or controlled release of fertilizers. *Scientia Agricultura Sinica* 39, 1598-1604.

Mahmoodzadeh, H., Nabavi, M. and Kashefi, H. (2013). Effect of nanoscale titanium dioxideparticles on the germination and growth of canola (*Brassica napus*). *J Ornam Horti. Plants.* 3:25-32.

Millan, G., Agosto, F. and Vazquez, M. (2008). Use of clinoptilolite as a carrier for nitrogen fertilizers in soils of the Pampean regions of Argentina. *Ciencia e InvestigationAgraria,* 35, 293-302.

Mahajan, P., Dhoke, S.K. and Khanna, A.S. (2011). Effect of nano-ZnO particle suspension on growth of mung (Vigna radiata) and gram (Cicer arietinum) seedlings using plant agar method. J Nanotechnol 2011:1–7

Naderi, M.R. and Danesh-Shahraki, A. (2013). Nanofertilizers and their roles in sustainable agriculture. *International Journal of Agriculture and Crop Sciences* 5, 2229-2232.

Naderi, M.R. and Abedi, A. (2012). Application of nano technology in agriculture the optimization of refinement of environment pollutents. Journal of nanotechnology.11.(1),18-26

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

Nel, A., Xia, T., Ma¨dler, L. and Li, N. (2006). Toxic potential of materials at the nanolevel. Science 311:622–627

NAAS (2013). Nanotechnology in Agriculture, Scope and Current Relevance 2013. National Academy of Agricultural Sciences, New Delhi.

Neill, O', Sen, A., Gupta, B. and Phillips, D.H. (2014). Distribution of arsenic and risk assessment of activities on a golf course fertilized with arsenic-containing. *Ascophyllum nodosum seaweed. Science of Total Environment.* 483, 252-259.

Perez-de-Luque, A. and Hermosin, M.C. (2013). Nanotechnology and its use in agriculture. *In Bio-nanotecmology: A Revolution in Food, Bomedical and Health Sciences*(D. Bagchi, M. Bagchi, H. moriyama and F. Shahidi, Eds.), pp. 299-405.Wiley-Blackwell, West Sussex, UK.

Prasad, T.N.V.K.V., Sudhakar, P., Sreenivasulu, Y., Latha, P., Munaswamy, V., Raja Reddy K., Sreeprasad, T.S., Sajanlal, P.R. and Pradeep, T. (2012). *Journal of plant nutrition.* 35, 905-927.

Prasad, R., Kumar, V. and Prasad, K.S. (2014). Nanotechnology in sustainable agriculture: present concerns and future aspects, *African Journal of Biotechnology*, 6, 13705-13713.

Qureshi, A., Singh, D.K. and Dwivedi, S. (2018). Nano-fertilizers: a novel way for enhancing nutrient use efficiency and crop productivity. *International Journal of Current Microbiology and Applied Sciences.* 7(2), 3325-3335.

Rai, V., Acharya, S. and Dey. N. (2012). Implications of nanobiosensors in agriculture. *Journal of Biomaterials and Nanobiotechnology.* 3, 315-324.

Scott, N. and Chen, H. (2013). Nanoscale science and engineering for agriculture and food systems. *Industrial Biotechnology*,9, 17-18.

Shaviv, A. (2000). Advances in controlled release of fertilizers. *Advanced Agronomy Journal*,71:1-49.

Silva, M.S., Cocenza, D.S., Grillo, R., Melo, N.F.S., Tonello, P.S., Oliveira, L.C., Cassimiro, D.L. Rosa, A. H. and Fraceto, L. F. (2011). *Journal of hazardous Materials,* 190 (1-3), 366-374.

Singh, M.D., Gautam, C., Patidar, O.P., Meena, H.M., Prakasha, G. and Vishwajith (2017). Nano-Fertilizers is a new way to increase nutrients use efficiency in crop production. Review article. *International Journal of Agriculture Sciences.* 9(7), 3831-3833.

Sonkaria, S., Ahn, S.H. and Khare, V. (2012). Nanotechnology and its impact on food and nutrition: a review. *Recent Patents on Food, Nutrition and Agriculture,* 4(1)**,** 8-18.

Suman, P.R., Jain, V.K. and Varma, A. (2010). Role of nanomaterials in symbiotic fungus growth enhancement. *Current Science***.** 99, 1189-1191.

Suppan, S. (2013). Nanomaterials in soil: Our future food chain. The Institute of Agriculture and Trade Policy, Minneapolis, MN, USA.

UNDESA (2015). World population projected to reach 9.6 Billion by 2050. *United Nations Department of Economic and Social Affairs,* New York, USA

Yan, X.L., Dai, T.F. and Jia, L.M. 2018. Evaluation of the cumulative effect of drip irrigation and fertigation on productivity in a poplar plantation. *Annals of Forest Science.*75 (1),pp.5. doi: 10.1007/s13595-017-0682-6.