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NANO FERTILIZER, BENEFITS AND EFFECTS ON FRUIT TREES: A REVIEW

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Abstract

Global agricultural systems face many challenges, including the problem of feeding orchids due to the deterioration of many agricultural soils as a result of contamination with chemical fertilizer residues and improving the growth of fruit trees and increasing their productivity and obtaining good quality fruits depends mainly on the availability of quantities Balanced of the necessary macro and micro nutrients and equipped in harmony with the requirements of the growth of trees, especially high-production varieties and in order to achieve food safety researchers tended to find ways to increase the efficiency of the use of fertilizer without being exposed to losses or pollution, so nanotechnology is a means useful for the development of agricultural, especially in fertilization programs, as Nano fertilizers are an effective alternative to traditional fertilizers, as they achieve many advantages due to their use with lower chemicals and the speed of absorption by the plant and their high stability under different conditions, which increases the ability to store them for longer periods. Nanotechnology can also be used to detect and treat diseases, by increasing crop production, improving their quality and ensuring crop sustainability.

Key words: Nanotechnology, Fertilization, Fruit trees, Nano zinc.

Introduction

Nano Technology

Nanotechnology is one of the new areas of research and has become the subject of modern science and the focus of its attention and has become at the forefront of the most important fields in physics, chemistry, agriculture and others. It means all that is small and the technology of Nano means micro-material technology or -Micro technology, Nano science is the science of modifying molecules or atoms and controlling the exact production of certain materials with atomic and molecular use to make new products is also the study of the basic principles for molecules and compounds measuring no more than 100 nanometers and nanometers is a unit of measurement equal to 10^{-6} millimeters or 10^{-9} meters (Reynolds, 2002, Ball, 2002, Roco, 2003, Chen *et al*., 2016). The principle of this technique is to capture, control and move nanoparticles from their original positions to other positions and then merge them with atoms of other materials to form a crystal line in order to obtain high-performance Nano materials (Fig. 1 and 2). These are the Nano materials building materials of the 21st century and the vary in terms of source and vary according to their proportions such as organic or non-organic materials natural or manufactured (Brunner *et al*., 2006, Auffan, 2009) and this article summarizes Nanot Nano materials echnology applications in agriculture, especially on fruit trees, which may ensure the sustainability of agriculture and the environment.

Nanotechnology importance in agricultural field

As a result of the increase in the percentage of pollution with the remaining in various agricultural products and the deterioration of agricultural soils and the decrease in the output and the consequent losses to the national economy, it was necessary to resort to different methods aimed at improving the production of food in full and improving the productive efficiency of the cultivated area and increasing the return from the agricultural process, therefore, the use of alternative methods, including nanotechnology and its most important applications are Nano fertilizers, which have been used on a commercial scale in recent decades to overcome these problems (Naderi *et al*., 2011, Rai *et al*., 2012, Kashyap *et al*., 2015) were also applied. Nanotechnologies in the

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production, processing, storage, packaging and transportation of agricultural products (Scott and Chen, 2003, Wiesner *et al*., 2006) research and studies have shown that this technology is promising in improving the agricultural field and is known as Agro-Nanotechnology (Cristina, 2007, Khafaji, Kadhim, 2010, Hong *et al*., 2013). In recent years, modern science has tended to use smart fertilizers or Nano fertilizers as an alternative to traditional fertilizers or as racks for their components, which are added to the soil either by mixing with them or with water in order to provide the plant with nutrient needs and enhance efficiency. Fertilizer, which contributes to the acceleration of plant growth as a result of the activation of the photosynthesis process and the increase of materials manufactured within the plant, which reflects positively in the increase of the crop, as well as the improvement of the properties of fertile soils by increasing the readiness of the elements as a result of the promotion and improvement of the seam surfaces between the manure and soil this encourages or improves bio-readiness as well as its environmentally harmless degradation and lack of concentrations compared to standard fertilizers, which helps in environmental sustainability (Prasad *et al*., 2012, Monreal *et al*., 2015, Mastronardi *et al*., 2015, Subramanian *et al.,* 2015, Roosta *et al*., 2015). It also has unique features such as high absorption, increased surface absorption, increased active substances in the plant, increases the ability of the plant to withstand different stress conditions and increases its resistance to diseases and insect injuries as a result of increased plant response to Nano fertilizers due to their easy entry. Plant cells are also suitable for transporting compounds to the target areas of the plant, whether leaves, roots or other plant parts (Fig. 1 and 2). In addition, the use of Nano fertilizers helps overcome soil and water pollution problems and reduce carbon emissions of conventional fertilizer plants that cause severe climate change (Subramanian and Sharmila Rahale, 2012, Roosta, 2015, Sekhon, 2014, Shang *et al*., 2019).

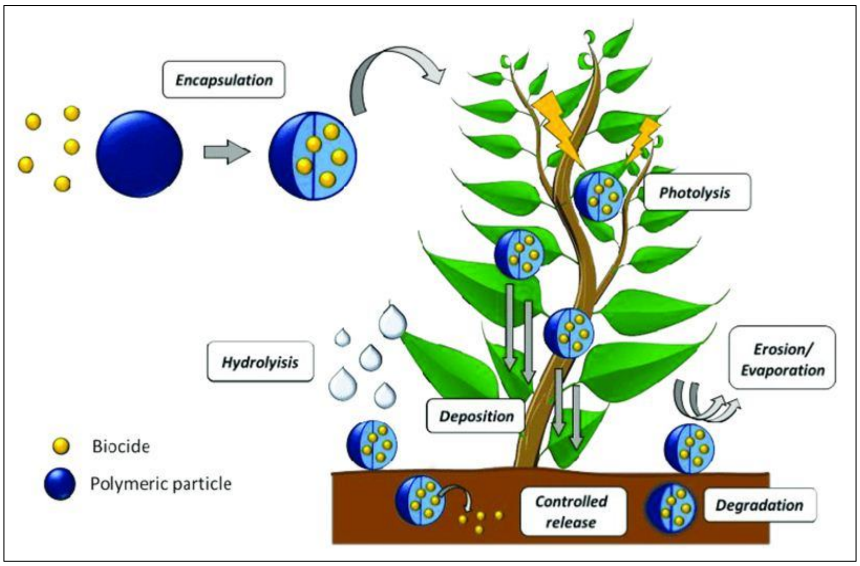

Fig. 1: Application of nanotechnology in pesticide delivery (Álvarez-Paino *et al.,* 2017).

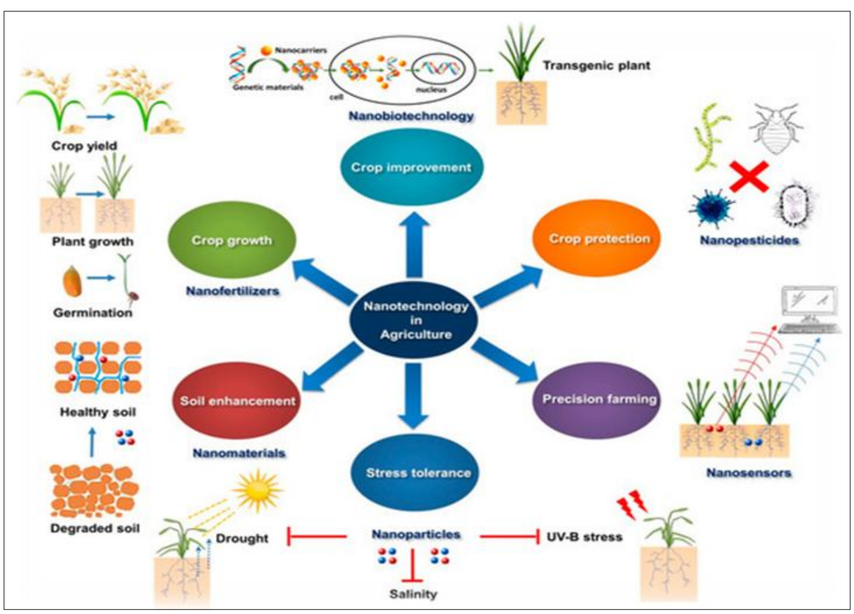

Fig. 2: Applications of nanotechnology in agriculture, improve crop growth, yield and productivity (Shang *et al*., 2019).

Applications of nanotechnology on fruit trees and fruits

Nanotechnology is now widely used in agriculture and horticulture as Nano fertilizer is used to increase vegetative growth, pollination and fertility in flowers, resulting in increased yield and improved product quality for fruit trees (Zagzog *et al*., 2017, Zahedi *et al*., 2019). The results of the study conducted to evaluate the spraying of the mixture of Nano fertilizer ZFM contained on Fe, Zn and Mn on the quantitative and qualitative qualities of almond varieties have shown increased concentration of elements Fe, Zn, Mn and Cu in the leaves and significantly and decrease disproportion of the percentage of fruit precipitation as ZFM spraying has improved fruit qualities and increased productivity (Kamiab *et* *al*., 2016), due to the fact that Nano fertilizer has unique properties due to its small surface area with high absorption, which causes an increase in photosynthesis and leaves area (Sekhon, 2014). Using of Nano calcium sprayed on blue berries under saline stress conditions led to increased vegetative growth and increased leaf content of chlorophyll (Sabir *et al*., 2014). In another study to compare the use of Nano boron and boron sprayed on the leaves of mango trees, the results showed that the use of boron *via* nanotechnology had a positive effect in increasing the overall yield and chemical properties of fruits and the content of the leaves of chlorophyll and elements N, P, K, Mn, Mg, B, Zn and Fe (Ahmed *et al*., 2019). Using boron Nano fertilizer has positively affected the growth of olive trees Increase the weight and dimension of the fruit and thus increase the yield as well as an increase in the proportion of oil in the fruits and increasing the concentration of elements N, P, K, B (Hussein and Abd-Elall, 2018). The spraying of mango trees with Nano zinc has also led to increased fruit weight and its number, increasing the yield, as well as increasing the leaf content of chlorophyll and carotene and increasing the concentration of elements N, P, K, Zn (Zagzog and Gad, 2017). In the experiment to evaluate the use of Nano fertilizer on pomegranate trees as trees were sprayed with Nano zinc and boron Nano-boron before full flowering, it was noted that spraying with Nano fertilizer had a positive effect in improving the quality of fruits of the tree, increase the number of fruits in the tree, they also got an increase in the ratio of T.S.S. and an increase in the maturity index, total sugars and total phenols and increasing the fruit product (Davarpanah *et al*., 2016). Spraying of palm trees with Nano ZnFeMnB has had a positive effect in increasing the leave area and the content of the leaves of total chlorophyll, carotenoids, N, P, K and reducing the rate of precipitation and increasing the weight of fruits and thus increasing the production (El-Sayed, 2018).

Treated loquat fruits with Nano silicon led to reduced weight loss of fruits and maintain the ratio of T.S.S as well as increase the content of fruits of glucose and fructose and increase the ability of fruits to withstand cold and this contributed to prolonging the period of storage of fruits inside refrigerated stores and maintaining for their quality (Song *et al*., 2016).

Conclusion

The use of Nano applications on fruit trees contributes very effectively to improving the quality of fruits and increasing the productivity of trees by improving nutrient management in modern agriculture as well as increasing the storing potential of fruits, as it was noted that the use of Nano fertilizer in the agricultural field preserves the soil. It reduces their pollution by reducing the amount of fertilizer used, which is positively reflected in the increased economic return of the farmer. We recommend further research on the effect of using different Nano fertilizers on fruit trees, as well as studying more varieties as the response of fruit trees to Nano fertilizers.

Reference

Akl, Ahmed, M.M.A., Y. Mohamed Ahmed and A. Zakier Mohamed (2019). Response of Keitte Mango Trees to Spray Boron Prepared by Nanotechnology Technique. *New York Science Journal*., **12(6):** 48-55.

Álvarez-Paino, M., A. Muñoz-Bonilla and M. Fernández-García (2017). Antimicrobial Polymers in the Nano-World. Review. *Nanomaterials*., **7(2):** 1-44.

Auffan, M., J. Rose, J.Y. Bottero, G.V. Lowry, J.P. Jolivet and M.R. Wiesner (2009). Towards a definition of inorganic nanoparticles from an environmental, health and safety perspective. *Nature Nanotechnol.,* **4:** 634-64.

Ball, P. (2002). Natural strategies for the molecular engineer. *Nanotechnology.,* **13:** 15-28.

Brunner, T.J., P. Wick, P. Manser, P. Spohn, R.N. Grass, L.K. Limbach, A. Bruinink and W.J. Stark (2006). *In vitro* cytotoxicity of oxide nano-particles: Comparison to asbestos, silica and effects of particle solubility. *Environ. Sci. Technol*., **40:** 4374-4381.

Brunnert, I., P. Wick, Manserp, Spohnp, R.N. Grass, L.K. Limbach, A. Bruinink and W.J. Stark (2006). *In vitro* cytotoxicity of oxide nanoparticles: comparison to asbestos, silica and effect of particle solubility. *Environmental Science and Technology*., **40:** 4374-4381.

Chen, Y.W., H.V. Lee, J.C. Juan and S.M. Phang (2016). Production of new cellulose nanomaterial from red algae marine biomass Gelidium elegans. Carbohydr. *Polym*., **151:** 1210-1219.

Cristina, B., I.I.P. Blandino and K. Robbie (2007) .Nanomaterials and nanoparticles: Sources and toxicity. *Bio interphases.,* **2(4):** MR17 - MR172 2.

Davarpanah, S., A. Tehranifar, G. Davarynejad, J. Abadía and R. Khorasani (2016). Effects of foliar applications of zinc and boron nano-fertilizers on pomegranate (Punica granatum *cv*. Ardestani) fruit yield and quality. *Scientia Horticulturae.,* **210:** 57-64.

El-Sayed, E.M. (2018). Effect of spraying some micronutrients via normal versus nano technology on fruiting of Sakkoti date palms. *Research*.,**10:** 39-43.

Hong, J., J.R. Peralta-Videa and J.L. Gardea-Torresdey (2013). Nanomaterials in agricultural production: benefits and possible threats? In: Shamim N, Sharma VK (eds) Sustainable nanotechnology and the environment: advances and achievements, vol 1124, ACS symposium series. American Chemical Society, Washington, DC, 73-90. doi:10.1021/bk-2013-1124.ch001.

Huang, B., F. Chen, Y. Shen, K. Qian, Y. Wang, C. Sun, X. Zhao, B. Cui, F. Gao, Z. Zeng and H. Cui (2018). Advances in Targeted Pesticides with Environmentally Responsive Controlled Release by Nanotechnology. Review. *Nanomaterials*., **8(2):** 1-18.

Kamiab, F. and E. Zamanibahramabadi (2016). The effect of foliar application of nano-chelate super plus ZFM on fruit set and some quantitative and qualitative traits of almond commercial cultivars. *J. Nuts.,* **7:** 9-20 .

Kashyap, P.L., X. Xiang and P. Heiden (2015). Chitosan nanoparticle based delivery systems for sustainable agriculture. *Int. J. Biol. Macromol.*, http://dx.doi.org/10.1016/j.ijbiomac.02.039.

Mastronardi, E., P. Tsae, X. Zhang, C. Monreal and M.C. DeRosa (2015). Strategic role of nanotechnology in fertilizers: potential and limitations. In: M. Rai (ed), Emerging nanotechnologies in agriculture (in press).

Monreal, C.M., M. DeRosa, S.C. Mallubhotla, P.S. Bindraban and C. Dimkpa (2015). The Application of Nanotechnology for Micronutrients in Soil-Plant Systems. VFRC Report 2015/3. Virtual Fertilizer Research Center, Washington, D.C. 44.

Naderi, M., A.A. Danesh Shahraki and R. Naderi (2011). Application of nanotechnology in the optimization of formulation of chemical fertilizers. *Iran J. Nanotech*., **12:** 16-23

Prasad, T.N.V.K.V., P. Sudhakar, Y. Sreenivasulu, P. Latha, Y. Munaswamy, K. Raja Reddy, T.S. Sreeprasad, P.R. Sajanlal and T. Pradeep (2012). Effect of nanoscale zinc oxide particles on the germination, growth and yield of peanut. *Journal of Plant Nutrition*., **35(6):** 905-927.

Rai, V., S. Acharya and N. Dey (2012): Implications of nanobiosensors in agriculture. *J. of Biomaterials and nano biotechnology.,* **3:** 315-324.

Reynolds, G.H. (2002). Forward to the future nanotechnology and regulatory policy. *Pac. Res. Inst*., **24:** 1-23.

Roco, M.C. (2003). A Broader societal issue of nanotechnology. *Journal of Nanoparticle Research*., **5:** 181-189.

Roosta, H.R., M. Jalali and S.M.V. Vakili Shahrbabaki (2015). Effect of nano Fe-chelate, Fe-EDDHA and $FeSo_4$ on vegetative growth, physiological parameters and some nutrient elements concentrations of four varieties of Lettuce (*Lactuca sativa* L.) in NFT System. *Journal of Plant Nutrition.*, **38(14):** 1-20.

Sabir, A., K. Yazar, F. Sabir, Z. Kara, M.A. Yazici and N. Goksu (2014). Vine growth, yield, berry quality attributes and leaf nutrient contentof grapevines as influenced by seaweed extract (Ascophyllumnodosum) and nanosize fertilizer pulverizations. *Scientia Horticulturae.,* **175:** 1-8.

Scott, N. and H. Chen (2003). Nanoscale Science and Engineering for Agriculture and Food Systems. A Report Submitted to Cooperative State Research, Education and Extension Service. USDA. National Planing Workshop, Washington.

Sekhon, B.S. (2014). Nanotechnology in agri-food production: an overview. *Nanotechnology, Science and Applications.,* **7:** 31-53.

Shang, Y., M.K. Hasan, G.J. Ahammed, M. Li, H. Yin and J. Zhou (2019). Applications of Nanotechnology in Plant Growth and Crop Protection: A Review. *Molecules*., **24(13):** 2558.

Song, H.W., W.M. Yuan, P. Jin, W. Wang, X.F. Wang and L.M. Yang *et al*., (2016). Effects of chitosan/nano-silica on postharvest quality and antioxidant capacity of loquat fruit during cold storage. *Postharvest Biol. Biotechnol.,* **119:** 41-48.

Subramanian, K.S., A. Manikandan, M. Thirunavukkarasu and C. Sharmila Rahale (2015). Nano-fertilizers for balanced crop nutrition. In: M. Rai, C. Ribeiro, L. Mattoso, N. Duran, (Eds.), *Nanotechnologies in Food and*.

Subramanian, K.S. and C. Sharmila Rahale (2012). Ball milled nanosized zeolite loaded with zinc sulfate: a putative slow release Zn fertilizer. *Int. J. Innov. Hortic.,* **1:** 33-40.

Wiesner, M.R., G.V. Lowry, P. Alvarez, D. Dionysion and P. Biswas (2006). Assessing the risks of manufactured nanomaterials. *Environ. Sci. Technol*., **40:** 4336-4345.

Zahedi, S.M., M. Karimi and J.A. Teixeira da Silva (2019). The use of nanotechnology to increase quality and yield of fruit crops. *J. Sci. Food Agric.,* (wileyonlinelibrary.com) DOI 10.1002/jsfa.10004.

Zagzog, O.A., M.M. Gad and N.K. Hafez (2017). Effect of nano-chitosan on vegetative growth, fruiting and resistance of malformation of mango. *Trends Hortic Res.,* **7:** 11-18.