

# The Role of Nano Micro and Nano Macro Fertilizers in Solanaceae Vegetable Crops

Zarina<sup>1</sup>, Aquib Ayub<sup>1</sup>

Division of Vegetable Science, Faculty of Horticulture & Forestry, 180009



naturesciencemagazine.in

Article ID: NSM.07.03.001

Modern Science for Healthier  
Future

Issue: January 2025

## Introduction

Indeed the farming industry has experienced a major revolution in the past years with new technologies emerging to redefine the field. Of all these changes, nano fertilizers have been identified as a positive solution to improve crop output and efficiency. One of them is the nano micro and nano macro fertilizers that provide important attributes for the vegetable crops through efficiency of nano nutrients, reduced harms to the environment and stronger and healthier bang growth. Passing our focus into nano micro and nano macro fertilizers their importance and usefulness in vegetable crop production in this article shall be reviewed.

## Understanding Nano Fertilizers

Nano fertilizers are crystalline forms of micro fertilizers with at least one dimension in nano scale which is between one to hundred nanometers. These fertilizers can be developed to get to the specific nutrients into the plants and enhance their uptake and usage. Nano fertilizers are categorized into two main types:

**1.Nano Micro Fertilizers:** They include iron (Fe), zinc (Zn), copper (Cu), manganese (Mn), boron (B) and molybdenum (Mo) as nanoparticles. These nutrients are needed in plants for various functions as well as activities bio chemically and they are needed in small amount than macronutrients.

**2.Nano Macro Fertilizers:** These fertilizers are macronutrients containing nitrogen (N), phosphor (P) and potassium (K) in the nanoparticle size. Macronutrients are needed in a comparatively greater amount than micronutrients and are directly involved in the various processes of plant growth, development and yield.

## Benefits of Nano Micro and Nano Macro Fertilizers

### *Enhanced Nutrient Efficiency*

Nano fertilizers are more effective in nutrient utilization than the conventional methods of fertilizer application. Soon after the nanoparticles penetration and adsorption, they easily distribute within plant due to their small size, hence uptake of nutrients takes place is efficient. This increases production efficiency, so that less fertilizers have to be used to realize the same growth and productivity and so basically decreasing production costs for farmers.

### *Controlled Release of Nutrients*

Another important benefit that has been associated with the use of nano fertilizers is the fact that it is possible to produce a slow release fertilizer. Nano encapsulation methods can also be applied in developing fertilizers, which discharges nutrients slowly and continuously, in tune with the plant demand at various developmental stages. This controlled release reduces the nutrient leaching or nutrient volatilization and makes nutrients available to the plant at appropriate time.

### *Reduced Environmental Impact*

Some of the advantages of nano fertilizers include, With nano fertilizers, the effects of continued farming are greatly decreased. Unlike the current commercial types, the traditional fertilizers cause costs such nutrient leaching that pollute water sources and trigger eutrophication. The controlled release nature of nano fertilizers means that not only is their use more efficient, there is also a low chance of polluting the environment since nutrient losses are also reduced. Furthermore the reduced application rates of the nano fertilizers lessen the greenhouse gases that results from production and application of fertilizers.

### **Improved Plant Health and Yield**

Nano micro and nano macro fertilizers improve yield and health of vegetable crops through foliar and soil application. This in turn facilitates efficient nutrients uptake, better root growth, better phosphorescence, and disease and pest resistance. Research work has shown that vegetable crops when treated with nano fertilizers give better yield, quality as well as enhanced nutritional quality compared with normal treated vegetable crops.

### **Applications in Vegetable Crops**

- **Tomatoes**

Nano fertilizers and in particular nano micro fertilizers offered very positive effects onto the tomatoes crop. Iron, zinc and copper nanoparticles have also been reported to enhance plant growth, yield and fruit quality of hydroponically grown tomato. All of these micronutrients participate in many activities like photosynthesis, activation of enzymes, and hormonal control. Nano fertilizers have improved nutrients absorption through the plant thus improving on the ability of the plant to withstand stress factors.

- **Peppers**

Both bell peppers and chili peppers undergo a boost from the use of nano fertilizers, as do many other vegetables. Nano phosphorus and potassium fertilizers especially have been seen to enhance increases in the root system, flowering and fruiting. It means that these macronutrients reach the peppers steadily in controlled amounts all the time enabling the plants to give out better yields and quality fruits.

- **Eggplants**

This vegetable also known as eggplants or aubergines can be benefiting from the use of nano fertilizers. Nano nitrogen fertilizers increase the rate of vegetative growth while plants fertilized with nano zinc and manganese bring better flowering and fruit development. When applied as a nano fertilizer to eggplants, there is a significant improvement in the plants' health, and thereafter the ability to disease and pest attacks, and consequently increased production.

### **Challenges and Future Prospects**

The effectiveness of the nano fertilizers has advantages but it has some limitations also. Nano fertilizers have the disadvantage of being made with high technicality and formulation hence making it expensive. Besides, the future effects of the nano fertilizers on the health of the soil and the adjacent environment should also be studied further.

Yet, these technologies have not been stopped due to their continuous development in principles of nanotechnology as well as the growing concern for the usage of eco friendly method of practice in agriculture, the future of nano fertilizers therefore could not be bleak. Depending on technological advancements, producers should find ways on how to make these products cheap and eco-friendly and therefore reach out to more farmers.

### **Conclusion**

Nano micro and nano macro fertilizers are major innovation in the field of agriculture as they are helpful for growing vegetable crops with numerous advantages. These fertilizers increase nutrient uptake, and deliver nutrients slowly and steady, decrease soil nutrient loss and contamination, and help in plant growth and production. Thus, as a result of further development of the agricultural industry, nano fertilizers will become an important key to making organic farming more productive. In the light of advancement in nanotechnology it has been made possible to foster a more efficient and green agriculture mechanization in vegetable crops.