

## Nano Fertilizers Used for Field Crop in Chhindwara District of Madhya Pradesh

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### ABSTRACT

*These fertilizers play significant role in the crop production up to 35 to 40% of the productivity. Below 50 nm size, the laws of classical physics give way to quantum effects, provoking different optical, electrical and magnetic behaviors. Nano sized active ingredients in fertilizer help to improve nutrient use efficiency and this could be due to their high specific surface area, which facilitates good absorption of the nutrients. The distribution of nano NPK element was found to be uniform and their use efficiency was 97.43 %, 98.11% and 97.03 %, respectively. Nano particles have more, sorption capacity and controlled release delivery at targeted sites as per crop demand. Paddy foliar application of nano chelated iron fertilizer (2.5 g L<sup>-1</sup>) at nursery and booting stages had the maximum effect on rice quality and quantity parameters. Nutrient content, quality and yield of wheat grains treated with Fe nano fertilizer was found to be significantly increasing up to concentration of 0.9 g L<sup>-1</sup> its applications will have huge potential to revolutionize agricultural production scenario by allowing better scientific management practices, mitigating issues of chemical fertiliser pollution, conservation of natural mineral reserves and saving on fertilizer import.*

**Keywords:** Fertilizers, Pollution, Nutrient, NPK

### INTRODUCTION

Plant needs 16 essential nutrients to complete its life cycle. The air and water provides Carbon, Hydrogen and Oxygen to the plants. Rest 13 elements are needed to be supplied externally to the crops in the form of organic and inorganic fertilizers. These fertilizers play significant role in the crop production up to 35 to 40% of the productivity. With growing

population and demand for more food, fertilizer consumption is increasing proportionately with agricultural production. In Greek language 'nano' means 'dwarf' say 'smaller'. The particle size of nano fertilizer ranges between 1 to 100 nano meter (1 nm = 10<sup>-9</sup> m). With different techniques innovative synthetic nano fertilizers are prepared in a readily available form to the plants.

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Because of their relatively larger surface area to mass ratio, they can become more chemically reactive and change their strength or other properties. Below 50 nm size, the laws of classical physics give way to quantum effects, provoking different optical, electrical and magnetic behaviors. Likewise, nano particles have more, sorption capacity and controlled release delivery at targeted sites as per crop demand. Therefore, nano fertilizers are preferred largely due to their efficiency and environment friendly nature compared to conventional chemical fertilizers.

## MATERIALS AND METHODS

### Methods of nano fertilizers applications

**1 Seed coating** seeds and fertilizers are two important inputs in crop production, but are used separately. Conventionally fertilizers are applied to crops by either spraying or broadcasting. However, one of the major factors that decide the mode of application is the final concentration of the fertilizers reaching to the plant. The distance between the fertilizer and the seed, has an impact on the plants capacity to utilize nutrients. So combining both materials into a unit of fertilizer coated seed may improve farming efficiency. When fertilizers are placed far away from the seed, the nutrients takes more time to react with the salts or ions of the soil and forms soluble compounds before the plant roots are reached the location of the fertilizer molecule. Hence, closer the fertiliser to the seed, the smaller the amount will be needed to develop fully grown plant. Thus, the effect of seed coated fertilizers will be more.

**2 Soil application** nano fertilizers are synthesized so as to regulate the release of nutrients depending on the requirements of the crops. Due to nanostructured formulation of fertilizer release of nutrients into the soil happens gradually and in a controlled way which is beneficial to increase soil microbial population and enzyme activity. Nano sized active ingredients in fertilizer help to improve nutrient use efficiency and this could be due to their high specific surface area, which facilitates good absorption of the nutrients. Teng et al. (2018) reported that the

amount of soil bacteria, actinomycetes and fungi treated with nano-fertilizers were 1.07 times, 1.13 times and 1.09 times more than that of chemical fertilizer treatment.

**3 Drip application** drip irrigation proved to be efficient in providing irrigation water and nutrients to the roots of plants, while maintaining high yield production. Along with drip irrigation, essential elements are directly made available to the active root zone, thus reducing quantity of nutrient fertilizers and increasing their efficiency from 80 to 90%, which ultimately helps to improve the yield and quality. Thus, it is possible to manage optimal nutrient management in arid and semi-arid areas by following combination of slow release nano fertilizers and drip irrigation. Hayyawi et al. (2019) revealed that, higher potato productivity of 250.7 Kg was achieved through combined application of one kilo nano N, P and K fertilizers through drip irrigation. The distribution of nano NPK element was found to be uniform and their use efficiency was 97.43 %, 98.11% and 97.03 %, respectively.

**Foliar application** foliar nutrition is the technique of feeding plants by spraying fertilizers directly to the leave so as to reduce losses and getting maximum yield. Foliar applications of nutrients enable plant for rapid nutrient utilization and permit the correction of observed deficiencies in less time than can be accomplished by soil applications. Foliar feeding enhances plant height, leaf area, number of leaves per plant, dry matter production, chlorophyll production, rate of the photosynthesis resulting in more production and translocation of photo synthates to different parts of the plant. Nano particles can penetrate the stomatal pores with the size less than 50 nm, hence significantly augment nutrient absorption and aid in production as compared with traditional fertilizers. Foliar spray of one kilo dose of nano chelated super fertilizer containing 12 nutrients was optimum for growth, yield, nutrient uptake and agronomic efficiency of one hectare wheat crop compared to conventional fertilizer and bio stimulators (Al-juthery et al., 2019).

**Difference between conventional and nano fertilizers**

Particulars	Conventional fertilizers	Nano fertilizers
Method of application	Soil, drip and foliar	Seed coating, soil, drip, foliar and drone
Purity	Lower proportion of essential nutrient. Ex Single Super Phosphate – contains 15% P <sub>2</sub> O <sub>5</sub> and rest 85% is impure material	Its highly pure and concentrated material without unwanted and ecologically harmful additives.
Nutrient use efficiency (%)	Bulk composite is not available for roots resource and low efficiency.	Nano structured formulation increase fertilizer use efficiency due to
Nutrient loss from soil	High loss rate by leaching of chemicals, runoff, volatilization, fixation, drift, evaporation, hydrolysis by soil moisture, photolytic and microbial degradation etc	Nanostructured formulation can reduce loss rate of nutrients into soil by leaching and/or leaking
Nutrient delivery	Uncontrolled delivery, nutrients are available within 4 to 10 days of application. Excess release of fertilizers may produce toxicity and destroy ecological balance of soil.	Nano nutrient is precisely controlled through encapsulation in envelope forms of semipermeable membranes coated by resin-polymer, waxes etc that enables slow and controlled delivery to the plants upto 40 to 50 days after application.
Nutrient bioavailability	Less bioavailability to plants due to large particle size and less solubility.	Improve solubility and dispersion of insoluble nutrients in soil, reduce soil absorption and fixation and increase the bioavailability
Cost of Transportation and field application	Bulky in nature so needs more cost for transportation and application in the field	Highly concentrated, need little cost on transportation and application in the field.

**Case study of nano fertilizers**

**Paddy-** foliar application of nano chelated iron fertilizer (2.5 g L<sup>-1</sup>) at nursery and booting stages had the maximum effect on rice quality and quantity parameters. It increased plant height, panicle length, grain weight and paddy yield and in addition enriched white rice in nitrogen, phosphorus and potassium concentrations significantly as compared to control (Saideh et al., 2020).

The application of 100% nano nitrogen fertilizer had given the highest growth performance with respect to plant height (57.9 cm), tillers per plant (6), plant dry weight at ripening stage (9.9 g) and yield (2.8 t ha<sup>-1</sup>) as compared to control. The results indicated that nano nitrogen could be used as an alternative to urea in the cultivation of rice (Rathnayaka et al., 2018).

**Wheat** -effect of foliar application of iron oxide magnetic iron nanoparticles (IMNPs) coated NPK at different rates (0.1, 0.3, 0.6 and 0.9 gm L<sup>-1</sup>) on wheat crop was reported by Yasser et al. (2018). Nutrient content, quality and yield of wheat grains treated with Fe nano fertilizer was found to be significantly increasing up to concentration of 0.9 g L<sup>-1</sup>.

**Maize-** treatment of seeds with 500 mg of nanoporous zeolite urea 'NANO ZEOUREA' recorded maximum germination (100 %)

within 5 days after sowing and found to be beneficial to soil microorganisms (bacteria *Enterobacter cloacae* and fungi *Trichoderma harianum*), earthworms *Eisenia foetidae* (Manikandan et al., 2019). In a field trial 16.33 % increase in yield was observed due to maize seed coating TERI Mycorrhiza, nano Phosphorus and Phosphorus solubilizing bacteria.

**Finger Millet-** Saraswathi et al. (2017) reported that, foliar spray of nano ZnO @ 500 ppm ha<sup>-1</sup> at 30 and 60 days after transplanting recorded highest grain yield (9.60 gm plant<sup>-1</sup>) and least in control without application of fertilizers (7.00 gm plant<sup>-1</sup>).

**Tomato-** foliar application of TERI nano MSN (Zn+Fe+P) 45 days after transplanting at concentration of two ml L<sup>-1</sup> increased plant height, number of leaves and tomato fruit yield by 38.13% followed by TERI nano P and TERI nano Zn+Fe.

Application of nano fertilizers in crop production system in India is at nascent stage. However, its applications will have huge potential to revolutionize agricultural production scenario by allowing better scientific management practices, mitigating issues of chemical fertiliser pollution, conservation of natural mineral reserves and saving on fertilizer imports. In the future, use

of powerful and less expensive nano fertilizers may prove one of the best alternatives to replace traditional fertilizers.

plant if concentration is more than the Optimum which result reduces growth and yield of the crop.

### CONCLUSION

Application of different nano-fertilizers have greater role in enhancing crop Production this will reduce the cost of fertilizer for crop production and also Minimize the pollution hazard. The application of nano-fertilizers in agriculture Should have a greater concern to society. Fertilizer nutrient use efficiency in crop Production can be enhanced with effective use of nano-fertilizers. Nano Fertilizers Improve crop growth and yield up to optimum applied doses and concentration but They also have inhibitory effect on crop

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