

Application of Nano Urea in Agriculture**Yeshe A. S.¹ and Gourkhede P. H.²**¹M.Sc. Student, ²Assistant Professor, Department of Soil Science and Agricultural Chemistry, VNMKV, Parbhani, (M.S.)**SUMMARY**

Although chemical fertilizers increase crop productivity, they create an imbalance in the soil's mineral content and decrease soil fertility. Large-scale use of chemical fertilizers causes irreparable damage to the soil structure and soil microbial flora. It affects the food chains across ecosystems responsible for heritable mutations in future generations of consumers. The rapid growth in the world population has increased the demand from the agricultural sector, making researchers wary of the overuse of chemical fertilizers by farmers. Nano-fertilizers have emerged as a promising alternative that ensures high crop production and soil restoration.

INTRODUCTION

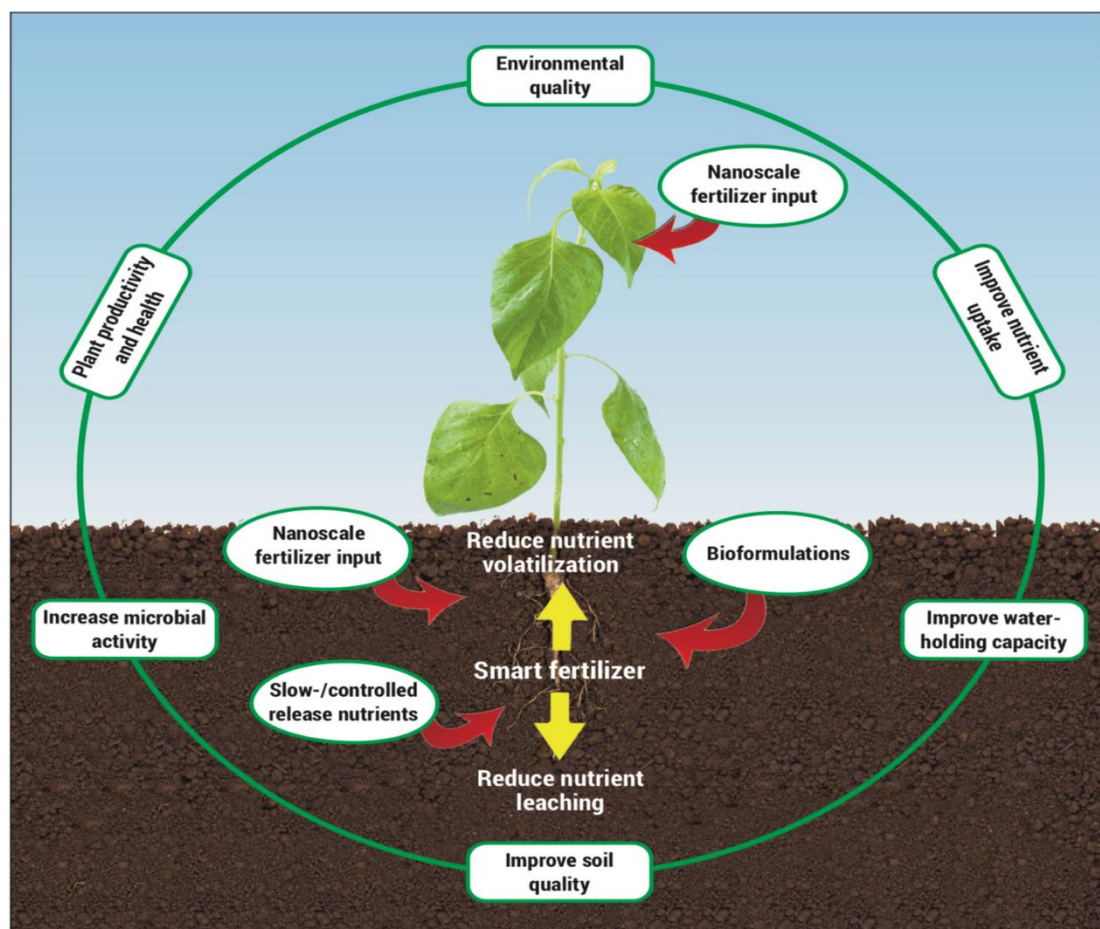
World's 1st Nano Urea Liquid is introduced for the farmers across the world by Indian Farmers Fertiliser Cooperative Limited (IFFCO). This is an inspiration taken from the call of the Prime Minister of India for reducing the use of Urea. The Nano Urea Liquid is indigenously developed after many years of dedicated and sincere research of IFFCO's Scientists and Engineers through a proprietary technology developed at Nano Biotechnology Research Centre, Kalol. IFFCO Nano Urea Liquid increases crop production with improved nutritional quality. It will also give a huge positive impact on the quality of underground water, significant reduction in the global warming with an impact on climate change and sustainable development. Translation of Nano Urea Liquid for farmers use will boost balanced nutrition program by reducing the excess use of Urea application in the soil. The excess urea causes an environmental pollution, harms soil health, and making plant more susceptible for disease & insect infestation, delayed maturity of the crop & production loss. Nano Urea Liquid makes the crops stronger, healthy and protects them from lodging effect. Nano Urea (Liquid) is a unique source of nitrogen. Nitrogen is constituent of plant chlorophyll, protoplasm, proteins and nucleic acid. It is responsible for greenness, vigorous growth and overall crop development. Majority of Indian soils are found deficient in available nitrogen. To meet crop nitrogen requirement, farmers apply traditional Urea in 2 – 3 splits as basal or top dressing but hardly 30-50 % of it is utilised by the crop because of its low use efficiency. Nitrogen is lost as ammonia or nitrous oxide (NH₃, N₂O) or leached as nitrate (NO₃) which pollutes our soil, air and water. Excess application of urea results into more attack of pests and diseases; delayed crop maturity, deficiency of nutrients and crop lodging due to excess growth. Nano Urea (Liquid) has emerged as a novel fertiliser for targeted and precise application of nitrogen. It can be easily transported, does not involve any subsidy, is environment friendly and its production also doesn't pollute or harm our environment in any way. It has been tested on more than 90 crops across 11,000 locations in collaboration with ICAR- KVKs, Research Institutes, State Agriculture Universities and progressive farmers of India. Application of 1 bottle of Nano Urea can effectively replace at least 1 bag of Urea.

Why Is The Use Of Nano-Fertilizers Better Than Conventional Fertilizers?

The unique properties of nanoparticles, such as high sorption capacity, the increased surface to volume ratio, and controlled-release kinetics to targeted sites, make them a potential plant growth enhancer. Because of these characteristic features, nano-structured fertilizers can be used as a smart delivery system of nutrients to the plant. Nano-fertilizers are released very slowly in comparison to conventional fertilizers. This approach improves nutritional management, i.e., increasing the nutrient-use efficiency and decreasing nutrient leaching into groundwater. Nano-fertilizers are specifically designed to release active ingredients in response to biological demands and environmental stress. Scientists have further stated that nano-fertilizers increase agricultural productivity by improving photosynthetic activity, seedling growth, rate of seed germination, nitrogen metabolism, and carbohydrate and protein synthesis.

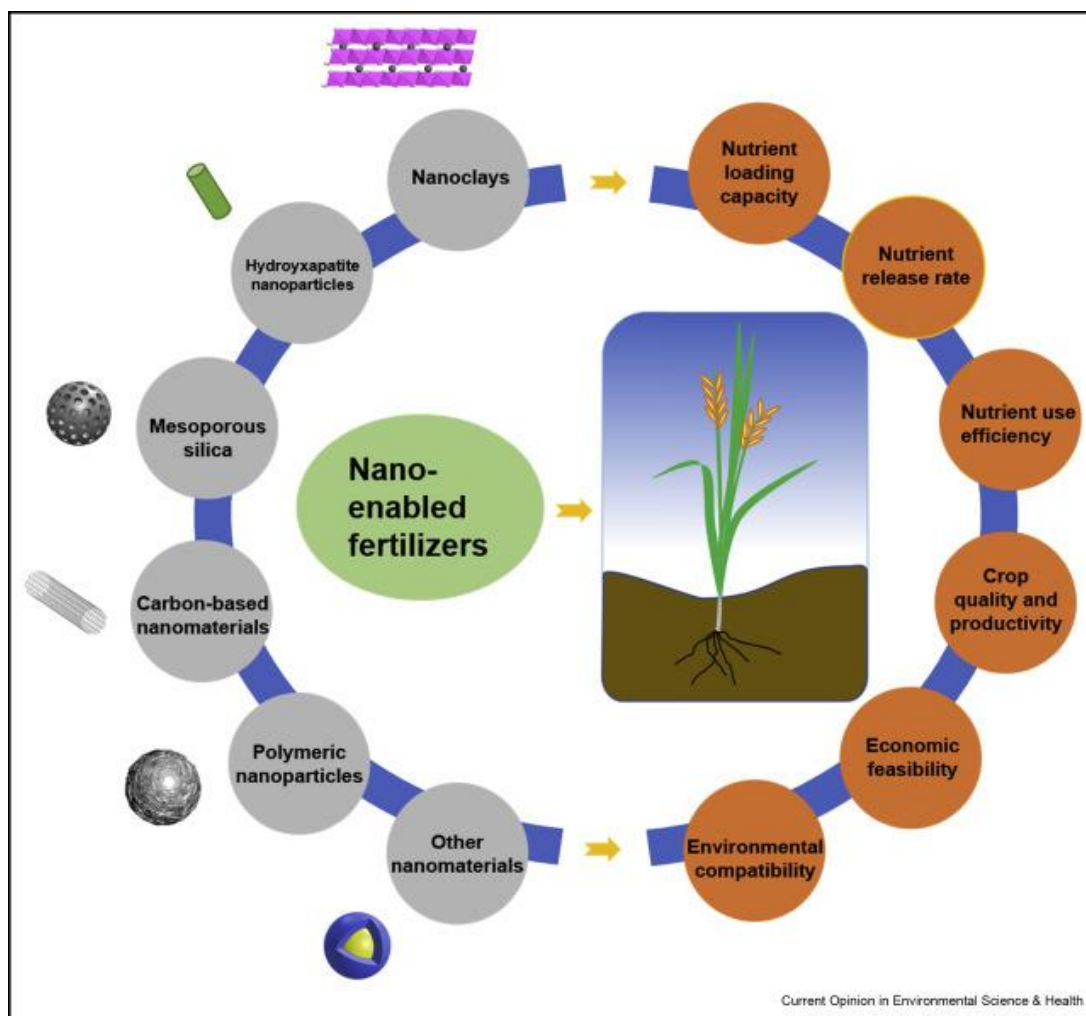
How Do Nano-Fertilizers Enter The Plant System?

Researchers have stated that the plant root system, which is the gateway for the nutrients, is highly porous to nanomaterials (nano-fertilizers) than conventional fertilizers. Stomatal openings in leaves are also reported to favor uptake of nanomaterials and their entry to leaves. Scientists have conducted experiments using the faba bean (*Vicia faba*), to determine the nanoparticle's efficiency to penetrate the plant system. They found that nanoparticles (43 nm in size) could penetrate leaf in large numbers compared to nanoparticles larger than 1.0 nm size. Nano-fertilizers are also reported to deliver nutrients through plasmodesmata. Plasmodesmata are nano-sized channels of approximately 50–60 nm size used to transport ions between cells. Carbon nanotubes and silica nanoparticles are useful tools for transporting and delivering cargoes (nutrients and other important biochemicals) to plants target.



Advantages of nanourea (Liquid):

- Small size (20-50 nm) of Nano Urea increases its availability to crop by more than 80 %.
- It effectively fulfils crop nitrogen requirement, increases leaf photosynthesis, root biomass, effective tillers & branches.
- It triggers pathways for uptake and assimilation of nitrogen and other nutrients inside the plants.
- It increases nutritional quality of the harvested produce.
- Enhances Farmers income by increase in crop productivity and reduction in input cost.
- Because of higher efficiency, it can reduce the requirement of conventional Urea by 50 % or more.
- Farmers can easily store or handle one bottle (500 ml) of Nano Urea
- It helps conserve soil, air and water quality. It also addresses issue of 'Global Warming' and in meeting UN Sustainable Development Goals (SDGs).



Properties of nano urea (Liquid):

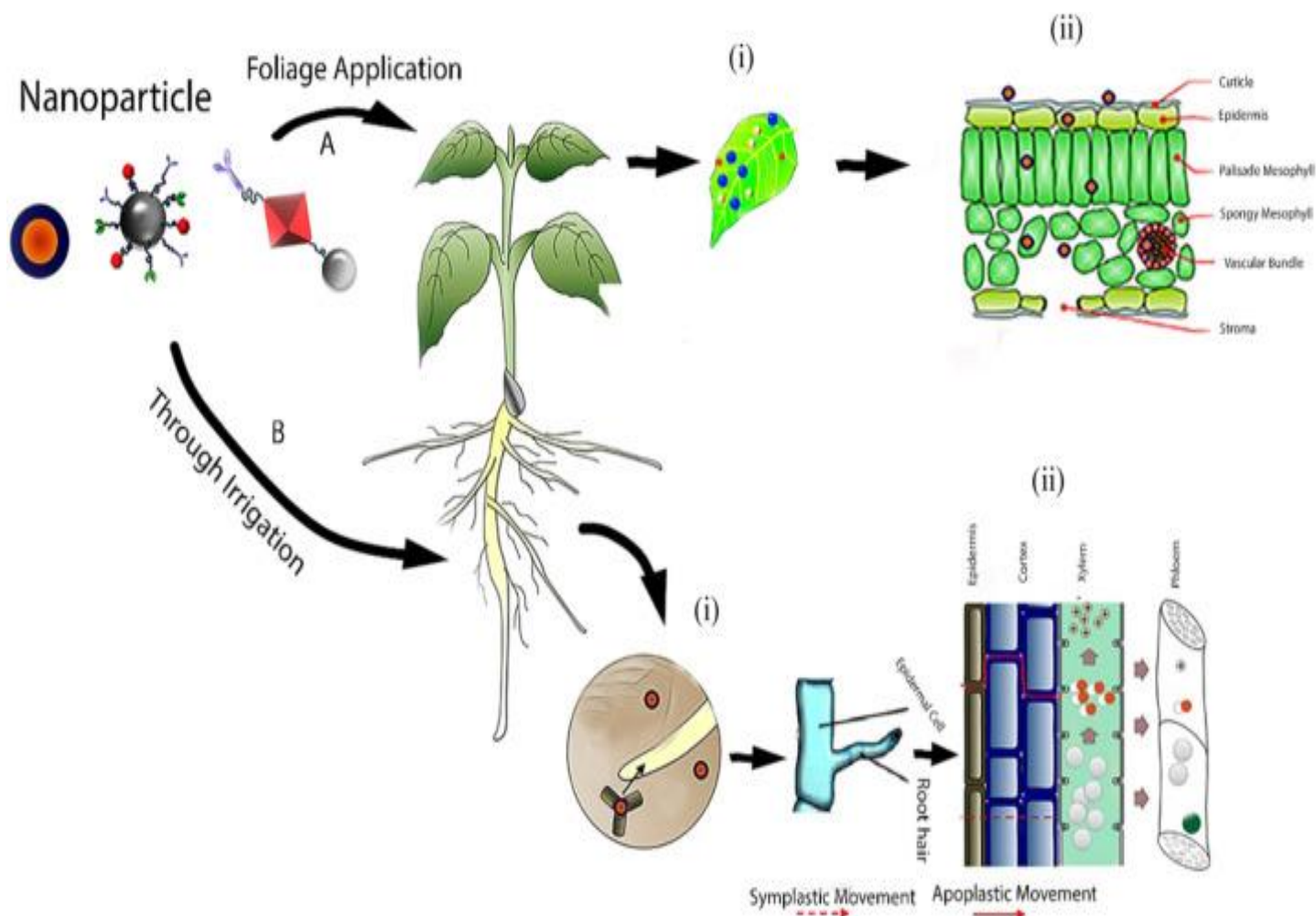
- It contains 4.0 % total nitrogen (w/v) evenly dispersed in water.
- Nano nitrogen particles size varies from 20-50 nm.
- Nitrogen present in Nano Urea converts into ammoniacal and nitrate form after hydrolysis inside the plant system.

Rate, Time And application :

- Mix 2.0 ml – 4.0 ml of Nano urea in one Litre of water and spray on crop leaves at active growth stages.
 - For best results apply 2 foliar sprays*-
 - 1st spray at active tillering / branching stage (30-35DAG or 20-25 DAT)
 - 2nd spray 20-25 days after 1st spray or before flowering in crop.
- DAG–Days after Germination; DAT-Days after Transplanting

Mode of Action :

- When sprayed on leaves, Nano Urea easily enters through stomata and other openings and is assimilated by the plant cells.
- It is easily distributed through phloem from source to sink inside the plant as per its need.
- Unutilized nitrogen is stored in the plant vacuole and is slowly released for proper growth and development of plant.



Application and Instruction:

- Shake well the bottle before use
- Use flat fan or cut nozzles for spraying on the leaves.
- Spray during morning or evening hours avoiding dew.
- If rain occurs within 12 hours of the spray of nano urea, it is advised to repeat the spray.
- Nano Urea can easily be mixed with biostimulants, 100 %water soluble fertilizers and agrochemicals. It is alwaysadvised to go for jar test before mixing and spraying forcompatibility.
- For better result Nano urea should be used within 2 yearsfrom the date of its manufacturing.

Safety and Precautions:

- Nano-Urea has been tested for biosafety and toxicity as per the guidelines of Department of Biotechnology (DBT), Government of India and OECD international guidelines.
- Nano urea is safe for the user; safe for flora and fauna and is nontoxic, however, it is recommended to use face mask and gloves while spraying on the crop.
- Store in dry place avoiding high temperature and keep away from reach of children and pets.

CONCLUSION

- Nano fertilizer and Nano urea applied alone and in conjunction with organic material have the potential to reduce environmental pollution owing to significant less losses and higher absorption rate.

- In addition, nanomaterials were recorded to improve germination rate, plant height, root development and number of roots, leaf chlorophyll and fruits antioxidants contents.
- Moreover, controlled and slow released fertilizer having coating of nanoparticle, boost nutrient use efficiency and absorption of photo synthetically active radiation along with considerably lower wastage of nutrients.
- The future of nanofertilizer and nano urea for sustainable crop production and time period needed for their general adaptation as a source of plant nutrients depend on varied factors such effective legislation, production of novel nanofertilizer products as requirements and associated risk management.
- There is a dire need for standardization of nanomaterial formulation and subsequent conducting rigorous field and greenhouse studies for performance evolution.
- For sustainable crop production, smart nanofertilizer and nano urea having the potential to release nutrients as per plants requirements in temporal and spatial dimension must be formulated.
- Lastly, researchers and regulators need to shoulder the responsibility by providing further insight in order to take full advantages of the nanofertilizer and nano urea for sustainable crop production under changing climate with the risk of causing environmental pollution.

REFERANCES

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Indian Farmers fertilizer Co-operative Limited IFFCO sadan, C-1 District Centre, Saket, New Delhi-110017 .
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The Effect of Nano-Fertilizer on Sustainable Crop Developments, Written by Dr. Priyom Bose Priyom holds a Ph.D. in plant Biology and Biotechnology from the University of Madras, India.