

Nano Urea: Application and Significance

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Introduction

Nitrogen is deficient in most of the Indian soils particularly the light textured ones which is one of the basic plant nutrients. N is involved in the formation of proteins, nucleic acids, growth hormones and vitamins and is an integral part of chlorophyll. An adequate supply of nitrogen is associated with vigorous vegetative growth and dark green colour. The recommended dose of nutrients for different crops were determined one to two decades ago but thereafter, the fertility status, crop varieties and other inputs have under gone a considerable change. Thus, there is an urgent need to give a fresh look to fertilizer requirement specially nitrogen under rainfed conditions.

Nano fertilizers are fertilizers, fertilizer bulk materials or extracts of botanical, microbial or animal origin manufactured through chemical, physical, mechanical or biological method either through Top-Down or Bottom-Down manufacturing process.

Nano material are defined as the materials with a single unit between one and a hundred nm in size in a minimum of one dimension. Nano-fertilizers are a new concept of nutrient management in crop and it is in its belonging stage there is a great thrust area in agriculture for sustainable crop improvement with major importance of nano-nitrogen. Nano fertilizers are in fact important because they are environmentally friendly and critical to promote sustainable agricultural development. This technology has enabled the exploitation of small Nano materials molecules that carry fertilizer to build the “smart fertilizer”, which is able to enhance the efficiency of nutrients use and reduce the cost of environment protection. Studies indicate that the use of nano-fertilizers causes an increase in plant nutritional efficiency, reduces their toxicity to soil organisms, as well as reduces the effects of potential stress due to over application of fertilization and reduces amounts of fertilizers used. Post effect of nano fertilizer application in soil showed better pH, moisture, EC and available nitrogen under nano fertilizer treatment than the conventional fertilizer.

Three classes of nano-fertilizers have been proposed:

- 1) Nanoscale fertilizer (nanoparticles which contain nutrients),
- 2) Nanoscale additives (traditional fertilizers with nanoscale additives), and
- 3) Nanoscale coating (traditional fertilizers coated or loaded with nanoparticles)

India's largest fertilizer co-operative IFFCO has begun the mass production of nano urea invented by 33-year-old Indian scientist Ramesh Raliya.

The term nanomaterial is based on the prefix nano which originates from Greek word meaning dwarf. More precisely, the word nano means 10^{-9} or one billionth of a meter. The word nanomaterial is generally used for materials with a size ranging between 1 and 100 nm. There are lots of advantages of nano fertilizers, like they increase three times in nutrient use efficiency, 55-60 times less requirement to chemical fertilizer, 10-12 time more stress tolerant by the crops, complete bio-source so eco-friendly, 30-35% more nutrient mobilization by the plants, 18-54% improvement in the crop yield. Present time IFFCO has introduced three types of nano fertilizers nano nitrogen, nano zinc and nano copper at Kalol unit in Gujrat. These products have been researched and developed indigenously at the IFFCO Nano Biotechnology Research Centre (NBRC). The Indian Farmers Fertilizer Cooperative Limited (IFFCO) introduced the world's first nano urea liquid for farmers across the world.

Nano urea is a source of nitrogen, a major essential nutrient required for better growth and development of crops. IFFCO Nano Urea liquid, based on nano technology, effectively fulfils crop nitrogen requirement when sprayed at critical crop growth stages. It is used in place of conventional urea and other nitrogenous fertilizers for better environment, soil health and farmers profitability. Nano urea contains 4% nitrogen by weight in its nano form.

Method and dose

A half bottle of nano urea with better use efficiency can effectively reduce upto one bag of urea. Application of nano urea has a considerable advantage in terms of a safe and clean environment with the reduction in the application of conventional bulk urea. Mix 2 to 4 ml of nano urea liquid in one litre of clean water and spray on crop leaves.

For better result spray twice

- ✓ At initial growth stage (tillering/ branching);
- ✓ Before one week of flowering.

Towards sustainability

Nano urea is a potential component of 4 R nutrient stewardship as it promotes precision and sustainable agriculture. It promotes clean and green technology as its industrial production is neither energy intensive or resource consuming.

Nano urea conforms to department of biotechnology (DBT), Govt. of India guidelines for evaluation of nano Agri-input products (NAIPs). These guidelines are harmonised as per approved international norms and OECD protocols. Nano urea has been declared safe for the user and the environment as per tests conducted by NABL accredited and GLP certified laboratories. Nano urea therefore, stands as a promising, sustainable and environmentally friendly solution to conventional bulk nitrogenous fertilizers like urea.

Key points

About nano urea

- It is a nutrient (liquid) to provide nitrogen to plants as an alternative to the conventional urea.
- It is developed to replace conventional urea and it can curtail the requirement of the same by at least 50%.
 - It contains 40,000 mg/l of nitrogen in a 500 ml bottle which is equivalent to the impact of nitrogen nutrient provided by one bag of conventional urea.
- Conventional urea is effective 30-40% in delivering nitrogen to plants, while the effectiveness of the nano urea liquid is over 80%.
 - Its effectiveness has been tested in over 11,000 farmers' fields for 94 crops like rice and wheat.
 - An average 8% increase in yield has been witnessed.

Developed At

- It has been indigenously developed at Nano Biotechnology Research Centre, Kalol, Gujrat in line with Atmanirbhar Bharat and Atmanirbhar Krishi.
 - India is dependent on imports to meet its urea requirements.

Cost

IFFCO has priced Nano Urea at Rs 240 per 500 ml bottle for the farmers, which is 10% cheaper than the cost of a bag of conventional urea.

Significance

- **Improves plant nutrition**
 - It has been found effective and efficient for plant nutrition which increases the production with improved nutritional quality.
 - It will boost a balanced nutrition program by reducing the excess use of urea application in the soil and will make the crops stronger, healthier and protect them from lodging effect.
 - Lodging is the bending over of the stems near ground level of grain crops, which makes them very difficult to harvest, and can dramatically reduce yield.
- **Improves Environment**
 - It will also have a huge positive impact on the quality of underground water, a very significant reduction in global warming with an impact on climate change and sustainable development.
- **Increase Farmers' Income**
 - It is easy on the pocket of farmers and will be effective in increasing farmers' income. It will also significantly bring down the most of logistics and warehousing.

Benefits of Nano urea

- a. Reduces the requirement of conventional urea by 50% or more.
- b. Required less and produces more: Efficacy of one bottle of Nano urea (500 ml) is equivalent to one bag of urea.
- c. Environment friendly product, can improve soil, air and water quality thus, helps in addressing the concerns of Global Warming and in meeting the UN SDGs.
- d. Cheaper than conventional urea.
- e. Reduce input cost to farmers, leads to increase in farmers' income.
- f. Improves crop productivity, soil health and nutritional quality of produce.
- g. Nano urea is developed to replace conventional urea and it can curtail the requirement of the same by at least 50 per cent. It contains 40.000 ppm of nitrogen in a 500 ml bottle, which is equivalent to the impact of nitrogen nutrient provided by one bag of conventional urea means 50 kg.
- h. To test its efficacy, around 11,000 farmer field trials were undertaken on more than 94 crops across India and results showed an average 8 per cent increase in crop yields.

- i. Nano urea has been included in the government's Fertilizer Control Order after the field trials were undertaken under National Agriculture Research System (NARS), 20 ICAR research institutes, State Agriculture Universities and Krishi Vigyan Kendras on 43 crops.
- j. The new nano urea liquid will increase the production of crops with improved nutritional quality. Cheaper than conventional urea, the new product is also expected to reduce the environmental pollution caused by the granular form, by reducing its excessive application that exacerbates soil, water and air pollution with climate change problems.
- k. The size of one nano urea liquid particle is 30 nm and compared to the conventional granular urea it has about 10,000 times more surface area to volume size. Due to the ultra-small size and surface properties, the nano urea liquid gets absorbed by plants more effectively when sprayed on their leaves.

Applications

Mix 2 to 4 ml of nano urea in one liter 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 (30-35 days after transplanting). 2nd spray 20-25 days after 1st spray or before flowering in the crop.

Note: Don't cut nitrogen applied through DAP or complex fertilizer at the basal stage. Reduce only top-dressed urea applied in 2-3 splits; Number of sprays of nano urea can be increased depending upon crop and its nitrogen requirement.

Application Instructions

1. Shake well the bottle before the use.
2. Use flat fan or cut nozzles for spraying on the leaves.
3. Spray during morning or evening hours avoiding dew.
4. If rain occurs within 12 hours of the spray of nano urea, it is advised to repeat the spray.
5. Nano urea can easily be mixed with biostimulants, 100% water-soluble fertilizers and agrochemicals. It is always advised to go for a jar test before mixing and spraying for compatibility.



6. For better result nano urea should be used within 2 years from the date of its manufacturing.

Precautions

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

References

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