

# The New Age of Fertilization: Exploring Nanourea's Paradigm Shift

Pooja Swami and Aarti Kamboj

Department of Botany and Plant Physiology, College of Biotechnology, CCS Haryana Agricultural University, Hisar, Haryana 125004.

\*Corresponding Author: [poojaswami06@hau.ac.in](mailto:poojaswami06@hau.ac.in)

Nanourea represents an unprecedented breakthrough at the intersection of nanotechnology and agriculture. This innovative composite, comprising nano-scale urea particles, possesses the potential to reimagine the landscape of fertilizer application, yielding substantial crop amplification while mitigating environmental repercussions. Conventional urea fertilizers, often plagued by inefficiencies that result in nitrogen overflows and ecological degradation, encounter a transformative solution in Nanourea. This innovation leverages nanotechnology to engender particles endowed with calibrated release dynamics, harmonizing nitrogen liberation with the precise demands of plant nutrient assimilation. The diminutive scale of Nanourea particles facilitates enhanced soil permeation, fostering augmented nutrient absorption by plants, thereby nurturing robust vegetative expansion and diminishing overall fertilization necessities. The consequential attenuation of nitrogen runoff fortifies water bodies and averts groundwater pollution. The profound potential of Nanourea to bolster agricultural productivity while concomitantly ameliorating ecological imprints engenders pronounced intrigue amongst scientific scholars, agronomists, and environmental vanguards. As the frontiers of nanotechnology expand, Nanourea emerges as a promising stride towards sustainable resolutions for the imperatives of global food security, propounding a trajectory towards efficacious and eco-friendly agrarian practices.

## Benefits of nanourea

**Enhanced Nutrient Efficiency:** Nanourea's controlled release mechanism ensures that nutrients are gradually released, matching the plant's uptake

needs, thereby minimizing wastage and increasing nutrient use efficiency.

**Increased Crop Yield:** Improved nutrient absorption due to nanoscale particles leads to healthier and more vigorous plant growth, resulting in higher crop yields.

**Reduced Environmental Impact:** Nanourea's controlled release reduces nitrogen runoff, minimizing water pollution and protecting aquatic ecosystems.

**Water Conservation:** By optimizing nutrient delivery, nanourea reduces the need for excessive irrigation, promoting water conservation in agriculture.

**Soil Health Improvement:** Nanourea's smaller particles enhance soil penetration, promoting better nutrient distribution and microbial activity, which contribute to improved soil health.

**Decreased Fertilizer Usage:** Nanourea's efficiency means farmers can use smaller amounts of fertilizer to achieve the same or better results, reducing overall fertilizer application.

**Sustainable Agriculture:** Nanourea aligns with sustainable farming practices by reducing environmental pollution, conserving resources, and promoting long-term agricultural viability.

**Enhanced Nutrient Uptake:** The nanoscale particles facilitate easier uptake of nutrients by plants, reducing nutrient losses and ensuring that crops receive the necessary nutrients for optimal growth.

**Mitigation of Nitrogen Loss:** The controlled release of nitrogen in nanourea helps prevent leaching and volatilization, reducing the emission of harmful greenhouse gases.

**Global Food Security:** By improving crop yields and making agriculture more sustainable, nanourea contributes to addressing the challenges of feeding a growing global population.

### **The scientific principle of nanourea**

Nano urea (liquid) encompasses 4% N within encapsulated nitrogen analogs or organically matrix-embedded forms. With dimensions ranging from 20-50 nm, these nanoparticles boast an elevated surface area and particle density per unit space, conferring advantages surpassing traditional urea. Their propensity to facilely breach cell walls or traverse leaf stomatal pores is evident. Following cellular ingress, phloem cells, plasmodesmata (40 nm diameter), and carrier proteins encompassing aquaporins, ion channels, and endocytosis mediate their dispersion across various plant compartments. Ergo, administering nano urea liquid via foliar application precipitates heightened nitrogen assimilation efficiency, culminating in augmented physiological growth, amplified grain yield, and elevated fruit quality."

### **Crop and dose requirement**

Nano urea proves amenable to application across a comprehensive spectrum of crops, spanning cereals, pulses, vegetables, fruits, flowers, medicinal, and ancillary varieties. Dilute 2-4 ml of Nano urea (4% N) per liter of water, subsequently disseminating this solution upon crop leaves during active growth phases. Notably, a quantity of 500 mL is generally adequate for a single acre, amenable to various application methodologies including knapsack, boom, power sprayers, and drones.

### **Time and method of application**

Dilute 2-4 ml of Nano Urea (4% N) in one liter of water, thereafter administering this solution onto crop foliage during phases of active tillering/branching (30-35 days post germination or 20-25 days subsequent to transplanting) for the initial spray. Subsequently, a second application is recommended 20-25 days post the initial spray or anterior to the flowering phase. It is imperative to exercise discretion in the administration of basal nitrogen through DAP or complex fertilizers, safeguarding against overlap.

### **Limitations of nanourea**

**Certainly, here are four important limitations of Nanourea**

**Cost and Affordability:** Nanourea production and application might be more expensive compared to conventional fertilizers, potentially limiting its adoption among small-scale or resource-limited farmers.

**Environmental Fate and Safety:** The long-term environmental impact and potential nanotoxicity of Nanourea require thorough investigation to ensure its safety for ecosystems and human health.

**Application Challenges:** Effective and uniform application of Nanourea might require specialized equipment or techniques, which could be a barrier for farmers lacking access to such resources.

**Variable Performance:** Nanourea's efficacy could vary across different soil types, crops, and climatic conditions, necessitating tailored recommendations and careful management practices for optimal results.

\* \* \* \* \*