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ROLE OF NANO FERTILIZERS IN AGRONOMIC BIOFORTIFICATION: REVOLUTIONIZING CROP NUTRITION

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Malnutrition and vitamin shortages have caused serious problems for the global population in recent years. Traditional fertilizers have played a significant role in increasing crop yields, but they frequently fall short of improving the nutritional value of the harvested produce. The development of nano fertilizers, which present a novel method for agronomic biofortification, offers a viable alternative. These cutting-edge fertilizers have the potential to change crop nutrition through the use of nanotechnology, effectively addressing nutrient deficiencies and supporting the global effort to eradicate malnutrition.

Understanding Agronomic Biofortification

The practice of strengthening crops' nutritional value by increasing their nutrient content through targeted fertilizer application is known as agronomic biofortification. The concept of agronomic biofortification recognizes the role of agriculture in addressing malnutrition and nutrient deficiencies. By using biofortification techniques, crops can be enriched with key micronutrients during their growth stages, making them more nutritious when consumed by humans. (White and Broadley, 2009)

Introducing Nano Fertilizers

On the other side, nano fertilizers represent a paradigm leap in crop nutrition. These fertilizers use nanotechnology to develop effective, focused, and environmentally friendly nutrient delivery systems. The fertilizers can increase nutrient uptake, decrease nutrient losses, and increase the bioavailability of micronutrients to plants by encapsulating vital nutrients within nano-sized particles. (Khot *et al*., 2012)

Advantages of Nano Fertilizers in Agronomic Biofortification

1. **Enhanced Nutrient Uptake:** Nano fertilizers help plants absorb nutrients more effectively. Due to the nanoparticles' small size and large surface area, roots can penetrate them more easily and nutrients are more readily available for absorption. As a result, crop output is increased as is the efficiency of fertilizer use. (Hussain *et al*., 2016)
2. **Controlled Release Mechanisms:** Nano fertilizers may be designed with controlled release mechanisms to provide the plants with nutrients gradually and continuously. Through the use of this controlled release function, nutrient leaching is avoided and a consistent supply of vital micronutrients is provided to plants at all stages of their growth cycle.
3. **Increased Bioavailability:** The solubility and bioavailability of vital micronutrients can be increased by using nano-sized particles, which can overcome the drawbacks of conventional fertilizers. Thus, crops cultivated with nanoparticle fertilizers have greater nutrient contents, making them more wholesome for human consumption.
4. **Environmental Sustainability:** Nano fertilizers are environmentally sustainable substitutes for traditional fertilizers. Their exact targeting lessens the requirement for heavy fertilizer application, reducing the chance of nutrient runoff and water body pollution. This lowers production costs for farmers while simultaneously preserving the environment. (Kah and Hofmann, 2014)

Challenges and Future Directions

Although the potential of nano fertilizers in agronomic biofortification is intriguing, there are still a number of issues that need to be resolved. These include worries about the cost-effectiveness, toxicity, and mass production of nanoparticles. In-depth research and development efforts are being made to tackle these issues and guarantee the secure and long-lasting use of nanoparticle fertilizers in agriculture. Availability of micro-nutrient based nano-fertilizers in market is also a major problem.

Conclusion

Global malnutrition and nutrient inadequacies can be addressed through agronomic biofortification employing nano fertilizers. These fertilizers provide tailored nutrient delivery, higher bioavailability, and increased crop yields by utilizing the power of nanotechnology.

Nano fertilizers have the potential to change agriculture with additional research and development, resulting in a healthier and more secure global food supply.

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