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# Nanotechnology Based Phosphorus Fertilizer-A Recent Approach for Increase Phosphorus Use Efficiency

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Phosphorus (P) is vital to plant growth and is found in every living plant cell. It is involved in several key plant functions, including energy transfer, photosynthesis, transformation of sugars and starches, nutrient movement within the plant and transfer of genetic characteristics from one generation to the next. Phosphorus is an essential nutrient both as a part of several key plant structure compounds and as a catalysis in the conversion of numerous key biochemical reactions in plants. Phosphorus is noted especially for its role in capturing and converting the sun's energy into useful plant compounds. Phosphorus takes its rightful place alongside Nitrogen and Potassium among the three primary macronutrients which are essential for successful plant growth. These three essential elements are to be managed in such way that their use efficiency is high so that food and nutritional security could be achieved with minimal environmental risk. Among these three primary nutrient elements P is widely deficient in soils of the world in general and Indian soils in particular next to nitrogen. Phosphorus use efficiency in most crops will be around 15 to 20 per cent.

## Functions of Phosphorus in Plant

Phosphorus is a part of the nucleic acid structure of plants which is responsible for the regulation of protein synthesis. Phosphorus plays a major role in the growth of new tissue and division of cells. Plants perform complex energy transmissions, a function that requires phosphorus. Without Phosphorus, photosynthesis could not occur. Phosphorus plays a key role in complex energy transformations that are necessary to all life, as a main ingredient in ATP (adenosine triphosphate). It is also a central component of DNA and RNA – and is necessary for building proteins and other compound.

1. Stimulated root development
2. Increased stalk and stem strength
3. Improved flower formation and seed production
4. More uniform and earlier crop maturity
5. Increased nitrogen N-fixing capacity of legumes
6. Improvements in crop quality
7. Increased resistance to plant diseases
8. Supports development throughout entire life cycle

## Symptoms of Phosphorus Deficiency

1. Stunted plants and yield affected
2. Older leaves are affected first and may acquire a purplish discoloration
3. Leaf tips will brown and die appear weak and maturity is delayed
4. Development of chlorosis as well as necrotic patches on the leaf margin

## Need of Nano fertilizers

In the past 50 years, the fertilizer consumption exponentially increased from 0.5 (1960's) to 24 mt (2013). The optimal NPK fertilizer ratio of 4:2:1 is ideal for crop productivity while the current ratio is being maintained at 10: 2.7: 1 in India. The fertilizer response ratio in the irrigated areas of the country has decreased from 13.4 kg grain / kg nutrient applied in 1970's to just 3.7 kg in 2005. About 27 kg NPK/ ha was required to produce one tonne of grain in 1970 while the same level of production can be achieved by 109 kg NPK/ha in 2008. The extent of nutrient deficiencies in the country is in the order of 89, 80, 50, 41, 49 and 33% for N, P, K, S, Zn and B, respectively.

## Importance of Nano fertilizers

1. Nano particles increase nutrients use efficiency
2. Decrease in residual effect
3. Production of safe and nutritious food.
4. They minimize cost and maximize profit.
5. Enhance plants growth and increase in productivity
6. They are nontoxic.

## Methods of Synthesis of Nano Phosphorus Fertilizers

**1. Synthesis of Rock phosphate nano particle by physical method (Adhikari *et al.* 2014):** Rock Phosphate (34% and 31%) collected from Udaipur, Rajasthan, size of RP reduced to nano size with help of 24 blade Rotary Mill, repeated this process for 5 times then material was ball milled the rock phosphate nano particle was synthesized.

**2. Wet chemical synthesis of Hydroxyapatite Nano particles (Taskin *et al.* (2017):** The nHA was synthesized by the wet chemical precipitation method, using calcium nitrate tetrahydrate (Ca $(NO_3)_2 \cdot 4H_2O$) as the source of calcium, diammonium hydrogen phosphate ($(NH_4)2HPO_4$) as P source.

**3. Biosynthesis of nano slow-release phosphate and potash fertilizer (Rajendran *et al.* (2017): a. Phosphate Nano SRF prepared by mixing 10mL of component A and 100g of component B.**

**Component A:** Emulsion of rock phosphate and potash were prepared by sonicating 0.25g of rock phosphate and potash in 10ml of neem oil for 30 min at 0.5 cycles and 80 amplitude.

**Component B**: Neem cake powder (100g) blended with 1x108 CFU/g of PGPR.

**4. Pelletized Nano SRF should be characterized.**

## Conclusion

By applying phosphorus in the form of nano fertilizers allows better dissolution, faster absorption and assimilation by the plant compared to conventional fertilizers thus, employing nanotechnology in synthesis of nano phosphorus fertilizers and their subsequent use is regarded as a breakthrough in achieving higher nutrient use efficiency with minimum environmental risk. Application of Nano zeolite phosphorus fertilizer plays a significant role in enhancing phosphorus content, uptake and yield components of peanut crop through improving the use efficiency of nutrient.

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