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Development of Smart Fertilizer Based on Nitric Oxide and Its Effect of Plant Growth and Immune System in the Crop

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[Introduction]

Agricultural application of the existing chemical fertilizers has been shown low nutrient use efficiency and resulted in environmental eutrophication. Also, encapsulated NPK fertilizers using micro-plastics have caused another serious environmental problem. In this context, to maximize the efficiency of crop nutrients efficiency and reduce environmental pollution, an increasing number of studies for smart fertilizers with slow-releasing nutrients have been proceeded. The research of fertilizer for crop nutrition based on nano-technology has been suggested as the advanced platform to overcome the limitation of chemical fertilizer used in the normal farming practice. In current agricultural field, Hydroxyapatite in the spotlight have the ability to release Phosphate and Calcium enough to be used as agricultural fertilizer. Furthermore, Nitric Oxide (NO), as a signaling molecule, has been reported to regulate diverse pivotal biological processes in plants including development, growth, biotic and abiotic stress defense responses. This complex made by the combination of Hydroxyapatite and NO is a suitable substance to conduct as the multi-functional smart fertilizer involved in plant growth and immune system. This study is to be the first step on developing smart fertilizer for the sustainable eco-friendly agriculture.

[Materials and Methods]

Using the binding principle of the carboxyl group, we synthesized this complex consisted of Hydroxyapatite, Humic Acid and NO. The NOA (NOA280i, SIEVERS) was used to detect the emission of NO gas, we confirmed that It continued to stably release NO gas. The growth and salt stress resistance of crops were evaluated with pot test using a growth chamber.

[Results and Discussion]

Under abiotic stress, we are well known that the plant roots release the compound of organic acids called as root exudate. We found smart fertilizer based on Nitric Oxide is melted by root exudate and nutrients such as P and Ca are released to use for plant growth. It also shows that NO combined with this complex affected on overall plant growth and immune system as signaling. This complex released NO slower and supplied P and Ca decomposed from Hydroxyapatite. The new type of fertilizer based on nanotechnology is considered to have a good effect due to its high availability in the agricultural industry.

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