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A Controlled-Release Nanofertilizer Improves Tomato Growth and Minimizes Nitrogen Consumption

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Abstract : Minimizing the consumption of agrochemicals, particularly nitrogen, is the ultimate goal for achieving sustainable agricultural production with low cost and high economic and environmental returns. The use of biopolymers instead of petroleum-based synthetic polymers for CRFs can significantly improve the sustainability of crop production since biopolymers are biodegradable and not harmful to soil quality. Lignin is one of the most abundant biopolymers that naturally exist. In this study, controlled-release fertilizers were developed using a biobased nanocomposite of lignin and bentonite clay mineral as a coating material for urea to increase nitrogen use efficiency. Five types of controlled-release urea (CRU) were prepared using two ratios of modified bentonite as well as techniques. The efficiency of the five controlled-release nano-urea (CRU) fertilizers in improving the growth of tomato plants was studied under field conditions. The CRU was applied to the tomato plants at three N levels representing 100, 50, and 25% of the recommended dose of conventional urea. The results showed that all CRU treatments at the three N levels significantly enhanced plant growth parameters, including plant height, number of leaves, fresh weight, and dry weight, compared to the control. Additionally, most CRU fertilizers increased total yield and fruit characteristics (weight, length, and diameter) compared to the control. Additionally, marketable yield was improved by CRU fertilizers. Fruit firmness and acidity of CRU treatments at 25 and 50% N levels were much higher than both the 100% CRU treatment and the control. The vitamin C values of all CRU treatments were lower than the control. Nitrogen uptake efficiencies (NUpE) of CRU treatments were 47–88%, which is significantly higher than that of the control (33%). In conclusion, all CRU treatments at an N level of 25% of the recommended dose showed better plant growth, yield, and fruit quality of tomatoes than the conventional fertilizer.

Keywords : nitrogen use efficiency, quality, urea, nano particles, ecofriendly
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