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Optimising nitrogen form ratios for enhanced growth, yield, and fruit quality in processing tomato (*Solanum lycopersicum* L.)

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Abstract

In Thailand, tomatoes are usually cultivated in open fields using flood irrigation, a practice that often leads to inefficient fertiliser use especially nitrogen. This inefficiency not only limits crop productivity but also contributes to environmental concerns such as nitrogen leaching and greenhouse gas emissions. Improving nitrogen use efficiency is therefore critical for enhancing tomato production and promoting sustainable agricultural practices. This study, conducted during the 2022–2023 dry season, aimed to evaluate the effects of different nitrogen form ratios nitrate (NO_3) to ammonium (NH_4^+), NH_4^+ to urea, and NO_3 to urea on the growth, yield, fruit quality, and carotenoid content of processing tomato. Three nitrogen sources were applied: NO_3 (15–0-0), NH_4^+ (21–0-0), and urea (46–0-0), under a randomised complete block design (RCBD) with thirteen treatments and three replications. The experiment was conducted in a plastic-net house to minimise environmental variability. Results showed that the NO_3:urea ratio of 70:30 led to the highest fruit number and total yield per plant. Conversely, the NH_4^+:urea ratio of 30:70 produced the highest average fruit weight, as well as the greatest fruit width, length, and flesh thickness. This ratio also recorded a favourable total soluble solids content of 4.81 °Brix. The 50:50 NO_3:NH_4^+ ratio significantly enhanced fruit redness and maximised lycopene and beta-carotene content. The highest ascorbic acid levels were found in treatments with NH_4^+:urea ratios of 50:50 and 70:30. These findings highlight that selecting appropriate nitrogen form ratios tailored to specific production goals can enhance both the productivity and nutritional quality of tomatoes, supporting more efficient and environmentally responsible farming systems.

Keywords: Antioxidants, Fruit firmness, Nitrogen efficiency, nutrient management

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