Under split and reduced nitrogen application, storage-root nitrogen content decreased at 35 days after transplanting (DAT), while carbon content and the C/N ratio increased. These changes were accompanied by altered hormonal status, including changes in IAA and ZR, and were subsequently associated with the formation of more storage roots. After approximately 80 DAT, however, a more adequate nitrogen supply was again required to maintain leaf function and support storage-root filling (Du et al., 2020). This stage-dependent pattern is more consistent with experimental evidence than the generalized statement that "low nitrogen promotes storage-root formation."

Multi-omics studies also support this stage-specific regulation. Lin et al. (2025) conducted integrated transcriptomic and metabolomic analyses of storage roots from three sweet potato cultivars, SJN, SCZ, and Y25, sampled at 70, 100, and 130 days. A total of 27 RNA-seq samples generated 232.38 Gb of clean data, with at least 7.14 Gb obtained per sample. Q30 values ranged from 93.60% to 95.06%, and 91.02%-95.37% of reads were mapped to the reference genome. In total, 16,303 differentially expressed genes and 1,566 metabolites were identified. Starch and sucrose metabolism were significantly enriched, and starch-related genes generally showed their highest expression at 70 days. Weighted gene co-expression network analysis (WGCNA) ultimately identified 14 candidate genes, among which *IbUGP2* and *IbglgA* were closely associated with D-glucose-6-phosphate and eight starch-related metabolites, suggesting that they may serve as important regulatory nodes during early starch accumulation.

Another integrated study combining miRNA profiling, transcriptomics, and degradome sequencing identified 29,633 differentially expressed genes and 510 differentially expressed miRNAs, and further screened several regulatory modules, including miR319-TCP4 and miR172-AP2 (Wu et al., 2025). Storage-root development therefore cannot be explained by a single "nitrogen-signaling pathway." Rather, it involves coordinated changes in sugar metabolism, hormonal regulation, secondary metabolism, and transcriptional control.

6 Nitrogen Application Strategies for Improving Sweet Potato Yield and Starch Content

6.1 Optimization of nitrogen application rate

One of the most common misconceptions in nitrogen management for sweet potato is to search directly for a fixed "optimal rate." In fact, the optimal nitrogen rates reported in different experiments vary considerably. In a two-year experiment conducted on a Humic Cambisol in Brazil, the maximum technical yield of marketable storage roots was 47.07 t/ha, corresponding to a model-estimated nitrogen rate of approximately 165.5 kg N/ha. However, when fertilizer cost was taken into account, the economically optimal rate was only 74 kg N/ha, at which the marketable storage-root yield was 43.73 t/ha (Higashikawa et al., 2025). In other words, an additional application of approximately 91.5 kg N/ha resulted in only about 3.34 t/ha of additional modeled yield, while nitrogen-use efficiency declined markedly at high nitrogen rates.

Other experiments have reported either lower or higher suitable nitrogen levels. Meng et al. (2023) found that Pushu 32 generally performed best at 120 kg N/ha among treatments of 0, 60, 120, and 180 kg N/ha, whereas in a sand-culture experiment with Orleans, a nutrient-solution nitrogen concentration of 100 mg/L was optimal during the storage-root initiation stage. These values cannot be directly converted or compared as equivalent nitrogen rates. One represents a field-based fertilizer application rate per unit area, whereas the other represents nitrogen concentration in the root-zone nutrient solution. Soil conditions, cultivars, and developmental stages also differed between the experiments. When these data are considered together, the most reliable conclusion is not that "sweet potato should receive 120 kg N/ha," but rather that yield commonly shows a pronounced nonlinear response to increasing nitrogen supply.

6.2 Timing and method of nitrogen application

Research suggests that adjusting the timing of nitrogen application may sometimes be more important than increasing the total amount supplied. Du et al. (2019) replaced the conventional single basal application of 100 kg N/ha with a reduced total rate of 80 kg N/ha, split between transplanting and 35 days after transplanting (DAT). Storage-root yield increased by 16.6%-19.0% over two years, accompanied by greater nitrogen uptake during the