middle and late growth stages and an increased nitrogen harvest index. In contrast, simply reducing the rate from 100 to 80 kg N/ha while maintaining a single basal application decreased yield. The issue, therefore, is not simply to "reduce nitrogen," but to ensure that, after reducing the total amount, nitrogen is supplied at the stages when the crop actually requires it.

From the perspective of storage-root initiation, however, nitrogen cannot be completely withheld during the early growth stage. Studies of carbohydrate dynamics have shown that an appropriate nitrogen supply reaching the root zone before or at planting is more favorable for the subsequent translocation of sugars and starch-related assimilates toward the roots. When nitrogen is supplied too late, a greater proportion of nonstructural carbohydrates may already have accumulated in the vines (Dong et al., 2025). A more reasonable strategy is therefore to use basal nitrogen to support seedling establishment and early root differentiation, while avoiding excessive early application. After storage roots have formed, additional nitrogen can then be supplied according to plant growth, soil nitrogen availability, and leaf nitrogen status rather than applying a large amount at one time during the early stage.

6.3 Coordination with other nutrients and water management

Nitrogen management should not be considered independently of potassium and phosphorus nutrition. Nitrogen-potassium interaction studies have shown that an appropriate potassium supply can improve leaf nitrogen metabolism and photosynthesis and can also promote storage-root formation. In a two-year field experiment, Shu et al. (2024) found that application of 240 kg K_2O/ha increased the average number of storage roots by 19.12%, individual storage-root weight by 16.54%, and total yield by 16.92% compared with the zero-potassium treatment. The coefficients of variation for storage-root length and diameter were also relatively low. This indicates that potassium may not only increase yield but also improve the uniformity and marketability of storage roots.

Phosphorus and water availability are equally important. A field experiment conducted on saline calcareous soil during 2022-2023 showed clear interactions between nitrogen sources and phosphorus fertilizer forms, making it difficult to explain final yield responses on the basis of nitrogen alone. In a late-season irrigation study, irrigation at approximately 75% of crop evapotranspiration favored the allocation of photosynthates to storage roots and resulted in relatively high yield and water-use performance (Kamel et al., 2025). Therefore, practical nitrogen recommendations for sweet potato should be developed in conjunction with soil phosphorus and potassium status as well as irrigation conditions.

7 Integrated Nitrogen Management for High-Yield and High-Starch Sweet Potato Production

7.1 Balancing vegetative growth and storage root formation

Excessive N supply promotes vine overgrowth at the expense of storage root development, reducing yield and harvest index. In high-starch cultivar Jishu 25, raising N from 75 to 150 kg/ha significantly decreased storage root yield despite no change in starch content (Duan et al., 2019). High N increases leaf area index, prolongs the cultivation cycle, and favors vegetative organs over root bulking (Ribeiro et al., 2021; Higashikawa et al., 2025). Conventional basal N management in China (90-200 kg/ha) far exceeds recommended rates and tends to hinder storage root formation (Du et al., 2019; 2020). Split application under reduced N rates mitigates this by lowering early soil-available N, promoting root initiation rather than vine expansion. Nitrogen form also influences vegetative balance: ammonium N (AN) increased adventitious root number and storage root yield, while amide N (XN) promoted starch concentration in potential storage roots (Si et al., 2018). Potassium (K) application counteracts excessive N absorption by reducing the leaf N/K ratio and increasing N transport to roots, improving yield by 15%-39% (Wang et al., 2020). Paclobutrazol (PBZ) application temporarily reduced branch length and increased fresh storage root yield under high N in the rainy season (Ribeiro et al., 2021).

Optimizing root-shoot partitioning requires managing the carbon-to-nitrogen (C/N) ratio and endogenous hormones during storage root formation. Du et al. (2020) found that split N application under reduced N increased storage root yield by 22.1% by elevating IAA and zeatin while reducing ABA during root formation, then