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Nitrogen Management Regulates Storage Root Development and Starch Accumulation in Sweet Potato

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Abstract Sweet potato storage root yield and starch accumulation directly determine its food, processing, and economic value. This study examines the effects of nitrogen management on storage root development and starch accumulation in sweet potato, with particular emphasis on source-sink relationships, carbon-nitrogen coordination, hormonal changes, nitrogen transport, and the regulation of related genes. The findings indicate that sweet potato responses to nitrogen vary markedly across developmental stages and among cultivars. During the early stage of storage root formation, an appropriate nitrogen supply favors cambial activity and the establishment of effective storage roots, whereas excessive nitrogen tends to promote vine growth, reduce the harvest index, and restrict carbon translocation to storage roots. After storage roots have been established, moderate nitrogen supplementation helps maintain photosynthetic activity and supports storage root bulking. Split application under reduced nitrogen rates can also improve nitrogen use efficiency and promote starch accumulation by regulating pathways associated with AGPase, GBSS, SBE, and related enzymes. These findings suggest that nitrogen management in sweet potato should shift from the use of a fixed application rate toward precise regulation based on developmental stage, cultivar-specific responses, and integrated soil-plant diagnosis. Such strategies can help achieve coordinated improvements in yield, starch productivity, and nitrogen use efficiency, providing a basis for green and efficient cultivation as well as the breeding of nitrogen-efficient sweet potato cultivars.

Keywords Sweet potato (*Ipomoea batatas* L.); Nitrogen management; Storage root development; Starch accumulation; Source-sink relationship; Nitrogen use efficiency

1 Introduction

Sweet potato (*Ipomoea batatas* L.) is not only an important food crop but also a major raw material for starch processing, food manufacturing, and feed production. In practical production, storage roots are the main organs that determine economic yield. Therefore, the performance of a cultivar or a cultivation practice cannot be evaluated solely on the basis of vigorous aboveground growth. Luxuriant vine growth does not necessarily result in a high storage-root yield. For starch-type sweet potato, storage-root dry matter and starch accumulation also need to be considered. Fan et al. (2025) showed that sweet potato genotypes differ substantially in their capacity for starch production. Such differences arise not only from variation in fresh storage-root yield, but also from starch content and source-sink transport efficiency. Starch quality itself is associated with amylose proportion, amylopectin structure, granule size, and gelatinization properties, all of which directly affect its suitability for different processing purposes.

This relationship becomes clearer when actual yield data are considered. Jiang et al. (2024) investigated the high-starch-yielding genotype H283 and reported a fresh storage-root yield of 43.20 t/ha and a storage-root starch content of 23.56%, corresponding to a starch yield of approximately 10.18 t/ha. In comparison, the control cultivar Shangshu 19 produced 28.455 t/ha of fresh storage roots with a starch content of 23.42%, giving a starch yield of only about 6.66 t/ha. Although the difference in starch percentage between the two genotypes was small, their starch yield differed by approximately 3.51 t/ha. This comparison shows that storage-root yield remains a major determinant of high starch productivity. How much carbon is fixed by source leaves and how efficiently that carbon is transported to the storage roots often determine the final starch yield.