Nitrogen management can inhibit or induce the sprouting of potato tubers: Consequences of regulation tuberization

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Abstract

Regulation of tuber dormancy and sprouting are pivotal for postharvest storage, sales, and seed breeding of potatoes (*Solanum tuberosum* L.). Nitrogen is an essential mineral nutrient required in potato production, which directly influences tuber development and quality. However, the effects of nitrogen on the post-harvest dormancy of potato tubers remain unclear, and their association with the initial tuber development are poorly understood. The aim of this study was to clarify the effects of nitrogen application rate on potato tuber dormancy and the associated physiological mechanisms. We obtained the tubers of different commercial potato cultivars (E shu3, Z shu5, and H shu3) at three nitrogen levels (0, 210, and 315kg N ha^{-1}) through field experiment, and then stored the tubers at room temperature (25 °C) in the dark for 0–16 weeks. The dormancy period and alkaloid accumulation of potato tubers were analyzed, and the quality of seed tubers was evaluated by examining eye sprouting and replanting. We also conducted a pot experiment to explore the differences in tuber and stolen development of one potato cultivar (H shu3) at the three nitrogen levels. The carbohydrate and phytohormone contents in the apical bud meristem of dormant tubers and the enlarged subapical region of stolons were measured. The results showed that a reduction in the nitrogen application rate extended the dormancy period of potato tubers by 3–6 weeks and thereby reduced the risk of alkaloid accumulation caused by tuber sprouting, which was favorable for potato storage and sales. From the perspective of seed potato breeding, nitrogen application markedly increased the number of sprouting eyes, resulting in more stems and higher tuber yield after replanting. Compared to the control,

nitrogen application promoted the sprouting of eyes at the apical bud of potato tubers, improved associated **α**-amylase activity and sucrose content, and increased gibberellin 1 (GA 1) content by 6.0 times. Nitrogen application also facilitated stolon elongation and growth, increased associated GA 1 content by 2.2 times, and delayed the enlargement of the subapical region to form tubers by 6–15 d. Taken together, the results indicate that nitrogen management (increasing or reducing nitrogen application rate) can be used as an agricultural practice to regulate potato tuber dormancy and sprouting. The intrinsic link between regulation of tuber dormancy by nitrogen application rate and its effects on tuber development is attributable to the regulation of tuberization. This research provides abundant physiological information for tuber dormancy and development in potatoes.