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Diurnal and Phenological Changes in the Rate of Nitrogen Transportation Monitored by Bleeding in Field-Grown Rice Plants (*Oryza sativa* L.)

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Abstract: Nitrogen uptake is essential for rice growth and yield. Thus, the development of a simple and rapid method for monitoring nitrogen absorption is strongly required. We examined the fundamental properties of nitrogen transportation monitored by bleeding, including diurnal and phenological changes, to discuss whether the analysis of bleeding sap could be used for monitoring nitrogen uptake by rice. The rate of nitrogen transportation monitored by bleeding was estimated from a combination of the nitrogen concentration in bleeding sap and bleeding rate. We found a clear diurnal change in the rate of nitrogen transportation monitored by bleeding; it was higher in the daytime than at night. In this study, the diurnal change in nitrogen uptake was not influenced by soil temperature but by the light condition. The rate of nitrogen transportation monitored by bleeding showed a phenological change with a peak around the panicle formation stage, while the bleeding rate peaked at around heading and was correlated with root length. The nitrogen concentration in bleeding sap continued to decrease gradually from the early growth stage. The cumulative amount of nitrogen uptake estimated by the bleeding sap analysis was less than half of that estimated by the plant analysis before the maximum tiller number stage, but the difference between these values decreased with plant growth. There was a significant positive correlation between the cumulative amount of nitrogen uptake estimated by these analyses throughout the growing period.

Keywords: [Bleeding sap](#), [Diurnal change](#), [Nitrogen uptake](#), [Phenological change](#), [Rice](#), [Root length](#)

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