Circadian and light-regulated expression of nitrate reductase in Arabidopsis

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The expression of a number of plant genes is regulated by an endogenous circadian clock. We report that the Arabidopsis NIA2 (nitrate reductase) gene shows robust circadian oscillations in mRNA accumulation which persist for at least 5 days in plants that have been grown in a light-dark (LD) cycle and then transferred to continuous light (LL). We further show that NIA2 mRNA accumulation oscillates in a circadian fashion in plants that have been grown in LD and then transferred to continuous darkness (DD). Results from nuclear run-on transcriptional analysis suggest that the oscillations in steady-state levels of NIA2 mRNA abundance are not primarily due to changes in transcription but, instead, reflect post-transcriptional regulation. The circadian oscillations in NIA2 mRNA abundance are paralleled by circadian oscillations in nitrate reductase enzyme activity (NR activity) in Arabidopsis plants that have been grown in LD and then transferred either to DD or to LL. Etiolated Arabidopsis seedlings express neither NIA2 mRNA nor NR activity. However, both NIA2 mRNA accumulation and NR activity are induced by exposure to white light. The inductive effects of light on NIA2 mRNA accumulation are due, at least in part, to a very low fluence phytochrome-mediated response. However, the persistence of circadian oscillations in NIA2 mRNA abundance for at least 5 days in LL demonstrates that the circadian clock is capable of overriding or gating the inductive effects of light on NIA2 mRNA accumulation in Arabidopsis for an extended, continuous period of time.

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