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Nitrogen addition alters photosynthetic carbon fixation, allocation of photoassimilates, and carbon partitioning of Leymus chinensis in a temperate grassland of Inner Mongolia

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Atmospheric nitrogen (N) deposition is sharply increasing in grassland ecosystems. Knowledge of the effect of N addition on carbon (C) fixation and allocation patterns of assimilated C is therefore critical to understand the effects on C cycles in terrestrial ecosystems. We conducted a field experiment to examine the effects of N addition (0 to 25 g N m^{-2} yr^{-1}) on photosynthetic C fixation and C allocation by *Leymus chinensis* using $^{13}CO_2$ pulse-labeling and measurements of the percentage of assimilation allocated to nonstructural carbohydrates (NSCs), secondary metabolites (SMs), and growth in a semi-arid temperate grassland. The net photosynthetic rate (P_n) and biomass of *L. chinensis* first increased and then decreased with increasing N fertilization, with peaks at 5 and 10 g N m^{-2} yr^{-1}, respectively. At the beginning of labeling, the δ^{13}C value and ^{13}C fixation by plant leaves increased significantly at these N levels, but decreased significantly at 25 g N m^{-2} yr^{-1}. N addition increased the root/shoot ratio and the proportion of assimilated ^{13}C allocated to roots, suggesting that C allocation to roots was increased by N addition. Moderate N addition increased the overall NSC and SM concentrations, but C allocation to growth decreased with increasing N. These results suggest that N addition increased photosynthetic C fixation, increased C allocation to roots compared with leaves and stems, and increased C allocation for storage and defense when growth was limited. N deposition under predicted future global changes will therefore affect the C cycle and C balance of terrestrial ecosystems through its effects on C assimilation and allocation.