Delayed autumnal leaf senescence following nutrient fertilization results in altered nitrogen resorption.

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Abstract: Increased atmospheric nitrogen (N) deposition could create an imbalance between N and phosphorus (P), which may substantially impact ecosystem functioning. Changes in autumnal phenology (i.e., leaf senescence) and associated leaf nutrient resorption, which is an important nutrient conservation mechanism in plants, may profoundly impact plant fitness and productivity. However, we know surprisingly little about how and to what extent nutrient addition affects autumnal leaf senescence in tree species, or how changes in senescence may influence leaf nutrient resorption. We thus investigated the impacts of N and P addition on autumnal leaf senescence and leaf N resorption in 2-year-old larch (Larix principis-rupprechtii) seedlings in a field experiment in northern China. The results indicated that nutrient addition (i.e., addition of N, P, or N + P) significantly delayed autumnal leaf senescence (based on a 50% change in leaf color from green to yellow), and decreased leaf N resorption efficiency (NRE) and proficiency (NRP), particularly in the N and N + P treatments. Improved leaf N concentrations were correlated with delayed leaf senescence, as indicated by the positive relationship between N concentrations in mature leaves and the timing of leaf senescence. On nutrient addition, larch seedlings shifted toward delayed-onset, but more rapid, leaf senescence. In addition, we observed an initial negative correlation between the timing of leaf senescence and NRE and NRP, followed by a positive correlation, indicating delayed and less efficient remobilization during the early stages of senescence, followed by accelerated resorption in the later stages. However, the latter effect was offset by the increased risk of early autumn frost damage, and thus failed to fully compensate for the negative effects observed during the early stages of senescence. Improved soil P availability increased leaf N resorption and thus weakened the negative impact of delayed leaf senescence on leaf N resorption, as such, P addition had no significant impact on leaf N resorption. Overall, our findings clarify the relationship between nutrient addition-resorption that linked with leaf senescence, which may have important implications for plant nutrient conservation strategies. In this study, we clarified the effects of atmospheric N deposition on plant nutrient cycling and productivity.

Keywords: Larix spp.; nutrient addition; autumn phenology; leaf senescence; nutrient resorption