Phalaris arundinacea L. (reed canary grass, hereafter RCG) is the most widespread invader of wetlands in Wisconsin, and it grows especially well where nitrogen (N) levels are elevated. Because of these traits, RCG is presumed to have high N uptake capability. In turn, the assumption of high N uptake leads some to propose using RCG to treat wastewater that is high in N. If these assumptions hold, one could grow RCG in N-rich water, harvest and dispose of the N-rich RCG, and end up with purer water.

Is there any evidence that RCG can purify water better than native vegetation? Should RCG be recommended for planting in wastewater-treatment wetlands? Andrea Herr-Turoff (2005) searched the literature for answers. Finding no clarifying data, she set out to answer this question using experimental mesocosms at the Arboretum.

Herr-Turoff compared N removal by wet prairie vegetation with and without invading RCG and under low- and high-N treatments. As response variables, she measured accumulation of N in plant tissues, retention of N in soil, and changes in N levels in water flowing through the mesocosms. This issue discusses what she found in the plant, soil and water responses.

1. RCG did not increase N accumulation in plant tissues

Wet prairie vegetation accumulated more N in its plant tissues without RCG invasions. RCG tissue N concentration averaged 1.0% in the low-N and 1.5% in the high-N treatment over two years. We found no evidence that RCG concentrates more N in its tissues than other wetland species.

Although tissue N concentration did not differ between RCG and wet prairie species, in August 2003, wet prairie vegetation accumulated more N because it accumulated more aboveground biomass. In August 2004, more N accumulated in the aboveground plant tissues in the wet prairie where the vegetation had ~50% more aboveground biomass and 20% greater mean tissue N concentration. The wet prairie had a greater abundance of native forbs, which had considerably more N in their tissues than the graminoid species. If we extrapolate to a wastewater wetland situation, one could harvest species-rich wet prairie vegetation and remove substantial amounts of N.

2. RCG had little effect on soil N

Soil N concentrations were much more affected by the N treatments, which increased inorganic soil N on all of the sampling dates. RCG did not increase soil total N or nitrate (NO$_3$-N) and had little effect on soil ammonium (NH$_4$-N) during 2003 and 2004.

While we found that higher N additions accelerated the expansion of RCG, we found no consistent evidence that RCG invasions increase soil N concentrations within these experimental systems.

3. RCG did not decrease N in discharged water

We found that ammonium and nitrate concentrations in the water discharged from the mesocosms were similar between the wet prairie and RCG treatments on all sampling dates, usually coinciding with similar soil inorganic N concentrations. While the high-N treatment generally increased soil ammonium and nitrates, the release of inorganic N to through-flowing water discharged was not consistently greater.

Conclusion

We found no evidence that vegetation invaded by RCG had greater N-retention capacity than the wet prairie vegetation it displaced in experimental mesocosms. The wet prairie had more aboveground biomass and tissue N accumulation than RCG, and it did not release more N in the water discharged from the mesocosms.
Future research needs

Our study tested one wetland type (wet prairie) under selected environmental conditions (low hydrologic disturbance, namely, intermittent flooding), so we do not generalize to other situations. Additional wetland types need to be tested.

High variability, especially in the leakage of N to the discharged water, warrants additional investigation of N retention patterns of native vegetation at larger spatial scales, where sampling can be more extensive.

Further tests of N retention by wetlands subjected to various disturbance regimes are needed, including the effect of harvesting to remove the N that accumulates in plant tissues. We need to know which native plants are tolerant of harvesting.

Despite the limitations of our study, the findings establish doubt that this aggressive invader retains more N than the native species it displaces. In the absence of evidence that native species cannot remove sufficient N, we suggest that treatment wetlands employ native species and not RCG. If treatment wetlands can sustain native species, they could help conserve biodiversity. At the least, the concept deserves field testing.

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This and earlier leaflets are also locatable as a link from the Arboretum web site, http://uwarboretum.org/research

For details, consult:


Close-up of RCG growing under high-nitrogen addition. Photos on this page by A. Herr-Turoff.