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Phenolic compounds from invasive *Fallopia japonica* inhibit nitrification

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Riparian zones, important hotspots for nitrogen retention, are at risk of losing ecosystem functioning by species invasion and chemical contaminants. Invasive *Fallopia japonica* is suspected of using polyphenolic compounds as a "novel weapon" to decrease nitrification which may be amplified by copper pollution. Inhibited nitrification results in lower nitrate availability for competing plants and is presumed to be part of *Fallopia japonica*´s competitive strategy. Polyphenols are known to enter the soil with leaf litter, but may also be exuded by roots. Yet, the entry pathway and the specific compounds hampering nitrification are not fully determined. Within the group of secondary metabolites produced by *Fallopia japonica*, emodin and resveratrol are frequently described, although their role in the invasion strategy via modification of nitrification has never been tested. As plants are likely to increase exudation and the production of polyphenols under stress, synergistic inhibition of nitrification may be expected under contaminant pollution. Hence, the following hypotheses were tested: (I) Resveratrol and emodin inhibit nitrification. (II) Under copper stress, *Fallopia japonica* increases the content of emodin and resveratrol. Therefore, both stressors act synergistically on nitrification inhibition. (III) As we assume polyphenols to enter the soil via root exudation, nitrification is more strongly inhibited in the rhizosphere compared to the non-rooted soil.

We ran a mesocosm experiment with *Fallopia japonica* and copper additions (0, 90, 270, 810 mg Cu kg^{-1} soil) over two growing seasons. In September of the second year, we analyzed total polyphenol, resveratrol, and emodin concentration in roots, fresh leaves, and senescent leaves using LC-HRMS. Potential nitrification was measured in the rhizosphere and the non-rooted soil. All samples were analyzed in fivefold repetition across all copper concentrations. We further tested how the nitrification in soil responds to additions of resveratrol and emodin.

Resveratrol inhibited nitrification while for emodin no significant effect was found. Under copper stress, concentrations of resveratrol in roots and emodin in senescent leaves were elevated, while total polyphenolic content was not influenced. Copper contamination had a strong concentration-dependent inhibitive effect on potential nitrification. Independent of the copper concentration, *Fallopia japonica* decreased the potential nitrification slightly more than the highest copper concentration (by 75 % compared to control). Despite the increase of resveratrol in roots, the stressors had neither a synergistic nor additive effect, because of the overwhelming influence of *Fallopia japonica* alone. In contrast to hypothesis (III), nitrification inhibition was lower in the

rhizosphere compared to the non-rooted soil, suggesting that nitrification was not primarily controlled by active root exudation but possibly more by aboveground leachates or litter decomposition. We link this to *Fallopia japonica*´s competition strategy hampering nitrification more in the soil that provides nitrate for competing plants.

Our data reveals that polyphenols produced by *Fallopia japonica* may act as a “novel weapon” to benefit the own nutrition and to outcompete other plants. By inhibiting nitrification outside the own rhizosphere, the nitrogen availability for the riparian plant community could be substantially reduced having potentially negative effects on the biodiversity of riparian ecosystems and their ecosystem functioning.