Biodegradation of Allelochemicals and Effects of Activated Carbon and Nitrogen-Rich Fertilizer on Raphanus sativus Development

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Japanese Knotweed (Fallopia japonica) is a highly dominant alien weed species that is increasingly abundant across the Americas and Europe, possessing several potentially allelopathic plant compounds. F. japonica poses a serious risk to plant biodiversity in natural ecosystems, replacing native species in its introduced range. Despite several allelopathic studies on these plants, their mechanism of invasion is not fully understood. To resolve this gap, we aimed to measure the allelopathic potential of F. japonica by initiating a novel growth and germination bioassay on one stress-sensitive crop Raphanus sativus. Given the inaccuracies of conventional detection tools, we decided to train an AI-based model to be our knotweed identification processor: our results showed improved prediction capabilities. This model was used to identify established F. japonica stands, under which rhizospheric soil was collected and homogenized. We inoculated radish seeds with allelochemicals from knotweed soil and treated this soil with activated carbon, nitrogen-rich fertilizer, and a combination of both. Here, we analyzed the phenolic compounds in knotweed soil and rhizomes using NMR spectroscopy. We also evaluated the influence of each treatment on allelochemical biodegradation rate, R. sativus growth, and R. sativus germination and compared these results against untreated potting soil to determine the phytotoxic effect of knotweed. We found that activated carbon accelerated allelochemical degradation and significantly increased germination and growth parameters, indicating its ability to ameliorate the inhibitory effects of allelochemicals. Hence, we suggest that activated carbon can augment best management practices (BMPs) which can be resource-intensive, short-term, and ineffective.

Awards Won: