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Species-Specific Growth Inhibition by Extracellular Self-DNA in a Two-Species Duckweed Community and Its Association with Oxidative Stress

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Extracellular self-DNA has emerged as a species-specific regulator of plant growth, yet its effects and physiological responses in aquatic plants remain poorly understood. This study investigated whether extracellular self-DNA preferentially inhibits growth in a two-species duckweed community and whether this response is associated with oxidative stress. Lemna perpusilla and Spirodela polyrhiza were exposed to self-DNA, non-self DNA, and mixed DNA. A dose–response assay using genomic DNA solutions ranging from 0 to 2,000 ng μL^{-1} identified the most inhibitory treatment. Growth was evaluated using frond number, root number, root length, fresh biomass, and dry biomass. Species specificity was examined by co-cultivating both species and exposing the culture separately to DNA from each species. Physiological responses to self-DNA at 1,000 ng μL^{-1} were assessed through reactive oxygen species (ROS), superoxide dismutase (SOD), peroxidase (POD), catalase (CAT), and malondialdehyde (MDA). Self-DNA caused stronger inhibition than non-self DNA and mixed DNA. In the two-species community, L. perpusilla DNA reduced L. perpusilla fresh biomass by 76.5% but S. polyrhiza by only 3.2%. Conversely, S. polyrhiza DNA reduced S. polyrhiza fresh biomass by 93.3% but L. perpusilla by only 14.5%, demonstrating reciprocal species-preferential inhibition. Self-DNA also increased ROS accumulation by 39% in L. perpusilla and 54% in S. polyrhiza, accompanied by enhanced SOD, POD, and CAT activities and elevated MDA levels. These findings show that extracellular self-DNA preferentially inhibits its source species within a mixed duckweed community and that this response is associated with oxidative stress, supporting investigation of self-DNA recognition and species-targeted aquatic plant management.

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