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Published by: Great Plains Agricultural Council: Leafy Spurge Symposium.

Differential enzymatic glucosylation of hydroquinone in tissue cultures of small everlasting and leafy spurge: An allelochemical detoxification mechanism

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Natural phytochemical interactions (allelopathy) offer potential new approaches to weed management and the development of new, ecologically safe herbicides. Traditional allelopathy studies have concentrated on the isolation and identification of putative phytotoxic agents, with minimal consideration of the underlying biochemical mechanisms. We now report a differential allelochemical detoxification mechanism that may play a prominent role in the observed dominance of the low-growing, noncompetitive forb, small everlasting, over the deep-rooted, noxious weed, leafy spurge.

Small everlasting has been observed to be allelopathic toward leafy spurge in the field. The mechanism of this allelopathic interaction was speculated to be based upon differing abilities of leafy spurge and small everlasting to metabolize hydroquinone: a phytotoxic phenolic compound isolated from small everlasting plant material (Manners and Galitz, 1985) and tissue cultures (Hogan and Manners, 1990). Hydroquinone is glucosylated to its corresponding monoglucoside, arbutin; a non-toxic, water-soluble compound, in callus and suspension cultures of small everlasting and leafy spurge. The glucosyltransferase enzyme responsible for the detoxification of hydroquinone was continuously detected in cell-free extracts of small everlasting callus tissue. This enzyme was biosynthesized only when hydroquinone was added to leafy spurge suspension culture cells and the enzyme activity in leafy spurge was found to be six-fold lower than that measured in small everlasting. This differential ability of leafy spurge and small everlasting to detoxify hydroquinone provides a biochemical basis for the observed allelopathic interaction between these two species.

References

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