ALLELLOCHEMICALS PRODUCED DURING GLUCOSINOLATE DEGRADATION IN SOIL

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Abstract—A variety of plant pests are suppressed by the incorporation of cruciferous plant material into soil. Although this effect is attributed to decomposition of glucosinolates into toxic products, little is known concerning glucosinolate degradation in the soil environment. Arenas (30 × 18 × 8 cm) that contained soil amended with 30 g defatted winter rapeseed meal (Brassica napus L.)/kg soil on one half and unamended soil on the other were constructed. Isothiocyanate concentrations in the soil were measured using infrared analysis of CCl₄ extracts, and ionic thiocyanate (SCN⁻) using ion chromatography on aqueous extracts. Quantities were monitored during a 100-hr time period in conjunction with a wireworm bioassay. Isothiocyanate production reached a maximum of 301 nmol/g soil at 2 hr, but decreased by 90% within 24 hr. Production of SCN⁻ reached a maximum of 180 nmol/g soil at 8 hr but persisted longer than isothiocyanate. Separate late instar wireworms (Limonius infuscatus Mots.) were repelled by the presence of rapeseed meal in less than 24 hr even though the meal was shown in separate experiments not to be toxic. We propose that rapidly produced isothiocyanates are responsible for this repellency, but other products such as SCN⁻ may play a role.

Key Words—Rapeseed, Brassica spp., isothiocyanate, thiocyanate, defatted

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INTRODUCTION

Glucosinolates are organic anions possessing a β-D-thioglucose moiety, a sulfonated oxime, and any one of a variety of aliphatic or aromatic R groups (Figure 1). Nearly 100 different glucosinolates have been isolated or identified from degradative products (Chew, 1988). They are produced exclusively in dicotyledonous plants and are most common in members of the order Capparales. Those plants with the highest concentrations are in the families Resedaceae, Capparidaceae, and Brassicaceae (Fenwick et al., 1983).

Glucosinolates themselves possess limited biological activity. However, enzymatic degradation by thioglucoside glucohydrolase (EC 3.2.3.1) results in the formation of a number of allelochemicals (Figure 1). Glucosinolate chemistry and degradation pathways in plant tissues have been reviewed (Chew, 1988; Röbbelen and Thies, 1980; Larsen, 1981; Björkman, 1976; Kjaer, 1976).

Interest in glucosinolates and the associated degradation products has been generated because of the possibility of using plant residues as a substitute for synthetic organic pesticides. Cruciferous plant tissues or tissue extracts have...