Role of soil persistence and mineralization of sorgoleone on the allelopathic potential of Sorghum bicolor

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Abstract

Sorgoleone is the major component of the hydrophobic root exudate of sorghum (Sorghum bicolor). Synthesis of this allelochemical occurs exclusively in root hairs and continues throughout the growth season. Sorgoleone production is optimum at 30∘C but is suppressed when approximately 20 μg of exudate mg-1 root dry weight accumulates at the root hair tips. Production resumes after sorgoleone removal and there is some evidence that sorgoleone levels increase when other species grow in close proximity to sorghum. Great strides have been made in our understanding of sorgoleone biosynthesis, including the characterization of the genes and enzymes required for production, though more effort is still required to understand the mechanisms of exudation from root hairs to the soil. Once exuded, sorgoleone interferes with several molecular target sites, including photosynthetic electron transport, however, in planta activity requires translocation of the allelochemical to photosynthetic tissue. Low levels of translocation suggest that sorgoleone inhibits photosynthesis only in young seedlings within the rhizosphere of sorghum. Consequently, knowledge of the fate of sorgoleone in soil is essential to fully understand its mechanism of action. Sorgoleone is strongly sorbed in soil, which increases its persistence, yet experiments show that microorganism mineralization occurs over time. The methoxy group of sorgoleone is mineralized most rapidly, whereas mineralization of the remaining molecule (ring and lipophilic tail) is slower. Mineralization kinetics indicate that soil microorganisms previously exposed to sorghum are able to use sorgoleone as a source of energy.

Keywords: allelochemical, soil fate, root exudate, dynamics

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