MICROBIAL DEGRADATION OF NEONICOTINOID INSECTICIDES IN THE SOIL

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Abstract

Imidacloprid and thiamethoxam are neonicotinoid insecticides that are widely used as seed treatments in cotton, primarily for the control of thrips (Thysanoptera). A study was performed in 2013 to determine the extent that soil microbes might degrade these insecticides into secondary metabolites. In July, soil was collected from a production field where neonicotinoid seed treatments had been used for many consecutive years and where performance problems against thrips were observed in cotton during 2013. At the same time, soil was also collected from a mowed grassy area with no previous exposure to insecticides. Part of the soil from each location was sterilized by autoclaving. Both sterilized and unsterilized soil were treated with an identical dilution of either Gaucho 600 (imidacloprid, Bayer CropScience) or Cruiser 5FS (thiamethoxam, Syngenta). The soil was mixed and stored for 15 days at shaded, ambient outside temperatures. After 15 days, the soil was again mixed and a subsample was sent to the USDA AMS National Science Laboratory in Gastonia, NC for analytical testing of neonicotinoid concentrations, including known metabolites. Thiamethoxam and two of its metabolites (clothianidin and clothianidin TZMU) were detected in soil treated with the Cruiser dilution. Imidacloprid and three of its metabolites were detected in soil treated with Gaucho. Imidacloprid metabolites found included imidacloprid olefin, imidacloprid olefin des nitro, and imidacloprid urea. Sterilizing the soil significantly reduced the concentrations of the imidacloprid and thiamethoxam metabolites. This suggests that soil microbes can degrade both insecticides. However, the amounts of degradation to secondary metabolites were relatively low, approximately 10-12% and less than 2% for imidacloprid and thiamethoxam, respectively. Previous soil exposure to neonicotinoid insecticides had negligible effects on the concentration of secondary metabolites. Considering the low levels of degradation and that several of the metabolites detected retain at least some insecticidal activity, it seems unlikely that microbial metabolism of either insecticide would appreciably impact their performance as seed treatments.

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