ENVIRONMENTAL FATE OF SYSTEMIC NEONICOTINOIDS: A POTATO CASE STUDY

Anders Huseth and Russ Groves [1/]

Introduction

To date, the in-plant distribution of the in-furrow, systemic neonicotinoid classes (IRAC MoA 4A) of insecticides are relatively unknown in potato. Variable insecticide concentration and distribution over time is thought to affect resistance development in numerous insect pests, including key pests of potato (Gould, 1984, Isaacs, 2002, Daniels et al., 2009). Dynamic insecticide expression in the crop creates sub-lethal refuges promoting the evolution of behavioral and physiological mechanisms of resistance (Hoy et al., 1998). Documentation of insecticide within potato foliage throughout the growing season will generate a concentration profile for systemic use patterns. Insecticide expression patterns will better inform times at which the crop expresses sub-lethal insecticide doses that have direct implications for resistance management of key insect pests in potato. Connecting the amount of insecticide delivered to the proportion taken up by the plant season-long is a key factor in documenting overall in-plant concentration and environmental fate of insecticides.

Concern for groundwater quality has sparked a discussion as to the potential impacts of water, nutrient and insecticide use patterns in Wisconsin's agro-ecosystem. Recent positive detections of neonicotinoids by the Wisconsin Department of Agriculture Trade and Consumer Protection (WI-DATCP) in groundwater throughout the state have begun a discussion addressing not only the above ground concentration of neonicotinoids within the plant but what possible losses may be occurring below ground. Several studies have documented the chemical properties of neonicotinoids and their interaction with biota in the soil, composition of the soil and movement of compound into the water. Unfortunately, few have documented the relative tradeoffs between application of labeled neonicotinoid rates in potato, in-plant expression of insecticide and losses into the environment.

Objective

The objective of this project is twofold: 1) quantify in-plant concentration of thiamethoxam in potato between emergence and senescence. 2) directly compare season long thiamethoxam concentration in water leachate for three systemic and a foliar use patterns in potato. Documentation of temporal insecticide translocation in water will provide an improved understanding of insecticide delivery technologies that may contribute negative environmental impacts on soil, water, and human health.

Project History

The research presented on in-plant neonicotinoid expression was conducted in the 2010, 2011 and 2012 growing seasons. Forthcoming results will be presented as part of an emerging

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[1/] Research Assistant and Associate Professor, Department of Entomology, 537 Linden Dr. Univ. of Wisconsin-Madison, Madison, WI 53706.

body of analysis determining both temporal and spatial (between plant) insecticide concentration variability in potato. Characterization of neonicotinoid leachate from potato was a project component that was deployed with several systemic use patterns in the 2011 and 2012 growing season.

Approach

Field experiment: Insecticide treatments of thiamethoxam (Platinum 75SG & Actara 25WG, Syngenta, Greensboro, NC) were selected to represent a common, at-plant potato neonicotinoid and represent the majority of neonicotinoid groundwater detections by WI-DATCP from 2008-2010. Commercially formulated insecticide products at maximum labeled rates for potato in Wisconsin will be applied (Boerboom et al., 2010).

A randomized complete block design with four treatments (e.g., in-furrow, seed treatment, impregnated polyacrylamide and foliar) and an untreated control was be planted using the cultivar Russet Burbank. Each plot had a zero tension pan-type water collection lysimeter installed directly beneath the potato hill at a depth of 75 cm. Systemic insecticides was be applied at-planting using a hand-held, CO_2 pressurized sprayer as a directed spray to the seed. Polyacrylamide horticultural copolymer granules was be impregnated at an application rate of 16 $^{kg}/_{ha}$. Thiamethoxam insecticide solutions (0.834 g/250 ml D.I. water) were mixed with 75 g polyacrylamide then slowly stirred until all liquid is absorbed. Impregnated granules were dried for 24 hours at 20°C. Treated granules were divided into even quantities per row (9.8 g per 20 feet imidacloprid, 9.6 g per 20 feet thiamethoxam) and evenly distributed.

Lysimeter chemical quantification: Lysimeters were sampled on a bi-monthly frequency. Following collection samples will be maintained at 4-6°C. Water samples will be analyzed monthly by the WI DATCP-Bureau of Laboratory Services with LCMS. Established standard operating procedures developed by WI DATCP-EQ will used for the analysis of neonicotinoid residues.

Literature Cited

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