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New seed treatments: the neonicotinoids

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New seed treatments: the neonicotinoids

Abstract

Three systemic insecticides applied as seed treatments will be used in Iowa this year: clothianidin, imidacloprid, and thiamethoxam. All three insecticides are in the neonicotinoid chemical family and closely resemble nicotine in mode of action. Neonicotinoids have high activity against sucking insects such as aphids and against chewing pests such as beetles and some Lepidoptera (cutworms, for instance). These chemicals are highly systemic in the plant roots and new leaf tissues, and can be used for several purposes, especially as seed treatment.

Keywords

Entomology, Agronomy

Disciplines

Agricultural Science | Agriculture | Agronomy and Crop Sciences | Entomology

INTEGRATED CROP MANAGEMENT

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Three systemic insecticides applied as seed treatments will be used in Iowa this year: clothianidin, imidacloprid, and thiamethoxam. All three insecticides are in the neonicotinoid chemical family and closely resemble nicotine in mode of action. Neonicotinoids have high activity against sucking insects such as aphids and against chewing pests such as beetles and some Lepidoptera (cutworms, for instance). These chemicals are highly systemic in the plant roots and new leaf tissues, and can be used for several purposes, especially as seed treatment. However, they have not been widely field-tested in the Midwest and their performance against pest species such as wireworms, seed corn maggots, and white grubs, still remains unknown.

All neonicotinoids have a mode of action that binds at a specific site in the central nervous system of insects. This causes excitation of the nerves and eventual paralysis, which leads to death. Due to the mode of action of neonicotinoids, there is no cross-resistance to conventional insecticide classes such as carbamates, organophosphates, and pyrethroids. Neonicotinoids act as acute contact and stomach poisons, combine systemic properties with relatively low application rates, and are relatively nontoxic to vertebrates (see table).

Neonicotinoids must be classified as highly toxic to honey bees. However, studies on toxicity exposure indicate that it is very unlikely that honeybees will die when the product is applied to seeds. Honeybees also rarely forage on seedling corn or soybeans. Also, it is very unlikely that commercial beehives will be negatively affected. Neonicotinoids pose only a low-toxicity hazard to adult ground beetles (predatory beetles) and a moderate toxicity hazard to the green lacewing, another predator.

Studies with clothianidin have shown low risk to soil-dwelling invertebrate species because the predicted environmental concentrations are lower than the no-observed effect for the most sensitive tested species. Three rates of clothianidin, sprayed to a field in Europe, revealed no significant differences between total numbers or total biomass of earthworms collected from plots treated at the highest rates (225 grams active substance per hectare) compared to the untreated control.

Thiamethoxam is the most soluble in water of the three products, which might be an advantage in dry soil conditions. However, other factors such as toxicity, persistence, and soil adsorption are important attributes of the overall performance of thiamethoxam.

Table 1. Neonicotinoid insecticides used in corn and soybeans in Iowa.

	clothianidin	imidacloprid	thiamethoxam
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Trade name	Poncho	Gaicho	Cruiser
Manufacturer	Bayer	Bayer/Gustafson	Syngenta
Solubility in water (mg/L)	327	610	4,100
LD50 (acute rat oral) (mg/kg)	>5,000	4,870	5,523
Labeled for corn	Yes	Yes	Yes
Labeled for soybean	No	Yes	No

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