# Using Crop Rotation as an Insect Management Tool in Corn

### What insects can be controlled by rotating away from corn?

Insects that overwinter in the field, are not mobile, and are host-specific to corn can be controlled with rotation away from corn to another crop. For example, the Northern, Western, and Mexican corn rootworms overwinter as eggs in the soil of corn fields and are host-specific to corn, thus rotation to a non-corn crop can effectively control them. However, although the European corn borer overwinters as a larva in corn debris and the Western bean cutworm overwinters as a larva in the soil, both emerge as moths and can move to other corn fields unimpacted by rotation away from corn. See Table 1 for listing of select corn insect pests an impact of crop rotation.

*Table 1. Selected insects and impact of crop rotation on injury.*

| Insect | Controlled by Rotating away from Corn | Explanation |
|---|---|---|
| Corn Rootworm (Western, Northern, Mexican) | Yes | Except for populations of Northern corn rootworm with extended diapause and populations of the variant Western corn rootworms. |
| Southern corn rootworm | No | The southern corn rootworm migrates into the corn belt as an adult and deposits eggs in existing corn fields |
| White grub | No | Grubs overwinter in the soil and are often more of economic concern when corn follows pasture, grass, or some cases soybean. |
| Western bean cutworm | No | Larvae overwinter in the soil of corn fields, and moths can fly to corn fields the following season. |
| European corn borer | No | Larvae overwinter in the within corn debris, and moths can fly to corn fields the following season. |
| Black cutworm | No | Moths overwinter in South Texas and Mexico and use storm fronts in the spring to migrate north. |
| Corn earworm | No | Moths overwinter in the southern states and migrate north during the growing season. |
| True Armyworm | No | Moths overwinter in the southern states and migrate north during the growing season. |
| Fall Armyworm | No | Moths overwinter in the southern states and migrate north during the growing season. |
| Billbug | Yes | Rotation of corn with a non-grass crop reduces the levels by starvation and by preventing reproduction. |
| Chinch bug | No | Adults migrate into corn fields. |
| Wireworm | No | Larvae overwinter in the soil and are often more of economic concern when corn follows pasture or sod. |

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**Can the corn traits for insect protection selected for my field break the corn rootworm lifecycle?**

It depends. Crop protection relying on a single trait (such as a single gene for a *B.t.* toxin) also relies on corn rootworm populations being susceptible to the toxin conferred by the trait. Populations of corn rootworm identified as being tolerant to a specific toxin can still be managed by corn products with multiple insect protection traits (in other words, multiple genes for multiple toxins). However, if corn rootworm populations have been increasing in the field, resistance or tolerance to the toxins may only be part of the story. In some regions northern corn rootworms can have an extended diapause allowing them to circumvent the corn-soybean rotation strategy and emerge as larva when corn is planted again. The western corn rootworm has a behavioral variant and can feed on soybean plants and lay eggs in soybean fields. The larvae then hatch and feed on corn planted after soybean. These insects should be managed with (1) in-row insecticide, (2) crop rotation, and (3) insect protection traits, especially in areas with or years following high insect activity.

**Is a three-year crop rotation better than a two-year crop rotation to reduce corn rootworms with extended diapause?**

It is possible to diminish northern corn rootworm biotypes with extended diapause with longer crop rotations. Insects with an extended period of dormancy during some stages of development are difficult to control with a crop rotation strategy.

**Why isn't crop rotation effective against more corn insects?**

Crop rotation helps to break the life cycle of insects with limited mobility and in fields with limited plant hosts between harvest and planting of the next crop. However, most insects that attack corn emerge from overwintering as adults and migrate to host plants. Corn earworm and black cutworms moths travel hundreds of miles from the south each year to re-infest fields in the Corn Belt.[1] These types of migratory insects are not controlled well with crop rotation. Crop rotation can be used to manage corn rootworms as females lay eggs in the soil at the base of the corn plants. The larvae have no known other agricultural host plant, so if corn is not planted, the newly hatched larvae will starve.

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**What other cultural tactics can be used to help manage potential insect injury?[2]**

- Tillage
  - » Insects that feed on seed and young seedlings are typically found in the soil or at the soil surface. Wireworms, cutworms, white grubs, and seed corn beetle are some of the insect pests affected by tillage either directly or indirectly. Residue accumulation on the soil surface provides protection for insects and can lead to increased injury to corn seed and small seedlings as observed more commonly in no-tillage or minimum tillage culture versus conventional tillage. Typically, early spring tillage incorporates the residue and brings many pests to the surface that attracts large numbers of birds. Birds flock behind tillage implements and prey on exposed insects. The combined action of these factors kills and disrupts populations of potential pests and can give meaningful protection to planted seed and small seedlings. Additionally, tillage destroys weeds that can harbor insects or attract females to deposit eggs in the field, such as the black cutworm moth.
- Soil Fertility
  - » Maintaining optimal soil pH and fertility are essential to vigorous plant growth and high yield potential, which can be critical to the crop's ability to perform in the presence of pests. The use of starter or banded fertilizers to promote seedling growth can be helpful in reducing damage for seedling pests, especially on cool, wet-natured soils and in no-tillage, where early growth is often slow.
- Rapid Seed Germination and Emergence
  - » Rapid germination and seedling growth reduces the time corn seedlings spend in the most vulnerable stages, from germination to the V6 stage. Therefore, ensure management factors that promote early germination (e.g. planter operation, product selection, starter fertilizer) are used in conjunction with planting when soil conditions are fit for germination and plant growth.
- Product Selection
  - » Corn products vary in their ability to withstand insect pests. Rapid germination, early vigor, strong ear shanks, tight husks, resistance to stalk rots, strong stalks, and uniform performance over a wide seeding rate range are all factors influenced by corn product genetics that can influence losses to insects. Seedling insects, stalk borers, and ear feeding insects are most influenced by corn product traits. Products with *Bt* traits for below and above ground pests can have a large impact on corn rootworms and many caterpillar pests.

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**How does crop rotation impact other crop management practices? [3]**

- Rotations and Plant Diseases
  - » Crop rotation can break many disease cycles, both in no-till and conservation tillage systems. Crop residue can contain inoculum for many important diseases in corn, thus rotations that use nonhost crops or resistant seed products provide an opportunity for the residues to decompose. This should decrease the risk of disease. Because certain diseases persist in the soil, there are some diseases, such as seedling damping off (*Pythium* spp.) and root rots (*Rhizoctonia solani* and *Fusarium* spp.), that can be managed only by combining the rotation with other techniques. Additional methods might include using appropriate seed treatments, delaying seeding, and installing tile drainage.
- Rotations and Weed Management
  - » Rotation can impact weed populations and diversity. Rotations provide the opportunity to rotate the herbicide mode of action, which should reduce the risk of creating herbicide-resistant weeds. The use of a "stacked" rotation can be effective in reducing this risk. In a stacked rotation, the same or very similar crops are grown two years in a row and then skipped for four or more years (e.g., corn-corn/soybean-soybean/wheat-wheat), this can allow the use of herbicides with long residuals in the first year of each crop while maintaining a long period (four years) where the land is rotated to other crops.
- Rotation, Residue, and Nutrient Availability
  - » Corn produces more residue than either soybeans or small grains. While this is an asset for building soil organic matter and protecting the soil from erosion it does present challenges, particularly in no-till systems. Forming a seedbed, controlling pests, and recycling nutrients can be more challenging. Soybeans tend to tolerate high-residue situations better than many other crops. The persistence of corn residue may slow nutrient recycling and the release of N from decaying stover. Following corn with a legume crop such as soybeans can help overcome this problem.
- Impacts on Yield in a Corn-Soybean System
  - » Studies at many universities have observed a 10 to 22% yield benefit for corn grown in rotation with soybeans compared to a continuous corn cropping pattern. A 15-year Wisconsin study found that the corn-soybean rotation was more profitable than continuous corn and rotations that include oats and alfalfa. In many fields, there is a corn yield decrease of about 5% to 15% for second-year corn relative to first-year corn. However, yield reductions generally stabilize after the third-year corn.

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## Sources


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[3] Sexton, P. 2019. Crop rotations can increase corn profitability and reduce pests. South Dakota State University. https://extension.sdstate.edu/sites/default/files/2019-09/S-0003-09-Corn.pdf


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