

# MANAGING CORN ROOTWORMS IN 2021

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## Introduction

Use of Bt toxins to manage corn rootworms has been a primary, if not singular, control tactic. However, field resistance has been a concern for several years, which has resulted in fields with unacceptable losses.

## Scope of Bt CRW Resistance in Wisconsin

Nationally, focus has been on resistance of the western corn rootworm which is the predominant species in many midwestern states. However, Wisconsin also has the northern corn rootworm species and resistance has been documented in North Dakota in 2018. Recently, the northern corn rootworm has been the most abundant, although personal observations suggest that western corn rootworm numbers are increasing. For this article, and for considerations of future management plans, we should collectively look at both species and assume either can be resistant to the plant incorporated Bt toxins.

Rootworm damage is cryptic. Feeding injury is below ground and not easily detected until lodging is severe. Furthermore, other causes of lodging (compaction, wind, etc.) may be misdiagnosed as rootworm injury. As a result, it is difficult to determine the scope of Bt resistance in Wisconsin. However, both documented and anecdotal reports of injury have occurred in many areas of the state. Resistance may be more commonplace in areas of high concentration of continuous corn and/or repeated reliance on the same Bt toxin.

## Detecting Resistance

To detect corn rootworm resistance, evaluate roots for feeding after mid- to late-July when larvae are nearing the end of their feeding period. For best results, finish root evaluations before corn roots have a chance to regenerate (mid- to late-August). Dig a representative sample of roots from each field and wash all soil off the roots. Look for signs of feeding damage that include scarring and root pruning. This step is important because it can verify early stages of Bt resistance, which allows for selection of management practices that can slow the spread of resistance.

## Corn Rootworm Management Practices

Diversifying corn rootworm management practices should be considered the cornerstone of future corn rootworm management plans. Crop rotation is at the top of the list. Rootworms overwinter as eggs that are deposited in corn during August or early September. Hatch will start the following spring and larvae will die if a crop other than corn is present.

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There have been some exceptions. In southeast Wisconsin, female western corn rootworm had been known to lay eggs in soybeans. However, this phenomenon has not been reported in the past decade. If concerned about damage to first-year corn, consider evaluating roots

of first-year corn fields for feeding. This practice will give some insight into the damage potential in future years. Northern corn rootworms have acquired, through the natural selection process, a method to circumvent annual corn/soybean rotations. Although not documented in Wisconsin, a proportion of their population can survive two winter chill periods before hatching.

To ensure the long-term durability of Bt CRW hybrids, incorporate other management practices in your rootworm management plans. Prior to EPA approval of the Bt CRW hybrids, soil applied, at plant insecticides (SAP) were the primary management tactic if crop rotation was not used. Use of a SAP on non-Bt hybrids can be a good alternative to Bt hybrids even at high beetle populations. However, soil insecticides will vary in their effectiveness and reading labels can provide good insight regarding their control niche. If the label language indicates if high beetle populations are expected to use a second management practice (high seed treatment rate, Bt hybrid) then consider using a different insecticide for those fields with high pressure. Rotating SAP and/or modes of action, is important. Although resistance has not been documented with the current EPA-approved insecticides, it must be considered a potential concern. Resistance has been documented to antiquated classes of insecticides that are no longer labeled and to foliar applied insecticides used to control adults. The point is to be aware of this potential for resistance.

The high rate of either thiamethoxam or clothianidin seed treatments on non-Bt hybrids partnered with field scouting can be an effective management practice only if beetle populations are low but still over threshold. Scouting data are important if seed treatments are to be used otherwise there may be significant risk of injury.

### Beetle Scouting

Although rootworm beetle populations were higher in 2020 compared to 2017 to 2019, it must be remembered that beetle populations were at historic lows during that 3-year period. Using field-specific beetle scouting data will allow crop consultants to choose those fields that are best suited for the above-mentioned alternative practices. Furthermore, it may indicate if field populations are below-threshold levels in which no control practices will be needed. To take advantage of below-threshold fields, adult beetle counts need to be conducted during the egg laying period (mid-August to early September) and at least two counts spaced 7 to 10 days apart are needed for accuracy. Beetles are somewhat migratory and may move from field-to-field depending crop phenology. A third scouting period would be nice but a minimum of two scouting dates would be required.

### Rotating Bt Toxins

Prior to a discussion of how to diversify management practices we should consider how to manage Bt CRW toxins if they are to be considered. Using the same, or similar, toxin for more than two years should be avoided. Annual rotation is better. Using the same, or similar, toxin on a routine basis will select for resistance to that toxin(s). Currently there are only four Bt toxins available. Three toxins have similar protein structure (Cry3Bb1, mCry3, eCry3.1Ab) and cross resistance has been documented between them. The fourth is Cry34/35Ab1 and has not been documented to be cross resistant with the previously mentioned proteins.

## Single vs. Pyramid Proteins

Using a pyramid hybrid, which can be loosely defined as a hybrid which has two Bt toxins to control the same insect, is a good management practice compared to a single toxin. Although there are some single toxin trait families available, most seed companies are moving to pyramids. However, if one of the two Bt toxins has been previously compromised you are essentially using a single toxin hybrid. Control may be acceptable for a period of time because the effective toxin masks the ineffectiveness of the compromised protein. However, selection pressure will be increased for the effective protein until it fails.

## Diversifying CRW Management Practices

Being aware of the management practices listed above, their management niche, the need to rotate Bt toxins and especially the need for these practices to be linked with a scouting program will provide the background necessary to diversify management practices. Using a one size fits all management program is at direct odds with the IPM concept.

General IPM principles should be used to develop a rootworm management program that avoids resistance while providing economical control. For example, fields with high (or higher) potential for rootworm damage consider using Bt hybrids or SAP on non-Bt hybrids. Perhaps a mix of both depending on acreage. Your goal is to reduce dependence on Bt hybrids and to provide an opportunity to rotate Bt toxins.

Corn fields with moderate beetle populations would still be good candidates for SAP insecticides on non-Bt hybrids. This will likely reduce input costs yet keeps your options open for using and rotating Bt toxins on those fields with high populations.

Based on current rootworm populations trends and/or your location in the state, you will undoubtedly have fields with low populations. Using the high rate (CRW rate) of a thiamethoxam or clothianidin seed treatment will provide economic and efficacious control while most importantly keeping options open for the high-pressure fields. This management option needs scouting data to verify low beetle populations.

## Using SAP with Bt CRW Hybrids

Questions are often asked regarding the need for overlaying SAP with Bt hybrids to control rootworms. This practice should be considered only if scouting information verifies beetle populations are extremely high and there is concern that either practice by themselves may fail. It should not be considered for average populations if trying to protect a Bt toxin that is already compromised. Using a compromised Bt toxin in this situation will only continue to select for resistance.