HOW TO FORM A CORN ROOTWORM MANAGEMENT PLAN

By Gil Gullickson
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If you're wondering why corn rootworm infestations have not plagued most areas in recent years, look to the sky. Prolific growing season rainfall has drowned corn rootworm larvae that hatched from eggs laid the previous year in many areas.

"In the last few seasons, we have had a lot of water," says Jim Lappin, AmVac marketing manager for corn and soy. "Larvae don't do well under highly saturated soils."

Still, corn rootworm always lurks in the background, as it's estimated it annually causes $1 billion in damage.

"If you do the math, we are spending more money today on traits and chemistry at a level we have never spent before," says Lappin.

TRAIT RESISTANCE

They're still a viable management tool in many areas, but problems are surfacing.

"We get calls from growers who say that traits are not doing the job they used to," says Lappin.

Signs of Bt trait resistance first surfaced in Minnesota and Iowa in 2009, says Ken Ostlie, University of Minnesota (U of M) Extension entomologist.

"This was six years after the first trait (Bayer's YieldGard hybrids containing the Cry3Bb1 Bt protein) was introduced in 2003, and it was not widely sold in that year," he says. "So, it took five years from when it was widely planted (in 2004) to where apparent resistance occurred."

Iowa State University (ISU) entomologists first confirmed bioassay rootworm resistance in 2011 to the Cry3Bb1 Bt protein that's in products like YieldGard Rootworm, several SmartStax offerings, VT Triple Pro, VT Triple Pro RIB Complete, and YieldGard VT Triple. University of Illinois researchers then discovered Cry3Bb1 resistance in 2012.

Corn rootworm resistance has also been confirmed to the mCry3A Bt protein that's in Agrisure Viptera 3111, AcreMax Trisect, AcreMax Xtreme, Agrisure Duracade 5122 EZ Refuge, Agrisure Duracade 5222 EZ Refuge, Intrasect Trisect, Intrasect Xtreme, and Qrome.

Research published in 2016 from Iowa and Minnesota shows that resistance to these proteins also confers resistance to the structurally-similar eCry3.1Ab protein that's in Agrisure Duracade 5221 EZ Refuge and Agrisure Duracade 5222 EZ Refuge. That's according to University of Illinois (U of I) entomologists Nick Seiter and Joe Spencer and Kelly Estes,

They note cross-resistance among these Cry3 Bt proteins should be expected for Illinois western corn rootworm populations.

“If you have resistance to one, you can have resistance to the other two,” adds Ostlie.

ROOTWORM TRAIT PYRAMIDS

Pyramids have typically been recommended for resistance management, as they contain two corn rootworm modes of action. Examples are SmartStax hybrids that contain the Cry3Bb1 Bt protein and the Cry34/35/Ab1 Bt protein. (The Cry34/35Ab1 protein is also found in AcreMax Xtreme, Agrisure 3122 EZ Refuge, Herculex Xtra, Intrasect Xtreme, and Qrome.) Another pyramid is the Agrisure Duracade offerings that contain both the mCry3A and eCry3.1Ab Bt proteins.

Pyramids have particularly worked well in circumstances where rootworm infestation potential is high.

“We recommend planting SmartStax anytime there is corn-on-corn,” says Sean Evans, technology development manager for Bayer Crop Science. "It doesn’t matter if it is second year corn-on-corn or eight-year corn-on-corn. If rootworm shows up once in five years, you will recoup the extra cost of seed.”

Pyramids aren’t immune to resistance. In 2017, U of M entomologists published data that profiled a SmartStax hybrid in a Minnesota field. “It showed a high level of resistance to Cry 3Bb1 and elevated resistance to Cry34/35Ab1,” says Ostlie.

mode of action can accelerate resistance development.

"The ground level (for rootworm) is changing," says Ostlie. "As populations rebuild, we will see increasing resistance problems in pyramids, too. We even have suspected Bt resistance to several proteins with northern corn rootworm (in Minnesota), which would be a ground changer for us."

WEATHER IS A FACTOR

Corn rootworm problems could particularly surface in a dry year when larvae don't drown, says Lappin.

"With all four (rootworm) resistant traits having some level of resistance, it is just a function of not *if* but *when* we will have environmental conditions like we did in (drought year) 2012," he says. "It will translate to a change in management practices in the next few years."

Soil-applied insecticides – which AmVac sells – is a tool that corn farmers can use to incorporate into a resistance management strategy. Besides achieving better overall root protection, soil-applied insecticides can also supplement traits, too, says Lappin. They protect the 5% to 10% of the untraited corn in a refuge-in-a-bag hybrid product, he says. He adds soil-applied insecticides can also boost control of other seed-attacking pests.

"Our 10-year average is a 9-bushel-per-acre increase with granular or liquid insecticide in addition to traits," he says. "Insecticides apply protection on 5% to 10% of refuge plants. This translates into those plants getting more moisture and nutrients."

Not all agree, though. "Data from Bayer Crop Science shows there is not enough economic justification to pay for an application of insecticide on a trait," says Evans.

But 80% of the time, it doesn't pay.

TWO THINGS

"Farmers have to separate two things," says Ostlie. "What will population levels be like in their fields? And do they resist traits?"

Some good news: Normally, it takes two to four years for rootworm populations to rebuild. With low 2018 populations reigning across most areas of the Corn Belt, 2019 rootworm infestation odds are low.

"The dilemma facing many growers is they don't have a handle on corn rootworm populations in their fields," Ostlie says. "At low populations, the resistance can be present, but there will be no signs until populations build again. So, the more growers can do to keep populations low, the better off they will be."

Areas still exist where rotating corn with soybeans works as a way to manage corn rootworm, notes Evans.

In areas of Illinois, Indiana, and Iowa, though, the western corn variant has foiled corn and soybean rotation by laying eggs in nearby soybean fields that hatch the next year when corn is planted. In more northern areas like Minnesota, extended diapause occurs when corn rootworm eggs laid by females in corn fields lie dormant the following year in soybeans and hatch the subsequent year in corn.

Lack of recent rootworm infestations and lower commodity prices are prompting some farmers to forego rootworm-resistant traits.

"Some folks are looking hard as to if they can plant Double Pro (an above-ground insect and herbicide-tolerant trait package) where they have

"There are growers who are planting non-rootworm Bt corn with no soil-applied insecticide and are just taking their chances," adds Ostlie. "I can understand the economic necessity, but I would not take that chance unless I knew the populations were low in my field.

"Another thing farmers could do is look at the trait history in their fields," adds Ostlie. "The field we are having trouble with northern corn rootworm resistance (in Minnesota) has been a SmartStax field since that trait came out (the commercial launch was in 2010)."

Trait rotation can work, but Ostlie reminds farmers to be aware of cross resistance potential between Cry3Bb1, mCry3A, and eCry3.1Ab.

MONITOR FIELDS

"The population of rootworms in a field will reveal so much," says Ostlie. "Resistance signs first show up in changing beetle numbers. Since you'd like to make management changes before you get clobbered, use tools at your disposal like sticky traps for monitoring."

Sticky traps can be used to monitor rootworm populations in fields destined for corn the following year.

The economic threshold is two rootworm beetles per trap per day in corn following corn. For rotated corn, the economic threshold is one and one-half western corn rootworm beetles per trap per day in soybean. (These thresholds are based on a recent study in Iowa, which recalculated economic thresholds for corn rootworm based on updated crop values and control costs).

prioritize rootworm management strategies and give farmers a heads up on developing resistance potential.

"It helps you know which fields have low populations, how fast they are building, and how long you can take advantage of reduced risk by not using traits or insecticides or both," he says.

Some good news exists. A new corn rootworm management tool is coming. Companies like Syngenta and Bayer Crop Science are developing new RNAi technology to manage corn rootworm. Bayer Crop Science plans to launch its SmartStax Pro early next decade that will include a third mode of action using this technology in addition to the two now present (Cry3Bb1 and Cry34/34/Ab1) in SmartStax.

The event – termed CRW III – has a gene inserted into the corn cell that tells the corn plant to make a specific protein. When rootworm larvae ingest the protein, it stops a specific RNA in the corn rootworm cells from making a specific protein the rootworm larvae need to survive.

CONTINUALLY ADAPTING

"Corn rootworm always adapts to control measures, no matter what they are," says Duane Martin, commercial traits manager for Syngenta. "We see that with genetic traits, too. That is why you will always see Syngenta agronomists and sales people recommend to growers to use Integrated Pest Management systems as they manage rootworm problems."

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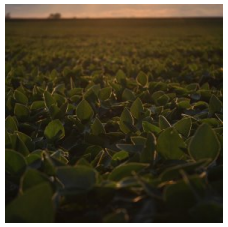

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