Advances in transgenic technology and insect resistance management are occurring at a rapid pace, and it can be hard to keep current. There are now 23 Bt transgenic corn products in five product lines that are resistant to certain insect pests.

The mix of traits, target pests and resistance management requirements vary from product to product and can be quite confusing.

To help farmers keep track of the changes to make the best hybrid selections for their farm, Chris DiFonzo (Michigan State University) and Eileen Cullen (University of Wisconsin-Madison) developed a table that presents a recent update of transgenic traits for corn. There are several items to take note of in the trait table.

Insect resistance

Six species of caterpillar (European corn borer, western bean cutworm, black cutworm, corn earworm, stalk borer and fall armyworm) are controlled or suppressed by Bt corn products.

Suppressed means that while some of the pest population may be killed by the trait, a significant number will likely survive. If farmers are expecting a specific pest problem, choose a product that is labeled to control that specific pest, not suppress it.

These Bt products target caterpillars, although not all products control the same group of caterpillars. Beetle-specific transgenic products target corn rootworm larvae; some products target both caterpillars and corn rootworm larvae.

Herbicide tolerance

Herbicide tolerance also varies among products. Some are only glyphosate or Roundup ready tolerant, some are only Liberty Link/glufosinate tolerant, and some are tolerant to both Liberty Link/glufosinate tolerant and glyphosate or Roundup ready. A few products only have some hybrids within the product line that are Roundup ready/glyphosate tolerant, and one is not herbicide tolerant.

Every year corn fields are mistakenly sprayed with a herbicide they are thought to be tolerant of. Be careful with hybrid selection and remember exactly what traits a hybrid has and where it was planted.

Refuges for resistance management

Insect resistance management requirements are continuing to evolve. Currently, two basic types of refuge are required—structured and non-structured.

A structured refuge refers to the five percent or 20 percent non-Bt corn plantings farmers are required to plant within, adjacent to or within a half mile of the Bt corn field.

Non-structured refuge refers to the inclusion of a certain percent of non-Bt corn seed in a bag of Bt corn seed (currently 10 percent). This is often called refuge-in-a-bag (RIB) and takes the responsibility of planting a separate refuge out of the hands of the farmer.

These differences in refuge size and location can be confusing and beg the question “Why?” Differences in refuge requirements are based on the biology, behavior and genetics of the pest, the pest’s relationship to the crop and the relative toxicity of the toxin or toxins within the plant.

Refuge size

Refuge size depends largely on the probability of resistance developing.

The initial transgenic corn hybrids resistant to European corn borer contain one gene that codes for the production of one toxin that targets corn borers (e.g. Cry1Ab). This toxin interacts with a specific receptor site in the insect gut.

Some of the newer transgenic hybrids contain two genes that code for two different toxins (e.g. Cry1F, Cry1Ab) that interact with two different receptor sites in the insect gut. Either one of these toxins can kill the corn borer.

If an insect develops resistance to one of the toxins, it would still likely be susceptible to the other. European corn borers are less likely to develop resistance in corn fields planted with Bt corn that produces two different toxins targeting corn borers than in corn that produces only one corn borer specific toxin.

Therefore, the refuge can be smaller for fields planted to corn that produces two toxins targeting corn borers.

Refuge location

Another example is the difference in refuge proximity to the Bt corn field. For lepidopteran resistant hybrids—those resistant to corn borer larvae—the refuge may be up to a half mile away; however, for coleopteran resistant hybrids—those resistant to corn rootworm larvae—the

refuge must be in or adjacent to the Bt corn field.

In this case, the mobility of the adult insect is the primary reason for the difference. Before they mate, female corn borer moths fly around more than female corn rootworm beetles, so the refuge can be further away for the corn borer resistant hybrids than for the corn rootworm resistant hybrids.

Long-term value

Many biological, behavioral, genetic, toxicological and other factors are examined and weighed before specific insect resistance management requirements are established. As more is learned and as new products are developed, insect resistance management will continue to evolve.

Although it does make corn hybrid selection more complex, resistance management requirements will help reduce the chance of resistance developing and help maintain the efficacy of these products well into the future.