Optimizing the Use of Biotech Sweet Corn

» Sweet corn varieties with insect protection and herbicide tolerance incorporated using biotechnology are available.
» *Bt* genes can provide protection against corn earworm, European corn borer, and other insect pests.
» Monitoring of insect pests is still necessary and insecticide applications may be needed for adequate control.

**BT Based Insect Resistance**

Commercial varieties of field corn containing genes for insect protection from the bacterium *Bacillus thuringiensis* (*Bt*) first became available in 1996. These varieties are protected against certain lepidopteran insects including European corn borer and corn earworm. In 2003, other *Bt* genes that conveyed protection against coleopteran insects, such as corn rootworms, became available in commercial field corn varieties. The *Cry* genes from *Bt* allow the plant to produce crystal (*Cry*) proteins that, once ingested, disrupt the intestinal tract of target insects, eventually killing them. *Cry* proteins are very specific, with toxicity to a narrow range of insects. This means that they have little or no effect on non-target organisms, including beneficial insects such as predators and bees. Another class of *Bt* insect toxic proteins, the vegetative insecticidal proteins (*Vip*), also convey protection against a range of insect pests through a different mechanism. These various *Bt* genes are now available in certain sweet corn varieties to provide management of important insect pests. 1,2

**Multiple Bt Toxins**

Several *Cry* genes have been isolated from the *Bt* organism, and through the use of biotechnology, these genes have been transferred into sweet corn plants. Each *Cry* gene produces a version of *Bt* toxin, and the various toxins have different ranges of activity against specific groups of insects. Attribute® varieties of sweet corn, from Syngenta, contain the *Cry1Ab* gene. This gene conveys good protection against European corn borer, but it is not as effective against damage by corn earworm and fall armyworm. 3

The Performance Series® sweet corn varieties, from Seminis, contain two *Cry* genes (*Cry1A.105* and *Cry2Ab2*) that protect against several lepidopteran insects, including corn earworm and European corn borer. The *Cry2* protein is particularly effective against fall armyworm. 3 Other stalk boring insects are also controlled by these two *Cry* proteins. A third *Cry* gene, *Cry3Bb1*, is present in the Performance Series® varieties and is effective against larvae of coleopteran insects, including the western, northern, and Mexican corn rootworms. These insects feed on roots, and the resulting damage can lead to plant lodging if feeding is severe. Rootworm management should also include avoiding the consecutive planting of corn and regular scouting programs for these insects, as insecticide treatments may be needed if population levels are high.

Attribute® II sweet corn varieties, from Syngenta, contain both the *Cry1Ab* gene and the *Vip3* gene, a combination that provides protection against corn earworm, European corn borer, cutworms, and fall armyworm. 3

One concern with using single *Bt* genes for insect protection is that this method puts selection pressure on the target insects, potentially leading to the development of biotypes of the insect that are resistant to the effects of the toxin. Using multiple *Bt* genes (pyramiding the genes) results in plants that produce multiple toxins with different modes of action (MOA), which helps prevent the development of *Bt* resistant insects. If an insect develops resistance to one toxin, it will still be killed by the other toxin that is present. Pyramiding genes, as is seen in the Performance Series® and Attribute® II varieties, helps prevent the development of *Bt* resistant insects. The application of insecticides with different MOAs also helps prevent the development of resistant insect populations.

**Corn Earworm Management**

*Bt* sweet corn hybrids have been shown to significantly outperform traditional non-*Bt* hybrids, regardless of insecticide application frequency, for the management of corn ear worm (CEW). Using *Bt* hybrids has also resulted in a marked reduction in the use of conventional insecticides for managing lepidopteran pests, such as CEW. 4

While the insect protection traits of the *Bt* varieties may be enough to adequately manage CEW on sweet corn in some circumstances, it may not be sufficient when insect populations are high or when field corn in the area is not silking and silking sweet corn is the most attractive site for egg laying. In these cases, the *Bt* varieties will need to be

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resistance to Bt toxins in large acreage crops, such as field corn and cotton, the US Environmental Protection Agency requires that certain percentages of the field be planted to non-Bt versions of the crops to act as a refuge for the insects. There is no such requirement for growing Bt sweet corn. However, there is a requirement that Bt sweet corn plants must be destroyed no later than 30 days, and preferably within 14 days, of harvest. Acceptable means of crop destruction include discing or plowing down of fields and rotary mowing. This helps minimize the survival of any Bt resistant insects that may have developed on the crop.

Benefits of Herbicide Resistance

The many of the currently available biotech sweet corn varieties are also tolerant to specific herbicides listed on their labels. These herbicide tolerance traits allow for pre- and post-emergence applications of the specific herbicides and increase the feasibility of using conservation tillage practices while maintaining adequate weed management. Herbicide tolerant sweet corn varieties can also be planted near corn and soybean crops with the same tolerance trait without the possibility of herbicide injury from unintentional spray drift.

Sweet corn yields can be reduced by early season weed pressure, and it is important to control weeds before they start competing with the corn plants, typically before the weeds are four inches tall. Using a diversity of weed management practices, including multiple herbicides with different sites of action, will help reduce the potential for the development of herbicide resistant weeds.

Sources:

For additional agronomic information, please contact your local seed representative. Developed in partnership with Technology Development & Agronomy by Monsanto.

IMPORTANT: Produce Marketing and Stewardship Requirements: This product has been approved for import into key export markets with functioning regulatory systems. Any crop or material produced from this product can only be exported to, or used, processed or sold in countries where all necessary regulatory approvals have been granted. It is a violation of national and international law to move material containing biotech traits across borders into nations where import is not permitted. It is the grower’s responsibility to talk to their produce handler or purchaser to confirm their buying position for this product so that the marketing requirements can be met.

Herbicide Information for Performance Series® sweet corn: Roundup PowerMAX®, Roundup PowerMAX® II (and Roundup WeatherMax®) herbicides are approved for use on Performance Series® sweet corn (containing the Roundup Ready® trait) in all U.S. states, the District of Columbia and Puerto Rico. If the directions for use on sweet corn with Roundup Ready® 2 Technology (which includes Performance Series® sweet corn) are not listed in the product label that is attached to the product you purchased, contact your Monsanto Company representative. Performance Series® sweet corn Insect Resistance Management (IRM) – Post-Harvest Requirements: Crop destruction must occur no later than 30 days following harvest, but preferably within 14 days. The allowed crop destruction methods are: rotary moving, disking, or disking down. Crop destruction methods should destroy any surviving resistant insects. Bt products may not yet be registered in all states. Check with your Monsanto representative for the registration status in your state.

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