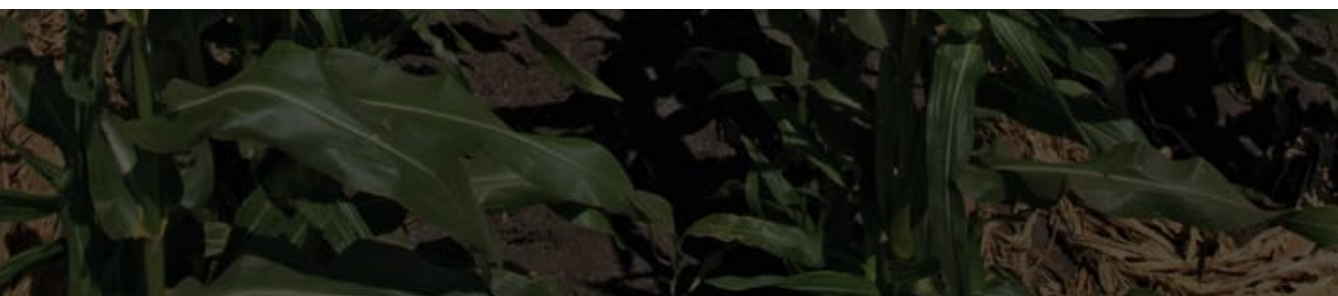


# Your role in growing ATTRIBUTE<sup>®</sup> sweet corn



syngenta<sup>®</sup>



A close-up photograph of a yellow ear of corn, showing the individual kernels in detail. The corn is positioned on the left side of the frame, with the rest of the image being a light, blurred background.

# ATTRIBUTE<sup>®</sup> insect-protected sweet corn hybrids

## High-quality, picture-perfect ears

ATTRIBUTE<sup>®</sup> insect-protected sweet corn varieties from Syngenta Seeds Inc. are a viable crop strategy for sweet corn growers throughout the country. Commercially grown since 1998, these ROGERS<sup>®</sup> brand hybrid sweet corn seeds provide a high level of above-ground protection against European corn borers and corn earworms throughout the growing season. With ATTRIBUTE insect-protected sweet corn hybrids, growers have another option for harvesting outstanding yields of high-quality sweet corn that meets market needs. When managed in accordance with the recommendations outlined in this guide, ATTRIBUTE insect-protected sweet corn can be a valuable addition to your crop management strategy for many years to come.

## How it works

ATTRIBUTE insect-protected hybrids have been genetically enhanced to minimize damage from European corn borers and corn earworms. As a result, each ATTRIBUTE insect-protected hybrid contains a gene that expresses the production of a protein from *Bacillus thuringiensis* (Bt), a naturally occurring soil bacterium that many growers use on their fields to manage some lepidopteran pests. When these lepidopteran insects consume a small amount of plant tissue, the Bt protein binds to their digestive systems, causing them to stop feeding and die within 48 hours. Bt protein is embedded within corn leaves, silks, stalks and ears throughout the growing season, providing comprehensive protection that won't wash off in the rain or degrade in the sun. However, when the silks are dried down, less of the active Bt protein is present.

To date, numerous studies have shown that Bt protein is adept at controlling European corn borers and corn earworms, while at the same time, harmless to beneficial insects, birds, fish, reptiles, mammals and humans.

## Sustainable Integrated Pest Management (IPM)

With ATTRIBUTE insect-protected hybrids, growers can decrease their use of insecticides by as much as 50 percent, depending on corn earworm pressure and environmental conditions. Fewer insecticide sprays means less spray drift, run-off and reduced worker exposure to chemical and environmental risks. By minimizing the number of insecticide sprays, growers can aid in slowing down or potentially reversing the development of pyrethroid resistance in corn earworm populations.

### Grower benefits

Developed to address the fresh market needs for sweet corn, ATTRIBUTE insect-protected sweet corn hybrids produce outstanding yields of high-quality ears with taste and nutrition that are on par with conventional hybrids.

The potential benefits of planting ATTRIBUTE insect-protected hybrids are many. With ATTRIBUTE insect-protected sweet corn, growers can:

- Farm more sustainably with less impact on the environment.
- Meet market demands for fresh corn in regions where insect pressure is greatest.
- Produce more marketable corn because of fewer sprayer-related incidents.
- Improve operational efficiency and associated costs by reducing the amount of labor and the number of insecticide sprays needed.

## Safe and strategic crop management

At Syngenta, we believe safety and strategic crop management should be top of mind. That's why it's important to know that:

- ATTRIBUTE insect-protected hybrids have a thorough and stringent review process conducted by multiple regulatory agencies. To date, ATTRIBUTE insect-protected sweet corn hybrids have received approval from the United States Department of Agriculture (USDA), Environmental Protection Agency (EPA) and Federal Drug Administration (FDA).
- The Bt protein found in ATTRIBUTE insect-protected hybrids targets only lepidopteran populations that naturally feed on corn plants or pollen. As a result, Bt does not produce adverse effects in other types of insects or plant species.
- ATTRIBUTE insect-protected sweet corn seed meets industry safety requirements for packaging and labeling.
- To clearly identify ATTRIBUTE insect-protected sweet corn seed, and ensure its proper handling, safety and use, ATTRIBUTE insect-protected sweet corn seed is coated with a distinctive bright blue color to distinguish it from traditional sweet corn, which typically is covered in a bright pink coating. Please follow the instructions provided for the proper use of ATTRIBUTE insect-protected sweet corn.

## ATTRIBUTE insect-protected sweet corn performance

Since 1998, numerous field trials of ATTRIBUTE insect-protected sweet corn have been conducted by Syngenta Seeds throughout the U.S. Results from these trials indicate that ATTRIBUTE insect-protected hybrids showed significantly less damage from targeted pests, while non-ATTRIBUTE protected plants suffered extensive damage from European corn borers and corn earworms. As a result, ATTRIBUTE hybrids are an effective strategy for controlling European corn borer and corn earworm insect populations.

Results to date indicate that under most conditions, more than 95 percent of ATTRIBUTE insect-protected plants remain virtually free of European corn borer and corn earworm damage throughout the growing season; however, the expected level of protection can vary depending upon environmental factors and seed purity. European corn borers and corn earworms can migrate from non-Bt plant to Bt plants, so some corn borer and earworm larvae may be seen on ATTRIBUTE insect-protected plants that border non-Bt fields. Because European corn borers and corn earworms cannot distinguish between Bt and non-Bt hybrids, egg masses may be found on ATTRIBUTE insect-protected plants. But once small larvae begin feeding on them, they quickly ingest the Bt protein and die.



To optimize yields and ear quality, scout fields for pest outbreaks, and where necessary, apply chemical insecticides to prevent economic loss. Insect pests which are not controlled by this Bt protein include: corn rootworms, cutworms, common stalk borers, silk fly larvae, sap beetles, aphids and flea beetles. Where possible, consult your area pest management specialists or local extension agents for additional insight on pest outbreaks in your area and suggested control options.

## IPM strategies

ATTRIBUTE insect-protected sweet corn hybrids are an important IPM tool that can reduce the need for chemical pest control. Unlike broad-spectrum insecticides, which can destroy beneficial insect populations, ATTRIBUTE insect-protected hybrids are not harmful to ladybird beetles, lacewings and other beneficial insects.

While ATTRIBUTE insect-protected sweet corn can be a powerful IPM tool to control European corn borers and corn earworms, it is not an end-all solution for pest control. Years of IPM experience have shown that using multiple-control tactics over time is the best strategy for preserving ecological diversity.

Under high corn-earworm pressure found in the southern half of the U.S. and with late-season planting, some pest damage can occur in ATTRIBUTE insect-protected sweet corn fields. If the market requires close to zero insect damage, some chemical control methods might be necessary. The number of applications and timing of these applications depend on the corn earworm pressure and environmental conditions.

Continue to use conventional insecticides judiciously to control infestations of pests that are not controlled by ATTRIBUTE insect-protected sweet corn. A multi-faceted approach, including practices like crop rotation and tillage, can go a long way toward controlling pest pressure.

## Does it pay to grow Bt sweet corn?

Galen P. Dively, Professor Emeritus and IPM Consultant  
University of Maryland, Department of Entomology

Sweet corn requires frequent applications of conventional insecticides to control ear-invading insects, such as European corn borer, corn earworm and fall armyworm. Broad-spectrum pyrethroids have been the standard control option but recently growers have applied substantial amounts of carbamates and newer reduced-risk chemistries to control abnormally high insect populations and increasing resistance to pyrethroids. Current insecticide control programs can be costly, have potential exposure risks, and require considerable time and management to implement.

As an alternative, the most potent bioinsecticide for sweet corn insect control is provided by the *Bacillus thuringiensis* (Bt) Cry1Ab endotoxin expressed in ATTRIBUTE® insect-protected hybrids. Acreage of Bt sweet corn has increased significantly in recent years with the introduction of improved ROGERS® brand fresh market hybrids. Many of the growers who have planted Bt sweet corn have not experienced GMO issues and fewer have expressed concerns about consumer acceptance.

Bt sweet corn clearly offers a more targeted and sustainable tool to control insect pests and significantly reduces the number of conventional insecticides. Based on multiple-year field trials, insect-protected ATTRIBUTE hybrids reduced silk sprays for ear-invading caterpillars by at least four applications. Other studies have not reported any adverse effects on beneficial insects in Bt sweet corn, whereas applications of pyrethroid insecticides reduced natural enemy communities up to 70 percent. Use of Bt sweet corn generally results in cost saving over conventional control programs, and can significantly reduce the time that growers spend in managing lepidopteran pests, as well as reduce the exposure risk from handling and applying insecticides. These benefits are valued by many growers who have been willing to pay more for the Bt technology.

Although Bt hybrids provide excellent protection against caterpillars, supplemental insecticide sprays may be needed to ensure fresh market quality ears. In the case of European corn borers, control is close to 100 percent. However, corn earworm and fall armyworm are more tolerant to the Cry1Ab protein. Especially when earworm moth activity is high, a greater portion of eggs is laid on wilted or brown corn silk which expresses less active Bt protein (within 10-14 days prior to harvest). At the same time, ear tips may be more exposed, so hatching larvae have a greater chance to survive, invade the ear and feed on kernels. By feeding on kernels, they also are exposed to a lower level of the Bt endotoxin because not all kernels contain the Bt protein. However, most earworms are affected by the protein, so there is significantly less kernel injury. Yet, the presence of these small larvae (usually <1/2 inch in length) and noticeable kernel injury still pose a quality problem for fresh market outlets. Under very high moth activity, it is not uncommon to find 30-40 percent of the Bt ears infested or showing minor tip damage.

The timing of insecticide applications in Bt sweet corn is different from non-Bt corn. The first spray should be directed at the ear zone at around 100 percent fresh silk, followed by a second spray four days later if heavy moth activity continues. Sometimes a third treatment is necessary. These sprays should also control fall armyworms and Western bean cutworms, which are even more tolerant to the expressed protein.

In summary, ATTRIBUTE insect-protected sweet corn ideally fits the Integrated Pest Management (IPM) philosophy. By deploying a host plant resistance strategy with a reduce risk bioinsecticide, Bt sweet corn can generate greater cost savings, particularly if used in late-season plantings which are subject to higher insect pressure. However, Bt sweet corn will not be insect-free depending on the pest composition and pressure, so regular monitoring of insects not affected by the Cry1Ab protein is essential for successful IPM.

# Grower cultural practices and recommendations for IPM

Working with EPA officials, university scientists, growers and key stakeholders within the seed industry, Syngenta Seeds has developed a series of best practices to preserve the continued effectiveness of ATTRIBUTE insect-protected sweet corn hybrids. As a grower, you play a critical role in this process. Therefore, it is important that you follow the simple steps outlined below to prevent the development of resistant insect populations.

Should you elect to purchase and plant ATTRIBUTE insect-protected sweet corn, you are required by the EPA to sign a stewardship agreement for your farm. Please contact your seed dealer for a copy of the required agreement. The Attribute Grower Stewardship Agreement (the “Stewardship Agreement”) was created to ensure you receive the important information you need to manage your crops safely and effectively.

As a condition of purchase, you will be asked to carefully monitor your fields on a regular basis for insect infestation. You may not purchase ATTRIBUTE insect-protected sweet corn without signing this agreement and the accompanying guidelines. Failure to follow the guidelines outlined in the Stewardship Agreement will prevent the future purchase of ATTRIBUTE insect-protected sweet corn.

## 1. Sign the Stewardship Agreement.

As outlined above, the Stewardship Agreement requires each grower to follow several critical steps to ensure ATTRIBUTE insect-protected hybrids remain an effective IPM tool. If necessary, Syngenta Seeds recommends the appropriate use of chemical control measures to prevent economic damage. When properly managed, ATTRIBUTE insect-protected sweet corn can be an effective IPM strategy for years to come.

## 2. Purchase and plant according to recommended guidelines.

A multi-faceted approach, including practices like crop rotation and tillage, can go a long way toward controlling pest pressure. ***In areas where there are two crops of sweet corn in a year, do not plant ATTRIBUTE hybrids in the same field in back-to-back growing seasons.***

## 3. Scout for non-target pests and use appropriate IPM strategies.

ATTRIBUTE insect-protected sweet corn fields will not be insect-free, so regularly scout for insects not controlled by ATTRIBUTE insect-protected sweet corn. If the market requires close to zero insect damage, some chemical control methods might be necessary. Continue to use conventional insecticides judiciously to control infestations of pests that are not controlled by ATTRIBUTE insect-protected sweet corn before economic loss occurs.

## 4. Scout for resistant European corn borers and corn earworms.

Routine inspections throughout the season are critical for successful IPM. During the scouting process, inspect your Bt sweet corn fields for higher than expected levels of European corn borer and corn earworm damage. Evaluate your ATTRIBUTE insect-protected fields during the mid-to-late whorl stage, looking for leaf and mid-rib feeding damage by corn borers. Prior to harvest, look for damaged ears or evidence of corn borers feeding on ears, ear shanks and stalks. Some damage from corn earworms may be present on the ear under some environmental conditions. Carefully inspect crops and crop tips for corn earworm damage. Contact Syngenta Seeds at 1-800-600-8056 if you observe unexpected damage.

***Destroy all ATTRIBUTE insect-protected sweet corn stalks in your fields preferably within 14 days after harvest, but no later than 30 days after harvest.***

Destruction of stalks will minimize the possibility of larvae surviving to produce the next generation of target insects.

## 5. There are only three approved methods for stalk destruction: rotary mowing, disking or plowing down.



## What to do if you observe unexpected damage

If you observe unexpected damage from European corn borers and corn earworms, call this toll-free number 1-800-600-8056 from 8 a.m. to 5 p.m. Mountain Time to report your observations.

A Syngenta Seeds representative will investigate the situation. After verifying the plants carry the proprietary Bt gene, and after other potential causes have been ruled out, the representative will collect European corn borers or corn earworms for laboratory assay tests. If resistance is suspected, Syngenta Seeds will inform customers and extension agents in the affected area and EPA officials. Insect monitoring programs will be increased and alternative control measures will be recommended.

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Note: All variety information presented herein is based on field and laboratory observation. Actual crop yield, quality, and level of claimed pest and pathogen resistances are dependent upon many factors beyond our control and NO WARRANTY is made for crop yield, quality, and level of claimed pest and pathogen resistances. Since environmental conditions and local practices may affect variety characteristics and performance, we disclaim any legal responsibility for these. Read all tags and labels. They contain important conditions of sale, including limitations of warranties and remedies. Alliance Frame™, Purpose Icon™, the Syngenta and Rogers logos are all trademarks of a Syngenta Group Company.

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