



TwinLink®
TwinLink®
Plus

2023 Insect Resistance Management (IRM) Guide

IRM Program for TwinLink® and TwinLink® Plus Cotton

Pest resistance presents a constant threat to crop production. The ability of the tobacco budworm to develop resistance to common insecticides, such as organophosphates and pyrethroids, has directed many changes in cotton production over time. Yet with proper planning, producers can substantially slow the rate at which resistance develops. Doing so is the goal of IRM programs and comprises a critical component of the stewardship of TwinLink and TwinLink Plus cotton technology.

BASF is committed to implementing effective IRM programs for TwinLink, TwinLink Plus and future traits that confer insect resistance to crops. In the United States, IRM programs specific to each insect-resistant crop are evaluated and approved by the U.S. Environmental Protection Agency (EPA) and mandated as a condition of registration. The IRM program for TwinLink and TwinLink Plus cotton is updated annually based on feedback from grower and industry groups, along with input from extension, research and regulatory experts.

IRM strategies for specific crops and regions vary due to region-specific differences in plant and animal biology, environmental and farming conditions, as well as public and producer concerns. The TwinLink and TwinLink Plus IRM plan has three major components: effective doses of multiple insecticidal protein, good Integrated Pest Management (IPM) practice and effective refuge. TwinLink cotton produces two insecticidal proteins from *Bacillus thuringiensis* (Bt), Cry1Ab and Cry2Ae, which have independent actions and result in the highly effective control of key lepidopteran pests in cotton.

TwinLink Plus produces the same two proteins, plus an additional vegetative insecticidal protein (Vip), Vip3Aa19. The addition of Vip3Aa19 is highly valuable in the management of lepidopteran pests and in delaying resistance. The other two IRM components – good IPM practices and effective refuge – rely on you, the grower. Prior to planting TwinLink and/or TwinLink Plus cotton seed, growers must read and sign the BASF Grower Technology Agreement. Doing so confirms that you read and will comply with requirements detailed in this IRM Guide.

Integrated Pest Management

There are many definitions of IPM; all have several components in common. All promote routine monitoring of pests, use of threshold-based control decisions, and a diversity of pest suppression methods, including cultural, mechanical and biological controls. These management tactics are deployed with consideration for both economic and environmental impacts, including those on beneficial organisms. Importantly, IRM and sound IPM go hand in hand.

The use of TwinLink and/or TwinLink Plus cotton will significantly reduce damage from caterpillar pests in cotton. Growers should understand that circumstances such as severe plant stress or high insect pressure may result in the need for supplemental control with foliar insecticides. In any case, should a grower experience injury to their TwinLink or TwinLink Plus cotton from caterpillar feeding above expectations given pest pressure and environmental conditions, it is critical that the grower contact their BASF sales rep and/or University extension. It is BASF's commitment to investigate any control failures, should they occur. Growers may also call the BASF hotline directly at 1-877-365-4287.



IPM Program for Insect Management in TwinLink® and TwinLink® Plus Cotton

- Select varieties best adapted to the specific area, taking into consideration the impact of crop maturity in managing pests. For example, late-maturing varieties poorly adapted to the area may incur greater injury from target insect pests.
- Use agronomic practices that optimize growth and yield of varieties to reduce pest severity. For example, excessive nitrogen rates can lead to higher aphid populations. Also, excessive nitrogen can lead to more vegetative growth that makes the crop more attractive for moths to lay eggs.
- Have a consistent pest-monitoring program in place and use treatment thresholds developed for the area.
- When possible, choose insecticides with the least impact on natural enemies, such as pirate bugs, lacewings and big-eyed bugs. Natural enemies supplement the level of control provided by TwinLink and TwinLink Plus cotton.
- After harvest, manage stalk destruction on a timely basis to limit pest overwintering.

TwinLink and TwinLink Plus cotton are as susceptible as non-Bt cotton to non-lepidopteran pests, such as stink bugs, plant bugs, aphids and spider mites.

Cotton Refuge

Refuges are a portion of the farming landscape that do not contain specific Bt genes and generate an abundance of susceptible target pests. These susceptible insects will mate with rare resistant insects that survive on the Bt crop, producing offspring that are killed by the Bt crop. This provides a mechanism to delay the rate at which resistance to Bt cotton increases in target pest populations, therein promoting the long-term effectiveness of the technology. Two types of refuge have been used in U.S. cotton: natural and structured refuge.

A structured refuge is an area of a grower's field (either embedded rows or blocks) that is planted to a non-Bt variety, with similar maturity and agronomic parameters to the planted TwinLink or TwinLink Plus cotton variety and managed the same. Structured refuges are required where risk of resistance is high, and availability of natural refuge is low relative to the adoption of Bt crops.

Natural refuges consist of crops other than those intentionally planted to serve as refuges, as well as non-crop vegetation, suitable to host target pests of TwinLink and TwinLink Plus cotton.

At present there is no structured refuge requirement for the Cotton Belt. Natural refuge has been approved for cotton growing states of Alabama, Arkansas, Florida, Georgia, Kansas, Kentucky, Louisiana, Maryland, Mississippi, Missouri, North Carolina, Oklahoma, South Carolina, Tennessee, Texas (excluding 15-Trans Pecos counties) and Virginia. Furthermore, there are currently no refuge requirements (i.e., structured or natural) for TwinLink and TwinLink Plus cotton in Arizona, California, New Mexico or the 15-Trans Pecos counties of Texas.

Areas Where TwinLink and TwinLink Plus Cotton Cannot Be Planted

Commercial planting of TwinLink and TwinLink Plus cotton is prohibited in Hawaii, Puerto Rico and the U.S. Virgin Islands. In Florida, planting of TwinLink and TwinLink Plus cotton is prohibited in Pinellas, Hillsborough, Hardee, Highlands, Okeechobee, and St-Lucie and all counties south thereof. TwinLink and TwinLink Plus cotton varieties are not registered in states outside of the traditional U.S. Cotton Belt. Therefore, neither can be planted in Alaska, Colorado, Connecticut, Delaware, Idaho, Illinois, Indiana, Iowa, Maine, Massachusetts, Michigan, Minnesota, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New York, North Dakota, Ohio, Oregon, Pennsylvania, Rhode Island, South Dakota, Utah, Vermont, Washington, West Virginia, Wisconsin, Wyoming and the District of Columbia. See *Figure 1 on page 3*.



Planting Restrictions and Refuge Requirements for TwinLink® and TwinLink® Plus Cotton

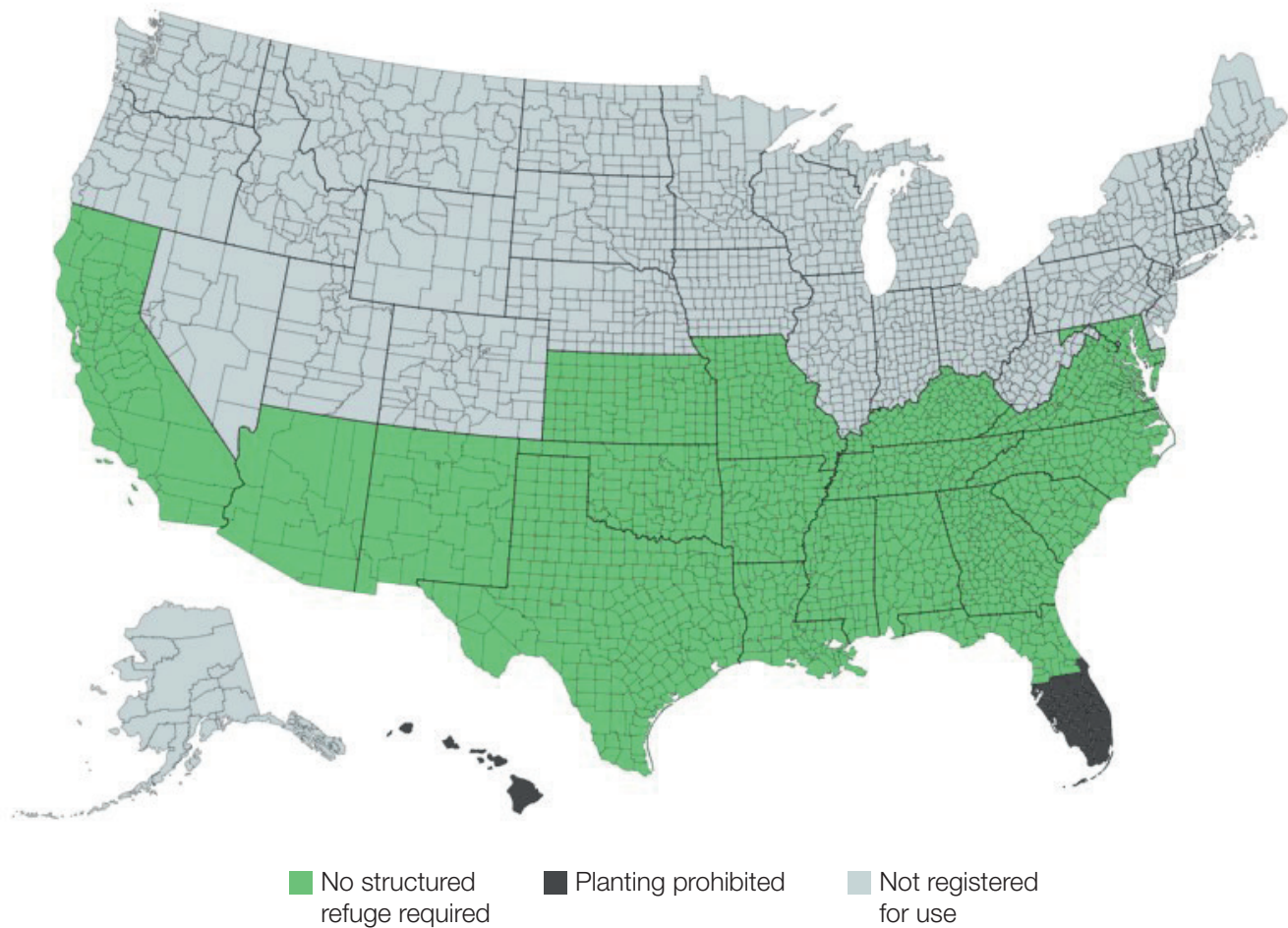


Figure 1. Planting restrictions for TwinLink and TwinLink Plus cotton. Producers should consult local authorities prior to planting to confirm requirements for specific fields or locations.



Commitment to Stewardship Initiatives

We set a high standard of customer care and stewardship and take a responsible approach to product launches, including those involving products of plant biotechnology. In addition, we have adopted stewardship programs for product launches that are consistent with the Excellence Through Stewardship® Guide for Product Launch Stewardship of Biotechnology-Derived Plant Products and the Guide for Resistance Management for Biotechnology-Derived Plant Products.

In advance of commercializing a plant biotechnology product, we are committed to meeting applicable regulatory requirements in all countries where the product will be cultivated and in key importing countries with functioning regulatory systems. These countries are identified by assessing the global markets and trade of the product using information available through the commodity value chain.

Additionally, we routinely consult with and inform key stakeholders throughout the value chain regarding our research and development pipeline and product launch plans. We also actively support the development of initiatives designed to facilitate global trade and minimize trade disruptions that may result from asynchronous approvals of plant biotechnology products or incidental small amounts of biotech material in a commercial product (low level presence or LLP).

* Figures are indicative only. Growers should always contact their local seed representative to confirm refuge planting requirements if they are unsure.

This program was developed to be aligned with the ETS Guide for Resistance Management of Biotechnology-Derived Plant Products.

Always read and follow label instructions.

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