

## Gene Pyramiding and Reduced Refuge Lead to Dow AgroSciences Refuge Advanced™ powered by SmartStax®



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### Overview

The principle of gene pyramiding has paved the way for advancements in refuge management for growers planting corn hybrids with *Bt* insect protection traits. The latest advancement, Dow AgroSciences Refuge Advanced™ powered by SmartStax®, offers a convenient, single-bag solution for refuge management in the Corn Belt, ensuring refuge compliance on fields where it is planted.

### The importance of Insect Resistance Management

Continuous, widespread exposure of insect pests to any control technology, including *Bt*, can lead to insect populations becoming resistant. Scientists and regulators have determined that **Insect Resistance Management (IRM)** strategies will delay the onset or prevent the development of insect resistance to *Bt* proteins. These strategies help preserve the durability, or lifespan, of *Bt* corn as an insect management tool.

A key IRM strategy involves planting refuge corn that does not contain the *Bt* gene(s) for control of the target insect(s), thereby reducing selection pressure on the target insect population. Insects that survive in a non-*Bt* corn refuge are not exposed to the *Bt* protein, so they are susceptible to *Bt*. Any *Bt*-susceptible insects that emerge from a non-*Bt* corn refuge will disperse and likely mate with rare individuals that are resistant to *Bt*. The progeny from these matings will be susceptible to *Bt*.

### Gene pyramiding for reduced refuge

Until **SmartStax** became available, with the broadest spectrum of above- and below-ground insect control, the U.S. Environmental Protection Agency (EPA) required

a non-*Bt* corn refuge of 20 percent for *Bt* corn acres planted in the Corn Belt. **Gene pyramiding** enabled the EPA to approve a reduced refuge requirement for SmartStax, from 20 percent to only 5 percent in the Corn Belt, and from 50 percent to 20 percent in cotton-growing areas.

The principle of gene pyramiding essentially means that multiple modes of action for control of the same insect are incorporated into the same hybrid. Published science indicates that a crop with more than one mode of action for control of the same insect challenges the insect to overcome all modes of action to survive. It is unlikely that insects will be able to overcome all modes of action.

The gene pyramiding in SmartStax allows for a reduced refuge without compromising IRM. Current regulations require that the 5 percent separate refuge for SmartStax in the Corn Belt be planted either in the same field as SmartStax® is planted or in an adjacent field.<sup>1</sup>

### Reduced refuge leads to a refuge-in-the-bag concept

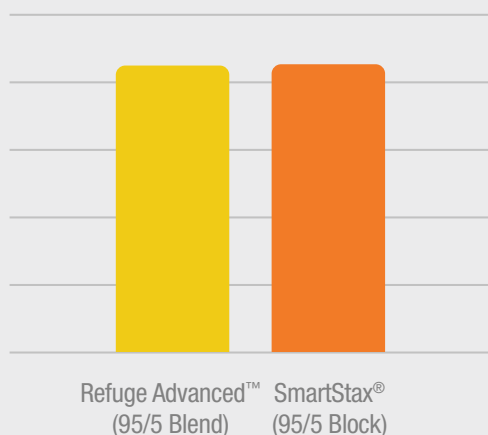
With the reduced refuge requirement for SmartStax, there was a logical progression from a separate refuge to a **refuge-in-the-bag concept**. As refuge-in-the-bag implies, non-insect-traited (non-*Bt*) seeds that serve as the refuge are blended in the same bag as *Bt* corn seeds. With this concept, refuge plants are interspersed with the *Bt* corn plants throughout a field, with no separate structured refuge required.

### Components of Refuge Advanced

Refuge Advanced is a blend of 95 percent SmartStax and 5 percent non-insect-traited refuge in the same bag. The blended non-insect-traited refuge seeds provide the necessary refuge both for above-ground lepidopteran pests and rootworms. IRM is not compromised, because Refuge Advanced is based on the same pyramiding principle as SmartStax.

With no separate refuge requirement,<sup>2</sup> Refuge Advanced is convenient for all growers because it simplifies achieving higher whole-farm yield potential. The concept ensures compliance with IRM requirements because the refuge will be interspersed with SmartStax throughout the field during planting.

### Blended or Structured 5 Percent Refuge for Maximum Yield Potential?



Yield data from 2010 across 42 locations show that the seed blend of 95 percent SmartStax and 5 percent non-insect-traited in Refuge Advanced delivers a more convenient way to achieve the higher whole-farm yield potential growers have come to expect from SmartStax hybrids with a 5 percent structured refuge, even under heavy insect pressure.



Larval distribution for rootworms is typically clumped, meaning not all of the refuge plants would be exposed to the pest.

pyramiding. Refuge Advanced simplifies achieving higher whole-farm yield potential by offering a convenient, single-bag solution with no separate refuge required. Both the traited and refuge seeds are blended into one bag, ensuring refuge compliance on the acres where Refuge Advanced is planted.

*Kevin Steffey, Ph.D., became the technology transfer leader, Insect Management, for Dow AgroSciences after a 30-year career as an Extension entomologist at the University of Illinois. Steffey is a past president and fellow of the Entomological Society of America. Steffey coordinates technology transfer activities relating to insect management for chemistry and trait-based products from Dow AgroSciences.*

### Seed treatments offer additional protection

All of the seed in Refuge Advanced is treated with a uniform rate of a leading seed treatment. The insecticidal seed treatment on the refuge corn in Refuge Advanced is sufficient to protect against seedcorn maggots and wireworms, which do not occur at economically threatening levels in the vast majority of fields.

### Summary

Gene pyramiding allows for a reduced refuge when planting hybrids with SmartStax technology — from 20 percent to 5 percent in the Corn Belt and from 50 percent to 20 percent in cotton-growing areas. The next logical progression from the separate, reduced refuge for SmartStax® is a refuge-in-the-bag concept, also based on the science of gene

<sup>1</sup>In cotton-growing regions, refuge requirements are reduced from 50 percent to 20 percent.

<sup>2</sup>In cotton-growing regions, a separate 20 percent structured refuge is still required for Refuge Advanced.

Images are for illustrative purposes only.

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