

## Introducing Traits with Pinpoint Accuracy

*Syngenta employs precision transformation and conversion to ensure performance*

RESEARCH TRIANGLE PARK, NC -- The art and science of variety development has blossomed over the past two decades, with big developments often making headlines along the way. Scientists have learned how to identify, move and track specific genes in order to deliver key traits in germplasm with new improvements emerging every year. The result: outstanding science, increasing choices for farmers and an industry that is keeping pace with high demand for hot products.

"But just as no hybrid or crop protection product is a silver bullet for producers, the breeding and biotechnology tools we use to introduce traits into elite germplasm must be chosen carefully to do specific jobs right," notes Roger Kemble, Head, Crop Genetics Research for Syngenta.

### Biotechnology and Precision Breeding

Today's seed developers can take either of two routes to introduce traits into their lines. The first is conventional breeding, crossing and re-crossing parent lines to transfer desired traits into germplasm that will be marketable. The second is a combination of biotechnology followed by conventional breeding. Here, genes for desired traits are taken from one source and then sophisticated molecular biology techniques are utilized to move it into a crop species. Conventional breeding is then used as necessary to cross the trait into other elite lines.

"Gene transformation is useful to bring desirable traits in from other species, such as glyphosate tolerance, insect tolerance or enhanced nitrogen efficiency," Kemble explains. "It's especially good for single-gene traits."

"When we're dealing with complex native traits – traits that are controlled by several genes and already present in corn, for example drought tolerance - conventional breeding is often our best approach," he adds. "Of course, what's called 'conventional breeding' today is much more advanced than the breeding of a generation ago. Now when we engage in crossing parent lines, we're able to use genomics – the study of genetic structures – and molecular markers that allow us to track key genes as they travel through the crosses. Our expertise at Syngenta lies in being able to effectively combine the technologies".

Kemble points out that Syngenta has a map of corn's chromosomes that pinpoints the locations and codes to more than 11,000 individual genes. Those maps can help the company's scientists zero in on genes they want to move, or allow them to identify the markers that flag the presence of key genetic material.

### Greater Accuracy

Scientists today can introduce desired genes into agrobacterium, which are used to transfer those target genes into crop species. Though employing agrobacterium and other strategies are consistent among leading seed companies, the individual tools of the trade can differ significantly.

"Introducing traits and creating the commercial lines to bring those traits to market rely on techniques that are often closely held secrets," Kemble explains. For instance, Syngenta uses a proprietary agrobacterium strain in its transformations. The result is greater accuracy and effectiveness than most laboratories can achieve with other agrobacteria.

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Once the gene is in the host plant (the T0 stage), it can be detected by a marker – a gene that is carried along with the trait’s DNA. As an example, marker genes can confer resistance to herbicides, so scientists can treat cells with the appropriate herbicide and leave only the ones that contain the marker (and the desired trait). Syngenta also uses a proprietary system that uses an alternative sugar source as a medium to select transformed plants, notes Kemble. Since only the plant cells containing the marker gene can survive on the medium, it’s reliable and simple.

### **Conversion: From Lab to Product**

Though moving genes from one plant to the next – especially across species – has generated headlines for years, much of the success of a new variety lies in the less-glamorous world of conversion.

“When we say ‘conversion,’ we’re talking about the steps between moving genetic material into a targeted line and working it into the elite lines of germplasm that are attractive to growers,” Kemble explains. “Poor conversion technology can lead to yield drag. At Syngenta, we’ve concentrated on fine-tuning conversion so that our lines retain their outstanding performance even after the introduction of new traits.”

Kemble points to Agrisure® RW, which has successfully been incorporated into Syngenta germplasm to provide control of northern, western and Mexican corn rootworm in elite hybrids from Garst®, Golden Harvest®, NK® and other corn brands – in each instance without any negative impact on yield performance.

That’s not easy, he notes. Syngenta transforms trait genes directly into elite lines of corn. This saves several generations of crosses and backcrosses that are usually needed to breed out undesirable traits when non-elite lines are used. Syngenta’s result is a rapid transfer of just the desired DNA into new hybrids with attendant high performance.

During the conversion stage, Syngenta’s library of genetic markers comes into play again, in a process called MAIC, or marker-assisted inbred conversion. The genetic fingerprints of key markers tell the Syngenta research team whether the desired genetic material has made it into the plant, and which other important elite genes are also represented in the line’s chromosomes. Because genes often occur in different versions, or alleles, the scientists can even track which line in the cross contributed the trait.

“Our MAIC platform has at least doubled the rate at which we can make our crosses and bring products to market,” says Kemble. “It really speeds the process up because we don’t have to carry forward every cross to see if the trait is present.”

### **More Complex, More Vital**

As seed becomes more complex, an outstanding MAIC platform will be even more vital. “We’re converting elite lines with double- and triple-stack combinations like glyphosate tolerance, corn borer resistance, Agrisure RW and stacks and traits with tolerance to a broad spectrum of lepidopteran insects,” Kemble points out. “And we – and our customers – expect those lines to perform better than before, so yield drag is not an option. That’s the technological challenge that we’ve been approaching, the reason we’ve focused on all the behind-the-scenes technology.”

As it is, the process is faster than it’s ever been – and in the case of the Syngenta, more accurate, too. That means farmers get more valuable traits sooner, without giving up an inch on performance.

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