

Perspective

Is Genetic Testing the Next Revolution in Agriculture?

Using genetic analysis assays developed with the VeraCode® technology, two researchers are working to improve the quality of crops and livestock.

Agriculture has always been central to human survival. The ability to farm directed where civilizations developed and how communities thrived. Inventions such as irrigation and the tractor revolutionized the physical aspects of crop and livestock farming. Today, exponential population growth and climate change are creating unique challenges for farmers working to maintain the food supply. To overcome these complications, many agriculturists are turning to science, genetic analysis studies in particular, to find new ways to make the most of available resources.

There are several research groups dedicated to taking a genetic look at ways to produce higher yielding crops and increase production efficiency in the meat and dairy industries. If farmers can select for, or against, a particular trait prior to growing a plant or animal to adulthood, they can save time and money. The key is finding an easy to use, cost-effective, flexible system that can run these genetic analysis tests in a timely manner. Ing. René Hogers and Dr. Richard Crooijmans are using DNA marker analysis strategies to improve crop and animal development, respectively.

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Ing. René Hogers is a Project Manager at KeyGene, a private research company that develops innovative applications and provides genetic and genomic research for plant and animal breeders, universities, and food and fermentation industries.



Dr. Richard Crooijmans is a molecular geneticist at Wageningen University. He developed the first chicken BAC library. His current interests include genetic screening for agriculturally important traits in chicken and pigs.

After looking at different technologies, they both found that the VeraCode technology and BeadXpress® Reader met their needs.

A FASTER, MORE COST-EFFECTIVE WAY TO EVALUATE CROPS

Ing. René Hogers works at KeyGene, a private research company that develops innovative applications and provides genetic analysis services for plant breeding groups in an effort to speed up the process of selecting plants with desirable traits. Currently, breeders are required to grow several generations to confirm the presence or absence of a particular phenotype. This can take years and waste precious resources on plants that will end up holding no value to the grower. Minimizing this generational breeding process will enable breeders to realize significant savings, while producing highly desirable products.

Using VeraCode technology and the BeadXpress Reader, Ing. Hogers works with his customers to screen for genetically fit plants, a practice known as marker assisted selection. Plants carrying the SNPs of interest are identified, allowing researchers to “decide which of the plants they should take and go on with and which ones they can throw away when the plants are still very small and with a just a few leaves. Picking out the right plants to go with the breeding processes saves a lot of time and also space in the greenhouses.” For now, Ing. René Hogers has applied this technique to fruit and vegetable crops such as tomato, melon, pepper, lettuce, and cucumber, as well as field crops such as maize, barley, and potato.

Ing. René Hogers chose the BeadXpress Reader for several reasons, including the throughput. “We can screen for over 200 selected markers that will be informative, even for closely related species or parental lines, in one assay,” he states. “This saves us time and costs.” When asked about the BeadXpress workflow, Ing. Hogers replies, “It’s more or less plug and play. With the

availability of the [VeraCode] GoldenGate® Assay, it will be easier to perform the assays. If we have a 384-plex, it takes about two to two-and-a-half hours to scan a whole plate of 96 samples.” In addition, Ing. Hogers is pleased with the results. “The quality is quite good, it’s very reproducible.”

AN EASIER METHOD FOR IMPROVING ANIMAL HUSBANDRY

Dr. Richard Crooijmans is also working to overcome new farming challenges. As a molecular geneticist at Wageningen University, he applies VeraCode technology and the BeadXpress Reader to genetic studies involving over 20,000 chickens and pigs. These may not be the sexiest animals in the barnyard, but they are extremely important to the agricultural industry. Many of these chicken and pig screenings are performed in an effort to remove a particular allele from the population, or as a way to study inheritance patterns. After analysis, only the desired animals are selected for breeding. To do this, Dr. Crooijmans needed a straightforward, accessible system. “We chose the VeraCode technology because it’s pretty easy to use and everything is digital. You don’t have to go through PCR where you have to load gels, with the potential to make mistakes. You don’t have to check all the genotypes and enter them into a computer, where you can make mistakes again. With the VeraCode system, it’s there and it’s ready.” A second reason for choosing VeraCode technology was the flexibility. “We have several regions we want to fine map, and [with VeraCode technology] we can just take specific SNPs and type them. This makes it very flexible. With other systems you have to do rather complicated assays and it also costs you more,” he states. He sums up his experience by saying that VeraCode technology was “the easiest of the systems” he evaluated. When screening a large number of animals, the savings in time, cost, and effort add up significantly.

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With Dr. Crooijmans' efforts, SNPs associated with specific traits can be quickly and easily identified, eliminating the need for generational breeding. For example, a broiler chicken (one meant for consumption) has different desirable genetic traits than one destined for egg laying duties (a layer chicken). "Current commercial testing looks for a phenotype. It costs a large amount of money every time. You have to phenotype quite a lot of individuals and then screen them, and follow in time. We want to replace these very expensive phenotyping systems," states Dr. Crooijmans. If these can be replaced with faster, cost-effective molecular screening tests, the quality of the livestock population can be improved at a relatively rapid pace with minimal time and expense.

When asked what the BeadXpress system has given him, Dr. Crooijmans answers, "knowledge and proven reliability as a partner in the animal sciences community. We showed that we can create and handle large data sets. With the help of

commercial breeding partners, we have access to a wide range of animal material. Now we can get things done much more easily. Many of the grant proposals we submitted have been approved."

APPLYING THE SNP ADVANTAGE TO AGRICULTURAL STUDIES

Although working on different aspects of the agriculture industry, Ing. René Hogers and Dr. Crooijmans had one thing in common: they both needed a system that was fast, reliable, and easy to use to screen for genetically appealing organisms. Both of them found a solution with the VeraCode technology and BeadXpress Reader.

Genetic analysis studies have the potential to change the way agriculture functions, significantly improving crop and livestock development. In the end, society may benefit from wider food availability at lower prices. Is this the start of the next revolution in agriculture? With researchers and agriculturists actively working together, we'll find out in a few years.

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CUSTOMIZED MOLECULAR TESTING WITH VERACODE TECHNOLOGY

VeraCode technology represents a revolution in screening applications and, perhaps, the next major evolution in agriculture. Using genetic screening techniques, growers can reduce the time, effort, and expense of producing better quality crops and animals.

How it Works

VeraCode technology uses cylindrical glass microbeads, each containing a unique holographic code that acts as an identifier, enabling customizable tracking of multiplex assay markers, samples, etc. Beads carrying different target SNPs can be pooled together to create an easy, inexpensive multiplex assay. Multiplexing levels ranging from a single target to several hundred targets per sample can be screened in a single well.

Reading the Code

Assays developed using the VeraCode beads are analyzed with Illumina's BeadXpress reader, a high-throughput two-color laser detection system. The reader scans the beads for their code and fluorescence intensity signals. Data is analyzed using Illumina's BeadStudio software or other third-party analysis program.

ADDITIONAL INFORMATION

To learn more about VeraCode technology and the BeadXpress Reader, visit www.illumina.com.

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