Breeding in Virtual Reality

KeyGene tackles brains overflow

Monique Krinkels

A human brain can only process so much information. Selection in a greenhouse filled with hundreds of plants is donkey work. And yes, there are graphs, statistics and photos available, but many breeders prefer also to observe the 'look and feel' of a new plant. KeyGene's new VR greenhouse presents statistics as well as plants, allows for time travel and international cooperation.

"And on the left you can see our new greenhouse," says Arjen van Tunen, CEO of KeyGene. I bent over to look down from the window, my hands resting on the balustrade. But there is no balustrade and I anticipate a drop to the floor below. Besides giving me palpitations, nothing happens. Fortunately, I am not on the first floor of KeyGene's office building, but in the virtual reality welcome room.

It is shocking how realistic the experience is. One moment you are in a stuffy office, the next you find yourself in the middle of a greenhouse, where on the one side graphs and statistics are floating in the air and on the other side 3D images of plants rise up from the sandy floor. The difference: a virtual reality headset and an ingenious computer programme.

Data overflow

It all started two years ago. "Our PhenoFab, where we analyse phenotypic variation, generates loads of information. Every day, every plant is photographed from all angles, producing hundreds of thousands of photographs. We screen for a whole range of traits in which the breeders are interested. The results are summarised in a report and for some people that works out fine. But most people prefer a visualised result. That is where our Virtual Reality Breeding Tool comes in," explains Marco van Schriek, team leader Digital Phenotyping & Greenhouse.

"Imagine you have a pile of photographs of different people and someone asks you to sort out the ones wearing glasses. You have to browse through the lot, one by one, to decide which are the ones with glasses. If the same group of people would be standing in a room, it would take only seconds to divide the two groups. When comparing tomato plants with so many different traits, the difference between the prints and seeing the virtual plants in our greenhouse is even more convincing."

As a fervent gamer, Marco van Schriek had experience with virtual reality. Today, virtual reality gear is mainly used to play games. "Only architects and designers use it professionally," he says. That is when he realised what VR could mean for breeders. He and colleague Rudi van Bavel started experimenting to support breeding with virtual reality and software that is used to create an environment. "Building a greenhouse was fairly simple once I had got the hang of it, but the addition of a high amount of photographs of the plants was a real challenge."

It did not take long before they presented their out-of-the-box idea to Arjen van Tunen, who immediately saw the opportunities it offered. After that, things moved quickly. Together with Christiaan Biemond, business developer digital phenotyping, and the software developers of the company, they have built a new, dedicated world wherein breeders can easily discern the differences between the plants of a new generation.

Big data

In hindsight, the development of the Virtual Reality Breeding Tool is a logical next step to PhenoFab, a greenhouse service operation that combines high throughput, non-invasive technology with trait interpretation to exploit phenotypic variation. Six years ago, KeyGene was one of the first companies that embarked on automated and robotized phenotyping in the agricultural area. It produces an enormous amount of information.

"A single research project within our digital phenotyping facility with, for example, 1,000 plants generates a huge amount of data. The 1,000 plants will be captured in nine images a day, seven days a week and for five weeks strait. That means that after one experiment over 300,000 digital images have been produced which have to be analysed and its data handed over to the customer. This is truly big data! It requires a complete new approach to data handling and reporting," explains Arjen van Tunen.

The cost of the virtual reality hardware is limited. "The headset and hardware costs a few thousand euros. The data handling however is another thing. For a single person to handle more than 80 gigabytes of data real-time is a true challenge!"

We want more

The Virtual Reality Breeding Tool was introduced and demonstrated last January at the Plant and Animal Genome conference in San Diego. At the Crop Innovation & Business Conference in Amsterdam held in April, the Virtual Reality Breeding Tool was explained by KeyGene's CEO Arjen van Tunen. The tool was also demonstrated to the CEO's and R&D directors of the four shareholders: Enza Zaden, Rijk Zwaan, Vilmorin & Cie and Takii & Co.

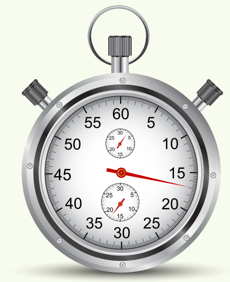
"It is remarkable how easily people get used to a virtual greenhouse. For the young, it resembles the gaming environment they are already familiar with. But even if it is the first time, you can find your way almost immediately," says Marco van Schriek. That is also my experience. It really does feel like natural surroundings. The windows of the greenhouse were opened when I visited KeyGene, as it was a bright and sunny summer day. Even the fact that there are floating screens around you does not disturb the feeling of naturalness.

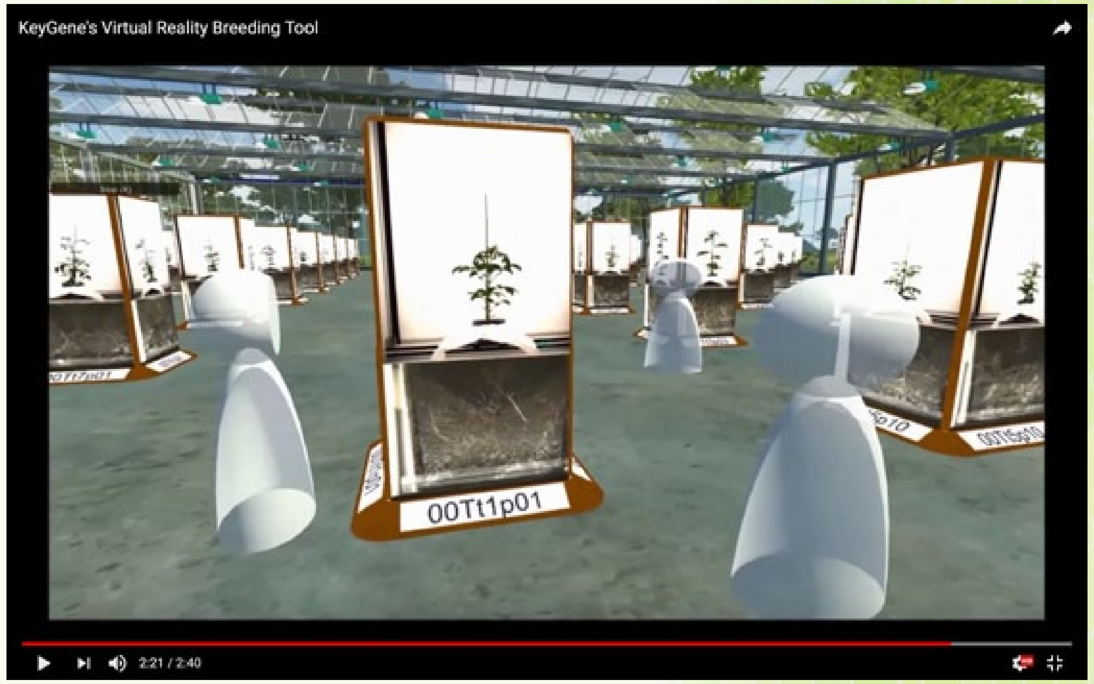
"Of course, there are breeders who find it too modern. They prefer written reports with graphs, statistics and photos and, if so, we can provide them with it. But most breeders react enthusiastically to the possibilities it offers. The most common feedback is that they want more: visualisation of the influence of weather and seasons, video instead of photographs, open field besides the greenhouse; their demands were quite overwhelming. And, of course, we continue to improve the software programme."

KeyGene

KeyGene was founded in 1989 by a number of Dutch seed companies. Their goal is to create synergy and higher efficiency in their molecular genetic research programmes and thus improve the breeding effort. At the time of its foundation, KeyGene employed three people. Since then, KeyGene has grown continuously and several times it has had to expand its facilities considerably. Today, KeyGene employs over 150 people. The company has four strategic shareholders active in the field of vegetable breeding: Enza Zaden, Rijk Zwaan, Vilmorin & Cie and Takii & Co.

The Virtual Reality Breeding Tool helps breeders to easily compare and select plants. Curious how the virtual greenhouse looks like? See for yourself: https://youtu.be/ou5_Q1mMLZs





An eye transmits data to the brain at the rate of 10 million bits per second

A virtual conversation

"Do you see how much these tomato plants have grown since last week," breeder A asks. "So much better than those of last year, as you can see on the left," says breeder B. "I'll show you the pictures from the moment this plant germinated." A: "Let's make a new filter. See how well-developed these roots are compared to the other plants." B: "Can you link the results with the genetic profile of the plants?" A: "Of course, just wait and see." B: "That is truly amazing. We should ask our colleague C from France to join us and have a look," proposes A. "Good idea, and tomorrow colleagues D and E in Monterey, California, might want to compare notes. I wonder which plants they will prefer."