

Exterior of seeds gives away genetic **make-up**

Monique Krinkels

24 **Curiosity, amazement, critical, the looks on the faces of the onlookers mirrors the novelty of the new device presented at the Seed-X booth during the ISF World Seed Congress in Nice. A well plate filled with tomato seeds goes into the GeNee and, within a few minutes, the machine distinguishes which seeds will produce yellow cherry tomatoes and which red ones.**

• **“The GeNee is the first** seed phenotype analysis system. It offers accurate real-time classification of a wide range of genetic traits in vegetable seeds and grains – with zero seed destruction,” explains Sarel Ashkenazy, Seed-X founder and CEO. “We are part of a group of companies which specializes in computer vision and artificial intelligence technologies. One of the companies is FDNA, which specializes in facial recognition and the correlation to human genetics. About two years ago, when trying to find new applications for the same technologies, we had the idea to try to establish a correlation between the seed ‘face’ and its genetics. After a few proof of concept experiments, we noticed that by developing customized algorithms, we can find the relationship between phenotype and genotype.”

The agricultural market is new to Sarel Ashkenazy. Until three years ago, he served as executive vice president at Kornit Digital Ltd, a company that is involved in digital printing technologies. As one of the pioneers, Mr. Ashkenazy led business development and sales from \$0 to over \$100 million. Before that, he was active in the Israeli Start-Up arena.

How does GeNee work?

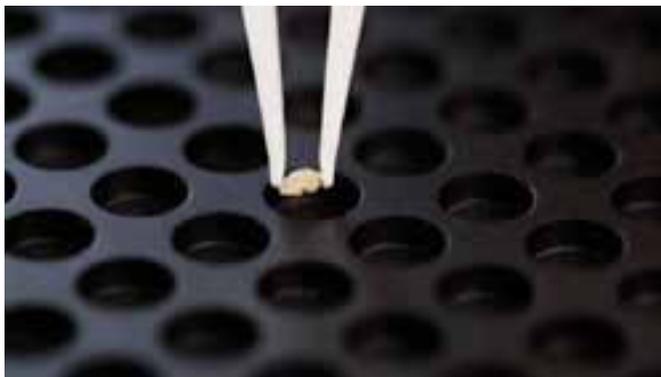
“Our technology is based on a combination of computer vision, artificial intelligence and proprietary algorithms which analyse the seed’s phenotype to detect genetic characteristics or traits on the seed level. We use different types of light wave lengths to capture the data. But it is the algorithms that form the heart of the system. That makes it possible to successfully classify between different varieties and lines by biotic

traits (such as viruses, nematodes and fungus resistance) and quality traits with no genomic markers, either sourced by single gene, or multi-gene (fruit colour, fruit shape, plant structure, pH and more). The breakthrough is that this approach is non-destructive to seeds and allows genotype analysis without doing any molecular genetics tests.”

What are the practical benefits?

“The first product we launched is called the GeNee, a portable seed analysis tool that helps plant breeders perform the selection process for every breeding cycle with greater efficiency. The main benefits are shortening breeding time and





GeNee's seed-by-seed examinations provide genotypic insights from seed phenotype analysis

'Seed-X is an AI-driven company that is revolutionizing seed quality and safety across the entire seed and grain value chain, for the benefit of seed breeders and producers to giant food companies,' says Sarel Ashkenazy

• increasing the probability of success. Conventional seed selection is very wasteful and hit and miss. Our technology supports the agricultural ecosystem by enabling breeders to achieve better results, faster and more sustainably. They can achieve the traits they desire at a fraction of the cost, while significantly reducing use of agricultural inputs – land, water, fertilizers, energy and chemicals. Seed producers can use GeNee to check the quality of samples. The results of the GeNee analysis tool are available on the Web Platform, which features charts, graphs and plots, delivering comprehensive insights about each individual seed/grain and revealing correlations between the seed phenotype and genotype."

How do people react to the GeNee?

"Most people working in plant genetics do not really believe that we can 'see' plant genetics on the seed level. So, naturally, we have to tackle this scepticism barrier, and we are doing this by conducting POC (proof of concept) experiments to demonstrate that it really works. Not only for the colour of cherry tomatoes, but also for classifying hybrids, or detection of traits such as virus resistances. Most breeders and genetics experts cannot imagine that we can detect these traits without any molecular testing or PCR. It's challenging to convince them that it is doable, but once they see the successful POC on their genetic material, this scepticism disappears."

Which crops can the GeNee handle?

"So far, up to 250 varieties of vegetable crops and grains are included in our data base. But it can be expanded very quickly. In order to adapt the algorithm for a new specific task – whether a trait or a different variety – it takes about four hours of imaging and six hours of training the algorithm. Of course, for each task you have to train the algorithm only once. After that you can use it forever, at least if it is based on the same genetic materials. The more users

we have, the faster it goes as the algorithm improves itself: it is a learning machine!"

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How reliable is the outcome?

"The seed industry cannot compromise on the results. Developing the precision and capabilities of our algorithms was a challenge at first. In order to train any AI algorithm, and specifically the deep learning which we use, you need to have large data sets for the training. Currently, after two years of operation and more than 150 experiments with different companies and academic institutes, in most of the crops, we no longer face this challenge."

What is the next step?

"The first product that we have is small-scale, mostly for breeding applications and for sampling check for seed quality. Our product pipeline features sorting machines for seed production that will enable sorting by genetic purity, germination probability and health parameters. Today, we are developing two types of sorting machines, a medium-speed sorting machine for vegetable seeds and a high-speed sorting machine for field crops. Of course, in both we are running the algorithm on each seed individually. These machines will serve both the seed industry for quality assessment in seed production and the food industry by identifying defects, disease contaminated grains and combat fraud by protecting IP consistency of grains."

What does Seed-X mean for the future of the seed industry?

"Making a big change in processes and changing lots of old methods – if you can sort out bad seeds from a batch, not only can you enhance every batch, the industry will not have to compromise anymore on quality, no more 90% germination as acceptable or 98% purity – all batches sold will be 100%. Moreover, we believe that, once we have the capabilities to enhance every batch, the seed production methods will change and will be less labour-intensive than they are today.

In the near future, Seed-X aims to utilise its vast crop knowledge base to create the world's largest phenotype-genotype correlations database, thus opening the way for quicker discovery and design of better breeds and maximizing yield/higher productivity, using even fewer resources."

