

Seed Valley

meets Food Valley



Food Valley Innovation Insights

It is better to know which varieties your customers want at an early stage of breeding.

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Until recently, food processing companies and seed companies have operated in largely separate worlds. However, the situation is changing. Breeders have much more to offer to food processing companies than in the past: DNA marker technology enables breeders to give new properties to processed food, at twice the speed. Moreover, food processing companies have become more interested in crops which are specifically adapted to their needs, and to the needs of their customers.

This Food Valley publication shows how the gap between breeders and processors has narrowed and how it could be further decreased. Managers of both industries argue why active collaboration is a better idea than waiting until seed companies bring new varieties on the market. Breeders have an increasing array of tools for introducing traits such as improved shelf life, health, colour or taste. To use them optimally they need input from the food industry. For example, what does shelf life mean for pre-packed lettuce?

Collaboration between two sectors with a completely different origin may seem complex. However, if food processors end up with better crops in this way, they can save a lot of money, as Rich Ozminkowski from Heinz stresses. Moreover, increased collaboration equips the whole food chain to meet the rising demands for food and sustainability from society as a whole.

Roger van Hoesel
Managing Director, Food Valley



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Food processors have to define precisely the taste they want for their product before breeders can start.

Breeders Have much to Offer

DNA marker technology and genomics enable seed companies to give new properties to processed food in a relatively short time. But to do this they need input from food processing companies. Collaboration is crucial, according to managers in both industries.

A lettuce processor, cutting and wrapping lettuce in plastic bags, has to select lettuce carefully. The lettuce not only has to be tasty and crisp; it also needs to stay fresh for at least four or five days. Difficulties finding a lettuce with a long enough shelf life once wrapped was the main reason for seed company Enza Zaden and one of the food companies to start a joint research project. “We wanted to solve this problem at a fundamental level”, says Enza Zaden project manager Chris Groot. “So, together we mapped out what happened to lettuce after it was cut up, and we noticed a gradual increase in browning along the cut edges of the leaves.”

Armed with this knowledge, Enza Zaden could search for DNA markers, identifiable pieces of DNA linked to recognizable traits such as 'brown colouring after cutting'. Now both companies expect their improved lettuce to hit the market within two or three years.

New Technologies

The lettuce project of Enza Zaden shows that breeders now have more to offer to food processing companies than they did in the past. The reason? The use of new technologies including DNA marker technology. Breeders can now halve the time it takes to breed a new crop, compared to 15 years ago. Groot: "Instead of six to eight years, we now only need three to four years to introduce a new trait."

DNA markers are like easily recognizable flags on the DNA that indicate the presence of useful or desirable genes. They allow breeders to predict already in the laboratory which traits a plant will probably show in the field, in the can, or when wrapped in plastic. They do not need to wait until a plant bears fruit to select the best plants. They analyze the DNA, and then they can predict which colour or viscosity the end product is likely to have. In the case of the pre-cut lettuce: the breeders can select the type that is most likely not to discolour and other desirable traits already at the seedling stage. Only a small number of varieties then have to be cultivated, cut and wrapped up in bags, just to be sure that the selected plants are indeed the ones that live up to expectations.

Predicting traits at the seedling stage will become even more reliable when breeders start to use genomics. As understanding of DNA grows, breeders not only gain more insight into useful DNA markers, but also into the genes involved in specific traits. Knowing more about DNA markers and genes makes the predictions at the laboratory stage more reliable, and breeders can select for an increasing number of traits at once.

Complex Traits

However, breeders can only find the right DNA markers and genes for a trait if they have enough information about the characteristics of the crop, its processing and the end product. Therefore, breeders need not only input from farmers, but also from the processors. Food processing

companies are interested in complex traits including shelf life, health, taste, shape and colour. But these traits first have to be translated into separate, heritable characteristics. Take shelf life: only the processor can say what this means for his packaged tomatoes or canned beans.

"Enza Zaden has analyzed improved shelf life for pre-cut lettuce, together with a processing company. Perishing is not only characterized by discoloration", Groot explains, "it also has to do with loss of anti-oxidant capacity, loss of sugar content, moisture loss, change in elasticity, microbial infections in older plants, and loss of nutritional value – vitamins for instance." Seed companies have to find different DNA markers for several of these traits.

Collaboration Crucial

Collaboration with the food processing company is crucial. Groot: “Food companies know exactly what happens in their cutting and packaging process, and what is going wrong with their product in storage.” In wrapped paprika for instance, the problem is not brown colouring, but yellowing. And in wrapped tomatoes, the main problem is likely to be mould.

The same goes for taste, explains Peter de Kok, researcher at NIZO food research. “Food processors have to define precisely the taste they want for their product before breeders can start.” Improving the taste of a product does not just mean increasing the amount of one or two taste aromas, he warns. Instead, taste

is a complex mix of several factors including sweetness, taste aromas and texture.

Reverse Engineering

To gain experience in breeding for taste, NIZO has started the research project ‘Naturally sweeter’, together with a breeding company, two food companies and Wageningen University and Research Centre. The goal is sweeter tomato ketchup with fewer calories. To define the desired flavour, a taste panel at NIZO samples tomato ketchups while the NIZO researchers pump different amounts of taste aromas and/or sugar into the subjects’ mouth and nose. “We call this reverse engineering”, explains De Kok. “First, you establish what is required to improve your product in

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We continuously improve the effectiveness of our platform and its standards.”

‘DNA marker technology more practical than genetic modification’

“Processors may have their doubts about collaboration with breeders because of the extremely high marketing costs of ‘genetically modified’ food. But using advanced DNA technologies is not the same as genetic modification. Genetic modification involves placing genes directly in a plant’s DNA. Think of, for instance, introducing tomato, rice or bacteria genes for mould resistance into a high yield tomato variety. DNA marker technology is just a tool to select precisely and quickly the most interesting progeny of crossings of wild tomatoes and modern varieties.

Using DNA marker technology for selection is at the moment more useful than genetic modification. This will continue to be the case for the next 10 to 20 years. None of the European vegetable and potato seed companies use genetic modification. Developing a GMO for worldwide use costs

between € 10 and a 100 million because of the strict European safety requirements. Unlike soy, cotton or maize, the markets for fruit and vegetables are too small for this kind of technology.

There is insufficient interest in changing the strict European rules at present. For most sectors this is not a problem. We do not need genetic modification for fruit and vegetables. I cannot think of hardly any property that is not present in wild species. If breeders can find them there, they can cross them with their own varieties, which is much cheaper and more accepted by the public. Genomics knowledge will make this crossing and selection process increasingly efficient. We recently sequenced the entire genomes of tomato and potato. Other plants and varieties will follow quickly because sequencing is becoming cheaper.”

Arjen van Tunen,
Director, KeyGene

terms of customer or consumer preference. Then, armed with that knowledge, you start investigating which routes, such as enzymes and genes, are required. Only then do you start breeding programs.”

Until now, there have been few joint reverse breeding projects where complex traits are defined (see also ‘Food Processors and Seed Breeding’, page 14). But demand for these is likely to rise in the future, according to De Kok. “If consumers want more sustainable products or products with less sugar and improved nutritional value, breeders and food processors will have to follow. Especially for leading brands, companies need to innovate constantly to maintain their position.”

‘Breeding your own crops can save millions of dollars’

“Food company Heinz is a good example of the advantages of close cooperation with breeders. Heinz saves millions of dollars each year because it uses high viscosity tomato varieties specifically developed for ketchup. Heinz has its own breeding company, called HeinzSeed, which has been creating hybrid tomato seeds for the global processing industry and growers market since 1934.

There are several benefits for food processors wanting to breed their own crops. First, there’s the marketing advantage. We can tell consumers how we are involved in the agriculture and genetics of our product, and thus we can educate them about the fact that tomato ketchup is not just a factory product. Our tomatoes are always easy to trace, and that may be important in a society where many consumers have concerns about food safety. Besides, we are assured of enough good quality tomatoes which we can process efficiently in the way we want.

Of course there are also risks. Heinz contracts the tomato growers to be sure of high quality tomatoes for ketchup. But then varieties may suddenly fail, leading to a seasonal shortage. The company cannot afford to be dependent on only a few varieties. HeinzSeed sells more than 50 different varieties, bred for different locations. If there is a surplus, the company allows the growers to sell the tomatoes to other processors.

Nowadays, breeders have fantastic tools. But these tools are of limited value if food-processing companies just wait for seeds to come on the market and do not understand and communicate what they need. We continuously figure out which characteristics are most important for our final product. How can we make the perfect ketchup? What sugars do we want in the tomatoes, what acids, which colour, which viscosity? A high yield is important for our growers and it makes the raw material cheaper. To the food companies that are not involved in the breeding of their raw material, I would just say they should become involved.”

Rich Ozminkowski,
Manager Agricultural Research,
Heinz



Food Processors and Seed Breeding

Many food processors and supermarkets are already involved one way or another in the breeding process to make sure that they get the products they want.

Some potato processors have their own breeding companies; potato starch company AVEBE is one example. Other potato processors try out promising varieties from external breeding companies, or discuss desirable traits with breeders. It is clear, though, that most potato processors are already involved in some way in the breeding process. “This is because they have to be absolutely sure that they can deliver the right fries or pre-packed and cooled potatoes at the right time”, says Hans Leerssen, secretary of the Dutch Potato Processing Association (VAVI).

The customers of the potato processors are big international players such as Albert Heijn, McDonald’s, Kentucky

Fried Chicken, hospitals or canteens. They want an exact length, colour, weight or sugar content for their products. Leerssen: “Processors stand to win contracts with these big customers, but only if they can deliver exactly the product their customer wants.” Therefore, most Dutch processors have started to contract potato growers instead of purchasing potatoes on the open market. And now they not only want varieties with traits that are important for their customers, but also with traits that are important for their growers.

According to Guus Heselmans, a potato breeder at potato company Meijer, increasing growing numbers of potato processors indeed visit him to discuss the traits they want. Already

at an early stage of the breeding process, their growers and factories start trying out new varieties. “The gap between breeding and processing has become smaller in recent years”, says Heselmans. He expects contact to become even more intensive, as new DNA technologies shorten breeding trajectories. ‘It is better to know which varieties your customers want at an early stage of breeding than when they have already reached the market”, Heselmans adds.

The VAVI is also a partner in the Wageningen research program Centre for BioSystems Genomics (CBSG), where the goal is to develop and adapt modern breeding technologies. The breeding is directed towards the three distinct market sectors:

fresh (for boiling), crisps and French fries (for deep fat frying) and potato starch (for industrial processing). Leerssen: "Our long-term goal is to ensure that modern breeding technologies remain accessible for Dutch potato breeders."

Pre-packed Fresh Vegetables

The Netherlands is not only a global leader in seed potatoes. The country is also famous for its vegetable seeds. Although joint vegetable breeding projects are still in their infancy (see 'Bridging Cultural Differences', page 20), introducing consumer traits in the rapidly growing sector of pre-packed vegetables is clearly a trend. Selecting varieties for taste is already common among tomato breeders.

In the last 15 years, Dutch tomato breeders have developed many sweeter and tastier tomatoes for pre-packaging, with names such as 'cherry tomatoes on the stem' and 'Tasty Tom vine tomatoes'. Most supermarkets stock at least 12 different tomato varieties: the cheaper ones for soups and sauces, the more expensive, pre-packed and sweeter ones for in salads or on bread.

Monsanto, together with Sainsbury's supermarket, recently developed easy-to-pick Bellaverde Broccoli, a 'sweet broccoli, high in vitamin C, fibre, the B vitamin folate, and potassium'. They have also launched a product site www.bellaverde.co.uk for this more expensive, pre-packed vegetable. And with Schnucks supermarkets,

Monsanto has teamed up to bring EverMild onions which offer 'a consistently mild and sweet flavour with less 'bite' and tears than regular onions'. This 'locally grown' product - intended for consumers in St Louis (US) - also has its own product website: www.evermild.com. According to this, the Monsanto vegetable breeders bring benefits to producers and consumers: These benefits include better disease resistance, higher yields, greater nutrition, better flavour, convenience and other desirable consumer characteristics, such as colour, texture and an improved shelf life. Thus, in the pre-packed vegetable sector, breeding for processing and consumer traits has taken off and consumers are prepared to pay extra for this.

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The gap between breeding and processing has become smaller in recent years.



Canned Vegetables

When it comes to canned, dried, fermented and frozen vegetables, the situation is somewhat different. Until recently, these food processors have had little involvement in the breeding side of their vegetables and fruit. However, Peter Rijnhout, Communications Manager for the Dutch Vegetable and Fruit Processing Industry Association (VIGEF), expects this to change. “Two main issues that the sector faces are innovation and improvement of the image of canned and frozen vegetables. This is why the processing companies should be involved in developing consumer traits including taste and colour”, Rijnhout says. However, this will probably take more time than in other

sectors. Vegetable and fruit processors have to deal with many niche crops, including different types of beans, spinach, cabbages, carrots and applesauce. The markets for the different processed vegetables and fruits in the Netherlands are small.

Rijnhout: “Two years ago, we organized a meeting between processors and 12 seed companies. We asked the seed companies: ‘What are you doing for us?’ ‘Nothing’, the companies said. They would like to do something, but the seed companies said they don’t have a budget for such small markets.” Now the VIGEF is trying to stimulate this debate at the level of PROFEL, the European Association of Food and Vegetable Processors.

In the meantime, some European processing companies are already showing signs of involvement in the breeding of their vegetables. For a few years now, agronomists from Bonduelle have been visiting not only the farmers who produce their vegetables, but also the seed suppliers. There they talk with the breeders and examine the seeds, explains Bonduelle agronomist Géry Capelle. “We check whether the new peas or carrots are the right colour - green or orange - or the right quality.” Bonduelle has no plans to intensify these contacts however, Capelle adds, because they are satisfied with the quality.



Bridging Cultural Differences



Cultural differences can be bridged. And breeding companies as well as food companies, research institutes or government can initiate joint breeding programs.

Small markets may be a bottleneck for intensifying collaboration, but they are not the only one, according to managers in both industries. First, there are cultural differences between seed industries and food companies. “They speak different languages”, notes Peter de Kok, a researcher at NIZO food research. “I have talked to several people from food companies. Do you know what they say about breeders and seed companies? ‘They always talk about yield.’ This makes sense because growers are their main customers. However, for consumers, taste is a very important trait.”

KeyGene Director Arjen van Tunen also sees cultural differences. “Breeders easily think: innovation in the food chain is the same as

improving seeds. It is an understandable perspective, because this is their expertise. However, they forget that food companies need to innovate in many different fields, such as health claims, marketing ideas, packaging methods, and making processes more efficient. Besides, some of the goals that can be achieved with improved seeds can also be reached by other means. For instance, spreading vitamin A among poor people can be done through Golden Rice – genetically modified rice plants making pre-vitamin A – but also with the artificially made vitamin A rice that DSM has produced. So for the food industry, seeds are only part of the food chain.”

There is also a difference in research cultures. Seed companies are used to spending up to 25% of their turnover on research; food companies spend only 4%. How the extra costs of joint breeding programs are earned back as a premium, when the value added is in a different part of the chain, remains a problem, especially when the markets are small.

Research Costs

Nevertheless, cultural differences can be bridged and ways to divide the research costs and share the benefits can be found too. For Enza Zaden research costs have not been a bottleneck, says Chris Groot, project-manager at Enza Zaden. The seed company is improving pre-cut lettuce together with a food processing

company (see 'Breeder's Have much to Offer', page 6). According to Groot, paying a slightly higher price for the improved lettuce seeds won't be an issue for lettuce growers, because they can sell their improved lettuce for a better price to food companies. And the food companies will recoup the higher price they pay when they sell their lettuce for a higher price to the supermarkets. "Seed is only 3 to 10% of the total cost price for growers", Groot explains.

Enza expects to earn back the money it has invested by selling more expensive seeds. Groot acknowledges that his company has taken a risk after much time and effort spent on meetings and research; the new lettuce may fail to show the desirable

trait. "That is why it is important to invest in long-term relationships with food companies and growers", he says. "We have to spread the research over several years, to be sure that the new traits are introduced in a sustainable way and work at different locations in the long term."

Take Initiative

Someone has to take initiative for joint breeding programs. Supermarkets are the leading link in the chain at present. They demand more sustainable or tasty products, and their growers - and thus their seed suppliers - adapt to these demands. However, when food becomes scarcer and more expensive, other links in the food chain may start to take the lead. Worldwide, there are already bio-

technology and seed industries that are starting to develop seeds with traits that are interesting for consumers and processors, such as Monsanto's 'Bellaverde Broccoli' and Enza's pre-cut lettuce with longer shelf life.

Food processing companies or research institutes also initiate joint breeding programs. Two examples are the joint research program 'Naturally sweeter' (see page 10), initiated by NIZO food research, several food companies, and the Centre for BioSystems Genomics (CBSG). CBSG is a consortium of major seed companies, the potato processing industry, universities and research institutes carrying out plant genomics research on potato, tomato, Arabidopsis and Brassica types.

Because these are new and risky projects, the initiators have received research subsidies from the government.

Finally, governments can initiate cooperation. In 2010, the Dutch government designated nine Top Sectors to be the focus of new business policy. Business representatives and research directors have been called in to advise on innovation and how the € 1.5 billion available should be spread over these sectors. Members of the teams responsible for the Agrofood and Horticulture sectors have already declared that it is important to stimulate joint programs. “We have to identify the horizontal line between these sectors”, one of them recently said.

The Dutch Minister of Economic Affairs, Agriculture and Innovation Maxime Verhagen, responsible for the initiative, has also indicated that he wants to see more collaboration between sectors. As he stated in a speech in March 2011: “The most fruitful innovations appear precisely at the interfaces of top sectors.”

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We have to identify the horizontal line between these sectors.

‘Companies must collaborate to meet rising demands’

“The food production chain can benefit from close partnership, but this may also bring societal benefits. More collaboration is needed to meet rising food demands. The world population will have grown from 7 billion to 9 billion by 2050. So we can expect an increasing demand for more planting material, and for more luxury and high-quality food. At the same time, leading supermarkets and food companies are now seriously striving to produce and sell more sustainable products, grown with less fertilizer and energy, and fewer plant protection products.

Our company develops seed enhancements to improve the performance of this starting material, including seed selection methods, seed disinfection methods and all kind of coating technologies. For instance, actives added through seed coatings can stimulate root development and make the plants better equipped to deal with changing growing conditions like drought and lack of nutrients.

Some supermarkets have already obligated their growers to use lettuce seeds with an INCOTEC ‘smart’ coating - containing added actives against aphids - because these had proved to be more sustainable. Growers were able to reduce their use of aphid protection products by 80 to 90%. We also see potential for joint projects with seed companies and food processing companies. Our coatings seem to increase certain plant substances in certain cases. The added actives may influence the genes and the phenotype development of the plant. Here we are on to something very special. Can we use coatings to increase the amount of starch in maize, or the amount of protein in wheat, or the sugar content in certain crops? We would like to find out how we can increase these yields in a sustainable way, using seed technology. To reach that goal, we need input from seed and food companies and to work jointly on creating this extra added value.”

Jan Willem Breukink,
CEO, INCOTEC Group BV

Websites

Food Valley
www.foodvalley.nl

Keygene
www.keygene.nl

Heinz Company
www.heinz.com

Dutch Potato Processing Association
(VAVI)
www.vavi.nl

Dutch Vegetable and fruit
processing industry association
(VIGEF)
www.vigef.nl

NIZO food research
www.nizo.nl

Incotec Group BV
www.incotec.com

Bonduelle
www.bonduelle.com

Food Valley

Food Valley stimulates innovation in the Dutch agrifood sector by partnering knowledge with enterprise, based on the needs expressed by the business community.

We offer:

- Answers to questions from entrepreneurs
- Support for project development
- Assistance in establishing innovative food companies in the region
- Support for developing spin-offs and start-ups
- Opportunities for innovation through the Food Valley Society

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