

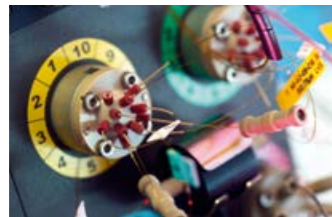


Government of the Netherlands

The Netherlands, no. 1 in seed for food
and nutrition security

Your partner in
quality seed

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Preface

The Netherlands is keen to share its expertise on seed with other countries



Marjolijn Sonnema
Director-General for Agro and Nature Policy
at the Ministry of Economic Affairs

By 2050, there will probably be 10 billion mouths to feed. The world's population is growing explosively, but we only have one Earth. Ensuring access to healthy, sustainable and safe food in sufficient quantities is a huge task. And in attempting it, we need to take into account a changing climate and environment. This presents the agricultural sector with an enormous challenge.

Every farmer will tell you that a good crop starts with good seed. Whatever the size of the company, the type of product or the type of consumer – the seed needs to generate a good yield, be resistant to diseases and produce a nutritious harvest.

The global food security challenge requires active involvement of the Netherlands, a world leader when it comes to seed. Our diverse seed sector is active throughout the world. Dutch companies are the world's number-one supplier of vegetable seed, seed for ornamental plants and seed potatoes.



Christiaan Rebergen
Director-General for International Cooperation
at the Ministry of Foreign Affairs

This success is a result of the unique Dutch approach of strong collaboration between businesses, government, inspection bodies and the research and education sector, creating a conducive climate for innovation and production. Recently, in its report *Enabling the Business of Agriculture*, the World Bank stated that the Netherlands leads the world in the area of seed regulations. We achieved high scores in regulatory areas such as policy, the availability of plant breeders' rights, the ease with which new varieties can be registered and released, and the efficiency of seed quality assurance measures.

We are very proud of this. But not only that: we also feel a responsibility to share our expertise and experience with the rest of the world. The Ministry of Economic Affairs and the Ministry of Foreign Affairs work closely together on this. We also play a leading role in developing international treaties on seed and support more than twenty countries in developing their respective seed sectors.

'Every farmer will tell you that a good crop starts with good seed'

In this way, we contribute to global food security – one seed at a time. This brochure contains examples of cooperation at the crossroads of aid and trade, involving the government, businesses, civil society organisations and knowledge institutions – the 'Dutch diamond'. It will give you an overview of all the aspects involved in making high-quality seed available to farmers worldwide, and the role of the Netherlands in this – now and in the future.

Quality seed and a strong seed sector are vital for SDGs

Pollination by hand as part of breeding pumpkin

The close collaboration in the Dutch seed sector between the business community, the government, inspection bodies and the research and education sector, and its strong international focus, is what makes it unique. Building on this strong home base, the Netherlands is supporting the development of domestic seed sectors in Africa, Asia and Latin America. Quality seeds and strong domestic seed sectors all contribute to food and nutrition security.

Of the international trade in seeds for the horticulture sector, 40% originates in the Netherlands. For seed-potatoes, this percentage is as high as 60%. Dutch seed companies have branches in a hundred different countries, involved not only in sales but also in the production of seed. Niels Louwaars, director of industry association Plantum: "The internationalisation of the Dutch seed sector is proceeding rapidly. The number of branches of Dutch seed companies outside Europe has increased exponentially over the past few years." That is not just good for the Dutch economy, but also for farmers and horticulturists worldwide. Quality seed is essential for them. Wherever you are, globally speaking, if you talk to a farmer, you will soon find the conversation turning to seed. Good seeds from good varieties, provided they have been properly cultivated, result in better harvests and resistance to prevalent diseases and pests, and give farmers and consumers value for money. Varieties that have been especially bred to contain

higher vitamin or mineral levels combat malnutrition, and varieties that are more resistant to drought or have shorter growing seasons can offer a solution to climate change.

Improving plant propagating material such as seed and seed-potatoes is therefore not only important for farmers: it also contributes to securing the food supply for a growing world population. A thriving seed sector – with businesses that are supported by sound government policy on issues such as plant breeders' rights, effective inspection services and strong knowledge institutions – contributes significantly to a number of different Sustainable Development Goals (SDGs), including SDG 2, ending hunger.

Quality seed is the basis

"The Netherlands boasts a unique combination of strong, internationally eminent seed companies, an excellent regulatory framework that promotes

innovation and guarantees quality seed and groundbreaking public-private research programmes," says Geert Westenbrink, Senior Policy Officer at the Dutch Ministry of Economic Affairs. "The Netherlands also plays an active and often leading role in developing the various international treaties on seed," adds Marien Valstar, Senior Policy Officer at the same ministry. This leading position is evidenced, for example, by the Enabling the Business of Agriculture (EBA) ranking published by the World Bank, which evaluates the efficiency of countries' agribusiness policies and regulations. The Netherlands is the number-one where seed regulations are concerned. The World Bank looks at aspects such as the availability of plant breeders' rights, the ease with which new varieties can be registered and released and the quality of seed control measures.

That is why foreign governments are keen to work with the Netherlands to develop their own seed sectors. Partnership projects have been launched in many countries. Often, these will focus on improving the seed production chain. "Seed is not a simple input that comes from a factory, where you can adjust production to the expected demand, as with artificial fertilisers and pesticides," Westenbrink explains. There is a whole chain of activities, from breeding to multiplication and distribution, that needs to take place before a farmer can access quality seeds. The seed sector is a sector in and of itself, and is a source of income for many farmers and seed companies.

The improvements realized in the partnership projects in turn stimulate Dutch companies to step up their investments and activities - not only by selling seeds and providing a wide range of high quality seeds, but also by producing seeds for the international market. The development of a thriving national seed sector ensures that farmers and horticulturist have access to a broad palette of

Seed from different sources

Farmers often get their seed from many different sources. Take a typical smallholder in Kenya, for example. She saves her sorghum seeds from the previous year's harvest, and does the same with cassava. She buys hybrid corn seed from a national seed company, and seed for beans on the local market. Vegetable seeds, on the other hand, she purchases from an international vegetable seed company, often one from the Netherlands.



Checking barley quality, Tigray

quality products. The cooperation and trust built in partnerships also helps to solve any issues that Dutch business run up against. "In the seed sector, more so than in other sectors, sector support and the growth and development of seed companies can go hand in hand," Westenbrink says. "By selling quality seed worldwide, and by supporting the development of local seed sectors in different countries, the Netherlands is contributing to achieving the SDGs."

Cooperation

The business community, government agencies and other stakeholders need to join forces in order to create a well-developed seed sector and, by doing so, contribute to greater food and nutrition security. Westenbrink says this requires a good enabling environment: responsive government

"The Netherlands has a unique system for monitoring the quality of seeds and seed-potatoes. The inspection services have been around for eighty years and have their roots in the sector. Commissioned and supervised by the government, they are responsible for monitoring compliance with the relevant regulations, but they also keep the sector on its toes. That is different from many other countries, where the inspection bodies are government agencies and focus on carrying out the statutory checks." John van Ruiten, director of the Netherlands Inspection Service for Horticulture

Grass pitch in the Arena football stadium, Amsterdam



Grass seed

With six specialised companies, the Netherlands is a major player in the global grass seed industry. Many football pitches and lawns used for events all over the world have been sown with Dutch grass seed.

policy, well-functioning inspection services and a strong research and education sector. These areas have traditionally worked together effectively in the Netherlands.

Plant breeding is a knowledge-intensive industry. On average, Dutch seed companies spend about 15% of their turnover on R&D in order to guarantee improved plant varieties and seed quality, with some companies even investing nearly 30%. This shows that business continuity is dependent on innovation. The Netherlands is at the forefront of research and education in the plant sciences, due in part to the ongoing support it receives from the government. Wageningen University's Plant Breeding degree programme is very popular among international students, and the Plant Sciences programmes in Amsterdam, Nijmegen and Utrecht also have very good reputations.

Policy

Inspection services that thoroughly monitor and review seed quality are indispensable to the seed sector. "The Dutch inspection bodies are world leaders," says Valstar. The Netherlands Food and

Consumer Product Safety Authority (NVWA) has final responsibility for the phytosanitary inspection of all imports and exports of plant material. The inspections are carried out by three bodies: the Netherlands Inspection Service for Horticulture (*Naktuinbouw*) for the horticulture sector, the Dutch General Inspection Service for Agricultural Seed and Seed Potatoes (NAK) for agricultural crops and the Flower Bulb Inspection Service (BKD) for flower bulbs. These services facilitate the worldwide export of propagating material and also contribute to the capacity building of inspection services elsewhere in the world.

Seed companies want to recoup their investment in the breeding of new varieties. To this end, it is important that appropriate arrangements for plant breeders' rights are in place. The Netherlands plays a significant role in the development and promotion of plant breeders' rights at the international level. Access to genetic resources is important too. After all, companies or public breeders can only breed new varieties if there is sufficient opportunity for the international exchange of genetic material. "The Netherlands plays a prominent role internationally in knowledge and policy development relating to propagating material, plant breeding and plant genetic resources for food and agriculture," says Kim van Seeters, the National Authority on Access and Benefit-Sharing for the Dutch Ministry of Economic Affairs. The objective is to ensure the proper implementation of the international agreements that are in place, so that breeders have access to diversity and the countries from which the genetic resources originate get a fair share of the benefits arising from their use. Funding the storage of seeds for the distant future – for example in the Svalbard Global Seed Vault – forms part of this policy.



Assessing seeds for germinative capacity

Good seed doesn't cost – it pays

The seed sector has a major impact on the rest of the agricultural chain. A grower in the Netherlands will pay around € 50,000 euros for 1 kilo of tomato seed. Just for reference: that's more than the price of 1 kilo of gold. This amount of seed will enable the grower to grow nearly 20 acres of greenhouse tomatoes, or 4.8 million kilos of tomatoes, which they will sell for € 3.5 million. These tomatoes will go on to be sold in stores for € 10 million – 250 times the value of the original seed.



The Netherlands' prominent position is the result of extensive consultation and coordination between the business community, inspection bodies, the research and education sector and policymakers, Marien Valstar concludes. "In the Netherlands, we're used to taking a pragmatic approach to things – without making any compromises where the maintenance of quality standards is concerned, of course. The various parties involved work together closely, but it's important that everyone remains aware of their own specific area of responsibility."

The Plantum industry association

Plantum is the Dutch industry association for companies in the plant reproduction material sector. Plantum represents and promotes the interests of its members and, on behalf of the sector, acts as a discussion partner with government representatives and interest groups, with the objective of strengthening the sector's competitive position on the international stage. www.plantum.nl

Facts and figures about the Dutch plant propagating material sector



€ 2.4 billion in exports annually



300 specialised plant growing and propagation companies, employing



11,000 people



30% of all applications for European plant breeders' rights are from the Netherlands – for vegetable seeds, this percentage rises to as high as 60%. This is a testament to the high level of innovation in the sector.

Vegetable horticulture

- 100 companies
- between 4,000 and 4,500 jobs
- 40% of the world trade in vegetables seeds comes from the Netherlands

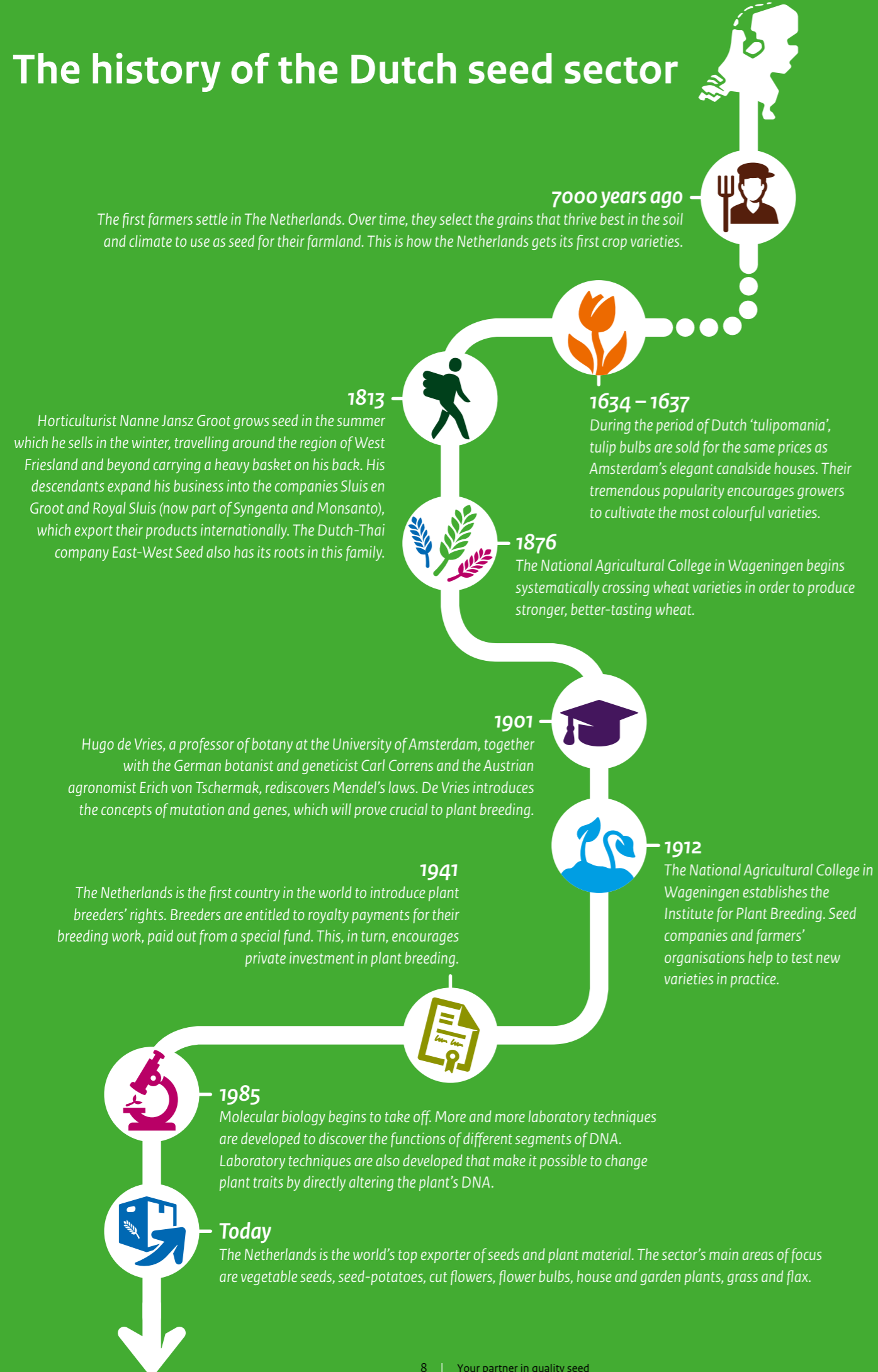
Seed-potatoes and arable farming

- 100 companies
- between 1,000 and 1,500 jobs
- 60% of the world trade in seed-potatoes comes from the Netherlands

Propagating material for flowers and ornamentals

- 130 companies
- between 3,000 and 3,500 jobs

The history of the Dutch seed sector



Modern plant breeding



Fine-tuning new tomato varieties

Dutch seed companies are improving an increasing range of plant traits – including flavour. The new vine tomato is aromatic, sweet and slightly tart, with a firm, juicy bite.

In the lab this machine is used to measure fragrances and flavours

Until twenty years ago, vegetable seed companies barely paid any attention to the flavour of their new varieties. In the year 2017, the approach to plant breeding is completely different. Take the tomato, for example. Dutch vegetable seed companies develop hundreds of new tomato varieties every year. They differ from one another in traits such as resistance to fungi and bacteria, crop yields and size of produce. Nowadays, which varieties end up making it onto supermarket shelves depends partly on the taste of the produce.

Taste panels

“Breeders now enlist the help of taste panels”, says Wouter Verkerke, researcher at the taste lab of Wageningen University & Research’s Greenhouse Horticulture business unit. These panels are made up of fifty experienced tasters. They give extensive feedback on the texture, taste and scent. The only drawback is that tasting 24 varieties takes at least a few days.

That is why Wageningen University & Research developed a method that makes it possible to evaluate the taste of a hundred different varieties in just one day. The laboratory measures the sugar and acid levels and the amount of aromatic substances. In addition, it identifies texture attributes such as ‘mealiness’ and ‘juiciness’. Nearly all Dutch vegetable seed companies have adopted this method.

Crunchy and firm

The score depends on the desired taste. Verkerke: “Companies want vine tomatoes to be sweet and fragrant, with a tangy kick and a firm, juicy bite. But snack tomatoes need to have a crunchy and firm texture and be slightly less fragrant, so that you keep eating them.” The desired taste can also differ from one country to another. The Japanese, for example, want a soft, sweet tomato without any tanginess.

Wageningen University & Research has identified some of the many genes responsible for producing certain flavours. This will enable seed companies to improve their tomato plants in an even more targeted way going forward, combining other desired qualities, such as disease resistance and salt tolerance, with a specific taste.



The new vine tomatoes



Plant breeders' rights promote the seed trade

Plant breeders' rights are important for the seed sector and promote the development of seed products for farmers and horticulturists – both in the Netherlands and worldwide.

Plant breeders' rights give a company that has developed a new plant variety the exclusive right to multiply and sell this variety for a certain period of time. To apply for plant breeders' rights, a variety must be distinct, uniform and stable. This must be assessed using a so-called DUS test procedure, which in the Netherlands is organised by the Board for Plant Varieties and carried out by the Netherlands Inspection Service for Horticulture (*Naktuinbouw*). "Plant breeders' rights are very important for farmers and horticulturists," says Marien Valstar, Senior Policy Officer, Seeds and Plant Propagation Material, for the Ministry of Economic Affairs. The development of new varieties requires significant investment. Without being rewarded for their efforts through plant breeders' rights, there would be little incentive for companies to breed new varieties and bring them to market. "It is thanks to

plant breeders' rights that farmers get to grow good varieties that have higher productivity and quality and are tailored to their production systems."

Standard

Countries can establish their own versions of plant breeders' rights or join the International Union for the Protection of New Varieties of Plants (UPOV), which has established a standard for plant breeders' rights. Many countries have opted for the latter. "The advantage is that it offers breeders from other countries the certainty that they can safely export their new varieties that country," says Valstar, who represents the Netherlands within the organisation. "This results in an influx of genetic material that local breeders can, in turn, use themselves." By setting standards, UPOV removes obstacles to trade and gives locally operating seed companies and farmers better chances in the market.

Exceptions

Valstar emphasises that farmers can continue to multiply the plants that they have traditionally been using. The restriction on multiplication and

Research into field potatoes prior to the granting of plant breeder's rights

Support from the Netherlands Inspection Service for Horticulture: the PVP toolbox

The Netherlands Inspection Service for Horticulture – or *Naktuinbouw* – supports and advises policymakers and inspection services in other countries in order to promote the use of plant breeders' rights worldwide.

The Netherlands Inspection Service for Horticulture monitors and promotes the quality of propagating material in the Netherlands and is responsible for conducting research into plant breeders' rights for Dutch and European plant breeders' rights applications for many agricultural and horticultural crops.

Naktuinbouw is an Autonomous Public Body, regulated by the Dutch Ministry of Economic Affairs. In order to support the introduction of plant breeders' rights in third countries, *Naktuinbouw*, using government funding, developed a

toolbox on Plant Variety Protection – the PVP toolbox. "We help policymakers and legislators all over the world with information and expertise on the development and implementation of plant breeders' rights," says John van Ruiten, director at *Naktuinbouw*. In addition, *Naktuinbouw* helps countless inspection services through advice and training, manuals and a helpdesk for questions on issues such as how to go about DUS testing. Training sessions are given in Wageningen or Roelofarendsveen, or, on request, in the country in question.

"Close consultation within the sector is essential," says Van Ruiten. "In the Netherlands, the government and the inspection services are in constant communication. They work together like cogs in a machine." www.naktuinbouw.com



Naktuinbouw communicate

sale only applies to the varieties protected by breeders' rights during a specified period. In addition, after plant breeders' rights have been granted, the use of protected material for further breeding continues to be permitted. This is referred to as the Breeders' Exemption. Furthermore, farmers can, subject to certain conditions, propagate protected material for personal use, the so-called Farmers' Exemption. Finally, there is the exemption for smallholders, who are permitted to multiply protected varieties for personal use and local seed exchange – without needing permission from the holder of the plant breeders' rights. The question as to which types of farmers should be granted an exemption has often been the subject of debate. The Netherlands advocates a broad interpretation. "It's important that clear agreements are established on a country-by-country basis," says Valstar, "so that everyone knows where they stand."

Patents

The advent of biotechnology also led to the emergence of patents as a form of intellectual property on plants. However, an important difference between plant breeders' rights and patent rights is that, under plant breeders' rights, competing plant breeders are free to use the protected material for further breeding, whereas under patent law this is

only permitted with a licence from the patent holder. In the spring of 2016, the European Commission decided to interpret the Biotech Directive in such a way that products of essentially biological processes (such as plant hybrids) are no longer patentable. According to Valstar, this is a good thing, as patents provide less scope for innovation through the exchange of genetic material. "And that innovation is urgently necessary, so that new varieties can be developed that go on to be exchanged through international trade."

Implementation

In addition to good laws and regulations, monitoring the implementation is important as well. Countries introducing plant breeders' rights need a reliable authority on plant varieties. They can conduct their own testing procedures for new plant varieties, but they can also elect to draw on DUS testing results from elsewhere. The Netherlands helps various countries by providing advice and capacity building relating to laws and regulations, but also by supporting them in establishing this type of authority – for example through technical research, courses for policymakers via the Wageningen Centre for Development Innovation (CDI) and through the Netherlands Inspection Service for Horticulture (*Naktuinbouw*).

Training in plant variety protection



Good phytosanitary policy is key

Rijk Zwaan

No country wants to end up bringing harmful diseases and pests upon itself by importing plant material. That is why exporting countries and products are subject to strict requirements. A phytosanitary certificate – a declaration stating that the products are healthy – is required for every shipment. As a world player in plant breeding, harmonisation of the regulatory framework is very much in the Netherlands' interest.

Countries can set their own rules for the importation of plant material, but under one condition: they need to comply with the principles set out by the World Trade Organization (WTO) on this subject. The most important of these is that import regulations must not conflict with current scientific knowledge. "This means countries cannot impose requirements at random," says Philip de Jong, Chief Phytosanitary Officer for the Ministry of Economic Affairs. Supported by his team, De Jong negotiates with countries from outside the European Union to which the Netherlands exports agricultural products.

Good trade relations are important for the Netherlands, as the country is one of the largest importers and exporters of plant material such as seed and propagating material. Dutch companies

benefit from uniform international regulations being in place. De Jong: "My work focuses on gaining and building trust in third countries, so that they get to know and trust our products and our guarantee system. That is why we sit down with our most important markets once or twice a year to discuss phytosanitary issues. We have agricultural counsellors in those countries all over the world. They ensure the lines of communication stay open. They explain how we work, and they listen. What are the requirements and the problems? Do our guarantees address these adequately?"

Phytosanitary certificate

A country establishing import regulations begins by conducting a risk analysis. To this end, it will request all the information about a certain product, and about any possible diseases, from the

Climate cell in a fyto laboratorium

exporting country. The risk will then be determined, and the rules that the exporting country must comply with will be established. Those rules will usually be incorporated into a protocol. By issuing a phytosanitary certificate, the exporting country guarantees that a shipment meets the rules set out in the protocol.

But things are rarely this straightforward for Dutch seed companies. That is because they produce much of their propagating material in other countries. They then send it on to the parent company, which inspects and processes it and prepares it for export. Since 2007, shipments exported from the Netherlands have required an accompanying health certificate from the country where the seeds were produced. De Jong: "This means that, even prior to production, companies need to think about where the material will be going. That makes things even more complicated." And each country has its own rules. "Complying with the regulations of country X doesn't mean you automatically comply with those of country Y."

Knowledge development

The Netherlands is also investing in knowledge development. "We like to give other countries the opportunity to take a look at our operations: how do we do things? And we also run training sessions. These types of initiatives ensure we don't just come to get something; we're also contributing to sector development in other countries. Those visits and training sessions contribute to building relationships."

Phytosanitary certificate



Naktuinbouw communicatie

World-class inspection body

In Emmeloord, in the heart of the Dutch seed-potato sector, the Dutch General Inspection Service for Agricultural Seed and Seed Potatoes (NAK) keeps a close eye on things. "A blue NAK label on a bag of seed potatoes is a guarantee of reliability all over the world."

The Dutch General Inspection Service for Agricultural Seed and Seed Potatoes inspects and certifies seed for agricultural crops, including grains, grasses and green fodder. But the most important product the Inspection Service deals with is seed-potatoes. "Seed-potatoes are really big in the

Netherlands", says director Erik Casteleijn. The Netherlands is the global market leader in seed-potatoes and exports to about eighty countries in Europe, North Africa and Asia. The NAK, too, is a world leader. Casteleijn: "Our strength is that we work alongside the sector rather than setting ourselves in opposition to it. This has created support in the sector for looking at the European standards as the minimum requirements, and making an effort to go beyond them. You don't see that anywhere else."

Symbol of reliability

During the growing period, the NAK screens the potatoes for disease. After the harvest, it takes samples for laboratory research. During the packaging and shipping stages, the product is monitored. If everything is in order, it gets a blue NAK certificate. "That's a symbol of reliability the whole world over." A phytosanitary certificate, covering the shipment as a whole, is also enclosed, issued by the Netherlands Food and Consumer Product Safety Authority (NVWA).

About forty delegations from other countries visit the NAK in Emmeloord every year. "This is the seed-potato sector's centre, complete with a laboratory, growers and trading companies. You can visit the entire production chain in just one day."

In addition, the Inspection Service organises field courses, laboratory work courses and modules at Wageningen University and the Potato Business School in Emmeloord. "And sometimes, we help countries to set up their own laboratories."



NAK Pim van der Maden

checking the quality of potatoes

Access to genetic resources

Access to genetic resources, and the fair sharing of benefits arising from their use, is laid down in international treaties. The Netherlands actively promotes the proper implementation of these treaties, as open access is important for innovation and food and nutrition security.

A lot of genetic material from crops is stored in national or international gene banks. Access to this material is important for enabling innovation and the development of new varieties by plant breeders or farmers. The same is true for the international exchange of this material. Climate change is driving the search for new varieties with genetic traits that often can only be found in source material deriving from abroad. Exchange of and access to genetic resources from elsewhere is also necessary to maintain and increase crop diversity. Diversity and innovation are important for safeguarding food security. To this end, international treaties have been established to regulate the preservation of, and access to, genetic resources and the fair and equitable sharing of benefits arising from their use – “Access and Benefit Sharing” for short.

Treaty

The objective of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA – known in brief as the Treaty) is the conservation and sustainable use of all plant genetic resources for food and agriculture. The countries that have signed the International Treaty agree that genetic material for 64 important crops is available to all signatories through a multilateral system.

Nagoya Protocol

The Nagoya Protocol was adopted in 2014 under the Convention on Biological Diversity (CBD). Complementary to the Treaty, the Protocol requires that countries that provide genetic resources have a share in any benefits accrued by companies or research institutes using this material.

The Dutch government has signed both international treaties and plays an active role in ensuring their implementation, says Kim van Seeters, the National Authority on Access and Benefit-Sharing in the Netherlands. “The Netherlands plays a prominent role internationally in knowledge and policy development relating to propagating material, plant breeding and plant genetic resources for food and agriculture. Dutch

plant breeding companies are industry leaders, especially where vegetables, potatoes, grass and ornamental plants are concerned. The proper implementation of the international treaties that are in place contributes to the conservation and utilisation of genetic diversity. And, of course, we also want to be a reliable trading partner.”

Fair sharing

The Netherlands is in favour of extending the list of the crops that can be freely exchanged under the ITPGRFA. Crops such as corn, rice and wheat are on the list, but important vegetables such as lettuce, tomatoes, cucumber and bell peppers are not. Van



Global Crop Diversity Trust



Global Crop Diversity Trust

Samples in a genebank

Seeters: “It’s important that source countries get a fair share of the benefits arising from the utilisation of genetic resources, but they also have a responsibility to provide access to their material.”

Policy in this field is also evolving thanks to the advent of new technologies, such as synthetic biology, which makes it possible to develop new plant traits without access to the original genetic material in which these traits occur. Source

countries and businesses are currently having discussions about whether those traits should also fall under the Nagoya Protocol.

Due diligence

Van Seeters promotes awareness of international policy on Access and Benefit Sharing in the business community. Businesses and institutions that receive and make use of genetic material from other countries of origin are reviewed to see whether they have made appropriate efforts to trace the origin of genetic material (due diligence) and whether they keep a record of this. “The Dutch plant breeding sector has its affairs in order where this is concerned.”

Capacity building

The Netherlands supports other countries in developing their own policies, for example by providing advice, training and capacity building through initiatives such as the ABS National Focal Point, which forms part of the Centre for Genetic Resources, the Netherlands (CGN) in Wageningen. This information point answers questions from businesses and institutions seeking access to genetic resources, but can also provide advice to countries of origin about how best to handle Access and Benefit Sharing. In addition, the Integrated Seed Sector Development projects and courses organised by Wageningen Centre for Development Innovation also cover Access and Benefit Sharing.

Crop Diversity Trust

In addition, with a €6.2 million contribution (between 2016 and 2018) the Netherlands also supports the Global Crop Diversity Trust, which funds gene banks worldwide, such as the Svalbard Global Seed Vault. The objective is the conservation and availability of crop diversity to ensure food and nutrition security in perpetuity. The Netherlands chairs the Donors’ Council, which is responsible for the Crop Trust’s day-to-day management.

Storage of seeds in the Global Seed Vault, Svalbard



Developing the seed sector

In order to ensure that farmers have access to the quality seed of their choice, a country needs to have a dynamic seed sector. Preferably, this sector will consist of a combination of small and medium-sized enterprises and multinationals, underpinned by strong private and public support. Developing the seed sector is a complex process that requires an integrated approach.

The most important thing is that the government stimulates responsible private investment in the seed sector. The introduction of plant breeders' rights is an example of this. This increases the

“The Netherlands supports countries in Africa and Asia in strengthening their seed sectors”

chance that businesses will be able to recoup their investments, which attracts foreign seed companies and can also provide a boost for domestic seed companies. A good phytosanitary service is also important, in order to guarantee the quality of the seed on the market and enable international trade.

But in addition to commercial crops, many farmers in most countries in the world also produce a range of crops that the private sector is not – or not yet

– interested in. The public sector can play a role here, for example with publicly-funded research, or by providing support to the sector to encourage companies to also produce seeds for crops that are less interesting from a commercial perspective. Oftentimes, these will be crops that are crucial to food and nutrition security, such as pulses (beans and peanuts), grains (sorghum and millet) and root and tuber vegetables (yam, cassava).

These crops are less commercially viable in terms of seed production because they are self-pollinating or grown through vegetative propagation. This means farmers can propagate these varieties themselves, rather than having to buy seed from a company. In addition, these crops often have low multiplication factors: the ratio between the seed that is sown and the grain it ends up yielding is low, which means it is relatively expensive for farmers to buy the seed.

Farmers visiting potato demo days in Myanmar

There is also a huge diversity in local varieties for niche markets. Seed production for these varieties is not commercially viable for seed companies, but the associated varieties remain popular among farmers and consumers because of the taste of the produce, or because the variety is particularly resistant to flooding or drought.

ISSD

There are many stages along the seed supply chain where things could go wrong (see diagram), from breeding to the testing and releasing of new varieties, seed production and the distribution to farmers. Services for seed producers, the applicable legal and regulatory requirements and the business climate can also all hamper the sector's smooth running. As part of the Integrated Seed Sector Development (ISSD) approach, a number of countries have gained experience in developing their seed sectors and tackling these types of obstacles. The key principle here is that farmers are entrepreneurs. Taking into account the costs and benefits of each, they get the seeds for their various crops from different seed systems that exist alongside each other. Farmers save seed from their own farmland and buy seed on the local market, but also from small local companies, medium-sized national ones or large-scale international seed corporations. Larger seed companies mainly focus on hybrid corn and vegetables. Local seed systems supply farmers with seed for crops such as sorghum, beans and cassava. There is room for substantial improvement in all these systems. This requires a tailor-made approach, as each system has its own unique dynamic.

In developing and testing new varieties of non-commercial crops, national and international CGIAR research institutes (for example: IRRI for rice and ICRISAT for beans) play an important role. Over the past years, the Netherlands has invested heavily in CGIAR institutes. The final stages of multiplication are often undertaken by small local



businesses, farmers' cooperatives and individual farmers. Releasing and stimulating the uptake of new varieties can be a problem. Institutes do develop new plant varieties, but they do not reach enough farmers – for example, because farmers are not informed about the new varieties. Multiplication of the propagating material for new varieties can also be an issue.

Building trust to overcome aversion to change, Myanmar

Quality

Seed quality control is important to enable imports and exports, but it is also important for the internal market. Seed is inspected to assess its germinating power and to ensure that it is disease-free, but also to confirm that the variety is authentic. There is counterfeit seed on the market in many countries, which is sold as seed for sowing but is effectively grain packaged as seed. For farmers who see, for example, only 10% yield as a result of the poor quality of the seed, that is a disaster. Effective quality monitoring requires that a sufficient number of inspectors – all adequately trained – be appointed, and an effort be made to crack down on fraudsters.

Seed for sowing chain diagram



Research institutes or commercial plant breeders develop new crop varieties, which are then multiplied in a number of stages. Plant breeders produce small amounts of *breeder seed*, which is then multiplied into *foundation seed* and subsequently into *certified seed*. Dutch and international companies complete all of these stages themselves. In developing countries and emerging markets the seed production chain is often more diversified. Here, various public and private organisations are responsible for the various activities in the chain.



Access to Seeds Index

Local breeding

It can also be a good idea to establish a more decentralised quality system for locally produced and traded seeds in addition to the national certification system. In Uganda, for example, a Quality Declared Seed (QDS) system has been established, where seed quality is inspected at the district level. Groups of trained farmers (local seed businesses) produce the seeds and sell them within the district. This system creates a niche that provides quality seed for food crops, such as beans, that are less commercially viable for larger seed companies. The Ugandan government has recognised QDS as a new seed class and incorporated it into national policy.

Entrepreneurship

The seed sector requires a long-term approach and a great deal of knowhow on the part of entrepreneurs.

Stimulating and developing local entrepreneurship is an important element in the development of the seed sector. Integrating a seed company into the domestic or export chain can help to create a market for quality seed. Another possible strategy, especially for seed companies specialised in seeds that yield low returns, is to focus on a local niche market and keep overheads low. In order to achieve a thriving seed sector, it may be necessary to show farmers the increased yields and the return on investment that can be achieved by using quality seed, in addition to introducing them to the optimum cultivation techniques that will enable them to make these potential returns a reality. This requires active marketing and promotion. Cooperation and consultation between seed companies, public institutions and farmers is also important to ensure that activities across the sector are well-coordinated.

Using the ISSD approach, Wageningen Centre for Development Innovation (CDI) – which forms part of Wageningen University & Research – and the Royal Tropical Institute (KIT) in Amsterdam are working together and running programmes in a number of different countries, including Uganda, Ethiopia and Myanmar. They are exchanging their experiences in ISSD Africa, a Community of Practice which is active in fourteen different countries and is partly funded by the Dutch government.

www.issdseed.org



ISSD Africa conference in Nairobi, 2016

WUR - CDI

Long-term investment by the Dutch government and the business community in the seed sector, by country.

Country	Activity
Burundi	<ul style="list-style-type: none"> ISSD Burundi, a project to strengthen the domestic seed sector and improve farmers' access to quality seed, coordinated by IFDC in collaboration with the Royal Tropical Institute (KIT) CATALYST, an agribusiness programme, focusing on a range of topics including seed, for Burundi, Rwanda and DRC, organised by IFDC in collaboration with KIT and WUR CDI.
Ethiopia	<ul style="list-style-type: none"> ISSD Ethiopia, a project to strengthen the domestic seed sector and improve farmers' access to quality seed, coordinated by WUR CDI A public-private partnership between Fair Planet and Dutch seed companies, with co-funding from the Netherlands (from the Facility for Sustainable Entrepreneurship and Food Security, FDOV), with the objective of giving companies access to markets and giving farmers access to quality crop varieties and seed The Seeds2Feed project, a public-private partnership between INCOTEC and other businesses (FDOV project) aimed at bringing seed-related technologies to market.
Ghana	<ul style="list-style-type: none"> The GhanaVeg project, aimed at strengthening the horticultural chain and the overall business climate, coordinated by WUR CDI in cooperation with the business community.
Indonesia	<ul style="list-style-type: none"> VegIMPACT, a public-private partnership between WUR and Dutch and local businesses aimed at strengthening the vegetable sector.
Kenya	<ul style="list-style-type: none"> HortIMPACT, a public-private partnership between SNV and various companies aimed at strengthening the horticultural chain A public-private partnership between Agrico and others (FDOV project) aimed at strengthening the potato chain A Dutch-Kenyan public-private partnership involving, among others, WUR CDI and Dutch seed-potato businesses, aimed at strengthening the Kenyan potato sector.
Myanmar	<ul style="list-style-type: none"> ISSD Myanmar, a project aimed at strengthening the domestic seed sector and improving farmers' access to quality seed, coordinated by WUR CDI.
Mozambique	<ul style="list-style-type: none"> The NICHE project, aimed at strengthening the capacity of higher education institutions in the Zambezi Valley relating to seed chains, involving KIT, WUR CDI and the Aeres Group.
South Sudan	<ul style="list-style-type: none"> Seed Sector Development project focussing on the development of a commercial seed sector for South Sudan, implemented by AGRA.
Tanzania	<ul style="list-style-type: none"> SEVIA, a public-private partnership involving East-West Seed, Rijk Zwaan and other parties (FDOV project), aimed at introducing farmers to new varieties and improved cultivation techniques in order to increase vegetable yields.
Uganda	<ul style="list-style-type: none"> ISSD Uganda, a project aimed at strengthening the domestic seed sector and improving farmers' access to quality seed, coordinated by WUR CDI.
Zimbabwe	<ul style="list-style-type: none"> A public-private partnership involving Bakker Brothers and other partners (FDOV project), aimed at strengthening the bean seed chain.
Africa-wide	<ul style="list-style-type: none"> ISSD Africa, a Community of Practice for African seed experts and their organisations, facilitated by WUR CDI and partners 2SCALE, a portfolio of public-private partnerships in nine African countries, involving IFDC, that focus on agribusiness clusters and value chains, including seed.
Worldwide	<ul style="list-style-type: none"> Dutch investment in international agricultural research, including plant breeding programmes by the Consultative Group on International Agricultural Research (CGIAR) Dutch investment in the Global Crop Diversity Trust The plant breeders' rights toolbox, assistance with plant breeders' rights in more than ten countries across Africa, Asia and South America, by the Netherlands Inspection Service for Horticulture (<i>Naktuinbouw</i>) The Access to Seeds Index, which measures and compares seed companies' efforts to increase the productivity of smallholders, launched by the Access to Seeds Foundation and KIT Various international courses on seed-related topics such as the development of the seed sector, plant breeders' rights and the sustainable use of genetic resources, organised in cooperation with entities such as WUR CDI, the Netherlands Inspection Service for Horticulture and CGN.



Education in order to stay ahead

Wageningen University & Research is educating new generations of researchers who will ensure the Netherlands remains at the forefront of the seed sector.

Carlos Castro Gamiz (22) is in the final year of the Plant Breeding & Genetic Resources Master's programme at Wageningen UR. Soon, he will be starting an internship at the Dutch seed company Rijk Zwaan, where he will be doing research into the taste of bell peppers. "Rijk Zwaan crossed a spicy pepper with a bell pepper and found a way to reduce the spiciness. I will be doing research to find out whether there are certain flavours in spicy peppers that can be used to develop new bell pepper varieties."

More hands-on

Carlos started out by doing a degree in Biology & Medical Laboratory Research at Hanze University of Applied Sciences Groningen. "But I've always been interested in plants. Research in this field is much more hands-on than in the medical world. I like the way the focus is more directly practical, and I like physically having something in my hands." Once he had completed his undergraduate degree, he enrolled in the Master's degree at Wageningen. "At the higher professional education level, the answer on an exam question is either right or wrong. At Wageningen University, it's also about the quality of your argument."

Quality research

Carlos is a generalist: during his degree, he is focusing on as broad a range of topics as possible in order to keep his career options open. "My Master's thesis is about the salt tolerance of quinoa. This crop is interesting in the context of climate change: it can grow on soil that is as saline as sea water. What genes play a role in this? That's what I want to find out. During my undergraduate degree, I researched the interaction between potato plants and pathogens."

Summer School Green Genetics

Since 2009, Wageningen Academy has organised the Summer School "Green Genetics" every year. Before the academic year kicks off, motivated Bachelor's students from research universities and universities of applied sciences spend a week studying plant breeding and new technologies. They get the chance to explore Wageningen University's research facilities and visit leading Dutch companies in the plant breeding sector.

Carlos took part in this programme as well. "It was a fantastic experience. You get to know a lot of companies, which makes it easier to apply for a job with them later on."



Potatoes are popular in East Africa

There is great demand for seed-potatoes in East Africa. Dutch companies are helping to develop the local market.

At an agro fair held in the autumn of 2016 in Eldoret in the western highlands of Kenya, many farmers raised the question: where can we find good seed-potatoes? Potatoes are popular in East Africa. The climate in the highlands of Kenya, Ethiopia and Tanzania is perfectly suited to potato farming, and demand for the crop is constantly on the rise due to the growing urban population. City residents increasingly prefer fries over the traditional maize porridge.

Potatoes are healthy and important for food security. The potato is the third largest food crop worldwide, partly due to its efficient use of water. But one of the obstacles to potato farming in East Africa is a lack of quality seed-potatoes. Farmers tend to use potatoes from the previous year, which

often carry diseases. The result is a reduced harvest. Dutch companies such as Agrico and HZPC, both world players in the production of seed-potatoes, are active in East Africa. Together with other Dutch companies, the development organisation SNV and the Dutch Embassy in Nairobi, Agrico is focusing on strengthening the potato chain in Kenya. Agrico produces seed-potatoes locally using propagating material from the Netherlands. HZPC does not import seed-potatoes, but so-called minitubers, which are used to produce disease-free seed potatoes locally. And then there's Solagrow, a company owned by Jan van de Haar, a Dutch seed-potato farmer based in Ethiopia. According to Van de Haar, using Solagrow's seed-potatoes could increase potato yields in Ethiopia sixfold. "Potatoes thrive in the Ethiopian highlands."

Seed potato in Rwanda

Businesses are investing more and more money in plant research

Dutch seed companies invest up to 30% of their revenue in research and development. Even before up-and-coming breeders have graduated or obtained their PhDs, they already have guaranteed jobs waiting for them.

Around the turn of the millennium, Wageningen University's Plant Breeding degree programme was going through a rough patch. In 2003, there were only three first-year students in the university's Plant Sciences programme. "Things have turned around completely now," says professor Richard Visser, head of Plant Breeding at Wageningen UR. "More than a hundred new students enrolled this year." The number of plant breeders is on the rise worldwide, Visser says. "After the 2008 food crisis, governments in many countries started investing more heavily in plant breeding. And young people increasingly see plant breeding as being useful for society. We now see the next generation choosing careers in this field for ideological reasons."

Many R&D departments have doubled in size
Over the past decade, the R&D departments in many Dutch seed companies have at least doubled in size. This is partly due to the opportunities for unprecedented progress offered by new technologies – and the fact that businesses want to stay ahead of the pack in a competitive field. Of the approximately 11,000 employees working for Dutch seed companies, roughly 3,500 have an advanced degree (MSc or PhD). Breeders with postgraduate qualifications are much sought-after by research institutions too. Wageningen UR and four other universities (Amsterdam, Utrecht, Groningen and Nijmegen) jointly invest about 250 million euros annually in the field of Plant

Sciences, of which 45 million is invested in plant breeding.

Internationalisation
The internationalisation of the Plant Sciences field at Dutch universities is a striking development. At least half of the approximately 1,100 MSc students and 400 PhD students in the field enrolled at Dutch universities are from abroad, underlining the Netherlands' role as a global leader in plant breeding. Dutch seed companies have offices in more and more countries. Researchers who studied in the Netherlands – including those who came from other countries to study – end up in laboratories and greenhouses in countries as diverse as Paraguay, Argentina and Turkey.

Research with companies
There are thirty Plant Sciences professors in the Netherlands who have their own research groups. More and more often, they partner with companies to do research. In addition, the research schools undertake fundamental research for the longer term. Visser: "For example, we are looking at drought resistance, and the relationship between this quality and a plant's resistance to fungi. Increasing our knowledge in this area enables breeders to cross varieties in a more targeted way. This leads to faster and better results."

Tomatoes with measurement equipment for DNA analysis



Wageningen University & Research



Potato selection by farmers

The Dutch plant breeding industry's great strength is its focus on diversity

Dutch plant breeders are true all-rounders. In addition to improving plant varieties for high-input applications in traditional agriculture, they also focus on organic agriculture. In the Green Breeding research programme, businesses work alongside researchers to develop robust crop varieties that are more suited to the specific challenges of organic farming.

Robust crop varieties are less dependent on pesticides and high fertiliser levels and more resistant to changing climate conditions. "There is a high demand for hardy crops in organic farming, but they are also useful in making conventional farming more sustainable," says Edith Lammerts van Bueren, Senior Researcher at the Louis Bolk Institute, a Dutch knowledge institute for sustainable agriculture. She is also Extraordinary Professor of Organic Plant Breeding at Wageningen UR – the first chair to be established in this field anywhere in the world.

The ten-year research programme entitled "Green Breeding" began in 2010. So far, it has resulted in seven new potato varieties which are resistant to the plant pathogen *Phytophthora*. Other research focuses on vegetables such as leeks, spinach and tomatoes. Researchers from the Louis Bolk Institute and Wageningen UR have joined forces with plant breeders from thirteen companies, which contribute 40 to 50 percent of the costs by allowing the research to be conducted on their premises.

"The great strength of the Dutch seed and plant growing sector is its focus on diversity. That means it produces a range of different products for different markets, including for the organic market," says Lammerts van Bueren. "The Dutch government also invests in a broad range of projects within the field." The Ministry of Economic Affairs makes a €1 million contribution to the Green Breeding programme every year.

The programme focuses on pre-competitive research, screening resistance genes in wild varieties, for example, and introgressing them into modern varieties so that the commercial plant breeding sector can continue to cross these. The programme does not use genetic modification.

Visit of the Louis Bolk institute to the field



Louis Bolk Institute



Global Crop Diversity Trust

Prepared for the worst

The island of Spitsbergen, six hundred kilometres north of Norway, is home to the largest gene bank in the world. The Netherlands, too, has most of its seed collection stored within it. If ever the country were to be struck by a major catastrophe, we would have a back-up waiting for us there.

“What if?” Those two words most accurately sum up the idea behind the Global Seed Vault. What if countries or regions were hit by catastrophes such as wars, volcano eruptions or floods, and their gene banks were lost? In case of this eventuality, the seeds of tens of thousands of plant varieties are stored, neatly organised, in a vault 120 metres inside a mountain way up north – ready to be sown again. “The Global Seed Vault is a great idea,” says Theo van Hintum from WUR Centre of Genetic Resources, The Netherlands (CGN). “If disaster were to strike somewhere, we’d still have duplicates of all the seeds stored there. That’s a very reassuring thought.”

This “back-up” of national and international gene banks is located on the Norwegian island of Spitsbergen – far from war and other disasters, preserved deep in a permanently frozen mountain-



Global Crop Diversity Trust

Entrance to the Global Seed Vault



Global Crop Diversity Trust

side: the perfect location for seeds. Above ground, the gene bank is nothing more than a door in a giant concrete wedge jutting out of the mountain. Buried deep underground, there is a meticulously organised storage space: racks full of numbered boxes containing seed samples. If you look more closely, you will see that the vault is essentially a world library of plant varieties. The stored seeds represent the history of agriculture and illustrate the importance of diversity.

Diversity

We have already lost an astounding amount of diversity because we did not have adequate systems in place to protect it. To ensure sufficient diversity for current and future use, we need to collect and store seeds, and ensure that they are made widely available. That is why we have gene banks. But these, too, could be lost as a result of catastrophes or other unexpected events. In this scenario, we would have one backup left: the ice-cold Global Seed Vault.

Van Hintum: “Vulnerability is why we’re doing this. A seed collection that exists only in your own country is vulnerable. That’s why the Netherlands has stored duplicates of its seed samples in various European countries – and triplicates in Spitsbergen. All things considered, that makes us less vulnerable. Even in a doomsday scenario, our seed collection would be reasonably well-preserved.”

The Dutch national gene bank was one of the first to store about 80 percent of its seed collection on Spitsbergen. This concerns 22,500 samples of

cultivated varieties and wild populations, placed inside 40 boxes with seed bags containing about 500 seeds each.

Major gaps

Our food production depends on genetic sources. About seventy countries have seed collections stored on Spitsbergen. But there are still major gaps: France, for example, has only two samples there, while China has none. “There’s definitely room for improvement. But we’re in no hurry. I have no doubt we’ll get there,” says Van Hintum. Each country remains the owner of its seed collection. That is the strength of the Global Seed Vault, also referred to as the Doomsday Vault. Every fifteen years, the gene bank in Wageningen tests the germinating power of the Dutch seed stored in the Global Seed Vault. “If it is too low, we will produce new seed. Whenever seed is multiplied, we set aside seeds for duplication in Europe and triplication in Svalbard. This way, we ensure that the seed samples are constantly rejuvenated.”

So far, one gene bank has asked to have its seed collection back: ICARDA (the International Center for Agricultural Research in the Dry Areas) in Syria. The war left this international gene bank based in Aleppo unable to continue its research activities. It had part of the seed collection sent back so that they could continue working with it in Lebanon and Morocco. Already, a proportion of these requested samples have since been returned to the Doomsday Vault.

www.croptrust.org

Global Seed Vault

Better seed for smallholders

The Access to Seeds Index, developed in the Netherlands, maps seed companies' efforts to reach small-scale farmers.

What can seed companies do to enable small-scale farmers in developing countries to benefit from the work they are doing? For example, they could breed corn to develop traits that are particularly interesting to these farmers, such as drought resistance and salt tolerance. They can also breed other crops that are important for small-scale farmers, such as sorghum, millet, black-eyed peas or amaranth. This is what the Kenya Seed Company in East Africa is doing. This company also uses mobile seed shops – motorbikes with a cart behind them – to sell seed to farmers.

Multinational field-crop seed companies
These examples are from the Access to Seeds Index, a report compiled in the Netherlands which

compares seed companies' efforts to ensure small farmers have access to varieties that are suitable for them. The first Index was published in 2016. Written in an accessible way, this 200-page report sets out data showing which seed companies do well on which points. DuPont Pioneer was ranked the best of seven multinational field-crop seed companies. The Dutch-Thai company East-West Seed topped both the list of ten multinational vegetable-seed companies and the list of seventeen seed companies that are active in East Africa. "Seed companies are doing more to reach small-scale farmers than most people think," says Ido Verhagen, executive director of the Access to Seeds Index Foundation. "When we started our research in 2015, people said we wouldn't find anything. But



Access to Seeds Index

Reaching the village level: mobile seed shop in Uganda



East-West Seed

East-West Seed: training sessions and demonstrations

The originally Dutch company East-West Seed has been breeding vegetables for small-scale farmers in Asia since 1982, and for the African and Latin American markets since 2008. The company has grown to be the market leader in Indonesia, the Philippines, Thailand, Sri Lanka and Myanmar. About 18 million smallholders grow crops from East-West Seed, including bitter gourds, spicy peppers, watermelons, cucumbers and tomatoes.

Maaïke Groot, Company Representative for Europe, is proud of East-West Seed's high ranking in the Access to Seeds Index. "It's an incentive to step up our game even more. For example, we trained 43,000 farmers in 2016,

and we aim to double this number in the coming years." East-West has employed 130 knowledge transfer advisors to provide this training. With the aid of farmers, demonstrations and training sessions, they demonstrate how higher yields can be achieved using simple cultivation techniques and better seed. Groot: "Smallholders can recoup the costs of seeds by using better cultivation techniques. That's in our interest, but their key role in securing the global food supply and economic growth is in everyone's interest. That's why we have partnered up with local governments, knowledge institutes and NGOs in Asia and the Netherlands to encourage more widespread adoption of these techniques."

it wasn't anywhere near as bad as that. Apart from a few countries in West Africa, companies are selling seeds to smallholders in nearly all developing countries."

Completed surveys

The Access to Seeds index is based on surveys completed by seed companies and conversations with stakeholders, including farmers. The research was funded by the Dutch government and the Bill and Melinda Gates Foundation. The idea behind the initiative is that the good examples will encourage other companies to step up their efforts. Verhagen: "Companies think they won't be able to make any money from crops like amaranth or sorghum. If you're able to show that others already are, this can convince companies to start selling these seeds too." One of the most interesting innovations the researchers encountered was an insurance system developed by Syngenta. The seed bags that farmers buy contain a card with a code. The farmers can

text this code to Syngenta, free of charge, along with their location. The company then collects data from weather stations and satellite images. If it turns out it has been too dry or too wet on the farmer's land in the first two weeks after they sowed the seeds, they get an automatic refund.

Extreme weather

The plan is to publish a second Index in 2018, which will once again contain a global analysis and regional analyses of southern Africa and South Asia. In the meantime, the research team is continuing to gather new ideas. Verhagen: "More and more farmers tell us they want varieties that can withstand extreme weather. At the same time, we are seeing that institutes in developing countries have already developed a lot of good varieties. Seed companies can save time and money by using these."

www.accesstoseeds.org

Extension services by East-West Seed

Production

More and more Dutch seed companies are establishing production locations abroad, including in far-flung places. Proximity to new markets, climate conditions and low labour costs are key drivers for this.



Seed production, East West Seed Myanmar

Local production is growing



Afrisem demofield, Tanzania

Vegetable breeding companies in the Netherlands have many plant-breeding and seed-production locations abroad. Rijk Zwaan, for example, has eight breeding stations in important horticultural regions. Often, other breeding companies – including companies from within the Netherlands – end up flocking to such regions as well. Companies also use a lot of locations for field trials under local conditions. The local climate and day length are important factors in choosing production locations for seed multiplication abroad. The availability of a sufficient number of motivated staff is another important criterion. Tropical vegetable seed grower East-West Seed (EWS) – coordinating from its head office in Bangkok – works with fifteen local breeding stations, spread across markets throughout Asia, Africa and Central America. Here, new varieties are developed that not only produce higher yields but are also resistant to local viruses, pests and climate conditions. The eighteen million smallholders who buy these improved seeds increase their incomes by

doing so, and produce healthy vegetables for local markets.

The seed is largely produced by contract farmers under the supervision of local teams. For example, EWS has been working with 1,300 farmers in Thailand for thirty years. These farmers grow seed in fields that are a quarter to half an acre in size. In India, 2,000 smallholders grow seed for about twenty different types of vegetable, including onions, tomatoes, spicy peppers and local vegetables. In addition, the company has its own production farms for new varieties. Because of their cooler climates, some of the production takes place in New Zealand, China, South Africa, Italy and France.

For all seed companies, climate is an important reason for choosing tropical production locations. In Asia, the distinct winter season, characterised by cool and dry weather, is ideal for seed production. The high availability of agricultural labour is also important. Tomatoes, watermelons and cucumbers are hand-pollinated; some plants, on the other hand, need to be prevented from self-pollinating, for example by manually removing the stamens. Companies are also increasingly producing in Africa – for example in Ethiopia – and Central America.

The entire production process contributes to local job creation – from the highly-skilled breeders to the contract farmers, and from them to the smallholders collecting the seeds who contribute to the local economy through the labour-intensive but lucrative process of vegetable cultivation.

Family business



The northern part of the Dutch province of Noord-Holland is home to a remarkable number of family businesses specialising in plant breeding and seed technology. Businesses such as ENZA, PopVriend and Bejo are all based in what is called the country's "Seed Valley". What is the strength of a family business like Bejo?

World-class family businesses

The seed companies run by the Beemsterboer and Jong families merged in 1978; they distributed the shares and expanded the family business into a multinational. "Many seed companies started small, often on the retail side," says John-Pieter Schipper, who became the CEO of Bejo a few years ago. "They were family-owned businesses. Some of them continued to develop successfully; most of them no longer exist."

What is the advantage of a family business?

"The long-term focus. We have the scope to pursue developments that take a lot of time. Developing a new crop for the market can take anywhere from 7 to 15 years. You need to sow for several seasons, select seeds, collect seeds, sow again, and so on. "Another advantage is that we're closely involved with our customers, the growers. We have long-term relationships with them that often span multiple generations. We have a low staff turnover rate, so we've been in contact with some of the same customers for many years."

What does that long-term focus mean for investment?

"Crop development is what keeps a seed company running. We invest about 15% of our turnover in research and development, which is par for the course in this sector. We never borrow money from the bank. This company wants to do everything

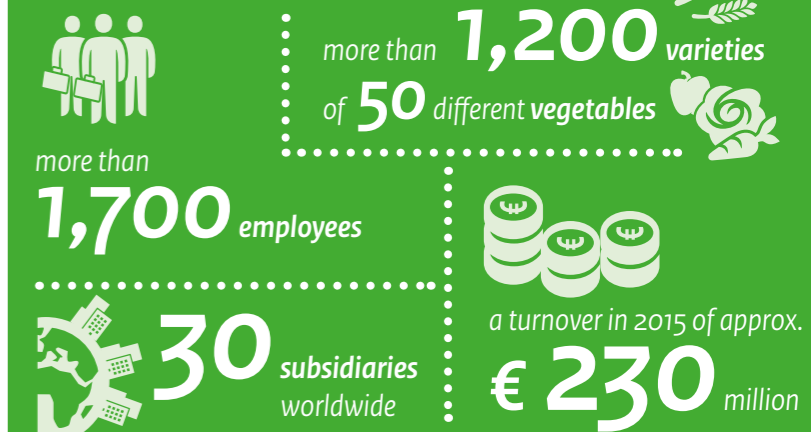
under its own steam. Our philosophy is autonomous growth. We don't spend money until we've earned it first. We find that works well."

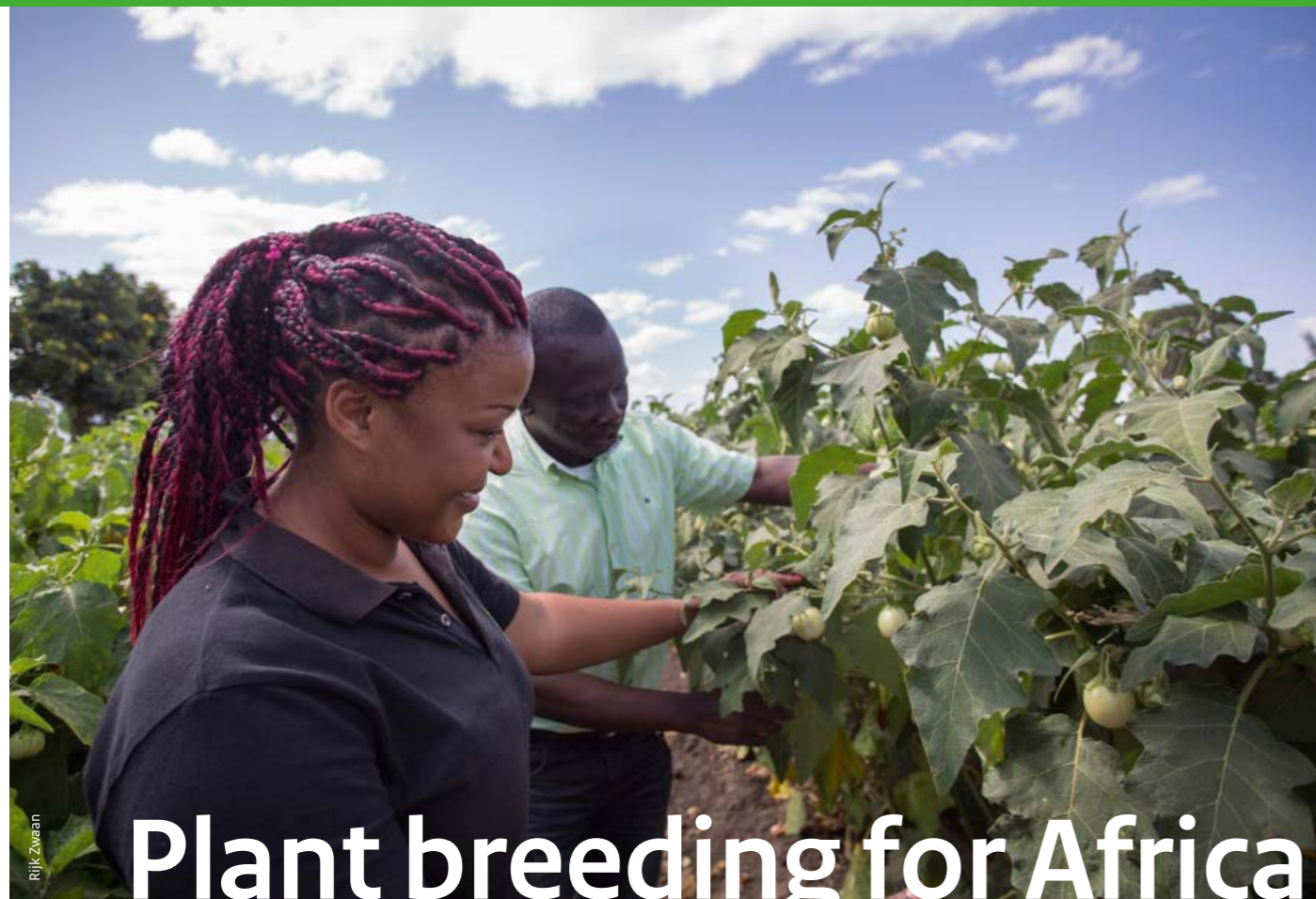
Are there also drawbacks to a family business?

"Business succession can get tricky in a family business. The two families are no longer represented on the board, but we do have family members working for the company. We feel that's important, for the sake of participation. They also serve as cultural ambassadors for our company."

Development of new varieties at Bejo.

Bejo in facts and figures





Plant breeding for Africa

Specially developed, quality seeds for local vegetables for the East-African market – that’s new. The Dutch seed breeding company Rijk Zwaan recently introduced the first hybrid varieties, developed in Tanzania.

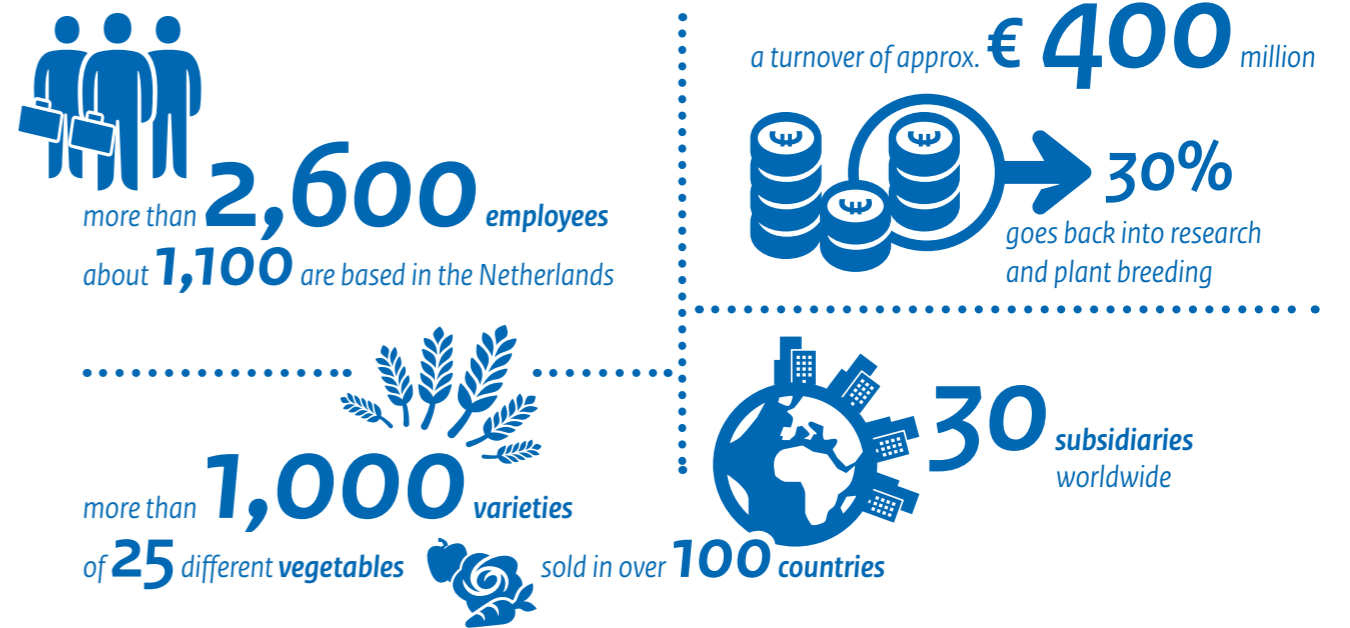
In early 2017, three new hybrid varieties of the typically African white eggplant were introduced to the East African market. This is the first result for the plant breeding station Afrisem, established by Rijk Zwaan at the foot of Mount Meru near Arusha in northern Tanzania. The eggplant has been specially improved for the African market and growing conditions – a process which took nearly a decade. This eggplant ripens faster than other eggplants, making it grow faster. It produces high yields and is resistant to diseases. What is important for the chain is that it has a longer shelf life after being harvested than other varieties. In addition to eggplant, Rijk Zwaan is also breeding other local vegetables, such as African kale, chinense pepper and tomatoes.

Established in 2008 by Rijk Zwaan, Afrisem is the first Dutch breeding station for high-quality African vegetables in East Africa. East-West Seeds is also involved in three breeding programmes launched by Afrisem. Rijk Zwaan is the fifth largest vegetable seed company in the world and breeds seeds for

Breeding of African white aubergine at Rijk Zwaan Afrisem



Rijk Zwaan in facts and figures



markets that include Europe, the US and emerging economies in Asia and Latin America. Rijk Zwaan also sees a growing market among the many smallholders in Africa.

Oil-spill effect

The properties of the eggplant developed specifically for Africa mean that farmers are able to earn more from growing it while at the same time having to use fewer pesticides. However, they do need to use the right cultivation techniques – techniques which are appropriate to the local circumstances – says Edwin van der Klugt, Business Manager at Rijk Zwaan. That is why the company has established a demo station in Arusha, and is building a team of crop specialists and product developers for East and West Africa. “Many of our activities are currently focused on the area surrounding our station in Tanzania. We’re aiming to achieve an oil-spill effect in terms of how quickly these ideas and techniques spread. We’re convinced that a long-term approach will give small-scale

farmers the opportunity to play a key role in building a sustainable food supply which can respond to population growth and urbanisation in Africa.”

Van der Klugt emphasises that Rijk Zwaan will never be able to reach all the farmers in Africa. “For the right scale and local knowledge, we are actively seeking to establish partnerships with governments and local growers’ organisations.” Rijk Zwaan works alongside others in public-private partnership projects such as AIM and SEVIA.

Public-private projects with Rijk Zwaan

SEVIA: Seeds of Expertise for the Vegetable Industry in Africa (SEVIA). Partnership between Rijk Zwaan, East-West Seeds, Wageningen Plant Research, and the Dutch Ministry of Foreign Affairs. The objective is to contribute to the development of the vegetable industry in Africa. The programme trains trainers who, in turn, advise farmers across Tanzania on cultivation techniques.

AIM: Amsterdam Initiative against Malnutrition (AIM). Partnership between businesses and organisations and the Dutch government, with the objective of increasing farmers’ incomes and making more vegetables widely available, thereby giving people access to healthier nutrition. The ‘Vegetables for All’ project connects farmers with the local markets. Health education is contributing to a growing demand for vegetables.

HortIMPACT: A public-private project in Kenya launched by development organisation SNV, which connects companies with each other and with farmers. The objective is to build a business case for horticulture that is profitable for companies and beneficial to farmers.

High-tech for better crop varieties

Robotic cameras, molecular tweezers and virtual reality greenhouses are all helping to develop the crops that are in demand with supermarkets and consumers. The Dutch company KeyGene is at the forefront when it comes to these technologies.

At KeyGene in Wageningen, 140 researchers are working on developing better plant varieties for agriculture and horticulture. The company helps plant breeders all over the world by developing new breeding techniques, bioinformatics solutions and databases cataloguing the characteristics of different varieties. KeyGene CEO Arjen van Tunen has noticed that the plant breeding sector in the Netherlands is changing. "It used to be that we looked mainly at traits like higher yields and ease of harvest. Now we also focus on all sorts of other attributes that are important to retailers and consumers, such as flavour, appearance and shelf life."

Molecular techniques

Faster breeding and breeding to improve an increasingly large range of traits have become possible thanks to new methods based on molecular knowledge, methods which Dutch research institutes and seed companies are investing heavily in. These methods make it possible to change a plant's DNA in a much more accurate way than before. Take CRISPR-Cas9, for example, molecular 'scissors' which researchers can use to cut or replace several DNA bases in a targeted manner. Thanks to the ever-growing databases of DNA sequences and the associated plant variety characteristics, researchers are gaining an increasingly accurate understanding of where exactly to cut the DNA to get a certain trait. KeyGene is looking into the possibilities that CRISPR-Cas9 offers for developing virus-resistant fruit and vegetables using conventional breeding techniques," says Van Tunen. "But with CRISPR-Cas9, it can be done a lot faster."

Phenolab

New imaging techniques are also helping to take plant breeding to the next level. In the so-called Phenolab, robotic cameras take sixteen pictures of all the plants every day, from the roots to the tips. Breeders who upload these pictures to their computers using special software can see straight away which plants are growing best. Van Tunen: "In a virtual reality computer environment, researchers

can walk through a 3D test bed by themselves, no matter where in the world they are."

Vertical farming

In order to feed the growing urban population, Philips, Wageningen UR and the Dutch seed companies are among those working on vertical farming – plants grown in stacked trays under LED lighting in climate-controlled warehouses. Van Tunen: "We are currently investing €2 million in a testing facility for vertical farming. We are hoping to develop varieties here that grow faster under LED lighting, and which also have other benefits, such as being tastier and healthier."

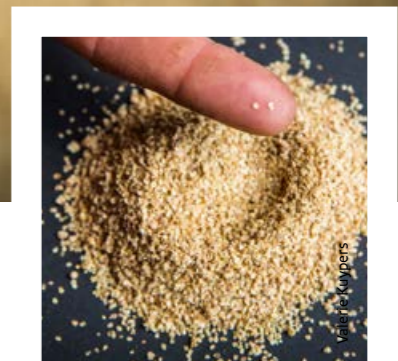


Research going on in the Phenolab of KeyGene



New: potato seed

Various companies are developing a new method of hybrid potato breeding which produces potato seed rather than seed-potatoes. This will enable them to develop new varieties much more quickly.



Dutch companies such as HZPC, Bejo and KWS are investing heavily in the development of potato seed, which will soon become an alternative to seed-potatoes. The smaller company Solynta developed the hybrid breeding technology at an early stage. This technology makes it possible to combine positive traits in hybrid varieties much more quickly than is possible with conventional plant breeding. For example, in just two years Solynta introduced two resistance genes to the potato pathogen *Phytophthora* into a susceptible hybrid – something which would have taken more than fifteen years using the currently common breeding methods. The field-testing phase for Solynta's new products will begin soon.

Potato seed is easier to transport and faster to produce than seed-potatoes. Millions of seeds can be produced in just one growing season. The risk of plant diseases is much smaller when growing from seeds than when using seed-potatoes. In 2014, Solynta was named a National Icon by the Ministry of Economic Affairs for being one of the companies in the Netherlands with the most promising innovations.

Offspring

Solynta aims to bring the first hybrid potato seeds onto the market in 2021. By running workshops in Tanzania, Kenya and Uganda that were made possible thanks to support from the Dutch Food & Business Knowledge Platform, Solynta has looked into how small farmers can use hybrid potato seed and what adjustments to the cropping system are required for this to be possible. Over the next few years, Solynta will be working with local private partners and public knowledge institutions to explore ways in which these new hybrid-seed-based cropping systems can contribute to food security in East Africa.

A disadvantage of hybrid crop varieties, of vegetables for example, is that they are not suitable for generative propagation. The offspring of hybrids have different traits, and tend to be weaker than their hybrid parents. Potatoes are special in that the hybrid varieties can be propagated vegetatively. The offspring are genetically identical to the parents, as is the case with conventional potatoes now. This enables farmers to use 'farm saved seed' for hybrid varieties too.

Potato seed

In the future, the Netherlands aims to continue to utilise its leading position as a seed producer to contribute to global food security and economic development. What are the challenges and opportunities involved in this?



Wageningen University & Research

Partners in quality seed for the future food supply

To be able to continue to feed the growing world population in the future, the agriculture sector has to produce higher yields, reduce its environmental footprint and adapt to a changing climate. The development and use of quality seed is the key to achieving this. That is the conclusion Geert Westenbrink and Marien Valstar from the Dutch Ministry of Economic Affairs have arrived at after sitting down together to consider the future. “Better seed has the potential to better feed the world’s population. The challenge lies in turning that potential into a reality by developing

new varieties and getting the seed to the farmers. Experience has also shown that the introduction of quality seed leads to higher yields and better-quality produce, thereby creating a chain of change throughout the rest of the agriculture sector. Quality seed is a catalyst for change.”

The key feature of the seed sector is its diversity. Each country has different farmers dealing with different circumstances, and all of these farmers have different seed requirements. New varieties need to be tailored to the local circumstances,

says Valstar. “The genetic potential has to reflect the local cultivation conditions and techniques.” In some situations, a robust variety is more innovative than a high-yielding one. The strength of the Netherlands, Westenbrink and Valstar conclude, is that companies, policymakers and knowledge institutes have experience of taking a broad approach to the sector, including the flexibility that underlies the great diversity of breeding methods and seed companies.”

“The Netherlands is a small country. Our farmers have learned to make optimum use of a small area of land and grow exactly what the big cities in our country need, but also what is needed by the German Ruhr region or London. They had to do this in a way that was intensive and sustainable at the same time,” says Valstar. “This is based on an effective cooperation between government and the business community – with an efficient consultation structure in place – and a thriving sector supported by high-quality research, education and regulation,” Westenbrink adds. This partly accounts for the Netherlands’ strong international position. “This is what enables us to play a key role in much of the international consultation that is taking place about issues like plant breeders’ rights and access to genetic resources.”

In the future, the Dutch government will continue to promote and support the internationalisation of the seed industry. Businesses will expand their distribution and marketing to even more countries, and will continue to breed varieties tailored to local needs and the demands of climate change. This will result in even more quality seeds reaching farmers everywhere.

In addition, the Netherlands will continue to support other countries in strengthening their own seed sectors through initiatives such as

“High-quality seed is a catalyst for change”

public-private research projects and the PVP toolbox developed by the Netherlands Inspection Service for Horticulture (*Naktuinbouw*). As part of the Integrated Seed Sector Development (ISSD) approach, Dutch experts sat down with policymakers from various countries to identify and seize the key opportunities and tackle the challenges in an integrated way. A good example is the road map that was developed in order to strengthen Myanmar’s seed sector. “By supporting other countries, we are also helping to remove obstacles to our own business activities in those countries,” says Valstar. “It’s a win-win situation. After all, Dutch companies will only stand a chance of succeeding if their activities contribute to, and go hand in hand with, economic development in the countries they’re working in.” Dutch seed companies look beyond their own immediate interests, Westen-

brink adds. “Seed companies have a local presence and are part of the local community. Corporate social responsibility is a key priority for them, and they tend to be viewed as welcome additions to the local market.”

Another key aspect of the seed sector concerns the significant public interests involved. “We need to make good use of the available genetic resources, and it’s vital that farmers have access to quality seed,” says Westenbrink. “Significant private interests come into play as well. All this makes the field complex. With their experience with business operations, government policy and international legislation, Dutch businesses and experts can help other countries make sense of this complexity. We expect that the Netherlands’ strong position and international network will enable the country to play an even bigger role in seed development going forward. In doing so, it will be contributing to the transition of the agricultural sector worldwide that is necessary.”



East-West Seeds

The Netherlands, your partner in quality seed

The Dutch seed sector enjoys a global leading position. Dutch seed companies operate on a global scale. The Dutch government, too, is very proactive in providing a supportive policy framework. The Netherlands' research and education sector, as well as its inspection services, are among the best worldwide.

Over the next few years, the demand for food is set to increase – in Africa, Asia and Latin America in particular. Quality seed is essential in order to meet this demand. The Netherlands is keen to share its expertise in order to support the development of strong seed sectors that can contribute to global food and nutrition security.

This brochure presents a brief overview of the role of Dutch companies, policymakers and researchers in the development of quality seed and seed sectors globally.

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