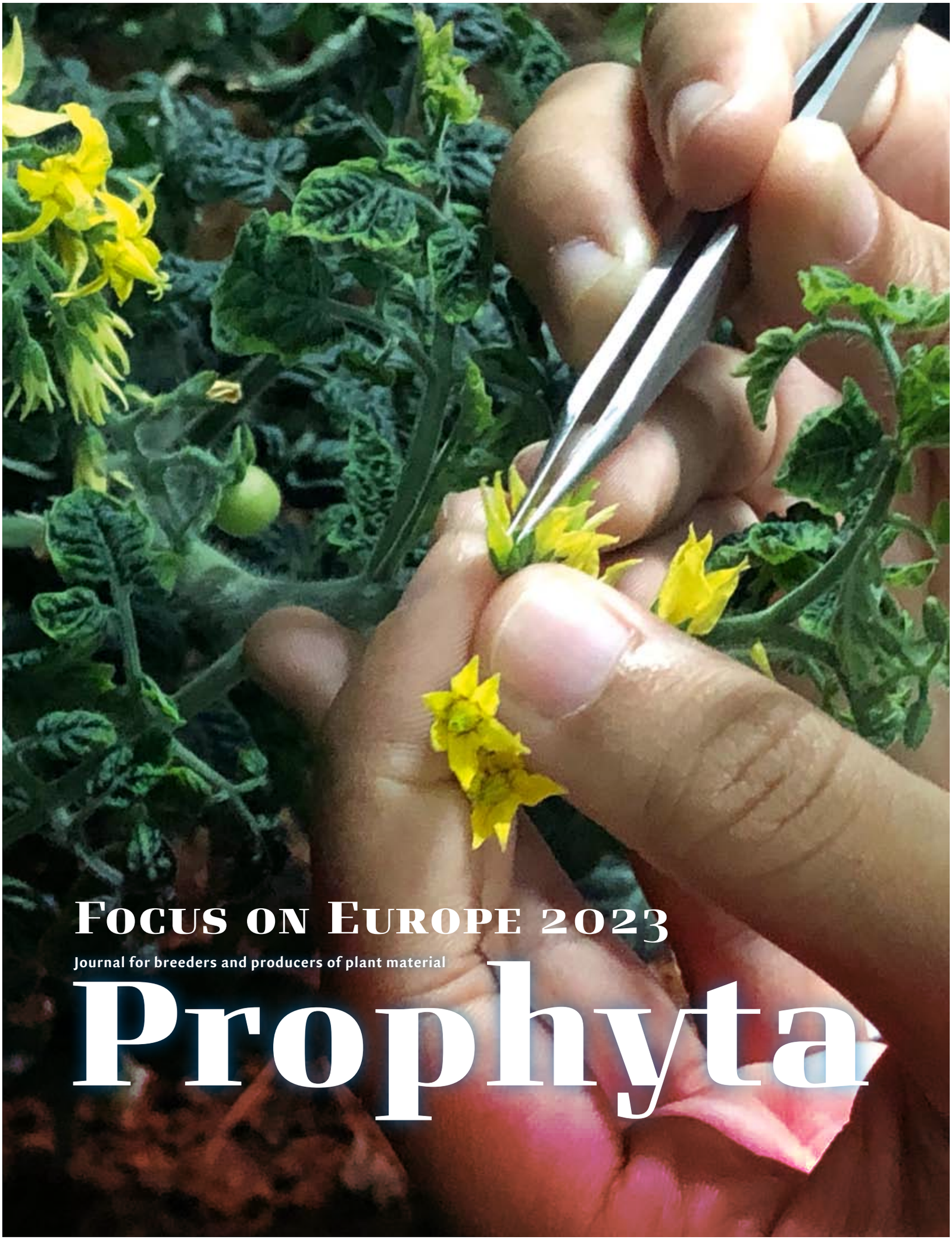

Focus on Europe 2023

Journal for breeders and producers of plant material

Prophyta

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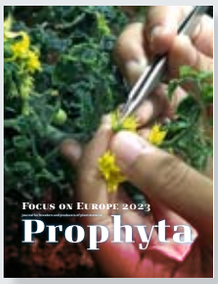

On the cover: Plant innovation and plant variety protection have a huge positive effect on Europe's economy by increasing crop production, employment rates and the gross domestic product, while it is at the same time beneficial for the environment

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Revision in Ukraine's seed law

The seed law and plant variety protection system in Ukraine have been adjusted in order to comply with the legislation of the European Union. The changes came into force on 10th June. One of the amendments is that varieties registered in the US and EU will be listed without two years of official trials (based on the information from the applicant). Furthermore, official trials are possible not only by the usual procedure in the Ukrainian Institute, but also by companies' own trials or using results of trials received in other UPOV member states. Observational yield trials (OT) results will be available to the public and published anonymously for all varieties.
Companies that have authorized laboratories are allowed to carry out tests for Quality Certificates. Field inspections for variety certification may be done by private certification authorities for the category of seeds 'certified' (only for Ukraine, not for export). Import of seeds for breeding and research purposes has become easier. It is not restricted to varieties listed in Ukraine, but also possible for varieties registered by the OECD.
The Ministry of Agricultural Policy of Ukraine mentions that some of the laws still require further clarification. According to the Seed Association of Ukraine, over 40 decrees had to be adjusted.

Sunak signs Horizon agreement

'This is the right deal for the UK, unlocking unparalleled research opportunities, and also the right deal for British taxpayers,' says British Prime Minister Rishi Sunak

To the huge relief of researchers in Great Britain and the EU, the British Prime Minister Rishi Sunak finally agreed on the conditions to rejoin the Horizon Europe R&D programme. Many of the UK's leading researchers were left in limbo for years over the future of their world-leading research projects. From 1 January 2024 onwards, British researchers and organisations will once again be allowed to participate fully in multi-centre EU research and innovation programmes, as an associated country for the remaining life of the programme to 2027.
Horizon Europe, EU's flagship innovation programme, is the world's biggest research programme ever, with a budget of € 95.5 billion.
The Horizon Europe programme permits association to like-minded countries with a strong science, innovation and technology profile. It gives countries outside the geographic proximity of the EU entrance to international cooperation in research. In July, New Zealand was the first non-EU nation to join Horizon Europe. Norway and Israel followed suit. Formal negotiations are currently ongoing with Canada and the Republic of Korea. Exploratory talks with Japan closed in September 2022 and technical discussions are ongoing.
While negotiations between Brussels and the UK government were concluded successfully by mid-July, Mr. Sunak waited until September before signing the agreement. His hesitation was due to a seemingly cheaper, UK-led, alternative international collaborative research programme, drawn up by the science minister, George Freeman. Before the UK left the EU, however, Britain was a net beneficiary of the scheme – paying € 7.9 billion and receiving € 8.4 billion. Oxford, Cambridge and University College London were among the top ten recipients of its funding and Horizon paid for at least 16,000 jobs.
"EU Framework Programme (FP) has been the basis of scientific collaboration for over 30 years. From early detection of ovarian cancer to developing clean energy networks involving hundreds of universities and many industrial partners, the FP lets us do things that would not be possible without that scale of collaboration," says Professor Dame Sally Mapstone, president of Universities UK, the collective voice of 142 universities across the UK. "Allowing our scientists to work together, irrespective of borders, is in all of our interests."
Professor Robert Hall, Deputy Business Unit Manager Bioscience at Wageningen University & Research, is also enthusiastic. "The UK is our most important national research partner. In the recently completed FP Horizon 2020 programme, WUR had research projects with over 350 academic institutions based in the UK. So far, British research groups were able to participate, as long as the British government financed their share. This created a serious element of uncertainty leading to fewer partnerships with the UK. From 1 January onward they will be our partners again and will also regain a position to coordinate projects as well as being a project partner.

Green plates

Is agriculture part of the problem the world is facing or part of the solution? In the Netherlands, the focus is on agriculture as part of the problem. In particular, the greenhouse gas emissions and their harmful effects on the climate are food for much discussion. And while power plants, factories, planes and cars are major contributors to nitrogen emission, in general, the farmer is blamed.

Last month, during the 78th United Nations General Assembly in New York, the 9th Science Summit took place. Together with the World Wide Fund for Nature, Wageningen University & Research presented a more positive view. In 'From Global Goals to Greener Plates: Empowering Nature with Sustainable Diets', they argued that improved food systems and a so-called 'planetary diet' is high in health benefits, has low environmental impact and will feed the 10 billion people that will populate earth in 2050.

The planetary diet has been introduced by the medical journal, The Lancet. It consists of half a plate filled with fruits and vegetables and the other half with whole grains, plant proteins (beans, lentils, pulses, nuts, etc.), unsaturated plant oils, modest amounts of meat and dairy, and some added sugars and starchy vegetables. As failing global food systems and a growing world population are inextricably linked to climate change and biodiversity loss, a planetary diet could solve major problems. Vegetal agriculture is therefore part of the solution.

In 2015, the United Nations set out Sustainable Development Goals to eradicate poverty, inequality, injustice and environmental issues by 2030. It is a shared blueprint for peace and prosperity for people and the planet, now and into the future. Sustainable agriculture is a vital element in reaching these goals and there are only seven years left to realize these objectives. The UN noted in its latest report that lack of progress is universal, so the organization demanded urgent action.

It is understandable that progression has been hindered. The lingering effects of the Covid-19 pandemic, the war in Ukraine, a weak global economy and the impacts of the climate crisis have taken their toll. Although life might look logical in the rearview mirror, it has to be lived looking forward through the windshield. Both innovative plants as well as new agricultural systems are urgently needed to fill people's plates with green food. There is work to be done.

Monique Krinkels

EC proposes new NGT regulation

The European Commission (EC) has proposed to ease the introduction of varieties obtained by new genomic techniques (NGT), such as CRISPR-Cas. The alleviation only goes for varieties that could also be developed naturally or through conventional breeding (so-called category 1). Varieties that are not comparable to conventionally bred plants (category 2) will still be subject to risk assessment and authorization before they can be introduced on the market. Since the products of these techniques may be patentable, the Commission proposes to organise a study on such intellectual property rights.

The Dutch seed association Plantum is pleased that the Commission intends to create clarity and differentiates some NGT from classical GMO, but still has some questions about the current proposal. Plantum considers it crucial that the proposed verification process to determine if a variety is category 1 or 2, is efficient and without unnecessary administrative and financial burdens. Given that administrative burden is a major bottleneck for applications in the current GMO-legislation, this is a crucial point for companies, especially SMEs. Plantum also asks for more clarification regarding the criteria mentioned in Annex 1 of the proposal, particularly those that are open to multiple interpretations. These criteria need to be clear and based on science, as they determine whether a variety is considered 'conventional-like' or still a GMO. Furthermore, Plantum considers the patent issue not directly linked with these genomic techniques since such rights can also be granted on several products of conventional breeding. The Dutch seed association would like Europe to take steps much quicker that avoid undue interference of such rights in breeding.

The proposal will be discussed further in the European Council and the European Parliament. The Spanish Presidency has expressed the ambition to reach a decision before the end of their term on 31 December 2023.

In Short

More to read: Hybrid potato

In 'Impact of hybrid potato: the future of hybrid potato from a systems perspective', the authors describe the expectations of Dutch breeders, scientists and development experts about the consequences of new varieties from true seed. The book is written by Professor Paul Struik, crop physiologist at Wageningen University, Peter Gildemacher, agronomist at the Royal Tropical Institute in Amsterdam, Dirk Stemerding, specialist in the social consequences of innovations in agriculture, and Dr. Pim Lindhout, founder and research director of Solynta, the pioneering hybrid potato breeder.
Starting with the technical aspects of breeding and multiplication, it explains why the current focus on diploid varieties enables more uniform hybrids than the older tetraploid ones, which were introduced several years ago, and which were not successful in competing the traditional vegetatively multiplied varieties.
The next chapters describe the scenarios of cultivating potatoes from seed, obtaining market acceptance and the impact on food security. The focus of these chapters is on developing countries, especially sub-Saharan Africa, as the authors expect that these countries have the highest potential to benefit from these new varieties and, at the same time, it will be the most challenging to reach the smallholder farms.
Chapter 5, gives insight into the regulatory aspects, including variety registration, Plant Variety Protection and the farmers' exemption, and also certification schemes for plant health in various multiplication schemes. True potato seeds are not yet included in the EU marketing directive, but inclusion is expected in the 2024 update.
Chapters 6 to 10 describe and discuss more deeply the potential and the challenges of the different scenarios, and the social implications they may have for producers and consumers. It is expected that several different companies will enter the markets soon, and new areas will become suitable for potato production, leading to higher volumes available for consumption. New forms of private-public cooperation are needed to overcome the challenges and reach the smallholder farmers.
Chapter 11 gives a clear conclusion: "Hybrid breeding may revolutionise the potato world, especially in low- and middle-income countries."

'Impact of hybrid potato: the future of hybrid potato from a systems perspective' by Paul C. Struik, Peter R. Gildemacher, Dirk Stemerding and Pim Lindhout is published by Brill | Wageningen Academic, ISBN paperback: 978-90-8686-392-1, ISBN ebook: 978-90-8686-946-6 (open access via www.brill.com).

A **centennial** celebration to be remembered

Monique Krinkels

In 1924, 84 seedsmen convened in London, United Kingdom, to talk about international trade and how to overcome the barriers they encountered. They decided to create a federation where rules for international seed trade could be discussed. A century later, a multiple number of seedspeople (as it is no longer only men) will assemble in Rotterdam, the Netherlands, to celebrate the centennial of the federation.

From Monday 27 May until Wednesday 29 May 2024, seedspeople from all over the world will be expected in Rotterdam, the Netherlands. "And, as it is the centennial, we anticipate every seed company in the world will send representatives," explains Anke van den Hurk, member of the organising committee and deputy director of Plantum. "The idea of organising the 2024 World Seed Congress in the Netherlands came up about fifteen years ago. The former director of Plantum, Aad van Elsen, brought it up as a joke, but it was a jest with a serious undertone. The present director, Niels Louwaars, shared his enthusiasm and the joke was repeated every so often, until the time came to compile a bid proposal."

In July 1924 representatives of eight West European seed companies met in London. As international trade shot up, the need arose to establish common rules to bring clarity and consistency to contractual relations between buyers and sellers of seed for sowing purposes. The original name of the organisation - Fédération Internationale du Commerce des Semences - makes clear that French seed companies played a leading role. At the same time, the International Seed Testing Association (ISTA) was established in Cambridge, UK, to develop internationally agreed standard procedures for sampling and testing of seeds.

Chairman of the Organising Committee, Jaap Mazereeuw: 'I know from experience how much energy celebrating an anniversary brings about'

Highlights

As yet, not all the details of the event have been nailed down, but the highlights are clear. Jaap Mazereeuw, CEO of Enza Zaden, has been chosen as Chairman of the Organising Committee. "The ISF World Seed Congress is a wonderful event where the international breeding sector, agriculture and horticulture come together," he says. "As a global player in the vegetable breeding sector, Enza Zaden is happy to contribute. The fact that the ISF will celebrate its 100th anniversary in the Netherlands next year was an additional reason for me to indicate to the organisation that I would like to take on the role of chairman. This year, we are celebrating our 85th anniversary as a family business and I know from experience how much energy celebrating an anniversary brings. So I'm really looking forward to it!"

The tenders of the SS Rotterdam - boats used to transport passengers and their luggage to and from the ship - are today in use as water taxis in the city's vast harbour

In 1996, the World Seed Congress (or FIS/Assinsel Congress as the name was before the merger of the two organisations) was held in the Dutch capital, Amsterdam. "This time, the congress will be organised in Rotterdam, 90 kilometres south of Amsterdam," says Anke van den Hurk. "It is a modern, vibrant city, where innovative thinking is common practice. It is an inspiring environment that fits well with the seed industry."

Maritime heritage

Rotterdam's history goes back to 1270, when a dam was constructed in the river Rotte (meaning muddy water). Today, the city is a major logistic and economic centre, nicknamed the gateway to Europe. It has, as Europe's largest seaport, a renowned maritime heritage. Even if a participant to the World Seed Congress returns home immediately after the event, that fact cannot be overlooked.

The main congress location is the Ahoy arena (a

With a total area of 30,000 m2, the Ahoy is one of the largest event halls in the Netherlands

The RDM Submarine Wharf, with its impressive high steel ceiling, will be the décor of the Farewell Party

name derived from a sailor shouting a greeting to an oncoming ship) and the Welcome Party on Monday night will be held on the SS Rotterdam, also known as 'The Grande Dame'. This steam ship was once the flagship of the Holland-America Line and later became a cruise ship, sailing many oceans to be ultimately turned into a hotel. The SS Rotterdam was built by the Rotterdam Drydock Company and launched in 1959. The Farewell Party takes place in the Submarine Wharf of the Rotterdam Drydock Company, with its rough and industrial character. It was built in 1928 to protect the submarines under construction from prying eyes and the shipbuilders against the weather.

Seed country

While the Netherlands is densely populated, agriculture and horticulture are important economic factors, exporting processed and unprocessed goods worth 40.4 billion euro per year. Top quality seeds and planting material are vital to this, as the lack of space forces farmers to use their land effectively with high value crops. That stimulated the creation of innovative varieties and the export of seeds since the mid-1700s. The seed sector is organised by Plantum, whose mission is to create the best possible (inter) national business environment for breeding, propagation and production of seeds and young plants. Traditionally, the Netherlands is focussed on trade, as well as the tertiary sector, the provision of services to other businesses. It has developed an excellent knowledge infrastructure and effective public institutions for quality controls, variety registration and plant breeders' rights. The country is renowned for its innovative ornamentals, seed potatoes, vegetables and grasses.

As the Netherlands is one of the smaller countries in Europe, it will be easy for participants to visit other companies. The main glasshouse area, 'Westland', is only a stone's throw away and even 'seed city' Enkhuizen can be reached within a one-and-a-half-hour drive.

'These are **exciting times**'

Monique Krinkels

For the last 25 years, Vice Secretary-General, Peter Button, has been involved in Plant Breeders' Rights, of which 23 years at UPOV in Geneva. This autumn his last feat was unveiled during an event in Viet Nam: UPOV e-PVP, a web-based system developed by UPOV for the administration of plant variety protection by UPOV members. "Improving the service to UPOV members and breeders has always been one of my priorities."

When Peter Button chose biology at university in the late-70s, little could he foresee where his career would lead him. "It was not plants that initially captured my interest, but nature and genetics. I grew up on a farm in Cornwall in the South West of England, a boy's paradise. My father eventually sold the farm and we moved into a town, but I greatly missed the countryside," he explains. Studying biology was therefore a logical step.

"Fortuitously, my career revolved around plants. First, in cereal breeding at Twyford Seeds Ltd. in Oxfordshire, UK, and later as general manager of Twygen Ltd (later Gentech Propagation Ltd.) in Dundee, Scotland." The latter company was involved in developing micropropagation systems for producing potato minitubers and later for soft fruits. "That completely changed my life. Besides moving from England to Scotland, it meant encountering a completely novel technique. In 1987, commercial micropropagation of potatoes was a revolutionary development. I first had to go to California to learn more about it."

The next step was Technical Liaison Manager at the British Society of Plant Breeders Ltd. (BSPB) in Ely, then Technical Liaison Officer for the Plant Variety and Seeds Division of the Ministry of Agriculture in Cambridge, followed in 2000 as Technical Director of UPOV, Geneva, Switzerland. Ten years later Peter Button became Vice Secretary-General of the intergovernmental organisation.

Exciting times

"These are exciting times," states Peter Button. "Digitalisation has so much to offer. My predecessor responsible for technical matters at UPOV, Max Thiele-Wittig, was the first to recognise the possibilities and introduced a CD-ROM of variety information, to assist in the examination of variety denominations." Today, this database is available online as 'PLUTO', which shares a name with the mythical god who nurtured seeds for a bountiful harvest. PLUTO contains information on plant breeders' rights (PBR), plant patents (PLP) and national listings (NLI).

The next step was the launch of the GENIE database, to provide information to support cooperation between UPOV members, followed in 2017 by 'UPOV PRISMA', an online tool to submit application data to PVP Offices of participating UPOV members. To date there are over 70 countries covered by UPOV PRISMA. The tool has a multilingual interface, so it can be used in the applicant's preferred language, whether English, Japanese, Serbian or Swedish (or many others).

But the cherry on the cake is UPOV e-PVP. "I could not imagine the advent of blockchain technology which allowed us to develop the UPOV e-PVP system. It represents a major leap forward," says Peter Button. "It was launched at an event in Viet Nam, when Viet Nam became the first UPOV member to use the full UPOV e-PVP package of services." UPOV e-PVP combines the widely used PLUTO and UPOV PRISMA services with an administration module for PVP offices to manage and publish PVP applications and a DUS Report Exchange Module, to exchange DUS reports between PVP offices.

"Developing UPOV e-PVP has been a major investment but, in my view, well worth it. It is one of the positive side-effects of Covid-19, as the pandemic forced us to find alternative ways of working without travel. This led to more efficient ways of working and also allowed us to save money from our travel budget. These savings, combined with financial support from Japan enabled us to embark on the UPOV e-PVP proj-

UPOV members

UPOV has 78 members covering 97 States.
African Intellectual Property Organization, Albania, Argentina, Australia, Austria, Azerbaijan, Belarus, Belgium, Bolivia (Plurinational State of), Bosnia and Herzegovina, Brazil, Bulgaria, Canada, Chile, China, Colombia, Costa Rica, Croatia, Czech Republic, Denmark, Dominican Republic, Ecuador, Egypt, Estonia, European Union, Finland, France, Ghana, Georgia, Germany, Hungary, Iceland, Ireland, Israel, Italy, Japan, Jordan, Kenya, Kyrgyzstan, Latvia, Lithuania, Mexico, Montenegro, Morocco, Netherlands, New Zealand, Nicaragua, North Macedonia, Norway, Oman, Panama, Paraguay, Peru, Poland, Portugal, Republic of Korea, Republic of Moldova, Romania, Russian Federation, Serbia, Singapore, Slovakia, Slovenia, South Africa, Saint Vincent and the Grenadines, Spain, Sweden, Switzerland, Trinidad and Tobago, Tunisia, Türkiye, Ukraine, United Kingdom, United Republic of Tanzania, United States of America, Uruguay, Uzbekistan and Viet Nam .

(Photo: Emmanuel Berrod, WIPO)

Peter Button: 'I could not imagine the advent of blockchain technology, which allowed us to develop the UPOV e-PVP system. It represents a major leap forward'

ect. However, realization of the UPOV e-PVP system would not have been possible without the vision and ability of our IT-manager, Hend Madhour"

Independent

UPOV has its offices in Geneva, within the World Intellectual Property Organization (WIPO) headquarters building. "UPOV and WIPO are separate organizations but we have an agreement between the two organizations. As a part of the agreement, the Director General of UPOV is appointed as the Secretary-General of UPOV, currently Mr. Daren Tang. UPOV also has the benefit of receiving services from the WIPO financial, human resource and administrative departments. But we are a fully independent organization and pay for the services that we receive from WIPO."

The mission statement of UPOV is: 'To provide and promote an effective system of plant variety protection, with the aim of encouraging the development of new varieties of plants, for the benefit of society.' By becoming a UPOV member, a country supports plant breeding and the creation of new varieties suited to the needs of its farmers. And, as every country is dependent on agriculture to ensure sufficient food supply, every country in the world could benefit from adhering to the UPOV Convention.

"When I put forward my vision for UPOV as a candidate for the position of Vice Secretary-General, a major focus was on how to increase information on the benefits of the UPOV system, so countries could make informed decisions about whether to become a UPOV member. Another key aspect was to improve services for UPOV members because that is important to realize the full benefits of plant variety protection. Therefore, I wanted to highlight the importance of technology and cooperation to achieve an impact with UPOV's limited resources."

It is not easy for a country to take the path to UPOV membership and then to implement the UPOV Convention. "But it is well worth the effort. It's fair to say that I did not imagine the scale of what we would be able to demonstrate on the socio-economic benefits of UPOV membership – which has even been viewed in terms of billions of dollars from Asia, through Africa to Latin America.

Expansion

When, in the mid-fifties of the last century, countries became aware that protection of their plant innovations was a key issue, encouraged by the International Association of Plant Breeders (ASSINSEL), International Federation of the Seed Trade (FIS) and International Community of Breeders of Asexually Reproduced Ornamental and Fruit-Tree Varieties (CIOPORA), the first UPOV Act was developed. Twelve European countries signed the 1961 Act. Amendments were made in 1972 and 1978, and in 1991 the present Act was adopted by 19 countries. Since that date, the importance of the UPOV Convention has

Protected varieties

Plant variety protection by the members of UPOV until 2022:

504,188 applications were filed;

345,594 titles of protection were granted;

193,006 titles of protection ceased to be in force;

161,232 titles of protection were in force.

'It is clearly important to conserve plant genetic resources, because these are the raw materials for plant breeding,' says Peter Button

been recognised worldwide. In 2000, when Peter Button arrived in Geneva, UPOV had 46 members and at present plant variety protection is covered by legislation according to the UPOV Convention in 97 States and more are to follow suit.

It is sometimes claimed that the UPOV Convention favours the industrialised countries, as it was founded by a few Western European states. "But don't forget that many developing countries are struggling with the same problems Europe faced in the post-war era. At the time, the availability of food in Europe was far from secure. The ultimate goal of UPOV is to encourage the development of improved varieties to maximise sustainable productivity."

The latest UPOV Act stems from over 30 years ago. Since that time, the world of plant breeding has changed dramatically. The 1991 Act mentions essentially derived varieties, although the scope of that protection is still under debate, the production of GMO's was still in its infancy, patents on plant related inventions were rare and the term New Breeding Techniques never heard of. Is it time for a new, completely revised Act? "It would be important to be clear on what the purpose of any revision would be," suggests Peter Button. "So far, we haven't received any calls to amend the Act. The 1991 Act is delivering impressive results."

Hugely profitable

Some NGOs claim that subsistence farmers become dependent on the large multinationals, who 'force them to buy expensive seeds'. It is a rather condescending view of farmers, implying that they are not capable of making economically viable choices. A study by agricultural economist, Steffen Noleppa, HFFA Research GmbH, of the situation in Viet Nam after ten years of UPOV membership, underlines the success of plant variety protection.

"Thanks to plant breeding activities in Viet Nam after UPOV membership in 2006, the annual income of farmers increased by 24%. Also, thanks to plant breeding after UPOV membership, the agricultural sector (including floriculture and horticulture) was able to add a sectoral economic value of almost US$ 3.5 billion. Adding income increases along the various value chains of, all in all, more than US$ 1.5 billion totals a GDP impact of around US$ 5.0 billion. This accounts for more than 2.5% of the current national GDP of Viet Nam." The same goes for Kenya and Peru. In Kenya, access to protected plant varieties after UPOV membership enabled the country to develop a US$ 1 billion cut-flower industry that employs 500,000 Kenyans. Before Peru became a UPOV member in 2011, it did not have any significant export of blueberries. Following UPOV membership, more than 60 new protected varieties of blueberries were introduced and Peru has become the largest exporter of blueberries in the world, with its annual export worth around US$ 1 billion.

"At the same time, I understand the concerns that genetic resources may be lost if farmers switch to new varieties because they produce a better income for them. It is clearly important to have measures to conserve plant genetic resources, because these are the raw materials for plant breeding and for improving agriculture for the future. This is also very relevant, as climate change means that relying on conservation in nature runs the risk of losing these resources forever... But PBR encourages breeders to conserve and use plant genetic resources. Our video 'Using the UPOV system to benefit custodians of native wild germplasm in Argentina' also provides a great example of how PBR can support in situ conservation work." (See https://multimedia.wipo.int/upov/en/argentina.mp4)

Successor

This Spring, UPOV appointed a successor to Peter Button, who will retire on 22 October. On 23 October, Yolanda Huerta Casado, a national of Spain, will take over the post. The seventh Vice Secretary-General of UPOV is an experienced intellectual property lawyer and has worked at UPOV since 2001, since 2017 as Legal Counsel and Director of Training and Assistance. What will be next for Peter Button? Will he return to the UK? Will he become a PBR consultant? "My children have Swiss and UK citizenship so maybe we will stay in Switzerland, but Japan is also an option as my wife is Japanese. And I would certainly like do something in the field of plant breeders' rights or the sector more widely, but I am not sure what exactly. I have postponed all decision-making until I have completed my term as Vice SecretaryGeneral of UPOV."

Sow to Grow

Sow to Grow is a so-called 'experience centre' where people can learn more about plant breeding and seed production. It is based on self-discovery learning, for instance by making changes in a giant DNA string to develop a healthy, red coloured sweet pepper, made visible on a large screen. Besides the regular visitors, the museum also receives school groups for a one-morning experience. Another activity is a 6-week course for new employees in the seed industry to learn about plant breeding, seed production and regulatory aspects

Contact: Sow to Grow, Westerstraat 111, 1601 AD Enkhuizen, the Netherlands, www.sowtogrow.nl, info@sowtogrow.nl

The experience centre Sow to Grow in the Netherlands inherited a vast collection of historical objects from the former national seed museum Saet & Cruyt. From seed machines, plaster models, photographs, a library and watercolours, to the rare botanical books of the Weinmann collection. In this edition of Prophyta, the treasurer reveals one of his favourites: a flower model by Robert Brendel.

Spotlight on

A flower model

Monique Krinkels

As early as 1866, Robert Brendel (1821-1898) opened a studio in Breslau in Poland where mainly botanical models were designed. The goal was to use them in biology lessons. Until then, Professor Ferdinand Cohn, director of the Plant Physiological Institute at the University of Breslau, used wax models, which made them very vulnerable.

When the demand for the models steadily increased, Cohn called in fellow townsman Brendel, who then started a workshop to construct them. In his studio, craftsmen with an artistic aptitude manufactured the botanical teaching aids. They made the models from diverse materials, such as wax, wood, papier-mâché, cotton and glass, which made them less likely to break. At the end of the 19th century, Brendel's son, Reinhold, joined in and made the studio one of the most important in the world. The models were made up to 1927.

Brendel delivered his models worldwide. His teaching aids were used at secondary schools, universities and agricultural training centres. The teachers' manuals presented the botanical models as essential tools in the subject of botany. In the school garden, the students could see plants growing up. But what the parts of the plant are, could only be shown in class with Brendel's models, which could be completely dismantled. The teacher pointed to the parts, while the students watched from the school benches.

Debate among breeders **back in full swing**

Niels Louwaars and Sjoerd Bijl

Some 15 years ago, breeders in Europe started to get uneasy about the Biotechnology Directive. The increased use of patents poses a problem to plant breeders, who had grown accustomed to plant breeders' rights to protect their intellectual property and to its breeders' exemption to secure their access to parent materials for breeding. It led to ongoing discussions.

Dr. N. Louwaars is managing director and Sjoerd Bijl is Legal Counsel and IP Policy Advisor at Plantum, Gouda, the Netherlands, n.louwaars@plantum.nl

When it was first introduced, the Biotechnology Directive (98/44/EC) did not generally cause too much concern amongst plant breeders. At the time, the use of biotechnology in breeding was limited to transgenics, and transgenic crops did not seem to have much of a future in Europe. The subsequent interpretation of the directive by the EPO, however, meant that it allowed for much more than just transgenic plants to be covered by patent protection. For instance: the molecular characterization of germplasm – also of existing or even wild plants – could suddenly constitute a novel and thus patentable invention. All breeders would concur that it is breeding that needs to be supported, and that it is the combination of all traits that constitutes a (new) variety.

No exemption

In contrast to plant breeders' rights, patent law did not include a breeders' exemption. Consequently, patenting makes the use of protected germplasm exclusive to the patent holder and to those who can negotiate access to such materials. Breeders want to breed, not to spend their efforts and resources on such negotiations. Breeders need clarity, which breeders' rights provide, whereas the multitude of patent claims leaves room for interpretation and, consequently, risk. Before long, the most useful parent material could contain one or several patented traits, making the breeding of commercially viable varieties difficult, if not impossible, for all but a handful of larger companies.

A fierce discussion started and, in 2010, Plantum went for the most logical solution, given the main concern of breeders – a full breeder's exemption in patent law. Whereas the Dutch politicians – 'across the aisle' as Americans would say – approved the logic, both the wider seed community and governments in the EU did not. The debate did yield a number of other measures though, such as a limited breeders' exemption, implemented in the unitary patent system and some national legislations, a voluntary database (Pinto), licensing platforms on the EU- and international level, and eventually the exclusion of products of essentially biological processes from patentability. This mosaic of measures undoubtedly rounded the sharpest edges of patents on plants and traits, but cracks are already starting to show that no real solution has yet been achieved.

The aptly called limited breeders' exemption still necessitates licensing agreements to be held before new varieties can be marketed, or sometimes even before they can be developed. The databases and licensing platforms created by the sector remain voluntary and based on subjective interpretations by complex patent law and even more complex patent claims - and creative claim drafting has already been proven to be a successful method to bypass the most recent patentability exclusions.

So we are back to square one – the same situation as 15 years ago. Or even worse, because with the technological developments, we can expect increasing numbers of patent applications in the near future. Alarm bells are ringing even louder than before in more EU member states than before and likely across more aisles than before.

History indicates that limiting patentability cannot be the solution, because there will always be applicants with creative thoughts and pens that bypass well-meaning legal exceptions. It is the limitation of the scope of the rights that needs to do the job, so that breeders and farmers do not have to worry about product or product by process claims.

Proactive

Would this reduce innovation? Not at all. According to Euroseeds, breeding companies relying on breeders' rights are on average able to invest 15% of their turnover in R&D. This impressive figure blows most other industries – you know, the ones using patents – out of the water.

Would it support the diversity of our seed sector? For sure, as it avoids costly patent landscaping, litigation costs and other trouble.

Would it improve the public image of our sector, which is so necessary to be heard by politicians on the multitude of dossiers that we need their support for? Most definitely.

So let's be proactive and not be dragged into rearguard battles and let's focus on innovative breeding, rather than building defensive walls around our labs. Those who want to patent materials, be my guest, but leave plant breeders and farmers out of any of your claims.

EU protects native plants against **harmful aliens**

Johan van Valkenburg and Henk Groenewoud

The search for new or better plant varieties has regularly led to the introduction of species that show invasive behaviour in Europe. A study revealed that 60% of the alien species observed in the wild in the Netherlands are linked to the horticultural sector. The EU has listed the species that are most harmful to nature. Trading, breeding, transporting or importing of these species into the EU is forbidden.

In 2022 the authorities assessed the oriental bittersweet (*Celastrus orbiculatus*) to be an invasive alien species, but the regulations will only be applied from 2027 onward

Since 2019 the import and trade of the Senegal tea plant (*Gymnocoronis spilanthoides*) is forbidden in the whole of the European Union

Worldwide, invasive alien species are seen as one of the main causes of biodiversity decline and species extinction. To combat this decline, governments have developed policies to prevent the introduction of invasive alien species. In Europe, that policy has been given the force of a law with the Invasive Alien Species (IAS) regulation. The core of the regulation is a list of species, the Union List. Species on the Union List should no longer be imported, bred and traded pursuant to Article 7 of the Regulation.
The initial Union List was published in 2016, containing 14 plant species, 8 aquatic plants and 6 terrestrial plants. In the Netherlands, some of the aquatic plants on the initial Union List were part of the so-called Water Plants Covenant. In this covenant, the horticultural sector had already imposed the restriction on itself not to market certain species anymore because of the risks to biodiversity. This applied, for example, to the well-known aquarium and pond plants fanwort (*Cabomba caroliniana*) and parrot's-feather (*Myriophyllum aquaticum*).
The ban on the cultivation and trade of water hyacinth

Species on the EU List

The full name of the European Invasive Alien Species regulation 1143/2014 is Regulation (EU) No. 1143/2014 of the European Parliament and of the Council of 22 October 2014 on the prevention and management of the introduction and spread of invasive alien species. The core of the regulation is a list of invasive alien species of Union concern: the 'Union List'. Member States and the Commission can propose inclusion of certain species on the Union List (Article 4.2 and Article 4.4). To this end, a scientific risk assessment must have been carried out (Article 5), which shows that the species meets certain criteria (Article 4.3). For example, the species must be able to establish a viable population, have a significant adverse impact on biodiversity or the related ecosystem services, and be able to spread in at least one biogeographical region shared by more than two Member States.
A scientific forum assesses the scientific quality of the risk assessment (Article 28). Following approval by the Scientific Forum, the Commission will make a proposal to amend the Union List (Article 4.1).
The vote on this proposal takes place in the Invasive Alien Species Committee with representatives of the Member States (Article 27). Decision-making takes place by qualified majority of votes, with a correction for the number of inhabitants of each Member State.

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Free movement of goods

One of the cornerstones of the European Union is the free movement of goods. This is regulated in Article 26 and Articles 28 to 37 of the Treaty on the Functioning of the European Union (TFEU). The abolition of customs duties and other restrictive regulations means that goods can be transported and traded throughout the EU without obstacles. This has brought many benefits to the European economy (Source: Europa.eu and Europa-nu.nl).

Giant hogweed (*Heracleum mantegazzianum*) displaces native plant species and contains substances that, if damaged combined with exposure to light, can cause severe skin lesions

Water primrose (*Ludwigia grandiflora*) out-competes native plants by forming dense mats at river margins and in ponds

(*Eichhornia crassipes*/*Pontederia crassipes*), on the other hand, has been experienced by the sector as a bolt from the blue, as there is no risk to biodiversity in the Netherlands, but a serious economic importance for part of the sector. In the more southern parts of Europe, however, the water hyacinth can proliferate and cause major problems in water quality management. As a consequence of the free European market, plants grown in the Netherlands can be sold in Southern Europe without hindrance or supervision.
In the first addition to the Union List in 2017 with nine plant species, there were terrestrial plants that were important for the horticulture sector. This was especially true for beautiful fountain grass (*Pennisetum setaceum*) or at least the plants that were marketed under that name. After careful investigation by the Netherlands Food and Consumer Product Safety Authority (NVWA), the European Commission has agreed that the plants with the beautiful red coloured leaf belong to another less invasive species, namely *P. advena*. This once again emphasizes the importance of using correct naming by the floricultural sector.

Species on the Union List

TERRESTRIAL PLANTS: *Acacia saligna*, *Ailanthus altissima*, *Andropogon virginicus*, *Asclepias syriaca*, *Baccharis halimifolia*, *Cardiospermum grandiflorum*, *Celastrus orbiculatus* (from 2027), *Cenchrus setaceus* aka *Pennisetum setaceum*, *Cortaderia jubata*, *Ehrharta calycina*, *Gunnera tinctoria*, *Hakea sericea*, *Heracleum mantegazzianum*, *Heracleum persicum*, *Heracleum sosnowskyi*, *Humulus scandens*, *Impatiens glandulifera*, *Lespedeza cuneata*, *Lygodium japonicum*, *Microstegium vimineum*, *Parthenium hysterophorus*, *Persicaria perfoliata* aka *Polygonum perfoliatum*, *Persicaria wallichii* aka *Koenigia polystachya*, *Prosopis juliflora*, *Pueraria montana var. lobataa* and *Triadica sebifera*.
WATER AND SHORE PLANTS: *Alternanthera philoxeroides*, *Cabomba caroliniana*, *Eichhornia crassipes aka Pontederia crassipes*, *Elodea nuttallii*, *Gymnocoronis spilanthoides*, *Hydrocotyle ranunculoides*, *Lagarosiphon major*, *Ludwigia grandiflora*, *Ludwigia peploides*, *Lysichiton americanus*, *Myriophyllum aquaticum*, *Myriophyllum heterophyllum*, *Pistia stratiotes* (from 2024) and *Salvinia molesta*.

Additions

With the addition in 2019, a common avenue tree of the urban environment came into view for the first time: the tree of heaven (*Ailanthus altissima*). This tree is resistant to pollution and the stony environment of the city and therefore seems suitable as a shade tree and as cooling against the warming climate. The big problem, however, is that it is spreading more and more and is already causing major problems locally in southern Europe in forest management, verge management and at archaeological sites. Would it have been an option if planting had been limited to only clonally propagated male trees? Without seed formation there would have been no uncontrolled spread, and perhaps no reason to place the species on

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Other species regarded as invasive

The Scientific Forum has assessed several plant species as invasive, but they have not yet been added to the Union List: Acacia maernsii, Tradescantia fluminensis and Zostera japonica. Species the Scientific Forum still has to assess: Broussonetia papyrifera, Cortaderia selloana and Delairea odorata.

Parrot's feather (*Myriophyllum aquaticum*) was a popular plant in aquaria as well as ponds but has become a noxious weed in many areas

the Union List because of nuisance in roadside and forest management.
The supplement for 2022 explicitly takes into account the financial consequences for growers for some varieties. A transitional period has been included for the tropical floating plant water lettuce (*Pistia stratiotes*), which, like the water hyacinth, has been added because of the risk in Mediterranean countries, and for the Oriental bittersweet (*Celastrus orbiculatus*), a more temperate species cultivated, among other things, for its decorative autumn branches with fruits. The fact that this time a transitional period has been included for many cultivated species is no guarantee that this will be done again with future additions. Each update weighs the pros and cons of each species and votes on the final List proposed by the Commission.

Developing the Union List

On the website of the European Commission, an overview is published of the species that could be added to the Union List in the future. The website explains the procedural steps and shows the species at different stages of the decision-making process. The homepage is easy to find in a search engine with the keywords 'European Commission invasive alien species'.
Searching through the many details is, however, difficult. A little further down on the start page is a fold-out section titled 'Process towards adding species on the Union List'. There, the procedures are explained, such as the role of the Scientific Forum, with a reference to the risk assessments currently being evaluated by the Forum. At present, work has started on the fourth revision.

Search for alternatives

The selection and breeding of many species currently on the market is less advanced than that of 'classical' ornamental plants and food crops. As a result, many characteristics are still present that enable the plant to multiply and establish itself without human assistance. In principle, this means that there is a risk of naturalization. This also translates into the origin of the vast majority of plant species currently on the Union List: 13 of the 14 aquatic and riparian plants and 14 of the 16 Union List species established in Europe have been introduced through the horticultural trade.
It is expected that the Union List will be expanded with new species in the coming years. It is therefore important for the plant sector to be aware of the possible damage they can cause when introducing new species. There are signals that growers voluntarily - even before risk assessments have been carried out - switch to less invasive varieties of species, for example varieties that do not set seed and are difficult or impossible to reproduce.
A possible legal bottleneck for future Union List species is that the text of the European regulation does not distinguish between varieties: if a species is on the Union List, the rules resulting from the definition of 'species' in Article 3 also apply to "... all parts, gametes, sperm, ova or propagules of those species, as well as any crosses, varieties or breeds, capable of surviving and subsequently reproducing". How to deal with this in a world that wants to switch to less invasive cultivars was recently submitted to the European Commission.
A similar problem exists with *Gunnera*. After molecular research, the plant that until recently was considered *G. manicata* in Europe appears to be a hybrid. This species has not yet been reported as potentially invasive anywhere in the world. This hybrid recently described as *G.* x *cryptica* has as mother plant *G. manicata* and as father plant *G. tinctoria*.

RBPs optimize **seed germination**

Nikita Sajeev, Mariana Silva Artur and Leónie Bentsink

Research proved that seed-specific RNA-binding proteins (RBPs) can be used as tools to optimize germination, especially in sub-optimal conditions for agriculture. This type of fundamental research is required to guarantee the availability of high-quality seeds that are able to germinate in a wide range of environmental conditions.

Seeds are the beginning of a plant's life cycle. They contain an embryo which will become the seedling, often surrounded by a nutritional tissue called the endosperm, and a protective layer called seed coat or testa. The ability of seeds to produce an entire new plant forms the basis of crop production, and high-quality seeds can positively contribute to yield, and thereby a farmer's income, but also to sustainable seed production in the face of climate change.

Germination

To establish an entirely new plant, seeds must go through a complex process called germination. The decision of seeds to germinate or not must be made very carefully in order to maximise the chance of survival of the future seedling. This decision is highly influenced by the environment in which the seeds need to germinate. For instance, is there enough water and is the temperature right for the future seedling to thrive in?

If the conditions are not ideal, seeds can remain in a quiescent state, for hundreds of years even, without losing viability. When environmental conditions are ideal for seedling establishment, seeds will absorb water and swell, leading to two visible stages of germination called testa rupture (when the seed could rupture) and radicle protrusion (when the root protrudes through the seed coat and germination is complete).

The chance to make the final commitment to germination occurs between these two visible stages, but it is higher at testa rupture. At testa rupture, if there are sudden adverse changes in the environment, seeds can still stop or slow germination. However, once radicle protrusion occurs, the seed is committed to establishing a seedling. Although, there has been much research conducted on seed germination, we are still at the tip of the iceberg when it comes to understanding the molecular mechanisms that underlie the decision to stop, slow-down or speed-up seed germination.

The stages of Arabidopsis seed germination

Key player

Proteins are the readout of DNA and perform most of the work in cells. As such, they also control whether germination occurs or not. Researchers from the Wageningen Seed Science Centre discovered that the translation, the processes that leads to the formation of proteins, is strongly regulated during seed germination. This finding was at the base of the research conducted by Dr. Nikita Sajeev, a former PhD student at WSSC, who successfully defended her thesis in January 2023. The study by Nikita Sajeev was based on identifying RNA-binding proteins (RBPs) that could be involved in the regulation of protein translation during seed germination.

RBPs have been emerging as key players in the regulation of plant development and growth. These understated proteins can bind target messenger RNAs (mRNAs containing the genetic code to produce individual proteins) and determine the fate or function of the mRNA. Therefore, RBPs can

Wageningen Seed Science Centre

This research was developed in the Wageningen Seed Science Centre (WSSC), led by Prof. Leónie Bentsink. The WSSC is the expertise centre for seed science technology, research and education at Wageningen University & Research. Comprised of two technicians, two postdocs, six PhD and MSc/BSc students, the WSSC develops and transfers expertise in all fields related to seed science and technology.

Beyond understanding the regulation of seed germination at the molecular level, the researchers at WSSC are studying the regulation of seed longevity, how seeds interact with their microbiome and how they survive environmental stress, such as desiccation and high temperature. To perform such advanced research, WSSC has excellent facilities and resources at its disposal for advanced seed research, technology and education at national and international levels. WSSC collaborates with a wide variety of partners at universities, national and international research institutes, non-governmental organisations (NGO's) and actors in the private and public seed industry.

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Nikita Sajeev identified RNA-binding proteins (RBPs) that could be involved in the regulation of protein translation during seed germination

control the ability of an mRNA to produce proteins in an extremely efficient way, especially in changing environmental conditions.

First database

Nikita Sajeev extensively optimized and used an mRNA interactome capture method to identify the repertoire of RBPs present at the testa rupture and radicle protrusion stages in the embryos of model plant species *Arabidopsis thaliana*. This resulted in the first database for mRNA binding proteins present during seed germination. Over 500 RBPs were identified, among which several were dynamic, novel and developmental stage-specific RBPs. Several RBPs had previously been implicated in seed germination. One of the RBPs identified belonged to the hyaluronan mRNA-binding protein family. This RBP was shown to inhibit germination under optimal conditions, while another RBP from the same family which was identified in this study (named ATRGGA) has been reported to regulate germination under salt and osmotic stress conditions. Taken together, this study provided a detailed insight into the world of RBPs during seed germination and is a reservoir of candidates for future RBP research in seeds.

Seeds for the Future

Worldwide, the Netherlands is the largest exporter of vegetable seeds. It holds this position thanks to an innovative seed industry, supported by a public research infrastructure. Wageningen University & Research, a combination of a university and a research institute, has played an important role in bringing innovations, often based on fundamental and applied research, and providing education and training from the basic to the academic level. Many students who have graduated from Wageningen University find employment at the various seed companies. WSSC contributes to this by providing high quality seed science and technology teaching to MSc and BSc students, and by developing cutting-edge fundamental seed research with potential applications by the seed industry.

Early in 2018, members of WSSC came together with potential collaborating parties represented by Plantum. In January 2021, the Seeds for the Future (SftF) initiative started. This initiative is based on safeguarding the future of seed science, technology and education in the Netherlands and beyond. It has three major pillars: I. Education, II. Contact, knowledge transfer and valorisation, and III. Research and innovation.

Specific goals of the SftF include:

- To stimulate the attention of students in the field of seed science and technology;
- To increase the number of young people with an interest for a profession in the seed sector;
- To maintain and improve the infrastructure for research and education in seed science and technology;
- To unlock the potential impact in education for new young professionals in seed-science (at the MSc and PhD level) and provide seed science or technological based thesis and/or internships;
- To unlock potential impact in innovation to the seed industry;
- To create flexibility and ad-hoc investment in specific seed related topics, and grant discovery sprint projects aiming to test particular ideas, new technologies or concepts.
- To provide opportunities for knowledge transfer through courses and through presentations at scientific meetings and in publications, through possibilities for training company staff and consultancy.

Currently, the following parties are involved in the SftF initiative; Plantum, ASP Quality Support B.V., Rijk Zwaan Breeding B.V., Bejo Zaden B.V., Germains Seed Technology B.V., Bayer Crop Science Monsanto Holland B.V., ENZA Zaden B.V. and Vilmorin & Cie. The initiative is open to other companies to join. More information about the SftF initiative can be obtained via Leónie Bentsink (leonie.bentsink@wur.nl) and Monique van Vegchel, Plantum (m.vanvegchel@plantum.nl)

Can we overcome **phytosanitary** barriers

John van Ruiten

Since November 2019, emergency measures have been in place in the European Union to prevent the spread of Tomato Brown Rugose Fruit Virus throughout the continent. Recently, the quarantine status has been extended until the end of next year. But hopefully resistant varieties will end the phytosanitary barriers.

Almost 10 years ago, a new strain in the Tobamovirus group occurred for the first time in the Middle East region (Jordan, Israel) in tomato cultivation. Identified as Tomato Brown Rugose Fruit Virus, the pathogen spread very rapidly around the world and within a number of years, it had become a big problem in tomato cultivation everywhere. The virus can also occur in sweet pepper, but because existing resistance in many varieties proved to be effective against ToBRFV in that crop, the practical problems were not as severe as in tomatoes. It soon became apparent that the resistance against Tobamoviruses in many tomato varieties was not at all effective against this new virus.

Virulent virus

ToBRFV can spread mechanically from plant to plant, via tools or hands and via plants or seeds. The virus is quite persistent and can remain infectious for many years. It can survive in soil, plant material and debris. Mechanical spread is probably the most important source of new infections. The virus can be spread by people working in crops who have eaten infected tomatoes some days before. ToBRFV infections can, dependent on the time of infection, lead to severe losses in both quantity and quality of tomato production.
Symptoms (chlorosis, mosaic and mottling of leaves and necrotic brown spots and rugosity on fruits) make it impossible to sell tomatoes. Losses of over 50-60% in infected crops have been reported. Strict hygiene management (especially also for people working in the crops), cleaning glasshouses and equipment, and use of disease-free seeds and plants are necessary to prevent the virus from entering production systems. Since 2020/21, the first (partially) resistant varieties have been entering the market. Resistance is being regarded as the ultimate tool to control the virus and to safeguard good production.

Stringent measures

Many phytosanitary authorities in the world have taken measures to prevent the introduction and/or spread of the virus. The virus has been occurring in the EU since 2016 and, since 1 November 2019, official EU emergency measures have been in place. And with those measures, the virus received official quarantine status. Both to prevent the import of infected seeds and plants, but also to prevent the spread of the virus within the Union.
A rigorous inspection and testing system is in place. All imported seed lots have to be tested, as well as material from all production locations. PCR test protocols have been developed and standardized to harmonize laboratory testing. The protocols used are very sensitive. In some cases, the question arises whether, especially with higher CT values (above 30), infectious virus is present or that the remains of non-infectious virus particles are detected.
This is an issue that requires attention, because there is a risk of discarding seed batches that do not pose practical risks for spreading virus and contaminating crops.
Recently, the EU emergency measures (2023/1032) have been renewed and extended until 31 December 2024. Although, because of the already widespread occurance of the virus, it was proposed by a number of countries, the EU was not in favour of transferring ToBRFV to the RNQP category, mainly because there is still a high number of infections detected in samples of imported seed lots. Less stringent requirements are applicable for tomato growers. Reporting an infection of the production crop with the virus is still required, but fruits can be marketed until the end of the season.

Resistance

An interesting option in both disease management for growers and also in phytosanitary policy is the use of better resistant varieties. In the new EU regulation, an option is given (in article 8.5) that testing of seeds and plants is not required if the varieties are proven resistant. For sweet pepper (*Capsicum annuum*), a list of resistant varieties exists (containing L3 or L4 resistance genes) which is used, but there is not yet an official list of resistant tomato (*Solanum lycopersicum*) varieties. The resistance mechanism of the L genes in *Capsicum* spp is based on a hypersensitivity response in which rapid localized cell death prevents the spread of the virus within the plant. A standard CPVO protocol is available for determining the presence of L3 and L4 genes.
The characteristic (ToBRFV resistance) is currently

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Whether ToBRFV should remain a quarantine pest or become a Regulated Non-Quarantine Pest is a matter for much discussion

not yet included in the official DUS testing procedures that are applied when new tomato varieties are registered in the EU and/or plant breeders rights are requested. In a CPVO project, the variety testing Examination Offices are developing a protocol for testing (both with markers and bio assay). But it presumably will take another 2-3 years before a resistance test will be part of the official procedure. In this project (2022-2024), a notation scale for different classes of resistance must be developed and also the markers used for various resistance models have to be validated. A specific point of attention is the EU patent on the ToBRFV virus. The owner (BASF) has given permission for official testing.

Breeding

Development and introduction of resistant varieties, however, is taking place at full speed. All tomato breeders realise that resistance will, in the years to come, be almost an absolutely necessary requirement to succesfully introduce their new varieties in the market, certainly in the EU. It is estimated that so far in 2023 already more than 50% of the glasshouse cultivation in the EU in tomato is done with IR or HR resistant varieties.

Resistance to ToBRFV can be created using gene material from wild *Solanum* species. Or it can be created with gene mutations from other existing (resistance) genes in tomato varieties. Also for ToBRFV, similar to other resistances, various models (related to the background) of resistance are developed. In one model of resistance, plants can be infected but the virus is latently present and does not show symptoms, unless there is a heavy infection rate under certain circumstances. In the second model, the virus that infects the plant causes a hypersensitivity reaction of the plant. It shows some lesions, but it prevents the virus from replicating in the plant. Both models are helpful for growers and can assure that a good production is possible. At present, many new varieties brought on the market have the 'model 1' (two third) or 'model 2' resistance (one third).

Two levels of resistance can be distinguished: IR and HR. According to ISF definitions, Intermediate Resistance are plant varieties that restrict the growth and/or development of the virus and/or the damage. They will show less symptoms or damage than susceptible plant varieties. The definition of HR is plant varieties that highly restrict the growth and/or development of the virus under normal pest pressure.

There is not always a sharp distinction between IR and HR and seed companies have their own specific interpretation of both levels of resistance.

Phytosanitary perspective

Looking at resistance as a prevention tool from a phytosanitary perspective, resistance 'model 1' still makes it possible for the virus to spread and to be infectious to non-resistant material, whereas resistance 'model 2' gives better safeguarding of not spreading the virus. Therefore. it can be expected that, if an official list of resistant varieties is created, fulfilling the phytosanitary article 8.5 requirement, it should contain resistance genes that prevent the virus from replicating in plants and cannot be present in seeds and pantmaterial.

It is expected that discussions on creating such a list (and actively applying the article 8.5 exemption) will take place over the next months.

Strategic Plan CPVO 2022-2026

An **ambitious** roadmap

Alessio De Laurentiis

Due to its unique position, the Community Plant Variety Office acts as a bridge between EU policies and private entities such as breeders, scientists and industry organizations. These stakeholders heavily rely on the CPVO to implement and administer the CPVR system. CPVO's strategic plan bolsters this position.

The Community Plant Variety Office (CPVO) is a self-financed EU agency, responsible for the management of the Community Plant Variety Rights (CPVR) system. Its mission is to "*operate, develop and promote an efficient intellectual property rights system providing customer-centric services, thereby supporting innovation and the creation of new plant varieties for the benefit of society*". The **cpvr** system plays a crucial role in promoting innovation in plant breeding and ensuring the availability of high-quality, climate-resilient varieties.

In light of the current climate change and significant environmental modifications, including extreme weather events witnessed in recent years in Europe and globally, the role of promoting plant breeding innovation has become even more critical. With July recently being recorded as the hottest month ever, drought-resistant varieties are no longer just a nice-to-have, but an absolute necessity.

Contribute to shaping a legal and policy framework fit for purpose

Greener

In 2022, the CPVO released its Strategic Plan 2022-2026. The plan sets out a vision for a greener and more digital future for plant variety protection, while maintaining the agency's commitment to continuously improving its operations, delivering on its mission to its stakeholders, building a more sustainable food system for the future and contributing to the EU's political priorities.
In the words of its President, Francesco Mattina: "*CPVO's vision towards 2026 arises during times of unprecedented challenges, from responding to climate change to meeting increasing demands for healthier, sustainable food. Under a collaborative framework, CPVO aims to enhance customer service through strategic partnerships, thereby improving operational efficiency to the benefit of users, while fostering a greener, more digital organization with agile, specialized teams ready to adapt to rapidly evolving challenges in the breeding sector.*"
The CPVO's Strategic Plan 2022-2026 goals are: strive for operational excellence, develop the PVR value chain, contribute to shaping a legal and policy framework fit for purpose.

Operational excellence

The agency has initiated its journey towards achieving operational excellence by refining processes and services and uplifting performance. This vision is materialising through the incorporation of Lean management principles1, optimising operational structures, and fostering a cultural shift towards efficiency and adaptability. A newly established Digital Transformation Unit will pilot initiatives and coordinate a coherent approach across all units and services of the CPVO.
Furthermore, internal control protocols, key to CPVO's streamlined operation, are continually strengthened to ensure compliance with changing rules and to minimise environmental impact through a comprehensive sustainability programme.
The agency keeps up with the times by recognizing and promoting the use of digital technologies, allowing efficient access to its variety database for users. Large datasets facilitate research and cross-referencing of information, simplifying the work of researchers. The emergence of Artificial Intelligence, which is witnessing remarkable advancements, holds incredible benefits, if properly regulated. The CPVO remains vigilant about the developments in this area.
Structural enhancements include the creation and restructuring of units to capitalise on strengths. For instance, the People and Resources Unit has initiated an HR strategy to develop human resources and bolster financial management. Meanwhile, the Legal & Governance Affairs (L&GA) Unit, is improving efficiency and consolidating legal roles.
Further operational improvements include establishing a Communication and Stakeholders Relations sector. The Quality Audit Service (QAS) focuses on reinforcing the reliability of Examination Offices' decisions by implementing entrustment requirements and monitoring compliance. This commitment to enhanced operational structures aims to exceed user expectations.

Value chain

While CPVO has effectively supported breeders

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Develop the Plant Variety Rights Value Chain

The Community Plant Variety Office (CPVO) is an agency of the European Union. It manages the largest system of plant variety rights in the world. Since the creation of the CPVO in 1995, the office has received about 78,000 applications, of which over 62,000 were granted, with over 30,000 rights currently in force

granting Plant Variety Rights (PVR), it acknowledges the need for improvement and the establishment of a holistic, user-friendly service platform. As a future competency hub, the CPVO aims to advise stakeholders on developments in plant breeding and sustainability in the agri-food system.
The agency plans to enhance the enforcement of PVRs by collaborating with international organizations and legal institutions to share resources and best practices. Furthermore, with a deep understanding of developments in plant breeding, CPVO will ensure the protection of innovative varieties. This involves leading the development of technical procedures for DUS testing within and beyond the EU.
The agency aims to provide expertise on EU-funded projects that are related to variety research and testing. In order to broaden awareness of Plant Variety Rights (PVR), CPVO is developing programmes designed to educate relevant audiences about the latest research and innovation in the plant domain.
Possible investments in digital innovation, such as AI-powered chatbots and Machine Learning, are being explored, with the intention of improving user support and training. By ensuring cost-effective, high-quality DUS testing, CPVO is seeking to maintain a robust foundation for CPVR protection.

Framework

The CPVO is adapting to significant changes in the PVR sector, driven by technical advancements and climate change challenges. A revision to the Basic Regulation, which provides the legal basis for the system, is needed. The CPVO is actively supporting the European Commission with this revision.
CPVO's objective is to anticipate and influence policy-making, monitoring future trends, developments and technological advancements that may impact PVRs and plant innovation. By building confidence with the relevant decision-makers, the agency aims to continue benefiting society with its work. This involves strengthening technology watch and horizon scanning capabilities, while fostering cooperation with other EU institutions. Cooperation with other EUIs (European Union Intellectual Property Office - EUIPO, European Food Safety Authority - EFSA) or other organizations (European Patent Office - EPO - and Customs Organizations, etc.) are actively sought.
External communication and outreach activities are being reinforced to promote CPVO's work. Lastly, a commitment to developing the next generation of PVR professionals involves partnering with educational institutions and providing learning modules about the CPVR system. This aims to inspire and equip a larger proportion of students and professionals to contribute to the future of plant innovation.

Ambitious blueprint

The CPVO's Strategic Plan 2022-2026 serves as a comprehensive and ambitious blueprint that not only charts the course for the agency's future, but also underscores its unwavering dedication to fostering innovation in plant varieties within the European Union. The plan seeks to establish the highest level of technical harmonization and legal certainty, guaranteeing robust, dependable and enforceable decisions on Plant Variety Rights (PVR) across the EU.
By aligning closely with the EU's Farm to Fork Strategy and climate change objectives, the Strategy demonstrates its commitment to the broader goals of sustainability and environmental responsibility. By adhering to these principles, the CPVO aims to play a pivotal role in driving the sustainable development of the EU's agri-food sector, ensuring a more resilient and efficient agricultural landscape.

Lean management refers to a technique developed with the aim of minimising the process waste and maximising the value of the service to the customer, without compromising the quality.

Recording Characteristics

Artificial intelligence establishes flower properties

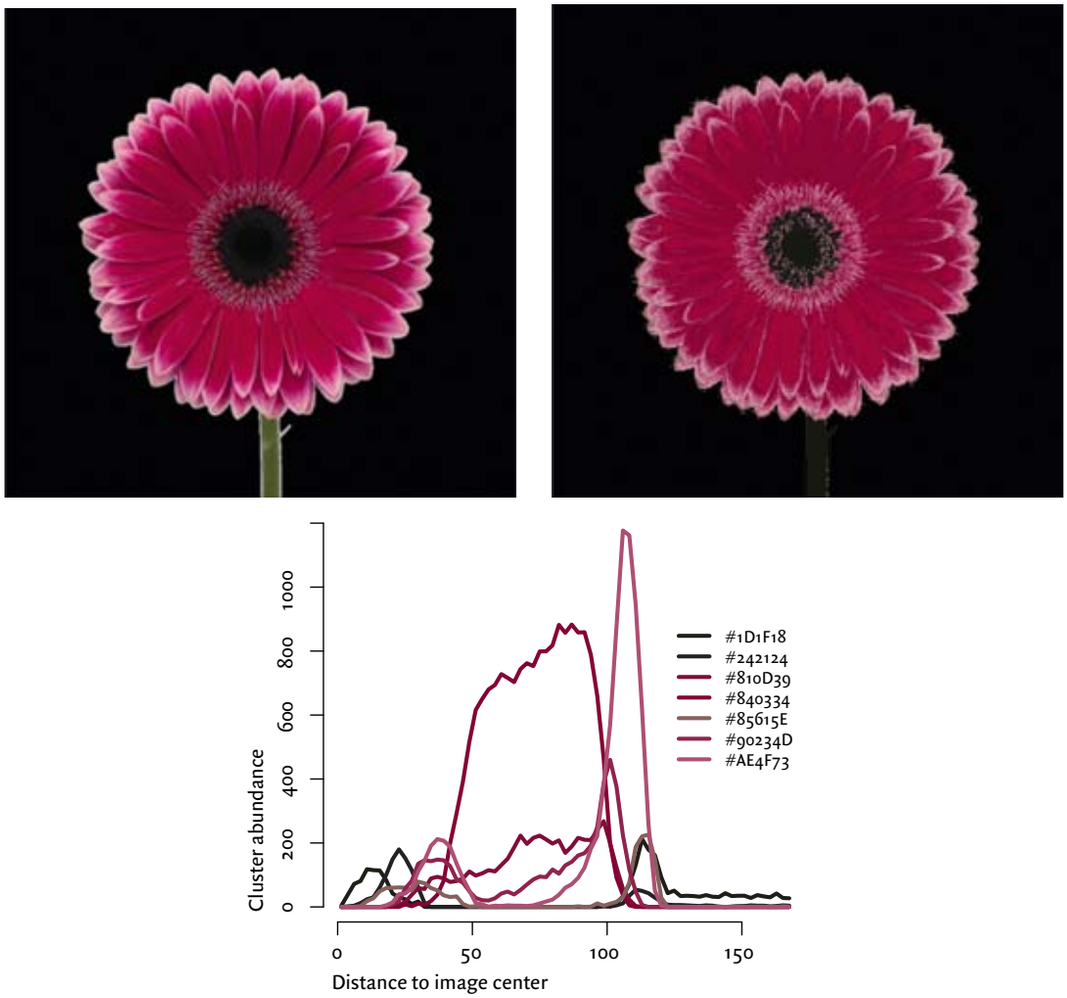
Marleen Kuijsters

The colour of a rose or the form of gerbera petals: artificial intelligence in horticu lture helps to record the properties of flowers. Researchers at Wageningen University & Research envisage numerous future possibilities for AI. Ron Wehrens: "New varieties are allowed onto the market only if they offer something new, and AI can help to record those features."

Breeders and growers develop a large number of new flowers and plants each year. Before these varieties enter the market, Floricode (product registration) and Naktuinbouw (Netherlands Inspection Service for Horticulture) record a number of characteristic properties in their registration system. For example, the colour of the flower or the form of the petals. "In this way, the properties of these varieties are unambiguously recorded," says Ron Wehrens, the Business Unit Manager of Biometris at WUR. "That's handy for auctions. It protects the rights of the breeder and also provides a clear basis for the system of admission. New varieties are admitted to the market only if they have something new to offer."

Specialists have to describe a variety with the utmost care. To support them, the TIK project MODOMA (Morphological Descriptions of Ornamentals through Machine Learning) of Floricode, Naktuinbouw and WUR studied the possibilities offered by artificial intelligence. The researchers used photos of roses and gerberas – taken in a standardised manner – to automatically extract the properties of flowers. To do so, they linked the photos to databases of flower features.

"It appears that artificial intelligence can consistently determine some of the properties of a flower. For example, in 85% of the cases there's no doubt about the colour," says Ron Wehrens. "One out of six flowers has a colour that falls a bit between the categories. In the case of very pale flowers, for example, we might hesitate between white, yellow, pink and orange. It's



The original gerbera image (left) is decomposed in only a few (here seven) colours. The middle panel shows where a particular colour can be found, with respect to the centre of the flower. The right image shows the flower reconstruction using only the seven colours

exactly in these sorts of cases that a computer can eventually provide better standardisation."

More reliable

According to Wehrens, computerisation has many advantages. "The process becomes not only more reliable and reproducible, but it can also be done at places where no experts are present. Searching for comparable cultivars becomes easier and breeders can use the registration information in their own business operations and development. And from an international perspective, harmonisation will become easier."

The study also showed that it is possible to register colour with relatively simple configurations. A colour standard recorded in a photo can be used to correct for any differences in lighting. Wehrens: "More classical methods sometimes arrive at the same results. But AI works more efficiently; the computer algorithms can recognise flower properties without the flower having to be separated from its background."

In addition to colour, the researchers also tested other properties: a set of 16 properties spread across the two crops and the databases of Floricode and Naktuinbouw. Each of these properties consisted of two to five possible values (for example, very small, small, medium, large, very large). This resulted in an accuracy ranging from 35%-99%; properties with many possible values were more difficult to identify than, for example, properties that included only two levels.

"In addition, some properties are easier to see in photos than others," says the researcher. He points to the heart of the gerbera as an example. "The middle of the flower consists of two sorts of petals. It is still difficult for AI to determine what percentage of the heart is from one sort and how much is of the other. And that's also difficult for experts to see. This can be improved by training the algorithm with more photos. There are many future possibilities."

Prototype

In addition to their main project, the researchers have delivered a prototype of a software package that can be used to explore databases of flower features. For example, it is possible to find varieties that have the correct values for certain features or to identify varieties that strongly resemble one another. This software package can be used not only for flowers but also for other crops, such as vegetables.

More information: https://biometris.github.io/modoma/. You can find a demo at https://shiny.wur.nl/modoma

Protecting plant innovation **profitable** for all

Francesco Mattina, Nathan Wajsman and Ángela Martínez

In the past quarter of a century, plant breeding innovation has supported low-input agriculture and generated better conditions for environmental protection, to the benefit of European farmers and growers and end-consumers alike. That is the main conclusion of the joint EUIPO-CPVO study of the impact of the Community Plant Variety Rights' system on the EU economy and the environment.

The EUIPO-CPVO joint study constitutes the first of its kind to holistically assess and quantify the societal impact of the Community Plant Variety Rights (CPVR) system. It was publicly released on 28 April 2022 in Angers (France), the city seat of the CPVO, on occasion of the policy conference "Plant Variety Protection: the path towards more sustainability, innovation and growth in the European Union". This event was organised by the CPVO under the remit of the French Presidency of the Council of the EU.
The study fulfils the objective of quantifying the contribution of the CPVR system to the EU's economy, as well as to the environment. The analysis was conducted in the light of the regulatory framework of the United Nations' Sustainable Development Goals (SDGs) and of the European Green Deal (in particular, its Farm to Fork and Biodiversity strategies). The scope of the study covers over 80% of all registered varieties in the EU[1] and the relevant period considered is that running from 1995 to 2019. The various impacts of the CPVR system are analysed from the perspective of the year 2020.

Core findings

PVP systems serve as a driving force to encourage the breeding of new varieties and, in a market economy, it can be expected that plant breeders will protect those varieties expected to be commercially successful. Likewise, the high expectations of farmers and growers is reflected in the strong uptake for novel protected varieties. Against this background, the departing point of reference taken in the study for measuring the general impact of a Plant Variety Protection (PVP) system is the number of applications filed for PVP and of titles granted under such regime. The impact of the CPVR system on the EU economy is analysed in the context of the following dimensions: the counterfactual decrease in crop production in the EU in 2020, in the absence of the CPVR system; the contribution of the system to EU employment rates, as well as to the EU's GDP; and the size of the holders of CPVRs.

Additional crop production

In the study, the conclusion is reached that plant breeding across all agricultural and horticultural crops in the EU has had a vast impact on innovation-induced yield growth in farming in the past quarter of a century. To reach such conclusion, a gradual approach was adopted to transfer statistically observable yield growth rates into plant breeding-induced yield developments. The following steps were taken: i) calculation of the average yield growth rate per year (over the past 25 years) of the main crops (i.e.: arable crops, fruit, vegetables and ornamentals); ii) calculation of the innovation-induced yield growth[2]; iii) calculation of the plant breeding induced yield growth rate[3]; and iv) calculation of the share of varieties protected under a CPVR[4].

> '... a driving force to encourage the breeding of new varieties'

The analysis is approached from a 'contrast' perspective positing that the advantages of a PVP system are unearthed best by means of the disadvantages that would have arisen in the absence of such a system. The fundamental question asked here is: what is the quantity of crops that would not have been produced, had the CPVR system not been in place? The analysis led to the finding that, in the absence of the CPVR system, the level in the EU 2020 crop production would be 6.4% lower for agricultural crops, 2.6% lower for fruits, 4.7% lower for vegetables and 15.1% lower for ornamentals. As a corollary, the additional production brought about by plant variety innovations supported by CPVR protection in 2020 was sufficient to feed (worldwide) an additional 57 million people

Landmark study

This article serves to present, in a nutshell, the core findings in the landmark study "Impact of the Community (EU) Plant Variety Rights' system on the EU economy and the environment", co-authored by the European Union Intellectual Property Office (EUIPO) and the Community (EU) Plant Variety Office (CPVO). The full study is available in English language on both the EUIPO and the CPVO websites, along with an executive summary thereof available in all 23 official EU languages.

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Without EU-protected plant breeding progress, a remarkable volume of high yield crops would not be on the market today

thanks to agricultural crops, 38 million thanks to fruits and 28 million thanks to vegetables.

Employment rates

The additional crop productivity stemming from CPVR protection translates into higher employment rates in the EU. More specifically, a total direct employment gain of over 90,000 jobs (25,000 additional workers in the agricultural sector, 19,500 in the horticulture sector and 45,000 in the ornamental sector). When considering indirect effects, i.e. the employment gain in upstream and downstream sectors (e.g.: farm supply or food processing), the employment rate increases by 800,000 jobs.

In addition, not only does the CPVR system contribute to employment, but the jobs created are also better remunerated (e.g. worker wages are 12.6% higher in the agricultural sector and 11% higher in the horticulture sector). Furthermore, breeders who work on Research and Development leading to plant innovations also generate economic effects. It is estimated that companies protecting their innovations under CPVRs employ more than 70,000 workers altogether and generate a turnover of over 35 billion euro.

EU's GDP

The additional value added (i.e. contribution to the Gross Domestic Product (GDP)) generated by CPVR-protected varieties amounts to EUR 13 billion (EUR 7.1 billion for agricultural crops, EUR 1.1 billion for fruit, EUR 2.2 billion for vegetables and EUR 2.5 billion for ornamentals). From a macro-economic point of view, the conclusion is reached that without the added production attributable to CPVR protected crops, the EU's trade position vis-à-vis the rest of the world would worsen, where the EU would become a net importer of some crops for which it is an exporter today. EU consumers would also have to face higher food prices.

Holders of CPVRs

By the end of 2021, there were 28,514 CPVRs in force: EU Member States account for 77% of these, while third countries for 23%. The top ten countries when it comes to CPVR proprietorship are the following (in order of relevance): the Netherlands (accounting for more than one third of all CPVRs), France, Germany, United States, Switzerland, Denmark, United Kingdom, Italy, Spain and Belgium. Altogether, these countries represent 91.3% of all active CPVRs. Regarding the size of the holders of CPVRs, it was found that large firms own 40% of CPVRs, with the remaining 60% owned by small and medium-sized enterprises (SMEs) or physical persons. It was also found that SMEs represent 93.5% of all CPVR registrants. This finding serves to underscore that SMEs are key players in the breeding sector and their valuable role should be acknowledged and supported.

Thanks to the CPVR system the equivalent of one third of the Lake Constance has been spared

Environment

Regarding the impact of the CPVR system on the environment, this impact is shown by means of the demonstrated quantitative reductions brought along by the CPVR system.5 Firstly, without plant breeding progress in CPVR-protected varieties, several millions of hectares of land would have been necessary on a global scale, in addition to the global area already used in 2020 (more specifically: more than 6.5 million hectares for agricultural crops, 111,000 hectares for fruit crops and 90,000 hectares for vegetable crops). Secondly, the operation of the CPVR system translates into a significant reduction in the Greenhouse Gas (GHG) emissions from agriculture and horticulture by over 62 million tons per year, an amount equivalent to the total GHG footprint of Hungary, Ireland or Portugal. Overall, the EU protection of plant varieties from 1995 to 2020 has resulted in the avoidance of almost 1.2 billion extra tons in GHG emissions. Thirdly, the CPVR system has resulted in reductions in water use in agriculture and horticulture by over 14 billion m^3, an amount of water equivalent to one third of the volume of Lake Constance on the tripoint of Germany, Switzerland and Austria.

Future

Looking back at the past is necessary to learn and apply the knowledge gained to the present, with a view to actively designing the future. The said knowledge is precisely what the EUIPO-CPVO joint study serves on a silver platter. The quantitative findings reveal that the European citizen, as well as the environment, benefitted.

When glancing into the crystal ball of the future, one can see a context marked by a growing world population and the drastic effects of climate change. Future-proof varieties should thus not only produce higher yields but also be adapted to biotic and abiotic stresses. Here, plant breeding innovation remains key to assure food security, while doing so in a sustainable manner, where industrial property protection plays an important role in stimulating the innovation cycle.

1) For agricultural crops, the scope includes the following: maize, wheat, oilseed rape, potato, barley, sunflower, ryegrass and durum wheat. For fruits, the crops considered include peach, strawberry, apple, wine, apricot, blueberry, raspberry, plum and cherry. For vegetables, the scope encompasses the following crops: lettuce, tomato, pepper, melon, bean, pea, cucumber, cabbage, onion, spinach, endive and leek. For ornamental crops, all crops are grouped into and regarded as one single cluster (due to methodological constraints).

2) The innovation-induced yield growth was calculated in terms of 'hectare-related total factor productivity'.

3) The plant breeding-induced yield growth rate in EU agricultural and horticultural farming was calculated by means of multiplying the innovation-induced yield growth rate by the share of plant breeding.

4) The share of varieties protected under a CPVR was calculated (per crop) based on the ratio of varieties included in the CPVR Register in relation to the number of varieties included in national listing registers, the EU Common Catalogue registers and the FRUMATIS register.

5) Ornamental crops were excluded from the scope of the analysis due to data constraints.

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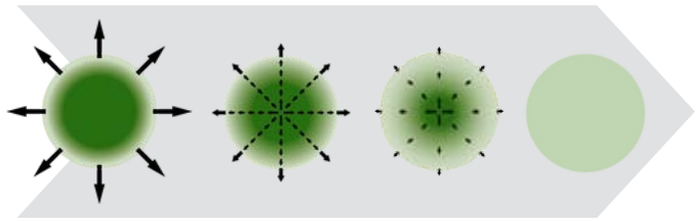
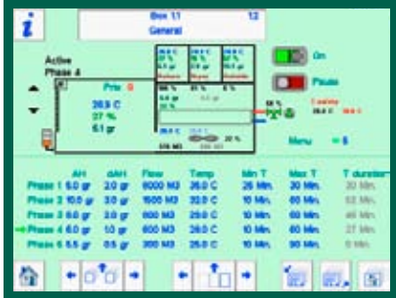
Agratechniek understands the need to reduce energy costs while achieving better drying results. This becomes especially critical as more seed companies aim to receive, store, and package seeds with lower moisture content. To achieve quick and successful seed drying, it becomes essential to employ dried air in the final drying phase. Agratechniek accomplishes this by utilizing our ABC Processor in combination with a Central Hybrid Air Dryer.



ABC Processor



Save Up to 65% on Energy Costs With Our Advanced Processor

- **Automated Drying Process**
- **Variable Air flow & Heating Capacity**
- **4-5 Drying Phases**

Each phase adapts to the specific needs for optimal drying

- **Energy Efficient**

The ABC Processor enables variable temprature and airflow which lowers 65% of the energy cost compared to a fixed air flow and heating system. The tables indicates the decrease in kWe.

% control	kWe	m3/h	Delta-T	kWe
100	22	30000	5	48
80	11,3	24000	13	100
60	4,8	18000	20	115
40	1,4	12000	20	77
20	0,2	6000	4	8
Total	39,7			348

Variable Air Flow & Heating

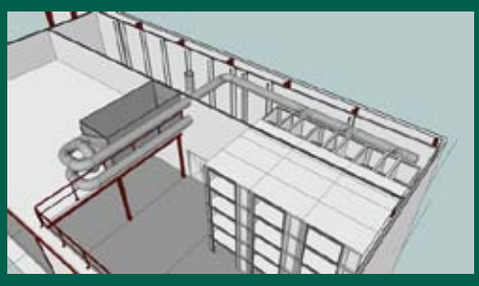
% control	kWe	m3/h	Delta-T	kWe
100	22	30000	20	192
80	22	30000	20	192
60	22	30000	20	192
40	22	30000	20	192
20	22	30000	20	192
Total	110,0			960

Fixed Air Flow & Heating

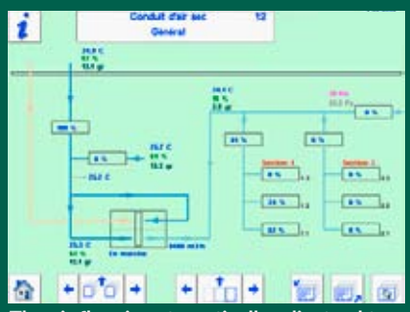
Central Hybrid Air Dryer

Distribution of Dried Air to Multiple Drying Sections

The process air is dehumidified by condensation and adsorption



The hybrid air dryer distributes the process air to different drying sections



The air flow is automatically adjustsed to each specific section, box or container

Advantages

- Utilizing dried air results in:
  - A shorter drying time at lower temprature with less electricity and heating costs
  - An increase of the drying capacity of your installation
- The Central Hybrid Air Dryer:
  - 1 large air dryer for all your drying sections
  - It automatically distributes the dried air to the sections where it is needed.
  - It automatically adjusts the amount of air to the drying demand of each section

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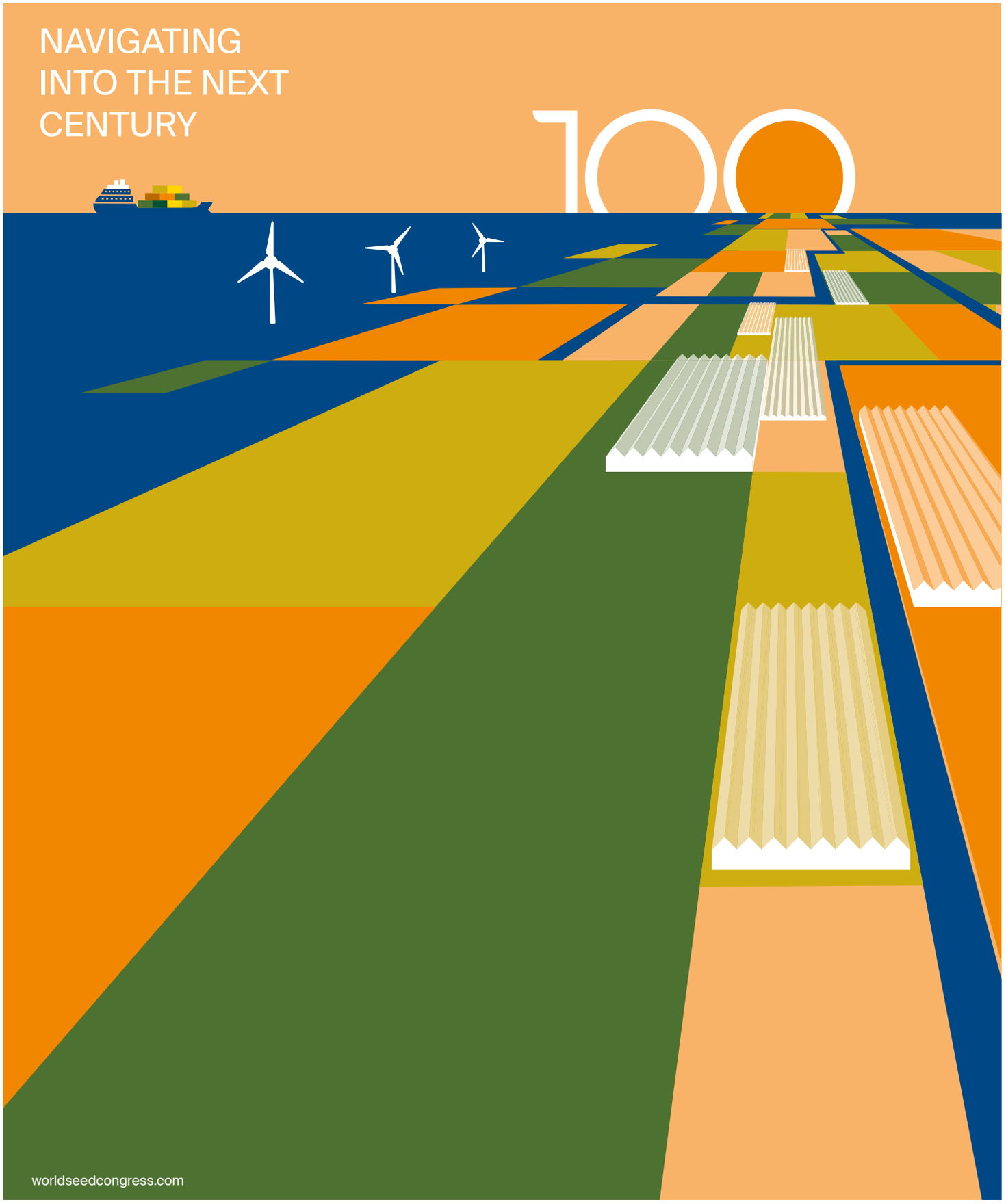

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