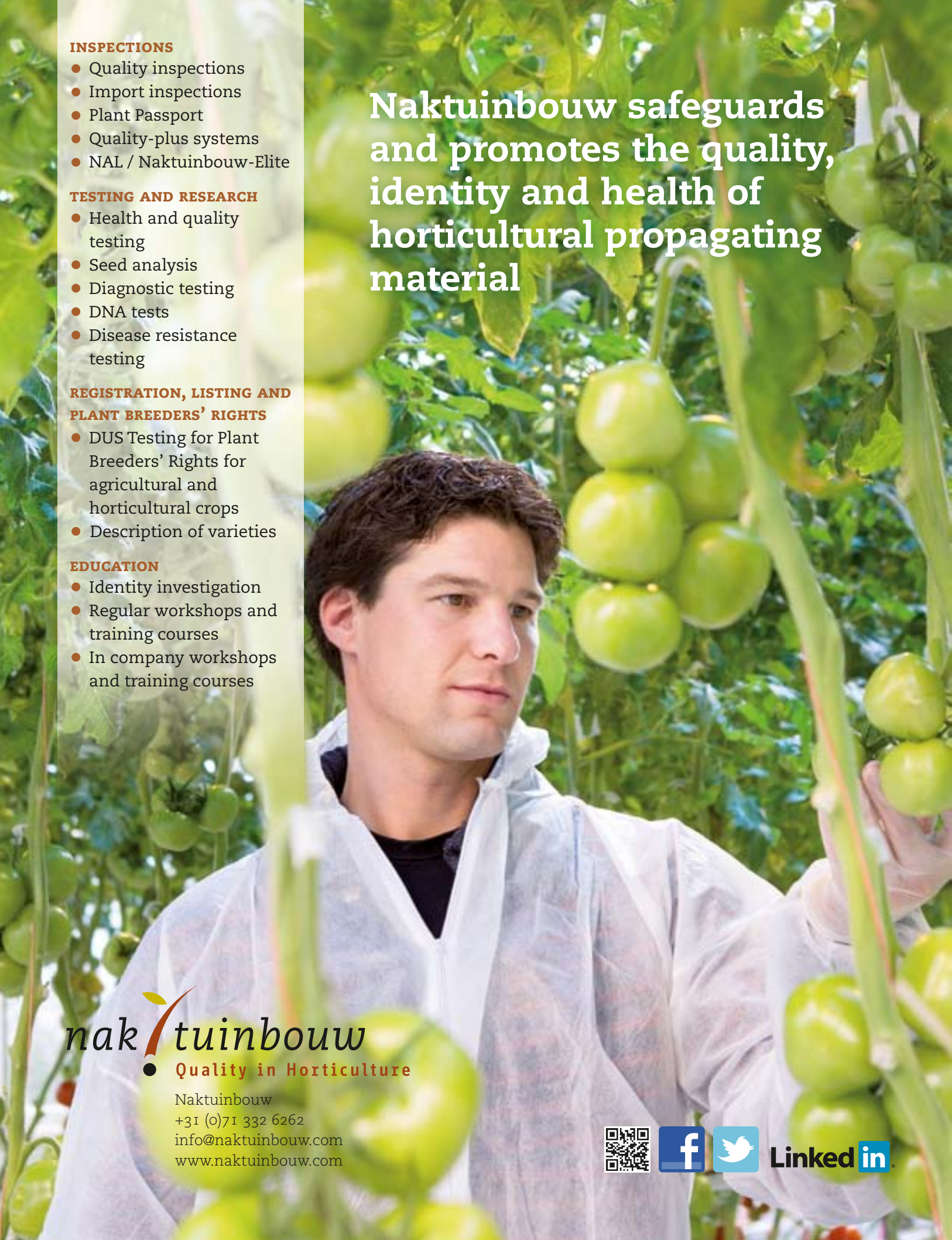
Focus on Europe 2022

Journal for breeders and producers of plant material

Prophyta



INSPECTIONS

- Quality inspections
- Import inspections
- Plant Passport
- Quality-plus systems
- NAL / Naktuinbouw-Elite

TESTING AND RESEARCH

- Health and quality testing
- Seed analysis
- Diagnostic testing
- DNA tests
- Disease resistance testing

REGISTRATION, LISTING AND PLANT BREEDERS' RIGHTS

- DUS Testing for Plant Breeders' Rights for agricultural and horticultural crops
- Description of varieties

EDUCATION

- Identity investigation
- Regular workshops and training courses
- In company workshops and training courses

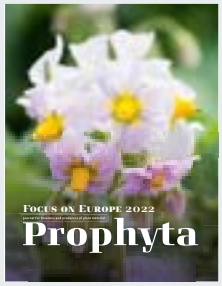
Naktuinbouw safeguards and promotes the quality, identity and health of horticultural propagating material

naktuinbouw
Quality in Horticulture

Naktuinbouw
+31 (0)71 332 6262
info@naktuinbouw.com
www.naktuinbouw.com

LinkedIn

Prophyta Focus on Europe 2022
A publication of the Prophyta Foundation in co-operation with Blue Bird Publishers
EDITORIAL ADVISORY BOARD
Theo Ruys, John van Ruiten, Sally van der Horst, Erik Toussaint and Marien Valstar
PUBLISHER/CHIEF EDITOR
Monique Krinkels
CONTRIBUTING EDITORS Guido Van den Ackerveken, Jeroen Balemans, Rik Lievers, Pim Lindhout, John van Ruiten, José M. Soriano-del-Castillo, Emily ter Steeg, Anita van Stel and Hedwich Teunissen
COVER PHOTO Tadashi Okabe
SUB EDITOR Mireille McNutt
GRAPHIC DESIGN Marcel Bakker, De Ontwerperij
PRINTED BY Global Printing
GENERAL INFORMATION
www.prophyta.org
ADDRESS Blue Bird Publishers
VOF, Jan Kostelijklaan 16
1981 CG Velsen-Zuid
the Netherlands
phone +31 (0)255 521 852
prophyta@prophyta.org
www.prophyta.org



On the cover: Eleven leading Dutch companies in the potato sector are conducting joint research within Holland Innovative Potato (HIP). Goal is to reduce the use of crop protection products by 90% by 2030

Focus on Europe 2022
Journal for breeders and producers of plant material
Prophyta

Floriade closes its gates

A STATUE CONSISTING OF THOUSANDS of metal bees welcomed visitors to the Floriade world horticultural exhibition which closed on 9 October 2022. The 12-metre high statue will remain a landmark in the city of Almere. 'Beehold' is made by Florentijn Hofman, a Dutch artist known for his immensely large sculptures. He broke through internationally with his gigantic 'Rubber Duck', which floated around in various locations across the world.
It was the seventh time that the Dutch horticultural sector showed its capabilities with sixty hectares of gardens and international pavilions. The theme this time was 'Growing Green Cities'. Despite high expectations, the number of visitors remained disappointingly low. Initially, the organization expected over two million visitors, but later they had to adjust that to a mere 600,000. According to the Horticultural Council, it is therefore not yet clear whether another Floriade will take place in 2032 (Photo: Angelique Broersen-van Hal).

On the market: a purple tomato

THE USDA HAS APPROVED a genetically modified tomato that contains a high level of anthocyanins, antioxidant compounds with widely-recognized health benefits. Besides preventing diseases, this tomato has a longer shelf life than garden variety red tomatoes, thus reducing waste.
The tomato was developed by biochemist Professor Cathie Martin and her team. To engineer the purple tomatoes, the scientists used transcription factors from snapdragons (*Antirrhinum majus*) to trigger the plants to produce fruits with more anthocyanin, creating a dark purple-fleshed tomato. A study in 2008 showed that cancer-prone mice that were fed purple tomatoes lived around 30% longer than those that ate normal tomatoes.
Together with Professor Jonathan Jones, Cathie Martin initiated Norfolk Plant Sciences Ltd, a spinout company from the John Innes Centre and The Sainsbury Laboratory. It is the UK's first GM crop company, aimed at finding ways of commercialising research into plants with enhanced health-giving compounds. According to the US Department of Agriculture: "From a plant pest risk perspective, this plant may be safely grown and used in breeding."

New Managing Director at Plant Sciences Group

WAGENINGEN UNIVERSITY & RESEARCH (WUR) has appointed Dr. Richard Harrison as the Managing Director of the Plant Sciences Group (PSG) as of 1 September 2022. He succeeds Ernst van den Ende, who is now Managing Director of the Animal Sciences Group. Harrison had been director of NIAB Cambridge Crop Research since 2011, overseeing genetics, breeding pathology, biotechnology and data science research departments at NIAB's Cambridge headquarters, as well as some of the statutory services in seed certification and variety testing.

Mushrooms as protein source

In their quest to find new and sustainable sources of protein, scientists are looking with particular interest at edible mushrooms. Researcher Karin Scholtmeijer is hunting through Wageningen's vast mushroom collection for prime candidates for protein production. So far, she has selected sixty edible species. Mushrooms are excellent model organisms. They break down woody waste and convert it into food, an empty building suffices to produce them and their growth pace is incredibly fast.
Dr. Scholtmeijer wants to find out more about exactly how the selected species accumulate protein. This knowledge is needed in order to improve protein levels in mushrooms. "This can be done using conventional breeding or molecular biological techniques, but also using random mutagenesis and by screening strains for higher protein production. Finally, we are also looking at the influence of growing conditions and substrate choice. It may very well be that one species of mushroom produces a lot of protein on beet pulp, while another does well on wood chips."
This project was selected by staff and students of Wageningen University & Research as one of the six research projects to receive funding for its potential contribution to the development of alternative protein sources.

Hap-pea birthday Mendel

On 20 July this year, it was the 200th anniversary of the birth of the father of modern plant breeding, Gregor Johann Mendel. The Gregor Mendel Institute celebrated the event with a 'Hap-pea Mendel Day'. Mendel was born in 1822 in a German-speaking family in Heinzendorf bei Odrau, Silesia, Austrian Empire (today known as Hynčice, Czech Republic). While farmers had known for millennia that crossbreeding plants could favour certain desirable traits, Mendel succeeded in determining exactly how the 'laws of heredity' predict the phenotype of a crop.
Mendel used peas to establish that invisible 'factors', today known as genes, regulate plant characteristics. And he did not use just any peas. For his experiments, he chose pea selections from the Benary company, today

a famous breeder of ornamentals but, at the time, also of vegetables. The company was founded in 1843, when young plant breeder Ernst Benary decided to start a seed business in Erfurt, Germany. Gregor Mendel became an esteemed customer when he conducted his experiments with peas between 1856 and 1863.

Not a day too soon

No one can have missed it: the consequences of climate change have been obvious last summer. Record-breaking heat waves, droughts that have not been seen since the 16th century, a wildfire season far above the average, so-called hunger stones predicting famines resurfacing in rivers, followed in September by life-threatening torrential rains in the Mediterranean are the writings on the wall that there is definitely something going wrong. In its August report, the Global Drought Observatory said that 47% of Europe is in 'warning' conditions, meaning the soil has dried up. As a consequence, harvests are down: 16% for maize, 15% for soybeans, 12% for sunflowers and 10% for potatoes, compared to the average of the previous five years, according to EU forecasts. Statistical data on the effects on seed production are not yet available, but it is clear that the sector has not got away unscathed. Mitigation to abate the causes of climate change seems far away, as a victim of shilly-shallying and political hassle.
The EU Agriculture Ministers endorsed that the EU must now act in a coordinated way to maximise sustainable increases in agricultural production and accelerate the use of modern techniques, during their informal meeting in Prague last September. Under which rock have these politicians been hiding? It has been known for decades that climate change will have dramatic effects. In 1938, the first notice of global warming was made public, in 1992 the Earth Summit was held in Rio de Janeiro, in 1997 the Kyoto Protocol was ratified, and the Paris agreement was signed in 2015. Time and time again, politicians have been made aware of the risks. To no avail it seems.
Adaptation to reduce the results of climate change will take time. There is an urgent need for new varieties that are more drought and heat tolerant and for hybrids that can quickly be adapted to new diseases. There is no time to lose. In the Netherlands, a public-private programme has been initiated to create extra resilient crops to cope with changing conditions. A new, virtual institute, named CROP-XR, will receive 42 million euro from the National Growth Fund to develop a novel breeding approach. It is not a day too soon to prevent the hunger stones' ancient warning of famines coming true.

Monique Krinkels

New Virtual Institute CROP-XR

Revolutionary methods for extra **resilient crops**

Guido Van den Ackerveken

The world faces challenging problems: a growing demand for plant products and shrinking agricultural areas, while harvests are threatened by the effects of climate change. Furthermore, the need to protect the environment requires cultivation methods that reduce the burden on soil, water, air and biodiversity. The virtual research institute CROP-XR aims to tackle these challenges by means of developing a novel breeding approach.

Today, many farmers grow crops designed to deliver peak performance under precisely controlled conditions. Water, fertilizers and chemical plant protection products are administered in the exact amounts required by the plants to optimize growth. Tomorrow's crops will have to give reliable harvests without such intensive measures, even if they are under greater pressure from their environment: from heat and drought, new diseases and pests, floods, soil salinity or greatly reduced fertilization. For sustainable and productive agriculture and horticulture, there is an urgent need for more resilient (eXtra Resilient → XR) crops. These future varieties should be able to withstand stress factors without the help of intensive control measures or chemical crop protection products, but with retention of yield and quality.

Accelerating breeding

In order to breed these new varieties, present breeding methods are inadequate. The problem is that existing advanced plant breeding methods can select on simple traits transmitted by one or a few genes, but fail to introduce complex properties, in which many genes and processes interact intensively. Resilience is pre-eminently a complex property. For the required breakthrough to a new generation of crops, a major shift to a new generation of breeding methods is needed first. In short: a new 'green revolution'.
In the Netherlands, a new virtual institute has been founded in which world-leading research groups and plant breeding companies are jointly developing an innovative method to make numerous agricultural crops extra resilient. In a research programme, they integrate modern plant biology with artificial intelligence (AI) and digital models into ground-breaking 'smart-data' methods for plant breeding.
The new institute, named CROP-XR, is financed by the National Growth Fund of the Netherlands. The Dutch government has earmarked a total of 20 billion euro for the period 2021-2025 for project investments, which have the highest potential for structural and durable economic growth. These are: knowledge development, research, innovation and education. In total, CROP-XR will receive 42 million euro from the National Growth Fund. This subsidy will be used to get CROP-XR started during the first ten years.

Potato

Worldwide, potato is the third largest crop in terms of human consumption, but it is also an important source of industrial starch and protein and can, therefore, play a crucial role in the transition from animal to vegetable protein. The potential value of potato starting material is more than ten billion euro. Potato cultivation suffers from many pathogens and insects and now uses a lot of crop protection products. Eleven leading companies in the potato sector are conducting joint research within an association: Holland Innovative Potato (HIP). They are working on the breeding of new, resistant varieties. The goal is to reduce the use of crop protection products by 90% by 2030. Furthermore, research in CROP-XR will help make potatoes more resistant to a wider variety of environmental stress conditions, such as heat, drought, salinization and heavy rainfall.

Chrysanthemum

Chrysanthemum is the world's second largest ornamental crop. The commercial crop 'chrysanthemum' stems from many diverse plant species. The genetic diversity available to chrysanthemum breeders is therefore complex but also has large potential. It offers many starting points for introducing characteristics such as tolerances to diverse climates, diseases and pests in new varieties. Technological progress is crucial in order to improve breeding which plays a key role in sustainable production in the future. Dutch chrysanthemum breeders work closely together at the pre-competitive level. So far, the entire chrysanthemum genome has been mapped and techniques have been developed to unravel its complex genetics.

Prof. dr. A.F.J.M. Van den Ackerveken is Professor of Translational Plant Biology at the Department of Biology, Institute of Environmental Biology, Utrecht University, the Netherlands, g.vandenackerveken@uu.nl

Plants experience stress from many different directions and finding answers to more than one stressor at a time is a complex task for plant breeders. due to climate change and stricter rules on plant protection products, future crops will have to be 'extra-resilient'

The gap between efficient and predictable breeding the plant varieties needed in the future and the available knowledge on resilience mechanisms and large data sets is huge. CROP-XR will be an institute where science and research by institutes, expertise and needs of seed companies and the views of societal stakeholders come together and reinforce each other. The theory of change behind CROP-XR is that of a long development pipeline that runs from fundamental biological and data science research to impacts of the application of newly developed products. Within that model, the institute covers the innovation chain, from ground-breaking fundamental to translational research. It actively invites, seeks out, supports and connects public and private parties in the entire chain and ensures they cooperate more effectively.
An important first step of the project is to understand how plants can withstand environmental threats, such as prolonged drought, extreme heat and pathogens, thanks to a complex interplay of hereditary factors. These fundamental insights are immediately applied to develop stronger, more resilient varieties of a number of model crops to be grown sustainably in more extreme conditions. The goal is to accelerate the translation of this knowledge into commercial varieties and, at the same time, stimulate the dissemination of knowledge (including education) in this area.
The institute operates through overarching activities,

Lettuce

The vegetable crop lettuce is full of vitamins, minerals and antioxidants. It is the second most eaten vegetable in the United States and comes in fifth in the Netherlands. The crop has an annual global production value of approximately 11 billion euro. Major threats in lettuce cultivation are pathogens (such as fungi and aphids) and climate change (heat, salinization, shortages of clean water). Breeding for resilience is important for reliable and sustainable production in the future. The expansion of the acreage in Asia and South America also requires new characteristics. Lettuce is suitable as a model crop because there is much genetic and genome information available as well as powerful methods for experimental studies (e.g. in programmes such as lettuceknow.nl).

Onion

With an annual worldwide production of 85 million tons, the onion belongs to the most widely grown vegetable crops. In the coming years, however, there are major challenges in onion cultivation: due to short crop rotations, many growing areas are infected with soil diseases, such as Fusarium and white rot. Furthermore, salinization and periodic droughts have resulted in yield reduction due to the weak root system of the onion. In wet periods, leaf fungi cause a lot of damage. To date, resistance breeding against fungi and bacteria has yielded limited success. The onion genome is complex, making the search for solutions to biotic and abiotic stressors complicated.

www.meetmany.eu

Euroseeds Congress is looking forward to welcoming you in Malta!

WHAT:
3 full days of meetings, business and networking possibilities. A unique opportunity for important policy discussions, successful trade and professional exchanges.

WHO:
Seed professionals from all around the world.

WHEN:
October 16-18, 2023

WHERE:
Malta

For more information visit: **euroseedscongress.com**
or contact **euroseeds.congress@meetmany.eu**

Euroseeds
Embracing Nature

Tomato

Tomato is amongst the top worldwide rankings of most grown vegetables. Nearly 5 million hectares of tomatoes are grown all over the world. There is a large number of varieties for fresh consumption, as well as for the processing industry.
A large part of the breeding work is focused on disease resistance. Depending on growing conditions and regions, different resistances are desired against viruses, leaf fungi, soil fungi, nematodes and insects.

Furthermore, a number of global viruses are a major threat to tomato cultivation, such as ToBRFV, TYLCV, TSWV, PepMV. Partly due to climate changes, tomato varieties will also have to be adapted to abiotic stress and limited availability of water and fertilizers.
Tomato is used extensively in plant biology research. Much genetic information and many research methods are available, resulting in quick implementation in the breeding process.

such as knowledge transfer, business development and stakeholder-society interaction. Five closely related programme lines are defined:

- developing, testing, optimizing and validating an artificial intelligence-based 'smart-data' plant breeding concept (Plant-XR);
- shared data, AI and modelling infrastructure (Data-XR);
- crop breeding for resilient production systems such as strip cultivation (Agro-XR);
- knowledge development and training of human capital (Edu-XR); and
- initiating and supporting SMEs and new research consortia, with a view to application of the smart-data concept to a variety of crops (Transfer-XR).

Plant-XR is a ten-year public-private programme line designed to build a revolutionary scientific foundation, integrating plant sciences, such as genetics, physiology, plant pathology, bioinformatics and systems biology, and digital data-based sciences, such as building large data collections, data pattern analysis through artificial intelligence, and mechanistic modelling. The state of these sciences gives researchers the belief that a conceptual breakthrough is possible; to generate computational working models of traits including complex interactions and between plant and environment. These mechanistic models can then be used to identify new breeding targets to enhance the speed to develop highly resilient crop plants.

Maximising positive impact of **hybrid** breeding

Emily ter Steeg and Pim Lindhout

Scientific breakthroughs in plant breeding show how biological limitations are constantly shifting and how challenges can be overcome. Potato used to be considered as one of the most unsuitable crops for hybrid breeding. Nonetheless, hybrid breeding is now being applied in potato. The question arises: how can the positive impact of hybrid breeding on global nutrition security be maximized?

In May 2022, our article titled '*Crucial factors for the feasibility of commercial hybrid breeding in food crops*' was published in Nature Plants (co-authors: Prof. Paul Struik and Prof. Richard Visser). The article provides an integrated overview of the biological and economic factors which determine whether a commercial plant breeder will opt for the hybrid breeding system. The hybrid system enables the breeder to systematically combine genes, exploit heterosis and introduce desirable traits. Alternatively, the breeder may continue to apply the – arguably – less efficient, open-pollinated, or self-pollinated breeding system. We concluded that the investment in the commercial application of hybrid breeding in crops depends on the size of the market and added value of the hybrid products. Market and product value should compensate for the higher breeding and seed production cost.

Maize, wheat and potato

The status of hybrid transitions in maize, wheat and potato illustrates these findings. Maize is a cross-pollinator and the first crop in which hybrid breeding was applied over hundred years ago. Its obvious separate female and male inflorescences facilitated the development of female and male parent lines. The male parts can be easily removed manually or mechanically to generate female plants, resulting in low seed production costs. Initially, maize suffered from strong inbreeding depression, but a strong heterosis offered an incentive to continue hybrid breeding. Nowadays, most modern maize cultivars are hybrids, and these are also bred and grown in developing countries. A wide variety of cultivars exists, which are well-adapted to different environments and can be used as feed, food or biofuels.

Wheat is a self-pollinator for which the self-pollinating breeding system is still used. The key obstacle for hybrid wheat is that the low added value of hybrid varieties does not cover high costs of seed production. The heterosis effect in wheat has been relatively small, probably because genetic variation in wheat is low(er). Moreover, wheat produces only one seed per crossed flower, making manual pollination too expensive. Attempts to introduce male sterility, genetically or chemically, have not yet been commercially successful. A hybrid transition will require a reduction of seed production costs and identification of heterotic pools to obtain stronger heterosis effects. The development of heterotic pools can now be accelerated using big data and markers to improve prediction abilities. Still, commercialization of hybrid wheat remains uncertain: companies have

Drs. E.M.S. ter Steeg, department of Social Sciences, Wageningen University & Research, Wageningen, the Netherlands, emily.tersteeg@wur.nl; Dr. W.H. Lindhout, former R&D director at Solynta, Wageningen, the Netherlands

Unlocking wheat's full potential

At BASF, we are unlocking the full potential of wheat through a globally-driven, locally-tailored advanced breeding platform, to advance one of the world's most important crops, for today's wheat farmers and for generations to come. "At present, we are working to deliver a hybrid wheat variety with high performance and reliability in a sustainable package that enables the farmer to farm not just today, but tomorrow and for decades into the future," says Ed Souza, Global Head Wheat Breeding.

Wheat farmers face increased challenges and demands for more – more profitability, more consistency in both yield and quality, while continuing sustainable practices. They need innovation, reliable tools and trusted partners to achieve more with less, in their specific growing conditions. We are convinced that, with the combination of recommended agronomic practices, hybrid wheat will give farmers more opportunities to grow wheat profitably, while balancing economic, societal and environmental sustainability. Through hybrid wheat, BASF is facilitating access to more quality wheat, providing more people around the world with its nutritional benefits.

Our long-term commitment and substantial investment in wheat innovation includes primary R&D breeding stations and operations around the globe, an extensive global trial network and a dedicated team of experts around the world, focused exclusively on bringing hybrid wheat to market in the second half of this decade. Regarding farmers' willingness to 'pay for a hybrid (more expensive) variety': all BASF products must provide value through the potential of increased profitability (ROI). As the hybrid wheat project is still in development, no specific details can be given at this point of time.

Hybridization of wheat is the logical next step, building on growers' experiences from hybrid barley (Photo Syngenta)

shifted between investing and divesting.
Hybrid breeding has only recently been applied to potato, a strict cross-pollinator. A reduction in ploidy level, from tetraploid to diploid, enabled the production of inbred lines much more efficiently. However, the diploid potato shows strict self-incompatibility and strong inbreeding depression. These hurdles have been overcome through the introduction of a self-compatibility gene from wild species and consistent breeding for more vigorous inbred lines. Half a dozen breeding companies and even more research institutes are now focusing on fundamental and applied research in hybrid potato breeding and the first commercial varieties are expected to reach the market in the coming years.

Abiotic stresses

While (hybrid) breeding has been highly effective in increasing plant resistance to biotic stresses, pests and diseases, abiotic stresses continue to pose a challenge. Often resistances to biotic stresses are controlled by a single gene. The resistance gene can be identified and introduced with marker-assisted breeding, and hybrid breeding is the most efficient system to do this. Modern hybrid varieties tend to have several resistance genes reducing the need to use chemical crop protection. The added value of resistant cultivars is obvious when confronted with the pest or disease. Many farmers will prefer hybrids because the risk of crop failure is lower. Simply put, all farmers want to spray less to the benefit of the environment, public health and their wallet.
Contrary to biotic stresses, abiotic stresses tend to be controlled by many genes and resistances are polygenic traits. The identification of different genes and Quantitative Trait Loci (QTLs), with minor effects and many interlinkages, is very challenging. Subsequent introduction of QTLs in varieties through a breeding programme is also challenging. These factors make the impact of abiotic breeding programmes less obvious and relatively limited. Meanwhile, the investment is higher, thus disincentivizing (commercial) breeding efforts focused on abiotic stresses. However, climate change has created an urgent need for robust cultivars, which are resilient to conditions such as droughts or salinity.
In the Netherlands, multi-million public-private partnerships, Plant-XR and Crop-XR, will kick-off this year. XR is an acronym for 'eXtra Resilient.' The aim is to develop cultivars, which are more resilient to abiotic stresses and require fewer chemical inputs. This development of 'XR' cultivars will require a better understanding of plant growth and development under different (extreme) conditions. Moreover, it will require better tools to analyse the data generated by experiments to facilitate and speed up the breeding process. Artificial intelligence will be used to crunch plant performance data under abiotic stresses. Knowledge institutions will work together with leading breeding companies, based in the Netherlands, who are co-funding the project. The focus will be on vegetables, ornamentals and potato. Such large-scale collaborative programmes are crucial to achieve progress.

Priority crops

Furthermore, while hybrid breeding has become the dominant system for some crops, it has not been

Innovation in Seed Coating Technology

Centor Group is committed to taking a fresh approach towards better crops, better environmental outcomes and better food.

Centor Group
seed improvement technologies

EUROSEEDS 2022 MEET US AT TABLE 116

SEED APPLIED PRODUCTS

SEED TREATMENT EQUIPMENT

ANALYTICAL EQUIPMENT

CONSULTING TRAINING/ R&D

aginnovation
seed improvement technologies
T: +1 209 367 4109
www.aginnovationusa.com

Centor Europe
seed improvement techologies
T: +31 651 038 533
www.centoreu.com

Centor India
seed improvement technologies
T: +91 868 831 9724
www.centorindia.com

Centor Oceania
seed improvement technologies
T: +61 3 8779 2170
www.centoroceania.com

www.centorgroup.com

Crops such as wheat, oats and barley are self-pollinators, thus to create hybrids male sterility is a necessity

Logical next step

While there have been significant gains in the productivity of wheat over the past 6,000 years, particularly during the latter part of the 20th century, maintaining this progress has proven difficult as farmers today are adapting to unprecedented change. "As one of the world's largest crops and a primary source of protein for many people, it is critical that growers are able to improve wheat productivity, while also looking after the natural environment now and for future generations," says Rob Hiles, EAME Cereals Strategy and Portfolio Lead for Syngenta Seeds.

Hybridization of wheat is the logical next step, building on grower successes already experienced from growing hybrid barley – not only yield benefits, but yield stability, nitrogen use efficiency, fungicide reduction and grassweed management, on top of the ability of the hybrid to outperform.

"Despite historical industry challenges in developing a robust hybrid wheat system at scale, since 2011, Syngenta Seeds has been significantly investing in a dedicated and highly experienced team of people to create a CMS (Cytoplasmic Male Sterility) hybrid wheat system, expansive germplasm diversity, robust data analytics, precision farming technology and a scalable and reliable seed production system to make this a commercial reality for growers across Europe," adds Hiles.

"Syngenta launched X-Terra wheat prototype hybrids to a large network of northern French growers in 2021. Creating a co-development network enabled growers to experience X-Terra trials at scale – witnessing tillering ability and higher bio-mass, combined with overall positive farmer satisfaction. Over time, we aim to deliver a flow of innovative products, improving every year, which will help reduce the need for pesticides and fertilizers, assisting growers' efforts for better soil management and water conservation, while meeting the ambitions of the EU's Green Deal," shares Anne Azam, Syngenta Seeds Business Unit Head France.

applied in others, which are important for nutrition security. Maize and tomato are examples of popular crops for commercial plant breeders, because of advantageous biological features, high gross product margins and large global markets. The hybrid system is dominant for both crops. Meanwhile, breeding efforts in crops like fruit trees, cassava, sweet potato and quinoa have been limited. The same applies for many 'indigenous' or local crops. Their 'disadvantageous' characteristics make a return on R&D investments uncertain. Logically, commercial breeders are more inclined to invest in those crops for which a return on investment is certain.

Like abiotic stresses, it is possible for public and private stakeholders to join forces and launch breeding programmes for these crops, improving their performance. The World Vegetable Centre (WorldVeg) develops Open-Pollinated Varieties, hybrids, inbred lines and traits, which become part of the public domain. Moreover, they have also launched breeding consortia in Asia and Africa, and members gain access to certain exclusive lines. WorldVeg works on global vegetables, like tomato and chilli pepper, developing robust varieties tailored to local climatological conditions and the needs of smallholders. This facilitates the private sector to develop improved varieties specifically for markets in Asia and sub-Saharan Africa. Moreover, WorldVeg works on local crops, such as amaranth, a dual-use vegetable grown for leafy greens and grains. In this way, WorldVeg makes it easier for the private sector to establish a breeding programme for such a crop. Its activities are financed through public funds and private sector contributions.

Similarly, Beumer and Stemerding (2021) propose a joint hybrid breeding programme for potato in the lowland tropics. This is certainly an interesting idea, but the question of ownership of inbred lines and cultivars must be settled for public-private partnerships to work and before launching hybrid breeding in new crops. Public and private actors can collaborate and co-finance breeding programmes. The question can be raised whether public funding should be used to develop public inbred lines and hybrid cultivars, which are universally accessible. In vegetables, such lines and varieties exist thanks to organisations like WorldVeg. In potato, it will take considerable resources to achieve this. The shared goal of joint breeding programmes would be to develop inbred lines and hybrids for priority crops.

Conclusion

Pressure on food systems is unprecedented because of climate change, resource depletion and population growth. The importance of plant breeding grows, along with the urgent need for cultivars, which allow us to reduce our global footprint. Public and private actors complement each other and can work in innovative partnerships to meet this need. We should focus on crops that can underpin global nutrition security and develop cultivars adapted to the conditions of the future, in which resource scarcity and harsher climates will be normal.

Agri Information Partners

ICT specialists in Seed Business

Agri Information Partners is the partner for delivering information management solutions based on substantive knowledge of the agricultural sector. We are specialized in breeding.

- **Combination of innovation and no-nonsense**
- **Flexible tailor made solutions**
- **Global market leader in breeding software**

Check our website www.agripartner.com

Join the next generation breeders!

Agro Business Park 67
6708 PV Wageningen,
The Netherlands

+31 (0)317 - 47 13 00
info@agripartner.nl
www.agripartner.com

mercado &Brida

Not method nor processes but **'omics'** should be decisive

Jeroen Balemans

The lines between conventional plant breeding and genetic engineering are blurred nowadays. Rather than focusing on the methods and processes behind the creation of a genetic engineered crop to determine if testing is needed, a more effective framework would examine the specific new characteristics of the crop itself by using so-called '-omics' approaches.

Current approaches for triggering safety testing of genetically engineered crops vary dramatically among countries and generally lack scientific merit. For example, when dealing with varieties made using the powerful gene editing system known as CRISPR, the European Union regulates all varieties, while other governments base decisions on the size of the genetic change and the source of inserted genetic material. Meanwhile, in 2020, the U.S. Department of Agriculture established a rule that exempts from regulation conventionally bred crop varieties and GE crop varieties that could have been developed by methods other than genetic engineering.

The DNA of table potatoes still contains resistance genes against the water fungus Phytophthora, they are just not active. With gene editing, these genes could be switched on

New approach

A Policy Forum article published in *Science* in September calls for a new approach to regulating genetically engineered (GE) crops. The paper was written by a group of American experts and Ken Giller, professor in Plant Production Systems at Wageningen University & Research. Rather than focusing on the methods and processes behind the creation of a GE crop to determine if testing is needed, the paper asserts, a more effective framework would examine the specific new characteristics of the crop itself by using so-called '-omics' approaches. In the same way that biomedical sciences can use genomic approaches to scan human genomes for problematic mutations, genomics can be used to scan new crop varieties for unexpected DNA changes.

Additional -omics methods such as transcriptomics, proteomics and metabolomics test for other changes to the molecular composition of the plants. These measurements of thousands of molecular traits can be used like a fingerprint to determine whether the product from a new variety is 'substantially equivalent' to products already being produced by existing varieties – whether, for example, a new peach variety has molecular characteristics that are already found in one or more existing, commercial peach varieties. If the new product has either no differences or understood differences with no expected health or environmental effects when compared with products of existing varieties, no safety testing would be recommended. If, however, the product has new characteristics that have the potential for health or environmental effects, or if the product has differences that cannot be interpreted, safety testing would be recommended.

According to the authors, the '-omics' approaches, if used appropriately, would not increase the cost of regulation. Fred Gould, University Distinguished Professor at North Carolina State University, co-director of NC State's Genetic Engineering and Society Center and the corresponding author of the paper observes: "It's likely that most new varieties would not trigger a need for regulation. The most important question is: 'Does the new variety have unfamiliar characteristics?'" The paper estimates that technological advances could make the laboratory cost for a set of -omics tests decrease to about € 5,000 within five to ten years.

Establishing an international committee composed of crop breeders, chemists and molecular biologists to establish the options and costs of '-omics' approaches for a variety of crops would start the process of developing this new regulatory framework. Workshops with these experts, as well as sociologists, policymakers, regulators and representatives of the general public, would enable trustworthy deliberations that could avoid some of the problems encountered when GE rolled out in the 1990s.

The Policy Forum article can be found on: www.science.org/doi/10.1126/science.abo3034

Soriano García's Collection

Largest collection on **bulbiculture** catalogued

José M. Soriano-del-Castillo

In April 2022, the cataloguing of the collection of José Miguel Soriano García, responsible for the training and research of bulbiculture in Spanish-speaking countries, was completed. His work contains the world's largest private collection of slides, paintings, videos, CDs, DVDs and books on two main themes: bulbous plants and European gardens and parks.

Eleven years after his death, the gigantic collection of José Miguel Soriano García (Almería, 21 July 1941 – Valencia, 3 August 2011), assembled during the last quarter of the 20th century and the beginning of the 21st, was finally recorded completely. The collector of this material was director of the International Flower Bulb Centre in Spain for twenty years, until his retirement in 2010.

The catalogue features a total of 11,000 slides, along with photolithography, videos, CDs and DVDs. Furthermore, it includes a collection of more than one hundred books on bulb farming, gardening and agriculture, many of them out-of-print, but with high historical value, and even books from the 18th century on this topic. Finally, the catalogue includes an art gallery of modern and old pictures and paintings that provide further in-depth coverage into the floral culture of the 19th and 20th centuries.

Developing bulbiculture

In 1925, the International Flower Bulb Centre (IFBC) was created to develop bulbiculture throughout the world. Half of the flower bulbs are destined for gardening and the other half for cut flower cultivation, although these values vary widely between countries. For example, in the UK and Italy, the ratio of the proportion of dry and forced bulb cultivation is 4 : 1 and 1 : 4 respectively. However, in Taiwan the ratio between dry and forced is 5 : 95.

To properly develop this project, IFBC's technicians carried out an extensive study aimed at disseminating bulbs for parks and gardens. The first result was spectacular and created true sources of colour in the gardens, managing to attract amateurs and professionals who admired and studied the possible combinations of the bulbs, in terms of shapes, volumes and colours that could be applied in several gardens – the gardens of Versailles, the urban gardening of Madrid, the public gardens of Geneva, among others.

This development began as a result of the annual exhibitions of spring bulbs that have been held in the famous Keukenhof Park (Lisse) since 1949. On its almost 30 hectares, the different applications of bulbous plants are displayed, from spring flowering to the field of gardening, together with a small, covered area for the novelties of the application bulbs in the field of cut flowers. Furthermore, this place has even been an exhibition of summer flowering bulbs applied in parks and gardens. Keukenhof has always been visited by both professionals and amateurs and, as a result of this, the park focussed on developing a more universal programme to observe the development and quality of the flowering of the bulbs in countries with a different climate to that of the Netherlands.

José Miguel Soriano García regularly visited the flowerbulb trials at the Laboratory for Flowerbulb Research in Lisse, the Netherlands

This important project was developed in two parts: study of spring flowering bulbs for naturalizing in the following countries: England (Harrogate), Germany (Höxter), Finland (Ruukki), Spain (Valencia) and the Netherlands (Rotterdam). These studies were carried out for five years, following their naturalization; study of summer flowering bulbs for naturalizing in the following countries: England (Harrogate), Germany (Höxter), Spain (Valencia) and the Netherlands (Rotterdam) and were held for three years, following their naturalization. In Spain, the research was carried out by Mr. José Miguel Soriano García, until his retirement in 2010, through the IFBC in Spain.

The IFBC in the Netherlands stopped its activities on 31 December 2011 due to lack of funds. Up to that time in the Netherlands, there were two principal

Professor J.M. Soriano del Castillo is researcher at the Food & Health Lab, Institute of Materials Science of the University of Valencia, Spain, jose.soriano@uv.es

José Miguel Soriano García was appointed Knight of the Order of Orange-Nassau and received the decoration from the Dutch ambassador in Spain. To his right, his wife and Co Buschman, crop specialist at the International Flower Bulb Centre, Hillegom, the Netherlands

separate organizations for the promotion of ornamental products; the IFBC (flower bulbs) and the Dutch Flower Office (flowers and ornamental plants).

A biography

José Miguel Soriano García was a technical agricultural engineer, specialising in horticulture and gardening (School of Agricultural Engineers, Madrid, University of Valladolid and the Polytechnic University of Valencia). His professional career began in 1969, as technical director at a company in Almeria called Primores, which specialised in the production of cut flowers, and as founder and advisor of the Meteorological Station of Félix. In 1974, he was redeployed to Valencia as a technical advisor on ornamental crops at Veyrat's Seeds.

Since 1975, he was the founder, adviser and technical director of several Spanish scientific journals and wrote best-selling encyclopaedias of flowers, plants and gardening. Later, from 1977 to 1983, he developed the free pursuit of his profession, teaching as a professor and lecturer on ornamental crops in various training centres, colleges and university schools throughout Europe. In the 1980s, he created the world's first online plant and flower service and, until his retirement in 2010, he was the technical director in Spain of the bulbous plant crop trials at the Stichting Laboratorium voor Bloembollenonderzoek (Laboratory for Flowerbulb Research). Furthermore, he established and directed the Spanish-Dutch Chamber of Commerce in Valencia from 1985 to 1988. Two years later, in 1990, he created and directed the IFBC in Spain until 2010.

The collection

Although the researcher died in August 2011, it was not until the subsequent eleven years that an exhaustive study of his collection was carried out. It was divided into two large sections. The first section is on bulbiculture as a result of his analysis carried out in Spain, together with the historical-cultural studies of bulbs throughout the ages. The following section includes some of the European botanical gardens, parks and gardens, addressing many of the species found in them, as well as unpublished aspects of many of them. This allows us to see the evolution of gardens and parks in Europe and their specialization in centres for the purpose of studying, teaching, training and research.

Among the information on the gardens and parks in this collection, it includes details from Geneva, Basel, Bern and Zurich (Switzerland), Bonn and Hamburg (Germany), Meise (Belgium), Amsterdam, Leiden, Utrecht, Limmen, Groningen and Delft (the Netherlands), Madrid, Valencia, Córdoba, Tenerife and Elche (Spain), Copenhagen (Denmark), Fontainebleau, Versailles, Paris (France), London (United Kingdom), Lisbon (Portugal), Malmö (Sweden) and Tivoli (Denmark), among others.

Looking for a venue

In addition to this great cataloguing work, which was created with the aim of being donated, it is a collection that is looking for a venue with a central headquarters capable of hosting and making available to the international community not only the slides, but also other cultural elements with the aim of understanding the historical-cultural and investigative evolution of the world of flower bulbs and gardens and parks.

Super-spreader curbed by phytosanitary policies

Rik Lievers

Phytosanitary matters are an essential part of genebank management, even though it sometimes hampers making diversity available. By adhering to the rules and by setting up phytosanitary policies, the risks of spreading diseases can be minimized. By maintaining good contact with national plant protection organisations, genebanks can promptly address problems with phytosanitary regulations and help improve them.

Genebanks are established and funded by national governments or research institutes to conserve and provide germplasm for plant breeding and crop research. To meet the requirements of agriculture in a changing environment, new varieties are developed using genebank material. The flow of seed material from genebanks to researchers and plant breeders can be seen as an essential step in the breeding process.

In their mission to make genetic diversity available, genebanks have generated extensive collections of seed samples of landraces, old varieties, wild populations and other potential sources of valuable genes. These seed samples are often stored in vacuum-sealed containers in dry and cold (-20°C) conditions. Under these conditions, the seeds can remain viable for several decades.

Phytosanitary policy

Because genebanks work with many different plant species, they deal with many different seedborne diseases and pests. As the seed samples in genebanks originate from all over the world and are issued to users worldwide, genebanks are potential super-spreaders of diseases and pests. It is, therefore, of the utmost importance that genebanks are aware of their status as potential super-spreaders and establish sound phytosanitary policies to minimise the risks of spreading disease.

Setting up a phytosanitary policy for a genebank is a challenging task, since reducing the risk of spreading diseases conflicts with the primary task of genebanks, which is to provide genetic resources for research and breeding. Cumbersome phytosanitary measures, such as costly disease testing, visual inspections, strict hygiene protocols and phytosanitary certification, hinder the free flow of genetic resources from genebanks to the research and breeding communities. Besides that, new diseases are continuously popping up, and old ones become less relevant. Furthermore, the rate at which new diseases are emerging is likely to increase due to climate change and increasing international trade. Consequently, the legal requirements, the supervision thereof, and the testing methods are continuously changing and becoming ever more complex.

How can genebanks deal with this situation? At the Centre for Genetic Resources, the Netherlands (CGN), we have been developing such a phytosanitary policy. This policy aims to reduce the risks of spreading disease as much as possible and to ensure we comply with the applicable and continuously changing phytosanitary regulations, while doing our job: conserving and distributing plant genetic resources.

Phytosanitary regulations

Since December 2019, a comprehensive package of EU measures has been in force to prevent the spread of plant diseases within the EU: the EU Plant Health Regulations (EUR-Lex - 32016R2031 - EN - EUR-Lex (europa.eu)). The National Plant Protection Organization (NPPO) in the Netherlands assists with implementing these regulations and checks compliance. Good contact with NPPO's is essential for genebanks to understand and stay up-to-date with the complex and constantly changing phytosanitary regulations. At CGN, we have appointed a 'Phytosanitary Matters Specialist', who is responsible for maintaining contact with the NPPO and keeping track of the phytosanitary regulations. The Phytosanitary Matters Specialist also translates the complex regulations into workable instructions for curators, who are responsible for specific crop collections.

Implementing regulations

In general, phytosanitary regulations require that when seeds are produced, the plants are visually checked for diseases and pests listed as quarantine diseases. NPPO inspectors regularly visit CGN to do this. Seeds often need to be tested for such quarantine diseases. If a seed sample tests positive, this is reported to the NPPO, and the seeds cannot be used for seed production or be distributed to users. If no uninfected replacement sample is available, and treatment of the seeds is not possible, the seeds are unfortunately lost. For non-quarantine diseases, exceptions from most phytosanitary requirements exist for small amounts of seeds for research and breeding. Nevertheless, to reduce the risks of spreading diseases, CGN chooses to perform visual inspections for non-quarantine diseases.

A plant passport (within the EU) or phytosanitary certificate (outside the EU) accompanies the shipment as proof that the material meets all requirements.

Dr. R. Lievers is curator at the Centre for Genetic Resources, Wageningen University & Research, Wageningen, the Netherlands, rik.lievers@wur.nl

If phytosanitary regulations take the special position of genebanks into account, genebanks can continue with their core mission to make genetic diversity available to researchers and breeders

In some cases, untested seeds may still be issued with the permission of the NPPO, provided that the recipient places the seeds in quarantine and has them tested upon arrival. If CGN cannot meet the phytosanitary requirements of a country, the seeds will not be issued. For all shipments, CGN includes a message to the user, stating that CGN has done its best to ensure the material is clean and meets all the phytosanitary requirements. However, a 100% guarantee that the material is clean cannot be given, and the user's vigilance remains important at all times. CGN does not accept warranties for the phytosanitary condition of the material.
By following these rules, the risk of spreading plant diseases is minimal, and CGN is reasonably indemnified against legal liability in the unlikely event that a quarantine organism is detected in one of its distributed accessions.

Not made for genebanks

CGN is comfortable working with most phytosanitary regulations. Nevertheless, CGN has noticed that phytosanitary regulations often focus on large commercial seed lots stored for relatively short periods. Genebanks, on the contrary, store very small amounts of seeds for long periods. Seed lots generally do not contain more than several thousand seeds; typically, several tens of seeds per sample are distributed to users. Seed stocks will rapidly deplete if all samples need to be tested for every newly occurring disease, as tests designed for commercial seed lots generally require hundreds, if not thousands of seeds. As a result, seed samples have to be regenerated prematurely. Apart from considerable costs, these extra regenerations lead to a loss of genetic variation due to genetic shift and unavoidable selection, not to mention pollen and seed contamination and other factors that threaten the genetic integrity of genebank samples during regeneration.
In some cases, it is questionable whether testing historic genebank samples for newly emerging diseases makes sense. Take for example ToBRFV, which occurs in tomato and pepper. ToBRFV only appeared in the Middle East in 2014 and then spread to the rest of the world. Most pepper and tomato seed samples from the CGN were produced well before 2014, packed in vacuum bags, and stored in the freezer. These historical seed samples can obviously not carry this disease. Yet strict regulations designed for commercial seed lots for short-term storage require testing of all seed samples.
In practice, this meant that CGN had to cease its distribution of tomato and pepper accessions. This conflicts with the primary task of genebanks according to national laws and international treaties, namely to make genetic diversity available. It took a considerable investment of time and money and a waste of seeds to confirm that CGN's collection was, as predicted, free from ToBRFV.

SEED AT ITS BEST

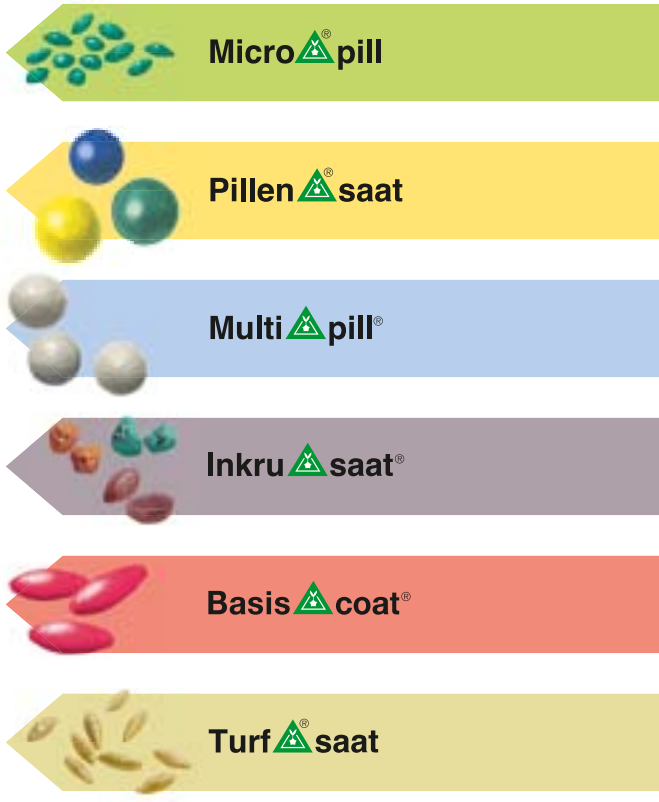
lopri.com

NEUTRAL AND INDEPENDENT CONTRACTUAL SERVICES FOR ALL SPECIES OF SEEDS

- Processing
- Pelleting
- Film-Coating with insecticides, fungicides or biologically active ingredients
- Seed tapes and other seed forms (e. g. Cressbar®) also with certification and worldwide logistics

WE ALSO OFFER TAILOR-MADE:

- Products for use in organic farming
- Pelleting and film-coating technology
- Coating material and polymers



www.suet.de

SUET®
Wir machen Saat gut!

SUET Saat- und Erntetechnik GmbH | PO Box 1780 | D-37257 Eschwege | Phone: +49 5651 927-5 | Fax: +49 5651 927-324 | info@suet.de

Super-spreader curbed by phytosanitary policies

Testing for multiple diseases

When we tested CGN's tomato and pepper collection for ToBRFV, we also decided to test the same samples for the Tomato Mottle Mosaic Virus (ToMMV). We received information from the Dutch NPPO and CGN's user community that this virus could be given a quarantine status soon. Eventually, some of the seed bulks turned out to be infected. The seeds in infected bulks were produced in several EU countries, before the earliest known occurrence in Europe. The data showed that ToMMV is already widespread in Europe and that regulation as a quarantine disease makes little sense.

This information has been considered in the Pest Risk Analyses of the European and Mediterranean Plant Protection Organization (EPPO), the outcome of which will be used for drafting new phytosanitary legislation. Furthermore, because the RNA extracts of CGN's tomato and pepper collection (created for the ToBRFV tests) are stored and made available for future use, it is much easier to do similar studies in the future. In this way, genebanks can provide insight into the spread of new diseases and ensure that new phytosanitary regulations are based on correct data.

Improving regulations

The specific situation of genebanks needs to be brought to the attention of decision-makers in Brussels, so that when new diseases emerge, the phytosanitary regulations will also take into account the interests of genebanks and its users. Exceptions from testing for historical genebank material would be desirable, as well as the possibility of testing on fewer seeds.

Besides lobbying for better regulations, genebanks can also try to anticipate which newly emerging diseases pose a risk in the near future and may soon be regulated as quarantine diseases. Good contact with the NPPO and the user community are essential to know which diseases are relevant. When a genebank collection is being tested for particular diseases, as required by legislation, it could be tested simultaneously for these potential future quarantine diseases. This does not only avoid wasting seed with every new disease, it could also provide valuable data that could contribute to better regulations.

ISF World Seed Congress

SOUTH AFRICA 2023
Cape Town 5-7 June

The International Seed Federation and the South African National Seed Organization warmly invite you to the ISF World Seed Congress 2023 in Cape Town, South Africa, from 5 – 7 June. Enjoy the generosity of our people, with the "I am, because we are" spirit of ubuntu against the unforgettable backdrop of the South African landscape.

www.worldseedcongress.com

Organizers

ISF

SANSOR®

Organic network event unites Dutch companies

Anita van Stel

On 22 June, the first organic network event was held jointly by the Dutch seed association Plantum and Bionext. During this meeting in Brussels, Belgian representatives of many different seed and value chain groups shared ideas, experiences and foresights about organic farming in the context of the 'Farm to Fork strategy' (F2F).

All farmers need good seed, irrespective of their farming system and the markets they serve. The seed supply of the organic crop production sector has grown substantially over the last decade. Within Plantum, the association for seeds and young plants in the Netherlands, several members are concentrating on this sector. A growing number of members produce organic seed as well as serving their conventional customers. Now that the Farm to Fork strategy explicitly mentions a goal to extend the percentage of organically used farmland to 25%, the issues around seed supply are increasingly becoming an important issue.

Plantum has regular contact with the organic value chain organisation Bionext, but it was now high time to create a joint event to highlight the issue of organic quality seed. Bionext is the Dutch chain organisation for organic agriculture and food, connecting the chain from farmer to consumer. Brussels was chosen as the location for this Dutch event because eventually, many policies, rules and regulations are made there. Also present were Dutch members of the European parliament, Mohammed Chahim (Group of the Progressive Alliance of Socialists and Democrats), Bert-Jan Ruissen (European Conservatives and Reformists Group) and Annie Schreijer-Pierik (Group of the European People's Party), representatives of the Commission and the Permanent Representation of the Netherlands to the European Union.

Plantum and Bionext organised the event, pro-actively acting on current developments. Livia Hendriks, Public Affairs specialist at Plantum, explains: "The bulk of the decision-making on the organic sector has already taken place in Europe and now it is the Netherlands' turn to implement them. Within a few months, the Netherlands will present its Organic Action Plan. The Ministry of Agriculture, Nature and Food Quality (LNV) states that organic production and consumption must grow, as such following the European ambition resulting from the European Green Deal. European countries can develop their own actions. Plantum is very willing to contribute to this translation into workable implementation plans."

Niels Louwaars, Managing Director of Plantum, notes that the members have a growing interest in organic cultivation. Louwaars: "Producing organic seed is very knowledge intensive. The Netherlands seed sector is known to be able to tackle such complexities. The organic sector is a growing market for different seed companies."

Simone van Trier, moderator, led an interesting discussion with Heleen Bos, specialist organics at Rijk Zwaan, Arie van der Berg, association of organic farmers Het Biohuis, Bart Kuin, head of crop management at Bejo Zaden and Marian Blom, project manager Bionext

National efforts

One of the prominent questions at the event was how the goals of increasing organic production can be met, both from the consumption and the production perspectives. Participants discussed which national efforts are required and how the innovative Dutch breeding and seed companies can contribute to this goal, in conjunction with the organic value chain.

Marian Blom, regulation expert at Bionext and one of the panellists at the event, shares the positive vibes coming from this event: "Dutch seed companies can play an important role in providing good quality organic seed to the European organic sector, and so help to achieve the F2F goals. And these events are an excellent opportunity to explore the different views of relevant parties and develop a common understanding."

Not all answers were immediately apparent during the event. Plantum and Bionext are looking forward to a second edition of the network event later this year.

Growing acceptance demands harmonised **legislation**

Monique Krinkels

As more and more countries tolerate or accept the use and production of cannabis, the need arises to have solid laws and regulations. Breeders and producers of cannabis for either industrial, nutritional, medical or recreational use should be able to rely on clear legislation. CIOPORA, in collaboration with the Belgian law office Altius, delved into the matter.

In the EU, the legal situation regarding the medical and/or recreational use of *Cannabis sativa L.* varies from officially legalised to tolerated, or even prosecutable. Malta was the first EU-country who officially legalised the production, possession and recreational use of cannabis. Last December, the Maltese government decided to allow the possession of up to a maximum of 7 grammes of cannabis 'on the go', and up to 50 grammes at home and up to four plants (adults only of course). In Germany, the consumption of cannabis is allowed, but not its possession or selling. The latter two are considered crimes. On the other side of the spectrum, in Eastern European countries it is severely punishable. In Bulgaria, for instance, there is no distinction at all between heroin or marijuana, and a drug user may face up to eight years in prison.

Challenge

The new market opportunities with cannabis were one of the vogue subjects discussed at CIOPORA's 61st Annual General Meeting in Cologne, Germany, last April. Over 100 breeders, lawyers and IP experts from over 20 countries listened to a presentation about this rising crop. It motivated Dr. Edgar Krieger, Secretary General of CIOPORA, to shine light on the present situation in the EU. Philippe de Jong and Raus Bregt of Altius, a law firm specialized in IP, together with Paulo Peralta, CIOPORA's Technical Expert, prepared a factsheet on the topic. It is the latest of fifty studies that CIOPORA has prepared and that its members can freely access on the website www.ciopora.org.

For Cannabis breeders the Regulatory framework is crucial. It must be clear and preferably harmonized what can be grown, sold and consumed. Breeders of cannabis need harmonized rules that are adapted to their needs and replace the antiquated and fragmented legislation in the EU Member States. The experience shows that having an adequate legal framework allows for better development of the industry, more informed consumers and more robust protection of the innovation of cannabis breeders," says Edgar Krieger. "In the case of the European Union, it would be ideal to have common legislation for countries, building on the existing structure that protects other plant varieties."

The international illegal status of cannabis is provided by three United Nations treaties: the convention of narcotic drugs (1961), the convention of psychotropic substances (1971) and the convention on illicit traffic (1988). The list of narcotic drugs includes cannabis, cannabis resin and extract, and tinctures of cannabis. Under EU law, the same applies: these products are illegal drugs. According to the EU Court of Justice in 2010: "Since the harmfulness of narcotic drugs, including those derived from hemp, such as cannabis, is generally recognised, there is a prohibition in all Member States on marketing them, with the exception of strictly controlled trade for use for medical and scientific purposes."

Legal/illegal

There are four types of cannabis that can be distinguished by its use:

- industrial (hemp) – i.a. ropes, textiles, bioplastics and biofuel
- nutritional – i.a. non-dairy milk and cheese
- medical – i.a. to mitigate pain caused by multiple sclerosis and cancer
- recreational.

Another distinction is by its chemical profile. Fibre cannabis contains less than 0.2% dry weight of the psychoactive tetrahydrocannabinol (Δ9-THC), whereas the drug type cannabis contains 20% or more.

CIOPORA

CIOPORA is the international community of breeders of asexually reproduced horticultural plants. The members are breeders and title holders of ornamental and fruit varieties, as well as industry associations, IP lawyers and other actors involved in commercialization of plant varieties (affiliate members). The goal is the development, improvement, and harmonisation of Plant Variety Protection (PVP) systems worldwide. The organisation has 145 members.

A special part of CIOPORA is the CIOPORA Academy. It is the first worldwide educational programme specifically designed to share expert knowledge on intellectual property (IP) throughout the horticulture chain. The training is set up as a series of workshops and webinars, taught around the globe by experts in IP for plant innovations.

This article is based on the CIOPORA Factsheet: Cannabis in the EU, made together with the lawyer office Altius and published on the membership area of www.ciopora.org, in July 2022

Edgar Krieger: 'It is crucial for any breeder to have effective IP protection of their innovations. Cannabis breeders don't have it today. The added value of cannabis varieties for medical purposes lays in the dried flowers and products processed thereof. In the CPVR Regulation 2100/94 – like in most other national PBR laws – the scope of protection does not include processed material, not even in form of the cascade. So, I don't think that the law provides for effective protection for cannabis varieties

There are three legal categories of cannabis-based products:

- for medical or scientific purposes
- when it does not qualify as a narcotic drug, such as CBD oil
- for industrial purposes (hemp), with a THC-content lower than 0.2%. From 1 January 2023, the maximum THC content for fibre cannabis will change to 0.3%.

International law does not prevent the medicinal use of cannabis or cannabis-based products for the treatment of specific medical conditions. A 2019 European Parliament Resolution on the use of cannabis for medicinal purposes appears to have stranded without further action. The authorisation of medicinal products containing cannabis or cannabinoids does not differ from other medicines and can only be granted if safety, quality and efficacy of the product concerned are confirmed during the assessment.

There is no harmonised EU law on the use of recreational cannabis as such. The response to drug offences is the responsibility of EU Member States. The question whether recreational cannabis is legal, can thus ultimately only be answered from a national perspective. In principle, because of international law, recreational cannabis is officially illegal in the EU Member States.

EU neighbour

Switzerland has become the first European country to launch a pilot cannabis sales programme to study the effects of cannabis legalisation. The so-called 'Weed Care' pilot programme officially started on 15 September 2022 and is expected to last two and a half years, ending in March 2025. The programme includes 370 participants, based in Basel.

IP Protection

Plant Breeders' Rights: Varieties of Cannabis sativa L. can be protected by Plant Breeders' Rights, as any other plant. However, a pitfall can be the variety denomination. According to the CPVO, names of unsavoury characters from recent history or words with an offensive or abusive meaning in a language of the EU are prohibited. Due to the controversial nature of cannabis, the applicant may meet resistance in situations under the public policy restriction, where the proposed variety denomination is deemed to refer to an illegal narcotic. Currently, according to the PLUTO database of CPVO, more than 370 registrations have been approved under Cannabis sativa L. in EU Member States and 677 worldwide, with numbers growing steadily since 2019. Another problem could be the condition of novelty: many varieties are sold/commercialized on the black market. This may affect the novelty condition.

Patents: Plants exclusively obtained by essentially biological processes have been declared excluded from patentability. But plant-related inventions fall within the scope of the general patent scheme.

Legal framework

Plant variety rights (PVR) - Regulation (EC) 2100/94 of 27 July 1994 on Community plant variety rights (Basic Regulation) establishes a system of Union plant variety rights. The scope of an EU PVR extends across the European Union. In parallel, Member States may grant national property rights for plant varieties.

Phytosanitary framework The EU Plant Health Regulation 2016/2031 establishes harmonised rules to determine the phytosanitary risks posed by any species, strain or biotype of pathogenic agents, animals, or parasitic plants injurious to plants or plant products (pests) and measures to reduce those risks to an acceptable level. Regulation 2016/2031 is supplemented by various implementing and delegated regulations.

Plant Reproductive Material (PRM) - The EU PRM legislation is intended to ensure identification, performance, and quality to the user of the PRM and is, to that end, based on two elements: (a) the registration (or 'listing') of varieties, and (b) the certification of PRM that can be placed on the market. The framework consists of the horizontally applicable Council Directive 2002/53 of 13 June 2002 on the common catalogue of varieties of agricultural plant species, which is supplemented by 11 vertical Directives that regulate the PRM of specific crops. Industrial cannabis currently falls under the vertical Directive 2002/57 of 13 June 2002 on the marketing of seed of oil and fibre plants. The PRM legislation is currently under review.

Access and benefit sharing (ABS) - Regulation 511/2014 concerns compliance with rules as set out in the Nagoya Protocol to the Convention on Biological Diversity, to which the EU and its Member States are parties. The objective of the Nagoya Protocol on ABS is the fair and equitable sharing of the benefits arising from the utilization of a genetic resource with the country that provided that genetic resource.

Cosmetics Regulation 1223/2009 on cosmetics aims to ensure consumer safety. It regulates substances intended to be placed in contact with the external parts of the human body or with the teeth and the mucous membranes of the oral cavity, with a view to cleaning them, perfuming them, changing their appearance, protecting them, keeping them in good condition or correcting body odours. The CosIng database can be used as a tool to look up the status of particular substances and ingredients, for example, by using the keyword 'Cannabis'.

Pharmaceuticals - The requirements and procedures for marketing authorization, as well as the rules for monitoring authorized products, are primarily laid down in Directive 2001/83 and in Regulation 726/2004. They also include harmonized provisions for the manufacture, wholesale, or advertising of medicinal products for human use. Additionally, EU Regulation 536/2014 provides for common rules for the conduct of clinical trials (to test the safety and efficacy of medicines under controlled conditions) in the EU. The pharmaceutical legislation in the EU is comprehensive. It applies to any substance having properties for treating a disease or any substance modifying physiological functions by exerting a pharmacological or metabolic action. Consequently, cannabis-derived medicinal products arguably fall under the existing definition of a medicinal product, laid down in the EU legislation.

Narcotics - Council Framework Decision 2004/757/JHA of 25 October 2004 lays down minimum provisions on the constituent elements of criminal acts and penalties in the field of illicit drug trafficking.

Source: CIOPORA factsheet 'Cannabis in the EU', July 2022

The growing number of cannabis breeders need new, uniform rules to replace the antiquated legislation in the EU Member States

There are no plant patents in the EU, but the EPO registers 1,299 patents related to cannabis inventions worldwide.

Trademarks: For medical cannabis, trademarks are unproblematic, but any sign that is perceived to be referring to an illegal narcotic, such as recreational cannabis, risks being rejected on public policy grounds or on accepted principles of morality. Overall, there are 109 registers for cannabis under the EU TM, these include applications for TM, pending and completed registrations.

Trade secrets: The EU Trade Secrets Directive 2016/943 harmonises the rules for the protection of undisclosed know-how and business information (trade secrets) against their unlawful acquisition, use and disclosure. A trade secret can be anything, ranging from a cultivation technique to a business plan. Any type of information can, therefore, be protected as a trade secret.

Design rights: To protect packaging or accessories of cannabis-related products, design rights may be a relevant tool. These rights are regulated by Regulation 6/2002. To be eligible for protection, the design must be new and have an individual character.

EU Commission processes results of **consultation**

John van Ruiten

At the end of 2022, the EU Commission will present its view on the future of the EU Plant Reproductive Material (PRM) legislation. Currently, 12 directives for marketing seed and plant material in agriculture, horticulture, viticulture and forestry regulate variety registration and certification (of quality and identity) of this material.

The EU Plant Reproductive Material legislation has been in place since 1966, when the first EU directives, mainly for agricultural crops, were created. In the 1990s, directives for fruit plants, ornamental crops and vegetable plants also came into force. More than 12 years ago, the EU Commission already tried to modernize PRM legislation. With regard to a draft Plant Health Regulation and an Official Control Regulation (OCR), a proposal was made to integrate all the existing rules into one single Regulation. Because of very different opinions on the application of possible requirements for variety registration, among other things, especially in relation to the marketing of amateur varieties and conservation varieties, the proposal did not reach the finish line. The European Parliament was too divided and the commission withdrew the proposed PRM Regulation in 2013.

> 'The answers from NGO's and individual citizens were contrary to the opinion of public authorities, business associations and academic institutions'

Plant Health

In December 2019, the Plant Health Regulation (PHR) came into force, together with the OCR. The plant passport system and the import control system now functions on that basis. As was foreseen, for some points (definitions, documents, control systems, disease classification/RNQP's and standards) there are considerable differences between PHR and PRM directives. New PRM legislation might help to overcome at least some of these differences.
Before new legislation is proposed by the Commission, a procedure is followed in which 'Have Your Say' and stakeholder consultation programmes are a crucial (and obligatory) element. Statements regarding problems, objectives and options for the legislation (based on topics which have been under discussion during the last years) are presented on the EU internet site and the public (and specific stakeholders) are invited to give their opinion. The stakeholder consultation answers and expressed opinions give the EU Commission additional input for the development of a proposal for legislation which can be achieved. Together, of course, with the results of discussions in SCOPAFF and Council meetings.

Consultation

In the winter/spring of 2021/22, the stakeholder consultation PRM was carried out and the results were presented in June. As was expected, there was a wide range of views on the desired form and content. Almost 2,500 responses, of which 80% was from individual EU citizens, were sent in. Especially remarkable was the high percentage of responders from Sweden (50% of the total). Obviously, specific publication and announcements on the possibility of giving your opinion have worked very well there.
Also, it was possible to see that campaigning by organisations had an effect, because exactly identical answers were given by various respondents. After Sweden, most reactions came from stakeholders in Germany, France and Spain.
Overall, it can be seen that the answers from NGO's and individual citizens were contrary to the opinion of public authorities, business associations and academic institutions. As such, this is an important point of attention, because clearly the knowledge about the content of the rules and the views on the goals and effects of legislation are so different and also so polarized.
Around 60% of the professional businesses, business organisations and public authorities answered that the legislation is important and needed, basically is fit for purpose, but that it needs to be updated. More than two thirds of these responders felt that the new rules must apply to the marketing of PRM to all kinds of users, with no exceptions. Respondents from NGO's and citizens strongly disagreed with that opinion.

Harmonisation

Further alignment of the rules (harmonisation) is

Ir. J.E.M. van Ruiten is director of Naktuinbouw, Roelofarendsveen, the Netherlands, j.v.ruiten@naktuinbouw.nl

EU Phytosanitary Matters

This year, the EU Commission started a programme and active policy in which Member States have regular audits to check how they are carrying out obligations of the Plant Health Regulation (PHR) and if this is being done in a way that is officially prescribed. Themes this year are import/export controls, issuance of plant passports, Anoplophora inspections/measures and Xylella controls. The results of the audits carried out might lead to adjustments in operational activities in the countries concerned (and in other Member States).

High on the list of points on the monthly agenda of the Standing Committee on Plants, Animals, Food and Feed (SCOPAFF) Plant Health of the Union are still ToBRFV (Tomato Brown Rugose Fruit Virus) and Xylella fastidiosa. There are various opinions on the desired status of ToBRFV. In most EU countries, eradication of verified infestations is being carried out. In EU import controls of seeds of sweet pepper and tomato from China, Turkey, Peru and Israel, more than incidental positive test results in samplings are being found. This causes ongoing concern and export countries must pay extra attention.

The list of host plants of Xylella is still growing. Another 20 species have been added to the already long list. This means that inspection, combined with regular sampling and testing, is needed for marketing plant material. The full list of hostplants can be found on the websites of NPPO's and/or inspection authorities. Records of new detections of Xylella infestations are still concentrated in the regions where the bacterial disease occurred previously (mainly Italy, Spain, Portugal). In Spain, eradication is leading to good results in the Andalusia and Madrid regions.

From January 2023 onwards, third countries from which exports of host plants to the Union take place, must actively check and monitor production regions to check if they are free of Xylella. And they must provide this information to the EU Commission before 31 December to continue the possibility for export.

In 2019, the new category RNQP (regulated non quarantine pests) was introduced. Many diseases which had a quarantine status before were transferred to this category, because they regularly occur in the Union. But also serious diseases, that were previously regulated via the marketing directives, are now also regulated in the domain of Plant Health. This causes unclarity and the EU Commission has proposed to regulate RNQP's completely via the PHR. This has serious consequences for certification programmes in seed potatoes and fruit plants.

Amendments of the PHR came into force in April 2022. New quarantine pests and new import requirements were listed, such as Meloidogyne enterolobii, which means that import inspections on host plants of this pest (a.o Ficus, Philodendron) originating from certain countries are intensified.

Recently, four renewed directives on the control of potato diseases (Globodera, Synchytrium, Clavibacter, Ralstonia) were published.

New concerning findings of quarantine pests are non-european bark beetles (Euwallaceae), the mealybug Ripersiella hibisci, and the black whitefly Aleurocanthus spiniferus (in Citrus and indoor produced ornamentals). Additional information on newly occurring diseases/pests is also monitored by EFSA and EPPO. Publications/reports from these organisations are available in the public domain.

supported and many feel that unnecessary complexity and ambiguity exists and that this should be removed. The majority, however, is of the opinion that separate policy instrument for various commodities should also exist in the future. From the answers, it was very clear that many respondents felt that Forest Reproductive Material (FRM) has to be regulated separately from other PRM.

In general, there was huge support ,both from the public and the professionals ,for the thought that there should be simplified rules for conservation varieties and amateur/hobby varieties with respect to registration and certification. Also, the statement that PRM rules should contain a set of sustainability criteria was supported by most, except by the business associations. Difficulties in harmonising VCU requirements were signalled.

Most respondents did not support the statement that the Official Control Regulation should be applicable to PRM rules. They fear an increase in administrative burden and additional control costs.

New proposal

The EU Commission plans to come up with a new PRM legislation proposal (either various directives or a Regulation) at the end of the year. Then consultations and discussions on this proposal will start. It is envisaged that it will take until about 2027 before renewed legislation will come into force.

In the meantime, a number of issues have to be 'repaired' in the present text/requirements of the existing directives. Some of these are: the position of RNQP's (Commission has proposed to bring all norms/standards for diseases to PHR and Plant passport system), requirements for organic seeds and plant material, certification of seeds and seedlings in fruit plants, and equivalence (and import regulations) of seeds and plant material from third countries.

Maximise your seed's potential with Seed Technology Solutions

prime pellet filmcoat health polymer

Spinach goseed®

Now available!

Minimise stress, maximise performance.

Key benefits:

- Promotes plant emergence
- Maximises crop performance to increase yield
- Contains bio-stimulants + micronutrients for improved early crop growth
- Enhances plant health to minimise impact of abiotic stress

Visit **spinachgoseed.com** to find out more!

germains® seed technology

We Maximise Nature's Potential®

Four generations focussed on innovation

Monique Krinkels

Last September, Gautier Semences in Eyragues, France, celebrated its 70th anniversary. From great-grandfather Jacques-Paul Gautier (seed producer), to Henry (sales), Jacques (breeding) and Jeanne (brand manager), the family has been involved in vegetable seeds. The company is still 100% family-owned and offers a wide range of varieties in Europe, Asia and America.

Henri Gautier started selling seeds in Provence, first on a bicycle, then on a motorbike, and later by car

It all started in 1952 when Jacques-Paul Gautier, together with his 22-year-old son Henry, founded a horticultural seed production and marketing company in the small village of Eyragues, south of France. The name: JP Gautier & Fils; the premises: his house. Seventy years later, the company is internationally renowned under the name Gautier Semences, has several subsidiaries in other countries, over a hundred employees, state-of-the-art research facilities and an impressive list of their own bred varieties. The company is still 100% family-owned, with the fourth generation, Jeanne Gautier, active as Product Marketing and Brand Manager.

Local selections

JP Gautier & Fils limited its marketing activities to the Provence and developed its own bean lines. Twelve years later, when Jacques-Paul retired, the range the company offered had been extended to all vegetables that were grown in Provence at the time - the showpieces, in addition to beans, were cauliflower, melon, tomato, lettuce, fennel, carrot and leek.
The sixties were a time of formidable change in horticultural seed production. The first vegetable hybrids were introduced and that proved to be a game-changer. Henri Gautier did not hesitate to create new varieties, understanding that new methods and know-how were necessary. He contacted the French public research institute, INRA (National Institute for Agricultural Research), which was responsible for the crop improvement programmes in the country. In 1973, the company opened its first research centre just outside Eyragues, at the location where the headquarters can still be found. Initially, it was just a greenhouse, a small laboratory and one breeder, resulting in the first Gautier variety in 1979.

Future generations

In the meantime, the third generation, Jacques Gautier, studied plant breeding at the L'Ecole d'Ingénieurs de PURPAN in Toulouse. He joined the company in 1984, modernised the laboratory and gave selection and breeding a boost. In the early nineties that resulted in a tidal wave of new varieties, among which the famous melon 'Galoubet' and the tomatoes 'Castelane' and 'Olivade'. In the same period, the company expanded with a subsidiary in Alicante, Spain, and started the production of organic varieties. Subsidiaries in Italy, Turkey and Morocco followed suit and, since 2018, the markets in Asia and America are also being served. The latest achievement is a new segment in the market of tomatoes: the premium cherry tomatoes on the vine based on excellence in taste with its leading variety 'Piccolo'.
The focus on high-tech breeding was further developed by the opening of a biotechnology lab in 2000. Fifteen years later, research was moved to the 'Serre de l'Innovation', an innovative research centre in an eye-catching building on the outskirts of Eyragues. The arrival of the fourth generation, Jeanne Gautier, has brought a digital acceleration. E-shops for organic seeds and the launch of consumer brands to energize chain management.
Gautier Semences is still looking forward with new talents, new investments in facilities to improve performance and of course new innovative varieties, always focused on taste.

Easier to prove **fraud** thanks to advanced DNA technology

Hedwich Teunissen

With the implementation of new, sequence-based DNA technology, evidence of infringements becomes stronger and even more convincing. Naktuinbouw developed its Variety Tracer service further over the last number of years and new opportunities for checked relationships have proven their usefulness.

DNA to quickly check on the identity of a variety, to verify swaps or mix-ups or to investigate the potentially illegal activities of others with your protected variety or parental line. These are just some examples of identity questions for which DNA technology and genotyping can be applied.

Strong IP system

Horticulture is a very important and innovative sector. When compared to many other sectors, even innovative sectors like pharma and biotech or IT and software, the companies in the vegetable seed industry are top investors, spending approximately 20-25% of their budget on innovation and research and development in breeding and quality assurance programmes (source: EU *Commission Annual Global Survey*). As a result, many new varieties with innovative characteristics are developed annually. With this focus on innovation, intellectual property protection, in particular Plant Breeders' Rights, is very important. It provides for the return on investment and safeguards new innovations and creations for the years to come.

All the newly produced innovative varieties need to enter the market. Naktuinbouw, as one of the official Examination Offices in the EU, tests 2,000 of these new varieties in approximately 250 different crops for registration for marketing and Plant Variety Protection each year. Unfortunately, innovation in horticulture and production of highly valued varieties also leads to fraud, such as illegal propagation of seeds and plants.

A highly innovative and popular variety can be relatively easily propagated. This is very common for vegetatively propagated crops, but even for F1 hybrids (for example, in tomato) illegal propagation by cuttings can regularly be seen. The illegally propagated material is then sold using different names. In this way, the illegal propagator can benefit from the innovations in this variety without a licence contract and without paying royalties. The proportion of material that is actually believed to be illegally propagated (in general) is estimated to be around 12.5%, and for tomato even up to 40% in some European regions (source: *Annual AIB Infringement Surveys 2010-19*).

A second type of fraud that is widely seen in horticulture is 'imitation'. The good name of a popular variety is misused. Inferior seeds or plant material, often F2

Custom made solutions

Using a sledgehammer is not always the best method of cracking a nut. Applying sequence-based DNA technology that creates massive amounts of data is very powerful but is not always the most efficient way to prove fraud. Naktuinbouw Variety Tracer aims to develop custom-made experimental approaches for each individual case, including all necessary experimental controls to distinguish real (genetic) diversity from technological error rates. In every individual case, we start by asking two questions: 1. How deep do we need to look into the genomes? (which DNA technology is most appropriate in the specific case?) and 2. How extensively do we need to compare? (which controls are essential for accurate interpretation of the results?)

Comparing is always relative. The use of a larger number of DNA markers will increase the differences between closely-related plants. But also the number of differences between non-related controls will increase. In the end, the relevance of the controls included in the experiment are determinative for the accuracy of the conclusions. Extensive validation studies of methods and technologies on 'performance' are crucial to prove fit-for-purpose. The availability of DNA databases consisting of common knowledge varieties is a very powerful tool to use for enforcement. All possible controls needed for data interpretation are available in these databases! Currently, Naktuinbouw develops such DNA databases for several crops to support the management of variety collections in Distinctness, Uniformity and Stability (DUS) testing. Extensive DNA databases are available for potato, Phalaenopsis, strawberry, raspberry, blueberry, tomato, cannabis, French bean, onion and rose. DNA databases for many other crops are currently in progress. As spin-off, these databases are applied as references and controls in Variety Tracer projects on variety identification and enforcement. Integrity is guaranteed as genotypic information can only be used and released after the exclusive consent of the variety owner. The titleholder is the owner of the protected variety and this includes its genotype.

Dr. H.A.S. Teunissen is molecular biologist at Naktuinbouw, Roelofarendsveen, the Netherlands, h.teunissen@naktuinbouw.nl

Analysis of genotyping data obtained by next generation sequencing

or unidentified material, is sold in false packaging with fake logos, using the name of a popular and well-known variety of another company. A third type of fraud is the illegal use of a parental line of a competitor to produce a F1 hybrid that is almost identical or very similar to a popular F1 variety.
Although these kinds of suspicions are not new, it has always been very difficult, time-consuming and expensive to (legally) prove this kind of fraud. Naktuinbouw has obtained experience with different crops and recently developed three strategies which can be of help.

Proving fraudulent use

How can you prove that a (protected) parental line is used to produce a commercial hybrid variety? We suggest that this kind of suspicion is not new and is widely present among companies. The availability of advanced DNA technology has opened the door for breeders (owners and/or PBR titleholders) to actually obtain evidence for this specific category of potential infringements.
Imagine you are the titleholder of a very successful sweet pepper variety. This variety is a protected F1 hybrid and the parents, which are also PBR protected, are not available on the market. One day, not very long after the introduction of your variety to the market, you observe a new hybrid of a competitor that is very similar to your successful hybrid. We all know that the breeders' exemption under the UPOV system allows breeders to use protected varieties to create new, distinct, uniform and stable varieties with improved traits. The breeders' exemption assumes, however, that breeding is time-consuming, giving the owner of the initial variety a head start before new and competing varieties enter the market with the same traits.
It is therefore suspicious when this 'look-very-much-like' variety is launched only a short time after your variety. One plausible explanation of obtaining a look-a-like variety in a very short time is the (mis)use of the same parents. But how to prove this? There are several strategies:

Fishing for inbreds in a suspicious hybrid seed lot: Production of hybrid seed is a manual and very precise operation. Anthers need to be removed (emasculation) from the bisexual pepper flowers to ensure that the flowers can be (artificially) pollinated by pollen grains obtained from the desirable father only. Occasionally, when something in the emasculation process goes wrong, self-pollination might occur. This might result in a very low proportion of inbred plants (selfed mother plants) in the hybrid seed lot. These inbred plants can be identified using DNA markers, as the genotype that is expected for inbreds is identical to the genotype of the mother. Once identified, the inbred plants from the suspected seed lots can be directly compared (either morphologically and/or genetically) to the protected parental lines that have been potentially misused. This strategy has been demonstrated to be effective in several crops so far. Whether finding inbreds in a suspicious seed lot is

Analysis of long stretches of DNA using the Oxford Nanopore MinION sequencer

actually possible depends on many factors. In some crops, for example Brassicaceae, cytoplasmatic male sterility is very common, preventing the rare occurrence of self-pollination during the production of hybrid seeds. In crops where it is unlikely to determine inbreds, an alternative strategy must be applied.

Parent-offspring test (statistical evidence): A strategy that is commonly used in forensics and paternity tests in humans is based on statistics. What is the likelihood of a particular male to be your father? The same strategy can be applied to plants. In a research project on broccoli, we have genotyped a suspected hybrid variety and compared it to a variety of potential parental lines. In addition, we included several other hybrid varieties (full sibs, half sibs and non-related hybrids) and their known parents in the analysis. Parent-offspring tests were performed. Based on the similarity values for the proven parent-offspring combinations used as controls, the similarity results for the suspected parent-offspring combinations could be interpreted. This strategy appeared to be very effective in terms of convincingness versus costs. When statistical evidence is considered not entirely sufficient, more powerful evidence can be obtained by investigating the inheritance of large regions of DNA from parents into F1 hybrids.

Multiple Sequence Alignments (smoking gun evidence): The Next Generation Sequencing (NGS) revolution enables us to look both more deeply and more widely into plant genomes, revealing massive amounts of data that can be compared. When applying sequence-based DNA technology (either based on reduced representation libraries or whole genome sequencing approaches), the information of large DNA strands can be used for heritability studies. In Multiple Sequence Alignments, the inheritance of large DNA strands well spread over the genome, from potential parents to offspring, can be compared. This type of evidence is very strong (smoking gun evidence), but also challenging to obtain. The quality of the sequence data is crucial, as well as the downstream bioinformatics. This strategy is currently the expensive option, but with very high potential.

The Sherlock Holmes concept

The Naktuinbouw service called Variety Tracer was 'born' nearly twenty years ago and especially developed to answer all kinds of questions about the identity of plant material, suspicion of repeated cropping and suspicion of infringement of Plant Breeders' Rights. The service provides a 'Sherlock Holmes concept' which can be used to settle (legal) discussions about identity. In the old days, random marker technologies were used, such as the AFLP and crop-specific Simple Sequence Repeats (SSRs). Nowadays, more advanced DNA technology such as Genotyping-in-Thousands by Sequencing and Whole Genome Sequencing (NGS) approaches are being implemented, although sometimes, and for some crops, the 'oldies' are still going strong.

Variety Tracer is one of the little gems of Naktuinbouw: a custom-made approach is the default procedure as the client's needs are unique in every potential infringement case. Furthermore, Naktuinbouw's independent position and their highly skilled research team, combining professionals on morphological comparative research and experts in the field of molecular biology, bioinformatics and data science, are the ingredients for success. It is the combination of – and synergy between – these elements that guarantees extremely sound analyses and provides important evidence, which of course is crucial for the two parties (both the accused and the accuser) to find answers and/or to settle disputes.

Three strategies

The availability of three different strategies to prove the fraudulent use of a protected parental line opens the way to effective enforcement for breeders and variety owners. Depending on the situation and the crop concerned, just one or a combination of strategies can be applied. A combination of strategies will shed light on the case from different angles, making the evidence stronger and more convincing.

Seed drying & equipment

AGRATECHNIEK BV from HOLLAND is specialized in drying all kinds of seed.
We have more than 35 years of experience with Seed drying and processing technology

Individual open box dryer

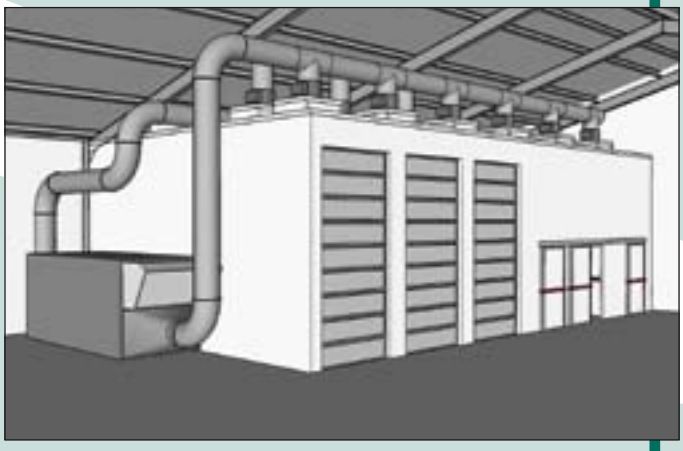
Drying of seed
(A) in boxes
(B) per box individual.
Per box a fan (C)
and heating source (D).
Extracting outside air (E),
dehumidified air (F)
or inside air (G).

Individual closed box dryer

Individual closed drying units for conditioned drying of seed in boxes.

Optimal use of dried air

Central hybrid air dryer (left) to be connected to different drying installations, drying units or drying rooms;
optimal and economic use of dried air.



Drying seeds in closed rooms and Seed vault for storage

Central hybrid air dryer for drying rooms (left) and seed vault (right). Storage of previous seed at 15°C and 20% RH or 10°C and 25% RH.

Humidification of too dry seed

Humidification unit (A) to increase moisture content of too dry seed without making the seed wet.Damp air will be distributed through the seed by any kind of aeration system. The safest way for automatically humidification of your seed

Agratechniek b.v.
Lou Nieuwenhuizen
SEED DRYING INSTALLATIONS & EQUIPMENT

Anna Paulowna, The Netherlands
+31 223 522824
info@agratechniek.com • www.agratechniek.com

GENOVIX®

BOOK A DEMO AT GENOVIX.IO

Innovating in Your Field Since 1990

Increase your profitability with Genovix for plant breeding and variety testing. Our Genovix learning centre is designed to empower your research.

Visit us at **booth #18** at the **Euroseeds Congress 2022 in Berlin,** from **24 to 26 October.**

AGRONOMIX SOFTWARE a CULTURA company