

THE ANNUAL 2021

Journal for breeders and producers of plant material

Prophyta

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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

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COVER PHOTOGRAPH

Franca Pedrazzetti

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 Kostelijcklaan 16
1981 CG Velsen-Zuid
the Netherlands
phone +31 (0)255 521 852
info@bluebirdpublishers.com
www.bluebirdpublishers.com

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On the cover: Volunteers of the Swiss ProSpeciesRara have saved 150 varieties of tomatoes for future generations, among which the 18th century's 'Amish pasta', one of the most aromatic types of tomato

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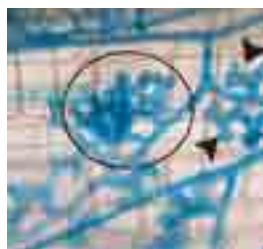
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Andean lupin oil has excellent fatty acid composition and is therefore suited for food applications, such as margarines and mayonnaises, but also for cosmetic applications, especially hair care products, lipsticks and nourishing anti-aging skin care products

Aphid's appetite ruined

RESEARCHERS at Wageningen University & Research have discovered that a resistance gene in thale cress (*Arabidopsis thaliana*) against the green peach aphid, also affects other aphids and whiteflies. In an experiment published in *Plant, Cell & Environment*, researchers demonstrated that this gene is found in every part of the plant (the roots, leaves, stems and buds), but is only active in the so-called phloem – the cells which transport the sugar-rich sap through the plant. They also discovered that the gene works against other species of aphid and whitefly which, like the green peach aphid, feed on phloem sap. The tobacco whitefly and mustard aphid are however unaffected and still feast on the plant, but for the latter this does involve an unusual spitting ritual. These aphids would repeatedly inject their needle-like mouth parts into the phloem and then spit, doing so up to 20 times before they actually began to eat. This suggests that repeatedly injecting spit with special proteins helps the mustard aphid bypass resistance.

First Andean lupin granted PBR

ON 29 DECEMBER 2020, Plant Breeders' Rights were granted to Vandinter Semo BV for the Andean Lupin variety 'Cotopaxi'. The variety is named after a stratovolcano in Ecuador, the country where the Andean Lupine stems from. Cotopaxi is the result of collaboration between Vandinter Semo, Hanze University of Applied Sciences and the H2020 BBI-JU European research project LIBBIO. Andean Lupin (*Lupinus*

mutabilis) has its origin in South America and is one of the four lupin species fit for human consumption. Andean Lupin is a sustainable alternative to soybean because of its comparable oil and protein content and its contribution to biodiversity and soil improvement. See *Prophyta – The Annual 2020* for an article about this crop. It is the first Andean Lupin variety in Europe that has been granted Plant Breeders' Rights.

Sow to Grow shows the history of lettuce

WHILE THE ANCESTOR to today's lettuce was hardly edible (hairy leaves, thorns and a bitter milky sap flowing through the stems), there are about 2,500 examples of *Lactuca sativa* that are preserved in the genebank of CGN. The Dutch Museum 'Sow to Grow' in Enkhuizen, the Netherlands, has planted a selection of different lettuce types in the Monastery Garden beside the museum. Inside, an exhibition is focused on the history of lettuce with its various forms and applications. This summer, the museum will be open again after seven months of lockdown due to the covid-19 pandemic. Sow to Grow is always worth a visit to gain more insight into the breeding of plants that contribute to the world's food supply and human well-being. The opening days and times are Wednesday to Sunday from 12.00 to 17.00 hrs. The museum is closed on Mondays and Tuesdays. Visitors should comply with



the government restrictions to combat the covid-19 virus. Book in advance, disinfect hands, wear a mask and keep 1.5 metres distance.

In the forecourt of the museum, Sow to Grow, numerous examples of vegetables and flowers are shown in their natural environment.



During the past two years, the European Commission conducted a study on the 'appropriateness of current GMO legislation and regulations'

Current GMO legislation ineffective

IN ORDER TO MAKE GMO legislation more sustainable, future-proof and uniformly implementable, new policy instruments must be developed. That is the main conclusion of the long-awaited EU report on the application of new genetic techniques, such as Crispr Cas9, in Europe and its relationship with genetic modification legislation.

The report concludes that most of the methods studied have no specific safety risks, compared to generally accepted methods. There are several ethical aspects, both for and against the use of these methods. The report's conclusions clearly indicate the need for new regulations. Current legislation is not fit for purpose, given the technological developments. New rules must be future-proof and uniformly enforceable.

In 2018, the European Court of Justice ruled that gene editing products are regulated and covered by GMO legislation. This was a disappointing statement for plant breeders, but also for growers and traders of agricultural products, as it makes the wide use of this technology practically impossible.

EU Commissioner for Health and Food Safety, Stella Kyriakides: "The published study concludes that new breeding techniques can contribute to sustainability, in line with the goals of the Farm to Fork strategy. With consumer safety and the environment in mind, it is time to have an open dialogue with our citizens, member states and the European Parliament on the use of these biotechnologies in the EU."

Science-based decisions

This April, the European Commission published the results of a two-year study into the 'appropriateness of current GMO legislation and regulations'. Thanks to, among others, the Dutch government's influence, Brussels decided to review its 2018 decision that mutants obtained by gene editing should be treated completely differently from 'classical' mutants obtained by radioactive irradiation or chemicals. As a result of false arguments, products created with the novel techniques fall under the strict European Directive on genetically modified organisms, while they cannot be distinguished from varieties acquired by conventional cross breeding or a classical mutagenesis technique. There is no way of telling one from the other.

The new report concludes that new breeding techniques, such as Crispr Cas9, contribute to sustainability, in line with the goals of the Farm to Fork strategy of the European Union. It is time to have an open dialogue with citizens, Member States and the European Parliament about the use of these biotechnologies in the EU, stated EU Commissioner for Health and Food Safety, Stella Kyriakides. The crucial term in this statement is of course 'these biotechnologies'. The European government still believes that genetic engineering might be a threat to its citizen's health and Europe's nature and/or that there are ethical objections against artificially altering the genome of a plant. Without any science-based arguments. It was 27 years ago that Calgene introduced the transgenic tomato, 'Flavr Savr', on the market, after the US Food and Drug Administration (FDA) declared it as safe as a regular tomato. Supermarket chains, Sainsbury's (UK) and Safeway (USA), together sold 1.8 million cans of tomato paste made from 'Flavr Savr'. No adverse effects were ever recorded.

Today, nearly 200 million hectares of biotech crops are planted in 30 countries, none of which have reported any significant health damage or environmental harm. The monarch butterfly, a focal species for the anti-GMO activists, thrives in the USA, pests have not developed resistance to Bt, nor have any superweeds emerged. As to the ethics: medicine would not be where it is now without biotechnology. Since the gene for human insulin was incorporated into the bacterium *E. coli* in 1982, researchers have been using recombinant technology to develop new ways of healing people. Today, most pharmaceuticals are produced using biotechnology. It is, therefore, time not only to reconsider regulations that concern gene editing techniques, but also the EU legislation covering the whole spectrum of modern plant biotechnology. And please politicians, only use science-based arguments to set up new legislation, as anything else is just bogus.

Monique Krinkels

Impact of **Brexit** could have been dramatic

Ton van den Born

6 They were tense days for Europe and the United Kingdom, in December 2020. Brexit had already been hanging like a shadow over the political debate in London and Brussels for four years. But how would it ultimately take shape, deal or no-deal? Not until the day before Christmas was the conclusion reached.

• **In retrospect, it turned out** that there had been much tinkering with an agreement. But had it not worked out, according to Professor Robert Hall of Wageningen University & Research, the consequences for research collaboration within plant breeding and other disciplines would have been ‘fairly dramatic’. What does Brexit mean for researchers and students?

Robert Hall was asked 18 months ago to find out what a no-deal Brexit would mean for Wageningen University & Research (WUR). He teaches plant metabolomics and is deputy manager of the Bioscience business unit within the Plant Sciences Group of Wageningen UR. Moreover, he is originally from Britain. The Board of Directors wondered what the consequences would be, for example, for research collaboration. How could WUR best prepare for this?

Hall is a member of the ‘WUR EU council’, a sort of Europe team that was set up a few years ago. “We are trying to build stronger links between Wageningen and Brussels and support the EU in making strategic choices, for example, in EU programming.”

The EU council consists of a core group of five people led by Martin Scholten, who was director of Animal Sciences until last year. Scholten is now a full-time advisor to the Board of Directors for Europe and the regions. And Robert Hall is in the core group representing the Plant Sciences Group. “This year we coordinated the production of policy papers amongst other things, for example in the areas of protein transition, crop resilience and climate adaptation.”

Quite dramatic

The question to Hall to find out what consequences Brexit would have, was not intended for Brussels, but for an internal report. What to do as WUR? The Board of Directors of Wageningen UR also wondered how important the British research collaboration actually was. Hall: “It turns out that in Wageningen we collaborate the most with the United Kingdom. More than, for example, with much larger countries such as the US, China or Canada.”

“You see a lot of collaboration with the United Kingdom throughout Wageningen UR,” he continues.

“Also in breeding, and more broadly in Plant Sciences, there are many contacts. It is very unusual for a British group not to be involved in a European research



‘British participation in European research had fallen by a third in 2020 due to the uncertainty about the future position,’ says Robert Hall

project. British people are also most often coordinators of European projects. How come? The Dutch and the British find each other very quickly and get along well. Our cultures and way of working fit well together. As soon as we start a European research project, we often ask British people and vice versa they often come to us.”

“If that were to disappear, it would be quite dramatic. The question was, for example: if there is indeed a no-deal Brexit, without agreements about programmes, will British scientists still be able to participate in European programmes?” Or in concrete terms: will they participate in Horizon Europe, successor of Horizon 2020 until 2027, the new programme with which the European Commission wants to promote science and innovation?

A development was already underway. “Before the deal came, Europe was already looking the other way, away from the United Kingdom and more to other



Erasmus students no longer can afford to go to excellent universities such as Reading, Sheffield, Manchester or Nottingham, as they no longer receive funding from the Erasmus+ programme', says Jeroen Ouburg

'It is very unusual for a British group not to be involved in a European research project'

countries. British participation in European research had fallen by a third in the last year due to the uncertainty about the future position."

"We have been thinking about bilateral collaboration, we have established links with the United Kingdom, we have produced a whole advisory document. But in the end, it turned out that all our worries were included in the deal. There appeared to have been hard work behind the scenes. It is not all official yet - the agreement still has to be signed by Brussels - but the British can continue to participate." They will continue to actively work in the ongoing projects under Horizon 2020 and will also participate in Horizon Europe.

"It is then more or less 'business as usual' for British scientists. The decline in British participation has reversed. In any case, this year they can participate closely in European research, and continue to coordinate it if they were doing so. Good news for the researchers."

No more financing

It is a different story for students. "Different rules apply," says Jeroen Ouburg, international advisor at Corporate Strategy & Accounts at Wageningen University & Research. Those other rules affect both exchange students from here and there and also Dutch students who want to do the entire course in the United Kingdom, or vice versa, British students here. And then, for example, also do a work placement at a company.

The United Kingdom has decided to leave the EU student exchange programme Erasmus+. It is not possible to say exactly how many students that will affect, but according to Erasmus+ figures, 17,000 British students went to Europe in 2018 and about 2,300 students came to the United Kingdom from the

Netherlands alone. Also from Plant Sciences, Erasmus students often went to excellent universities such as Reading, Sheffield, Manchester or Nottingham. That is ending, but Marie Curie scholarships for PhD Students will continue. "Because they fall under Horizon," explains Ouburg. The United Kingdom has an alternative in mind for British students who want to go to Europe, namely the Alan Turing programme. "Interest in exchanges to the UK remains," says Ouburg, "but students no longer receive funding from the Erasmus+ programme. They must apply for a visa, arrange insurance and also pay a deposit with the National Health Service. Then you are soon talking about a few hundred pounds." And that is just small change compared to the thousands of pounds a foreign student will pay annually for a bachelor's degree at a British university. This also applies the other way around for studying in the Netherlands, Ouburg adds. Britons will have to pay the high fees here. He then expects a shift in who will and can come or go. "You want all students to have the opportunity, but that will be difficult; I don't know if it will work. That is the biggest concern."

Many universities have already contacted each other after the referendum in 2016 and discussed continuing to facilitate exchanges after Brexit by means of no exchange of funds. "Then you are talking about the duration of the exchange, the accreditation of courses and, above all, the balance. For example, one student from Wageningen versus one student from Reading. Then you can offset costs against each other."

Comparison with other associate countries of the EU is difficult because Norway, for example, does participate in Erasmus. "We are entering unknown territory with Brexit," says Ouburg. He is confident that there will eventually be more clarity, but warns to be vigilant about the rules. For example, whether a work permit is required if you are going to do a work placement at an organization in the United Kingdom. "Check it out carefully, because if everything is not in order, then the fine can be high, or you will not be able to enter the country."

Phytosanitary certificate

Unlike Erasmus, the Turing programme is aimed at the whole world. The British government has said that British students will then be able to study not



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‘In the long term, once interests diverge, there can be consequences’



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only in Europe, but at ‘the best universities’ around the world.

Apparently, the British government did not want to impose too many restrictions and rules so as not to hinder scientific collaboration. Undoubtedly from the understanding of how important this collaboration is for the scientific level, innovation and development domestically. Hall: “It is still easy for those with higher education to cross the border and carry out research work in the United Kingdom. No visa is required coming from the EU. But for cheap labour it is much more complicated, with the consequence that it is now proving difficult to find people for strawberry picking and harvesting asparagus.”

Besides for individuals, researchers and students, Brexit has consequences for trade and materials. “As far as research material is concerned, it is still fairly easy,” says Hall. “Unlike for trade, because there are now many restrictions. As far as research material is concerned, it has become at most a little more complicated, but the Nagoya protocol (international agreements for genetic material, 2010), for example, is much more complex. If you want to research material from another country, you need, for example, permission from the government of that country.” This also affects Dutch companies that are active in breeding, propagation and cultivation of seeds and young plants. According to Niels Louwaars, managing director of trade association Plantum, major problems have been averted for the time being. The sector, the companies and also the inspection services were prepared when, on 1 January 2021, the requirement came into force that a phytosanitary certificate was required for the import of high-risk plants and

plant products - lists of those (regulated) plants are available online.

More information about this can be found on the Brexit page of Naktuinbouw. It also states that, on 11 March, the British government decided to postpone trade regulations until January 2022. According to Louwaars, this primarily means some breathing space for British exports. But after that date, shipments of regulated plants and plant products will require more identity checks and phytosanitary inspections.

New opportunities

Robert Hall is very happy that an agreement was reached. “It would have turned out very badly otherwise. Bilateral collaborations had been set up, but the United Kingdom could not have participated in European consortiums for at least a few years. Participation in European projects will now cost them more money. Just as is the case for associate countries such as Norway and Switzerland; they already pay for participation.” The costs for British researchers in EU projects will then ultimately be borne by the British government.

In addition, because Britain is no longer a member state, they can no longer participate in strategic discussions about the direction of research in Europe. “In the long term, once interests diverge, there can be consequences,” Hall says. “But I have every confidence that ultimately the impact will be limited for research and for the scientists. Perhaps there will also be new opportunities.” 🌱

Spain as a portal between the old and new world

John van Ruiten

IO Unfortunately, the World Seed Congress will not be a physical meeting ground this year. Due to covid-19, we will not be able to shake hands in the dazzling city of Barcelona, Spain. The history of that country enriched the world with numerous crops, without which today's greengrocer shops would be half empty.



Popcorn might well be the world's oldest snack archaeologists discovered in excavations in Peru, dating as far back as 4700 BC

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

• **Talking about Spain and agricultural products,**
• one automatically mentions olives, grapes, tomatoes
• and oranges. For olives and oranges, Spain is the
• largest producer in Europe and for wine, the third
country. And the country is one of the important
producers of food and drinks in the European Union.
The food sector has a total value of €100 billion.

Exchange

But, as is also the case in many other countries, the most important agricultural products of today do not have their history in the country itself. They were introduced, some quite recently, some thousands of years ago. This article brings us back in time. From ancient history to the period of transatlantic 'discovery' voyages. The period of the start of what is today known as 'the Columbian exchange', the massive spread over the globe of crops, animals - and unfortunately the associated pests and diseases. Not only do the crops grown in a country often come from far, but also the people living there have roots that often tell a story of invasion, occupation, migration and mixing, etc. So, through the ages, Iberia had an influx of Caucasian people (more than 5,000 years ago), Phoenicians (the first colonists

More to read

This article is not written to describe in detail what happened with crops, with cultivation techniques and the global spread of crops (and gene material) in the years after Columbus. Certainly, it does not pretend to be scientific. With this article, I hope to interest readers in this subject that started in Spain, of which one might say that it is, apart from the development of agriculture and domestication of plants that started 10,000 years ago, by far the most important event in the history of our planet.

Very many exceptionally good articles, books and studies have been published that highlight various aspects of this subject. Personally, I can recommend the books of Charles Mann (1493 and 1491), Jared Diamond (Guns, Germs and Steel) and articles by Alfred Crosby (the Columbian Exchange and Ecological Imperialism) that provide fantastic historical (and original) views on this fascinating period in our history.

of the whole Mediterranean region), Greek, Carthaginians, Romans (bringing the language that now dominates Spain), Visigoths and Moors. They all brought their culture and specific food products and agricultural techniques. Olives and grapes were brought to the country by Phoenicians, the Moors brought oranges and the technique of irrigation. But the history of the introduction of tomatoes and potatoes is a very different story.

Columbus

The history is well-known. Queen Isabella from Castile accepted and financed the plan of a pioneer from Genoa, Italy, called Christopher Columbus, to seek a western sea route to the East Indies, hoping to play an important role in spice trade. Knowing that the earth is not flat but round, convinced him that this should be possible. However, during his four journeys sailing under the Spanish flag, he never reached the Indies. But during his first voyage, on 12 October 1492, he set foot ashore on the Guanahani island, in what is now named the Bahamas. He called the island San Salvador.

It was the beginning of an era in which the Spanish dominated the western hemisphere and sea routes (whereas the Portuguese - and partly the Dutch - dominated the eastern part of the world). Spanish 'conquistadores', during a period of around 50 years, overwhelmed and occupied most of the areas and people in the Americas. With weapons (guns), bringing diseases with them, with horsepower and a culture of feeling superior, they had a dramatic influence on the original population of Aztecs, Incas and other local inhabitants. Over 90% of the people did not survive this 16th century period.

Silver and gold

Those products (stolen and mined) were the first to be shipped to Europe. In the late 15th century and beginning of the 16th century, as far as we know now, there were no spices or other food products transported from the Americas to Spain. Of course, agriculture in the communities of the Americas was small scale, although quite highly developed, with domesticated crops (and selections) like Phaseolus beans, maize, pumpkins, chili peppers, potatoes and

In the 16th century, the Aztec diet was dominated by fruits and vegetables. Maize, beans and squash were the three staple foods



II

tomatoes. They used terraces, chinampas (floating islands), drainage and irrigation systems. It was with the return of Hernan Cortez that, in 1528, the first cacao beans (*Theobroma cacao*) were brought to Spain, together with the technique of making chocolate and chocolate drinks. It was the start of the spread of this product around the globe and the start of cultivation of the cacao beans in African and Asian colonies of European countries. It is documented that, in 1518, the first tomato seeds

were probably introduced in Europe. But not with the purpose of growing tomatoes for eating. It is remarkable that the plants were grown in gardens as strange/new ornamental and medicinal plants, and not as a new food commodity. From DNA research on herbarium material, we now know that the seeds were not from the wild indigenous species of tomato, but from what we now would call tomato selections (that were the result of a domestication process over thousands of years in Meso America).

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The Spanish conquistadores not only brought new crops to Europe, but also new words, borrowed from the Aztec people and their Nahuatl language. The English vocabulary was enriched with, for instance, avocado (ahuacatl), cacao (cacahuatl), chili (chilli), chia (chian), chipotle (chilpocotli), chocolate (chocolātl), guacamole (ahuacamolli) and tomato (tomatl)

- Obviously, seeds were gathered/taken by the Spanish
- as interesting plants, but without the indigenous
- knowledge to grow flavoursome fruits.

Even more remarkable is the introduction of the potato crop to Europe. The first potatoes came to Spain in around 1565. The Spanish chronicler Pedro de Cieza de Leon was the first westerner to describe the potato in 1540 in his Chronicles of Peru: 'in the vicinities of Quito, the inhabitants have with maize another plant that serves to support in great part their existence: the potatoes, that they are of the roots similar to the tubercoli, supplies of one rind more or little hard; when they come bubbled they become to hold like the cooked chestnuts; seccate to the sun call them chuno and they are conserved for the use.'

13

The first potatoes in Europe were grown in monastery gardens in and around Seville as ornamental plants. No one dared to eat the tubers of this plant from the nightshade family with its toxic members. Potato plants were considered weird, poisonous and evil. It is said that some plants were given to the Pope in Italy, as a medicinal plant, by Philip II, king of Spain during the period 1556-1598. The great botanic scientist Clusius received some potato seeds in 1588 from an Italian source and sowed them in the botanical gardens of Antwerp, and later Leiden. The name, *Solanum tuberosum*, was first given in 1590 by Gaspard Bauhin, a Swiss botanist who used binomial names a long time before Linnaeus.

And although the tubers of potatoes were eaten on a very small scale around 1600, it took still more than 100 years before cultivation of this crop really took off, and it became an important source of feed for cattle and carbohydrates for people – so more than 150 years after the introduction of the crop in Europe. It takes a long time for people to get used to new foodstuff and to overcome prejudices!

Global crops

Tomatoes, maize, beans, potatoes, pumpkins, peppers: these six commodities are nowadays considered global crops. Bred and developed further, with the ability to grow them in many climates and regions. They all came to Europe via Spain in the 16th century. At the same time, Europeans brought their staple food and crops to the Americas, such as wheat, cabbage, onions, peas, lettuce, apples, pears and peaches. From their colonies, they also spread rubber trees, coffee, bananas, and many more crops to the 'new world'. 🌱



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Network saves Swiss cultural-historical diversity

Monique Krinkels

14 ProSpecieRara is the driving force to save the Swiss genetic and cultural-historical diversity of cultivated plants and livestock for future generations. It does this together with a network of volunteer variety supervisors and breeders across this Alpine country.

In a corner of the beautiful Merian Gardens, in the Swiss city of Basel, is the headquarters of ProSpecieRara, a non-profit foundation established in 1982 with the purpose of preserving cultural and genetic diversity in plants and animals. Meaning literally 'for rare species', the foundation sees its main goal as combatting the loss of diversity, but its diversity management goes further than just maintenance. It endeavours to promote the availability and utilisation of heirloom varieties and neglected cultivated plants. The foundation's portfolio is split into three sections – (i) field crops, vegetables and ornamental plants, (ii) fruits and berries and (iii) rare breeds of animals.

Resources

ProSpecieRara exists largely through the generosity of donations with 14,000 registered donors. It also receives government grants and income from EU funding. The foundation employs 30 members of staff, equivalent to approximately 20 full-time equivalents.

Outside of Switzerland, there is also a branch of ProSpecieRara in Germany.

Portfolio of ProSpecieRara

locations	varieties
15 vegetable gardens	1,600
15 ornamental gardens	1,200
121 orchards	1,800
2 vineyards	90
72 berry gardens	400
17 animal farms/parks	32

Seed and the seed savers

The basis for maintaining its seed bank is a seed savers' exchange. ProSpecieRara can, for instance, count in its collection 120 varieties of beans, 90 varieties of potatoes and over 1,200 varieties of ornamentals. These are all maintained by its extensive network of individual enthusiasts.

Seed is outsourced to gardeners and hobbyists all over Switzerland. These guardians of the collection follow annual courses in growing and harvesting the crop, after which the seed is sent back to the seed store at the headquarter in Basel. Some seed guardians also offer their seeds directly via the ProSpecieRara online seed catalogue to other members. <https://www.prospecierara.ch/pflanzen/sortenfinder.html>. Such is the interest in supporting the seed saves initiative that there is a waiting list of over two years to join.

Establishing the collection

The core of the collection is established from varieties which are common to or have been cultivated in Switzerland. While cultural value plays an important

role in determining if a variety enters the collection, other important characteristics are taken into consideration, for instance, hardiness and nutritional value. ProSpecieRara estimates that only about 30% of the former existing diversity is still in use, with 70% of the agricultural genetic diversity having already been lost. Only 120 edible species form part of the commercial value chain in use by breeders and larger seed companies, whereas 7,000 edible plants in the world could be utilized. Most of these can be summarized as neglected crops.

The ProSpecieRara label

ProSpecieRara success not only lies in maintaining a catalogue of its heirloom varieties, but also in making these available to the public. It has created and developed its own private and certified label (<https://www.prospecierara.ch/ueber-uns/uetesiegel.html>). Seed packets, which are available to hobby gardeners and sold extensively through various seed suppliers, are tagged with the ProSpecieRara label.

The foundation also joined forces with the second largest supermarket in the country, the Coop, which since 1999 now offers organically grown ProSpecieRara varieties in its produce section. Swiss citizens throughout the country can buy seasonal heirloom tomatoes, carrots, beets, salad greens and more at their local supermarket, all labelled with the ProSpecieRara logo. This tactic has been especially helpful, as it has brought several varieties of rare foods back from obscurity and onto people's plates. It is estimated that one third of the Swiss population are aware of the ProSpecieRara label.

Focus on ornamentals

15 years ago, ProSpecieRara also started to collect old endangered ornamental varieties and species. As the foundation's mandate not only covers the conservation of the genetic diversity but also cultural heritage, it was an obvious consequence that ornamentals would become an additional field of engagement. An inventory of Swiss seed catalogues from 1870 until 1950, initiated by ProSpecieRara, resulted in a list of over 65,000 entries. Only 10% of this amazing diversity was still available on the market and in existing collections. It became clear that something had to be done to safeguard at least a small part of this heritage



The Saaser Mutte is a Swiss mountain sheep that has been worked with in the Saas Valley and the Simplon region near the Italian border for generations

in an always faster developing international business, where short time trends often define breeding activities.

New niches

Following a very successful seed-for-all campaign between 2007 and 2009, in 2010 Switzerland established its own legal directive on registration, allowing the marketing of non-registered niche varieties. Registration can take place via a simple description and a one-time registration fee of CHF 50 (€ 45) per variety.

Swiss Government backing increased in 2016 with a new directive for sustainable use of Plant Genetic Resources for Food and Agriculture supporting the breeding of niche varieties. Based on this directive, ProSpecieRara and its partners are now leading four projects to develop new niche varieties. These include neglected crops such as pear-shaped onions, bulbous chervil, and white coloured carrots.

'Big industry' cooperation

Béla Bartha, director at ProSpecieRara, is disappointed in the response and support from the major seed companies. He believes that there is much to be gained from working together, but he finds communication difficult and generally negative. He sees a role in offering support for maintaining varieties which are no longer registered, or which fall out of a breeding programme. He believes that the foundation could be a documentation centre for maintaining breeding history and some of the very crucial breeding lines/varieties issued from former breeding programmes, that stood as a starting point for many other varieties that followed, the so called 'milestone-varieties'.

Access to private collections remains an obstacle. He believes this strategy to be very short-sighted because future breeding will depend on easy access to worldwide plant genetic resources. Here, the work of ProSpecieRara, as a foundation, could fill a gap.

From berries to beasts

ProSpecieRara boasts an incredible collection of berries. 72 gardens maintain a collection of over 400 varieties, and the foundation has, for instance, one of the largest collection of gooseberries in the world. It also maintains 32 rare breeds of animals, including 12 goats, 7 sheep, 1 dog (the Appenzeller Mountain Dog) and even 2 species of bees.

Secret to Swiss success

Béla Bartha: "The secret to our success lies primarily with our network of enthusiasts and professionals. We have seen since Covid-19 that these supporters have grown by more than 30%. We have been able to create a national platform integrating all stakeholders and the supportive legal environment gives us the freedom to operate as well as the allocation of resources. We have a funding structure which is based on several pillars and the creation of a PSR label/brand has helped to promote the idea to a broader public and to improve the quality of the management of plant genetic resources. Our endeavours match well with the climate of biodiversity, conservation, and sustainability, which the Swiss consumer expects and embraces. We see a blooming future for our foundation that could become even better if breeding companies would open themselves towards a fruitful collaboration by providing easier access to their diversity of obsolete varieties, instead of giving them up and throwing them away." 🌱



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New dryer halves energy use

Monique Krinkels

As seed companies grow, so do their demands and their impact on the world around them. “As a company, Seed Processing Holland is seeing an increase in the size and capacities of installations they build and in the demands regarding energy efficiency and environmental friendliness,” says Peter Oussoren, Chief Commercial Officer at Seed Processing Holland.

Increasing volumes in seed processing machinery is an aspect of encouraging high-quality seed development. Seed breeding and production companies are aiming to generate more high-quality seeds to match the demand. “The challenge the seed sector faces is how to sustainably improve access to quality seed,” explains Peter Oussoren. “Seed Processing Holland supports sustainability goals, creating a solution which not only holds more volumes of seeds, but is also a sustainable innovation, considering synthetic refrigerants are major climate killers and are gradually being phased-out by law. Our



“The Bulk Box Dryer creates a win-win-win situation for producers in the vegetable, field crop and hemp seed market with great returns on investment, environmentally friendly production and energy saving,” says Peter Oussoren

company started developing alternatives to traditional conditioned dryers which use synthetic refrigerants and expel energy instead of reusing it.”

Future-proof

The Conditioned Seed Box Dryer is a future-proof solution, Oussoren claims. “It is implemented using advanced technologies which make an impeccable drying process possible. This process uses a heat pump, or several pumps depending on the seed

volumes which need to be dried. The heat pump produces and delivers hot water to the air heaters and cold water to the air de-humidifier, using a water glycol mix as the energy carrier. The air heaters transfer the warmth from hot water into the air flow. Inside the Dry Air Generator, the air flow is cooled, the moisture condensates on the coil and is discharged or evacuated. Both of these airflows mix in the ventilation mixing chamber as conditioned air and are blown into the drying boxes. In short, conditioned air is air that has been altered in temperature and/or humidity to meet design requirements and serves an insulated room. Furthermore, drying boxes are placed inside large, insulated cells (the drying chambers). With this closed system all boxes receive the same conditioned air which results in a uniform high-quality dried product.”

Sustainable solution

To integrate a heat pump installation with a water glycol mix as energy carrier has two significant sustainable advantages. The design of the solution makes the drying process very efficient, saving 25-50% on energy. “Furthermore, using a central heat pump makes it possible to reuse surplus energy which consequently saves costs. The surplus energy is recovered in the last phase of one drying process and is re-used in another, making the drying process even faster.”

“Increasing capacity is another important requirement in the seed sector in order to supply high-quality seed. Providing the appropriate combination of heat pump(s), air de-humidifier and air ventilation system is essential, so the number of drying chambers can be expanded endlessly. With a higher capacity as a result.”

With the increasing demand for bigger (size and capacity), energy-efficient and environmentally friendly installations a new solution has been created. “The original successful drying technology, combined with 20 years of experience designing and building dryers, shaped the innovative and modular Bulk Box Dryer. Suitable for large quantities of seed and plant material - such as seed umbels, heads, pods, or cobs - and with uniform drying results, regardless of ambient climate conditions,” concludes Peter Oussoren. 🌱

Maximising benefits by combining protection measures

Ángela H. Martínez López

18 Plant variety rights and patents often take centre stage in debates on plant breeding and intellectual property rights, but what about trademark rights? How can trademarks be used to the advantage of breeders, as a tool to maximise returns from the investments incurred?

• **A symbiosis between plant variety rights** and trademark rights may represent a reinforced form of intellectual property protection, so it is interesting for breeders to master the key features of both. Offering some key notions in this regard is precisely the aim of this article.

Distinction

The basic distinction between trademarks and plant variety denominations is that, whereas the essential function of a trademark is the indication of a commercial origin ('origin function'), the essential function of a plant variety denomination is the designation of a generic product ('generic-designation function'). The origin function of a trademark consists of guaranteeing that the goods or services that bear it originate from a specific undertaking. A trademark distinguishes goods or services from a particular undertaking from those of other undertakings, and a trademark rights' titleholder is entitled to prevent other traders from using signs that are likely to cause confusion with his/hers. In addition, trademark rights are capable of performing other functions. Such functions may also be performed by plant variety denominations, but do so in a different manner, so it is worth exploring these divergences in the context of the marketing of plant-related products.

Quality-Assurance function: Trademarks used with varieties serve to guarantee that said varieties meet certain quality specifications, such as specific market-differentiation attributes (e.g.: colour, size, flavour).

Plant variety denomination

Every plant variety to be protected by plant variety rights must be designated by a unique generic designation: the plant variety denomination. The plant variety denomination can be in the form of a code or of a fancy name and serves the public interest by enabling the specific identification of a variety by consumers and its distinction from other varieties.

The use of the plant variety denomination is mandatory for anyone commercialising variety constituents of a protected variety, this requirement applies even after the expiration of the breeder's right in that variety (a plant variety right extends to 20-30 years, depending on the applicable law). In essence, the plant variety denomination is born with a given plant variety right, but outlives the latter and is associated with the existence of the variety itself.

Likewise, plant variety denominations can play a role of quality assurance, since quality is attributed to the variety that is identified by means of its denomination. This role rather consists in indicating 'true-to-type' varieties in sales, enabling consumers, such as seed propagators or growers, to be assured that the variety constituents that they are purchasing correspond to the specific plant variety they are looking for.

Advertising function: A trademark can be used for promotional purposes, with a view to persuading consumers. For instance, plant varieties addressed at premium consumer markets are often sold under a trademark. Where a variety enjoys widespread reputation, the plant variety denomination may also play an important advertising role. In general, however, it is only varieties with an already established consumer association that are likely to be presented with greater visibility of the plant variety denomination.

Investment function: Any long-term investment in a trademark eventually falls back on its titleholder. As for plant variety rights' titleholders, these may not draw such a strong direct commercial benefit from the consumers' association with a given plant variety denomination, at least not in the long run, since plant variety rights have an expiration date, and since plant variety denominations must be freely used by anyone.

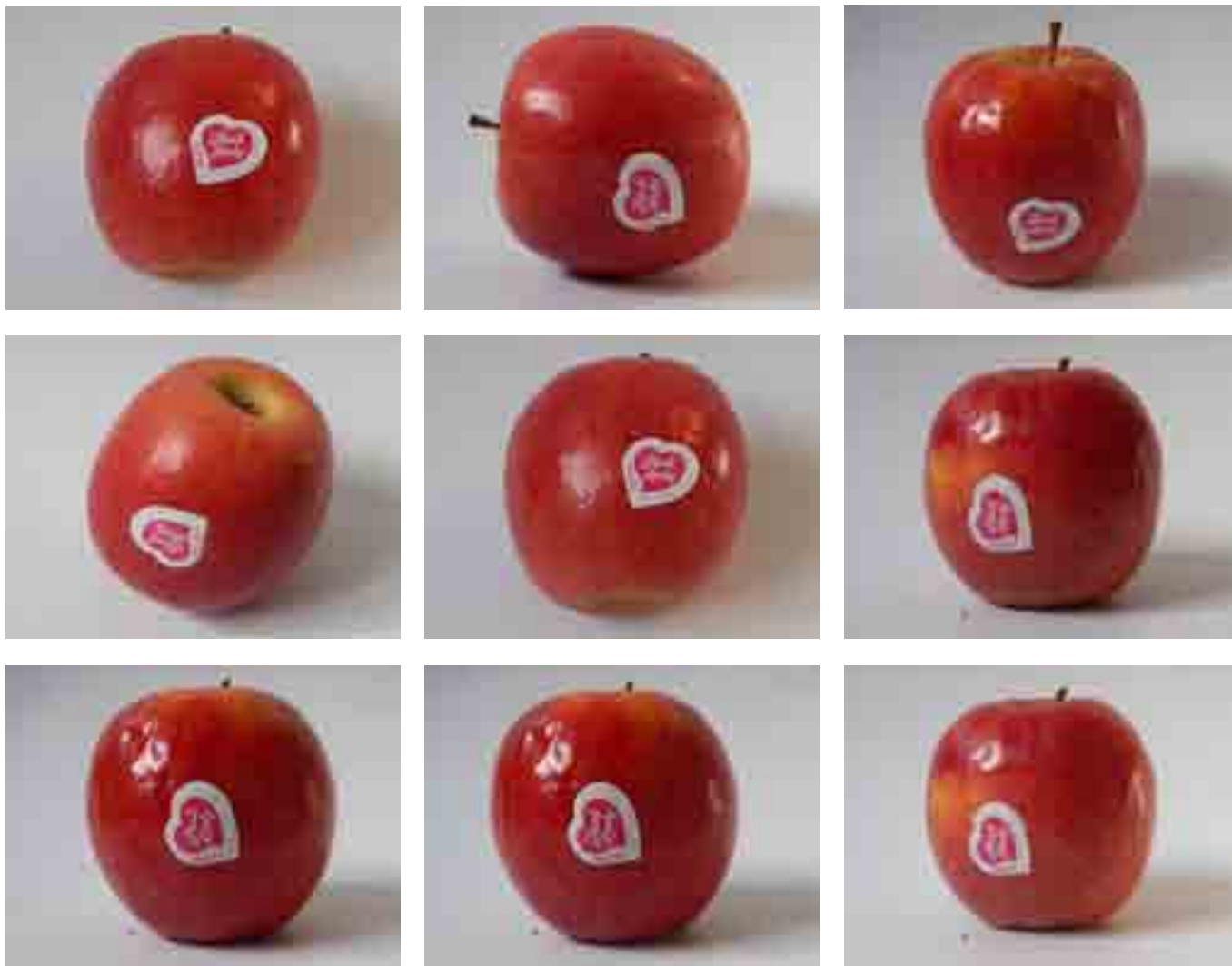
Identification

The legal compatibility between plant variety denominations and trademarks is proclaimed in Article 20(8)

UPOV Convention: where a variety is marketed, it is permitted to associate a trademark with a registered plant variety denomination, as long as the latter remains easily recognisable. To this end, trademarks cannot be placed within demarcating quotation marks, and should ideally be accompanied by the notice ®. This is to avoid confusion with plant variety denominations, which are usually reproduced within single quotation marks and should be preceded by the indication 'Variety' or 'Var.'

In practice, plant variety denominations are especially relevant to seed propaga-

A. H. Martínez López is Legal Officer at the Community Plant Variety Office (CPVO), Angers, France, angela.lopez@cpvo.eu. This article reflects her own views and does not represent those of the Community Plant Variety Office (CPVO) or Euroseeds.



The trademark Pink Lady® is registered in more than 80 countries and used to market several apple varieties, including 'Cripps Pink', 'Sekzie', 'Rosy Glow', 'Ruby Pink' or 'Lady in Red'. The trademark is primarily used as guarantee that the apples sold under it meet a set of quality specifications concerning sugar content, firmness, and colour

tors and growers, yet they are rarely visible to the end consumer at the point of sale. What is more, consumers are often unaware of the intrinsic difference between trademarked names, trademarks and plant variety denominations on product packaging. It is thus to be regretted that no 'official universal notice' such as that for copyrights (©) or for trademarks (™ and ®) exists for plant variety rights.

Dr. P. van der Kooij proposed the introduction, preferably at international level, of a notice indicating that a plant variety is protected by plant variety rights. Such a notice could have the character of an 'official recommendation' (e.g.: by UPOV) and its use be promoted by plant variety rights' offices and plant breeding organisations. The author fully supports this initiative and goes further by suggesting that said notice could consist of a circle-figure embracing a simplified fancy seedling. A sign exclusively devoted to registered plant variety rights would certainly enhance the market visibility of plant variety denominations and reduce potential conflicts of perception with trademarks on the part of users.

Problematic aspects

In view of the fact that plant variety rights are limited

in duration, whereas the life of a trademark right can be perpetuated endlessly, a breeder may feel tempted, upon the expiration of his/her plant variety right, to apply for a trademark identical or highly similar to the plant variety denomination associated with said expired plant variety right, in order to 'artificially' expand via the trademark rights system the monopoly acquired with the plant variety right.

However, resorting to this practice should be avoided. First, the exclusive monopoly granted by a plant variety right is designed to be confined to a given period, and this restriction should not be circumvented. Precisely to prevent this from happening, at EU level, a specific absolute ground for refusal of the registration of 'EU trademarks consisting of, or reproducing in their essential elements, an earlier registered plant variety denomination' has been foreseen with Article 7(1)(m) of Regulation 2017/1001 on the European Union trademark.

Second, if such a trademark right were to be allowed registration, third parties would be prevented from selling the plant material under the controverted trademark. They would indeed find themselves forced to introduce another trademark for the same variety or to enter into negotiations with the trademark right

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Functions	Trademark	Plant variety denomination
Indication of commercial origin	Yes	No
Generic designation of product	No	Yes
Quality assurance	Yes (for meeting quality specifications, e.g.: colour or firmness of variety)	Yes (for indicating true-to-type varieties in sales)
Advertising	Yes (performed effectively)	Yes (for commercially successful or well-reputed varieties)
Investment	Yes (titleholder draws direct benefit)	Yes (weaker in terms of drawing commercial benefits)

The alternatives for breeders: plant variety rights, trademark rights, or both*

	Plant Variety rights Only	Trademark rights Only	Plant Variety & Trademark rights
Plant Sector Concerned	Applies to the vast majority of plant and plant-derived products	Applies to varieties for which the breeders' rights have expired, but are still actively promoted in the market, as well as to varieties in the ornamental sector	Applies to agricultural seeds, a small proportion of fresh produce and ornamentals
Use of the Right	The breeder is able to control the propagation of seeds and plant materials	The breeder is able to control the sale of plant products, which are differentiated and sold using the trademark	The breeder can control both the propagation and sale of the new variety, as well as quality standards
Market Targeted	Mass market rather than niche market	Usually niche or premium markets	Usually niche or premium markets

*© EUIPO-Deloitte Study

titleholder in order to come to a licence agreement. What is more, a trademark right could be (mis)used to scare away non-licensees lacking IP knowledge from freely propagating variety constituents from a formerly protected plant variety, even when this is legally allowable once the concerned plant variety right expires.

Another problematic aspect of which breeders should be wary is that of 'trademark genericism'. This situation concerns those terms that might have been registered as valid trademark rights but over time have become generally accepted in the relevant trade as common designation for the product in relation to which they were registered (e.g.: the former trademark right 'aspirin'). The paradox underlying

genericism is that it is often the result of a successful brand.

In addition, when commercialising a specific variety, the risk may arise that a plant variety denomination which is in the form of a code or 'nonsensical' name and is fixed in tags next to trademarks consisting in fanciful and easy-to-remember designations, may result in the trademark becoming the generic designation for the variety in the mind of the targeted consumer.

To avoid falling prey to trademark genericism, trademark right titleholders should proactively monitor the marketplace and take action, where appropriate, to ensure that no operator jeopardizes the distinctiveness of their signs. For example, titleholders should

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A stylized seedling notice affixed to packages could indicate that a variety is protected by a plant variety right



Trademark rights

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A trademark can be defined as a distinctive sign enabling the identification of the products or services with which it appears as originating from a unique source. The intangible value of a trademark thus lies in the consumer's association of the brand with the goods and/or services in relation to which it is used.

Trademarks can enjoy legal industrial property protection, which can be attained at national, regional or international level, in conformity with the legal principle of territoriality. Signs eligible for protection may consist of words or designs, letters, numbers, colours, the shape or packaging of goods, or even sounds. In applying for a trademark, applicants must indicate the goods and/or services in relation to which they wish to register their trademark, in accordance with the International 'Nice Classification System'. Registered trademark rights can then be renewed and perpetuated endlessly.

assure that their trademarks do not appear in dictionaries as generic names, set clear trademark usage protocols when concluding licenses on trademark rights, and oppose variations in the use/display of the trademark.

Strategies for breeders

Breeders are encouraged to make use of an 'overarching trademark' for promoting a range of varieties sharing similar characteristics (e.g.: appearance, flowering times, resistance). This generates a number of benefits:

- the trademark is coupled with a special feature, rather than with a single product, and the risk of trademark-genericism is thereby minimised;
- the reputation gained with the trademark is extended to several plant varieties;
- the trademark can be used limitlessly to promote new improved varieties; and
- flexibility is gained in the promotion of a range of early, mid, and late-season varieties under a single trademark, to keep up with supplies of varieties recognised by consumers as sharing the common traits.

The big question that remains is: when should plant breeders avail themselves simultaneously of both plant variety and trademark protection? In practice, this decision largely depends on the competitiveness of the plant segment, the life cycle of the variety, the number of years a breeder has within which to make the necessary return on investment, and the geographies of interest.

Regarding the agricultural, fruit and vegetable industrial segments, these are characterised by

mid- to long variety development cycles, where plant variety rights represent an essential tool to recoup the long-term investment. As to the ornamental segment, variety development cycles are significantly shorter. The cut-flower market is particularly competitive, where breeders estimate that they generally have over three years to make the return on investment. Rapid introduction of products into the market is crucial to create high volumes of demand, so breeders here often opt for monetising their creation via trademark rights, as such are generally awarded quite promptly. As to the geographies of interest, trademark protection should be sought in those territories to where varieties are shipped and sold. Moreover, concluding territorial licenses or using tailor-made trademark rights adapted to the local language and cultural habits in the targeted territories can prove advantageous for the marketing of varieties on a global scale. In conclusion, a solid understanding of the catalogue of intellectual property rights that breeders have at their disposal is desirable, so that they can take advantage of same to the fullest extent, where the weight of trademark rights should be duly considered in marketing strategies. 🌱

Disabling plant susceptibility genes

Anna Finkers-Tomczak, Johanna Acevedo Garcia, Wladimir Tameling and Colette Broekgaarden

24 **Breeding for disease and pest resistant crops is often a race against time. Newly emerging variants tend to circumvent resistance based on single and specific R-genes. One way to achieve more stable and broad-spectrum resistance is to target the so-called susceptibility (S) genes.**

In nature, plants and their attackers (herbivorous insects, viruses, bacteria, fungi and nematodes) tend to live in a dynamic harmony with each other and their environment. Growing single genotypes in monocultures, which is often the practice in contemporary food production, makes this harmony out of balance and creates a suitable environment for pest and disease epidemics to occur and spread, resulting in major yield losses in crops. For decades, plant breeders have been trying to develop crop varieties that are resistant to pests and diseases. The most common approach in breeding for resistance implements dominant resistance genes (R-genes). R-genes usually code for immune receptors that recognize the invader's molecules and trigger the plant's immunity to kill or reduce the performance of the invader. However, pests and microbes often evolve rapidly and overcome the specific and narrow R-genes-based type of plant immunity. Moreover, in many crop-invader combinations, no R-genes have been found and the major yield loss is difficult to prevent with other methods. Therefore, breeders are searching for alternative approaches for their resistance breeding programmes. One of the very promising alternatives is the loss-of-susceptibility (LoS) approach.

Susceptible interaction

Plant attackers need to establish a close and dynamic interaction with their host plant. They need to both counteract plant immunity as well as to modify the plant's metabolism, and sometimes even tissue, to achieve optimal feeding, development and reproduction. This interaction can be multi-layered and very sophisticated. On the one hand, the attacker needs to

massively reprogramme the site of interaction with its host to take a maximum advantage of nutrients needed for its own development. On the other hand, it has to avoid by all means recognition by the host and the triggering of induced immune responses. Recently, fundamental research has revealed new insights in the way plant attackers are establishing an interaction with their hosts and subverting plant immunity. It has been discovered that pathogens and insects introduce effector molecules into the host plant tissues in order to reprogramme the plant's metabolism or to interfere with its immune response. Identifying the host proteins and processes targeted by plant attackers and bringing subtle changes that tip the balance in favour of the crop is the goal of the LoS approach.

Discovery

Plant factors that are putatively involved in an interaction with the attacker can be considered as susceptibility genes (S-genes). One approach to identify such S-genes involves analysis of gene expression during the initial biotrophic interaction phase. By comparing the transcriptome of plant tissue colonized by the invader with comparable healthy tissue, it is possible to identify specific processes, pathways and genes the attacker targets for its own benefit.

Another approach is to identify effector molecules secreted by the invader and determine the value of effectors for breeding, for example, via silencing of the candidate genes in the pathogen. Subsequently, these core effectors can be used as baits in protein-protein or protein-DNA interactions screens to find the host plant targets they interact with, enabling breeders to use this knowledge in their breeding programmes. The ultimate aim of LoS breeding is to generate subtle changes in a plant gene to disrupt the interaction with the attacker. This can be achieved by searching for natural variants or by discovering additional genetic variation by classical mutagenesis or the use of genome editing. Using classical mutagenesis approaches, random SNP mutations are generated in the crop genome. Large offspring populations can be screened to identify plants carrying mutations in the gene of interest. This approach can yield early stop codon mutations, resulting in recessive loss-of-function alleles, but also provide the breeder



Interaction of insect effectors with plant targets leads to successful infestation

Dr. A. Finkers-Tomczak,
Dr. J. Acevedo Garcia, Dr.
W. Tameling and Dr. C.
Broekgaarden are researchers
at KeyGene, Wageningen, the
Netherlands, anna.finkers-tomczak@keygene.com



Rice sheath blight disease symptoms caused by the fungus *Rhizoctonia solani*



Microscopic image of early rice infection, target phase for transcriptomic analysis in the LoS approach. The pathogen penetrates the plant by means of lobate appressoria (arrowhead) or infection cushion (circle) or both

with different kinds of point mutations (like splice variants and mutations resulting in single amino acid changes) that may break the interaction with the attacker without affecting the plant's housekeeping function of the gene.

One of the best-known examples of an S-gene is the mildew resistance locus *O* (*mlo*) in barley, which confers broad-spectrum, non-race specific resistance to almost all isolates of the powdery mildew fungus *Blumeria graminis* f. sp. *hordei*. Induced and natural *mlo* alleles have granted stable powdery mildew resistance in the field for more than 30 years already. Interestingly, the *mlo*-based powdery mildew resistance is not restricted to barley but is also found in other plant species, such as wheat, tomato and pea. This illustrates that a good S-gene target can provide a strong, effective and durable resistance in multiple crops.

Geminiviruses example

Over recent years, a team of scientists from KeyGene, in cooperation with four vegetable breeding companies, proved that introducing changes in the so-called dTP-gene required for successful virus infection makes pepper plants resistant to geminiviruses. The results of this discovery are currently being used in pepper breeding programmes. Moreover, a presence of similar mechanism in cassava and cotton will allow breeders to use this type of S-gene in a much wider variety of host crops.

Aphids example

Aphids are among the most destructive pests on cultivated plants in temperate regions. Control of aphids via breeding is difficult as they rapidly develop mechanisms to overcome plant R-genes. To date, frequent application of and/or coating of seeds with pesticides is used to keep aphid numbers at acceptable levels. Nowadays, the ban on systemic pesticides by governments adds another layer of complication to the battle against aphids.

Recently, *arabidopsis* S-genes encoding proteins that interact with aphid effector proteins to aid the compatible plant-aphid interaction have been identified and validated at KeyGene. Knock-out mutations in these S-genes significantly reduced aphid population build-up. Translating this knowledge from the model to the crop plants will facilitate obtaining the new aphid resistance sources.

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Parasitic nematodes example

Root-knot nematodes are renowned for their wide host range and are master-manipulators of numerous host processes. In order to establish their feeding sites in plant roots, they need to circumvent the host immune system. To achieve this, nematodes secrete many effectors molecules, some of them proven to be essential for their parasitism. They can target many plant processes, including nutrient transport, cell cycle and auxin transport.

Currently, in cooperation with commercial breeding partners, we have selected tomato S-genes that contribute to the successful interaction of the nematode with its host plant. By creating novel alleles of these S-genes in tomato, using genome editing and mutagenesis, we hope to achieve a stable and broad-spectrum resistance of tomato to *Meloidogyne* spp, including those that break the popular *Mi* (R-gene based) resistance.

Fungi example

Rice is the second most grown cereal crop in the world. Rice yield is reduced by up to 50%, due to the sheath blight disease (ShBD) caused by the fungus *Rhizoctonia solani*. To date, control of ShBD is achieved largely by extensive use of fungicides, since germ-plasm with complete resistance is not available. In the frame of an Individual Fellowship, Marie Skłodowska-Curie Action, (RiZeSisT, H2020 grant agreement No. 791867) KeyGene has identified essential rice S-genes that serve as targets to generate durable and broad-spectrum resistance to ShBD. In cooperation with the University of Milan (Laboratory of Professor Martin Kater), these leads are being validated by generating novel (mutagen-induced) alleles of the identified genes. Later on, this knowledge may be translated to other crops affected by the same pathogen. 🍄

ABS hampers collecting expedition

Chris Kik

26 Ten years ago, a collection expedition took place for the three species of the *Allium ampeloprasum* complex, native to Greece. These species are considered as the crop wild relatives of cultivated leek (*Allium porrum*). Unfortunately, only one-third of the collected material has been regenerated so far. The cause: the parties were not able to conclude an arrangement.

• Nowadays, crop wild relatives (CWR) are considered important gene reservoirs for the genetic improvement of their related crops. However, the occurrence of CWR in gene banks worldwide is often poor and the wild relatives of cultivated leek (*Allium porrum* L.), namely *Allium ampeloprasum* L., *A. bourgeaui* Rech.f. and *A. commutatum* Guss., are no exception to this. These CWR can be crossed successfully with cultivated leek. Collecting expeditions are therefore vital to acquire genetically unique material. The breeding of new leek cultivars takes many years as the crop is a cross-fertilizing (segmental) autotetraploid ($2n=4x=32$). Major challenges in leek breeding are the identification and subsequent introgression of disease (e.g. *Phytophthora porri*) and pest resistances (e.g. *Thrips tabaci*), as these organisms cause major yield reductions when a crop is infected. To date, no adequate resistances have been found to many diseases and pests in cultivated leek germplasm.

Initial agreement

An agreement on the basis of which the collecting mission could take place, the so-called Mutually Agreed Terms (MAT), was negotiated between the Greek Ministry of Rural Development and Food, the University of Patras and CGN for the collecting mission. An authorization (prior informed consent; PIC) to collect the three leek CWRs in Greece was issued by the Greek competent national authorities on Access and Benefit Sharing (CNA-ABS) and countersigned by CGN, as a basis for collecting and subsequent distribution of the material. In this arrangement,



Methoni Castle on the Peloponnese peninsula is the natural habitat of *Allium commutatum* Guss

it was agreed that the material collected would be regenerated by CGN and a fair share of each successfully regenerated population would be sent to the Greek gene bank.

Another agreement was concluded between CGN and a number of breeding companies. In this agreement, it was stipulated that breeding companies would co-finance the expedition and help to regenerate the material sampled. Furthermore, an embargo period of five years after the successful regeneration of an accession was negotiated before the material would become available in public databases.

Hampered by ABS

Unfortunately, a problem was encountered after the collecting mission. The Dutch collectors and the Greek CNA-ABS were not able to conclude whether the material collected could also be used for commer-

A. bourgeaui

A. bourgeaui is predominantly found on the Greek Aegean islands, but populations of the species have also been recorded from the Aegean coasts of both east continental Greece and west Asia Minor. It is a chasmophyte and can be found on limestone cliffs and inland rocky slopes and occurs mostly in small populations

A. commutatum

A. commutatum has a broader distribution range compared to *A. bourgeaui*, as it occurs also along the Adriatic coast and on the Mediterranean islands and islets west of the Italian peninsula (Sicily, Sardinia and Corsica). It occurs in coastal habitats and can be found on islets and shores and is able to dominate the area.

A. ampeloprasum

A. ampeloprasum has a very broad distribution range and can be found in the entire Mediterranean region and as far as Afghanistan in the East. It is a ruderal species which occurs in disturbed places such as cultivated and abandoned fields; population sizes range from small to large. The populations were found on altitudes ranging from 5–567 m.

Dr. C. Kik is head curator at the Centre for Genetic Resources, Wageningen University & Research, Wageningen, the Netherlands, chris.kik@wur.nl



Allium bourgeaui ssp. *bourgeaui* Rech.f. in its natural habitat: Achata beach on the island of Karpathos

cial purposes. The consequence was that the breeding companies, who were involved in this project, preferred to focus their contributions primarily on material for which it was certain that it could be used in their own breeding programmes. This meant that only a small number of Greek populations could be regenerated annually, as the Dutch national gene bank CGN did not have enough capacity to carry out a large number of regenerations per year. It resulted in a low speed regeneration for these three species. Another consequence is that the utilization of the material is limited, as it can only be used for research purposes. Therefore, collecting missions should ensure the appropriateness of the terms and conditions of ABS, in all its aspects, well before initiating expeditions.

Expedition

Allium ampeloprasum was mainly found adjacent to cultivated fields or abandoned agricultural fields. Contrary to its name ('ampelos' in Greek means 'vineyard' and 'prason' means 'leek'), the species was only observed growing between grapevines a few times. The populations sampled often consist of 1-15 plants. Two types of *A. ampeloprasum* plants were observed: a sexual type (type I) with a small inflorescence (ca. 10 cm in diameter), small bulblets (bulbs in between

foliage leaves which embrace the large renewal bulb; < 7 mm length) and with seeds; and b. an asexual type (type II) with a large inflorescence (ca. 20 cm in diameter), larger and more flattened bulblets, and with shrivelled (nonviable) seeds.

The populations sampled of *Allium bourgeaui* consisted of 1-50 plants at altitudes ranging from 2-522 m. *A. bourgeaui* comprises three subspecies, subsp. *bourgeaui* Rech.f., subsp. *cycladicum* Bothmer and subsp. *creticum* Bothmer. The three subspecies are distinguished from each other on the basis of the colour and shape of papillae of the perianth. Because collecting took place when the flowering period was over and seed had set, it was not possible to recognize the three subspecies on the basis of these traits. Identification of the three subspecies is nevertheless possible, as the three subspecies have a distinct and scarcely overlapping distribution pattern. More precisely, ssp. *creticum* can only be found in Crete, ssp. *bourgeaui* only on the Eastern Aegean islands of Rhodes, Karpathos and Kasos, and ssp. *cycladicum* on Cyclades, Ikaria and the eastern part of the Greek mainland. The habitats in which these subspecies were found ranged from rocky gorges and steep hillsides to more accessible locations, like field borders and hillsides along roads.

The population size of *Allium commutatum* can vary



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Overview of the collecting sites of the leek CWR collecting mission 2009. The blue, yellow and red dots indicate *A. ampeloprasum*, *A. commutatum* and *A. bourgeaui*, respectively



Allium ampeloprasum L. in its natural habitat near Mylopotamos, Kythira, in the southern part of Greece

considerably between locations: from 1-15 plants (Diakofti, Kythira) to over 100,000 plants (Methoni, Monemvasia, Kythira Chora castles), but mostly occurs in relatively large (>50 plants) populations. When it occurs in large populations, it forms mats, where almost no other plant species can be found. These large populations can also be found on islets near the coast. During the expedition, the species was collected on islets in front of the coast (Andros), but also on coastal shores (Xerokambos, Crete) and close to old castles (e.g. Monemvasia, Peloponnese). One population was found on a steep rocky inland hill on the western Peloponnese (Lake / Lagoon of Kaiafas; ca. 1 km from the actual shoreline). However, this can be considered a relict population as in the past, due to the fluctuation of the sea level, the present location of the population was actually a coastal area. Only a number of islets in front of the south-western coast of Andros were visited during this mission due to the relative inaccessibility of these locations. Inhabitants of the islands have knowledge of the presence of *Allium* species on these islets, as these islets are often called 'Prasoudha' or 'Prasonisi' (islet of prason).

On three occasions, we observed that next to *A. commutatum* or *A. bourgeaui* also *A. ampeloprasum* was present. The *A. commutatum* / *A. ampeloprasum* combination was found on a sandy beach plain (Kythira). The *A. bourgeaui* / *A. ampeloprasum* combination was found on a clearly disturbed rocky slope along a road (Karpachos) and on a (probably disturbed) rocky slope along a road (Peloponnese). The mixed populations were located at altitudes between 2-177 m. Plants with intermediate morphological characters, suggesting hybridization between the two species, have not been observed in the localities concerned.

In total, around 4,000 km in Greece were travelled by car, boat and plane and 104 populations were collected: 62 single species populations of *A. ampeloprasum*, 20 of *A. bourgeaui*, 19 of *A. commutatum* and three mixed populations, which consisted of two *Allium* species.

Initially, a protocol was developed for regeneration in the Netherlands. However, only three years after sowing the originally collected seeds, the next generation could be harvested. Therefore, a second protocol was developed in which the first stages of the regeneration took place in the Netherlands and the later stages in Cartagena, Spain. This procedure shortened the production of the next generation of seeds by one year.

As the collecting took place in 2009, the regeneration of the material started in 2010. In 2013, the first eight populations were successfully regenerated and, subsequently, these populations were included as accessions in the Dutch gene bank and, thus, placed in the public domain (<https://www.wur.nl/en/Research-Results/Statutory-research-tasks/Centre-for-Genetic-Resources-the-Netherlands-1/Genebank/Special-collections.htm>). This was only in 2019, as there was an embargo period, which has been agreed upon by the breeding companies co-financing the mission and CGN, on the material and information of five years after the successful regeneration of a population. In the coming years, all accessions which are successfully regenerated will be placed in the public domain.

The percentage of populations that have been successfully regenerated to date is 39% (42/107). The mean germination percentages of the populations regenerated to date are 78%, 65% and 89% for *A. ampeloprasum*, *A. bourgeaui* and *A. commutatum*, respectively. Eight populations (seven *A. ampeloprasum* and one *A. bourgeaui*) have been donated to the Czech gene bank in Olomouc, as no seeds could be produced from these populations, but enough bulbs/bulblets were present for maintaining these populations vegetatively. During regeneration up until now, ten populations of *A. ampeloprasum* (15% losses; 10/65), three of *A. bourgeaui* (14% losses; 3/22) and two of *A. commutatum* (10% losses; 2/20) were lost due to no germination or decay of bulbs. 🌱

Science-based information reduces unwarranted **trade barriers**

Bénédicte Lebas and Rose Souza Richards

30 The ISF Regulated Pest List Initiative provides science-based information on regulated host-pest associations that are a risk to seed health, in order to support scientifically-based phytosanitary requirements and promote the harmonization of national phytosanitary regulations for the safe movement of seed worldwide.

• **Vegetable seed are produced** in many countries, shipped to central facilities for processing, sanitation and upgrading, treating, testing, and repacking before being re-exported. The complexity of the movement of seed internationally is compounded by challenging phytosanitary regulations imposed by National Plant Protection Organisations (NPPOs). The ISF Regulated Pest List Initiative (RPLI), initiated in 2011, plays an important role in supporting the seed industry when such challenges arise.

Objectives

The ISF Regulated Pest List Initiative develops crop specific pest lists for seed - regulated species that are traded internationally. The list provides information on whether seed is a proven or not-proven pathway for pest transmission, based on a rigorous scientific assessment and review. That allows for a reduction in the number of existing regulated pests that are not technically and scientifically justified. The ISF Secretariat noted that, out of over 1,000 regulated pests listed in the ISF Regulated Pest List Database, 77% of those had the conclusion that either the crop

is not a host for the pest in question (29%) or seed is not a pathway (48%).

The supply of healthy seeds is essential to help assure growers of a healthy crop. Moving seed internationally, either for research or trade, is subject to phytosanitary regulations to minimize the risk of introducing or spreading pests worldwide. However, in some instances, the phytosanitary measures imposed are unnecessary as seed is not a pathway for the entry, establishment or spread of the pest in question. The ISF Regulated Pest List Database is an important resource to the national seed associations and to the seed industry to support them in their engagement with their respective NPPOs when new or updated phytosanitary requirements are proposed by providing the assessments of the relevant pest in the crop in question. The ISF Regulated Pest List Database also serves as a basis for the development of seed health tests for regulated pests that are necessary to protect plant health and enable trade. In an initiative taken by an ISF partner organization, the NPPO of an Asian country was invited to review its pest lists for five vegetable seed crops using information in the

Is seed a proven or not-proven pathway for pest transmission, based on scientific assessment and review

Seed species	Regulated pests (no.)	References cited (no.)	Is seed a pathway? (no.)			
			Yes	Pathway not proven	No	Not a host
Bean	97	413	23	14	41	19
Brassica	118	380	11	12	52	43
Carrot	92	259	4	7	43	38
Cucumber	90	205	4	8	50	28
Lettuce	64	156	3	10	36	15
Melon	69	178	6	14	33	16
Onion	94	183	7	12	43	32
Pepper	107	256	9	19	45	34
Spinach	38	105	8	3	13	13
Squash / pumpkin	54	208	5	8	29	12
Tomato	178	579	14	35	89	40
Watermelon	58	212	4	7	31	16
Average (%)			9	14	48	29

Regulated Pest List Database for these crops. Consequently, 14 pests of these five crops were removed from the country's list of regulated pests. Import permits for seed from these crops have now been changed accordingly as well.

Database

The Regulated Pest List Database currently contains 12 lists of crop specific regulated pest that together account for 90% of vegetable seed traded internationally (link to ISF database: <https://pestlist.worldseed.org/public/pestlist.jsp>). Information on whether a pest is regulated is obtained from national import requirements databases of the seed companies and NPPOs. The ISF Regulated Pest List may contain two categories of regulated pests: Quarantine pests: pests that are

Dr. B. Lebas is Technical Lead – RPLI – Consultant at the International Seed Federation, Nyon, Switzerland, and Dr. R. Souza Richards is Seed Health Manager at the International Seed Federation, Nyon, Switzerland, r.souzarichards@worldseed.org



Of the 1,000+ regulated pests listed in the database, 77% of the conclusions are either the crop is not a host for the pest in question, or seed is not a pathway

Workplan of the RPLI Team

Ranking **New crop pest list to be developed** Existing crop pest list to be updated

1	Peas	Tomato
2	Okra	Pepper
3	Artichokes	Carrot
4	Runner beans	Squash and pumpkin
5	Radish	Lettuce

not present in a country or 'present but not widely distributed', with potential economic importance and that are officially controlled (ISPM 5).

Regulated non-quarantine pests: pests that are already present and can be widespread, but their presence in plants for planting (including seeds), combined with the intended use, leads to unacceptable economic impact (ISPM 5).

Process

The assessments of the ISF Regulated Pest List Database follow the principles of International Standards for Phytosanitary Measures (ISPM) guidelines and is based on scientific evidence and the industry experience.

The ISF pest risk assessment consists of three stages: 1. Initiation, 2. Risk assessment and 3. Risk management, and are described in the flowchart. For each regulated pest in a crop-specific list, ISF provides information on whether the transmission of seed-borne pests has been observed under natural field condi-

tions, as recommended by ISPM 38. This is because a pest that has been shown to be transmitted under experimental conditions may not be transmitted under field conditions. In most cases, experimental conditions cannot mimic what happens in nature, creating an artificial environment that supports seed transmission that would not happen in the field.

Experiments where mechanical inoculation is used does not reflect how viruses are transmitted in the field. Also, not all pests that have been proven to be seed-transmitted in one host are necessarily seed-transmitted in all known hosts (ISPM 38).

The potential for a specific pest to establish and spread is assessed, and recommendations are made, taking into consideration their biological and epidemiological characteristics, as well as the risk management practices put into practice by the seed industry. Information on detection methods and risk mitigation measures are provided for regulated pests for which seed is a known pathway or pathway is not proven.

What's new?

Two new crop specific pest lists are being finalised and will be uploaded to the database very soon: the eggplant pest list with 75+ pests and the maize pest list with 150+ pests. Furthermore, following a notification from an ISF member, Tomato leaf curl New



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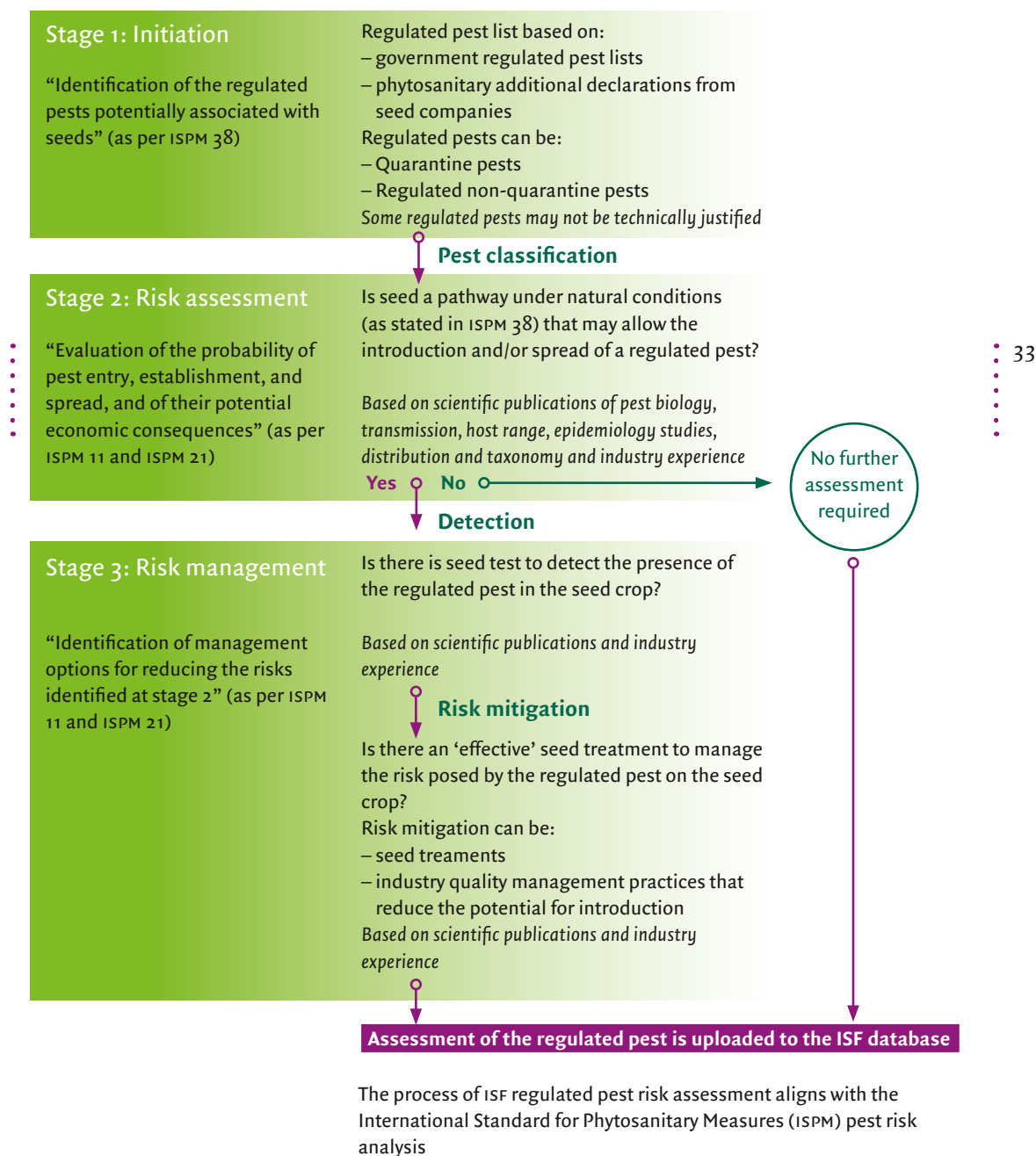
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ISF assessments of regulated pest list

ISPM's pest risk analysis (PRA)



Delhi virus on Cucurbitaceae (i.e. cucumber, melon, watermelon, squash and pumpkin) and Solanaceae (i.e. pepper and tomato) has been assessed and will be added to the ISF Regulated Pest List Database.

What's next?

A workplan will be established, based on the responses received from ISF members from a survey conducted in February 2021 to rank the top five crops for which 1. a new pest list is required and 2. the existing crop pest list needs to be updated.

How can you contribute?

The ISF Regulated Pest List Initiative (RPLI) relies on

the participation of ISF members for the assessments of regulated pests for crop specific pest lists. Any assessment of pests is processed independently and reviewed with rigour to ensure quality information. At least three volunteers are required for each pest list assessment. The ISF RPLI Technical Lead coordinates the review process and contacts ISF members when needed. You can also help by promoting the ISF Regulated Pest List Database as a key resource for ‘seed-is-a-pathway’ pests, their detection and quality management practices that mitigate their risk. 🌱

Unlocking the potential of plant-based proteins

Roger Staats

34 Whether going fully vegan or embracing a more 'flexitarian' lifestyle, consumers are switching to plant-based food options in ever-increasing numbers. With 9 billion people to feed in the world in 2050, there are many reasons why: from perceived benefits for people's own health and wellbeing, to concerns about animal welfare and the environmental impact of meat farming, or just the desire to be 'on trend'.



Background information kindly provided by F. van de Velde from his inaugural lecture at HAS University of Applied Sciences: https://www.has.nl/media/jyppyr3/inaugurelerede_fredvdvelde_has-university-of-applied-sciences.pdf

Parallel to global population growth, the average standard of living is also increasing. Together, this has resulted in a major increase in the demand for proteins and protein-rich products. If we want to carry on feeding the global population, we will need to produce around 60-70% more food by 2050. Producing this food using the current balance between plant-based and animal-based proteins is unrealistic. Hence, not only more food needs to be produced, we have to make the move from the consumption of animal-based proteins towards plant-based proteins. Professor Fred van de Velde, HAS University of Applied Sciences and Expertise Group Leader Protein Functionality at the food technology company NIZO, Ede, the Netherlands, and Ton Wouda, Commercial Manager Arable Crops at Limagrain Field Seeds, Rilland, the Netherlands, both contribute to this goal.

The taste challenge

Ambitious targets have been set for the transition to plant-based protein: a 50:50 balance in 2025 or a 60:40 balance in 2050. However, these are often difficult to translate into something that people can 'feel'. Fred's aim is more concrete and tangible, saying: "let's eat 10 grammes more plant protein per person per day." This directly focuses on what a consumer has to do, rather than on the technology behind the transition or the landscape changes required. Although many consumers consider replacing meat with vegetable alternatives, they are unwilling to give up the sensory reward of eating meat. The perception of meat is characterized by specific sensory attributes, such as bite and juiciness, that are rare in other food products. This is due to the fibrillar structure of the muscle tissue in meat. The majority of current meat alternatives, based on vegetable proteins such as soy, wheat or pea, lack this fibrillar structure. The challenge for food producers is thus to deliver plant-based protein ingredients and applications that are tasty, healthy, stable, safe and sustainable. Fred: "In general, these proteins are known to be more sustainable and cost-effective than animal proteins. But challenges remain: low solubility and off-flavour and off-taste."

Protein ingredients

"At NIZO, I work on the interaction of proteins and



carbohydrates in relation to structure, texture and perception. In the field of protein functionality, my focus is on the application,

characterisation and production of alternative protein ingredients. Through extraction and processing, we obtain high quality protein ingredients. And understanding the functionality of these new ingredients means we can control the properties and perception (feeling in mouth, flavour) of the final products."

"We have successfully developed technology to produce fibrillar structures from vegetable proteins. We used soy and pea protein isolates to optimize the production protocol to obtain these fibres. In parallel, we developed milder process protein ingredients. The resulting pea protein extract is high in the flavour attributes Pea and Green related to smell. It is also low in Beany, Cardboard and Wet Socks attributes associated with oxidation off-flavour and heat-induced protein deterioration."

The texturizing functionality of the fibres has been tested by preparing hamburger type meat alternatives which have the juicy and bite characteristics typical of meat products. This technology is ready to be implemented into new tasty meat replacers that deliver the required bite experience."

From seed to consumer

"As a professor and researcher at HAS University of Applied Science, I can take a chain approach to improving these proteins. Only by involving the entire chain can we achieve our ambitious goals, such as selecting and developing varieties of peas and field beans (also called faba or fava beans) that have an increased protein content or improved protein composition."

"In the PULSE project, I work with major producers in the complete supply chain; from field to fork." PULSE is the acronym for Protein Utilisation from Legumes for a Sustainable European crop. The project's focus: to achieve an improvement in all links in the protein

Through extraction and processing, high quality protein ingredients is obtained



production supply chain. All the companies involved have their own position within the chain. Customer requirements for vegetarian products are collected and processed by food producers and eventually result in the information needed for seed selection. Improvements therefore spread across the entire supply chain, from what is required from the actual product that the consumer will buy, via extraction to the selection of seeds, i.e. selecting those seeds that produce the proteins needed to achieve the correct texture or functionality in the final product. Fred adds, “we are going to improve on this functionality and focus on sources of protein for applications in high value-added products.”

New sources

Plant protein ingredients for foods, such as concentrates or isolates, have a protein content varying from 50-90%. These ingredients can be obtained from established sources, such as soya, wheat, maize potatoes and peas. However, a second generation of plant protein ingredients is currently emerging, including canola (rapeseed), duckweed and legumes like chickpeas, faba beans (fava or broad beans) and lentils. A third category, still in its infancy, are proteins from green leaves or seaweed, flax and sunflower seeds, but also from algae and nuts.

The choice of new sources is highly dependent on the protein yield per hectare. In the Dutch and European climate, legumes such as the faba bean, pea and lupin show good results with faba yields of almost two tons of protein per hectare. In the longer term, aquatic plants such as duckweed (or water lentils) have great potential because they can produce yields of up to seven tonnes per hectare. There is one condition, namely that these crops have to be capable of being cultivated all year round, which is not yet possible in

the Netherlands in the open field. However, as far as the near future is concerned, the focus is on land-based agricultural crops.

Breeding for transition

To answer the question, ‘What can breeders do to improve the protein transition?’, we turn to Ton Wouda, at Limagrain Field Seeds. Ton and his group work directly with the chain, from farmers and distributors to food and feed producers, to help them successfully respond to the challenges of the transition.

“At Limagrain, we saw that plant proteins were becoming increasingly important, especially in the Netherlands. Soya was our start, thanks to its high protein content, but after a few years we stopped working on soya, as it didn’t mature quickly enough in our climate, nor was there sufficient breeding activity to reach the targets set.”

“So, five years ago, we started looking at opportunities for crops like faba beans, as we knew they have a high protein yield per hectare. Importantly, we worked together with farmers’ organisations to involve the farmers directly, as there’s little point in spending time on research if no farmer is going to take up the offer and grow the crops. Strangely, faba beans used to be widely grown in the Netherlands, but wheat took over, as it was more profitable, and cheap soya was imported for animal feed.”

“However, now we see great interest in crops grown for plant protein used in new forms of plant-based foods for human consumption and which support a sustainable transition, including from major players like Unilever. This is pushing us increasingly in the direction of local production and processing. In reality, 90% of all production is mainly for animal feed. Although small, plant-based protein for human consumption is, however, important for the image of

“Making vegetables available for everyone.”

This is the ambition of Hilal Kanik and Canan Acarbulut, tomato breeder and selection co-ordinator tomato respectively, both working for Rijk Zwaan in Antalya. Read their story on rijkzwaan.com.



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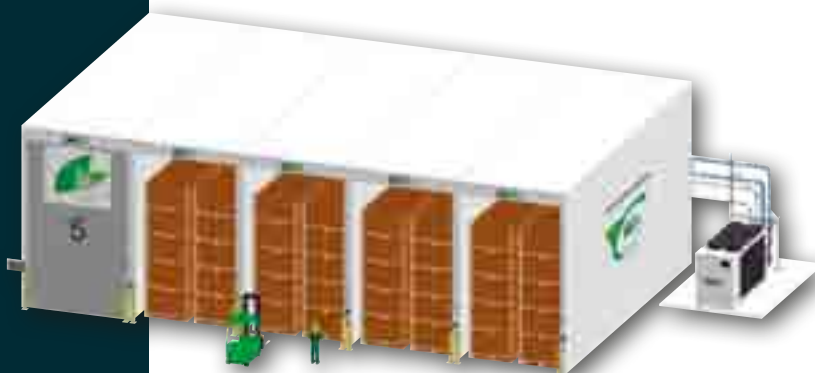
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There are aspects that take more time to improve



commercial producers; they can state on the label that their products are sustainable and sourced locally.”

Improving yield

“We looked internally at all the pulse sorts and noted that, for example, peas were successful in France and the UK, as far as protein levels were concerned. However, to answer the question, how can we effectively increase protein yields, we saw more opportunities in faba. We were able to quite rapidly increase its protein content from 24% to 32%. However, there’s more than increasing the protein content. We have also been able to make faba suitable for winter production; winter faba yields up to 20% more than the summer crop. In this way, we see a win-win situation: both increased protein content and increased yield. And, importantly, to spark the interest of farmers, not only do pulse crops like faba improve the soil organic matter content, but they also add significant amounts of nitrogen to the soil, making it possible for farmers to plant a follow-on crop, like radish or mustard. So yield is important, but there are many additional aspects indirectly associated with the choice of crop.”

“We are able to quickly react to new market opportunities, as we have been breeding plants and new varieties for many years; we have an extensive genetic database and vast experience. However, there are aspects that take more time to improve, for example, disease resistance, kernel size increase, etc. Luckily, there are an increasing number of genetic tools and skills to help us work more effectively on achieving these additional goals.”

Other breeding goals

“For example, beyond protein yield, another important factor is the composition of the protein. Can we optimise that as well, make it fit for different processing and consumption purposes? A crucial aspect of

the answer to these questions is by working through the chain. In this way, from the producers to the farmers, there is an awareness of the protein transition, the need for protein-based plant foods, and this encourages the farmers as they know there will be a market for their products, that they can grow them, and that there will be no sudden switch back to soya from Brazil or Argentina. We also support farmers with in-field activities, to show them which varieties, how best to grow them, etc. - in this way they learn from each other.”

“Farmers want reliable crops and predictable yields. Here again, we work in the chain to help farmers improve the yield with practical things like seed systems, seed size, plants in a row, precision drilling, etc. We then also help them with the choice of chemicals to protect against diseases, as part of the process of achieving sustainable production. We find ways to help with the economics: for example, farmers grow faba and feed it to their own animals, rather than buying in feed. We also stimulate farmers to grow for farmers; arable farmers provide animal farmers with faba in exchange for manure.”

The potential unlocked

These two experts show that the protein-transition to plant-based protein is ongoing and achievable, and that it is not an individual or single company-driven process. Both emphasised the involvement of the complete chain, with Ton especially relating to the importance of getting the farming community on board, with many practical examples. What has been discussed here is, of course, only related to the Dutch market. So, as the market for sustainable plant-based food and feed grows and we work towards achieving the 2050 targets, let’s remember Fred’s adage; set easy to understand goals: “let’s eat 10 grammes more plant protein per person per day.” 🌱

Concern about viruses, bacteria and pests

John van Ruiten

38 Undoubtedly, the leaving by Britain from the EU on 1 January 2021 was the most significant moment in the EU last year. With regard to phytosanitary procedures, Brexit also had an enormous impact on trade to and from the UK. It was the start of inspections when planting material was exported to Great Britain.

• **For export of seeds and planting material** from the UK to the EU, it had in fact already been clear for a long time what the position would be: the existing PHR EU rules for importing material from third countries became directly applicable for all UK material to be sent to the Union from the beginning of the year. For existing marketing requirements (like variety registration, seed quality, certification standards, etc.), the EU and UK agreed on mutual equivalency at the start of 2021. No specific rules or procedures are currently necessary.

Big problem

There is one very big problem and, up until now, that is the import of seed potatoes from the UK into the Union. This is not allowed. As EU phytosanitary rules generally make the import of Solanaceous planting material (except seeds) impossible, this also applies to seed potatoes from the UK. Especially Scottish producers of seed potatoes and their customers in the EU suffered from this situation. So far, the authorities have not found a solution to overcome this problem. Although import of EU seed potatoes into

the UK is possible, the principles of reciprocity are not applicable. Just like other third countries, the UK must follow the derogation procedures of the EU. For export of EU products that are plant-passported in the EU, it is obligatory to have a phytosanitary certificate accompany the shipment to the UK with effect from 1 January 2021. For other seeds and also for fruits, vegetables and cut flowers, the use of international phytosanitary documents has been delayed until 1 January 2022. One of the reasons is a shortage in inspection capacity on the British side.

Practicalities

Since its introduction on 13 December 2019, the new Plant Health Regulation in the EU (PHR, 2016/2031) has been in force and the system is implemented in all member states of the EU. Some practicalities are

still being discussed but, in general, the new rules are clear. The revised lists of EU quarantine pathogens and RNQP diseases with specific inspection norms have been published. Some discussions are ongoing about the status of some nepoviruses. For the movement of seeds within the EU for research and trials, like DUS testing, it became clear that no plant passports are required, unless specific quarantine requirements are applicable. This exception is only for seeds, not for the movement of other plants for planting.

A consideration for authorities in the EU is the development of informative and properly accessible datasheets of relevant PHR regulated organisms (RNQP's and Q's) to supply adequate information to companies and citizens when they have to deal with health questions about plants. In the Netherlands, NVWA (Netherlands Food and Consumer Product Safety Authority) and Naktuinbouw are developing these datasheets.

ToBRFV

One of the most important topics and points of concern in the EU is the situation with ToBRFV (Tomato Brown Rugose Fruit Virus). From 1 April 2021, additional rules and requirements have been in place. Basically, all tomato and sweet pepper seeds (of non-resistant varieties) have to be officially tested with a prescribed PCR protocol (and found to be negative) before seeds are allowed to be marketed or imported into the Union. Also, all existing batches of seeds in storage, produced in the last number of years, have to be officially tested before their first introduction onto the market.

The ToBRFV virus has already been detected in the EU and in more countries outside the EU. Cases in EU tomato cultivation have already been reported in Spain, Germany, Italy, Netherlands, Poland, Czech Republic, Belgium, France and Greece. It turns out to be very difficult to eradicate the virus once it is present in a production facility.

Whenever seeds are imported from third countries, the EU has obliged member states to take and test official control samples from 20% of the imported lots.

Xylella

The occurrence of the bacterium *Xylella fastidiosa* in



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

Some practicalities are still being discussed but, in general, the new rules are clear



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some crops (*Olea*, *Nerium*, *Polygala*, *Prunus dulcis*, *Lavendula dentata*, *Coffea*) is still an issue of major concern. The disease is increasing its occurrence in Mediterranean countries, although not very rapidly. Records of infected orchards and nurseries are now coming from Italy (Puglia, Liguria, Toscana), France (Cote d'Azur, Corsica), Spain (Valencia region and Balearic Islands) and Portugal (Porto region). For issuance of the plant passport, obligatory random sampling and testing of the aforementioned host plants is necessary in the EU.

Since 1 January 2021, the NPPO of third countries must provide a written statement to the EU that they are officially free of *Xylella fastidiosa* (based on official survey, including obligatory testing), prior to export of planting material of host plants to the EU. Without this statement, import is not allowed. This has caused a lot of concern amongst plant propagators making cuttings in African or Latin American countries.

Quarantine pests

Finally: there is specific concern in the EU about the following quarantine pests:

- Tomato Leaf Curl New Delhi major Virus outbreaks in France (causing damage in commodities like cucumber, courgette, tomato, sweet pepper and eggplant). The virus is not known to be transmitted by seeds
- *Euwallacea fornicatus* is a beetle species that can occur in tropical trees and shrubs (like *Ficus*) and can be of concern to greenhouse growers and outside cultivation in southern EU regions. Recent isolated findings in Germany and The Netherlands

(both indoor) are of specific concern. EU is considering stricter import requirements

- *Eotetranychus lewisi* is a spider mite species which causes damage in *Euphorbia pulcherrima* (Poinsettia). A recent outbreak in Germany has caused specific concern. This mite has a broad host plant range and may have entered the EU via cuttings from African countries
- *Scirtothrips aurentis* in citrus, strawberry and *Rubus* (and possibly other crops). Recent isolated cases in Spain. Import measures are in place

An amendment of the EU PHR is currently being discussed:

- The nematode *Meloidogyne enterolobii* will be regulated as a new quarantine pest and strict import requirements will become valid, with impact on plants for planting with growing medium from all third countries
- Import requirements of all plants for planting with growing medium will be stricter from countries where *Popillia japonica* is present
- Specification of the regulated non-EU viruses in fruit and the regulated non-EU tephritidae are relevant changes. These viruses and non-EU tephritidae were already generally regulated, but are now specified up to species level
- Specific import requirements for hosts plants of *Eotetranychus lewisi* (*Euphorbia*, *Fragaria*, *Rubus*) 🌿

Global seed movement poses demanding challenges

Rose Souza Richards

40 The global and timely nature of the seed trade involves long-term storage of seed, as well as repeated re-export from the same seed lot to multiple destination countries. This presents challenges to the process of phytosanitary certification, distinct from those of the international movement of other commodities.

Seed is a globally traded agricultural product.

- The value of seed trade is constantly growing.
- In 2018, it was estimated that the international commercial seed market was worth about \$42 billion*. Today, there is no country that could fully supply farmers with seed of their choice solely from their own production. Seed companies produce and trial seed in different countries all over the world to mitigate the risk of crop failures due to several different reasons, including adverse weather conditions or pests. By finding optimal locations for seed production, timing of harvest, and localized expertise, the seed sector ensures the steady supply of seed for farmers everywhere.

Adapt to changes

Predictable international movement of seed is critical to ensure food security. One of the biggest challenges to industry is to prepare the list of additional declarations needed to ship a crop globally. Advanced preparation is the key to success. When a new phytosanitary measure is put in place, seed exporters typically have product in varying stages of development, including planned seed production, in-process seed production, recently harvested seed, as well as seed in inventory. Without suitable equivalent phytosanitary measures available, seed exporters are sometimes left without a means to meet the newly established phytosanitary requirements.

The adoption by different National Plant Protection Organizations (NPPOs) of restrictive phytosanitary regulations on seeds, including vegetable seeds, is observed to be increasing. Vegetables as a group account for 15% of the global seed market*. When assessing pest risk and determining the appropriate phytosanitary measures to apply, NPPOs should always consider the intended use of the seeds with the adoption of multiple equivalent options, so as not to create additional barriers to international trade, as stated in the international standard ISPM 38 (the International Movement of Seeds part of the International Standard on Phytosanitary Measures).

NPPOs should also refrain from introducing prescriptive seed testing protocols that have not been validated internationally. Especially because protocols evolve quickly (e.g. new PCR primers) and may become obsolete in a short time. For many pests, the

requirements rely on the adoption of seed testing as an analysis report which challenges the seed industry's ability to comply to the requirements and affects the movement of seed, because testing methods may not exist or may not be available. This scenario is very real when phytosanitary measures are being imposed that are not even necessary, as seed is not a pathway for the entry of the pest in question, or if present, it cannot establish and spread.

Since phytosanitary measures can and do impact trade, it is important that NPPOs clearly communicate new or changed measures well in advance of implementation, and that these measures are science-based. This is important to allow NPPOs of exporting countries to verify scientific need, feasibility, trade impact and to prepare for implementation. But it is also important for producers, to anticipate and prepare for quality management adaptations such as: new field inspections to be organized, new tests to be implemented, new seed treatments to be applied, etc.

Science-based

Increased phytosanitary regulation that takes a non-science-based approach contradicts ISPM 38 (the International Movement of Seeds part of the International Standard on Phytosanitary Measures), which calls for NPPOs to recognise equivalent phytosanitary measures for seed movement. Additionally, these increasing regulations significantly add to the costs for, and impact the ability of, seed companies to get seed to farmers when they need it.

There are numerous published articles on plant diseases in which the authors note that the pest in question was found on seed. Often, the relevance of such publications is questionable. The presence of a plant pathogen on seed does not necessarily mean that it transmits a disease or that seed is a pathway for establishment of the pathogen. The conclusion drawn of a pest being seed-borne or seed-transmitted may be based on experimental evidence, limited observations or, in some cases, simply suggestive statements.

Many pests that are not seed-transmitted or for which seed is not a pathway for establishment are, nevertheless, regulated. Seed companies must meet these requirements, even when they are not technically justified to move seed. ISPM 38 (the International Movement of Seeds part of the International Standard

Dr. R. Souza Richards is Seed Health Manager at the International Seed Federation, Nyon, Switzerland, r.souzarichards@worldseed.org



The presence of a plant pathogen on seed does not necessarily mean that it transmits a disease

on Phytosanitary Measures) does address this issue by stating that a pest risk analysis (PRA) for seeds should consider if the transmission of pest was done or observed under natural conditions. Because if the transmission was only observed under experimental conditions, further confirmation is necessary.

Zero-risk

ISPM 11 (the Pest Risk Analysis for quarantine pests part of the International Standard on Phytosanitary

Measures) clearly recognizes that zero-risk is not a reasonable option in risk management and describes pest risk management as the process of identifying ways to react to a perceived risk, evaluating the efficacy of these actions and determining the most appropriate mitigation options to achieve the desired level of protection.

While countries are free to determine the required level of protection for a given pest in a specific crop, and whether that level should be the same for the whole country or for certain areas (e.g. pest free areas or zones of low prevalence), it is a challenge for the industry when a country sets the required level of protection unrealistically high. In those cases, a pest risk management measure may become a technical barrier to trade and, therefore, impact food security.

Harmonization

The ISF Regulated Pest List Initiative, or RPLI, aims to facilitate the harmonization of phytosanitary requirements for the international movement of seed by sharing information on regulated pests of inter-

nationally traded seed species, based on a scientific assessment of whether pests are a risk and the experience of the seed industry in managing this risk. These pest lists are independently revised by a minimum of three experts from different seed companies. Currently, the vast majority of regulated pests are for pests where seed is not a pathway. On average, for 77% of the pests regulated on seed for the vegetable crops listed in the RPLI, seed is not a pathway, or the crop is not a host for the pathogen.

It is important that NPPOs recognize and implement international standards published by the International Plant Protection Convention (IPPC) - in the case for seeds, this standard is ISPM 38: *International movement of seeds*. This includes adopting phytosanitary measures that are proportionate to the assessed pest risk for the seeds of a given species, origin, and purpose of import. Global trading operations of plant products rely on crucial communication and transparency of science-based phytosanitary requirements to protect plant health and ensure international safe trade of goods.

Emerging trend

The seed industry is concerned that recent phytosanitary measures adopted by some NPPOs for the regulated pest Tomato Brown Rugose Fruit Virus (ToBRFV) do not follow the ISPM guidance for equivalent measures, nor did they provide enough time for exporting NPPOs to comply with the changes in regulations, as they were implemented under emergency.

The seed industry has noticed an emerging trend, where NPPOs are moving more towards the adoption of only one phytosanitary measure for imported

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SCAN ME FOR MORE INFO

Seeds are the foundation for crop production and, as can be seen from the trade model, the movement of seed around the globe presents many challenges



seed: seed health testing with molecular testing is rapidly becoming the phytosanitary import requirement of choice. This is in direct contradiction to ISPM 38, where the adoption of equivalent measures is important for the international movement of seeds. We believe that such increased reliance by NPPOs on seed health testing, specifically molecular PCR testing, will be detrimental to the supply of seeds to final countries of sale and have a significant negative effect on food security.

Testing requirements by NPPOs are outpacing the development and validation of official international methods. Currently, methods are developed and validated through rigorous procedures (e.g. International Seed Federation – International Seed Health Initiative (ISF-ISHI); and US National Seed Health Systems (NSHS)). However, many NPPOs are now developing their own methods and are testing seeds at the point of entry. In some cases, these national seed health tests are not known or familiar to the exporting country and/or company and have not been internationally validated or recognized for phytosanitary certification purposes by the exporting NPPO.

The seed industry acknowledges that the process of validation may take several years per method and that, while there are only 50 or so international methods, there are many hundreds of pests for which validated methods are needed. Until recently, this was not an issue because most importing NPPOs offered Additional Declaration (ADs) options of either seed health testing OR “country free from” OR “pest free place of production”. But the recently adopted emergency rule for Tomato brown rugose fruit virus (ToBRFV), for example, eliminated the “country free from” option, necessitating that all seed must be tested offshore prior to entry into the country of import. The seed industry is concerned with the adoption of similar phytosanitary measures for other pests; therefore, we ask that NPPOs consider defining multiple equivalent phytosanitary measures to achieve the required protection, as recommended by the ISPM on International Movement of Seeds.

Seed health laboratories

There is a need for more third-party laboratory accreditation systems around the world in seed exporting countries, with molecular seed health testing as the phytosanitary import requirement of choice. Many NPPOs themselves have limited capacity for molecular seed health testing for export certification purposes and have no internally validated national protocols to meet such requirements. Comparatively few international methods exist, but the demand is rapidly increasing. Currently, seed health tests are performed by a small number of primarily government/public research laboratories and, in a limited number of countries, by third-party entities (accredited by NPPOs). For the latter, it has been an emerging interest by many NPPOs to set up accreditation systems for third-party laboratories.

However, where an authorized national NPPO approved method does not exist, test results from accredited entities are not allowed to be used to issue phytosanitary certificates and all testing will have to fall back on the government laboratories. This will result in delays for the export/import of seed lots which could create a significant problem in the seed supply chain. If farmers miss planting season windows because seed is not delivered to the fields in time, the result would be serious food and feed shortages. This is a situation that we cannot afford to find ourselves in, especially in these already volatile times.

A combination of flexibility in phytosanitary measures, accreditation of more private laboratories (including seed company laboratories) to perform seed health testing for the purpose of export/import, and international collaboration in protocol development will guarantee healthy seed reaches growers when and where they need it.

ISF and the seed sector are always willing to work alongside NPPOs on phytosanitary measures, as healthy seed is also our goal. We remain committed to our vision of a world where the best quality seed is accessible to all, supporting food security and sustainable agriculture. 🌱

*Fao.org. 2019. [online]
Available at: <http://www.fao.org/3/ca6929en/ca6929en.pdf>

High-yielding hybrid papaya gains ground

Monique Krinkels

44 Until recently, papaya could only be grown in tropical countries. A drawback, as the fruit is difficult to transport because papaya easily gets bruised when harvested green. Spain was the first European country where the melon tree would thrive, but today production is even possible in Dutch greenhouses.

Initially, the palm trees on which papayas grow were up to ten metres high. The thin trunk without any branches is crowned with a 'hat' of huge leaves in the axils from which the flowers - and later the fruits - grow. The melon tree, or *Carica papaya*, originates from Mesoamerica, (southern Mexico, Central America, and northern South America). Today, the fruits are produced in over 70 countries and are eaten worldwide. It takes one year for the melon tree to start producing papayas and then it bears fruit all year round for three years. The diameter of the fruit is from 10 to 30 cm, the length is up to 45 cm.

Three genders

"We started breeding papaya in 2000," says Jan Lippstreu, fruits & flowers crop manager at East-West Seed International Limited. "So far, we have eleven hybrid varieties." Besides papaya, Lippstreu is also responsible for several types of melon and the brightly coloured ornamental marigold.

"Papaya is an interesting plant from a botanical point of view," he explains. "It is not a tree but a herbaceous, fast-growing shrub. Furthermore, there are three genders: a plant can either be female, male or hermaphrodite. Male plants have only stamens and bear no fruits. Female plants have an ovary and can bear fruits when pollinated, but the fruits are round and unwanted. Only hermaphrodite plants produce the elongated fruits that are marketable."

It means an extra step in selection: removing all female and male plants as soon as the first flowers



appear and the sex of the plants can be determined. Male plants can be easily recognized: their flowers are conspicuously different, as they are borne in large numbers on a branched, drooping flower stalk. Female flowers are borne in the axil of the leaf petiole, are bulbous at the base and, before they open,

pointed at the tip.

But even if the plant is a hermaphrodite, one has to beware. Under certain conditions, its flower morphology is unstable and subject to 'sex reversal'. Cool winter weather or high soil moisture can lead to a shift toward femaleness, where the stamens fuse to the carpels or ovary wall. The resulting fruits become severely ridged and unmarketable.

Dwarf varieties

Harvesting fruits from a ten-metre-high tree is a cumbersome exercise. Luckily, the varieties of East-West Seed are dwarf types, with a height of 1.5 to 3 metres, which make for easy picking. Breeding goals differ per region. Where Latin Americans prefer to eat the papaya's sweet red meat, Thais harvest papayas when they are still green to be used in salads and Filipinos prefer the fruit to be cooked.

"We recently introduced a new hybrid variety for the Mexican market, a maradol type named Maradona F1. It shows great potential as it is a super sweet tasting

Changing the world

The global media organisation, Fortune, ranks East-West Seed at number 28 out of 53 in its annual 'Change the World' list of global companies that are 'doing well by doing good'. The list is intended to showcase the power of capitalism to improve the human condition by identifying companies that have made an important social or environmental impact through their profit-making strategy and operations. The focus of East-West Seed is on smallholder farmers who play a critical role in ensuring the adequate supply of agricultural products. They produce 70%-80% of the world's food and are vital to food security and nutrition, especially in developing countries.



East-West Seed proves that you can make a real difference in people's lives while also operating a successful business, the two do not need to be mutually exclusive.



Marigolds are the only ornamental in the crop list of East-West Seed Company. Its main use is decorating temples in Asia, but the flower can also be used in meals

papaya with an excellent brix and a high yield. Moreover, this papaya has a good shelf life and transportability and is therefore a real asset in our portfolio,” says Jan Lippstreu. Katherine Panergayo is the papaya breeder at East-West Seed Company. “This variety was among the first set of test hybrids developed by East-West Seeds. It took us eight years to develop the hybrids and another three years of testing and commercial seed production, before the selected hybrids could be introduced to the market.”

Besides eating quality, yield and transportability resistances are enormously important. “Our varieties must be tolerant to heat and drought, as flower abortion is a real problem. Furthermore, tolerance against the fungus *Colletotrichum* is a vital characteristic, as is resistance against the Papaya Ringspot Virus and, of course, the many pests that threaten production.

Dutch papaya

A few years ago, Spanish growers started to produce papayas in their greenhouses. The cultivation was concentrated in Tenerife in the Canary Islands, and also in the south-east of the mainland (Almería, Málaga, Granada and Murcia). The fruits might be slightly smaller than in tropical regions, but that is compensated for by the easier transport to European consumers. As the result of a trial at Wageningen University & Research, one of the East-West varieties has found fertile soil in the Netherlands.

In a greenhouse of 4 hectares, 12,000 melon trees were planted and, in the autumn of 2020, the first fruits were harvested. In this climate, every tree produces on average two fruits per week, more in



The newly introduced Maradona F1 has a super taste, according to Jan Lippstreu

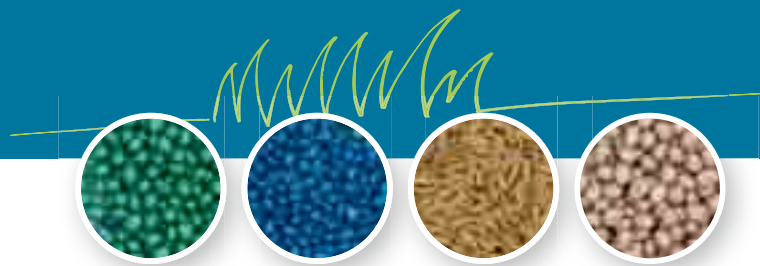
the summer than in winter. So far, the pioneering growers only had experience with the production of tomatoes and cucumbers and peppers, so there was a lot to learn. They hope to expand papaya production in the Netherlands to 40 hectares within the next decade.

Ornamentals

East West Seed specializes in tropical vegetables, but there is one exception however: marigold. At the start of this millennium, the company started a breeding programme for this ornamental. Especially in India, the flower is enormously popular. Not only as part of a bouquet to be gifted to a host, but as a garland to be used to decorate the Hindu and Buddhist statues in temples. Especially while preparing for festivals, the demand for marigolds is high. Garland makers only use the flower itself; the stem is removed.

“Breeding and seed production of marigolds is difficult. The double flower hampers pollination,” explains Jan Lippstreu. “On the other hand, the plant itself is robust. It can withstand storms, rains and drought without any problem. Our hybrid varieties are characterized by their abundant flowering and dense canopies, with a strong petal firmness.”

India is not the only market for marigolds. In Thailand, Vietnam and Indonesia, temples are also decorated with this brightly coloured flower. And embellishing temples is not its only application. Marigolds are used in medicines (against skin conditions and inflammations), culinary recipes (as a ‘poor man’s saffron’) and even in perfumes, adding a herbal, aromatic fragrance to the scent. 🌸



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SEED & SERVICES

Marketing of Seeds and Planting Material

EU starts talks on new PRM legislation

John van Ruiten

At the end of April 2021, the EU Commission published the results of a stakeholder consultation process and of a PRM (Plant Reproductive Material) study that took place at the end of 2020. Together with this publication, the Commission launched a proposal, as a follow up of this study, to start a revision process of the legislation on the marketing of seeds and planting material in the Union.

Currently, twelve directives, many of them originating back to the mid 60's, govern the quality requirements for marketing seeds and planting material in the EU. The study by the EU Commission published in April contains opinions of many interviewed stakeholders in the member state countries. These include government authorities, scientific institutes, non-governmental organisations and organisations of companies active in seed and plant production and marketing.

Better regulations

Almost ten years ago in the EU, the so-called 'Better regulations' proposal lay on the desks of member states and the EU Parliament. The objective was not only to create new phytosanitary legislation, but also to simplify and harmonize seed legislation in all agricultural and horticultural sectors, including forestry. Through application of the Official Controls Regulation, the aim was also to harmonize the execution of the rules and requirements in seed legislation and create a 'level playing field' in the Union.

Especially in the European Parliament, there were a number of big concerns around this PRM proposal, mainly regarding the rules for registration of varieties, of which it was thought that they were too severe for amateur gardeners and some niche markets. Also, the 'one size fits all' suggestion (all twelve seed sectors integrated in one set of legislation) was obviously one step too far for some member states and the Parliament. In the end, the only option left to the Commission was to withdraw the PRM proposal. As known, the proposal for renewing the Plant Health Regulation (PHR) was adopted and since the end of 2019, this phytosanitary legislation (on plant passports, imports and exports, and on measures to control and prevent harmful organisms spreading

According to the EU Commission, adjustment of legislation on the marketing of seeds and planting material in the Union is absolutely necessary



in the Union) have been in place, together with the Official Controls Regulation (OCR).

New developments

The Commission now concludes from the results of the study that the evaluation, which was done 15 years ago and led to the PRM proposal, is still valid. But another aspect has been added: in recent years technical developments in production processes and breeding have been huge. And, even more importantly, the Commission has proposed new policy initiatives in the EU on sustainability, organic agriculture, conservation of biodiversity and the necessary adaptation to climate change. The Green Deal, the Biodiversity Strategies and the Farm to Fork strategies are key elements in the EU policy to be adopted in new legislation in the coming four years. The Commission also wants to adjust relevant existing legislation to support these new goals.

Five other elements have been identified that make adjustment of legislation absolutely necessary according to the Commission:

- Lack of coherence in the 12 directives (also causing many derogations and non-harmonized implementation)
- Rigid and complex procedures to modify rules and high burden on certification authorities
- Outdated provisions cause non-harmonized implementation and there is no synergy with other policies
- There is a lack of a risk-based framework and difficult IT support possibilities
- The present legislation does not take into account technical and scientific developments

Options

The Commission is now proposing a number of options to the member states to continue with the revision process:

- Option 0: No change in the structure of directives

but take into account new policy items

- Option 1: Amending directives to align the structure and introduce measures to support sustainability
- Option 2: Introduce amendments to directives to respond to the need for more sustainability and more biodiversity. More flexibility and allow for easy adaptation to technical and scientific developments

It is expected that especially new rules for easier (and cheaper) registration processes of varieties for non-professional use will be brought to the table. Also, it is foreseen that sustainability requirements for variety registration in all crops (possibly with the exception of ornamentals) will be proposed, such as more disease resistance/tolerances and better adaption of varieties to stress conditions.

Favourite option

It is up to the ministers of agriculture of member states and the EU Parliament to express their basic preference for one of these options. In a meeting on 26 May 2021, the ministers of member states gave their first reactions. In general, it seems that they support amending the existing legislation. It is felt that option 2 is the favourite option for the Commission itself. A renewed impact assessment of new legislation proposals (organised by the Commission) will be published mid-2021. Further meetings with stakeholders in dedicated meetings are foreseen, as well as further consultation with all interested parties. In general, it takes at least three years to change EU legislation. With these quite ambitious ideas, it will certainly lead to many discussions, and it is a challenge for the Commission to get enough support to adjust the legislation. Certainly, seed and plant producers in the Union (generally they are quite satisfied with the existing legislation) have to be closely involved in the process of amending articles and drafting the new rules during the next year. 🌱

Eradication is **impossible**, but damage can be limited

Ton van den Born

48 The threat of *Xylella* to growers in Europe has heavily influenced phytosanitary legislation in Europe. The last step was the EU Implementing Regulation 2020/1201 which the European Commission adopted in August 2020 in order to prevent the spread of *Xylella fastidiosa* in the EU. It is time for education to be more aware of this, thinks Bram de Hoop of NVWA.

“**Xylella has not yet arrived** in the Netherlands,” says Bram de Hoop, plant health officer at the Netherlands Food and Consumer Product Safety Authority (NVWA). “In 2014, coffee plants with *Xylella* were intercepted which had been imported into the Netherlands as ornamental plants. They turned out to be infected with the bacteria without displaying any symptoms.” The NVWA implements the response with any findings or outbreaks of *Xylella*. It also informs growers, traders and private individuals how they can help to prevent an outbreak of the harmful plant disease in the Netherlands.

Xylella fastidiosa is a bacterium that crawls into the xylem vessels of a plant. The sap flow from roots to leaves is disturbed and the plant dries out. The bacterial disease is not dangerous to humans. The list of host plants is growing, and now includes more than three hundred plant species. For example, olive trees, lavender and grapes. But the bacteria can also occur in nettle, for example, in other weeds, grasses and some garden plants. A plant passport is mandatory for high-risk host plants, stating origin and producer. A tracking code is also required for trading.

Deathblow

There have been findings, not only in the Netherlands, but also in our neighbouring countries. “Germany, where *Xylella* was found in a privately-owned oleander, immediately pulled out all the stops,” says De Hoop. “A buffer zone of five kilometres was set up.” It was prohibited to import or export regulated plants or plant material within that zone. “Painful for

Photo: NVWA



‘Eradication scenarios remain terrifying’, says Bram de Hoop

the growers. The Dutch plant cultivation sector is very concerned about the risk.” Until now, it has been shown that *Xylella* causes problems, especially in warm and dry climate conditions. But the bacteria are also found in colder countries, in Canada, for example. And the conditions in the Netherlands are also suitable. The spread of

Xylella fastidiosa is mainly via cicadas, such as *Philaenus spumarius*, which also occurs here.

The Mediterranean area has been badly affected. “The heel of Italy is completely covered. There is large-scale mortality of olive trees. In Andalusia, you will find *Xylella* in almond trees, in Northern Israel there is a source and Corsica, where the bacteria mainly affect the milkwort, is completely sealed off from plant traffic. Furthermore, several host plants infected with *Xylella* were found on a peninsula in Tuscany two years ago. The Italians are doing everything they

Phytosanitary legislation

Bram de Hoop, plant health officer, represents the Netherlands Food and Consumer Product Safety Authority (NVWA), part of the Ministry of Agriculture, Nature and Food Quality, at the European Commission in Brussels. There he is talking about the technical legislation in the phytosanitary domain. For example, the regulations that have been established to reduce the risks of plant diseases such as *Xylella fastidiosa* (Xf), to prevent spread and to coordinate intervention in case of

contamination. In the Netherlands, the NVWA oversees, among other things, food safety and animal and plant health. The organization is also responsible for the phytosanitary tasks that should prevent the introduction, formation and spread of harmful plant diseases and pests. Since 1992, the European Union has been working on regulations that should prevent the introduction and spread of diseases and pests in plants. The European Food Safety Authority (EFSA) coordinates research and

advises the European Commission. Partly due to *Xylella*, phytosanitary regulations have been tightened considerably in the EU. The Plant Health Regulation has been in force in the EU since December 2019. A distinction is made therein between quarantine organisms (such as *Xylella* and specific longhorn beetles such as *Anoplophora chinensis*) and a category of diseases and pests (so-called *regulated non-quarantine pests*) for which propagating material is the main source of dispersal. For

In Italy there is large-scale mortality of olive trees as infection by the dreaded *Xylella* bacteria is spreading



can to prevent any spread, but you dread to think that *Xylella* could be found in the tree nursery area near Pistoia (about 200 km away). That would be the deathblow there.”

Buffer zones

“*Xylella* is q-regulated,” continues De Hoop. There is no control method for the bacteria that is not very particular and kills hundreds of different plants. The quarantine status then means that the EU will do its utmost to prevent introduction, formation and further spread. Nurseries with specific host plants such as coffee plants (*Coffea*), lavender (*Lavandula dentata* L.), oleander (*Nerium oleander* L.), olive (*Olea europaea* L.), milkwort (*Polygala myrtifolia* L.) and almond (*Prunus dulcis*), for example, need to be tested regularly. De Hoop refers to a previous EU regulation from 2016 (2016/2031) on which the emergency measures for *Xylella* are based: ‘Member States should take all necessary phytosanitary measures to eradicate Union

quarantine pests, when found to be present in their territories.’

This initially means that all host plants in a circle of a hundred metres around the contamination are destroyed and buffer zones are set up. In the latest EU Implementing Regulation, the clear-cut zone is limited to fifty metres. Buffer zones (the zone where no plants can be traded for up to five years after an outbreak) have also been adjusted, says De Hoop. From 10 km to 5 km around the source for containment areas such as the heel of Italy and from 5 to 2.5 km if member states apply eradication. “But those eradication scenarios remain terrifying.”

In 2019, an exercise was conducted in the Netherlands with local authorities and trade associations as to what it would mean if *Xylella* were detected. “Not focussed on the eradication - difficult to simulate - but mainly on the communication and cooperation that will then take place.”

“We experienced such a scenario in 2008, when the

example, the issue of plant passports by companies, which had already been made mandatory a number of years earlier, was further extended to include all plants for planting, including plants intended for the end customer.

Considerations for such a regulation are that on the one hand trade can continue smoothly, but that on the other hand protection is optimal in order to prevent the introduction of infected plants. Two conflicting issues, because more trade in

plant material increases the risk. New terms have also been introduced in the legal field. Tools for enforcement and sanctioning in case prevention measures are not complied with. The Implementing Regulation 2020/1201 regulated the measures to prevent the introduction and spread of *Xylella*. That regulation was an update of an implementing order first drawn up in 2014. In collaboration with, among others, the European and Mediterranean Plant Protection Organization (EPPO) and the XF-ACTORS

consortium, the NVWA has gathered considerable knowledge about *Xylella* and its threat to Dutch agriculture and horticulture. About the variety of host plants, the possible vectors, prevention and the approach should *Xylella* be found in the Netherlands. In 2019, the European Commission designated the National Reference Centre - Plant Health (NRC) of the NVWA as a European Reference Laboratory (EURL) in the field of harmful bacteria in plants. *Xylella fastidiosa* is one of the core activities of this EURL.

Eradication is **impossible**, but damage can be limited

longhorn beetle *Anoplophora chinensis* was discovered in Boskoop.” There, all the trees were cut down and gardens cleared in a zone of a hundred metres around the location, taking into account the risk of spreading. “If you can then demonstrate that it involves a recent introduction, you can limit the measures.” This exception clause also applies to Xylella.

• **Limp**

- What can the NVWA advise your growers and traders?
- “It has been said before, and it is obvious, but be careful what you buy from southern Europe. Especially when it comes to coffee plants, lavender, milkwort, oleander, olive, almond; the usual suspects. Be sure to stay alert if you are importing from contaminated areas or from the vicinity of contaminated areas. You can request additional test guarantees. That might be smart.”

Good information can also help, thinks De Hoop. “That people know about it.” So not so much the growers, but the broader group. “Think about tourists, so that they don’t buy plants and take them back with them.” Compared to animal diseases that directly threaten food (dairy, eggs, meat) or zoono-

ses that can pass from animals to humans (such as Covid-19, Lyme disease, Q fever, or avian flu), a plant disease such as Xylella may be less likely to appeal to the imagination of that tourist. But more awareness of the risks would be good.

Education can also help. They can learn about the risks of Xylella, ask themselves questions such as: how does the bacteria spread and what are the regulations in Europe? How do you prevent the introduction of Xylella and what to do if that fails? De Hoop: “That should be included more in education, in secondary vocational education and higher professional education. I have occasionally taught about spraying licences in secondary vocational education, and the phytosanitary research is only one aspect there. That certainly deserves more attention.”

Regardless, since 2013, when Xylella first appeared in Italy, there has been a significant development. “Looking at the longer term, we are on the right track,” says De Hoop. “There are tools, there are regulations, there is action, but I don’t think we will get it completely eradicated. We can, however, limit the damage.” 🌱

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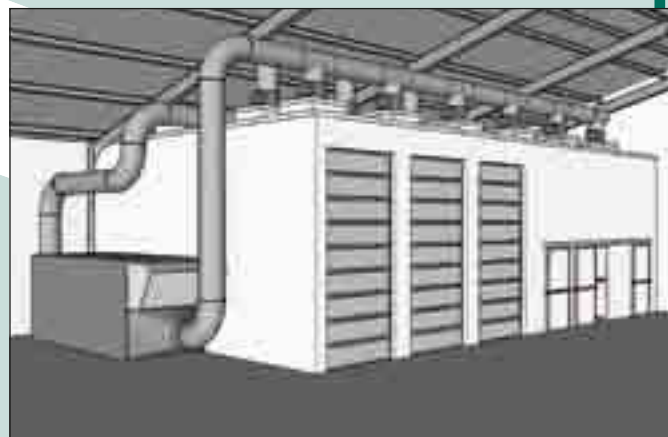
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Central hybrid air dryer (left) to be connected to different drying installations, drying units or drying rooms; optimal and economic use of dried air.

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