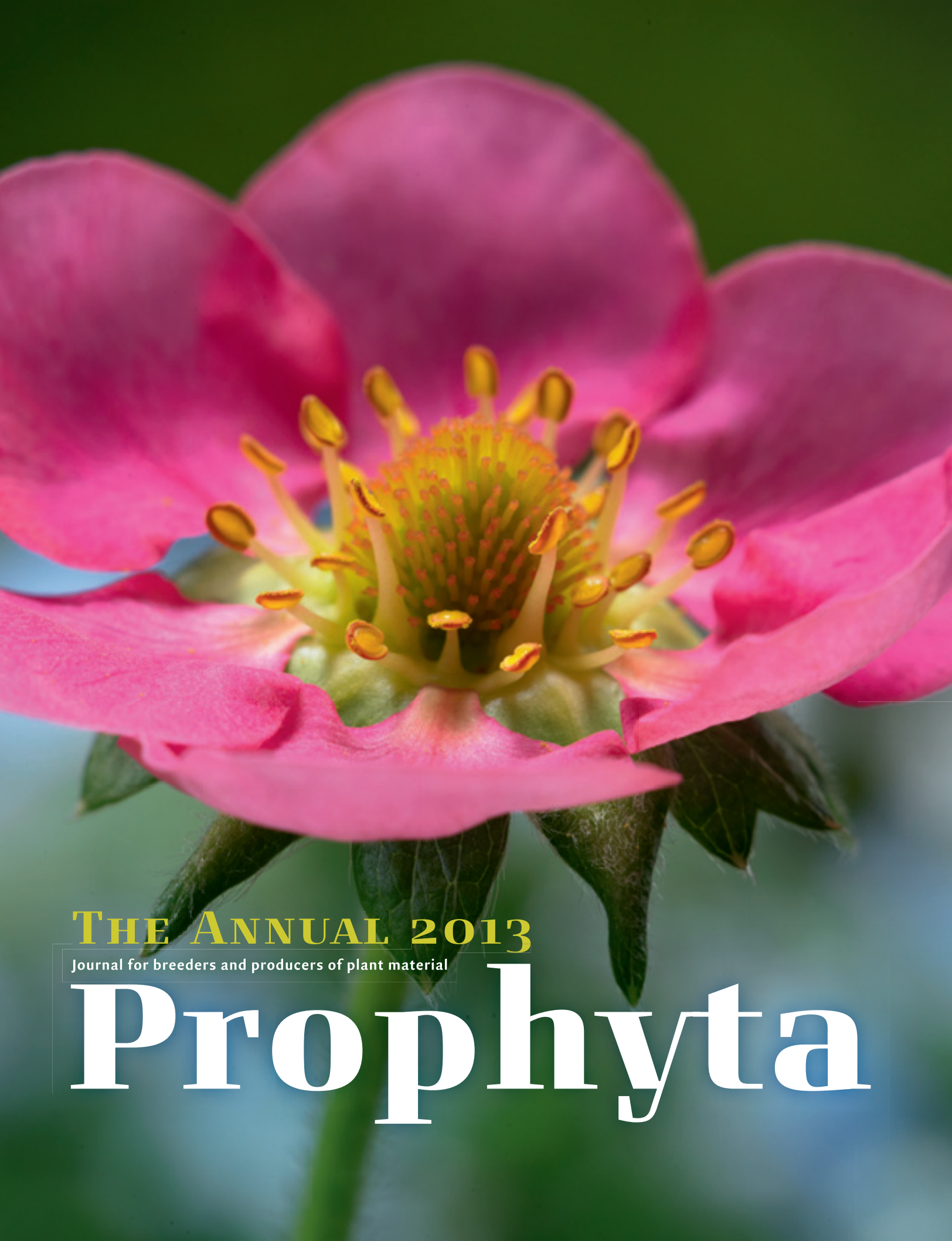

THE ANNUAL 2013

Journal for breeders and producers of plant material

Prophyta

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China and Australia grant patent to Keygene

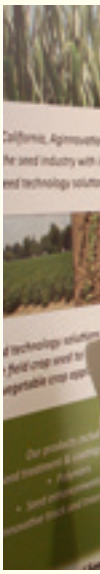
Both the State Intellectual Property Office of the People's Republic of China and the Australian Patent Office granted KeyGene's patent entitled 'High throughput screening of mutagenized populations', which protects methods for detecting induced and natural genetic variation in large plant populations. These methods form the cornerstone of KeyPoint MB programs, which deliver novel genetic variation in selected genes for trait improvement in crops at industrial scale. Using this approach, large numbers of improved genes involved in traits such as biotic stress resistance and drought tolerance have been obtained for a number of crops. Results so far included maize plants with improved drought tolerance, short-stem canola and soybean with altered fungal resistance. Development of these valuable and proprietary pre-breeding materials was completed within timeframes of less than six months. Significant cost savings can be made because KeyPoint MB products do not require deregulation.

Collaboration gives companies worldwide coverage

A company with five to ten employees has limited opportunities to invest in R&D. Another restriction is that the size hampers global trade. Last year, Jan-Willem Hoopman created a solution to these limitations: the Centor Group, an international collaboration of similar companies.

Regional

It was in 2010 when Jan-Willem Hoopman started to explore opportunities with company owners who faced the same limitations he met: too small to become a global player, too enterprising to be satisfied with a regional role. His company, the Hoopman group, is an old family-owned company, over a century old. It started as, and still is, a manufacturer of farm equipment but for decades it has been renowned for its seed enhancement equipment. Among its products are a unique seed drying system and equipment for upgrading, disinfection, priming and coating of seeds. "Our customers are mainly in our own region", he says. "On other continents there are similar companies who offer complimentary and overlapping technologies. The plan is that we will act as each other's agents and sell each other's products. The advan-



The Centor Group was launched last year at the APSA Congress in Bali, Indonesia

tage for our clients is that all the services are provided by a company close to home."
So far, the Centor group consists of four seed technology suppliers. Besides the Hoopman Group, it includes Australian-based Agritec (formerly known as Seed Solutions), Aginnovation LLC (a US-based company), Centor Thai and Centor India, based in Thailand and India respectively. Centor will expand this year with companies in South Africa and in Brazil, thereby covering all five continents.

Added value
To increase the value of cooperation, the Centor Group also invests in R&D and education. Rhino Research Technologies, Thailand, specialises in researching and developing seed technologies, including seed enhancements, seed sorting and upgrading, seed coating, seed treatments and pelleting, and seed recovery. The International Seed Academy in Thailand is a non-profit company with the aim of bringing seed technologies within the reach of most companies. "Although new seed technologies are relatively easy to retrieve abroad and machines, protocols and systems can be purchased, there is often little practical information or support and little customization of those technologies. The International Seed Academy organises hands-on training as well as a seed captain programme, with speakers from top academic institutes such as Wageningen University, the Netherlands, Davis University, USA, and Kasetsart University, Thailand."

Join the team
With six companies and two institutes spread worldwide, the Centor Group seems to be complete. Not according to Jan-Willem Hoopman, however. "There is room for expansion. Companies with either interesting products or technologies are welcome to join us. The same goes for companies that can offer sales efforts. What we want to be is the 'One Stop Global Seed Tech Shop' that operates worldwide, but at the same time close to our customers. We are therefore constantly on the lookout for opportunities that complement and enhance technologies needed and used by our clients."

For more information: www.centorgroup.com

New breeding goals?

Never before has Prophyta included articles covering such a wide time frame. From the ancient scientist, Theophrastus, who created the first 'classification system' of plants, and the Greek deity Persephone, who is associated with seeds, to future oriented scientists who are researching whether plants can be grown on Mars. The latter might seem far-fetched but US President, Barack Obama, has authorized manned missions to Mars within a decade or so. Former Apollo astronaut, Buzz Aldrin, and the Dutch entrepreneur, Bas Lansdorp, have even suggested that by 2023, a permanent settlement should be founded on Mars. And the 100 years Starship Foundation, financed by the US Defense Advanced Research Projects Agency (DARPA) and the National Aeronautics and Space Administration (NASA), is preparing for interstellar travel within the next century.

Even if we leave the stars aside, a decade is not much time in terms of breeding plant varieties that are able to cope with conditions elsewhere in our solar system. And these varieties are an essential prerequisite if humankind is ever to explore the universe, as the basic necessities would have to be satisfied on location. So far, research is limited to whether the mineral composition of Martian soil suffices for known varieties, or that certain nutrients are lacking. But presumably it will be preferable to have special varieties that are better suited to the growing conditions in the domes where the colony will have to live.

Of course, that does not mean that breeders all over the world should shift their attention to breeding extra-terrestrial plant varieties. Coping with present demands is enough of a challenge for most of us. Especially as the growing world population will have to be fed, the demand for luxury foods is rising and the battle against 'unhealth' in the Western world, due to an unhealthy lifestyle, simply demands an increase in fruit and vegetables consumption. Add to that the consequences of climate change, plant diseases quickly spreading over the world and a shrinking availability of suitable farming land, and the endeavour is clear. But that does not mean that we should not look further than that. For people who believe space travel is, for the time being, mere fantasy: 'Every great adventure in science has issued from a new audacity of imagination', as the philosopher John Dewey stated. And while he is not a Greek philosopher but an American, his view on scientific evolution seems true enough.

Monique Krinkels

Digital floriculture counter opened

STARTING ON 1 JANUARY 2013, a new international digital horticulture counter has been opened by Floricode, the Netherlands. As the name already suggests, it is the intention to centralize all kinds of horticultural business codes and enable all users to exchange information about trade codes and registration codes.

Spider in the web

Floricode, situated next to the Naktuinbouw in Roelofarendsveen, the Netherlands, is acting as a spider in the horticulture web of legislation, registration, information and data exchange. The main goal is to facilitate all business players in the field of horticulture business. This is, indeed, a major step forward, because it depends so much on different companies expressing interest in so much different data. The users of the Floricode database are growers, traders, breeders, transport and logistics service providers, auctions, as well as their software suppliers.

Floricode follows the Dutch initiative Tuinbouw Digitaal (Horticulture Digital). This very ambitious initiative is aimed at the combined most important Dutch organizations, like the Wageningen University and the Dutch Ministry of Agriculture. It aims to be the European leader in the field of information management in horticulture chains by 2015, and worldwide by 2020. As Leo van der Zon, CEO of Floricode, explains: "We want to be recognized as a compact, goal-oriented and agile organization, enabling the floriculture branch to perform efficient digital business."

Main goals

There are four main goals for Floricode which will cover the majority of needs. The first activity is registration. Floricode is registering and managing the name and taxonomic description (phenotypically) of products and their botanical characteristics. Also pictures are taken of all products as an extra precaution and back-up control.

Encoding is the next step. This is a crucial necessity for the digital trading in floriculture, amongst which are the characteristics according to the regulations, the product codes and the GPC (= Global Product Classification) codes. Furthermore it includes specific company, product and location barcode encoding (GS1), logistic means and process variables. And also GLN (Global Location Number) allocation is an important part. Standardizing is an important goal for a flawless electronic exchange of commercial, logistic and financial information through open message standards. Floricode is aiming to join UNCEFACT (United Nations Centre for Trade Facilitation and Electronic Business) and ISO to be able to secure Floricode standards internationally. The Floricode website is the central distributing location for all information about products and services. Also one can find a calendar of meetings and events meant to inform the floriculture branch about the latest developments.

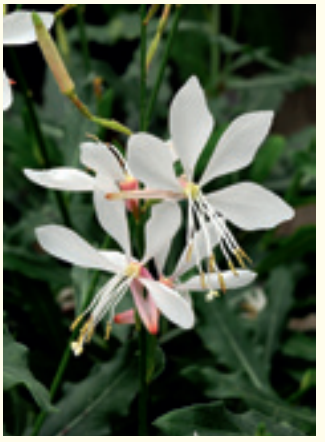
www.floricode.com is not (yet) available in the English language. More information: info@floricode.com.

Judges enthusiastic about Gold Medal winners

No less than six varieties have been awarded the Fleuroselect Gold Medal 2014. This honour is awarded to novel varieties that have been tested by expert and independent judges and proven to clearly supersede existing varieties in terms of breeding innovation and beauty. These varieties are the trendsetters of the moment, and represent the absolute top in breeding. Fleuroselect's Gold Medal Winning varieties are displayed in more than forty Public Gardens across in Europe, the USA and Asia.

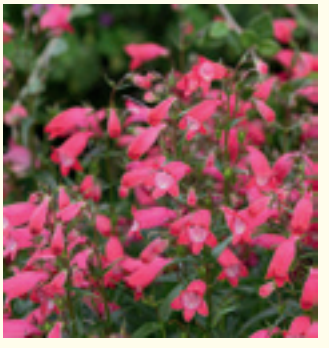
▶ **'SweetSunshine® Provence'** The breeder of Petunia cultivars 'SweetSunshine® Provence' drew inspiration from the romantic, rich colours of the French lavender landscape in designing this breakthrough in small, double-flowered petunias. Selecta Klemm succeeded in creating a variety which is also early, sturdy and has the cutest flowers.The judges were particularly impressed with its vigour and colour shading.

▲ **'Profusion Double Hot Cherry'** During the trials, Zinnia x hybrida 'Profusion Double Hot Cherry' scored particularly well in innovation and overall appearance. The jury was impressed by this annual's intense, non-fading colour and its outstanding garden performance.
The breeders of Sakata Ornamentals created an annual with fully double flowers with non-fading petals.



▲ **'Sparkle White'** The jury loved this Gaura lindheimeri of Kieft Seed for its excellent garden performance and strong branching habit. This herbaceous plant provides densely clustered branched stems carrying single, white flowers with a 3.5 diameter. Gaura lindheimeri is known for being drought tolerant.

▼ **'Carillo Red'** The Penstemon x mexicali 'Carillo Red' of PanAmerican Seed has a new, strong red colour, is early flowering and has improved upward branching. That makes this seedraised perennial a splendid addition to any garden It thrives well in sunny conditions and needs a well-drained, moderately fertile soil. 'Carillo Red' is best planted in groups and looks fantastic in front of a perennial border, or in a more formal bedding style garden.



▲ **'Zahara Sunburst'** This exciting Zinnia marylandica of PanAmerican Seed scored exceptionally high in the garden trials with a 1.8 out of 2.0 for innovation. Especially the new red-yellow bicolour pattern and the floriferousness stood out during the trials. The marylandica species is a hybrid cross developed in the University of Maryland, from which it takes its name, in the early 1980s.

▼ **'Pinto Premium White to Rose'** Gold Medals are awarded to the latest accomplishments in breeding and this Pelargonium x hortorum of Syngenta absolutely fits the bill. Having obtained one of the highest scores ever achieved in the Fleuroselect pack trials including an exceptional 1.89 out of a possible 2.0 points for innovation, this Pelargonium is bound to break records.
The judges were unanimous in deciding that the variety has superb retail value.

Our flora and fauna is natural, but cannot be taken for granted

Nature's wealth is abundant and essential for life. At Rijk Zwaan we are acutely aware of this. We develop the very best vegetable varieties and vegetable seeds, every day again, making use of the raw materials and possibilities Nature has to offer us. But we also accept Nature as it is. After all, our aim is to continue developing new varieties for many years to come and that is only possible if we use our knowledge with respect for Nature. That's what we believe in.

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Support the Foundation

The Prophyta Foundation is an independent non-profit organisation, aiming at informing interested parties worldwide about developments in e.g. plant breeder's rights, breeding techniques, genetics, biodiversity, technology, regulations, phytosanitary matters and more. Our communication methods include at present our Prophyta Annual and our website www.prophyta.org. The Foundation primarily works with volunteers, but in order to recover costs for these activities we need advertisements for our annual magazine and/or direct financial support to the Prophyta Foundation.

We greatly acknowledge the companies mentioned below for supporting Prophyta, by either advertising or donating. Please feel free to contact our secretariat (P.O. Box 40, 2370 AA Roelofarendsveen, the Netherlands, email: foundation@prophyta.org) to join membership of our distinguished group of agricultural and horticultural companies, both for further information or for donations.

Abrasem	Brasilia, Brazil	www.abrasem.com.br	Brazilian Seed Association
ABZ Seeds	Bovenkarspel, the Netherlands	www.abz-strawberry.nl	F1-hybrid strawberries
Agri Information Partners	Wageningen, the Netherlands	www.agripartner.com	Computer software
Agro Business Solutions	Grootebroek, the Netherlands	www.agrosolutions.nl	Computer software
Agronomix	Winnipeg Manitoba Canada	www.agronomix.com	Computer software
Bejo Seeds	Warmenhuizen, the Netherlands	www.bejo.nl	Vegetable seeds
Corn. Bak	Assendelft, the Netherlands	www.bromelia.com	Bromeliads
De Groot en Slot	Broek op Langedijk, the Netherlands	www.degrootenslot.nl	Allium
Enza Zaden	Enkhuizen, the Netherlands	www.enzazaden.com	Vegetable seeds
Fleuroselect	Noordwijk, the Netherlands	www.fleuroselect.com	Organisation for ornamentals
Hoopman Group	Aalten, the Netherlands	www.hoopmangroup.com	Seed technologies
Naktuinbouw	Roelofarendsveen, the Netherlands	www.naktuinbouw.nl	Inspection, varieties, testing
Rijk Zwaan	De Lier, the Netherlands	www.rijkzwaan.nl	Vegetable seeds
Suet Saat- und Erntetechnik	Eschwege, Germany	www.suet.de	Pelleting and seed coating
Takii Europe	De Kwakel, the Netherlands	www.takii.nl	Vegetable and flower seeds
Takii & Co., Ltd.	Kyoto, Japan	www.takii.co.jp	Vegetable and flower seeds
American Takii, Inc.	Salinas, CA, USA	www.takii.com	Vegetable and flower seeds
Valoya Oy	Laskut, Finland	www.valoya.com	LED grow lights

Prophyta

'Greece made agriculture a myth and a science'

Monique Krinkels

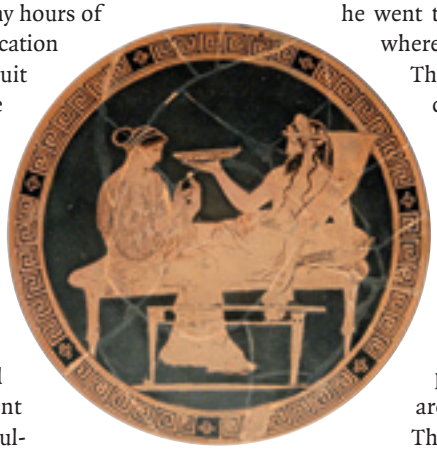
In mid-April, the International Seed Federation announced on Facebook that the magical 1,500 attendance barrier had been reached. Athens will have as many participants as Rome in 2000, Monte Carlo in 1998, Amsterdam in 1996 and Seville in 1990. "It is an honour to host the ISF Annual Congress in Greece", says Mr. Vasilis Paisios, president of the national organising committee. "Our seed association, EEPES, considers it a challenge to organise this event."

"Our country has, despite its rather small size, a large variety of crops. Assisted by the favourable weather, our agricultural and horticultural products have superb quality", states Mr. Vasilis Paisios. The seed trade association, EEPES, embraces 43 companies that breed new plant varieties and produce, process and sell seeds. "Though this does not include all seed producers, as some are relatively small companies."

Paisios is proud of his country and its grand history. In the invitation he states "Long ago, with an antithesis expected from developed cultures, we made agriculture a myth and a science at the same time. A deity, whose daughter split her life cycle under and over the earth, and writers like Hesiod and Xenophon that took steps towards scientific agriculture." He refers to the daughter of Demeter and Zeus, Persephone, who was abducted by Hades, the god of the underworld, and who is associated with seeds. She is the personification of plants germinating in springtime and withdrawing into the earth after harvest.

Home products

With its perfect climate and many hours of sunshine, Greece is a perfect location to grow agricultural crops, fruit and vegetables. As a result, the agricultural sector is important for the Greek economy. More than 3% of the GDP is earned in this sector, employing 12.6% of the working population. About 31.2% of the land in Greece is farmed. A third of the agricultural production consists of fruit and vegetables. The Greek government has therefore earmarked agriculture as one of the four promising sectors as a priority to stimulate economic growth. The government also wants to strengthen the market for its own products and become less dependent on imports of fruit and vegetables.



Persephone, abducted by Hades, the god of the underworld, is the personification of plants germinating in springtime and withdrawing into the earth after harvest

The Greek cuisine is an important part of the culture. Consumers attach a high value to fresh and high quality products. For instance, tomato is a characteristic ingredient in many of the recipes and a produce of national pride. Greeks spend a large part of their income on food, some 17.3%. The country has the highest consumption of fruit and vegetables per capita in the EU, reaching 365 kg/capita/year. And while most consumers believe that locally grown products are superior to imports, the economic crisis forces them to buy foreign products in the supermarkets.

"The globalised markets bring cheap products from all over the world", explains Paisios. "They come from countries with minimal – if any – regulatory settings, much lower farmers' income and cheap local currencies. It is obvious that this situation is not sustainable, since agricultural income is gradually losing its power to keep farmers on their land."

Greenhouses

The first greenhouses in Greece were introduced during the sixties by the Dutch agricultural engineer Paul Kuypers, or 'the Dutchman' as he was locally known. He emigrated to the island of Syros where he introduced modern sowing techniques. A few years later he went to the village Ierápetra on Crete, where he started to build greenhouses. The farmers in the village soon discovered that greenhouses offered the possibility of several yields per year, instead of just one, and became enthusiastic about greenhouse cultivation.

His influence can still be seen today, as half of the greenhouses in Greece are located on the island of Crete, with Ierápetra being the most important area, followed by the Messara plain. The Peloponnese area holds another 25% of greenhouses. The remaining 25% are scattered throughout Greece, with higher concentrations near major city centres like Preveza, Athens and Thessaloniki. The main crops that are cultivated in greenhouses in Greece are: tomatoes, cucumbers, sweet peppers, watermelons, melons and aubergines. Of these crops, peppers, cucumbers,

Greece produces 500 million litres of wine per year. 10% of the wine receives a V.Q.P.R.D.-certificate (Vin de Qualité Produit de Région Determinée), but much of the table wine has a comparable, excellent quality

watermelons and tomatoes are often export-oriented cultivations.
The majority of fruit and vegetables produced in Greece are intended for direct consumption. In general, domestic consumers regard processed fruit and vegetables as being of inferior quality.

Small farmers

Various socio-political and geographical reasons have led to significant fragmentation of land ownership in Greece. More specifically, about 95% of the cultivated area is owned and operated by small farmers. The average size of land ownership for small farmers is about 0.1 – 0.4 ha. Consequently, Greek horticulture suffers from well-known disadvantages to competitiveness, organisation and professionalism that derive from fractured land ownership.
The administration has tried to solve these negative effects by organizing producers groups, but their organisation has often been problematic. In some cases, these groups have harmed competitive growers instead.
According to the ISF, the estimated value of the domestic seed market in Greece is 240 million US$. Most of the seeds are imported: 47 million US$ of field crops and 27 million US$ of vegetable seeds. Greece also exports seeds: 8 million US$ worth of field crops and 2 million US$ of vegetables.

Legislation

Legislation in Greece often used to be confusing and hard to understand. However, the major state agencies and institutions are reorganising, with the assistance of EU and IMF consultants. With the implementation of reforms on the way, improvements should come about.
The major government institution responsible for implementing policies in the agricultural sector is the Ministry of Rural Development and Food (MRDF). The ministry plays a vital role in the following fruit and vegetables related fields:
– Granting licenses to import products from third party (non EU) countries
– Inspecting the phytosanitary conditions of farms and greenhouses
– Consulting with European officials in horticultural matters like subsidies, implementation of European policies and legislation etc.
– Implementing modernisation campaigns and also investing independently in cooperation with the Ministry of Development and Competitiveness
– Supporting research through public research institutions

The ministry has a countrywide presence through central agencies and departments and special and decentralized agencies. The ministry also has the supervision of a number of other agricultural related

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'During their stay in Athens, the multinational delegates at the ISF Congress will enjoy the superb quality of our products', says Mr. Vasilis Paisios

institutions and organizations. The most notable of these institutions are:

- Benakeio Fytopathological Institute: its main purpose is to cover phytosanitary matters, but also to study and propose policies to the MRDF on safety and quality issues regarding agriculture and the minimization of impact to the environment by agricultural activities.
- Geotechnical Chamber of Greece: its main activities regard scientific consulting to the MRDF.
- National Organization for Agricultural Insurance (ELGA)
- National Agricultural Research Foundation (NAGREF)
- AGROCERT: this organization is responsible for the certification of agricultural production techniques, agricultural products and the supervision of other private certification institutions.

The most competitive research institutes are: Agricultural University of Athens, Agricultural University of Thessaloniki, Agricultural University of Thessaly and the Agricultural Department of the Technological Educational Institute of Crete. Other well-known institutes are the Mediterranean Agronomic Institute of Chania (M.A.I.CH) and the Thessalonica Agriculture Institute.

Suffering from the crisis

Greece has been suffering for years from the economic crisis that hit Europe five years ago. The country entered a deep recession from which it is struggling to emerge. Investment by both the private and public sectors has ground to a halt. Public sector debt has increased substantially as the state had to rely on official support loans to fund social payments, payroll expenses and the fiscal deficit. In addition to a fiscal and debt crisis, the country is facing competitiveness and employment challenges. It has lagged behind its European peers in key measures such as foreign direct investment (FDI), labour input productivity and workforce participation, and it suffers from low labour mobility and flexibility. At the same time, the recession is rapidly morphing into a jobs crisis, concludes McKinsey in their report 'Greece ten years ahead'.

In May 2010, Europe established a temporary rescue mechanism, the European Financial Stability Facility (EFSF). Its task is to safeguard financial stability in Europe by providing financial assistance to euro area Member States. All euro countries stand surety for the amount of 440 billion euro to make loans possible. Last year, the European Stability Mechanism (ESM) was founded as a rescue fund for all EU countries. It has a budget of 60 billion euro. ESM is now the main instrument to finance new programmes. In parallel to the ESM, the EFSF continues with the ongoing programmes for Greece, Portugal and Ireland.

Overregulation

Mr. Paisios is owner of a company that sells agricultural inputs. Besides seeds, Alfa Agricultural Supplies also produces fertilizers and plant protection chemicals. There are 85 employees, among them 36 agronomists spread all over Greece. The existing offices are in Athens, Thessaloniki, Komotini, Larissa, Volos, Arta and Heraklion in Crete. Alfa Agricultural Supplies distributes vegetable seeds, maize, turf and forage seeds and industrial crops such as cotton, sunflower and oilseed rape.

"The problems with seeds are more or less the same as in most of the medium to small producing countries in the world. Basically, this can be summarized as lack of long term planning and investment and thus reduced research. Furthermore, we have to cope with the obstacles posed by increasingly overregulated national, European and international authorities", he says.

"In general, agriculture in Greece is caught between an expensive euro and a continuous flood of regulations and controls that steadily increase production costs. Today most of the crops' prices are set in US$ and the parity between the euro and the dollar has not been favourable to the income of Greek farmers for a long time."

Ancient Greek philosopher systematized botanical world

John van Ruiten

Much information about food, drinks, crops and use of plants comes from the time of the beginning of Greek literature (Homer, around 800 BC and Hesiod, around 750 BC) and from the first Greek scientists Aristotle and especially Theophrastus. The latter was the first to attempt to systemize the botanical world.

The classic Greek period, lasting from 800-146 BC, after which the Roman Empire became dominant, is not only an interesting period for politics, wars, literature and philosophy, but also for the development of agriculture, trade and science. Ancient Greece can be regarded as the place in Europe where agriculture, horticulture and viticulture were introduced and further developed. These methods came from Asia, especially the Mesopotamia region, and from Egypt.

International trade

With the troops and officers of the armies of Alexander the Great returning from the battles in Asia from 334-323 BC, many new species were introduced.
In addition, as a maritime nation, Greek traders maintained intensive contacts with countries all around the Mediterranean Sea. Agricultural products were introduced and marketed, shipped with the renowned Greek vessels. The products were stored in so called amphoras - large, generally 20-40 litre stone/clay/ceramic containers, that could contain not only food, but also oils, wine and other liquid substances. Amphoras were sealed with resin, originating from the Aleppo pine (Pinus halepensis). It is said that the preference of the Greek for wines like retsina, that has a strong flavour of resin, dates back to those times.

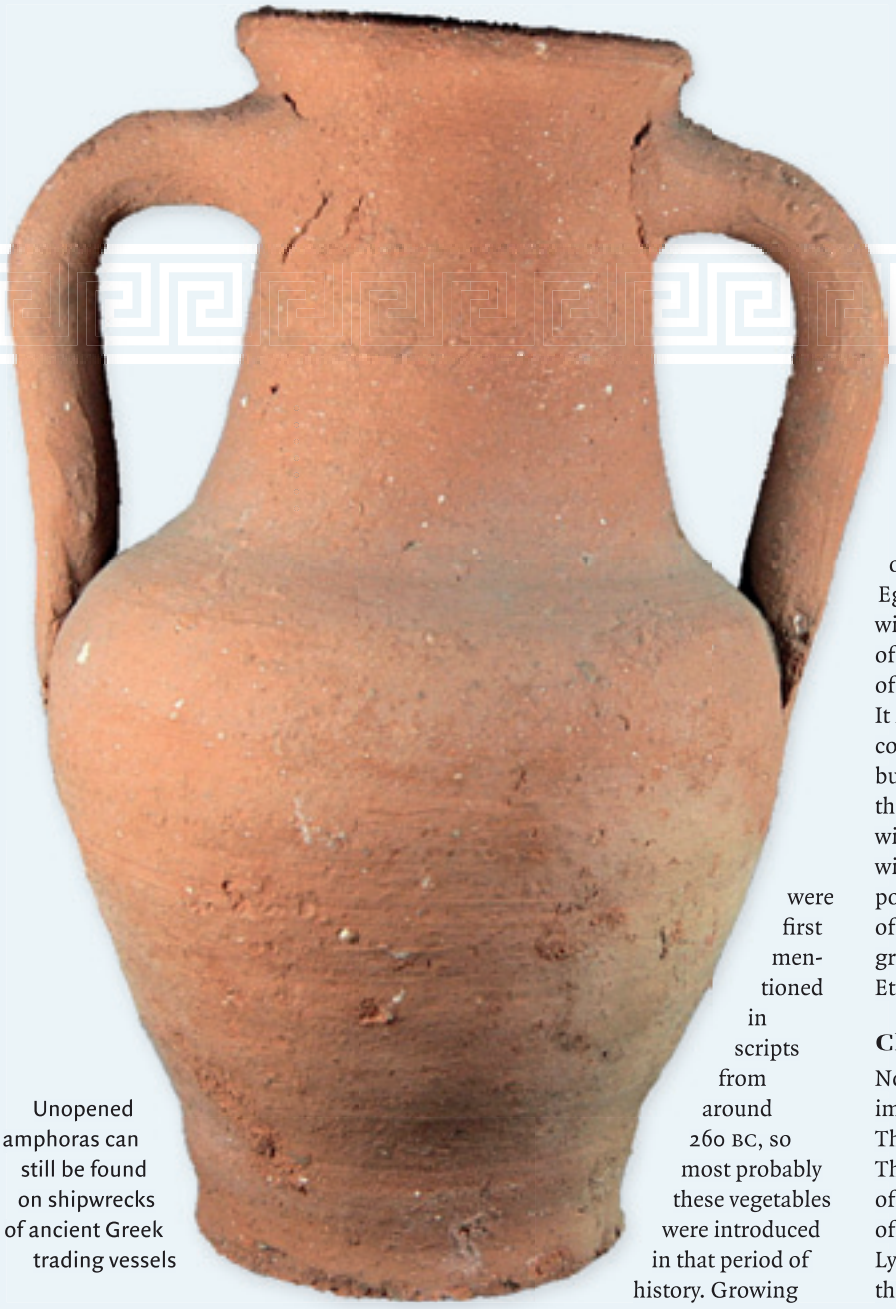
Besides the use, smell, taste and properties of the plants, Theophrastus also describes in 'De causis Plantarum' how crops should be grown, from preparing the soil and using manure, to sowing and reaping

Farming

Most of the food was produced by small farmers. Greece was a so-called urban-agro society. There were many small states with cities/capitals that were often in a permanent state of 'war' with each other. Farming was mainly a man's activity and unlike, for example, mining or rowing vessels, or building big temples, there was hardly any slavery in agriculture. Animal husbandry consisted of herding sheep, goats and cows. A limited amount of dairy was produced and there were hardly any pastures. Farmers grew for their own consumption, paid 'tax' in kind to the landowners and sold their produce to the urban aristocracy. Small farmers had a lot of subservience and respect for the rulers of the state and cities. There was no power at all for farmers in marketing their products. Every scrap of cultivable soil was used to yield a crop. Irrigation techniques were quite well developed. A lot of terraces on slopes were cultivated. And the climate for growing most crops in Greece is simply perfect.
The diet of 'the ancient Greeks' consisted basically of meat or fish, with bread from wheat and spelt (Triticum spelta). Additionally they used olive oil, rapes (Brassica rapa), parsnip (Pastinaca sativa and possibly also other carrots) and beans like faba beans, chickpeas and lathyrus. Lentil soup was the most frequent dish in rural areas. In some years there was an abundance of fruits like figs (Ficus carica), olives (Olea europaea) and pomegranates (Punica granatum). Also pears and apples were known to the ancient Greeks, but were only available in limited quantities. And, of course, the Greek knew all about grapes and wine. On many slopes in mainland Greece, but especially on the Mediterranean islands, grapevines were planted and sweet wines (mainly red) were produced.

Vegetables

Fresh vegetables were only available in season and often not for ordinary people in the cities. Important vegetables were various beets and beetroots (Beta vulgaris such as chard and radish), onions (that originally came from regions near India), fennel (Foeniculum vulgare) and celery ('selinon', both celeriac and cutting celery). In years with a poor harvest, due to for instance droughts, even oak seeds were eaten as basic food.
Homer wrote in the 'Odyssey' about the medicinal healing power and beneficial effects of celery, a plant originating from Egypt. In 'Iliad', the horses of Myrmidons 'were grazing on fields of wild celery in the swamps around Troy'. There was also an association of 'death' (used on graves of brave people) surrounding this plant with its typical smell and dark leaves. Also the use of chicory leaves is reported. Cucurbits



Unopened amphoras can still be found on shipwrecks of ancient Greek trading vessels

were first mentioned in scripts from around 260 BC, so most probably these vegetables were introduced in that period of history. Growing crops and a good harvest were above all under the influence and power of the goddess of agriculture: Demeter.

Apart from using plants for food, fruit and drinks, and tree wood for ships, building and for instruments, the ancient Greeks were familiar with using plants as medicines or poisons. It is generally accepted that the great philosopher Socrates committed suicide by drinking a poisonous drink made from hemlock (Conium maculatum). This poison from plant origin was generally used when criminals were sentenced to death by the courts of Athens.

Also, ornamental growing was important in ancient times. Many rituals needed ornamentals and during feasts flowers like rose, lily, narcissus and (very popular) violets were used in crowns and garlands.

Wine

The wine culture that most probably originated in Mesopotamia around 5000 BC, came to all Mediterranean countries in the following ages. It is assumed that the Greeks learned the techniques of growing wine grapes and making wine from Egyptians and the inhabitants of Asia Minor. Much wine was consumed as it was a disease-free source of liquid. In Homer's 'Odyssey' and 'Iliad', two types of wine are mentioned, 'Promnus' and 'Maroneus'. It is not known which varieties were used (the variety concept of course was not known in those days), but from analysis of wine found in amphoras, it is thought that the taste is comparable to a strong Tokaj wine. But it was certainly a very sweet and yet strong wine. And also here: good wine production was not possible without the consent of Dionysus, the god of wine. Later on, the tradition and techniques of growing and making wines was transferred with the Etruscans to the Roman Empire.

Classical botanical science

Not very broadly known, but nevertheless very important, was the work and the knowledge that Theophrastus (371-287 BC) brought to the world. This 'all round' academic thinker, who was a follower of the famous Aristotle, is regarded as 'the father of botany'. He presided as head (scholarch) of the Lyceum for more than 35 years, further developing the philosophy of Aristotle, studying physics, ethics, logic, grammar and history.

The Lyceum near Athens was a college and it possessed the first, what we now call, 'botanical garden' in the world. He wrote two books that became famous and that were very influential to biology and the understanding of nature until the late middle ages. It was the first attempt to systematize the botanical world. In 1483 AD, Theophrastus' 'Historia Plantarum' was translated into Latin by Theodore Gaza. The book consisted originally of ten volumes. Some years later, also 'De causis Plantarum' (originally consisting of eight volumes of which six survived) was published.

It is hard for us to imagine, so familiar nowadays with the basic understanding of biological processes, that in the days of these Greek scientists, there was no idea at all about how, for example, the

The goddess Demeter, sister of Zeus, Poseidon, Hades and Hera, gave the greatest gift to humankind: agriculture, particularly cereals

propagation process took place. Even studies by Theophrastus did not reveal that. In a famous study of date palm (Phoenix dactylifera), he wrote: "that it is wise to bring the male palm to the female palm because by that action the fruits on the female palm will stick to the plant and will ripen." The principle of pollination was not yet known. But Theophrastus detected the process of germination.
For Theophrastus, as for many Greek thinkers, 'bringing order in nature' was important. To understand the order of the plant species, many scientists made a comparison with humans and animals. A lot of attention was devoted to finding the 'soul' of plants. Most of them agreed: "the soul must be on the cross point where roots and stems are connected." After forest fires, after winter, after cutting of stems, many plants were not dead, but could regrow from that point.

With their galleys, the ancient Greeks travelled all over the Mediterranean Sea

Classic taxonomy

Of course, the ancient Greeks did not have any idea about the origin of domesticated species. They accepted cultivated species and plants as a gift from God. There was a broad understanding that morphology of plants was unstable and that, depending on the circumstances, certain types of plants would grow. At this time, Theophrastus created the first 'classification system' of plants. He was obviously interested in the question: "what aspect differentiates one plant from another?" With a special interest in trees and shrubs, he classified plants into four groups on the basis of their use, habitat and duration: Trees, high shrubs, low shrubs and herbs (annual, biannual, perennial). Interestingly he did not yet appreciate how important flowers were to plants (but at the time there was not even a fundamental knowledge of the reproduction process in humans and animals).
Theophrastus described almost 500 different plant species, all of them used by man. Only those plants had common names. Weeds, herbs, grasses not used were not denominated by anybody. Plants were described mainly on the basis of their growth and leaf morphology. Wheat types were referred to as 'Libean', 'Black Sea', 'Thracian', 'Sicilian', 'Egyptian' and they were described with characteristics such as maturing early or late, whether they had a weak or strong growth, were fast or slowly ripening and whether they had few or many glumes or husks.
He described plant species and gave names to Paeonia, Narkissos, Aspharagos, Elleborus, Krokos and Iris. After his death in 287 BC, Athens honoured Theophrastus with a public funeral, which was very exceptional for philosophers. Thanks to him, ancient Greece is not only the cradle of philosophy, ethics or grammar nowadays, but it can also be regarded as the society where the foundation of our understanding of biology and plant science was laid.

Readers interested in learning more about Theophrastus and his contribution to 'plant taxonomy' are advised to read the magnificent work of Anna Pavord, '*The Naming of Names*'.

Meticulous preparations create relaxed atmosphere

Monique Krinkels

For delegates attending the ISF Congress one thing is paramount: nothing should disturb a meaningful gathering. For perfectionist Nathalie Huguenin, the ISF Secretariat's Event Manager, this is right up her street. Back in 2004, the ISF started with the organisation of this year's Congress, to make perfectly sure that everything meets with the ISF standards.

From a hospitable congress venue, suitable hotels, smooth transportation, a memorable opening ceremony and gala dinner to well-trained staff, everything needs to be considered before the ISF delegates and exhibitors arrive. Previously, most of the work was done by the local Organising Committee, but today the ISF Secretariat has the overall responsibility. Since 2009, Nathalie Huguenin has been in charge of the yearly ISF Congress, as well as other ISF meetings that take place around the world.

How many years in advance do you start with the organisation of the event?
"We start six years in advance. However, due to today's fast changing world, it was agreed by the ISF Executive Committee and Board of Directors to progressively reduce this timeframe to four years, which remains a very prudent timeline for an event of such size. The selection of the local congress organizer has been the responsibility of the National Organizing Committees, who could consult the ISF Secretariat before their final decision. The congress venues and locations for the social events are chosen according to the needs of the event and are inspected during the site visits before these are approved."

How many times have you been to Greece to prepare the congress?
"Having Greek heritage, I have visited Greece quite regularly. For congress matters, I have been to Athens a couple of times. On average, two to three site inspections are necessary in the planning phase of each congress. I have already travelled once to Beijing (China 2014), Warsaw and Krakow (Poland 2015), and also to France to review the best location for 2019. Additional site inspections planned before the end of 2013 include a visit to Punta del Este (Uruguay 2016) as well as one last trip to Beijing before the ISF World Seed Congress 2014. In view of the organisation of the congresses which will be taking place in 2015, 2017 and 2018, further site inspections will take place next year."

How many delegates do you expect this year?
"This year the 'early bird' record was broken with a total of 1051 registrations, from which 933 are active

The welcome party on Monday evening is often a memorable event. Last year in Rio de Janeiro, Brazil, the delegates were received in the Copacabana Palace

Human Relationship

Modern technology cannot replace face-to-face meetings

With smartphones, tablets, notebooks, communication satellites and wifi, it is easy to keep in contact with other people all over the globe. Whether you are on the top of the Mount Everest or in the middle of the ocean, the person you would like to contact is just a few button clicks away. Will meeting face-to-face become outdated?

In 1924, seedsmen from all over the world travelled to London for the first FIS Congress. In the first decades, the congresses were held whenever need arose, but since 1952, it has become an annual event. Why is it that people travel from all over the planet once a year to see each other for three days? And has it not become superfluous in this time of electronic appliances?

Smiley faces

Marcel Bruins, Secretary General of ISF: "Nothing can replace the value of face-to-face communication. When people communicate, there are not only the words that people say, but also the intonation and most importantly, the body language. These latter two items do not come across very well electronically, so that's where face-to-face meetings come in. And we should not forget the social part after all the meetings are done - these encounters add greatly to the experience of coming to a congress.

There are several other advantages of face-to-face communication: it's more effective and things get done. One simple 5 minute conversation could eliminate 15 back and forth e-mails. And when there are many people in a meeting, there's more energy and opportunities to participate and creatively contribute. You can brainstorm more easily and solve a handful of problems.

And as I mentioned before, there's the large area of nonverbal communication. Someone who frequently checks their watch or yawns is a sign that it's probably time to wrap things up or change your delivery style and/or subject. The opposite is also true; if colleagues are smiling, nodding or leaning forward, you know that they're interested.

When people come together for the ISF World Seed Congress, there's a feeling of community because we're better able to socialize and interact with one another. We quickly build a bond that sets the foundation for trust and, ultimately, lasting business relationships. Ask yourself why you make an effort to attach smiley faces to sensitive emails. And why we put extra question marks or exclamation marks at the end of serious e-mails? We know that we need to overemphasize via e-mail because we have the urge to communicate what is normally only possible through face-to-face communication. That's why so many people come to the ISF congress each year. And we, at the Secretariat, work very hard to provide them with the best place to meet."

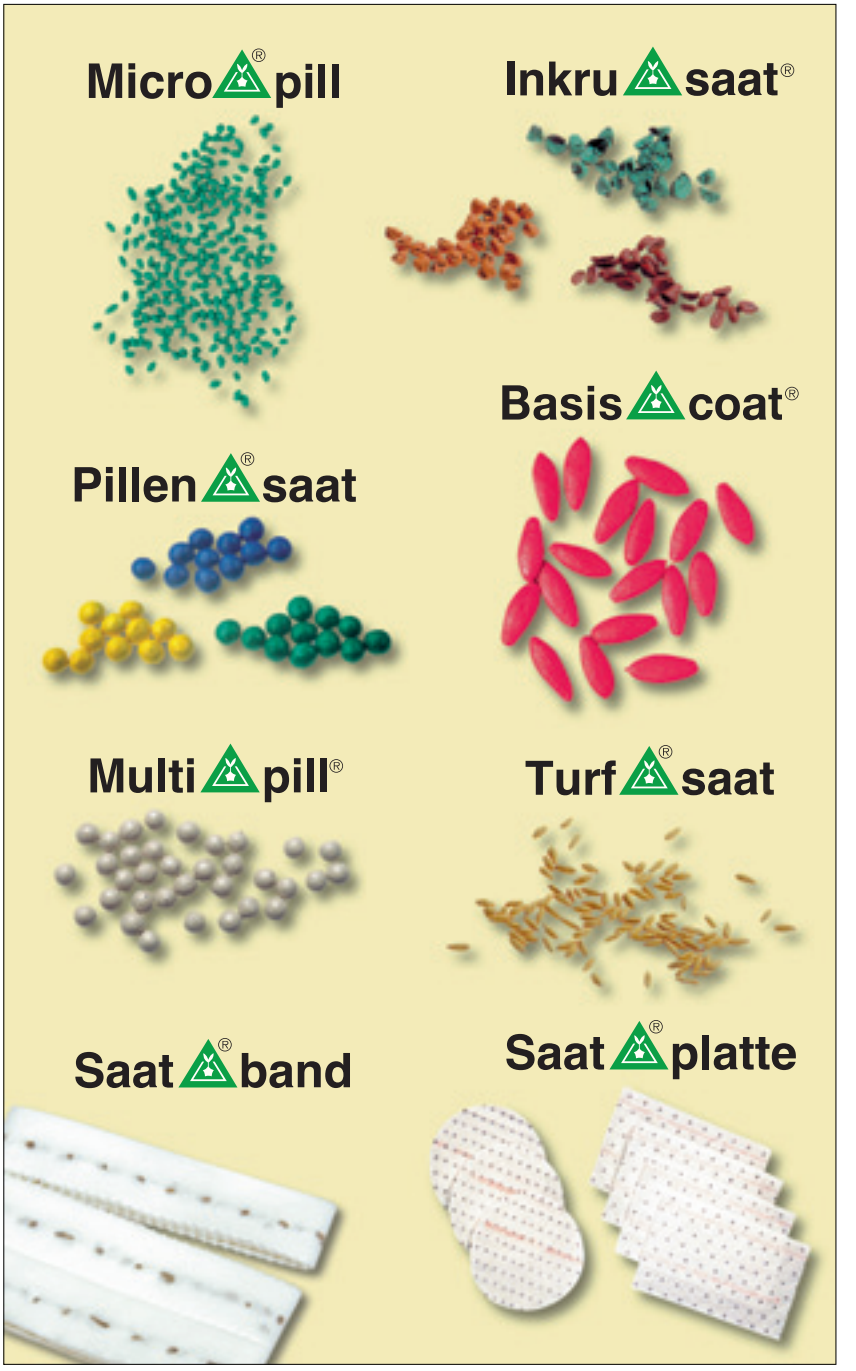
Warm human relationship

Nathalie Huguenin: "In spite of the faster and easier means of communication available today, the importance and the benefits of face-to-face meetings remain. Travelling from the four corners of the world to a place where a large majority of seed industry representatives will be gathering still has unbeatable value: in just three days, delegates make hundreds of personal contacts and numerous commercial agreements that would otherwise require dedicated travels or lengthy telephone and email exchanges.

Moreover, the ISF Congress is international and unique: it embraces all crops, from cereals to hybrid vegetables, industrial species to ornamentals, and all regions - from Europe to Oceania, North America to Africa. Breeders, research scientists, production specialists, legal counsels, sales managers and business consultants all attend the Congress with the near certainty of finding new partners, developing new businesses, creating new opportunities for their respective companies and getting together with old friends.

When I started working in ISF, I was surprised by the commitment of the Congress delegates. I soon realised that seedsmen and seedswomen are special people and they have a special way of doing business that is based, above all, on a warm human relationship. I now understand why the motto says: Seed is Life."

Seed at its best



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Meticulous preparations

congress participants (delegates and exhibitors) and 118 accompanying persons. In relation to previous years' statistics and taking into consideration all probable registrations and cancellations, we expect approximately 1500 participants (all categories included) in Athens."

Since the first ISF Congress in Bangalore in 2003, every year some improvements have been made. From the way the shipment of materials for the exhibitors is organised, to the free lunches. What are your plans for this year?
"The big step forward this year is to take advantage of technology and provide the delegates with an application (app) that will work on iPhones, iPads and Androids and a web version of it for all other phones. A mail-out will be sent to all registered attendees early enough prior to the congress explaining the benefits and changes, which will allow them to get familiarized with the new app and learn all the great features. As a consequence, the printing of the Congress Programme and Delegate list, as was the case in the previous years, will no longer be implemented. This change was decided following an analysis of the congress surveys' responses, which revealed that over half of the delegates did deem these documents necessary."

What are the future plans for improvements?
"The significant plans for the future are of course to better evaluate the needs and expectations of the delegates and to produce events that exceed expectations and learning experiences. As of 2015, a Core Professional Congress Organizer (Core PCO) has been mandated to support the ISF Secretariat with the organization of future congresses. Their team is also partly involved for the Athens and Beijing Congresses, which will allow them to be fully up-to-speed for Krakow in 2015. They were also involved in the evaluation of countries and especially venues proposed for 2019. The first site inspection with the Core PCO took place a few weeks ago in preparation of that same year's congress. In previous years, the ISF Event Managers started the organization of each congress from scratch with a new local PCO and, of course, a new National Organizing Committee. The greatest advantage of having a Core PCO in the future will be that experience from each congress will be used in an optimized way to bring the necessary improvements for the future ones."

How did you end up in the seed world?
"I was immerged in the hospitality world throughout my younger years and 'got the bug'. I graduated from the Hotel Management School of Lausanne, Switzerland, and made my way through hotels, airlines and sports events, enjoying leading teams from 5 up to 200 people. Every time I had the same goal and challenge of delivering high quality service to very valuable clients. After my mandate in sports events in 2008, I saw the job opening at ISF, applied and after some rounds of assessments, I was offered the job. Being the Event Manager of the International Seed Federation since 2009 is a great privilege and honour, as it focuses strongly on building and maintaining relationships with our members, delegates, sponsors, exhibitors, media and other stakeholders and ensures that their satisfaction and expectation levels during the ISF World Seed Congresses and other ISF Meetings are exceeded every time."

Due to the economic situation, Greece is suffering from social unrest. Does the ISF have an emergency plan?
"According to Marcel Bruins the situation in Greece has been monitored continuously and he has followed some of the developments with a certain amount of concern. The ISF President and Secretary-General visited the Greek National Organizing Committee (NOC) in 2012 to discuss the progress and potential risks. The ISF Secretary-General has analysed and assessed the worst things that could happen, and has developed a backup plan for each of these items. Each year the ISF Secretariat takes out congress insurance to provide cover if one or other disaster should affect the congress. This year for Greece we have taken some additional cover for riots and strikes and for reduced attendance. These extra measures should limit the financial impact to a minimum in the case of disaster striking, for example. Congress insurances, like a lot of other insurances, also exclude a lot of things, such as communicable diseases or Icelandic volcano action. If those things happen, there's very little we can do."

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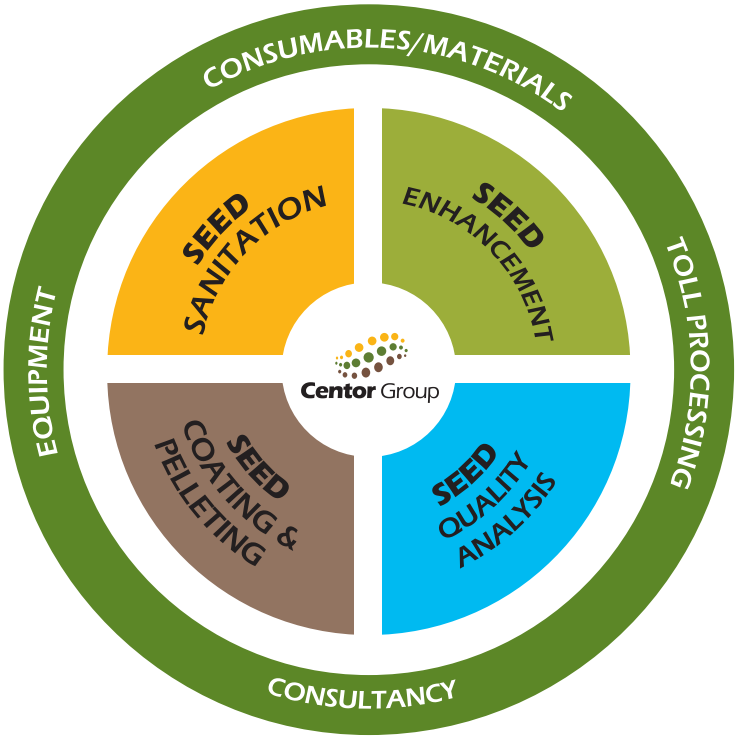

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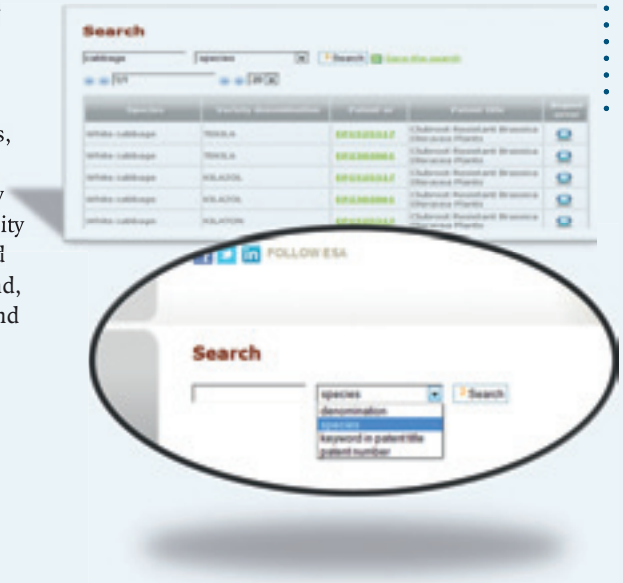
ESA's Patent Database to go live soon

Szonja Csorgo

In its position on IP protection for plant-related inventions, adopted in 2011, ESA has identified the need for more transparency regarding the patent status of plant varieties and committed itself to increase such transparency. The organisation has therefore started to develop a database. This summer it will be going live.

When starting a breeding programme, a breeder must know whether the biological material he intends to use ultimately falls under the scope of a patent application or a granted patent. Although there are many publicly accessible patent databases, ESA's unique project provides the link between a variety and a patent, information which is currently not available elsewhere. Due to the lack of availability of this information, breeders might be discouraged to make use of one or other variety which, in the end, may significantly impede innovation in breeding and constitutes a practical limitation of the breeder's exemption. Under plant variety protection law, this compulsory exemption to the right allows further breeding with a protected variety and the commercialization of the newly bred variety thereof.



Scope and objectives

In order to facilitate and increase transparency, ESA decided to set up a specific database providing information on the patent status of commercially available plant varieties. In its starting phase, the database will focus on varieties commercialized in Europe. Nevertheless - since varieties from all over the world may be used in a breeding programme in Europe - the long-term goal will be to widen the scope and to also cover other continents. In addition to patents already granted, patent applications will also be covered from the moment of their publication. The main function will be the search tool function that will allow users to look through the content of the database on the basis of a number of search criteria, such as variety denomination, species, patent number or keyword. Besides this key function, however, many other user friendly tools will be included. Thus, the main objective of the database is to allow breeders to make a more informed choice when selecting varieties for a breeding programme. The ability to check whether a particular plant variety is covered by the scope of a patent should make such informed choices possible. Although ESA is targeting breeders in the first instance, it believes that the database will also be a valuable tool for farmers, growers, public authorities and others. The database will be publicly accessible for all interested parties from the ESA website. However, in order to become a user, registration will be required. The database will be launched on 1 July 2013.

Promotion

In order to avoid any drawbacks in innovation and to make the database a success, commitment by companies thereof is crucial. Thus, ESA wishes to promote this tool, which creates mutual benefits for all its contributors, on a large scale. A first extensive presentation will take place on 27 May during the meeting of the ISF Breeders Committee at the ISF Congress in Athens. Following the public launch, further presentations are planned during autumn to various forums such as CPVO or UPOV.
For further information on how breeders can benefit from and contribute to the database, please contact the ESA Secretariat, phone +32 2 743 28 60, e-mail secretariat@euroseeds.org.

Plantum Director Niels Louwaars

'Make people enthusiastic about seeds'

Monique Krinkels

Will it be the discussions on biodiversity, the imminent ban on the use of neonicotinoids, the use of patents versus plant breeders' rights, the scope of breeders' exemption or something else that will dominate the corridors of this year's ISF Congress in Athens? Niels Louwaars, director of the Dutch seed association, Plantum, does not want to risk a prediction. "There are so many topics that are significant to the seed industry, and that's the fun of working for this dynamic sector."

As far as Niels Louwaars is concerned, the most important tasks of a national seed organisation is to create value for the members, e.g. through providing a platform where companies can discuss any important issue, to inform politicians about the consequences of their decisions, to communicate nationally and internationally what the views on certain topics are, and to provide practical services for the members. "And we want to make people enthusiastic about seeds. Inviting people to see for themselves what this sector is all about makes a huge difference. Whether they are members of parliament, civil servants and local authorities, partners in the value chains, and students, we can still amaze them."

New generation

Niels Louwaars has been director of Plantum since the autumn of 2011, as successor of Aad van Elsen. Still relatively unknown in the international seed organisations, he nevertheless has extensive experience in the seed business. After studying plant breeding in Wageningen, he worked for ten years in several developing countries. First as breeder and seed producer of local vegetable crops in Sri Lanka and field crops in Uganda, later as consultant on regulatory affairs in seed systems in a variety of countries. He was, for instance, involved in designing post control and an inspection systems, and assisting in the development of seed and breeder's rights laws in several countries in Africa and Asia. When returning to the Netherlands, he focused on the internationalisation of Plant Research International, worked at the Centre of Genetic Resources and specialised in plant breeders' rights, which even made him a part-time member of the Intellectual Property Chamber of the District Court in The Hague.

He is fully aware of the fast changes the seed world is going through. "A new generation of managers is coming up", he states. "There is a generation of generalist seed experts that manage companies, and for whom it is natural to spend a considerable amount of time on collective interests. Today, managers are often either oriented to research, operations, or marketing, focusing almost entirely on their own company. Luckily there are still people who believe in collectivity. For instance, Wim Nijssen, recently retired as CEO of Takii Europe, has become a member of the board of ISF. We have to groom a new generation of members of boards and committees to further develop effective national and international associations. These changes mean that an organisation such as Plantum has to adapt to new circumstances."

Besides that, the companies have changed as well. "Many multinationals have a subsidiary in the Netherlands, but their head office is elsewhere. Other members may be large or small companies, family-owned and often highly specialised. That means that finding the common goals within this diverse membership requires quite some effort at times."

Hot topics

One of the topics that is becoming really 'hot' in his view is biodiversity, especially the regulations around access and benefit sharing. "We have invested energy in that dossier from the outset of Plantum 12 years ago, but now things will really start to happen. There is a draft of an implementing regulation for the Nagoya Protocol in Brussels. It will be extremely important that companies can document the pedigrees of their varieties accurately, and have proof or the origins of materials used." In some crops, genebank materials and wild relatives of crops are frequently used. "Breeders should have unhampered access to these plants and the benefit sharing should be organised in a practical way."

A debate that has been ongoing for several years is the balance between patents and breeder's rights, an issue which was key in last years' ISF meeting. Many solutions are being discussed in parallel in a variety of forums.

One component of a solution Louwaars is based on what the aircraft industry in the USA did during the First World War. "At the time, it was of foremost importance that new aircraft would be developed. Instead of keeping the patents to themselves, the American aircraft industry had to throw all their patents in one basket to be able to design a good aircraft. A similar patent pool is currently under discussion in our industry."

Doing the same for today's seed industry is, however, not as simple as it seems. "Most of the globally operating vegetable seed companies are in favour of that system. But the problem at this moment is that the European Competition Authority has not clearly

'As long as you like complexity, working for this sector is really great', says Niels Louwaars

responded to a question whether this collaboration among companies could create risks of anti-competition law It is a complex matter."

Bee concerns

No less 'hot' at this moment is the discussion on the use of neonicotinoids. It was expected that the European member states would decide this spring whether or not the use of these insecticides will be banned altogether. "It all started four years ago, when maize growers used badly treated seeds. While sowing, they spread a chemical dust containing neonicotinoids that was fatal to several bee hives", Louwaars explains.

It is obvious that beekeepers are facing difficult times. "Bee colonies are threatened from all sides. Over the last decade, we have seen a steady increase in bees mortality during winter. Climate change, diseases, parasites, lack of suitable flowers, it all plays a part. Dust containing neonicotinoids may contribute to the increased bee mortality rate, but it is certainly not the only factor. Key is that these insecticides should be administered properly with good seed treatment methods, and that the chemicals should not be used unprofessionally (anybody can buy them in garden centres). When the treated seeds germinate, they are protected against harmful insects with a minute amount of chemicals. A moratorium for some seed treated crops, which is currently on the table for political reasons, would impair integrated crop protection. "And I doubt that bees will profit if older insecticides have to be extensively used again."

Upon request of the European Commission, the European Food Safety Authority (EFSA) has again studied the effects of neonicotinoid insecticides on bee colony survival, especially clothianidin (Bayer), imidacloprid (Bayer) and thiamethoxam (Syngenta). Neonicotinoids are neurotoxins that are chemically related to nicotine. "They are widely used, especially as they have a much lower toxicity in mammals than other insecticides."

The EFSA assessed the acute and chronic effects on bee colony survival and development, the effects on bee larvae and bee behaviour and the risks posed by sub-lethal doses of the three substances. The scientists concluded that knowledge gaps exist (based on new and unconfirmed guidelines) and that it cannot be excluded that pollen and nectar from treated plants might become toxic to bees. Politicians ask for a guarantee that the use of such chemicals is safe, a claim that, by definition, a scientist can never subscribe to.

"The sector has to design its communication on such matters very carefully. Scientific results provide only part of the arguments that are needed; other arguments are required to tackle the many issues that are rooted in – to put it more respectfully – other paradigms about agriculture and food supply. A seed association needs to have the skills to deal with such complex processes. I can confirm that we at Plantum are still learning, despite our very skilled staff specialised in a diversity of dossiers."

'Be innovative and create added value for growers'

In 75 years, Enza Zaden has grown from a simple seed shop into a renowned international company, with subsidiaries all over the world. The basic concept however has not changed a bit: be innovative and create unique products, was the adage of grandfather Jacob, his son Piet, as well as that of the present director, Jaap Mazereeuw.

This May, the head office of Enza Zaden was the centre of festivities. In a huge marquis, employees, business relations and students were invited to celebrate the 75th anniversary of the company. The party was not restricted to Enkhuizen, the Netherlands. At all locations where Enza Zaden has an office, events were organised to commemorate the day that Jacob Mazereeuw officially started his business. From China to Tanzania and from Australia to Brazil, every employee took part.

The third generation of Mazereeuws, Jaap, is at the helm today. Since 2011, he has been managing director. And just like his father, Piet, he started working for the company as a breeder in the R&D department. "Over the last fifteen years, Enza Zaden has expanded enormously", Jaap explains. "Together with Kees Visser, who sadly passed away last year, my father succeeded in globalising the company. We have over 1,400 employees in 41 locations."

Humble start

There is a world of difference between the Enza Zaden of 2013 and that of 1938. In the late twenties and thirties of last century, the economic depression was felt heavily in the Netherlands. The economic crises had severe consequences for Dutch agriculture and horticulture, as these branches depended, for a large part, on exports. Foreign countries obstructed trade, domestic sales dropped and production was too high. For growers, it was a time of hard work and low incomes. Max Steenberghe, Minister of Economic Affairs from 1933-1941, described the hardship as 'the economic desperation of the gardeners companies and the increasing poverty that goes with it'.

One of the families that were forced to give up their independence as vegetable growers were Jan and Anna Mazereeuw. Together with their fifteen children, they moved from the village Opperdoes to nearby Enkhuizen to make a living. At the age of twelve, their son Jacob started work. At the time, Enkhuizen was the centre of seed production in the world. In 1867, the company Sluis & Groot (today known as Syngenta) was established, a year later followed by Sluis Brothers (which later became Royal Sluis and is now a division of Monsanto). And these were not the only seed companies in the city at the time.

Soon Jacob started to work for one of the seed companies and as he became more and more enthusiastic, he enrolled in a horticultural evening class at the age of 22. Three years later he received his diploma. Besides his daily work, he started his own business selling seeds to amateur gardeners. His enterprising spirit met with success and at the age of 23 he started the Enkhuizer Zaadwinkel (Enkhuizen's seed shop) and became a full-time seed seller. Business went well and soon he had to move to larger premises and asked his brother Dirk to join him. At the end of the Second World War, Jacob decided to shift his attention from the amateur market to the professional growers. "Since that moment, the company has never stopped growing", says Jaap.

R&D

From the onset, Jacob was convinced that the company needed its own varieties to give added value. "My grandfather believed in R&D and was willing to invest in it. In the early fifties, he started selection work, for instance, of broad beans culminating in 'Ezetha's Witkiem', an early variety that became very popular with growers."

By the end of that decade, his son Piet became

The greenhouse where the company started its breeding activity stands proudly before one of the buildings. A memory of bygone years

Three generations of Mazereeuw with founder Jacob on the painting, his son Piet and grandson Jaap

the first breeder at Enza Zaden. Jacob had a small greenhouse built on the premises and assigned him the task of developing a new tomato variety. Within a few years, Piet had a breakthrough with the variety 'Extase', the first tomato that was resistant to Cladosporium leaf mould.

The original greenhouse where Piet Mazereeuw started his breeding work has been rebuilt at the head office. It is a memory of the first investment in R&D. Today, the company has over 1,000 varieties in 22 crops, to which 150 new varieties are added every year. The investments in R&D have skyrocketed. "We spend 30% of our turnover on research", explains Jaap. "That means that last year, 60 million Euros were used to create new, better varieties. Nearly 650 employees are involved in research and development."

It is one of the reasons the family firmly believes in protecting its own inventions. "The inventor has to be rewarded", states Jaap. "We develop novel technologies, overcome breeding barriers and unravel the desired properties to create varieties with an added value to our customers.."

To make sure that the Enza Zaden employees are among the best, the company promotes education. "Since 2010, we have had the Enza Academy, where current staff as well as upcoming talented youngsters get the training they need. We do that together with the French business school, INSEAD, and some foreign universities." But Enza Zaden encourages students even before they have become employees. Hence, the day students are invited to celebrate the 75th anniversary. And, together with the University of Amsterdam, Enza Zaden supports the establishment of a horticultural college in the region, to make sure more students will chose a 'green' study and become a future employee.

Bright future

The future looks bright for Enza Zaden. "Especially Asia shows a fast economic growth, while other markets are slowly recovering from the recession. These market dynamics demand a focused marketing policy."

Enza Zaden believes in integrating partners in the entire production chain, from seed to the final product in the supermarket. "To do so, we have developed several concepts. An example: Tribelli, a sweet mini pepper that has the right size and the distinctive sweet flavour to make it ideal as a healthy snack."

The company has a firm foothold in organic seed production. Since 1998, Enza Zaden has been participating in the organic seed company, Vitalis, and in 2012 became full owner. It has become one of the world's leading companies in organic seed production. In addition, Vitalis breeds and selects an increasing number of varieties in trials all over Europe. "Especially in the USA, there is a growing demand for organic food. There are even supermarkets that are completely organic."

Three generations

What would your grandfather say if he saw what his humble seed shop has turned into? "He knew. Seven years ago, whenmy father retired as CEO, he participated in the festivities. He was proud and satisfied that his dream to own his own business has grown into this enterprise", says Jaap. And your father? "He keeps going strong. He concentrates on developing our Chinese subsidiary. And, no, the fourth generation is still far too young to decide whether they share the interest of three generations of Mazereeuws, who felt attracted to seeds."

Protection is only half the job

Casper van Kempen

A recent review of the business plan of the Anti Infringement Bureau indicates that many of its members rated their companies' increased awareness of protection and enforcement as the organisation's most valuable contribution. It is followed by the strengthening awareness among our partners of our intellectual property rights.

Based on the positive results reached by the Anti Infringement Bureau (AIB) since its start three years ago, the members have recently decided for AIB's continuation for an indefinite period of time.

It is widely accepted that without intellectual property protection, one cannot legally act against reproduction of propagating material, so most AIB members have an IP protection policy in place. But protection on its own is only half the job - the other half is the enforcement of the intellectual property (IP) rights. Enforcement is often regarded as an activity only involving a company's legal service, but leading companies have shown that the opposite is true: effective enforcement involves many departments and levels of the company.

Effective enforcement of IP rights requires a clear enforcement policy and structure, so company managers should ask themselves the following questions:

Overall: before rolling out a new variety, do we give explicit consideration to the question if the product requires any IP protection? If IP protection is required, what kind of IP protection would be appropriate? Breeders' Rights protection on the new variety? On its parental lines? Would any trademark be appropriate? If it is found that IP protection is not required for the new variety, it is useful to document the assumptions underlying that conclusion.

R&D: try to anticipate possible piracy of the variety, by giving thought to what detection methods and techniques could be used.

Product development and procurement: do you make use of state-of-the-art protection technology (colour coating, hologram packaging, internet coding, etc.)?

Procurement and sub-contracting: Do you know your supplier? How sure are you that they do not do business with 'pirates'? The AIB Conditioning Audit Scheme recently monitored five pelleting companies who declared themselves open to audit for identity checks on the varieties supplied to them, to prevent the processing of counterfeited material.

Sales: how does sales management make sure that all infringement situations that sales staff encounter are addressed by them and reported to the company? When selling through distributors and external agents, have you made it clear to them what to do with infringement suspicions and who to contact in your company?

Sales: does the seed company have direct access to the customer's premises (the company raising young plants) to monitor the correct use of the genetics materials. This requires a specific clause in the sales conditions, and in some countries, a separate explicit signed agreement.

Sales and customer services: Do you know your customer's reputation and working practices? Is your sales personnel given guidance when to refrain from actively trying to sell to a customer? Do you have an internal system in place to routinely examine accounts and seek an explanation for a sudden drop in sales on an account? Does the company have a single point of contact to which sales staff should report any suspected infringement in confidence, without the 'whistleblower' fearing any comeback?

Dilemma

The last question is particularly relevant in cases of suspected vegetative propagation of protected varieties. The offender is usually a customer with whom the sales rep has an ongoing relationship, posing a dilemma for the rep, who will be reluctant to jeopardise that relationship. Is the sales rep equipped to explain that the customer is infringing his company's IP rights, which should be stopped and compensation made? Are we sure the sales reps will report all cases of vegetative propagation, even if in their opinion the percentage is relatively small? Paradoxically, despite the estimated significant percentages of vegetative propagation of tomatoes in Southern Europe, relatively few infringement cases have been brought to AIB's attention so far. The likely explanation is that many cases are seen but remain unreported by frontline people.

An effective way to control vegetative propagation would be to have a third party carry out inspection visits, to which the customers agreed in the sales contract. The inspection agent is impartial and has more distance from the customer. Any information on suspected illegal propagation can be fed to him, to be used during the inspection.

Legal process

Another important aspect of enforcement is the legal process. In Spain, the rural police are engaged in monitoring and inspecting growers and plant raisers

In Spain, the rural police are engaged in inspecting growers

to check on infringements. In Italy, however, this is unfortunately not the case. As IP holders have to defend themselves, AIB launched a pilot enforcement project in 2012, providing support to its members to take legal action in infringement cases. With the results from a range of identification tests undertaken by AIB on lettuces, an AIB member company took legal action and obtained permission from the court to search the alleged infringer's property. The evidence found there led to a court case which started in May 2012 and is still ongoing.

Experience of the legal process has been positive, showing firstly that it is feasible to obtain a search permit on the presentation of reasonable evidence, and secondly that the legal system is efficient, contrary to earlier pessimistic stories. Another boost was the judgment in the Rijk Zwaan versus Agriseeds case where, for the first time, the court awarded substantial damages to the rights holder (€205,000 plus a compensation for legal costs). In conclusion, there is no reason for Italian companies to sit idly by in IP rights infringement cases.

AIB members can now authorise AIB to take legal action on their behalf in infringement cases. This gives less exposure in the marketplace to the individual rights holders, and uses AIB as a platform to defend the IP rights of the vegetable seed industry. The first AIB legal action was carried out in the Netherlands in March 2013, when AIB searched the premises of an alleged infringing seed company.

Helping our partners

A completely separate approach is the dialogue with the partners to explore the feasibility of setting up voluntary private schemes on genetic material traceability. Two promising initiatives are already underway.

In discussions with retailers and processors, they broadly subscribe to the principle of respect for IP rights. A frequent question is how retailers and processors can ensure the integrity of their vegetable sourcing. AIB is engaged in a dialogue with GLOBALG.A.P. to examine possibilities for a voluntary scheme to link vegetable seed to the GLOBALG.A.P. Chain of Custody, with the aim of allowing processors and retailers to monitor the seed source of their vegetables.

The other initiative, which is at a more advanced stage, is to establish a traceability scheme for young plants with the aim to set up a collective EU trademark for use by plant-raisers who commit to respect production guidelines ensuring the traceability from seeds to plants.

The advantage to the grower is that products bought from a plant-raiser who uses the trademark are identifiable, providing an assurance that the plants delivered correspond to the variety ordered and are produced lawfully. Work on the scheme is now in full swing. In Italy, a pilot scheme is about to be launched by Assosementi (the Italian Seed Association), and the aim is to have the AIB scheme for a collective EU trademark ready before the next tomato planting season in Spain.

Sometimes the police are needed to force entry to the seed storage

Protecting Varieties

Raiding an alleged infringer requires secret preparation

Casper van Kempen

A successful raid in Italy requires good preparation, says Nicola Novaro, the Italian lawyer who is assisting the Anti Infringement Bureau (AIB) and breeding companies in their actions against infringements.

"There is nothing more frustrating than to arrive at the official address and to find yourself looking at a deserted, dilapidated house, which only serves as an address for administrative purposes", says Nicola Novaro. "If at that moment you have to start finding the 'right' place, you can be sure that there is no longer an element of surprise. In a recent case, our office had to conduct a synchronised raid in two different locations, which were 1,500 km apart. It is essential to check beforehand that the address of the company's legal seat is the actual centre of activities and not just a deserted postal address."

Surprise

To ensure that the raid is a complete surprise, it is also important, once a search order warrant is obtained from the Court, not to inform the authorities where the search will take place until the very last moment. "Do not underestimate how easily this kind of information is leaked, in particular in small local communities", Novaro says. "We travelled to a nearby town that same evening, and started our raid early next morning. The local bailiff accompanied the team, which consisted of the Court Expert, a representative of the right holder, a local lawyer and me. When we entered the premises and made the purpose of our visit known, we, fortunately, could sense that our visit came as a total surprise."

Novaro noted that first there was disbelief, then opposition. However, this was quickly overcome when the bailiff showed the official search warrant. "While we started our search activity, the other party tried to mobilise his lawyer, who appeared after some time." Another round of legal skirmishes took place, in which the alleged infringer tried to challenge the validity of the search warrant (lack of notification) and, when this was not effective, the method in which the search was conducted. "The trick is to stay calm, and not to be distracted by the sometimes blazing emotions, and especially to ensure that the Court Expert is properly guided in his or her activity."

Other barriers were erected: the doors to the seed storage were locked and the keys were claimed to be with people who were not present. "Most Court Experts will not give in to this kind of hurdle but remain adamant and calm, until full access is obtained. We could have called for police intervention to force our entry to the seed storage but, on this occasion, it was not necessary."

Finally, entrance to the seed storage room was obtained and seed samples were taken by the Court Expert from the various batches of allegedly infringing seed. This took time, but going through the entire supply chain information from the company, from seed purchase orders, seed pelleting orders, and customer lists, was much more time-consuming. As the entire document trail was available in printed files, there was no need to search the computer files. Copies were made of anything indicative of alleged infringement actions, including technical sheets, invoices and catalogues.

"It is often a challenge to finish this administrative search in one day. In some cases, we have to come back the following day", Novaro says. "But in this case, the work was rewarding: it became apparent who had propagated the seeds, where the seeds had been conditioned and to whom the seeds had been sold and at what price."

Amazing conditions

According to Novaro, it is sometimes amazing what kind of conditions you come across during the search. "Even the most basic phytosanitary conditions in processing, storing and packaging of the seeds are not complied with." This kind of situation can be grounds for filing complaints at the government inspection agencies, as a separate action from the infringement case.

At the end of the search, the bailiff has to close the search activity and seal all seized materials, photographs and documents. This, together with the Court Expert's final report is sent to the judge. In a subsequent hearing, the judge will decide about further investigations of the seized material, such as technical examination of the samples.

Astronauts need extra-terrestrial food

Monique Krinkels and Hajo P. Strik

Since 1972, no one has set foot on the moon, but there are many plans to travel beyond the earth's orbit. NASA, for instance, introduced its Hundred Year Starship programme in 2010 to send people on a one-way trip to Mars and, recently, travelling to an asteroid was suggested. In the near future, food will have to be produced in outer space and thus astro-varieties will be needed.

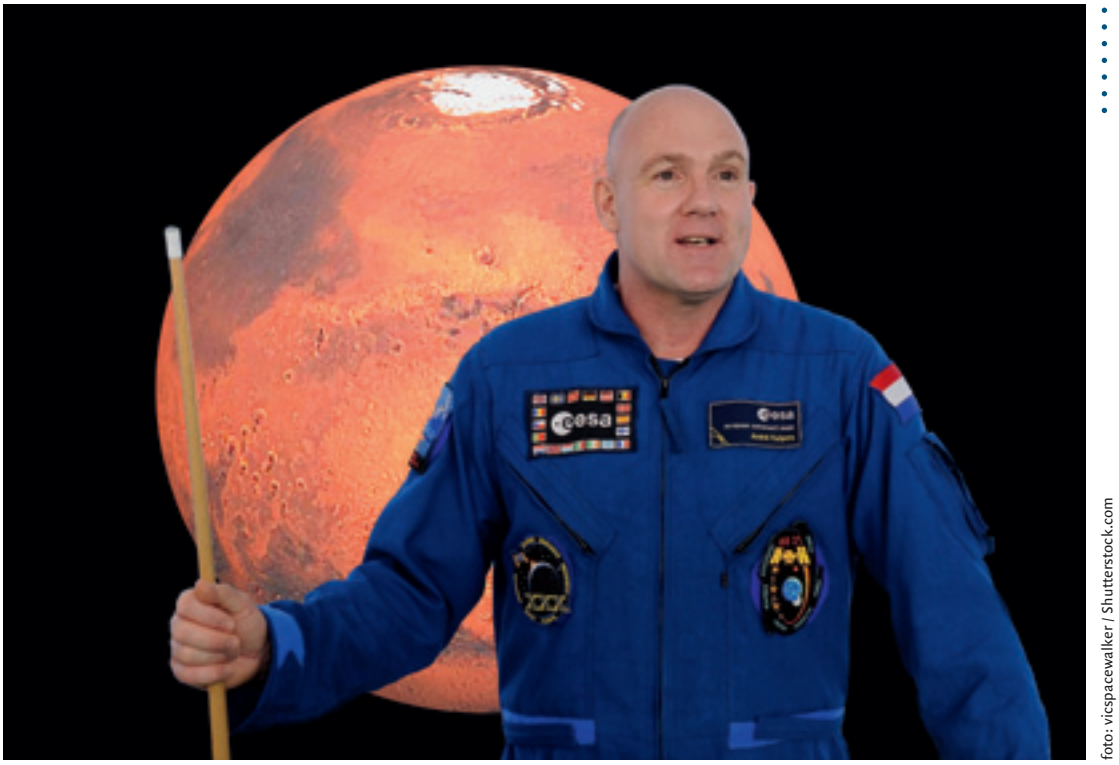


foto: vicspacewalker / Shutterstock.com

Last year Dutch astronaut, André Kuipers, stayed in outer space for 193 days, a world record. It was his second flight and it gave him, again, a new perspective on the world as we know it. He performed several experiments with seeds which gave new insights into genetic material behaviour. He shared his findings this spring at a future-oriented meeting of Incotec, world leader in seed technologies.

Erratic growth

During the Dutch Soyuz mission DELTA, in the International Space Station, André Kuipers germinated some rucola seeds, in Dutch called 'rocket salad' (how appropriate) in a weightless, completely dark box and showed that roots developed erratically. After he made a hole in the box, the seeds immediately started to orientate towards the light. The project was part of a national programme to evoke interest in science. In the Netherlands, 80,000 students between the ages of 10-14 participated in the experiments. In addition, 80,000 German pupils, a few local Russian schools in the region of Moscow and some in the Dutch Antilles joined in. They all copied the experiment from the ISS in their own classrooms, where plants' growth is determined by the laws of gravity.

Alien soil

This spring, Wieger Wamelink, researcher at Alterra Wageningen UR, started to study whether plants will survive in Martian soil or moon dust. "We already know the mineral composition of the soil on the moon, and of moon dust. So what I'm aiming to find out now is whether plants will grow in moon substrate, or whether certain essential elements are lacking", says Wamelink.
He will compare the requirements of certain species of plants with the mineral composition of the soil on the moon and Mars. Alterra has a database that can analyse 25 abiotic preconditions per species and calculate whether a plant species will survive or not. The database also stores information about heavy metals and minerals, although as yet there are

no fixed preconditions for these elements. Using this data, he will be able to determine which plant species would theoretically be capable of growing in moon dust or Martian soil.
Wamelink: "We will then allow certain species of wild plants and agricultural crops to germinate in pots of artificial moon and Martian soil supplied by NASA. The growth of these plants will be compared with that of the same species in ordinary soil from the Earth. Preconditions relating to heavy metals and minerals will be derived from our findings. Our research is based on the premise that an atmosphere will be available to the colony, perhaps in domes or buildings. We are also assuming the presence of water, either from the moon or Mars or transported from Earth. The plants would produce oxygen and recycle carbon dioxide, ultimately creating a kind of ecosystem."

Disease-free

It is doubtful that seeds in space will spontaneously remain disease-free, Kuipers warns. Even in the International Space Station, where everything and everybody is checked for unwanted life forms before entering, green spots and smears appear on fabric and instruments. He explains that farming on other planets is not something that is easily realized. In hostile environments, where no oxygen is available for man, plants can produce it using CO_2, and water can be found in frozen soils. A single disease, however, can be fatal for the complete food production of a human colony. Even in BioSphere 2, the experiment where people voluntarily shared a closed environment for years and where all technical support was available from outside in case of an emergency, crops started to deteriorate and seemed to lose resistance properties.
Kuipers is convinced that one day there will be a colony on Mars and future technologies in growing will support successful results. He emphasised that it will set new breeding goals in relation to high nutrition demands, stress sensitivity and other yet unknown factors.

Future challenge

Seed in its pure, sheltered form is in fact the most non-vulnerable product as has already been demonstrated by nature. Everybody knows the stories of ancient seeds, being able to germinate after many centuries. Or the palm trees growing from nuts that have travelled thousands of miles across hostile salt water oceans. Seed technology may in future have to aim for (very) long shelf-life storage and for germination accelerators. Space travel is still too far away for concrete breeding plans, but it is, in any case, a future challenge for seed companies.

New Rules Regarding Health Claims

An apple a day keeps the doctor away

Monique Krinkels

In the European Union, the use of health claims has been restricted to scientifically proven effects. If a fruit seller states that apples contain vitamin C, which contributes to a healthy immune system, he is breaking the law. Medical claims are forbidden altogether. On neither label nor packing, any suggestion that a nutrient may cure, treat or prevent a disease is allowed.

Since 14 December 2012, health claims for food have become forbidden in the European Union, unless permission is granted. That permission depends on the scientific proof that the food indeed has the promised effects. During the transition period, over 44,000 health claims have been submitted. Nearly 4,000 have been presented to the European Food Safety Authority (EFSA), the scientific bureau for food safety. This bureau was set up in January 2002, following a series of food crises in the late 1990s, as an independent source of scientific advice and communication on risks associated with the food chain. EFSA assessed the 4,000 claims and approved 222 of them. That means that the standards are set very high.

Complex matter

Broccoli growers may no longer claim that their produce helps to prevent cancer due to the anti-oxidants it contains. But producers of mushrooms, on the other hand, may state that their products contribute to reducing fatigue. At least if a normal portion of the final food product the mushrooms are used in, contains sufficient niacin to have this effect. The goal of the new EU-regulation is to protect consumers against unjustified claims. A claim can be any notice or indication in commercial statements, including illustrations, graphic presentations or symbols that might implicate that there is a relation between food or a food ingredient and health.
If a grower suggests an unapproved health claim for commercial purposes, he might be fined by the national food authorities. However, according to the European Responsible Nutrition Alliance, which has

Non-commercial advice

"Eating the right nutrients, vitamins and minerals helps our brain to function properly", explains Professor Philip Scheltens, director of the VUmc Alzheimer Centre in Amsterdam, the Netherlands. "Patients with dementia suffer either from malfunctioning synapses (a part of the connection between neurons), too few synapses or a low quality connection. These synapses consist of membranes built from phospholipids, proteins and fat. The combination of nutrients such as unsaturated fatty acids, uredines, choline and vitamins can improve the functioning of the membranes. It has been proven that large amounts of essential nutrients restore the memory of patients with an early form of Alzheimer's. What it means in the long run, however, has yet to be discovered."

The claim that apples contain vitamin C and therefore contribute to a healthy immune system is not allowed to be used commercially

It has not been scientifically proven that anti-oxidants in for instance broccoli help prevent cancer

The claim that the niacin in mushrooms reduces fatigue is approved by the European Food Safety Authority

criticised the EU-regulations, the guidelines are not as black and white as they seem. The organisation has therefore published a document on their website, www.erna.org, to help food producers to adhere to the law. For the European consumer organisation, BEUC, the new regulations do not go far enough, especially if it comes to food claims. Liquorice producers, for instance, may still try to cut a dash by mentioning that their products contain 0% fat, even though liquorice never contains any fat.

Unforeseen side effects

The new regulation has unforeseen side effects. It is, for example, no longer permitted to have labels on homeopathic medicines stating for which illness it is meant to be used. If the label used to say that a certain product promotes calcium absorption, it will now only state what it is, what it contains and what the correct dosage is. The effects of homeopathic products have, after all, never been proven scientifically, thus they are not approved by EPSA. As a consequence, the discussion on the working of homeopathic products is banned from websites, magazines and other media from July onwards. The suggested solution is that pharmacists who sell homeopathic products explain the working of these concoctions in a face to face discussion with their customers. The European Commission has not yet decided whether or not health claims on herbs and herbal potions are to be included in the new regulations.

Advice

Advice on food and health in a non-commercial relationship is still permitted. Research reveals that in 25% of all conversations with a general practitioner, food is a topic of discussion. It demonstrates that the awareness of the dangers of obesity and other food-related problems has grown. For doctors, the battle against 'unhealth' has been for a long time a matter of prevention of infectious diseases and accidents. They have had impressive results. Nowadays, the prevention of damage by an unhealthy lifestyle is foremost on the agenda. These welfare illnesses are linked to overconsumption, insufficient physical exercise, alcohol abuse and smoking.
In contrast to infectious diseases and accidents, that have nothing to do with choices, there is not much support to restrict the freedom of choosing a certain lifestyle. It took a long time before smoking was banned from public places, for instance, even though the risks were clear to everyone. Forcing people to live healthier is a hopeless endeavour. The most obvious thing to do is therefore to encourage a healthy lifestyle. Promoting healthy choices such as, for instance, eating naturally healthy fruits and vegetables seems the only practical way to prevent 'unhealth'. And luckily doctors are still allowed to do so.

Scientists have identified many nutrients that help the brain to function properly:
Strawberry: a rich source of antioxidants which protect neurons against infections. These fruits delay the process of ageing of the body and thus the brain
Bilberry: strengthens the signals between neurons
Olive oil: contains arachidonic acid, an important element of brain tissue
Apple: fresh apples can repair damaged brain tissue
Green asparagus: protects the small blood vessels and decreases the risk of a stroke
Almond: cleans the brain of harmful substances
Avocado: ensures a healthy blood circulation in the brain
Green leafy vegetables: the iron in these vegetables improves the power of concentration
Garlic: has a protective effect on brain cells
Carrot: has a protective effect on brain cells
Celeriac: contains choline which improves memory
Asparagus: contains folic acid which speeds up the functioning of the brain and keeps the spirit young

Naktuinbouw Accredited Laboratories

Reliable test results ensure seed quality

NAL is an official accreditation system of Naktuinbouw, based upon annual external audits by or on behalf of Naktuinbouw. It has the objective of accrediting seed companies and their laboratories for issuing quality/ health certificates giving adequate and correct information on marketed seeds.

Adrie Molenaar

Naktuinbouw Accredited Laboratories (NAL) was first presented at the FIS Congress at Oostende, Belgium, in 1994 and founded to facilitate international seed trade. NAL is the exclusive domain of seed companies. The 14 accredited companies together are responsible for the bulk in terms of value of marketed/exported seeds of vegetable crops (see www.worldseed.org).

The laboratories of these companies (or when outsourced other NAL or ASLN accredited laboratories) carry out quality and health tests on seeds and/or (parts of) plants. More information about the tests for which these companies are accredited can be found on the website of Naktuinbouw (www.naktuinbouw.com).

Currently, the 'NAL Conditions 2013' are in force. These conditions are an improved version of earlier issues of the NAL Conditions (1994 and 2009) and based upon three modules: quality management system, sampling and testing.

Accredited laboratories

Currently (with the year of first accreditation) the following are accredited: Bejo Zaden B.V., NL (1995), Syngenta Seeds B.V., NL (1996), Nunhems B.V., NL (1997), Rijk Zwaan Production B.V., NL (1998), Sakata Vegetables Europe S.A.S., F (2001), Monsanto Holland B.V., NL (De Ruiter Seeds (2002), Seminis Vegetable Seeds Holland (2003) and Western Seeds (2005)), Enza Zaden Seed Operations B.V., NL (2003), Incotec Europe B.V., NL (2006), Nickerson Zwaan B.V., NL (2006), Vilmorin S.A., F (2006), Germains Seed Technology, NL (2007), Nunhems USA Inc. (2010), Hazera Genetics Ltd., IL (2011) and Takii Europe B.V., NL (2013).

Process oriented

An NAL accredited laboratory is allowed to issue NAL quality certificates with test results from tests for which an accreditation has been granted. This is possible at any time when seeds are going to be shipped, because NAL is a process oriented system. The laboratory must carry out the test according to either an internationally agreed protocol, Naktuinbouw's own standard protocol or a Naktuinbouw approved in-house company protocol. In addition to the audits and review of protocols, accredited laboratories have an obligation to participate in NAL proficiency tests in relation to the tests for which they are accredited. Participation is not seen as a formal obligation. On the contrary, the participating laboratories welcome the results, because it gives them information about their performance. For 2013, Naktuinbouw has chosen the pathogens Pepino mosaic virus, Clavibacter michiganensis subsp. michiganensis, Pseudomonas savastanoi pv. phaseolicola, Pseudomonas syringae pv. porri, Xanthomonas hortorum pv. carotae, Acidovorax avenae subsp. citrulli, Xanthomonas campestris pv. Vesicatoria and Peronospora valerianellae to be included in the proficiency test programme, as well as germination, practical plant test, purity and thousand seed weight. An important issue is to realize broader international acceptance of NAL certificates by official authorities (on varieties, on seed quality and health). Naktuinbouw is taking that challenge on board and is active in communicating its programme with national plant protection organisations.

Extensions

Naktuinbouw is working on further extension of the NAL accreditation with other (optional) modules, such as Accredited Sampler, Accredited Field Inspection and Verification Programme Varietal Identity. They will become active and available next year.

John van Ruiten

Naktuinbouw Elite is a certification system especially for vegetative propagated material from ornamental crops. Participation is on a voluntary base and requirements are in addition to legal requirements.

Naktuinbouw Elite Ornamentals Crops

'Clean' materials within arm's reach

Participants

Accredited participants are: Anthura B.V. (NL), Beekenkamp Plants (NL), Elsner Pac Jungpflanzen (Ger), Florensis (NL, PT), Gediflora (BE), Grunewald Veredelings B.V. (NL), Hilverda-Kooij B.V. (NL), Imperial Plants and Horti Products B.V. (NL), InnovaPlant GmbH & Co KG (DE), Iribov B.V. (NL. PL, MK), Könst Alstoemeria (NL, CO), Moerheim New Plant B.V. (NL), PanAmerican Seed Europe B.V. (NL), Sakata Elite Propagation (USA), Selecta Klemm GmbH & Co (BE, ES), Stokman Rozen Kenya Ltd. (KE), Syngenta Seeds B.V. (NL, KE, GT), Van Zanten Plants (NL), VCI Nederland B.V. (NL), Vitrocom Holland B.V. (NL), Vitroflora (PL) and Volmary (DE).

The Naktuinbouw Elite system is based on the former Elite-certification schemes of NAKS, which have been running in the Netherlands since the 1960s. Due to globalization of the propagation market, these certification schemes have been internationalised and been running worldwide since 2001. In total, 24 companies are accredited with 36 production locations worldwide in Belgium, Columbia, Germany, Guatemala, Kenya, Macedonia, Netherlands, Poland, Portugal, Spain and USA. Approximately 250 genera of ornamental crops, which are tested for almost 60 pathogens, are included in the certification schemes.

Clean material

One of the objectives of the programme is to give the companies the opportunity and support to produce 'clean' (disease-free) propagation material. This is achieved by involvement of all participants as well as independent audits and sampling. Another objective of Naktuinbouw Elite certification is to obtain easier access to international markets with high standard propagation material. To achieve this, Naktuinbouw regularly informs several delegations of national plant protection organisations about the Naktuinbouw Elite system.
A quality management system has to be installed in order to be in control of the production of ornamentals. In order to start with clean propagation material, all new mother plants have to be tested according the certification protocols. To keep the mother plants free of pathogens, the production facilities have to be up-to-date and hygiene protocols have to be installed.
At least once a year, Naktuinbouw will audit the quality management system and several times a year Naktuinbouw will conduct a control sampling of the mother plants at the production locations. Those samples are tested in the Naktuinbouw Laboratory and, when found to be free of pathogens, crops can be certified.

Platform

Naktuinbouw offers a platform for the participants to discuss and further develop certification schemes. The board of Naktuinbouw is the body responsible for deciding about changes in the requirements in the certification schemes. Once a year, a meeting for all participants is organised to discuss the progress of the Elite system and the use of this quality mark, financial aspects, changes of protocols and developments in international legislation.

A recent example of this are the new requirements for Potato Spindle Tuber Viroid (PSTVd), which is a pathogen also on the agenda in the EU since 2006, mainly because it could be a threat to the food industry. Due to the occurrence of this pathogen in ornamental crops, testing of relevant crops (mainly Solanaceous plants) for this specific pathogen was implemented in the Naktuinbouw certification schemes in 2007. Since then, there has been a lot of discussion in the EU about the status of all Pospiviroids (10). Naktuinbouw Laboratory is closely involved in developing a general test for all Pospiviroids. This test has now been implemented in the schemes since 2012 and is applicable to more crops. The approach of Naktuinbouw Elite is to prevent infections by using the very latest techniques instead of waiting for an outbreak of disease.

New system promises high quality berries

John van Ruiten

The quality of plant material is of great importance, especially in cultivation when the production of young plants is requiring several years. The quality-plus system Naktuinbouw Elite Soft Fruit assures the quality of the propagation material to soft fruit producers. Since January 2013, this quality-plus system obtains besides strawberries also raspberries and .

A standard quality and phytosanitary inspection establishes if the material meets the minimum standards set for varietal trueness, varietal purity, health and quality. These standards are based on European legislation. With the standard quality inspection, the producer is responsible for the quality of the propagating material supplied. In each EU country this is monitored by authorities periodically inspecting the companies. Deliveries are made accompanied by good supplier's documents and a plant passport. Producers of propagating material who appreciate being rewarded for all the extra care and attention they devote to their crops can choose for quality-plus systems that demonstrate the added value or superior quality and health of their young plants. Propagating material that meets the stringent high standards may be marketed with a Naktuinbouw quality brand (Naktuinbouw Elite®) and/or certificate.

More assurance

The production systems of strawberries en raspberries change rapidly at the main production areas of Europe and elsewhere. One of these changes is related to the increasing demands of quality soft fruits in the supermarkets. Such a retail and consumers demand needs high investments in farm facilities, knowledge and not at least a high quality of planting materials growers starting. Consumers expecting to receive the same quality around the year and nowadays they also like to be informed who has produced the berries they just bought.

The change in new varieties get the impulses of these demands. New varieties once introduced have a much shorter life cycle. In de last years the amount of fresh raspberries sold is growing in the market and the propagating system is changing from open field propagation to greenhouses in substrate.

Since many years an excellent operating quality system is available for strawberry plant nurseries in the Netherlands. Those Dutch nurseries use this independent Naktuinbouw monitored system to improve health and trueness to material and varieties. Labeling and traceability is an essential instrument to give more assurance to soft fruit producers. Planting materials identified by Elite labeling and certificates make the distinction in the market.

Recently the Elite system for strawberries is widened also to Rubus (raspberries and blackberries) as well. The new regulations are reconstructed and updated to the latest global requirements. One of the new topics is the certification possibility for varieties propagated from tissue culture (and have proven to be stable and propagated without abnormalities).

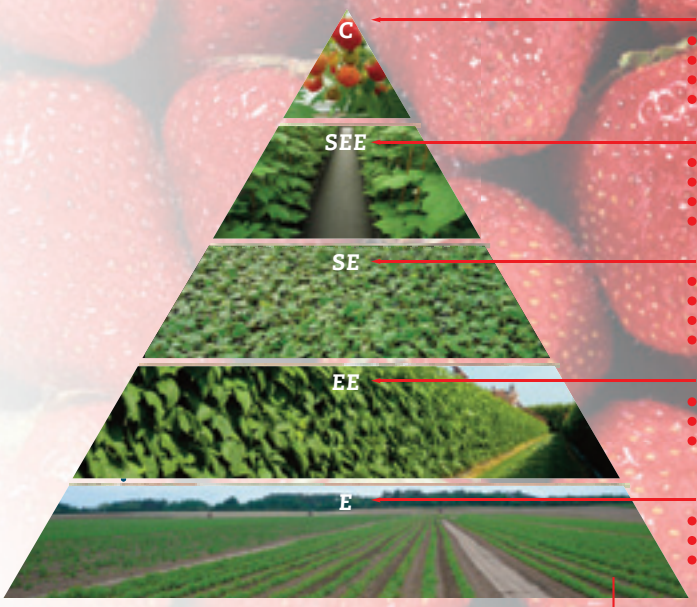
The new Elite Soft Fruit system is operating since 2013. In the Netherlands 48 propagators participate in the Naktuinbouw Elite Soft Fruit system.

The Elite system gives an extra guaranty above the standard phytosanitary inspections that make part of national regulations in every EU member state. Choosing for participation in Elite is on a voluntary basis for propagators. Every individual company decides whether they join or not. The regulations of this Elite system are composed by Naktuinbouw specialist and representatives of the propagators. The standards are formally set by the Board of Naktuinbouw. In the Netherlands over 95% of the strawberry plants produced are in one of the Elite grades.

Certified mother plants

Naktuinbouw provides services at the Test Center for the breeders and propagators as they want to commerce with their new advanced or acquired breeding product. A candidate plant, selected by the breeder, enters the system in February. These individual plants will be tested on a relevant ('Full') traditional (but surely not outdated!) way of indexing on indicator plants is also an important part of the program. During the process of testing (that needs normally one growing season) the candidate plant is able to produce young runner plants. These plants are both the starting material for nurseries to speed up the quantities at their nurseries and also these plants are to be maintained as the prebasic material to start further propagation next years).

Now the status has become Super Extra Elite (SEE). If a new variety becomes to be successful, propagators require new SEE mother material every following year. The 'improvement' for the breeding programs is to have their varieties under an approved system from the beginning, in this case the breeders has the control in supply of all plant material. Naktuinbouw Test Center in Horst offers this testing facility and makes an agreement with the breeder for additional services. More and more breeding programs in



Candidate plant
- Individual plants to be tested for relevant pathogens (EPPO)
- Identity check according to the variety description
- Checking the fruit for crumbliness
- High standards of hygiene in Candidate plant screenhouses

Super Extra Elite
- Annual testing for relevant pathogens (EPPO)
- Checking the fruit for crumbliness
- Identity check for 'off types'
- High standards of hygiene in SEE screenhouses

Super Elite
- Plants originate from SEE
- High standards of hygiene in SE screenhouses
- Intensive inspections
- Sampling when relevant

Extra Elite
- Plants originate from SE
- Plants grown on separate fields
- Intensive inspections

Elite
- Plants originate from EE
- Plants grown on fields with certified stock only
- Intensive inspections

Certified stock

Certified plants

European member states and from the USA as well find their way to this Test Center Facility.
Most of the bigger propagation nurseries have their own insect free screen houses. SEE mother plants starts runner production under high hygienic conditions and under control of a Naktuinbouw inspector. In this year the grade of the produced daughter plants become one level lower at Super Elite (SE). The Elite system allows to make an extra propagation step (generation) at this SE level as long as the condition compares to the regulation. After a maximum of two year SE (SE1 and SE2) propagation in greenhouses, plants move outside in the 'open' fields to be propagated as Extra Elite (EE) mother plants. To give an indication of quantities a variety arrives on a number of several 100,000 plants, started from one candidate plant at the beginning three years ago. The end of the propagation cycle, the 'lowest' category, is the E grade Elite (E) that, of which the plants are sold to the farms for fruit production.

Focus on health

Strawberries and raspberries are very susceptible to many diseases. With the increasing international trade of plants, diseases don't have the specific origin anymore. Diseases move with plants around the world. Changes of climate circumstances and increasing greenhouse productions are factors of consequence of these diseases in many countries and continents. The Elite Soft Fruit system focus on risks assessments on the nurseries, hygiene is the key word in this frame. Naktuinbouw trains nursery men on awareness of the risks taken on their farms. This helps to improve the knowledge for making daily decisions easily.
Crumbly Fruit is the name of an important disorder caused by incomplete drupelets setting and very often seen in raspberries and blackberries. This results in fruit that consist of 30% to 50% less well developed duplets than normal fruits of the same variety. Crumbly Fruit can have several causes, for example infection with the raspberry bushy dwarf virus (RBDV), less optimal pollination, infestation by gall mites or a spontaneous genetic mutation in plants.
Testing for viruses is a permanent part of the program the Test Centre carries out on raspberry and blackberry varieties. For certification, this material has the SEE-status. A specific test is aimed at fruit abnormalities caused by mutation. Spontaneous mutation in a mother plant can lead to the spread of mutated descendants that produce crumbly fruit. Susceptibility for Crumbly Fruit mutation can already be genetically determined in a parent plant of a variety used for crossing.
Some varieties are known to be more susceptible to Crumbly Fruit than others. On an international level, growers are confronted each year with quality losses caused by Crumbly Fruit in production plantations. Plant propagators therefore require greater assurances about the absence of Crumbly Fruit in propagating material.

Naktuinbouw Test Center

Naktuinbouw has test facilities for health of fruit crops (soft fruit, stone fruit, pome fruit) since the late 1980's. This Test Center serves programs for testing, heat treatment and maintenance of varieties or new breeding products that are allowed for certification. Candidate program's has different time schedules, from one year for strawberries and up to four to five years for a pear variety. Tests for PVR applications for CPVO trials are also part of the services. The facility has the license 2008/61EG that makes it possible for making importations for trial purposes from third countries in cases the health status doesn't comply with the EU requirements. The Test Center provides their services to international customers that have the intention to introduce their new varieties on a high health level, trueness to variety according to their time frame.

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Farewell to Nico Koomen

Monique Krinkels

After a period of more than 38 years of service in NAKG and Naktuinbouw, Nico Koomen stepped down last year as director of the Inspection Service for Horticulture in the Netherlands as he reached retirement age.

Succeeding former director Grooters, Nico Koomen became director of NAKG, the inspection service for vegetable and flower seeds, in 1976. In the period up to 2012, the inspection service grew considerably. The merger with NAKB in 2000 created an organisation working in the whole field of horticulture, in quality and phytosanitary inspection, as well as variety registration and testing for plant breeders' rights and also offered a broad range of laboratory services to companies globally. Today, John van Ruiten is Managing Director of Naktuinbouw. He has already worked as director of inspections of the organisation for many years.

Contribution

During the farewell gathering that was organised to thank Nico Koomen at the premises of Naktuinbouw in Roelofarendsveen, his contributions to the seed sector were remembered. Amongst many initiatives, particularly the international NAL system, created in the mid-1990s, can be mentioned. With this system of accreditation of vegetable seed companies and their laboratories, the foundation was created for using the laboratory test results of private companies to value them in an official capacity. In addition, the NAL system offered participating companies periodical professional audits and proficiency testing as benefits.

Nico Koomen can also be seen as the founding father of ECAS, the European Certification body for the agricultural sector. During the mid-1990s, the use of quality management systems as an instrument to safeguard product quality was also seen by Nico as an important tool for improvement.

Last but not least, his role as secretary of the Prophyta Foundation should be mentioned. For over 25 years, he promoted the journal, contributed articles, initiated interviews and played a vital part in developing the journal into the international magazine it is today.

Well-equipped

So, after his retirement, Nico Koomen leaves behind an organisation that now serves as a well-equipped and very professional inspection agency, a leading DUS testing station for plant breeders' rights and a service laboratory developing and using state-of-the-art protocols. In the coming years, Nico Koomen will continue his activities as chairman of the Netherlands Horticultural Council, the organiser of the Floriade and of the annual Netherlands Growers' Award.

Genetic Modification

Farmers long for drought tolerant maize

Marianne Heselmans

In the United States, a new drought tolerant maize variety has been introduced on the market. Critics of genetic modification, however, favour smarter irrigation and fertilizing.

Last summer, the Midwest of the United States was dryer than it had been in fifty years. For hours one could drive past maize that was brown, wilted and much too small. Because of the continuous heat and the lack of rain, many farmers were only allowed to irrigate every second day. The damage was estimated at 18 billion US dollars. No wonder farmers are desperate for drought tolerant maize varieties.

Brand new

There is now such maize. Starting in February 2013, farmers in Kansas, Colorado and Arkansas can buy a new maize variety from Monsanto and BASF. It is called DroughtGard and was tested last spring and summer. On the 250 trials fields, it produced on average 8% more kilos of grain per hectare than conventionally bred maize, according to the website of DroughtGard (www.genuity.com).
DroughtGard is the first genetically modified crop, in a long line of stress resistant GM grains, expected to arrive on the market during the next few years. Grains that will tolerate higher temperatures, lack of water and fungi. The US company Monsanto and the German company BASF have been working together on it since 2007 and have earmarked a total of 2.5 billion dollars for GM maize, soy bean, rice, rapeseed, cotton and wheat. DroughtGard is their first joint product. Amongst others, also the American-based Dupont and the Swiss Syngenta are developing similar grains. These big investors are targeting the American, Asian and Latin-American seed markets. They are avoiding Europe as they consider the European admission criteria to be too strict.

Doubts

Last summer, at the peak of the drought, the American press was already discussing DroughtGard and its possible successors. Are these varieties the solution for the anticipated droughts? The Union of Concerned Scientists in Washington expressed scepticism about the incorporation of DNA cassettes. “That technique is going to make a very small contribution against very high costs”, predicted the organisation in its June 2012 report, ‘High and Dry’. Gert Veldhorst, project manager at consultancy firm DLV Plant at Wageningen, also has his doubts. In the Netherlands, farmers select their maize to include strength, resistance to stem rot and starch content, but not on drought tolerance, he explains. The claim that a variety is drought tolerant is in fact difficult for farmers to verify. Every small plot reacts differently to drought. He advises Dutch farmers to provide additional vegetation on drought-sensitive plots, so that the roots can conserve water. And to grow winter maize instead of fodder maize, because these already start to ripen in July. But Dutch farmers have little experience of drought; the plots are small enough to spray every day and water is (still) cheap.
Dick Inze is more optimistic about the new GM maize. He is Professor in Plant Biotechnology at the University of Gent and founder of CropDesign, the plant biotechnology company that BASF took over in 2006 for more than 10 million euros. Inze’s group is not performing tests with maize farmers, but he has seen the harvest figures on the website. And he is surprised that this maize variety is outperforming the conventionally bred drought tolerant variety AuqaMax, from competitor Dupont, by almost 10%. “But we still have to see how good the variety will be in the market,” he says. “DroughtGard is obviously performing well in controlled field trials where maize was given water at set times. In ‘normal’ farming situations, rainfall is much more unpredictable.”

Chaperone

This first DroughtGard variety is still straightforward. Only a little synthetically-made DNA has been incorporated in the maize DNA. It contains a bacteria gene, derived from Bacillus subtilis, and some extra DNA that ensures that all maize cells have a continuous, ample supply of this bacteria protein. This ‘alien’ bacteria protein protects the maize against one of its reactions to drought, namely the misfolding of crucial hereditary mRNA molecules, after which the production of protein is messed up. That disturbs several processes, for instance growth. The Bacillus-gene encodes for a so-called chaperone protein that covers the mRNA and protects it. The chaperone-protein of the bacteria allows the plant to grow better even in dry circumstances, the inventors claim.
But the continuous and overall production of bacteria proteins costs energy, which in ordinary years can reduce the production of maize grains. But, according to Inze, both companies have worked together

Kernel maize is very susceptible to drought

to develop more subtle varieties, in which the genes are only active at certain times of the year or only in certain parts of the plant. Maize is especially sensitive to drought in the week that pollen is produced. It would therefore be more energy-efficient to have the protective bacteria gene only active just before pollen production starts and only in the organs that are involved. This is already possible.

All multinationals are already working on the next phase. The maize of 2020 or 2030 will contain mainly synthetic DNA, based upon the knowledge of the natural maize genes – of hundreds of genes and their interactions. With that knowledge they produce for example a so-called DNA-cassette which ensures that the stomata remain closed for longer during drought, so that more water is retained. About forty to fifty genes that are involved in this process have already been identified. Another cassette-in-the-making provides additional amino acid like proline, and/or a sugar like raffinose; two substances that attract water into cells. A third cassette produces more or longer roots, also a process in which dozens of genes are involved.

Inze's group has recently granted licences to BASF to develop yet another cassette, namely one that actively maintains the growth buds. Grains naturally stop mitosis in the growth buds already in mildly dry conditions to prevent the new leaves or ears from withering. But a farmer will always give some water, is the reasoning of the researcher. Therefore such a precaution is not necessary in the fields. The 'Belgian' cassette thus contains synthetic pieces of DNA which stimulate cells in the growth buds to maintain growth in mildly dry conditions.

Conventional solutions

Critics such as the Union of Concerned Scientists fear that gene technology will make the grain seeds very expensive. What all should be incorporated into a plant? Sometimes short periods of drought are interspersed with torrential rain, sometimes there are weeks of water shortage or periods in which high temperatures cause stress. Different DNA cassettes will be needed against different types of stress to give farmers some security. The organisation would rather see more investment in cheaper conventional breeding. It appeals for breeding programmes in crops that need only a small amount of water, such as amaranth, sorghum or alfalfa.

Inze recognizes that the development of each new GM maize variety will indeed cost approximately 100 million euro (120 million US$). But he expects that it will become much cheaper. According to Gurian-Sherman, agronomist at the rather worried Researchers' Association, GM varieties will however remain expensive for the next twenty years – he does not want to give any predictions for the period after 2032. Larry Wagner, agronomist at the South Dakota State University, also showed concern, in the Washington Post on 15 August last year, about the huge investments multinationals now make in drought-tolerant grains. "I sometimes worry that we place too much emphasis on genetics", he wrote. "Significant progress has also been made in growing techniques." According to the Iowa State University, the tolerance of American maize against drought is improving by 1% each year thanks to improved growing techniques and conventional breeding. The question is whether that little is enough to keep up with the expected increasing droughts in the Midwest of the USA.

Detection and Identification Technologies

Learning

Michel Ebskamp and Hedwich Teunissen

New techniques are becoming available for rapid detection and identification purposes in the sector of seeds and plants - not only for pathogens in plants, but also for systems (e.g. hygiene measures) and tracking and tracing. Currently, in the Netherlands, some new projects are ongoing to apply this technology in the seeds sector.

During the last 10 years, DNA-based techniques (PCR) have been introduced for the detection of many pathogens. For big scale routine testing, the use of ELISA as a sound and robust technique to assess the health of batches of seeds/plants/mothercrops (from a cost price background) is still appropriate. But as soon as the testing of individual plants (or plantlets) to be used for further selection and propagation is required, the focus is generally on PCR. Primers and protocols are widely available. Real-time PCR assays are used with TaqMan probes to further increase specificity.
Last year, Naktuinbouw invested a lot of effort into using DNA-based genotyping to identify different isolates/pathovars/forma specialis. Knowing the unique DNA fingerprint of the isolate responsible for an outbreak or an infested crop provides new opportunities to find the source of infection (the origin) in propagation systems, as well as in seedlots and batches of marketed plants. Clear examples are available in pathogens such as Clavibacter michiganensis (tomato) and Xanthomonas campestris (cabbage), in which this approach has already been proven to be successful.
Further scanning of isolates and infected material will extend the current database with specified information that will be helpful for both inspection agencies and companies.

Luminex

The Luminex technology is a multiplex detection system that uses colour-coded paramagnetic

from forensic research

The percentage of deuterium in the natural water varies and that might help determining the origins of a plant

microspheres. Specific antibodies are bound to these paramagnetic microspheres and viral or bacterial plant pathogens will bind to these labelled beads. This technology is already widely used in hospitals and can also be used for animal and plant pathogens. The advantage is that multiple pathogens can be detected in one sample. The Luminex technology can also be used to detect multiple DNA fragments - research is being done to further develop this technology.
Unraveling the human DNA sequence took more than ten years and cost over a billion dollars. With Next Generation Sequencing technologies it is now possible to obtain the whole DNA sequence of a complete organism (such as bacteria) for less than 1,000 euros. Every year we can obtain more data for less money. This development opens up many possibilities and applications. For example: sequence the complete genomes of Clavibacter michiganensis strains and related bacteria that are non-pathogenic on tomato to discover the DNA responsible for disease and design a very specific detection test. Or discover the unknown pathogen in a sympomatic plant doing diagnostics by sequencing. Use DNA sequences to discover infringements on Plant Breeders' Rights and use this data as evidence in a court case.
Another application for deep sequencing is being developed for diagnostics, based on the sequences of pathogens found in a diseased plant - a diagnostician will evaluate their relevance and come to a diagnosis (for example in testing pospiviroids).

Isotopes

A promising technique for identifying and separating various origins (production locations/regions) of plant material lies within the use of stable isotope ratios. Currently, a research project on the use of isotope ratios has started to see if this technology will be helpful to investigate questions regarding both homogeneity and also origin of plant and seed material that is marketed. For this purpose, the isotopes present in water (hydrogen and oxygen) are investigated.
The basic principle of the technique is that the amount (%) of deuterium in the natural water supply varies all over the world (as is also the case with isotopes of nitrogen and oxygen). Testing material in cases of uncertainty and when there are questions about traceability will most likely lead to information that will be helpful. It is expected that the technique (already in use in forensic research/customs programmes) will be widely available within a few years for business purposes and for inspection agencies.

Seed and plant companies interested in information and development (in their products/crops) of techniques as mentioned in this article are kindly invited to contact the R&D department of Naktuinbouw, the Netherlands, at info@naktuinbouw.nl

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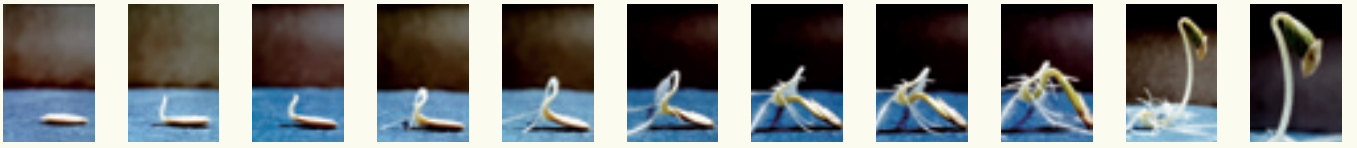

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Using High Pressure Sodium Lights as supplementary lighting produces weak plants with elongated hypocotyls

Combining Valoya LEDs with High Pressure Sodium Lights improved plant growth significantly to produce compact and strong plants

Lantmännen SW Seed, an international seed company with its head office in Svalöv, Sweden, has been able to significantly improve the greenhouse cultivation of oilseed rape (Brassica napus) using Valoya LED lights. The light solution is a hybrid use of both traditional High Pressure Sodium Lights (HPS) and LEDs.

Valoya Case Study

LED lights improve canola quality

Lars Aikala and Werner Horn

Oilseed rape is a very important crop and valued for its oil for food and fuel. The development of new oilseed rape varieties is driven by higher productivity demands and also by more specialized end products, for example for biofuels production.
In the breeding process of new oilseed rape varieties, the young plants are cultivated, typically during the winter in greenhouses, using supplementary lighting to improve or enable growth. Traditionally, High Pressure Sodium Lights (HPS) have been used for illumination. Plant quality has deteriorated during winter months due to the poor quality of the HPS light spectrum. The poor quality of the oilseed rape plants appears as elongated hypocotyls. These hypocotyls make transplantation of the plants into the field more difficult, causing damage to the plants and thus compromising their survival through the breeding programme. The plants should be compact, strong and have short hypocotyls. Plant quality can be partly improved by lowering greenhouse temperature, but this leads to a longer production time.
Lantmännen SW Seed has been working with Valoya lights both in Sweden and in Germany. The Lantmännen SW Seed team in Germany tested the effect of different light sources to improve the quality of the oilseed rape seedlings. They found that the use of Valoya LEDs together with the existing HPS lamps in the trial greenhouse improved plant quality to a level similar to the high quality of plants grown outdoors during the summer, i.e. strong, compact and with very short hypocotyls. Light intensity is not different compared with HPS alone and, when both lamps are combined, the positive growth effect is due to the spectrum of the Valoya LED lights.
Improving the quality of plants without slowing down the production time is very valuable for seed companies, as development programmes for new plant varieties are costly and can take as much as 15-18 years. Each plant in the breeding programme receives significant care and analysis during this time, which leads to a high cost. Thus, a strong plant equals high survival rates and, therefore, protection of the investment therein.
The oilseed rape seeds were sown on 10 December 2012 and grown until 7 January 2013 in the greenhouse at a temperature of 10°C. When they matured to '6 leaf stage', they were placed into vernalization at 2°-3°C for a minimum of 6 weeks at low light intensity. The plants were then transplanted to the field in early March 2013.

About Lantmännen SW Seed Lantmännen sw Seed is an international plant breeding and seed company. The core business is the development and marketing of new plant varieties and the production of seed. Cereals, oil seeds and forage grasses and legumes are the main crops. It is part of Lantmännen, a cooperative which is owned by 33,500 Swedish farmers. It has more than 10,000 employees, operates in 19 countries and has a turnover of sek 36 billion. More information: www.swseed.com

About Valoya Valoya is a provider of energy-efficient LED grow lights for professional use. Valoya led-lights have been developed using Valoya's proprietary led technology and extensive plant photobiology research. Valoya's customer base includes numerous greenhouses and research institutions all over the world. More information: www.valoya.com

Unexpected effects of deficient gas exchange

Geert-Jan de Klerk

With conventional cuttings, an airy substrate is beneficial for the development of a vigorous rooting system. When rooted in vitro, the microcuttings are stuck into a solidified nutrient medium that is poor in oxygen and that allows much less diffusion of gases. This article deals with the striking effects of this reduced gas diffusion on rooting.

Rooting of conventional cuttings and micro-cuttings (cuttings produced in tissue culture) is an obligatory step in vegetative propagation of most crops. In a previous issue of Prophyta, the backgrounds of adventitious rooting were discussed and also the choice between in vitro and ex vitro rooting was dealt with. For rooting in vitro, microcuttings are cultured for several weeks on a solidified nutrient medium to which a low amount of auxin is added. Ex vitro rooting is similar to rooting of conventional cuttings in which a high dose of auxin is added as a pulse when the cuttings are planted in soil. Each of these methods has its advantages and disadvantages and it depends of the crop which prevails.
When microcuttings are rooted in vitro, not only does the level and the duration of auxin treatment differ from ex vitro rooting, but also the rate of gas exchange by the section of the stem in which the new roots are formed. The diffusion of gases in air is 10,000 times faster than in water. We examined the effect of poor diffusion on the formation of the new adventitious roots for ethylene and oxygen. We compared microcuttings that are stuck into the medium with 1-mm stem slices cut from the stem of microcuttings and cultured on top of the medium. There are evidently more differences between shoots and slices than the rate of gas exchange, most notably possible interactions of the root forming stem tissue with other organs (e.g., apex, young leaves).

Ethylene

Ethylene has a vast effect on root and shoot regeneration. Its effect is, however, complex and difficult to unravel. A complicating factor is that auxin, the hormone that induces adventitious root formation, strongly increases ethylene synthesis. For apple explants, the amount of ethylene that was released into the headspace of a tissue culture container was increased several fold when auxin was administered. Figure 1 shows the effect of silverthiosulphate (STS) on apple shoots rooted at a high concentration of auxin. STS is a potent inhibitor of ethylene action. STS increased the number of roots, reduced callus growth and allowed more growth of leaves.
An increase of ethylene synthesis at a high concentration of auxin can also be deduced from Figure 2. In this experiment, shoots were rooted with a low

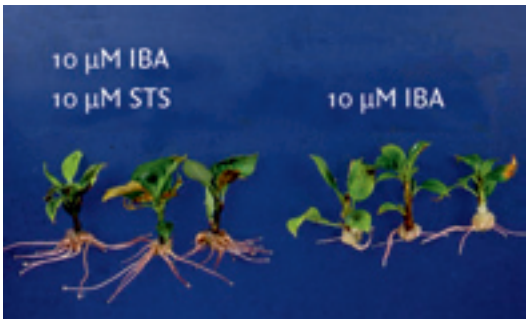
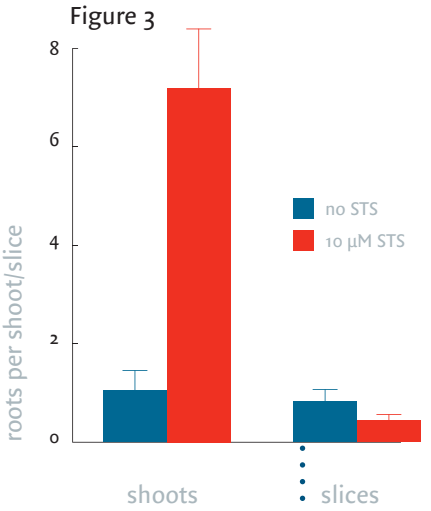


Figure 1 Shoots rooted at a very high concentration of IBA (1 µM is optimal). Note that STS, an inhibitor of ethylene action, increases the number of roots and reduces callus.

(0.3 µM) or a high (10 µM) concentration of the auxin naphthaleneacetic acid (NAA) and increasing concentrations of STS were added. At 10 µM NAA, STS promoted rooting. At this high auxin concentration apparently so much ethylene was produced that it became inhibitory. At 0.3 µM NAA, the concentration of ethylene in the shoots was adequate and STS was inhibitory at high concentrations.
We did a similar experiment with slices. Much to our surprise, we were unable to replicate the effect of STS (Figure 3). With the ethylene synthesis inhibitor aminovinyl glycine (AVG), we obtained the same results (promotion with shoots, no effect with slices). We also examined the effect of the addition of ethylene. As ethylene is a gas, it is complicated to administer it to tissues that are submerged in the medium. Therefore we added 1-aminocyclopropane-1-carboxylic acid (ACC), a direct precursor of ethylene in its biosynthetic pathway. ACC can be added via the medium and is rapidly metabolized to ethylene after uptake by the tissue. ACC promoted rooting in slices and inhibited rooting in shoots. This indicates again that in shoots there was too much ethylene in the tissue where the roots regenerated, whereas there was too little in slices. Added hormones are rapidly deactivated after uptake by plant tissues, either by oxidation or by conjugation (with a carbohydrate or an amino acid). Ethylene is an exception. Plants regulate its level by letting it diffuse out of the tissue. This explains the results summarised above. Ethylene accumulates in tissues that are stuck into the medium



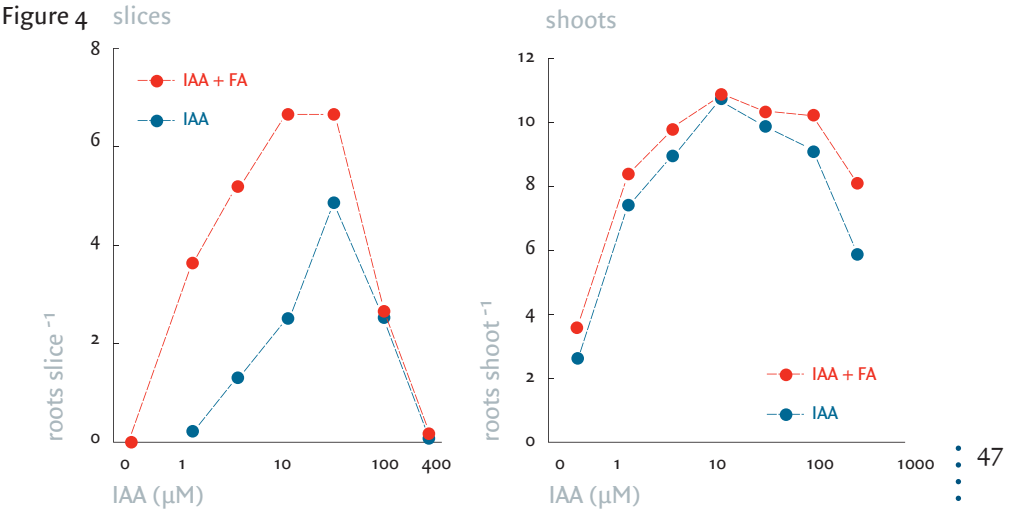


Figure 3 Effect of STS with shoots and slices at a high concentration of NAA.

Figure 4 Effect of ferulic acid with slices (left) and shoots (right). Ferulic acid only acts with slices.

because it cannot easily escape. Therefore its endogenous concentration gets too high and ethylene inhibitors (STS and AVG) become promotive and ACC inhibitory. In slices, ethylene can easily escape from the tissue and the effects of STS, AVG and ACC are just the opposite way round from shoots.

Oxygen and oxidative stress

The promotion of rooting by auxin was discovered in the 1930s. It was the first commercial application of plant hormones. There has been much research to find new substances that promote rooting and various have been discovered. Phenolic compounds are the most promising. It should be noted first that their action depends upon the chemical structure and some may even be inhibitory. We first examined a range of phenolics with slices and found that ferulic acid (a methylated diphenol) gave the best results closely followed by phloroglucinol (a triphenol). Promotion by phloroglucinol has been reported before by several researchers. The optimum concentration of ferulic acid was 0.3 mM. The high concentration indicates that it does not act as a hormone because hormones usually operate in the µM range (0.1-30 µM).

A laborious but very informative method to gain more insight into the interaction between a compound and a hormone is to determine its effect on the dose-response curve of the hormone. IAA shows a typical bell-shaped dose response curve when added alone: at low and high concentration there was no or little effect, but at intermediate concentrations there was a large effect (Figure 4a). When a dose-response curve was made in the presence of 300 µM ferulic acid, two main effects become clear. Ferulic acid promoted, but only at the low and intermediate concentrations of IAA. Second, the maximum number of roots increased. To jump immediately to the conclusion, both effects were due to alleviation of an oxidative burst brought about by wounding when cutting the slices. By this oxidative burst, the auxin we used, indoleacetic acid (IAA), was oxidized. Therefore, ferulic acid worked especially at low IAA concentrations and not at supraoptimal concentrations. When we used an auxin that is not oxidized, NAA, there was still an effect of ferulic acid but much less. The second effect is related to an overall protection of the tissue by which is can regenerate more roots. This overall protection was the cause of increased rooting with NAA.

We examined the antioxidative capacity of ferulic acid by measuring its effect on IAA oxidation using 14C-labeled IAA. When IAA with a 14C-atom in the carboxyl group of the molecule is oxidized, $^{14}CO_2$ is released. $^{14}CO_2$ can be trapped in a KOH solution and measured. We found that oxidation of IAA was almost completely inhibited by ferulic acid.

The experiment with 14C-labeled IAA was also carried out with shoots. The oxidation of IAA was at least 20 times lower than in slices. This was caused by the anaerobic conditions at the site of the wound. In shoots, protection was not necessary. Accordingly, ferulic acid promoted rooting of shoots only slightly (Figure 4b).

As noted before, many authors report that another phenolic compound, phloroglucinol, strongly promotes rooting of shoots. The different effectiveness of ferulic acid and phloroglucinol may be brought about by differences in pKa values. The pKa determines at which pH compounds are positively or negatively charged or noncharged. A noncharged molecule can penetrate membranes much more easily and therefore may enter cells. Because of its pKa, phloroglucinol penetrates more easily into the cells than ferulic acid. The wounding-related oxidative stress is localized in the apoplast and in the medium. Other oxidative stresses are located within the cells among others oxidative stress due to anaerobiosis. The promotion by phloroglucinol may be related to its beneficial effect on these stresses.

Conclusion

We did not foresee the differences in response of slices and shoots to ethylene and ferulic acid at all. They show that the physiology of plants should be scrutinized and that especially the differences with the ex vitro environment should be taken into account.

The Key to Hyperhydricity

Intercellular spaces are filled up with water

Geert-Jan de Klerk, Frans Krens and Niels van den Dries

When leaves of aquatic plants are cut off under water, they immediately float up to the water surface. This is caused by the large quantities of air in the intercellular spaces. The abundance of air in aquatic plants indicates a crucial function of the internal air spaces in the physiology of plants.

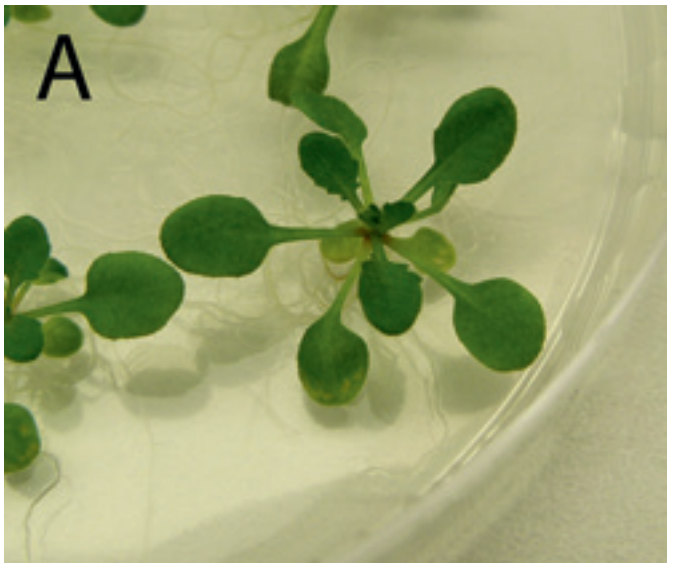
The importance of internal air spaces is also demonstrated by the way plants adapt to waterlogging of the soil. The plants that do survive waterlogging have the ability to modify their roots and have created air channels by programmed cell death of long strands of cells.
The primary importance of air spaces is that they enable rapid diffusion of gases like O_2, CO_2 and ethylene within the plant. Diffusion of gases in air is 10,000 times faster than in water. Fast diffusion of gases is severely hampered when the gas-filled intercellular spaces are filled up with water. Here we show that hyperhydricity is caused by the filling of the intercellular spaces with water instead of air.
Hyperhydricity, also called vitrification or glassiness, is a physiological disorder that is frequently observed in tissue culture and is often devastating in applications of tissue culture.

Extreme conditions

For plants, the in-vitro conditions are very unusual and extreme. The constantly high relative humidity (RH) (99.5%) is one of the major abnormalities. It has a marked effect on leaves and leads to various aberrations. Well-known are the nonfunctioning stomata. In tissue culture, the stomata are always open and they stay open after planting in soil leading to extensive wilting during acclimatization. Originally, it was believed that this wilting was caused by water loss because of limited wax deposition on the exterior of the epidermis (epicuticular wax).
However, later experiments showed that the nonfunctioning of the stomata is the most important factor in water loss. The wax deposited on the inside of the epidermis (intracuticular wax) is apparently sufficient to prevent evaporation via the non-stomatal pathway. It was also found that the stomata from in vitro plants did not respond to the plant hormone abscisic acid (ABA). ABA is the main signal for plants to close their stomata when they experience drought.
Another abnormality caused by the high RH is hyperhydricity. Hyperhydric leaves are brittle, curled, translucent and glassy. Microscopic investigations revealed large intercellular spaces in the mesophyll and a reduction of the palisade layer. The surface of hyperhydric leaves is often characterized by a thin epidermis with perforations, and scattered or no deposition of epicuticular wax. Hyperhydric stems exhibit reduced lignification, hypertrophy of parenchyma tissue, large apoplastic spaces and abnormal organization of vascular bundles.
On the physiological, biochemical and molecular levels, hyperhydric plants also displayed marked characteristics: a low chlorophyll content, reduced photosynthesis, decreased lignin synthesis, less lignin and cellulose, and high levels of ethylene.
More recent research showed the occurrence of reactive oxygen species (ROS) and enzymes related to anoxia. In hyperhydric tissue, stress specific proteins (Binding Protein, BiP) have been found.

Excess of water

Numerous articles deal with hyperhydricity in tissue culture, an estimated five hundred to one thousand. Many are about the effect of tissue culture conditions on the occurrence and severity of hyperhydricity, always judged by visual assessment. In addition, there are many articles on anatomical and biochemical characteristics as discussed in the previous section.
The profusion of hyperhydric characteristics has actually obscured the key factor, the excess of water within the plant tissue, even though this has given the disorder its name (Greek: prefix hyper = too much; hudoor = water). Water is the key factor because hyperhydricity disappears when the availability of water is reduced by adding more solidifier (agar or gelrite) or when the RH is lowered by ventilation or by bottom cooling. How extra water causes the hyperhydric symptoms has almost never been critically examined.
The water content of hyperhydric tissue has been measured by only few authors, for example, as percentage of the total fresh weight but the increase was only little. We found in apple shoots an increase of 85.2%-86.0%. For proper quantification, the localization of the extra water must be taken into account.
The localization has been studied critically only by Karleen Gribble from Sydney. Using NMR imaging and an environmental scanning electron microscope, she showed that hyperhydric plants have an excess of water in the apoplast.
It is surprising that the amounts of water and air in the apoplast of hyperhydric leaves have never been quantified. Apoplastic water can be measured easily



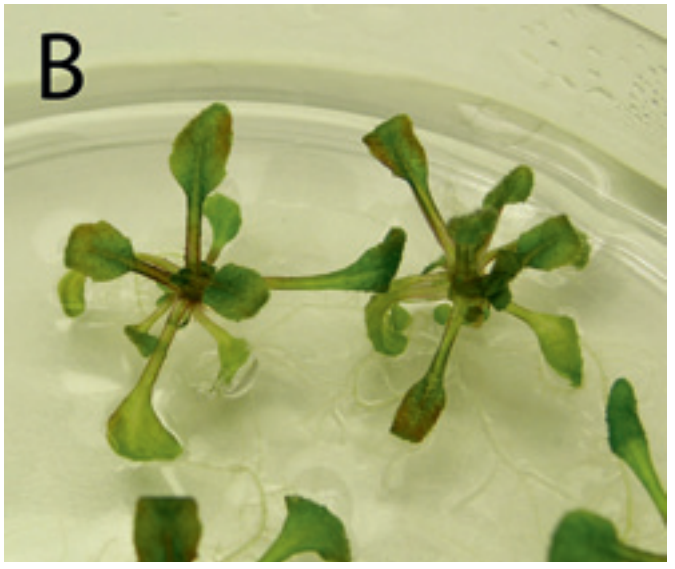
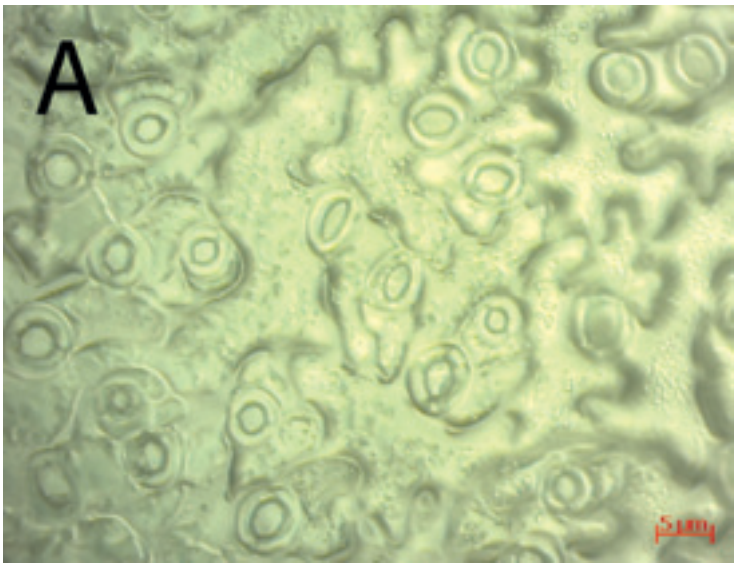


Figure 1 Normal (A) and hyperhydric (B) arabidopsis seedlings



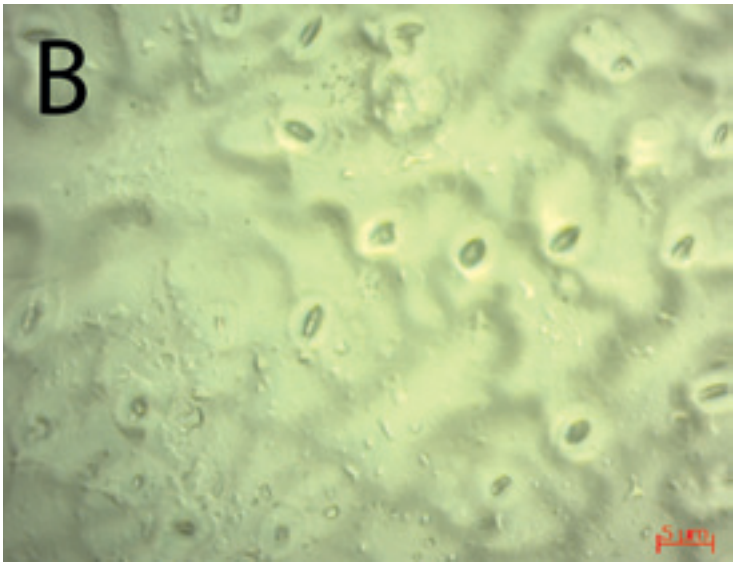


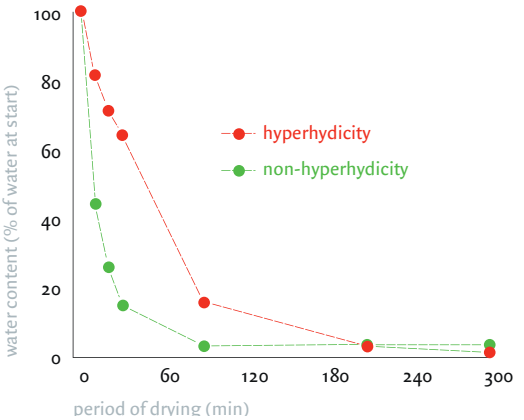
Figure 2 Behaviour of normal and hyperhydric seedlings upon immersion in water. Normal seedlings float and stay on the surface. In contrast, hyperhydric seedlings sink to the bottom

by centrifuging water out of the tissue at a low speed (20 min 3000g) and weighing. Apoplastic air is assessed using a pycnometer weighing the weight-increase of the pycnometer with tissue before and after air in the tissue has been replaced by water using vacuum infiltration. We examined this in hyperhydric Arabidopsis seedlings as a model (Fig. 1) and in various genuine crops. The results were always similar. In hyperhydric tissues, the air in the apoplast was replaced partly or almost entirely by water (Table 1). As a result of this replacement, the tissues became heavier. The overall specific density of the plants was higher than 1 and the seedlings sank immediately when immersed in water (Fig. 2).

The effect of the flooding of the apoplast on plant quality is very pronounced. The ultimate consequence was very severe: 20 days after transfer of seedlings to Gelrite medium, they died off after acquiring the hyperhydric phenotype. One of the obvious effects of flooding is hypoxia. With quantitative real-time PCR we examined the expression of genes known to be induced in Arabidopsis subjected to hypoxic conditions. Expression levels of eight of the nine examined genes increased more than two times. But apart from hypoxia, there are likely to be many more effects. Obviously, CO_2 accumulates in the cells but also signalling molecules like ethylene and methyljasmonate cannot easily get out of the cells.

Causes

Because hyperhydric tissues are located 0.1 cm-3 cm above the level of the nutrient medium, there must be a force that moves the water upwards to the apoplast. There are several possibilities, viz., root pressure in the xylem (or a similar phenomenon when roots are not present), the water flow in the phloem, and physical mechanisms like capillary action. Water translocation brought about by evaporation - which



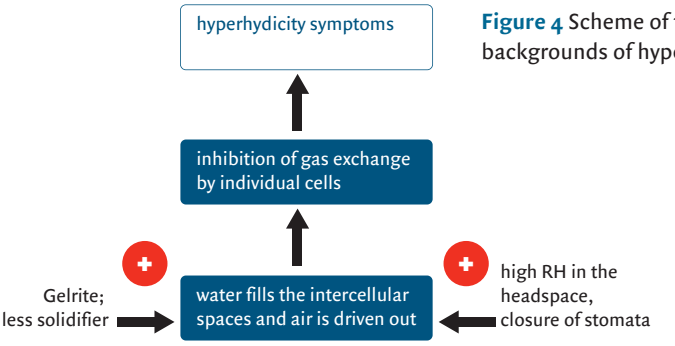


Figure 4 Scheme of the backgrounds of hyperhydricity

Figure 3 Epidermal prints of normal (A) and hyperhydric (B) leaves. Note that the stomata in hyperhydric leaves are much more closed. This leads to slower wilting when the leaves are cut off as shown by a slower loss of water (c). The characteristic shown in c is referred to as water retention capacity (WRC)

is the main force for water movement under ex vitro conditions - is not involved in the flooding of the apoplast simply because all the water that is translocated in this way evaporates from the leaves. The apoplast may be rich in solutes and attract water by its osmotic value but our measurements did not show indications of high concentrations of osmolytes.
Easy water availability is a very important factor as shown by a strong increase of hyperhydricity in liquid medium, when Gelrite is used as solidifier instead of agar or when the concentration of solidifier is reduced. The mystery of the driving force still needs to be solved.
In addition to an increase of supply, a decrease of removal of water may also lead to flooding. Normally, removal of water from the apoplast is brought about by evaporation. As mentioned before, hyperhydricity is indeed reduced when evaporation is increased by lowering the RH in the headspace of containers. We examined whether the water retention capacity (WRC) was different in hyperhydric and nonhyperhydric leaves. It is often claimed that hyperhydric plants wilt even faster than normal vitro plants because their stomata are open more. Much to our surprise when tested, the WRC of hyperhydric plants was a little better and epidermal prints showed that the stomata are closed more (Fig. 3). The WRC was only slightly increased but perhaps just enough to cause accumulation of water. The WRC of hyperhydric leaves was still much smaller than the WRC of ex vitro formed leaves. These leaves had lost only 10% of their water after 90 min, the hyperhydric leaves 85% and the nonhyperhydric ones 97%. The differences are probably due to differential closure of the stomata.

Conclusion

Hyperhydricity is a physiological disorder that often troubles tissue culturalists. Literature is abundant but at the same time confusing, because it focuses on the morphological, anatomical and physiological symptoms, and on curing, but hardly deals with the underlying causes. Although some researchers recognize that water in the apoplast is relevant - occasionally apoplastic air is mentioned - the volumes of apoplastic air and water have never been quantified. We found an unexpectedly large difference between hyperhydric and nonhyperhydric plants: in hyperhydric ones, virtually all air had disappeared from the apoplast and more water was found to be present. We believe this is the key to the hyperhydric disorder. Because the diffusion of gases in water is 10,000 times slower than in air, gases accumulate in the individual cells in hyperhydric plants and O_2 cannot enter. This leads to the hyperhydric symptoms (Fig. 4).
As curing treatment, the stress of poor gas exchange may be alleviated e.g. by application of stress protectants such as antioxidants. However, the flooding can be so severe that successful treatment of the symptoms is no longer possible. The main way of coping with the phenomenon would therefore be to prevent water accumulation in the apoplast by decreasing the supply to and/or increasing the drainage of the apoplast. As a matter of fact, this is the procedure of existing successful cures but they usually also decrease the propagation rate. Therefore novel methods? should be developed and some new leads have been identified recently on which we will report soon.

	Non-hyperhydric (Grown on agar)	Hyperhydric (Grown on gelrite)
arabidopsis	81%	15%
statice	48%	2%
crambe		6%

Table 1 The estimated volume of air in the apoplast of leaves is shown as a percentage of the volume of the apoplast. The remainder of the apoplastic space is occupied by water. The apoplast itself takes up 25%-40% of the leaf volume and consists for the greater part of large intercellular spaces

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