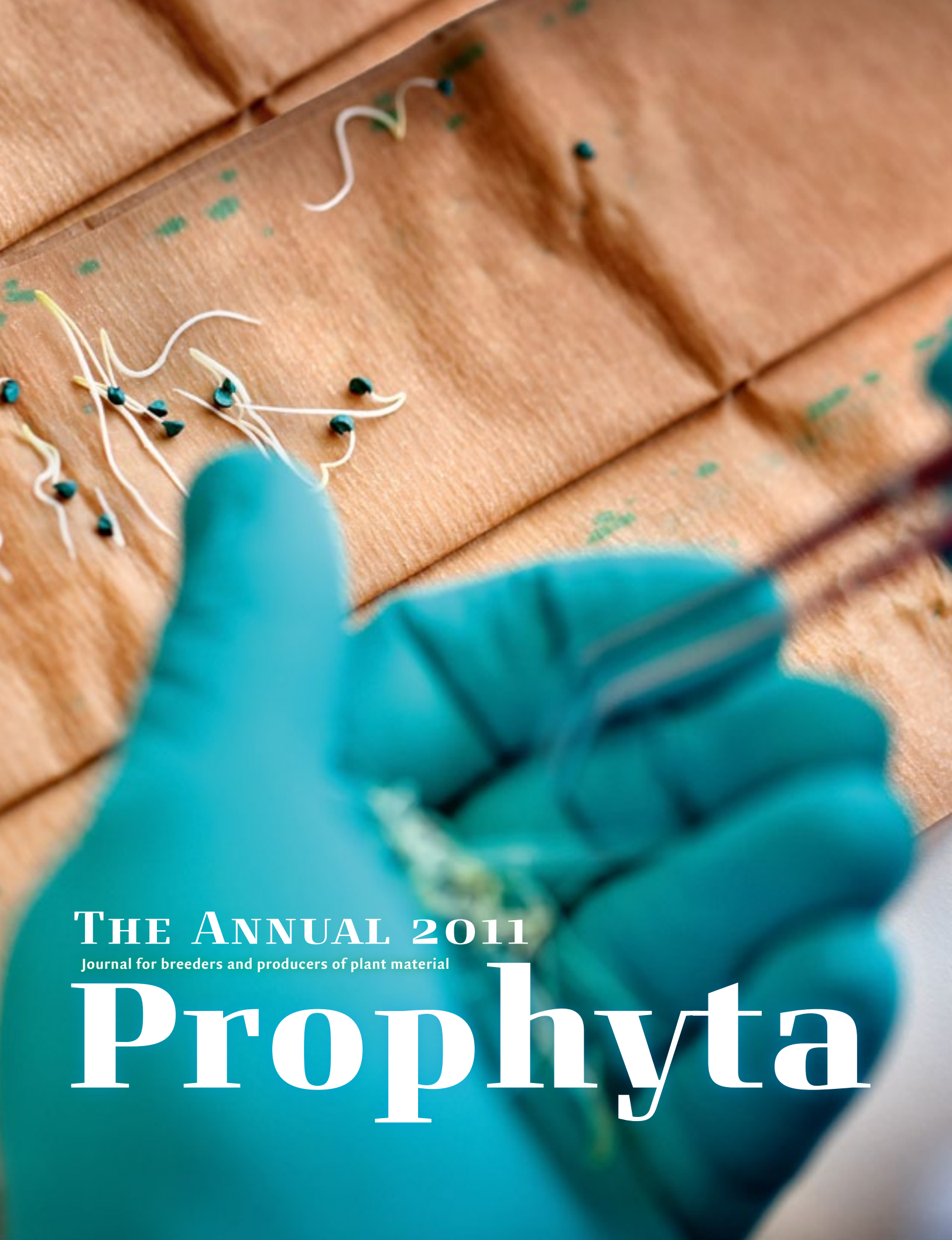

THE ANNUAL 2011

Journal for breeders and producers of plant material

Prophyta

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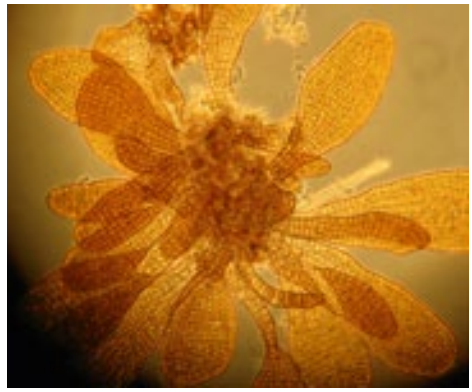

Prophyta – The Annual 2011
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Researcher discovers drought resistance genes

Researchers at Wageningen University in the Netherlands have discovered which genes are involved in drought-resistance of potatoes. Anitha Kumari found huge differences in the recovery of potato plants after three weeks of drought. She also discovered that there is a specific region on the chromosomes that regulates the reaction of the plants to droughts. Potatoes use water very efficiently. Per litre of water a potato plant produces more food than, for instance, wheat. The problem is, however, that potato plants cannot cope well with water shortage. The results of Anitha Kumari's research show that it is possible to breed potato varieties which are efficient with water and can also recover after a period of drought. Anitha Kumari used a cross of two potato plants that had two different wild potato species in their genetic background. The plants were kept dry for three weeks. When watered, some plants recovered, while others withered. Genetic analysis of the plants showed that the differences in activities of thousands of genes depended on one region in the DNA. This only became visible during the drought and not under normal conditions. This led to the conclusion that the reaction of the plants to drought is regulated in this part of the genome.

New race of downy mildew in spinach named

The international working group Peronospora farinosa (IWGP), has characterised a new race of downy mildew in spinach on a set of differential varieties and designated it as strain Pfs: 12. This race forms a threat to spinach growing. In May 2009, a new race of downy mildew was discovered for the first time in Salinas Valley in California, USA. This race breaks the resistance of several important resistant varieties of spinach and was discovered in more and more locations in 2010. The Pfs: 12 race presents a new threat because it is exceptionally well-adapted to Pfs: 1-11 resistant varieties that have been widely grown on a large scale in recent years. The Pfs: 12 race is distinct from the Pfs: 11 race because of its virulence on the differential varieties Campania and Boeing. The newest race has not yet been reported in the Netherlands. The appearance of Pfs: 12 is not an entirely unexpected event, according to the working group. In the past years, there have often been occurrences of resistance breakdown (Pfs: 5 in 1996, Pfs: 6 in 1998, Pfs: 7 in 1999, and Pfs: 8 and 10 in 2004, and Pfs: 11 in 2009). The cause may possibly be found in the intensive (year-round) cultivation of spinach and the limited opportunities to spray the crops. As a result of the emergence of the Pfs:12 race, spinach varieties' resistance to Pfs:1-12 will attract strong interest from both growers and breeders.

The working group IWGP

The working group, IWGP, was set up through Plantum NL by Naktuinbouw and companies with trading interests in spinach seed. The working group is supported by research centres in the USA, including the University of Arkansas and the University of California Cooperative Extension. The aim of the working group is to inventory the new races of downy mildew in spinach and designate them, where necessary. This will encourage communication between seed companies and growers about the resistance breaking races. These are races that are persistent enough to survive over several years in a wide area, and can result in significant economic damage. The IWGP is monitoring if new races occur by testing suspect isolates on a common differential set of spinach varieties that contains the relevant range of resistances. Researchers all over the world are invited to join the IWGP initiative and use the common host differential set to identify new isolates.

Variety descriptions and calibration books on website

WWW.NAKTUINBOUW.COM contains the variety descriptions of the varieties listed in the Netherlands and varieties for which Dutch Plant Breeders' Rights were granted in 2010. Calibration books can also be ordered via the website.

Variety descriptions

The variety descriptions are subdivided into the vegetable, agricultural and ornamental sectors. Consult this information via www.naktuinbouw.nl/en/article/variety-descriptions. New descriptions of varieties are added on a monthly basis. On request, older versions will be posted on the site.

Calibration books

Naktuinbouw uses calibration books to perform DUS testing. An explanation, accompanied by drawings and photographs, is given of each characteristic, based on the UPOV-guidelines/CPVO-protocols. Naktuinbouw makes these books available for interested parties. They can be used as a guide when completing the application form, when describing the variety and for a better understanding of the descriptions. The books cost € 60 (excl. VAT) each for a printed copy. A digital version costs € 300 (excl. VAT, incl. a printed copy).

www.naktuinbouw.nl/en/topic/calibration-books lists the books that are available in Dutch or English. You can also take a look at some examples of pages from the books. Calibration books can be ordered at kalibratieboek@naktuinbouw.nl.

New test to detect chrysanthemum viroids

Naktuinbouw Laboratories has developed a new test designed to detect chrysanthemum stunt viroid and chrysanthemum chlorotic mottle viroid in a single test. Viroids are the smallest pathogens in the world and only occur in plants. Chrysanthemums are prone to two different viroids: chrysanthemum stunt viroid (CSVd) and chrysanthemum chlorotic mottle viroid (CChMVd). CSVd is a quarantine organism in chrysanthemum. More is known about this quarantine organism than about CChMVd. Plants infected by CChMVd sometimes display chlorotic leaves and/or stunted growth of foliage, flowers and sometimes the entire plant. The symptoms may be confused with a nutrient deficiency. Infected plants may also be symptomless. Until recently, occurrence of this viroid was mainly reported from the USA and Japan, but it has now also been found on European plant material. CChMVd belongs to the Avsunviroidae family of viroids and was not detectable by the existing molecular tests for Pospiviroidae. CChMVd is also not detected by a general R-PAGE procedure (return-polyacrylamide gel electrophoresis). In practice, CChMVd is often present without any symptoms being visible, or it is not recognised as such. This makes it a hidden threat for chrysanthemum growing: symptoms mainly appear at higher temperatures.

Detection

The Product Board Horticulture funded a consultancy project to investigate the possibilities of detecting CChMVd using PCR. This project has been successfully completed. Naktuinbouw subsequently continued the development of the test to create a real-time RT-PCR and combined detection of both chrysanthemum viroids, so that both viroids – CSVd and CChMVd – can be detected in a single test. The process of extraction from leaf materials has also been automated. The new test detects the different strains of CChMVd and is highly sensitive, specific and fast. The test is a valuable addition to the screening process of chrysanthemum propagating material.

For more information, please contact Ellis Meekes, senior researcher at Team R&D, tel. +31 (0)71 332 6236, or e-mail: e.meekes@naktuinbouw.nl

www.prophyta.org is the new URL of Prophyta's website, where you will find more information and can download earlier editions of Prophyta, The Annual.

Quicksand

It would be the ultimate horror scenario: a reputed tomato variety, that has become the favourite of many growers, is suddenly qualified as a GMO. It would mean the destruction of all the produce and of the plants, the end of the variety and probably of the seed company as well. Not so long ago, this nightmare would be nothing more than that; a bad, but unrealistic dream. Today, it could easily become reality if seed companies are not careful.

Since the first genetically modified plant varieties were introduced on the USA market for commercial cultivation, the technology in creating GMOs has been significantly augmented. The knowledge of the genome of plants and the function of genes helped seed companies to accelerate the breeding process and the introduction of improved varieties. Today, new technologies have become available that do not change the genome of the end product, but use, for instance, synthetic DNA during the breeding process. It seems obvious that such a variety is not a GMO. An EU guideline dating from 2001 states: 'a genetically modified organism is an organism, with the exclusion of human creatures, in which the genetic material is changed in a way which is not provided by nature through mating and/or natural recombination'.

It is, however, not that obvious for the EU-authorities. The legislator seems to be utterly confused about the new possibilities science has granted breeders. For years, technical committees of the EU have been studying whether plants created with these novel techniques should fall under the GMO-regulations. They promised to produce an end-report by the summer of 2011. A concept report has been circulating, but that report has been quickly withdrawn again. It is rumoured that the committee suggested that cisgenic plants should not be subject to GMO legislation, much to the abhorrence of GMO-opponents such as Greenpeace. The question is whether the final report will be based on science or on politics. Will it be politically feasible to accept that a tomato with only natural tomato-DNA is a 'normal' healthy variety? Or should we discard all novel technologies and focus solely on traditional cross-breeding? The seed companies are wary of using the new technologies as long as the governments remain undecided. However promising a tomato variety might be, the likelihood that a seed company would be willing to spend an extra 7-10 million Euros to obtain permission to market it as a GMO, is nil, certainly in Europe where GMOs are still scarce. It is a shame that the discussions do not focus on simple and straightforward scientific arguments about whether something is healthy or not, but it still remains a political quicksand in which it is all too easy to drown.

Monique Krinkels

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.

Rijk Zwaan. www.rijkzwaan.com

RIJK ZWAAN
seeds & services

Fleuroselect presents 'fabulous five'

Fleuroselect, the International Organisation for Ornamental Plants, has presented five outstanding varieties that the Fleuroselect judges found to be superior in terms of breeding, beauty and performance, and have been crowned with the Fleuroselect Gold Medal. Each of these stunning varieties is an exciting addition to the ornamentals market. The fabulous five winners are: Agastache hybrid 'Astello Indigo', Alcea rosea annua 'Spring Celebrities Crimson', Echinacea hybrida 'Cheyenne Spirit', Salvia coccinea 'Summer Jewel Red' and Viola cornuta 'Sorbet XP Delft Blue'.

Agastache hybrida 'Astello Indigo' from Van Hemert & Co. Seeds, the Netherlands, is a completely new type of hybrid Agastache from seed, perfectly suited for use in pots and containers as well as garden beds. The Fleuroselect judges were impressed by the strong, bushy plants, showing the ideal combination of vigorous growth and compact habit. Beautiful, upright spikes are fully covered with fragrant, deep indigo-blue flowers with a delightful minty scent that attracts butterflies and bees. A first-year flowering perennial that is ideal for annual production and highly versatile for growers, being suitable for various pot sizes and production schedules.

Alcea rosea annua 'Spring Celebrities Crimson' from Sahin/Takii Seed, the Netherlands/Japan, is a completely new dimension in annual flowering Hollyhocks. The newest and most compact variety in the 'Spring Celebrities' series has unique, bushy dwarf plants that produce sturdy stems with an abundance of beautiful, large, rich crimson double blooms. Hollyhocks are the quintessential plants for the 'cottage garden' trend, and 'Spring Celebrities Crimson' brings this within the reach of every garden, patio or balcony owner with no need for huge borders, stakes or ties! Requiring no vernalization and with a short production time, growers will be delighted to offer this stunning variety.

Echinacea hybrida 'Cheyenne Spirit' from Kieft-Pro-Seeds, the Netherlands, is a complete innovation in first-year flowering seed perennials and in Echinacea. With its rich colour palette, evoking the spirit of the North American plains and prairies where this genus has its origin, Echinacea 'Cheyenne Spirit' will delight and inspire growers and consumers alike. In addition to raving about the colour mix, the Fleuroselect judges also praised this variety for its good plant habit, flower quality and its uniformity, exceptional for a first-year flowering variety.

Salvia coccinea 'Summer Jewel Red' from Takii Seed, Japan, is early, easy and compact. These key features will attract growers to the all-new Salvia coccinea 'Summer Jewel Red'. In the trials, Fleuroselect judges applauded the earliness of this fast-to-grow new variety, earlier and more compact than any dwarf Salvia on the market. Easy to schedule and ship. Compact plants fill pots or packs fully and show appealing, bright jewel-red blooms at retail. In the garden, this free-flowering red gem will shine all season long.

Viola cornuta 'Sorbet XP Delft Blue' from PanAmerican Seed, USA/Europe, is a gold medal winner with old Dutch charm. Blue is an immensely popular tint in dainty, small flowered Viola cornuta, and 'Sorbet XP Delft Blue' has a unique, true blue colour with a white face in a stable colour combination, as beautiful and precious as the porcelain that lends its name. The Fleuroselect judges were wowed by the flower colour and also praised 'Sorbet XP Delft Blue' for its earliness and stable garden performance. A perfectly matching addition to the outstanding Sorbet XP series and a firm growers' favourite, consumers will delight in the striking colour contrast which radiates brightly in shade and light.

Quality in Horticulture

nak tuinbouw

Naktuinbouw (The Netherlands Inspection Service for Horticulture) monitors and promotes the quality of products and processes related to the production of propagating material for the horticultural sector.

Professional skills are important for companies in the propagating material sector. Naktuinbouw provides training services, which are directly related to Naktuinbouw's own operations.

Inspections

Inspections
Certification
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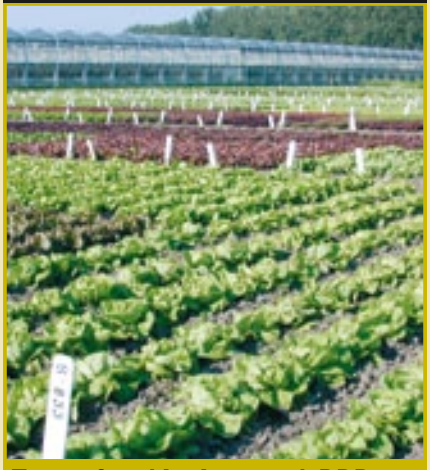
- Naktuinbouw Select Plant
- System Auditing
- Official Sampling
- Fytosanitary Certificates and Plant Passports

Laboratories

R&D
Seed Analyses
Plant & Seed Health Tests

- ISTA Certificates
- ELISA / Plating / IF / PCR
- Virus Free Nuclear Stock
- Naktuinbouw Diagnoster
- Naktuinbouw Accredited Laboratory (NAL)

Varieties & Trials



Tests for Listing and PBR (Plant Breeders' Rights)
Variety Registration

- DUS Testing
- Field Trials
- DNA-fingerprints
- Variety Descriptions
- Naktuinbouw Variety Tracer

Naktuinbouw: p.o. box 40, 2370 AA Roelofarendsveen, The Netherlands, **T:** +31 (0)71 332 62 62, **E:** info@naktuinbouw.nl, **W:** www.naktuinbouw.com

Prophyta Foundation

Support our initiative

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 advertisers for our annual magazine and/or direct financial support to the Prophyta Foundation.

We greatly acknowledge the companies mentioned underneath for supporting Prophyta, by either advertising or donating.

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Moerheim Roses and Trading	Leimuiden, the Netherlands	www.moerheim.com	Roses, bedding plants
Naktuinbouw	Roelofarendsveen, the Netherlands	www.naktuinbouw.nl	Inspection, varieties, testing
Plantum NL	Gouda, the Netherlands	www.plantum.nl	Seed association
Royalty Administration International	's-Gravenzande, the Netherlands	www.rai-worldwide.com	Breeder's rights
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Rossen Seeds	Hem, the Netherlands	www.rossenseeds.com	Vegetable seeds
SBW	Roelofarendsveen, the Netherlands	www.stbw.nl	Tissue culture
SBW do Brasil	Holambra, Brasil	www.sbwbrasil.com.br	Tissue culture
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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.

Britain proudly presents its **vibrant industry**

Monique Krinkels

It has been 23 years since seedsmen from all over the world came together in the United Kingdom. In 1988, FIS and Assinsel had a joint congress in Brighton, England. This year the capital of Northern Ireland, Belfast, will facilitate the international meetings. The British Society of Plant Breeders expects over 1,400 participants.

"It has been some years since the UK last hosted the Congress and we were somewhat daunted by the prospect when considering whether to offer to host." says British Society of Plant Breeders' Chairman Nigel Moore. "We are, however, very proud of our agriculture and seeds industry and now look forward with great excitement to the opportunity to welcome colleagues from around the world and show what we have to offer."

Endeavour

It has been a serious undertaking for the BSPB to organise the event. With slightly more than fifty members, the organisation is relatively small. "I have to thank our organising committee, chaired by John Gilbert, managing director of Germinal Holdings, so much for their huge effort", says Nigel Moore. "It is my good fortune to be chairman at the time when we are able to host the World Seed Congress in the UK." Nigel Moore is Director of Business Administration of KWS UK Ltd, a subsidiary of KWS SAAT AG. The company focuses on breeding cereals and oilseed rape, and bringing those varieties to market alongside maize and sugar beet varieties from parent

Agriculture

According to the Department for Environment, Food and Rural Affairs, DEFRA, the area of arable crops grown in the UK remained almost unchanged in 2010 at 4.4 million hectares. A little over 3 million hectares of this was used to grow cereal crops and oilseed crops account for a further 0.7 million hectares. The most predominant crop grown in the UK is wheat which increased by 9% between 2009 and 2010. The most noticeable differences are the much larger increases in the wheat areas seen in Scotland and Wales compared to other countries, though these areas constitute a fairly small proportion of the UK area. The total area of oilseed crops saw a large increase of 14% between June 2009 and June 2010, rising from 600 to 686 thousand hectares due to good autumn planting conditions. The largest increase was seen in the area of oilseed rape which increased by 72 thousand hectares. The area of linseed also saw a large increase (58%) in 2010 and now stands at 44 thousand hectares. In 2010 the area of cereal crops decreased by 2.0% to 3.0 million hectares. The largest drop was seen in the area of barley due to a combination of high stocks and low prices at time of planting. This led to a 27% decrease in the area of spring barley and a 5.1% decrease in winter barley area. In contrast to the reduction in barley the area of wheat in the UK increased by 9.2% from just under 1.8 million hectares in 2009 to 1.9 million hectares in 2010. This increase was largely due to the 8.4% increase seen in the English area of wheat, which amounts to an additional 139 thousand hectares. The increased area is in part due to the more favourable autumn planting conditions compared with the previous year. Scotland, Wales and Northern Ireland also had larger wheat areas in 2010 compared with 2009 with increases of 20%, 24% and 8% respectively.

Table 2. Fruit and vegetables grown in the open (x 1,000 ha)

Total fruit and vegetables	155
Orchards	24
Commercial orchards	21
Non-commercial orchards	3
Small fruit	10
Strawberries	4
Other small fruit	6
Vegetables	121
Peas and beans	34
Other vegetables and salad	87

Table 1. Arable crops (x 1,000 ha)

Total arable crops	4,431
Cereals	
Wheat	3,013
Barley	921
Oats	124
Rye, mixed corn, triticale	29
Oilseed crops	686
Oilseed rape	642
Linseed	44
Borage (England)	1
Potatoes	138
Other non-horticultural crops	593
Sugar beet	118
Field beans	166
Peas for harvesting dry	42
Maize	164
Root crops, brassicas, fodder beet	28
Other crops for stock feeding	34
Other	40

company breeding programmes. KWS UK has its headquarters at Thriplow, near Cambridge, and has a staff of 50. "We are currently at a crucial time for our sector", he says. "On the one hand, there is global pressure on agricultural production to sustainably meet the demands of population growth, improving human health and nutrition. The demand for food is set to increase by 50% over the next 20 years. On the other hand, it is important to protect biodiversity and conserve natural resources. Plant breeding and innovation based on sound science is perhaps the only truly renewable technology available to address these issues."

Development

He expects the discussions during the congress will be lively. "I look forward to progressive discussions throughout all of the committees, focussed on developing and enabling business environment for the continued research, variety development and rapid market access to plant breeding innovations. To meet the challenging global needs and provide the seed corn for a knowledgeable and well informed public food system requires the seed sector to be an exciting entrepreneurial prospect." In his view, Britain has a huge role to play in these developments. "The UK is not only a highly productive agricultural region, but also a significant centre of agricultural research. There are active breeders in agricultural crops, vegetables and ornamentals. In agricultural crops, the majority of breeding investment comes through UK subsidiaries of the larger international breeding companies, although there are smaller specialised breeders who are active within the market and they also form a valuable part of the BSPB membership." According to Nigel Moore, the BSPB and British plant breeders are very active in political circles. They deal with regulators and policy makers, not only with UK governments and assemblies, but also as active participants at a European level in the European Seed Association. "The need for global food and energy security, and Europe's role within that, has created a much higher profile and better informed political debate in recent months. One significant contribution from the UK is the globally focussed foresight report, coordinated by the UK chief scientist, Professor Sir John Beddington, which points the way for the sustainable intensification of agriculture with all the social, economic and environmental benefits which that can deliver.

Foresight

The Global Food and Farming Futures Foresight report appeared last January. It highlights the importance of agricultural science and technology in delivering the 'sustainable intensification' required to feed a growing population in the face of climate change and declining land, water and energy resources. A central role is envisaged for advances in plant breeding. Significantly, the Foresight report singles out the potential to apply both new and existing knowledge and technology to increase crop yields. It also calls for targeted investment in research to keep pace with the emergence of new and more virulent pests and diseases, and to develop new varieties of crops that are resistant to increased drought, flooding and salinity arising from climate change. The report also highlights the possible longer-term contribution of other more revolutionary breeding advances, such as the development of perennial grain crops, the introduction of nitrogen fixation into non-legume crops, and re-engineering the photosynthetic pathways of different plants. "The Foresight study represents the most comprehensive and authoritative analysis to date of the pressures building up on the global food supply system, from rapid population growth and urbanisation to climate change, land degradation and poverty. Plant breeders will be at the forefront of delivering the innovation required for the sustainable intensification of agriculture called for in the report. The challenge now is to turn its high-level recommendations into practical action", states Nigel Moore. "The report calls for a joined-up approach across a range of policy areas, but the simple fact remains that the most realistic prospect of delivering sustainable food security is through increased crop productiv-

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Horticulture

Vegetables and salad grown for human consumption make up the largest proportion of the UK's horticultural area at 121 thousand hectares, a decrease of 3% on 2009. The 7% increase seen in the total area of fruit offset this decrease and left the total area of horticultural crops almost unchanged at 169 thousand hectares.

ity per hectare on land that is already farmed. That will require clear, crop-specific targets for increases in productive yield and resource-use efficiency – to guide the most effective allocation of limited R&D resources and expenditure. It will mean developing more coherent public sector research strategies to ensure our rapidly advancing knowledge-base in plant genetics feeds through to practical innovation at the farm level and rapid uptake of new varieties by producers. It will also require a culture shift among policy-makers and regulators, particularly at an EU level, to create an economically stimulating and enabling regulatory environment for crop science and plant breeding innovation. Above all, we would strongly endorse the urgency for action signalled throughout the report. In plant breeding, a parental cross made today takes at least seven years to become a commercial variety. The timescales involved are such that we need to act now to deliver on the targets set out," concluded Nigel Moore.

Benign environment

"Within the whole of the UK, there are 17 million hectares of agricultural land, of which 6 million is cropped, with the remainder in permanent grassland or woodland", explains Nigel Moore. The climate and soil fertility is very benign, leading to average national wheat yields of around 8 tonnes per hectare, with productive farms in Eastern regions regularly achieving yields in excess of 10 tonnes. With intensive agriculture, environmental concerns are always a high priority and farmers unions have worked closely with regulators to put in place high quality traceability, assurance and environmental control schemes. Farmers' unions have also acknowledged the need for investment in research for their members' future business needs and have worked with the BSPB over many years to develop and continually improve the collection and compliance, with Farm Saved Seed royalties on cereals, oilseeds and pulses. "For agricultural crops, the UK has a vibrant certified seeds industry which has undergone some consolidation over the last decade and now provides a very efficient route to market for new varieties." With almost 2 million hectares under production each year, wheat is the national crop with the most significant breeding activity, with breeding programmes located in the UK by all major international cereal breeding companies. "Wheat is also the focus of many of our world-class research institutes working on more fundamental aspects of crop science. One constant issue for achieving delivery of innovation is financing the translational science gap between fundamental science and breeders' elite germplasm, which is a current active topic for the UK science funding bodies."

Table 3. Hardy nursery stock (x 1,000 ha)

Hardy nursery stock, bulbs and flowers	12
Hardy nursery stock	6
Bulbs and flowers grown in the open	5

Table 4. Glasshouses and protected crops (in ha)

Total glasshouse area	1,717
Vegetables, salad and fruit	895
Flowers, foliage and other plants	591
Not in use on 1 June 2010	193

Exciting times

"In these exciting times, the Belfast congress offers great opportunities for trading business and high level discussion of some of the big issues facing the sector." Nigel Moore hopes that all the delegates take home their personal share of the value created by such a Congress and that all enjoy their time in the region of Northern Ireland and the city of Belfast.

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Scottish and Irish put **barley** to excellent use

Hajo P. Strik

In the twelfth century, Scottish and Irish monasteries started to distil *uisge beatha* and *uisce beatha* respectively, or 'water of life'. Today, whisky is brewed from Japan to Canada and from Australia to Finland. It remains, however, originally a British-Irish invention. One of the main ingredients is barley.

The choice of varieties plays a significant role in the production process of whisky. In general, the Institute of Brewing and Distilling recommends a number of varieties every year (currently seven). Their recommendation is based on agronomic and economic yields, and disease and weather damage resistance, which are all important for farmers. Barley should, for instance, be resistant against mildew, Brown Rust and Rhynchosporium.

Fruity character

Whisky producers add some requirements. Single malt whisky has only two ingredients: water and barley. No wonder that distilleries put a high value on the quality of these two. "Distilleries need relatively dry barley, free of disease, infestation or debris. The barley also needs to be low in protein, have a high extract potential and a low viscosity for ease of processing. Low glycosidic nitrile (GN) potential is equally important, as this can turn into ethyl carbamate (EC) during distillation. Levels of EC are regulated by legislation in a number of countries", explains Sara Browne, of William Grant & Sons Ltd, the distillery that produces Glenfiddich. The company is one of the few that still grows its own barley. "No distillery could possibly grow enough barley for a whole year's production but we like to keep the tradition going. All of our barley comes from Scotland. We are very specific about varieties we select each year", stresses Sara Browne. The selection includes 'Optic', a spring malting barley by Syngenta Seeds. This variety has been on the recommended list for fifteen years and is one of the most-purchased varieties in Scotland. Another favourite is 'Oxbridge', a high-yielding barley by Limagrain. "We also regularly trial new varieties; for example, in 2011, we have brought in some 'Concerto' to assess its suitability for Glenfiddich. This GN-free variety bred by Nickerson Advanta has been fully approved by the Institute of Brewing & Distilling for brewing and malt distilling since last year. Key is how varieties perform during fermentation, where the fruity character of Glenfiddich must be created to ensure the spirit quality we require."

History

William Grant & Sons Ltd is an independent family-owned distillery, founded in 1886, and is still controlled by the fifth generation of the family today. The glen of the river Fiddich gives its name to the biggest-selling single malt whisky in the world: Glenfiddich. It is the only Highland or Speyside Scotch whisky to be distilled, matured and bottled at a single distillery. And just as the barley is always Scottish, so is the water. William Grant & Sons Ltd uses a single source of natural spring water, the Robbie Dhu springs. To ensure that the quality of the water matches that of the barley, the company bought 1200 acres of the Conval Hills that surround the distillery to protect the purity of the supply. The amount of barley the company needs is gigantic. To produce a bottle of Glenfiddich, the amount of barley required will vary depending on the quality of the barley – the better the quality, the less is needed. As a guideline, one tonne of good quality barley should produce 415 litres of New Make Spirit (young alcohol, when it comes out of the still) at 100% ABV (alcohol by volume). The New Make Spirit then needs to be reduced with spring water. Around 2% of the volume of a cask will evaporate during each year of maturation. Therefore, it takes 1.18 kg of barley to produce one 70 cl bottle of Glenfiddich that has ripened in the oak cask for 12 years.

Legal Uncertainties Obstruct Breeders

Unavailable **carrots,** uncertain **tomatoes,** stored up **potatoes** and forbidden **apples**

Marianne Heselmans

Genetically modified or not? Legally, there is a huge difference. But some new breeding techniques are in a grey area. As long as their status is unclear, companies are reluctant to use them.

European seed companies are encountering a problem. They own new, promising breeding technologies, but do not know whether the EU considers the seeds to be genetically modified. The definition of that classification has become a vague one. A guideline dating from 2001 states: 'a genetically modified organism is an organism, with the exclusion of human creatures, in which the genetic material is changed in a way which is not provided by nature through mating and/or natural recombination'.

Money

The importance of a European judgment is not only a correct definition; it is also a matter of money. The introduction of a genetically modified crop on the European market would cost 7-10 million Euros more than a traditionally bred one.

The procedure for market approval of a GMO is unaffordable for many companies. It would also be much too slow. A lettuce variety, for example, is marketed for only two or three years. The problem is further complicated for European companies not (yet) bought by Monsanto, BASF or by one of the other large multinationals. These independent seed companies have to compete with multinationals, who can afford the GMO procedure in Europe, and with seed companies in the United States and Canada, where market approval is much simpler and cheaper. As long as it is not clear whether the vegetables produced through the new breeding technique is a GMO, European seed companies keep it on hold, no matter how promising it looks. It would be catastrophic if the European Committee decides to brand a vegetable variety already on the market, as a

Photograph DigiDaan

Redder tomatoes

KeyGene is able to change DNA in a tomato accurately on a letter level. With its DNA-synthesis machine, it can introduce characteristics such as more healthy compounds or a redder colour. The machine almost identically copies a part of the gene that has to be switched off or altered. This piece of artificial DNA is then inserted into a protoplast of a tomato cell during mitosis, where it sticks on to the gene that has to be changed. Because the letter sequence of the tomato's own gene and the inserted synthetic molecule are not exactly the same the cell starts to repair the different letter. After cell division, the altered own gene remains and will be transmitted to its offspring. The synthetic particle of about twenty letters is broken down. COGEM has recently advised to exclude this technology from the GMO legislation, because changing genes in the classical way by mutagenesis – with chemicals or radioactive radiation – is likewise excluded. The users of the KeyGene technology have yet to decide whether they dare to use this technology for commercial varieties.

Photograph DigiDaan

As long as the EU-government has not made a decision, seed companies are wary to use the novel technologies

GMO. Supermarkets may decide to remove that vegetable from the shops and sue the breeding company.

Novel technologies

For decades, the world of plant breeders seemed clear and peaceful: they renewed their potato, cucumber and tomato varieties through cross-breeding or spontaneous mutations. Around 1940, two important new techniques were added: inducing random small changes in DNA (mutagenesis) with either radio-active radiation or chemicals. The genetic effects of these techniques were unpredictable, but at the time nobody thought it a problem.

Firm broccoli

The sweetest carrot or the firmest broccoli is often a hybrid. These excellent crops cannot be used in traditional breeding programmes. With reverse breeding, seed companies are able to produce perfectly complementing homozygous parental lines, through engineered meiosis. The method is based on reducing genetic recombination in the selected heterozygote by eliminating meiotic crossing over. During selection, breeders choose those plants that do not have the inserted synthetic DNA. It would take a company five years from the moment of discovery of the excellent plant to the market introduction of a new variety, if it would not be considered a GMO.

Opposition arose, however, when in 1985 the universities of Leiden, the Netherlands, and Gent, Belgium, succeeded in genetically modifying plants by introducing DNA that originated from a different species. In the last 25 years, GMO varieties have become popular in many countries across the world except for, amongst others, Europe, where only a few varieties have been approved. But as genetic modification was beyond the scope of the European seed companies, they did not waste time seeking alternatives. Together with universities, they developed novel breeding techniques. During the breeding process DNA is introduced, but in the final product the new DNA is no longer present. It has, for example, been outcrossed. Are those varieties GMO or not? The EU legislation is not clear, as it is about twenty years old, when those techniques did not exist. Rijk Zwaan has, for example, developed the reverse breeding technique, a technique that enables quick propagation of hybrid tomatoes or broccoli, coincidentally found to be very successful. “We have found an ideal tasting tomato in a greenhouse between less tasty tomatoes”, says Kees van Dun, molecular biologist at Rijk Zwaan. “It is a very sweet variety.” Researchers discovered how to block the genetic variation that occurs when chromosomes are crossed. They were able to produce seed from the tasty tomato. The small piece of DNA needed to block the cross-over, is no longer present in the final product.

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According to Greenpeace a cisgenic plant is a GMO and should be considered a biohazard

Improved potato

The research department of potato starch factory, AVEBE, in Foxhol in the Netherlands, faced similar difficulties. Research manager, Peter Bruinenberg, is eager to tell the problematic history of the potato containing only amylopectine. That is the type of starch that has industrial applications, amongst others in the paper industry. AVEBE developed this amylopectine-potato, because it was cheaper and environmentally friendlier to use. It is not necessary to remove the other type of starch which the potato produces naturally, with chemicals and high temperatures. But as the potato contained bacterial DNA, it was not accepted by the EU.
Ten years ago, AVEBE decided to focus on potatoes containing only potato-DNA. Last year, AVEBE's second potato entered the EU mills for approval. By now, the application file was over two thousand pages long and the board was asking themselves how long AVEBE could afford this. "Again and again, we receive additional questions, which force us to conduct extra field trials", says Peter Bruinenberg. "The costs are 250,000 Euros per trial."
The latest starch potatoes by AVEBE are coming closer to an 'ordinary' potato. These varieties possess three small fragments of potato-DNA that provide resistance against phytophthora. The DNA fragments have a letter-sequence that is exactly the same as three genes from a wild potato species. But also these so-called 'cisgenic' potatoes have been put more or less on hold by the board.

Clarification

Six years ago, seed companies started to request clarification from Brussels. The Dutch government asked its scientific advisory committee on GMOs, COGEM, whether nine 'GMO-like' technologies would fall under GMO-legislation. Scientists at Wageningen University studied the matter and came to the expected conclusion that there are no scientific arguments to put varieties, in which no DNA from other species is present, under the GMO rule.
"The consequences for the environment and for food safety are comparable with products that

Long lasting apples

The Canadian biotechnology company, Okanogan, has created apples that have a longer shelf life. A small piece of synthetic DNA is made with approximately the same letter sequence as the gene responsible for the brown discolouring of apples. As it is not exactly the same sequence and the sequence is also reversed, the plant starts a defence mechanism, comparable with a reaction to a virus. The plant prevents the brown discolouring gene from translating into the enzyme responsible for the discolouring. It is called an 'intragene' apple, as the gene is not natural but improved DNA.
Okanogan is striving to introduce the first apples as GMO on the American and Canadian market in 2013. Director, Neil Carter, has absolutely no plans to ask permission to enter the EU. "It would be unaffordable."
Wageningen University did it even more naturally. The Wageningen breeders have produced apples (variety Gala) containing the scab resistant genes from wild apples. That DNA is inserted in exactly the same way as it would be if it occurred naturally through cross-breeding.

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Photograph DigiDaan

are considered non-GMOs", declares research leader, Richard Visser, professor of plant breeding at Wageningen University. "There is after all no DNA present that would not be there naturally." Richard Visser also sees a practical problem: if varieties have the same DNA as 'ordinary' varieties, it is not possible to verify whether companies have or have not used those techniques. The EU put a similar request to a technical committee in 2007, but that committee is still waiting for the results of two studies. According to a spokesman, the committee will publish an advice this summer. It will then have to pass the European Commission and maybe even Parliament. A concept report has been circulating, but that report has been withdrawn again. It is rumoured that the committee suggested that cisgenic plants (such as apples with apple DNA) should not be subject to GMO legislation, while this is politically unfeasible. There are too many parties who consider cisgenic plants true GMOs. The multinationals belong to these parties - they do not want to limit themselves to cisgenesis, they simply want to be able to insert the best working pieces of DNA. But also the Dutch food safety institute, RIKILT, is making things difficult for breeders. In August 2010, it produced a report that cisgenic plants had to be treated in the same way as transgenic plants. The insertion of DNA using Agrobacterium could lead to 'genome disturbance' (unexpected interactions between genes in the plant) which would increase the chance that it produces allergenic substances. The Dutch parliament now wants a third study on cisgenesis.

Ten years

In Amsterdam, Herman van Bekkem, campaign manager of Greenpeace, is following the discussion with fascination. And, yes, according to him a cisgenic plant is a GMO and should be labelled as such. "We do not say this because cisgenesis would not be natural, but from the precaution principle: people should know that there are extra risks", he says as he points at the rikilt report. Van Bekkem does not know yet what to think of the reverse breeding technique or of the focused mutation that KeyGene has developed. "I am studying the subject." He cannot say anything about possible actions about crucial EU decisions. "We never do that in advance." Meanwhile, the Dutch advisory committee has to squirm to present reasonable arguments why a product is a GMO or not. President, Bastiaan Zoeteman: "It may take as long as ten years before anything changes in the rule."

Virus resistant root stocks

Some grape research institutes in Germany and France are wondering whether their grapes, cultivated on a root stock that has been genetically modified, are themselves GMOs. Grape plants are always grafted on root stocks of another variety, with better resistance against soil diseases. Ten years ago, the AIPlanta institute in Neustadt (southern Germany) developed root stocks that are resistant against grapevine fan leaf virus. The virus genes that were used are not present in the grapes themselves. At the moment, field trials are being conducted in Neustadt as well as by the French institute, INRA. The German authorities decided last year that, for the time being, grapes and wine produced on a GMO root stock must be labelled.

Passionate manager has been '**infected**' with seeds

Monique Krinkels

For over two decades, Aad van Elsen, managing director of Plantum, has been the face of the Dutch breeding and plant propagating industry to the outside world. With zest, he protects the interests of the Plantum-members and plant breeders' protection and breeders' exemption in general. This autumn, he will take his leave for early retirement, looking back on 24 years in the world of seeds.

If it is true that a cluttered desk is the mark of a genius, Aad van Elsen must be a mastermind. The spacious worktable in his office is overloaded with piles of papers, leaving scarcely room for two mugs of coffee. "It is an extremely busy time", he explains. "There are so many things that demand attention and I am hardly in my office." He had hoped to introduce his successor as managing director of Plantum, who could share the workload. "But we are still searching for a qualified candidate. I had announced that I would retire early summer, but I had to postpone it until October." But however full his diary, he is quite willing to share his experiences.

Accidental

That Aad van Elsen accepted a job in a Dutch branch organisation for agricultural seeds was purely accidental. For years, he worked abroad in developing countries as a specialist in plant pests or, more precisely, in the insects that transmit diseases from man to man. He started out in Niger and Ivory Coast, where he helped to beat the tsetse fly that transmits the so-called sleeping sickness, went to Bangladesh to strengthen the plant protection agency and then to Togo to do the same. "In Bangladesh I also worked on pest control of rats and in Togo I added the experience of protecting cassava against insects by biological control", says Aad van Elsen. "I had to return to the Netherlands in 1987, because my late wife, Winy, became seriously ill. That is why I accepted a job as Secretary-General of the NKB-VHZ. The NKB was a branch organisation for agricultural breeders and VHZ looked after the interests of the agricultural seed trade companies. At the time, they were still two separate organisations that shared a secretariat. At first, I believed it would be a temporary arrangement. After a few years, I would change jobs again, or so I believed. But I never realised that it would be so much fun. The seed branch infects you."

Uniting organisations

Within a year, the two organisations decided to merge. In 1990, the NTZ was founded in which breeding and trading companies of agricultural seeds and seed potatoes were represented. It was but the first merger in which he was involved. Uniting the industries that are focused on propagating material became one of his distinctive characteristics. In 1992, the NTZ, the branch organisation of vegetable seeds, merged with the NZP into the NVZP, and within a decade thereafter Plantum was formed. Today, almost all companies involved in breeding, tissue culture, production and trade of seeds and young plants of agricultural, vegetable and ornamental crops in the Netherlands are members. Aad van Elsen: "Only the trade in seed potatoes and the smaller flower bulb companies are not (yet) represented in Plantum." Much has changed since he started in the seed business. In 1989, there were four large players in the Netherlands. In agricultural seeds, Cebeco and VanderHave set the tone. Royal Sluis and Sluis & Groot/Zaadunie were worldwide leaders in vegetable seeds. Today, after two waves of takeovers, the majority of the seed companies are part of a multinational with a head office outside the Netherlands. "In the past, it was possible to have a meeting and take decisions instantly. The managing directors were present, so we could act quickly. Today, most members of Plantum bodies and committees have to consult their superiors before a decision can be taken. The dynamics of the discussions have changed completely."

Camaraderie

What he misses most is the feeling of comradeship. "Of course companies have always been competitors, but in the past everyone saw the benefits of cooperation and the value of collective goals and projects." Nevertheless, it is unnecessary to fear the influence of large foreign companies on the decisions of Plantum. "We have the system of one company, one vote, however large a company might be. The advantage of large companies is that they are contributing enormously to the public interest by participating in committees." It is not only the companies themselves that led to a change in attitude. "European legislation, for instance, forbids companies to cooperate in several fields to promote competition. Before that legislation came up, it was quite normal to discuss the price of certified seeds, to agree on the amount of seeds that would be produced or to compile statistics. As a branch organisation, we were involved in these matters. Now that these forms of cooperation are banned, our task has changed

Photograph Jean-Pierre Jans


Committees used
to be think tanks,
in which knowledge
was shared

The dynamics of the discussions have changed completely

fundamentally. At present, our work consists for a large part of lobbying in political circles and informing the world what the seed business does." In his view, the role of ISF has changed in the same way. "The committees used to be think tanks, in which knowledge was shared for the benefit of the whole branch. Today, there are many more opposing interests and consequently the role of those committees has changed. Moreover, there are other organisations, such as CropLife, a global federation representing eight multinational plant science companies. They are also represented at the FAO, UPOV and the OECD level so ISF is no longer the only spokesman for the international seed industry." The same applies at European level, where Plantum is also active next to ESA.

On-going discussions

What has hardly changed during the past two decades is the number of GMO-varieties grown in Europe. In the early nineties, the first varieties came on the market in the USA, but in Europe the opposition was hard to overcome. At first, it was the small activist groups that destroyed field trials of GMO-crops. The anonymous groups had names that appealed to students, such as Furious Diggers and Seething Potatoes. "But they were extremist groups", deems Aad van Elsen. "Today, we have opponents such as Greenpeace. They still do not accept the benefits of GMOs, but the discussion has become much more professional. It remains difficult, however, to use arguments when the other party is principally adverse to GMOs. You cannot argue against a belief. It has become an emotional dispute instead of carefully examining the pros and cons." He has some objections himself. "It is a new technology; therefore, we should be careful what we do. I do not doubt the food safety, but I don't like the ideas of transferring genes from one life form to another. I give up when it comes to luminous fishes with a firefly gene or salmon with antifreeze in its genome." Another on-going topic of discussion is biodiversity. It started in 1992 with the Earth Summit in Rio de Janeiro. "I believe we are on the wrong track there", Aad van Elsen stipulates. "The access to genetic material for further breeding is at stake here. The fundamental question is whether a plant belongs to a country or whether it belongs to mankind. Today, countries invest in protecting and keeping hold of their plants in the hope of earning money. It would be far better if they would offer it to breeders, especially for food crops. But even if a plant has only decorative value, why not let breeders have a go with it? Otherwise, the potential it has is just wasted." The same principle of free access also is at the heart of the discussion that has become very topical, about whether plants or genes should be patented or whether Plant Breeders' Rights should be the preferable way of protecting varieties. In the Netherlands, politicians have heated discussions on this issue. "Plant Breeders' Rights is, in my view, a perfect system in which breeders stimulate each other to further improve crops. In fact this whole discussion is a clash between cultures and of business models. Any IP system is a contract from society with the inventor and thus the fact that Europeans clash with Americans when it comes to patents has a cultural base. In the USA, it is important that you are the number one. It is something to be proud of. In Europe, it is not the done thing to stand out too much We are more convinced that live and let live is the principle to go by. On top of that, it is the business model of small- and medium-sized enterprises against the companies that have a rating at the stock markets and thus are sensible to the value of their shares. Personally I am convinced that society is better served by an open access system such as PBR with the Breeders' exemption."

Highlights

When asked what the highlights in his career are, Aad van Elsen first mentions the mergers. "Whether it was the Dutch associations, the merger between FIS and Assinsel, or the foundation of ESA, it all contributes to the progress of the industry. Of course, the ratification of UPOV 1991 was an important moment. I had only just started back then, so I was not really involved. Seed companies should be thankful to Joachim Winter, Bernard le Buanec, Peter Lange and Victor Desprez for their unrelenting effort to support breeding." Another remarkable moment was the introduction of European Breeders' Rights. "To have one system of protecting varieties in the whole European Union at a reasonable price is highly valuable." As an afterthought

Does a plant belong to a country or to mankind?

Photograph Jean-Pierre Jans

he adds: "and the prolongation of the PBR-period for potatoes to thirty years has been an important breakthrough." But he is also proud that Plantum had the courage to start the discussion about the interface between the patent system and PBR.
Aad van Elsen refuses to talk about the future of Plantum or the seed industry, as a whole. "That is up to my successor. What is important for Plantum is that my successor brings in new energy. He does not have to know much about seeds, I didn't either when I started, but he should be able to keep an overview. Plantum is just the voice of its members. Besides, our secretariat consists of people with an in-depth knowledge. For example Anke van den Hurk is the spokeswoman worldwide when it comes to biodiversity, Judith Blokland is an expert on Plant Breeders' Rights, and Sandra Poot is a specialist on phytosanitary regulations."

Sanding a boat

What his future will hold is still in hazy. Aad van Elsen looks forward to having more time for himself. "I will need time to decide what the options are and what I really want to do. It might well be that I can use my experience in another context. My main strength is that I can think out of the box, can manage an association, chair committees and know how to lobby. I would certainly consider a role in the seed industry; as I said earlier, I am absolutely infected with the seed-virus. But it would have to be a part-time commitment. I have a houseboat at one of the beautiful Dutch lakes which I would like to enjoy more than I can now, I would like to learn to play golf and I have recently acquired a 50 year old lifeboat. It needs to be refurbished completely and I look forward to doing that all by myself. Sanding that boat will certainly bring relaxation into my life."

LEDs start a revolution

Monique Krinkels

Will greenhouses still be needed in the future to grow young plants? In the Netherlands, experimenting with multi-layer production using LED (Light Emitting Diode) is in full swing. So far, with positive results. Plantlets thrive in the purple light and the energy bills have been halved. In countries where energy prices are higher, for example Africa and South America, payback time has decreased to less than one year.

Hybrid lighting increases the production of tomatoes by up to 25%

Incandescent lamps are currently being phased out by governments worldwide. The reason: these lamps transform only 5% of the energy they use into light, most of it is wasted as heat. A few years ago, the Dutch electronics giant, Philips, teamed up with Dutch growers to investigate the possibilities of LED-lighting as an alternative. In 2007, the first trials in greenhouses were conducted and a year later, Philips Horticulture presented the first products at the Horti Fair in Amsterdam, the Netherlands.

Light recipes

Choosing LED seems logical. Where traditional assimilation light, as well as TL-lights or the sun, spread a broad spectrum of wavelengths, LED lights only produce a single colour. That means that the light can be tuned exactly to the needs of the plant. Plants mainly need red and blue for photosynthesis and far-red, a colour that induces flowering, but the exact combination of colours differs per crop and the phase a plant is in. "Germination, for instance, demands a different light recipe than flowering. During the last few years, we have developed light recipes for several crops, and sometimes even for a certain variety, to optimize growing conditions", says Erik Jansen, product manager at Philips Horticulture. "The spectra can be modified to control photoperiod and growth cycle", he adds. "So it is possible to precisely guide the plants." Another major advantage is the fact that LED light produces much less heat. Therefore, the distance between lamp and plant can be quite small, which enables growers to use multi-layer systems more efficient. There are other advantages of LED lights. In the first place, LEDs do not 'burn out'. Instead, the light production decreases over time. LEDs have to be replaced when the light output drops below a certain percentage, in horticulture usually 90% (photon flux maintenance). And, whereas the traditional assimilation (fluorescent) light gives in after 10,000 hours of burning, LEDs easily produce sufficient light for over 25,000 hours (GreenPower LED Production Modules). That will compensate for the higher costs of the LED-lights, but also reduces the labour spent on replacing the lamps. Furthermore, LEDs are small, robust, reliable, and can be turned on and off instantly. The high costs per LED light unit will presumably decrease as it gains popularity. In 2008, only 7% of all the lights used worldwide were LED; in 2020 that is expected to have risen to a 75% market share.

Higher yield

The light recipes are developed in co-operation with seed companies, propagators and growers, as well as researchers from Universities. More than a hundred companies participated in establishing the perfect growing environment for the crops. So far, Philips Horticulture has developed a range of five GreenPower LED modules, mostly with a combination of colours: the Interlighting Module, the Production Module, the Research Module, the Flowering Lamp and the GreenPower LED String. In the special Research Module, a dimmer may be used so that the brightness of the lights can be reduced when needed. "Light can be administered very precisely", says Erik Jansen. In production horticulture, it is not yet possible for certain crops to replace the traditional assimilation lamps completely. For instance, in tomato and in roses, a combination is made with HID-lamps, the so-called hybrid lighting. HID, or High Intensity Discharge, is also produced by Philips in the series SON-T. Several companies are conducting field trials, for instance, The Improvement Centre, a Dutch innovation centre for greenhouse growers. "With HID lamps above tomato plants and interlighting LED modules between the lower canopies, we are able to produce 25% more tomatoes with 30% less electricity." At Marjoland, the largest rose producer in the Netherlands, trials

The red and blue LED lamps create a purple light that creates strong hardy ferns at Vitro Plus

Light Emitting Diode

The Russian scientist, Oleg Losev, discovered in the 1920s that diodes radiate light when electricity is passed through. But it took until the 1960s before LED lights were invented and only in the 1970s were LEDs developed that produce wavelengths other than red. Nowadays, the colours infrared, orange, yellow, green, blue, violet, purple and ultraviolet are available. To obtain these different colours, specific semiconductor materials are used, from gallium arsenide to produce infrared light to boron nitride to produce ultra violet. Only for broad spectrum white a different technique is used. Yellow phosphor is applied to a blue LED to convert its monochromatic light to broad-spectrum white light, similar to how a fluorescent light bulb works. It is less energy-efficient than the coloured LEDs, but white light may be necessary to enable people to assess the plants.

are also being held. Thanks to the Interlighting, up to 15% more stems have been produced.

Convinced

Tissue culture laboratory, Vitro Plus, started last year with a real production unit for multi-layer growing of its ferns. The hall looks like a futuristic spaceship, where sixteen layers of ferns in plugs thrive under the purple-looking light. Every week, 20,000 plugs are hardened here and the results are far better than with TL-lamps. According to operational manager, Ard Stoutjesdijk, the results are convincing, as a coincidental outcome is impossible with so many plants. The first advantage is the more efficient use of the space. Production has risen by 33%. Furthermore, the plants grow faster and develop better. They are stronger, which is an advantage during trade. Fides uses the LED-lights in the production of Chrysanthemum cuttings in Uganda. Reliable lamps are important to keep the mother plants growing vegetative. The trial with the LED flowering lamp has been a success. The results are similar to the traditional incandescent lamp, but at a fraction of the energy used. Electricity shortage is common in a country like Uganda, therefore Fides considers that a huge benefit.

Future

So what will the future plant propagating company look like? According to PlantLab in 's-Hertogenbosch, the Netherlands, the present day greenhouses will become obsolete. Light cannot be regulated, CO_2 and water escapes through the windows that have to be opened to control climate. PlantLab has, therefore, developed so-called Plant Production Units, closed nurseries without daylight where plants are grown under LED lights and ideal climate conditions. 'PlantParadise' they call this invention at PlantLab. This method enables growers to grow crops anywhere in the world under exactly the same conditions. Furthermore, the planning is exact, whether it concerns quality or the timing of the yields. The use of water is 90% less, there are no diseases so no pesticides are used, there is no burdening of the environment with CO_2, and the production is over three times higher than in a modern greenhouse. The researchers at PlantLab believe that, in the future, food-towers will appear in every town or village where food is produced for the local inhabitants. In their view, the outside climate should no longer play any role in food production. Mathematical models will plan exactly what the plant needs to generate the optimum results. They believe that is the only way to produce sufficient food for the world population. Last year, they succeeded in growing lettuce and potted plants in the closed units. It was expected to take some time before fruit-bearing vegetables such as tomatoes could be grown in these conditions. However, in January this year, the first tomatoes, courgettes, beans, strawberries, sweet peppers, maize and cucumbers could be harvested. The taste, quality and shelf life were perfect. PlantLab's goal is to realize the first City Nursery this year in one of the Dutch cities. The production of young plants can be integrated in it. According to Plantlab, a building of 100 x 100 metres and 10 growing layers is sufficient to supply 200 grams of fresh food 365 days per year to 100,000 citizens.

Q-bank helps to keep plants **healthy**

Harm Huttinga[1], Paul van den Boogert[2] en Hans Smolders[3]

The Netherlands is an important exporter of starting material, like seed potatoes, flower bulbs and vegetable seeds. This is largely based on the knowledge and skills to produce cultivars that fit the demands of users all over the world. The fact that Dutch starting material is free of plant pathogens is another important factor. The reference database of plant pathogens, Q-bank, is a valuable tool.

Nowadays everybody will agree with the statement that starting material for plant production should be free of pathogens. It is widely accepted that if you want to produce a healthy crop, you have to start with healthy source material, put it into a healthy environment and prevent the crop being infected from outside. When starting material is free of pathogens, evidenced by the attached export health certificate, it can be sold abroad without restrictions, because there is no risk that the importing country will be faced with unwanted pathogens.

Unique system

The Netherlands has a unique quality system in which the National Plant Protection Organisation (NPPO), the inspection services for arable crops, flower bulbs and horticulture, and also private testing laboratories, act together to augment and to secure the high quality of Dutch starting material with respect to health status. Absolute prerequisites for optimally running the quality system is the availability of i) reliable identification and detection methods and ii) collections of plant pests from which well-characterized isolates can be obtained for reference and for use as positive controls.
When the Dutch government reduced the funding of agricultural research in the last decade of the 20th century, the agrobusiness hesitated to accept the role of being the new funder of this research. This caused a lack of reliable identification and detection techniques, the slowing down of the introduction of new technologies and, last but not least, it affected the maintenance and updating of collections for plant pests which suffered a lot.

FES-program

At the end of 2005, the Dutch Ministry of Agriculture, Nature and Food Quality and the NPPO successfully applied for a grant from the Dutch Fund for Economic Structure Reinforcement (FES) in order to finance a program directed towards the strengthening of the Dutch infrastructure on plant health. A sum of € 9,000,000, to be spent in five years, became available for the following three research work packages.

Work package 1 the updating of collections of plant pests by adding new specimens to existing collections; digitalising the data of the specimens in the collections and making them accessible online through the internet.

Work package 2 determining base sequences of unique genes of regulated plant pests that can be used for modern identification and detection methods.

Work package 3 the development, validation and implementation of fast and reliable identification and detection methods.

The focus of this FES-program 'Strengthening the infrastructure for plant health' was set on four groups of regulated plant pests - insects, fungi, invasive plant species and viruses (including phytoplasmas and viroids).

Implementation

The actual situation with respect to collections of plant pests and connected databases was not clear at the beginning of the program. This made it difficult to allocate research to research organisations, based on a well-defined set of requirements in a tendering system. Therefore, it was decided to form research consortia for the pest groups under concern. All organisations actively involved in a particular field of interest were invited to join consortia in order to cooperate in the process of deciding on what research had to be done, and on which organisation was best equipped to do the research. This resulted in four consortia in which the NPPO, Inspections Services and research organisations (e.g. Wageningen University and Research Centre; CBS-KNAW Fungal Biodiversity Centre, Utrecht; Netherlands Centre for Biodiversity Naturalis, Leiden; University of Amsterdam) worked together. Each consortium was supervised by a Board of Supervisors (BoS). In regular meetings between members of the consortium and the BoS, results of research were evaluated and, if necessary, the research program was adjusted in mutual agreement in order to achieve the best possible results for the available money. This pre-competitive approach (in Dutch: 'werken onder regie') was applied for work packages 1 and 2 and the system was very successful; about € 5,500,000 was allocated in this way. It stimulated the cooperation between the partners in the consortia in a very effective way and led to an impressive amount of results of good research. Because

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Q-bank consists of well-characterised and properly documented species and strains present in collections

funding was limited, not all groups of plant pests could be covered in the program - e.g. the entomologists focussed on Tephritidae, Cerambycidae, Spodoptera and Bemisa; the mycologists worked on Phytophthora, Phoma and Colletotrichum.
The results of the research were stored in Q-bank. It comprises data of well-characterised and properly documented species and strains present in collections from which items can be obtained for further studies or use as positive controls in tests. Data is stored in a database using BioloMICS software of BioAware S.A. The database can be accessed online through the internet (www.q-bank.eu). This means that the results are accessible all over the world.
At a later stage, it was decided to also include data and collections of bacteria and nematodes in the system. Q-bank thus comprises ecological, morphological, physiological, and sequence data of items that are available in physical collections of plant pathogenic bacteria, fungi, insects, nematodes, phytoplasmas, viruses and viroids, and invasive plants.

New methods

Open tendering was used for work package 3, the development of identification and detection techniques for a total of € 2,700,000. It was remarkable that the consortia for the work packages 1 and 2 stayed united and even became larger by the joining of private laboratories.
The main focus of this work package was on making available for end users (NPPO, Inspection Services and private laboratories) new identification and detection techniques for bacteria, fungi, insects, nematodes, phytoplasmas, viroids and viruses. This includes development of new methods but also validation according to a newly developed 'Dutch validation guideline' (www.naktuinbouw.nl/en) and implementation in the laboratories of the end users. This resulted in 20 new methods.
Two other topics were addressed; i) the extraction of nucleic acid from 'difficult substrates,' like soil, and seeds; and ii) methods to determine the vitality of, for example, nematodes, and bacteria in treated seed lots. Part of the money set aside for developing methods for determining vitality of fungi, was used to determine the complete nucleotide sequence of Synchytrium endobioticum, the causal agent of the potato wart disease.
For invasive plants, a set of identification keys was developed that can be used to easily identify invasive plants. In 2011, all results of work package 3 will be included in Q-bank.
In the FES-program, 'Strengthening the infrastructure for plant health', about € 300,000 was spent on communication. Projects directed towards phytosanitary risks for entrepreneurs and people responsible for the green environment and in projects developed for educational purposes, resulted, for example, in Fytoquest (www.fytoquest.nl) and Fytocheck (www.fyto-ondernemerscheck.nl).

The future of Q-bank

From January 1st, 2011, Q-bank has been managed by the Dutch NPPO. The ambition is to develop Q-bank into an international standard for identification and reference. It should contain reliable additional information of regulated organisms (and their look-alikes) in the database and all described specimens should be present in scientifically curated collections from which they can be obtained for further use. In this way, Q-bank is supplementary to the information in EPPO diagnostic protocols. Q-bank will be unique in its identification keys of invasive plants and the possibilities of polyphasic identification.
The first important enlargement of Q-bank will be realised by adding the barcode results of the EC Framework 7-project QBOL to Q-bank. The agrobusiness has expressed interest in including the data and specimens of causal agents of quality diseases in Q-bank. Ideally, in the near future, Q-bank should be able to exist and to grow based on international funding, i.e. funding by, for example, the EC, national governments and agrobusiness.

Understanding Leads to Significant Improvements in Microcuttings

The roots of **rooting**

Geert-Jan de Klerk and Mehdi Massoumi

Cuttings produced in tissue culture can be rooted ex vitro in the same way as conventional cuttings, for example, by a dip in rooting powder. Alternatively, they can be rooted in tissue culture (in vitro) on a nutrient medium with a moderate auxin concentration. In vitro rooting often results in far better performance during acclimatization. The special conditions during in vitro rooting should be considered to achieve optimal in vitro rooting.

Rooting is a cornerstone of the horticultural industry. Some crops, in particular monocotyledons such as bulbous crops, root easily and usually do not need a special rooting treatment. Cuttings of woody plants are at the other end of the spectrum and often fail to root. Poor rooting has vast economic consequences. In conventional propagation, losses are estimated to be 10-25% with nursery crops and 5% with ornamental crops. These figures refer to survival rates and additional losses occur because of poor growth of cuttings and the need for intensive chemical protection. In micropropagation, an additional economic aspect plays a major part: rooting can be carried out in vitro or ex vitro. From the economic point of view, ex vitro rooting is preferable because in vitro rooting increases the costs per microcutting considerably. However, the choice between in vitro and ex vitro rooting depends on a complete outline of costs, including the performance after planting. The procedures for ex vitro rooting are the same as for rooting of conventional cuttings. With in vitro rooting, there are two new aspects that are usually unrecognized, namely the choice of auxin (is IBA the best auxin just as with ex vitro rooting?) and ethylene. They are discussed below.

Auxin

In the late 1920s, research on plant hormones began with the discovery of the auxin IAA by the Dutch plant physiologist, Frits Went. Soon after, it was demonstrated that auxin promotes rooting. The next findings crucial for the practical use of auxin in rooting were made in the 1930s: the discovery of IBA as an alternative for IAA, and the use of talcum powder as carrier of auxin enabling "rooting powder". Progress in fundamental research, though, was limited. Much of the research concerned the screening of newly discovered plant growth regulators and auxin analogues for their effect on rooting. A major problem for biochemical and molecular research is that only very few cells in a stem, far less than 0.1 %, are involved in the process. So when tissues are analyzed biochemically, their characteristics are swamped by the surrounding cells. A recent step forward was the discovery that rooting, just as other regeneration processes, consists of successive developmental steps. Auxin has distinctive effects in these steps. It has already been known for a long time, that auxin is required for the formation of root meristems, but inhibits their outgrowth. In apple microcuttings rooted in vitro using IBA, about half of the induced root meristems did not develop any further when IBA was not removed. The timing of the action of auxin was established in detail by giving 24-hour pulses with auxin on various days after excision of microcuttings. Thus, samples of 30 microcuttings were transferred to medium with auxin at various times after excision. Up to this transfer, they were cultured at auxin-free medium. After 24 hours at the auxin-containing medium, they were transferred back to auxin-free medium. During the 24-hour pulse, the auxin concentration in the tissue increases sharply and after the pulse it decreases to the original level within a few hours. These pulses showed that in apple microcuttings, auxin was active as a rhizogenic signal from 24-96 hours after excision. This timing was validated by pulses with the genuine anti-auxin PCIB (PCIB competes with auxin for the auxin receptor) and the cytokinin BAP (cytokinins are auxin antagonists). A summary of the timing in apple is shown in Figure 1. In Arabidopsis, mutants have been isolated for the successive steps.

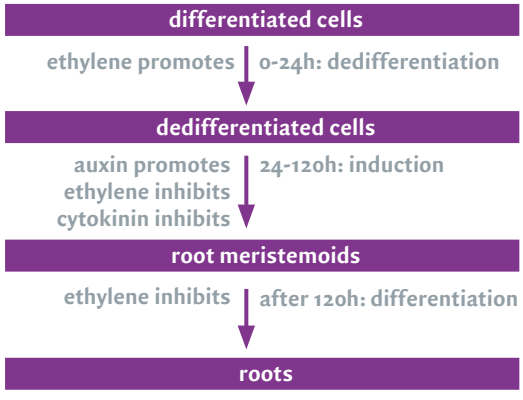


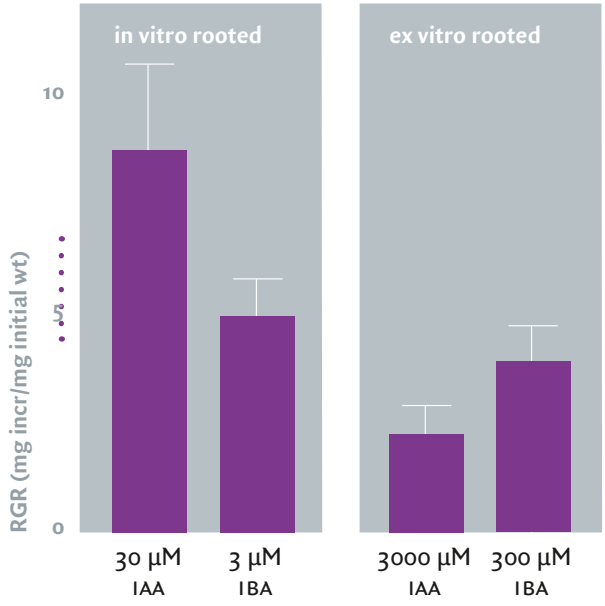
Fig. 1. Timing of the successive steps in the rooting process. The effect of plant hormones is indicated

Choice of the type of auxin

For rooting ex vitro, microcuttings are dipped in

Dr. Geert-Jan de Klerk and Mehdi Massoumi are researchers at Wageningen UR.

Fig. 2. Performance after in vitro and ex vitro rooting with IBA or IAA. For each, a range of concentrations was tested. In the bar graph, only the optimal concentrations are shown. The performance was measured as the RGR (relative growth rate)



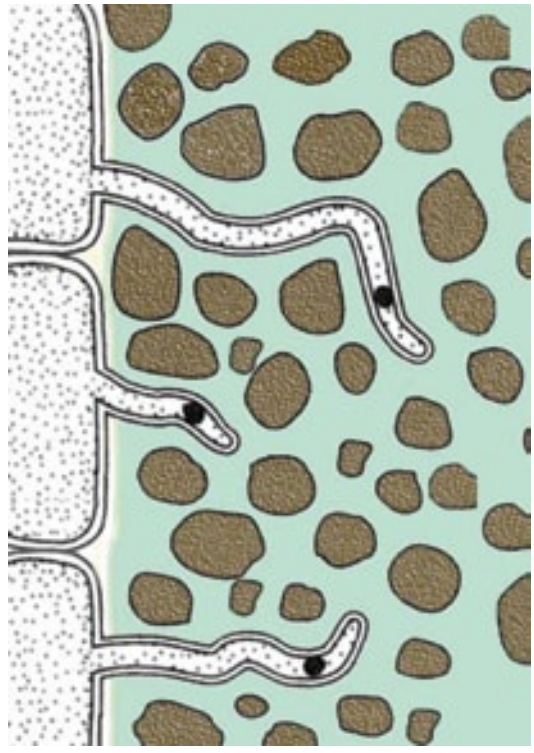


Fig. 3. Root hair that has grown in between soil particles. Root hairs formed after planting will grow in this way

rooting powder just as conventional cuttings. To the best of our knowledge, the kinetics of auxin uptake from rooting powder has never been determined. Expectedly, uptake occurs only during the first hours: auxin is rapidly metabolized by soil micro-organisms and moved away by water flow. In other procedures of ex vitro rooting, submersion (complete cuttings are submersed in auxin solution) or absorption (cuttings are placed with their basal end in an auxin solution), uptake also occurs as an early pulse. As noted above, the rhizogenic action of auxin takes place some days later, so a stable auxin like IBA should be used to keep auxin at a sufficiently high-level during this period. During in vitro rooting, on the other hand, microcuttings are cultured for a period of several days on "rooting medium". This is nutrient medium with a moderate concentration of auxin (in the µM range and not in the mM range, as used for ex vitro rooting). Auxin is taken up from the medium continuously, also during the period when it is needed for its rhizogenic action. Auxin is harmful after the meristems have been formed: it reduces root and shoot growth and promotes callus growth. Therefore, an unstable auxin like IAA that does not persist in the medium is advantageous. When the shoots are kept in the dark for the first week and are transferred to the light after that, IAA will be rapidly photo-oxidized. In this way, the persistence of IAA is minimized. Thus, on the basis of theoretical grounds, for in vitro rooting IAA may be preferable. For in vitro rooting of apple microcuttings, IAA was indeed far better than IBA. For ex vitro rooting, IBA was better (Figure 2). The rate of catabolism of IAA depends on the genotype, so with other crops IAA may be too unstable. For example, when a crop produces a high level of ROS (reactive oxygen species) at wounding (taking a cutting involves wounding), IAA may be catabolized at a high rate and an auxin that is resistant to oxidation is preferable.

Do in vitro roots function after planting in soil?

In scientific literature, there has been some debate about the functioning of in vitro roots after transfer to soil. Some researchers argue that they do not function. In vitro formed root tissues undoubtedly function poorly with respect to uptake of water and nutrients, because this depends on well-performing root hairs. Root hairs are tiny, hair-like outgrowths from surface cells of plant roots. They penetrate the soil and greatly increase the area available for the uptake of water and inorganics (Figure 3). They survive for a few days only. Root hairs are found just behind the root tip and are continuously being formed. Root hairs formed in vitro will not function after transfer to soil, since they are very vulnerable

Root hairs formed in vitro will not function after transfer to soil, since they are very vulnerable and will also not be located in between soil particles

and will also not be located in between soil particles. The advantage of in vitro formed roots is another one. When microcuttings with roots are transferred to soil, the roots appear to resume growth immediately and generate new root hairs quickly. Therefore, the roots will fully function again shortly after the transfer. In ex vitro rooting, roots still have to be initiated in soil: the new roots emerge from the shoot after more than a week, and only after that will they start to form root hairs and start to function.

Ethylene

Auxin is the main hormonal actor in rooting. Cytokinins are inhibitory but are still required but with a very low concentration. Another hormonal player is ethylene. The action of this gaseous hormone during rooting is complex. It should first be noted that auxin firmly promotes ethylene synthesis. Furthermore, ethylene accumulates in submerged tissues, thus also in the section of a stem that is placed into the medium. In plant tissues, ethylene is barely metabolized, if at all. Plants regulate endogenous ethylene levels simply by releasing it into the atmosphere. This release is blocked in submerged tissues. There are various tools available to establish the role of

Fig. 4. Various ways to inhibit or promote ethylene in tissue culture

Adddition

> Ethephon releases ethylene

Synthesis

> AVG blocks synthesis (expensive)

> ACC is a direct precursor and is metabolized to ethylene

Perception

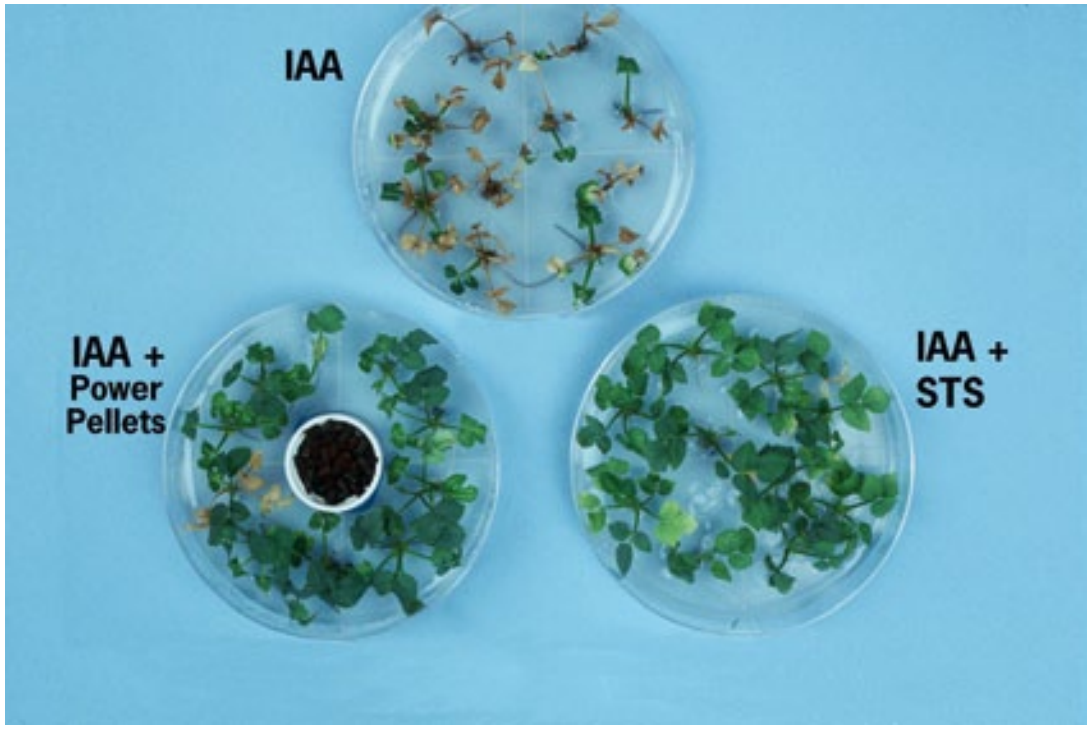
> STS (a solute) blocks perception (contains Ag which is a heavy metal)

> 1-MCP (a gas) blocks the ethylene receptor (inconvenient)

Removal from the gas-phase

> grains coated with $KMnO_4$, e.g. Power Pellets (cheap)

Fig. 5. Rose shoots rooted in vitro with IAA. The detrimental effect of ethylene was negated by adding STS (an ethylene inhibitor) or by removing ethylene from the headspace with Power Pellets. The Power Pellets are in the small vessel in the middle



ethylene (Figure 4). They have shown that ethylene is promotive during the dedifferentiation phase of the rooting process and inhibitory after that, during both the induction step and root growth. Finally, ethylene is needed for root hair formation. During in vitro rooting, the promotion of ethylene synthesis by the auxin treatment may cause problems, because ethylene accumulates in the headspace. In rose, this leads to leaf senescence (Figure 5). Senescence was prevented by adding STS to the medium, but this also resulted in poor rooting. When ethylene was removed from the headspace by $KMnO_4$, using "Power Pellets" (Ryan Instruments, Sassenheim, The Netherlands; several similar products are commercially available), senescence was inhibited. At the same time, rooting was not affected, because the Power Pellets did not remove ethylene from the tissue that was submerged in the medium, but only from the headspace. This treatment led to improved acclimatization.

Future

The results presented above are useful for growers, but do not solve the problem of recalcitrance to root. In rooting research during the past seven decades, the most promising progress about recalcitrance was not found in the rooting process itself, but in an improvement of the ability of cuttings to root. This was achieved by rejuvenation and stem elongation/etiolation. At Plant Research International, we have started research into the background of this enhancement. We are also developing an adequate system for rooting research in Arabidopsis. This allows the use of mutants and also to exploit the knowledge about the formation of lateral roots in Arabidopsis.

Breeders should **lock their doors** and be vigilant

It is only one year ago that the Anti-Infringement Bureau for Intellectual Property Rights on Plant Material (AIB) started its activities. Time to look back with director Casper van Kempen on his first year.

What are your main impressions after your first year?

"The increasing trend in the infringement of plant breeders' rights in vegetables is part of a marked global growth in intellectual property crime. Piracy and counterfeiting are no longer associated merely with luxury goods, but have invaded every economic sector. What was once a small-scale cottage industry has become a massive concern, already omnipresent and expanding rapidly. The OECD estimated the total global impact of IP infringement in 2008 at US$ 775 billion, and expects this amount to have doubled by 2015. In this respect, the vegetable sector is not alone in its fight against IP crime. The level of protection of vegetable crops, which are vulnerable to infringement, is still too low. This is partly due to the fact that, in the past, some companies did not have a clear protection policy. Many of them have now adopted a consistent protection policy, but it often takes years before the newly protected varieties take a prominent position in the commercial assortment. However, what struck me in particular, is the reluctance I often find with smaller-sized breeding companies to seek PBR protection. Somehow they have the impression that PBR is only feasible for larger companies, and that they are too small to justify the cost. In my mind, it creates an image of driving expensive cars without locks on the doors."

But is it not far too expensive for smaller breeders?

"I firmly believe the reality is often the opposite. A small or medium-sized company, which invests many years of work on a new variety, has, compared to a larger company, an even greater interest in protecting its precious assets, avoiding the situation that someone else should take it and run away with it, in all legality. It is not so easy to replace such a variety with an improved protected variety. This can be many times more difficult for small and mid-sized companies. Apart from which, the total costs for PBR are relatively low. The AIB has planned a workshop for breeders in the coming months to clearly explain the importance of seeking PBR protection, its costs, and the process of how to obtain it."

Are plant breeders' rights by themselves enough to avoid infringement?

"No, they are clearly not. It is only a starting point to protect your intellectual property right. Enforcement of that right has to follow. To use the car example again, when you buy a car, you have the papers to prove that you are the owner, but would you leave it unattended with the doors unlocked and the keys inside? I bet that if someone tried to steal it, you would not stand by idly, but you would try to find the thief and have him prosecuted. While PBR is invaluable in an infringement case, on its own it will not protect you against infringers. As rights holder, you have to enforce your rights, take action where you can and make infringement a less attractive activity. And here, AIB can help by putting together the pieces of evidence provided by its members, so that a solid case can be made against the infringer."

What else can breeders do?

Apart from PBR, I should stress that a breeding company should accompany it with other measures in order to make it more effective. Sales conditions of the breeding company should oblige the customer to pass on the contractual terms, in case the goods bought are sold on to a third party. Also, in contracts signed with the customers, it is always worthwhile including terms which remind the customer of what he is and is not authorized to do with the material bought, and may also provide sanctions in the case of non-compliance with such obligations. It is also advisable to stipulate in the sales conditions that the customer is obliged to permit the seller (right holder) access to its business premises, in order that the right holder can carry out inspections in the case of an alleged infringement. In addition to contractual terms, it is also recommended to use bag tags with a reminder for the buyer that certain acts with the material are not allowed, and constitute infringement of the IP right of the right holder. Best-in-class companies have an internal system in place which allows continuous tracking and monitoring of customers. What could explain the fact that one year you sell a large quantity of a popular variety, and the next year none? These are all extra tools in addition to PBR protection, which have also been included in the so-called Enforcement Toolkit, a reference document to help enforcement efforts of vegetable seed companies, which is being developed by ESA, with whom I collaborate closely."

Which infringement areas in the EU are you most concerned about?

"Vegetative propagation of tomatoes is a very large and growing activity, particularly in Spain and Italy, as the major producing countries in the EU. The other large infringement area is in lettuce, where Italy is a major producer. The shift away from lettuce heads towards processed lettuce has worsened the situation. The demand for processed lettuce has resulted in major growth of baby leaf lettuce, which is an attractive crop for infringement as the cost of seed is the major cost component in production."

Are there any concrete accomplishments yet?

"Obviously, the first year is full of exploring and initiating activities, and making yourself known and visible. Practical support is given to seed companies in situations where they are faced with infringement cases. AIB has now been connected to the main international enforcement platforms, as well as with the network of other anti-infringement agencies. In addition, AIB is actively supporting and contributing to the project groups that work in Italy and Spain, under the auspices of the national seed associations, on the promotion of the use of original seed. An important milestone I should mention is the establishment of the Conditioning Audit Scheme, which has been set up following a similar scheme launched by the British Society of Plant Breeders in 2004. Three leading European seed conditioning companies, Elsoms, Incotec and Suet, have signed a Cooperation Agreement with AIB, whereby the parties agreed to a protocol aiming to prevent the conditioning of illegally multiplied seeds that are protected by plant breeders' rights. This agreement, which starts with leafy salad crops, and geographically covers the entire EU plus Turkey, will give AIB an extra tool to track and trace the illegal production of seeds protected by plant breeders' rights that are being offered to the seed conditioning companies for coating and priming. It is hoped that more conditioners will join the Audit Scheme. This agreement is a good example of how chain partners can cooperate to protect IP rights, and make it more difficult for infringers to conduct their illegal business."

What concrete milestones are planned for the next 12 months?

"There are many. The Conditioning Audit Scheme, mentioned above, will become operational by 1 September. The AIB website will be launched in the coming weeks, which will include a 'hotspot' where anyone can anonymously report infringements. Variety comparison tests in lettuce are being commissioned by AIB in Italy. Written guidelines for internal procedures, based on best practices among the AIB member companies, are being developed. And the AIB will continue its investigations of infringement cases brought forward by its members to support them in taking legal action. Because, as mentioned earlier, there is no protection in the long term without active enforcement."

Sea farms enhance food production while lowering environmental pressure

Monique Krinkels

Most vegetable food and feed comes from land based farms. Only a few people in the Western world eat seaborne plants regularly. But the sea has much more to offer than an incidental delicacy such as seakale. The proteins in seaweed can become a valuable ingredient in food, as well as feed. In addition, it can be used as a raw material for several industries. The new company, Hortimare, stimulates sea farming by introducing new seaweed varieties on the market.

Seaweed contains an amazing amount of protein. Depending on the species, it can add up to 30% on dry weight basis, far more than grains, for instance. And as the demand for protein is snowballing, the product deserves attention. It is, however, not only the amount of protein that makes it an interesting crop, the quality of the protein is also far higher than in other products. "Today, proteins from soybean yields about 300 euro per tonne, while fish proteins yield 1,500 Euros", explains Job Schipper, founder of Hortimare. "Interestingly, the seaweed proteins have the same quality as fish proteins."

Rich source

But there are more food ingredients that can be extracted from seaweed. It contains alginates, a viscous gum with many applications, and sugars. Seaweed colloids (gum) can be found, for instance, in toothpaste, in hamburgers and in ice-cream. As a feed, it can partly replace soybeans and therefore lessen the burden that livestock farming places on arable land. It can also be used to replace fishmeal in fish feed. And it also has many more applications. Seaweed 'fields' around aquaculture cages could diminish the pollution that fish farming causes. In the coastal areas of Norway and Chile, huge quantities of salmon are grown in large, floating mesh cages. The cages hold the salmon, but are open to the marine environment, emitting large quantities of ammonium, nitrates and phosphates. These nutrients would be absorbed by the seaweed, preventing eutrophication of the environment and at the same time enhancing seaweed production. "It is a good example of the cradle to cradle principle. The 'waste' of the salmon production is used to produce seaweed, which can in its turn be used as fish feed." The potential is enormous. Approximately 60% (1.26 million metric tons) of the world's salmon comes from fish farms. Job Schipper estimates that the potential market of integrated aquaculture in Norway alone is an area of 500 km² resulting in 900,000 tonnes of dried seaweed.
In future, the pharmaceutical industry might be interested in seaweed ingredients as well. Analyses prove that seaweed contains substances which can be used in medicines to reduce swelling and stop bacterial growth, and it can also be used as an antioxidant or as a colouring matter for cosmetics. Another one of its uses is the production of bioplastic and biofuels. The latter looks promising. A seaweed field of 5,000 km² could produce sufficient energy for 10% of Dutch households.

Photograph: Hortimare

Two-month old Saccharina latissima, or Sea Belt, grown in Norway. The plants will reach a length of up to three metres

Primitive life form

Hortimare participates in several projects in developing new utilisations of seaweed, but the company's focus is on breeding, selecting and propagating young plants. Seaweeds are a type of algae that are attached to the bottom of the sea. Most seaweeds propagate themselves in a generative cycle which can be quite complicated. Seaweed is not a plant, but a more primitive life form called a protist, comparable to ferns. There are three types, named after their colour: green, red and brown. Seaweed has two phases in its life cycle. The sporophyte phase is the asexual, spore bearing generation of the plant, featuring diploid cells. By the process of meiosis, this sporophyte produces haploid spores. The haploid spores will then form a gametophyte generation by growing into multicellular, haploid gametophytes. These gametophytes can travel in the sea as phytoplankton or stick to a substrate. When a male and female gametophyte meet, they fuse and form a diploid zygote

Photograph: Hortimare

Laminaria digitata, or Oarweed, in the gametophyte phase (100x enlarged)

which will grow into a new generation of seaweed. "Hortimare supplies its clients with pollinated gametophytes that have developed into a small seaweed and is attached to a carrier, so that it can be transported to sea where the weeds can grow." The carriers can be either lines or nets. Selection and propagation takes place in a laboratory in Texel, one of the Dutch islands. Job Schipper has started his seaweed production with four species: Saccharina latissima, Laminaria digitata, Palmaria palmata and Ulva lactuca. Saccharina latissima is a brown seaweed, also known by the common name Sea Belt. It is lancet-shaped with wavy edges, and can grow up to four meters long. Sea Belt belongs to the largest living seaweed in the Netherlands. When Sea Belt dries, it produces a sweet, sticky material. Laminaria digitata is a thick brown leaved kelp with long fingerlike thallus, common on rocky shores. Palmaria palmata (Dulse) is a beautiful red-leaved seaweed, traditionally consumed in France, Ireland and Iceland, with a soft oyster-like taste. Ulva lactuca is an edible, green seaweed, more commonly known as sea lettuce. Job Schipper plans to add two more species to his assortment: the brown seaweed Laminaria digitata, or Oarweed, and the red seaweed Palmaria palmate, or Dulse. The latter is well known for its high mineral and vitamin content, which is comparable to vegetables. It has all the trace elements needed by humans.

Seaweed production

Hortimare can be found in the same building where the Royal Netherlands Institute for Sea Research is located. In his production unit, Job Schipper shows the large plastic tubs in which he grows his seaweed under fluoresecent light. Some tubs are filled with fully grown brown, green or red weeds, others have strings attached on which small, fluffy young weeds bob along on the artificial waves. The first task Job Schipper has set himself is to fully understand the process of propagation and to translate this to a situation outside the sea. The final goal is to obtain a position as an international acknowledged 'breeder' of seaweeds, comparable to the vegetable seed companies. "But it will take time", Job Schipper knows. "I am trying to introduce a completely new sector in the Netherlands. But it may grow to a sector with a turnover of hundreds of millions of Euros. What I am trying now is to find potential seaweed growers and companies that will develop mechanisation of this new form of farming."

Nations finally agree on access and **benefit sharing**

Anke van den Hurk

It took ten meetings of the Conference of the Parties to the Convention on Biological Diversity before the 193 parties agreed on 29 October 2010 in Nagoya, Japan. The Protocol on Access and Benefit Sharing will be open for signature until 1 February 2012 at the United Nations Headquarters in New York. The agreement covers all ecosystems, species, and genetic resources.

A new binding framework agreement on access and benefit sharing was agreed upon in Nagoya. To ensure that the Nagoya Protocol on access and benefit sharing (ABS) works though, national rules and regulations should be elaborated and implemented. Moreover, national focal points and competent authorities should be identified. The ABS tool of the International Treaty on Plant Genetic Resources for Food and Agriculture (IT PGRFA) with the Standard Material Transfer Agreement, which is exempted from the Nagoya Protocol, is a useful and workable tool creating a level playing field for all breeders, and it contributes to food security. The standard contract of the IT PGRFA should, therefore, be expanded to all breeding activities of all crops. As in the IT PGRFA, the breeders' exemption can and should be firmly recognized as an important tool for benefit sharing. At this stage, there is no need for further multilateral systems for the breeding sector. On the contrary, the focus on a new multilateral system may work counterproductively in the establishment of national rules and regulations. Last but not least, innovation, commercialization and trade should not be disrupted by checkpoints and/or certificates of compliance.

Expectations of the breeding sector

The adoption of the Nagoya Protocol finalizes a long and difficult negotiation process on access and benefit sharing. The Nagoya Protocol is a framework that needs further elaboration to make ABS work in practice. The following elements of the Nagoya Protocol are important for the breeding sector. First of all, it is good that the scope of the Protocol does not make any reference to retroactivity. However, it would have been better if retroactivity had been explicitly excluded, as proposed by the developed countries. No retroactivity implies that the Protocol only applies for accessions that are obtained after the Protocol comes into force and national rules and regulations are in place. The recognition of the fact that special ABS frameworks that are developed or already exist are exempt from the Protocol is very important for the breeding sector. This means that the International Treaty on Plant genetic resources, in particular the multilateral system with the Standard Material Transfer Agreement (SMTA), is excluded from the access and benefit sharing rules of the Nagoya Protocol.

Importance of national ABS rules

According to the Convention on Biological Diversity (CBD), a user is obliged to obtain prior informed consent (PIC) and mutually agreed terms (MAT) before genetic resources can be used. To negotiate PIC and MAT, it is important that national ABS rules and regulations are drafted. Furthermore, it should be clear what the National Focal Points are, that can assist users in establishing PIC and MAT, and the Competent National Authorities that are authorized to establish PIC and MAT. For the breeding sector, it is important that the status of the IT PGRFA is also clarified and it should be made clear which the responsible national competent authority is for the IT PGRFA. Only if the national implementation is realized might the ABS Protocol work and plant breeders may be able to establish agreements. For the breeding sector, it is important to have one agreement including both PIC and MAT. A breeder should know from the start of the breeding research what he is getting into, as the breeding process is long, 10-15 years, and expensive. The recognition of the need for expeditious access to genetic resources, such as plant pathogens and pests in article 8(b), in cases of present or imminent emergencies is very important. This should allow plant breeders to continue their important efforts in the breeding of resistances against those and prevent yield losses.

Compliance

As indicated above, users are required to obtain PIC and MAT. To prove that these are obtained, providers are required to supply the users with a certificate of compliance. Furthermore, countries are requested to establish at least one checkpoint to take care of compliance with PIC and MAT. It is clear that compliance should be organized in an appropriate manner. However, it is important that the implementation is not going to disrupt innovation, delay or even stop commercialization and/or limit trade. This means that (a) checkpoint(s) should be selected in an appropriate manner and that the no-show of a certificate of compliance does not

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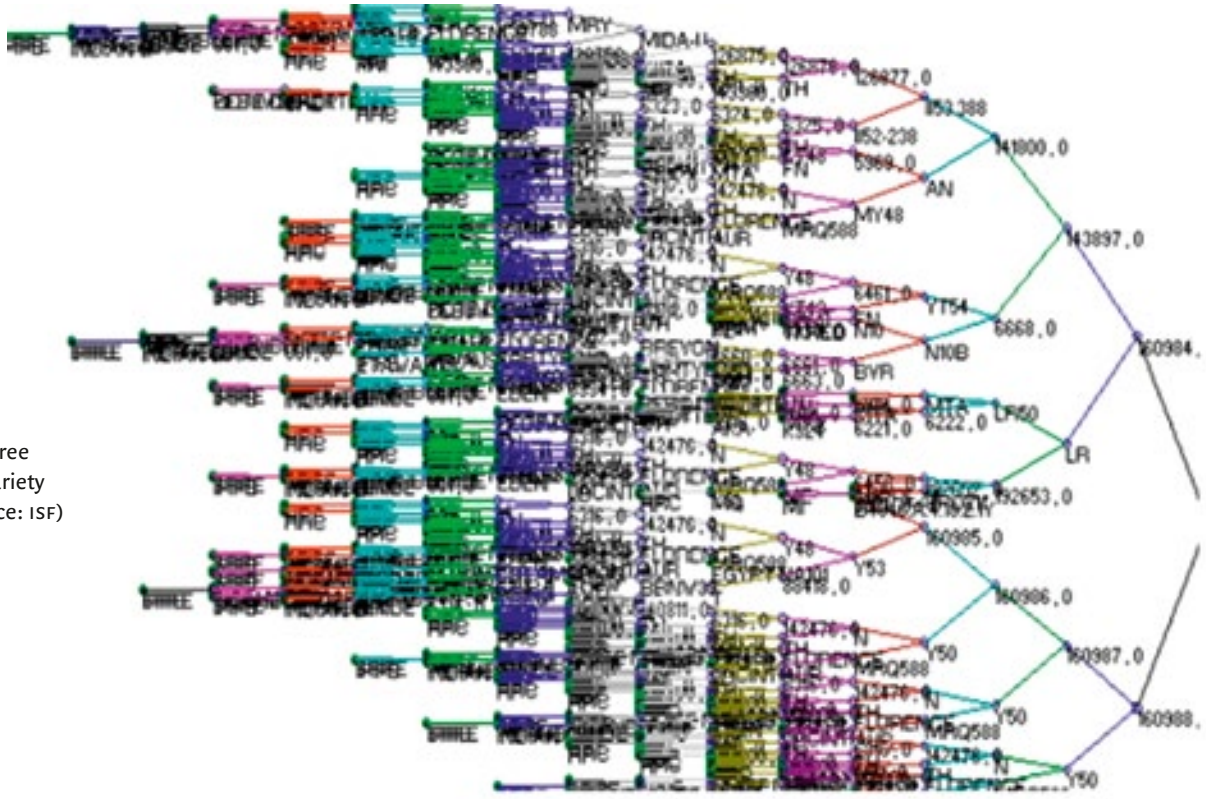

Figure 1. Pedigree of the wheat variety Sonalika (source: ISF)

mean that the user is not compliant. With regard to the latter, it is important to notice that most genetic resources used and commercialized will not require a certificate of compliance due to: the Breeders' exemption; receipt of the genetic resources before establishment and ratification of the Nagoya Protocol; receipt of genetic resources from countries that do not need PIC and MAT and, therefore, not provide a certificate of compliance. Another important aspect with regard to compliance for plant breeders is demonstrated in figure 1. A plant variety is developed through different crosses that may be quite numerous as the figure demonstrates. First of all, most genetic resources used may not have a certificate of compliance, which implies that control is hard, if not impossible. How many certificates are required for one plant variety developed? Secondly, the user may have so many contract agreements that follow-up is difficult, and may also lead to costs being too high. If in figure 1, for example, 15 of the genetic resources are linked to PIC and MAT, this will result in 15 times benefit sharing.

New multilateral mechanism

The breeding sector has big concerns about the proposal of a Global Multilateral Benefit Sharing Mechanism (GMBSM), as explained in article 10, and does not see a need for such a system for the plant breeding sector. The scope of the GMBSM is not clear and may be overlapping with existing scope of the Nagoya protocol. Moreover, reading the Protocol may lead to new negotiations, which may have a negative impact on the implementation of the Nagoya Protocol, and the development of national rules and regulations. The fact that for the breeding sector there are already two multilateral systems in place - the Global Crop Diversity Trust, and the multilateral system of the IT PGRFA - is an additional argument for no further multilateral systems.

Workable system

As indicated above the ABS obligations according to the Nagoya Protocol may not fit plant breeding. The benefit sharing mechanism of the IT PGRFA is well suited to the plant breeding sector. As genetic resources can be obtained through a standard contract, the continuous flow of genetic resources is guaranteed. So, a breeder knows from the beginning what the benefit sharing obligations are. Furthermore, the standard contract deals with the typical aspects of plant breeding such as the breeders' exemption and the multiple use of plant genetic resources. The standard contract also provides of a level playing field, all users, be they large companies, small companies or individuals, be they from developing or developed countries, will work with the same contract, based on turnover. In conclusion, the breeders sector, therefore, recommends extending the multilateral system of the IT PGRFA for all plant breeding activities, for all crops and all uses. This can be a good example of how ABS can be realized for a specific sector in practice.

EU reviews Plant Health **Regime**

John van Ruiten

The EU is reviewing its Plant health Regime. In 2014, it is expected that a new Plant Health Law will replace the current directive. Both the Commission and stakeholders want to improve the phytosanitary strategies and inspection systems. Key words are 'more prevention, better controls and rapid action'.

In 2009, the EU Commission started the process of evaluation and modernisation of the Common Plant Health Regime (CPHR), and its plant health directive 2000/29. This directive prescribes among other things protective phytosanitary measures against the introduction and spread of harmful organisms within the EU. Plant passport requirements form the basis of the marketing and movement of healthy seeds and plants.

Official authority

The plant passport is an official document, usually provided by the supplier, but always issued under the responsibility of the official phytosanitary authority. The passport can have many different shapes and forms, as long as the required information is clearly presented on the label or document that is accompanying the shipment. A plant passport states that the plants or seeds mentioned on the passport come from a production location that has been inspected and that the material has been found free of listed harmful organisms. Around 300 pathogens are regulated in this phytosanitary directive.

The (young) plants of the majority of species marketed, and some important seed crops, require plant passports when marketed. In the event that no harmful organisms are regarded as relevant for the species, a plant passport is not required. The directive also establishes requirements for the import of plants and seeds into the EU from outside countries. Basically, the requirements are the same as for trade within the EU. Once imported in one of the 27 member states, the material can be moved or marketed with plant passports throughout the EU. The origin of the material (country of production) has to be declared on the plant passport.

Results evaluation

On 28 September 2010, during a conference held in Brussels, the FCEC consortium that carried out the evaluation, presented the results and also recommendations were made to be included in the forthcoming proposals for changing and renewal of the EU plant health law. Stakeholders (authorities, companies, organisations, inspection bodies, NGOS) were invited to discuss the results. All stakeholders were invited to present their comments, not only during the conference, but also afterwards. Many of them took that opportunity. For interested readers: all documents, reports, comments and minutes of meetings can be found on DG SANCO website (http://ec.europa.eu/food/plant/strategy/evaluation_CPHR).
At the moment (spring 2011), the EU Commission is preparing draft proposals to change the legislation. Soon it is expected that a so-called Impact Assessment will also be presented, together with the proposals. It is then up to the Member States and all stakeholders to comment. Finally, and that is expected to happen in 2012, the Commission will present a proposal for a new Plant Health Law to the European Parliament. It is to be expected that new legislation will come into force in 2014 or 2015.

Most important topics

Roughly ten 'big' items can be seen as the most important topics under consideration for change. In general, it can be concluded from all comments that these review items are supported, as important points, by the majority of stakeholders.
The inclusion of Invasive Alien Species in the CPHR is proposed, not only plant pathogens, but also organisms that can have a wider environmental or economical impact. There is a relationship with biodiversity.
The prevention of the natural spread of organisms must be more explicitly included in the regulation. It is proposed to include co-financing measures in a solidarity fund to assist member states to carry out adequate programmes to monitor and control this spread.
It has been suggested introducing the concept of RNQPs into the legislation. Regulated Non Quarantine Pests are (normally) present and sometimes fairly widespread in the countries and their im-

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pact (damage) on crop cultivation is usually well known. The most important pathway for spread of RNQPs is seeds and plants. Therefore, it is suggested to investigate if a closer relationship with the existing EU marketing regulations is possible. One of the aims is also to divide the long list of harmful organisms (HOs, over 300 pathogens) into groups of priority. Some of these might then become RNQPs. Perhaps an automatic zero tolerance norm would not be applicable for RNQPs.
A very important point for the EU is to improve the prevention of new pathogens entering the EU. It has been recommended strengthening the measures for imports of seeds and plants. It has been suggested intensifying controls (and tests), introducing post-entry inspections for certain items and improving the collaboration with countries of origin. The inspectors working in border inspection posts of the EU must be better trained and a further EU harmonization of these controls is strongly advised.
It has been recommended significantly improving monitoring and surveillance within the EU, in order to detect possible outbreaks earlier and then to take immediate action (eradication or containment; forward and backward tracing).
It is recognised that the EU must take more immediate and better emergency action. Early detection, better and more rapid information exchange between member states and the development of contingency plans are necessary. Stakeholders must be encouraged to notify the official bodies earlier if harmful organisms are found.
Although the plant passport system is functioning quite well in general, it is advisable to review and/or revise some elements. The number of species requiring passports is to be reviewed (possibly it will be broadened to include all propagating material - seeds and plants for planting - of all species), the stage of the marketing chain to which plant passports should apply is under discussion (maybe no passports to final non-professional end-users) and also the form and content of the document is to be debated. Possibly an 'EU plant Health logo/mark' on labels or documents accompanying the material is a solution to reduce administrative costs and at the same time identifying products coming from registered, inspected and "clean" production locations.
The system of protected zones (ZP) in the EU will be reviewed and it has been suggested to possibly move towards Pest Free Areas (according to ISPM 4). This would give more clarity and uniformity in the application. It would also take away differences and distorted competition felt between private operators inside and outside the ZP.
It has been recommended that the EU needs to improve research and development, scientific advice, diagnostic tools, and training of inspectors (capacity building).
Finally, the EU wants to develop incentives for effective implementation. It has been suggested forming a 'solidarity fund' to be able to partly cover both the costs of eradication programmes and to cover loss of destroyed material. The EU is also looking for better opportunities for public-private cooperation on phytosanitary issues. Co-financing and/or cost-responsibility sharing (bonus-malus systems) are to be discussed.

Seed Treatment Has Become Seed Enhancement

Growing is so much more than sowing

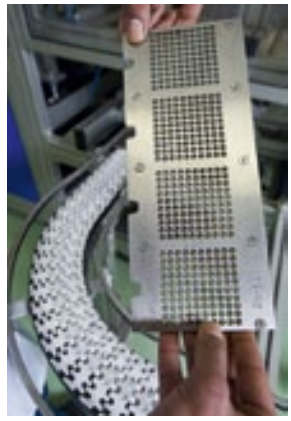
Hajo P. Strik

The productivity of seed is being influenced mainly by three elements; the genetic property, the quality of the seeds and the production circumstances. Incotec is contributing their added values to the crucial part of the production chain between genetic properties and production circumstances. The company does not call it seed treatment but seed enhancement, as it is by far more elaborate than just adding a protective layer.

When visiting Incotec's headquarters in Enkhuizen, the Netherlands it crosses one's mind that growing is so much more than sowing. Although seed treatment has already been taking place for many decades, in order to decrease low or bad germination and improve the harvest, it was raised to a professional level when Incotec started its specialized techniques. Growers no longer depended solely on soil quality, weather conditions and germination figures based upon tests. It was quite revolutionary, at the time, to be able to provide each single seed with its own mini quantity of protection against pests and diseases, or even its individual fertilizer. The Incotec pelleting techniques developed further and further, and multi-layers of seed enhancement products were attributed. Other seed treatment methods were introduced in order to improve germination or refining the seedlots, from cleansing of pollution through to sorting according to size and image of the seeds. Illustrative as a landmark for the changing attitude towards these techniques is the statement that Incotec prefers not to talk about seed treatment, but about seed enhancement. Because it is by far more elaborate than just adding a protective layer.

Improved

It may be too optimistic a suggestion that seeds treated by Incotec are always improved. Incotec's skilled technicians and researchers are no magicians and are not able to change a lot of bad quality seed into a high quality batch. But, yes, there are ways to improve the efficacy and the results in the very delicate phase from seed to young plant. It all depends on the natural properties of the seed and how they can be stimulated or improved. Bob Legro, Global Research Director of Incotec, explains. "There are so many influentials that we are only just starting to explore nearly unimaginable possibilities. Gene expression can be affected by external impulses , as one knows, but how specific can that be? Take, for example, the recent tests by Plantlab with innovative LED technology from Philips, which show that choosing the right light colour in the various growth stages can dramatically improve young plants to grow. The first results show that indeed one can speak of a 'light recipe'. Bob Legro also emphasises that the productivity of seed is influenced mainly by three elements; the genetic property, the quality of the plant starting material (mostly seed) and the production circumstances. "Incotec is contributing added values to the crucial part of the production chain between genetic properties and production circumstances." Nowadays, the company is focusing more and more on seed or growing stimulating characteristics of a natural kind, calling them 'active agents', which are preferably of natural origin, but not exclusively so. Natural indicators, like warning signals when plants are attacked by bacteria or other enemies, have been considered up to now as natural reactions or defending properties. "But", says General Manager, Henk Satter, "we are now looking from the original perspective, the other-way-around. By adding that specific pheromone, or other chemical warning indicated, into an extra layer or coating of the seed, that seed is signalling in advance that it already has a defensive property against the hostile environment."



Vaccination for seeds

"The more we know about natural defence systems and properties, the more we are able to provide seeds with an almost personal armour", adds Bob Legro. "You can compare it with the preventive vaccination for young children. You know in advance that there are certain disease threats, especially in childhood. Once they grow up, the danger is normally minimized. We are now able to provide seeds with a comparable protection. Though one never knows if there has been a real threat, the fact that the protection is present, is very reassuring for growers."
An example of the latest achievement in seed enhancement for field crops is GeniusCoat for cereals. It is a very innovative new seed treatment method that optimizes the the plant's ability to better use the available nutrients and thus increases yield potential. This new product underlines the aim of maximizing

By adding a pheromone into the coating, the seed has an almost personal armour

crop yield, despite the decreasing global resources available for crop production. It is a sustainable solution and a valuable addition to field crop additives. Impressive results are being achieved in a market that traditionally thought of large amounts of seeds to make profits. An average yield no longer suffices. Paying attention to the crops is a logical step forward in the shift towards end product results. Henk Satter explains: "Moving further into the product chain means that seed companies can plan further ahead. Normally, the life-cycle of a variety is much shorter than the long term goals of continuity for the whole product range. By using their own breeding expertise and our additional knowledge of seed improving, the seed companies can really offer added value to the growers. Growers are often heavily dependent on consultants, specialised in regional crops and with knowledge of soil and other natural influentials. I think that, in the near future, Incotec can offer an added value for those consultants. Our findings may contribute to higher yield and fewer losses." Closer to the grower also means closer to the end-consumer and thus retail and supermarkets. "Indeed, we have contacts with those influentials", says Henk Satter, without mentioning specific companies or organisations. "It can be a product asset for companies to be able to claim that their vegetables or flowers have been produced with minimal use of fertilizer, because the individual seeds have the exact amount in their coating. It is more and more important that sowing really means growing. Looking to the near future and the need for food, it is essential that seeds are no longer wasted. Still, there is much to gain because some traditional ways of sowing in developing countries must be changed. Sowing expensive seeds by throwing it around manually is not uncommon". The recent FOA statements underline his words, but improving growing needs focusing on already somewhat developed countries, like Brazil and booming China.

Recently, Incotec has adjusted the organization itself in order to optimize the service and is thus able to support and deliver on specific demands. Four specialized business areas are designated: Field Crops, Vegetables, Ornamentals and Analytical Services. Each business has its own R&D programme with highly qualified and extremely specialized technicians, who are experts on a particular seed type or technology. The sales and marketing activities are also organised per business area. In this way, each customer has his or her own contact; someone who is familiar with all the ins and outs of the market, who speaks their language and is aware of all the issues relevant to the specialized area. Acquisition of new technologies and business partners is also an on-going process. The recent announcement of the intended purchase of AgriCoat, LLC, located in Soledad, California, is an example of Incotec's drive to innovate. AgriCoat is a specialized Californian seed technology company with a strong position in the organic market, which includes a special and unique seed treatment product, Natural II.

Mission statement

Jan Willem Breukink, CEO of Incotec International, mentions the mission statement of Incotec. "We want Incotec to be recognized as the world leader in creating and delivering sustainable added value to seeds and vegetative genetic materials, to support the increasing need for healthy food and to make our contribution to the welfare of the world population." It is aiming high, but everybody within Incotec is supporting that goal. It is not a marketing credo or a sales argument, but really a topic that is mentally present in the company. Whether one speaks to the operators at the impressive machinery or to analysts in the hi-tech laboratory; everywhere one meets the engagement and motivation to underline that ambition. That 'active ingredient' is the invisible, but very present growing incentive of Incotec.

Synthetic **seeds** streamline storage and transport

Clayton Debiasi and Joyce Meire Ferreira

Modern agriculture has an important role to meet the market needs, offering the end consumer products of superior quality and the success of production starts, among other things, with the use of good quality seedlings.

SBW do Brazil is focussing more and more on cutting edge biotechnology techniques, characterized as a tool capable of more efficient and streamlined production, reducing production costs and offering superior quality to the seedlings consumer market. Among these biotechnology techniques, the status of somatic embryogenesis is gaining prominence and is becoming a major focus of development for the company.

Somatic embryogenesis

Today, somatic embryogenesis, within the world of plant tissue culture, is considered as one of the biotechnology tools with the highest potential for use in bio-factories for the production of seedlings worldwide, enabling significant gains in overall productivity while reducing costs, especially those related to labour costs, which are a significant component of the end price of a seedling.
This is a technique that allows the regeneration of a plant from somatic tissues under the effect of special culture media and under controlled temperature, humidity, light and irradiance conditions. These somatic tissues, often leaf segments or even floral devices, among others, generate under those conditions embryogenic cells that are able to develop into embryos after a series of biochemical, physiological and morphological changes, and in turn mature and become a complete plant.
Some of the phases will repeat themselves during the development of a somatic embryo and even within this second type, there are variations depending on the plant type.
In somatic embryos of dicots plants, as in the case of coffee, one can observe the stages: globular, heart, torpedo and cotyledonary, whereas in somatic embryos of monocots, such as sugarcane, the following stages have been verified: globular, coleoptiles and scutellum.

High propagation potential

The application of this technique allows one to obtain a large quantity of genetically identical plants, coupled with the high propagation potential, which allows the production of nursery plants, after selection of matrix material that presents a specific genetic pattern for more resistance to pests, diseases or even showing particular morphology (size and functional architecture) of interest, for example.
Another point to note is the fact that the technique of somatic embryogenesis, unlike conventional micro propagation of plants in vitro, promotes and facilitates the development and implementation of automation systems during the production process, especially when thinking about using large-scale commercial production.
This prospect of automating the somatic embryogenesis production process makes this junction of technology extremely attractive to the sector, envisioning productive efficiency coupled with cost reduction. In addition to the points already raised, there is the fact that in vitro production of genetically identical plants through embryogenesis and associated with automation process systems, can lead to synchronism of the production of thousands of embryos of several species and even optimize the use of space, reduce cultivation time and achieve low rates of somaclonal variants.

Numerous species

In vitro plants from somatic embryogenesis have been obtained for numerous species, such as carrot, tomato, peach palm, banana, cocoa, oil palm, orchids, lily, açai, citrus, coffee, pine and cane sugar. All species are likely to be subjected to the technique of somatic embryogenesis, but the added value and benefit that one can get, steer us towards the possibility of producing seedlings of species that are recalcitrant or problematic when applying conventional techniques of micro propagation in vitro, for example most of the woody crops (hardwood and semi hardwood) of the forestry group.
Another important point refers to the technique of association with the somatic embryogenesis of synthetic seeds. In this case, it enables the production of the so-called artificial seeds, which are nothing more than the somatic embryos covered in a layer of sodium alginate, often enriched with elements that nourish and promote growth and further development of embryos, just as it happens with a natural seed (zygotic embryo + endosperm).

Cryopreservation

So far, both the somatic cells, as the embryos them-

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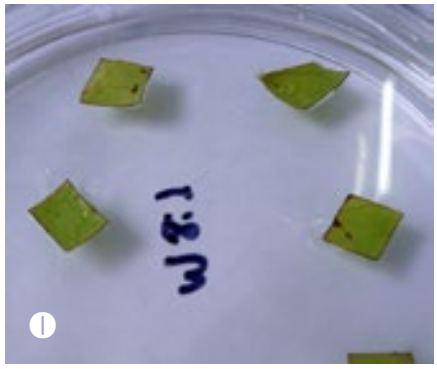
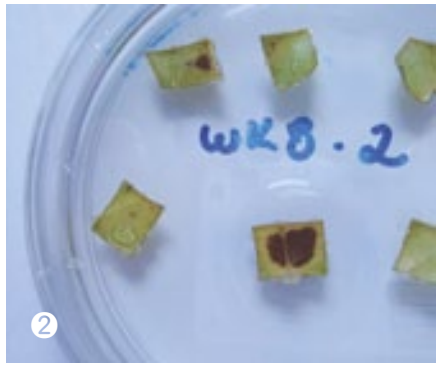




1 Leaves segments in induction medium
2 Primary callus formation
3 Embryogenic callus formation
4 Embryogenic callus multiplication
5 Somatic embryos formation
6 Somatic embryos formation
7 Somatic embryos germination
8 Plantlets rooting
9 Plantlets

selves can be kept at low temperatures, enabling long term storage and subsequent rescue in order to meet any production demands. This method is called cryopreservation - working with the use of liquid nitrogen at -1950C, enables the maintenance of viable materials. SBW of Brazil has already successfully applied this technology of somatic embryogenesis for in vitro plant propagation of species such as coffee and pine. In the case of coffee, the process starts from the use of leaf fragments of mature plants, previously selected in vitro where they form cells with embryogenic capacity. These embryogenic cells in turn are likely to be multiplied by the thousands and then induced to become somatic embryos. Having been able to form the embryos, it will be possible for them to mature, taking them up to the germination stage and, consequently, the formation of a complete plant, which can later be transplanted to the soil.
As for production of embryos of Pinus, the technique involves specific technological refinement and must be more precise than referring to the need to emulate various natural stages of plant development. The technique has proved to be interesting and, furthermore, the response of this species to the induction of somatic embryos has proven extremely effective and is already a commercial reality for SBW of Brazil. Moreover, the company is also investing in development and/or optimization of protocols for somatic embryogenesis for other species of commercial interest and demand, such as sugarcane, Phalaenopsis and lily, in addition to also seeking to achieve progress in automation systems of the complementary somatic embryogenesis process.
In summary, SBW of Brazil believes that one of the most efficient forms of production in vitro culture plants by means of tissue culture techniques is one that aggregates the production of somatic embryos and their subsequent encapsulation, applying both to some automated system, and thus making it possible to produce synthetic seeds, which can be stored and transported around the world in a dynamic and facilitated way.

The Ultimate Showpiece of Dutch Horticulture

Floriade 2012 gives a glimpse into **the future**

Guus Wijchman

Next April, the gates of the 2012 Floriade will open for a period of six months. By means of this world expo, Dutch horticulture will give an impression of the role played by this industry in today's society. At least as important is the glimpse into the future as presented to the general public. A future that is best described as the age of innovation and sustainability.

In 2012, the Netherlands will organize the horticultural world expo for the sixth time. This expo takes place every ten years under the name Floriade. In the intervening years, other countries invite the world to an international horticultural event that lasts six months.
The Floriade is organized by the Nederlandse Tuinbouwraad (Netherlands Horticulture Council). In Venlo, this takes place through cooperation by Venlo with five other surrounding municipalities. The Floriade is the ultimate showpiece of Dutch horticulture. In this case, horticulture includes floristry, the fruit, veg and mushroom industry, the tree nursery sector, the flower bulb sector, as well as the landscape contractors and gardeners. They each represent themselves in a 66-hectare thematic exhibition park.

Largest horticultural area in Europe

Previously, Floriade always took place in the west of the country. In itself, that is not so surprising. After all, this is not just the area of the Netherlands where most people live, meaning the most potential visitors, but also the area where well-known centres of ornamental plant cultivation are situated, such as the Westland, Boskoop, De Bollenstreek (Bulb Region) and Aalsmeer. However, the area around Venlo is at least as important for horticulture. Just across the German border, this is exactly the same. The horticultural companies in the Venlo region and the German state of North Rhine-Westphalia together form the largest unbroken horticultural area in Europe. The fact that this is divided by a border is becoming less important in the European Union. There is an increase in contact and trade back and forth. One of the examples that appeals to one's imagination is the new Rhein-Maas auction in the German town of Herongen, less than 14 km distance from the Floriade park in Venlo. Rhein-Maas was created as a result of a joint venture between the Venlo branch of the Dutch FloraHolland flower auction and two German floriculture auctions. Since October 2010 onwards, there have been eight joint auction clocks running. Asserted solely by the presence of all those Dutch and German horticultural businesses, choosing Venlo as the Floriade city for 2012 is completely understandable. The potential number of visitors also undoubtedly helps. 30 million consumers live

Artist ompression of Villa Flora

Building site of Villa Flora: futuristic use of technology to built eco-friendly

in this area, within a maximum travelling distance of two hours. Over half of these live in the previously mentioned state of North Rhine-Westphalia.

Horticulture and quality of life

Floriade 2012 is set up around the following central theme: 'Be part of the theatre in nature, get closer to the quality of life'. In itself, this theme is an invitation to the public to come to the Floriade and experience the wonder and power of nature. Visitors discover how important nature is for the quality of their lives. Furthermore, a visit to the Floriade makes them aware, more than ever before, of the fact that man is truly connected to nature. At the same time, this horticultural world expo demonstrates the importance of horticulture for the quality of life; not just today, but also in the future. At Floriade 2012, great attention is paid, for

example, to soil independent cultivation. Growing flowers and vegetables without soil does not make any demands on the use of our soil. It is also a solution for using water extremely efficiently. Of course, every country does have to be careful with its water consumption, but this is even more important for those parts of the world with a chronic water shortage. In those areas, this method of production can contribute to a more sustainable society. An integral part of quality of life is flavour. The

Floriade 2012 boosts the intercultural and interdisciplinary dialogue

The initiators behind Floriade 2012 wish to do more than just introduce millions of people between April and October next year to the role of horticulture and greenery in today's society. The event has instigated a series of Floriade dialogues, for example, dialogues that discuss the global food issue and other major subjects of the 21st century, in which the central question is how horticulture plays an important part in these. To that purpose, Floriade sought cooperation with, amongst others, the Food and Agriculture Organization (FAO) of the United Nations. The FAO supplies experts that will shed light on these issues, using their expertise. Apart from scientists, politicians and representatives of trade and industry will take part in these dialogues. The main focus of these dialogues is the fact that they are intercultural and interdisciplinary.

The first dialogue took place in November 2009 at the Wageningen University, Netherlands and discussed the necessity for green structural plans in urban green space management. The second one took place in June 2010 at the World Expo in Shanghai. On that occasion, subjects such as water and nutrient reuse in closed circuits, water efficiency, sustainable agricultural and horticultural ecosystems and water-related infrastructure systems in cities came up for discussion. In October of the same year, experts from all over the world once again discussed the subject 'water efficiency and innovation in green and food production' at the Wageningen University.

A fourth dialogue is programmed for October this year. The topic for that one will be product technology and agro-logistics. The fifth, a month later, discusses the global changes in food behaviour. Those changes are discussed from two different points of view. First, the participants in this dialogue will discuss the question how people can feed themselves better and more healthily. The other perspective concerns the consequences for the planet when the world population, because of the increase in prosperity, makes increasingly higher demands on food and, for example, starts eating considerably more meat.

The final meeting session will be held during Floriade 2012, premiering a symbiosis on structures of the Liveable City, both as a product and a result of an International World Exhibition.

organised fruit and veg growers in the Netherlands concentrate a major part of their Floriade entry upon this. However, that is only part of the story, because that entry links flavour to confidence. More than ever, today's consumers want to able to be confident that produce with a good flavour is produced in a way that warrants their trust. For the planting of fruit trees at Floriade 2012, a lot of thought has been given to worldwide climate changes. When the climate changes, well-known varieties may, all of a sudden, prove to be less suitable. For that reason, Floriade 2012 deliberately shows the old genetics alongside the new ones. After all, plant breeders will have to supply a solution to this problem. Much also depends on scientific research. It is, therefore, no wonder that there is close collaboration between Floriade 2012 and the Wageningen University (WUR), the university in the Netherlands that specifically focuses on the theme 'a healthy food and living environment'. For WUR, the world horticultural expo presents a unique opportunity to ensure all sorts of developments that were initiated by this university, become known about literally all over the world. Examples will be seen at Floriade 2012, but this will be expressed much more during the dialogues that will be organized before and during the exhibition (see box).

How horticulture will develop in the future will be shown at Floriade 2012 by means of five underlying themes. 'Relax & Heal' represents man's wellbeing, 'Green Engine' stands for the economic value of horticulture and sustainability, 'Education & Innovation' provides an idea of the innovative strength of Dutch horticulture, linked to education, and 'Environment' more or less speaks for itself, because without giving attention to our environment, life has no quality and there is also no future for horticulture. Finally, 'World Show Stage' includes all cultural events organised by Floriade 2012 and is aimed at contributing to the spiritual wellbeing of the visitors.

Cradle to Cradle

The connecting thread between these themes is the Cradle to Cradle philosophy of Michael Braungart and William McDonough. They assume that there is no such thing as waste. According to them, everything that is considered to be waste by most people is the basis for new products. They speak of an endless chain in which people design and manufacture products, all with the certainty that these ultimately yield new products or are given back to biological or technical cycles. The Cradle to Cradle philosophy is not just the basis for Floriade 2012, but also applies to the development of the area outside this. The Venlo region claims to be the first region in the world to embrace this philosophy. Cradle to Cradle certainly also applies to what will happen to the exhibition park after Floriade 2012 has

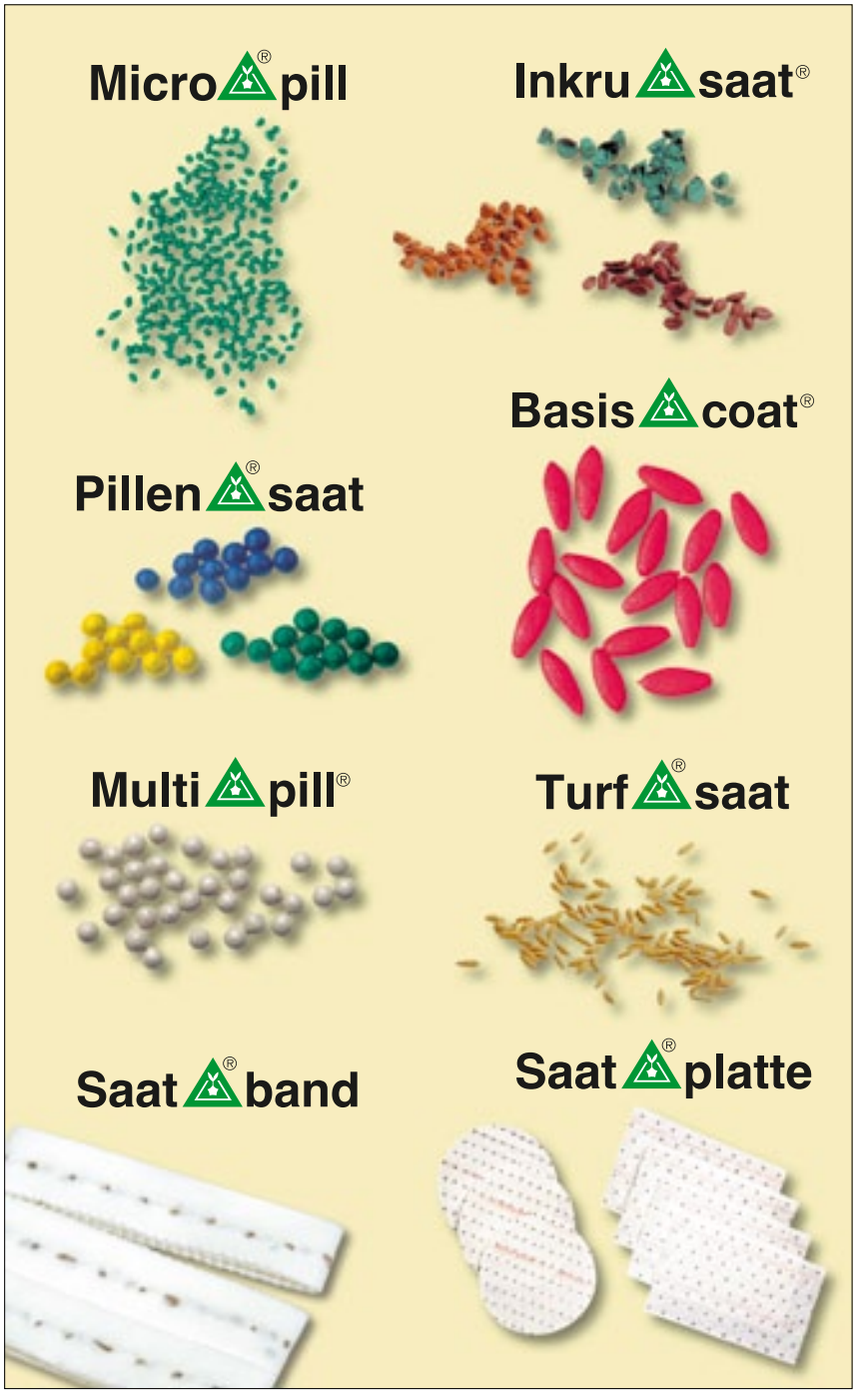
The horticultural companies in the Venlo region and the German state of North Rhine-Westphalia together form the largest unbroken horticultural area in Europe

finished. As soon as the gates close, the park will lose its unique function as being the green showcase where Dutch horticulture presents itself once every ten years. However, the park will be largely maintained. At a later stage, the park will house a high-quality industrial estate, the Venlo GreenPark. High-quality because few industrial estates in the world have green surroundings like this from the very start. In future, the two iconic buildings of Floriade 2012 will be the iconic heart of GreenPark Venlo. These are the InnovaToren (InnovaTower) and Villa Flora.

The greenest office building

The 70 metre high InnovaToren will welcome all visitors to Floriade 2012, like an ultramodern Arc de Triomphe. As soon as this event has finished in October 2012, several leading companies in GreenPark Venlo will move into the twelve floors of this tower. Villa Flora is an impressive glass building of over thirty metres high, which will soon house the constantly varying indoor exhibitions in the field of flowers and plants. In Villa Flora, Dutch horticulture will not just show how innovative and progressive this industry is, but the building itself also has a striking appearance in all respects. It combines all state-of-the-art environmental technologies and is, for that reason alone, a landmark of sustainability. This also expresses the cradle-to-cradle starting points without exception. After the 2012 Floriade has finished, Villa Flora will be known as the greenest office building in the Netherlands.

Seed at its best



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