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Looking at and beyond the here and now of the potato industry worldwide

The Netherlands and Japan are seeking collaboration for the digitisation of potato cultivation

During a virtual Digitalisation trade mission to Japan recently, within the framework of SMART Agriculture, robotisation and automation in potato cultivation were zoomed in on, among other things. With almost six hundred participants from the Netherlands and Japan, this digitisation mission, the largest online trade mission to an individual country from the Netherlands, attracted a great deal of interest.

After the well-attended session 'Developments towards a Data-driven Agriculture for Potato Production', Willemien van Asselt, the Coordinator for International Relations and Cooperation at the Top Sector Agri & Food, concluded that collaboration is important for the Netherlands and Japan. 'We can learn from each other. That's why I hope that it will not be a one-off session, but that this collaboration will continue'.

Inspiring the next generation

The session on data-driven agriculture for the cultivation of potatoes is part of the well-attended Smart Agriculture programme of the trade mission. During the livestream, three Japanese and three Dutch experts were given time to explain developments and challenges in data-driven agriculture. Moderator Rick van de Zedde, who is Senior Scientist & Business Developer for Phenomics & Automation at Wageningen University & Research (WUR), started the meeting with a problem the industry is facing in Japan: the number of farmers, while the average age of this occupational group is increasing. The labour force in Hokkaido, the region where 80 per cent of Japan's potato production takes place, is also declining. 'To solve the declining yield and labour shortage, we must not

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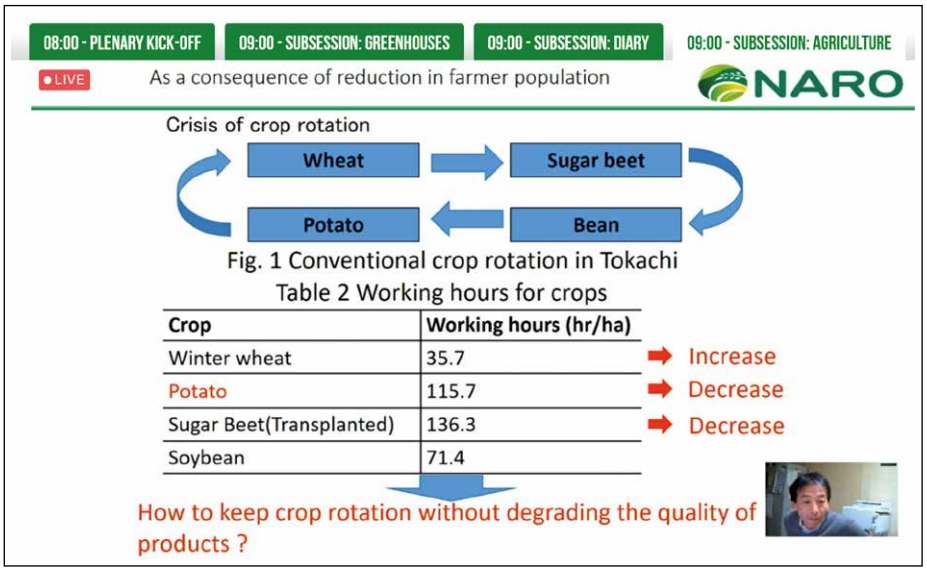


Noriyuki Murakami from the Agricultural Research Institute of Japan says that growers are less inclined to grow crops that require longer working hours, such as potatoes and sugar beet.

only understand and improve the quality of the potato itself, but also launch high-tech solutions for potato cultivation,' Van de Zedde says. 'The bottom line is that being a farmer is not such an attractive job for the younger generation any more. With artificial intelligence (AI), robots and impressive tools, we can inspire the next generation of farmers and show them that it's interesting to be a high-tech, data-driven grower. The general approach of this virtual trade mission is that the Netherlands and Japan can complement each other well in that respect. 'Our agronomic knowledge is very useful to achieve a strong efficiency boost in Japan, while Japanese high-tech is very interesting for our precision agriculture', says the moderator.

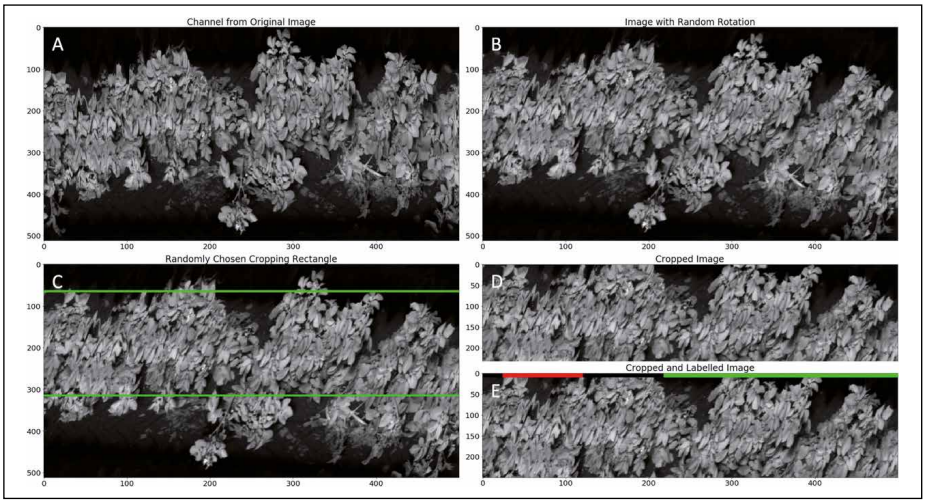
Information technology provides solutions

Dr Noriyuki Murakami of NARO, Japan's agricultural research institute, confirms that in order to tackle the problem posed by the decline in the number of farmers, help is needed from the technological perspective. 'In Hokkaido, crop rotation is very important in order to preserve the soil condition and protect the soil at the same time, growers are less inclined to grow crops that require longer working hours, such as potatoes and sugar beet. The question now is, how can we maintain crop rotation without affecting the quality of the products. The solution for this must be sought in information technology', says Murakami. Another challenge he sees for both the Japanese and Dutch agricultural sectors is the limited physical space, which requires high productivity to be able to compete on the world market. The demand for labour-saving and unmanned agricultural work that entails an increase in the scale of farming on Hokkaido also creates an urgent need for practical applications of smart agriculture, according to Murakami.

'Collaboration between Dutch and Japanese researchers is therefore important', is his conclusion.

Detecting diseases earlier

Murakami's NARO as well as the organisations and companies represented during this session are working, either in (international) collaboration of independently, on the digitisation of potato cultivation. The session continued with the projects and developments they are currently working on, including hyperspectral images, autonomous navigation, data management aspects and electrical impedance. Dr Gerrit Polder, WUR researcher in Computer Vision & Plant Phenotyping, talks about the detection of virus diseases in seed potatoes by using hyperspectral images and deep learning. 'The aim is to detect diseases as early as possible, even before they become symptomatic and we, as humans, can also detect them. With spectral cameras it's possible to find diseases earlier, because cameras can pick up subtle changes that provide information about the status of the plant,' explains Polder. Dr Satoshi Wada of the RIKEN Center for Advanced Photonics is involved in photonic sensors. 'Our optical technologies are applied to various measurements in agriculture, and their application to potatoes and in monitoring soil conditions when growing potatoes is also possible,' says Wada. RIKEN will investigate these soil



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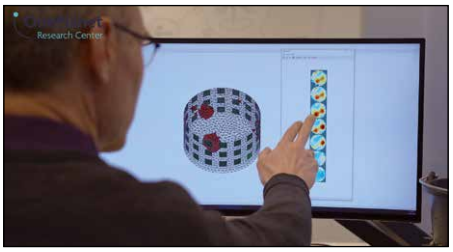

With electric impedance tomography, we can create images of potatoes developing in the ground. 'We're currently taking measurements in a bucket', says Jan Willem de Wit. 'The first results of a prototype that's used in the field are promising.'

conditions within a project under the Moonshot R&D programme, launched by the Japanese government to stimulate disruptive innovations that address societal challenges. 'What you see here are really new high-tech technologies that will now be used for agriculture and that will give an impetus to data-driven farming', is the enthusiastic reaction of moderator Van de Zedde to this project. He is curious about which soil properties RIKEN is going to measure. 'We want to know more about the micro-organisms living in the soil, investigate and measure the materials they produce and deliver to the plant. Our technology, with optical fibres that are directly put into the ground, can measure this detailed data,' says Wada.

Automation with communication systems

In this session, which focuses on reflecting the development towards data-driven potato growing, the RIKEN researcher is not the first nor the last speaker to talk about data. Van de Zedde wonders aloud how you can store all the produced data that wireless devices send to the cloud and how you can do something useful with it. This involves companies such as NTT Data, the data communication branch of the Japanese Nippon Telegraph and Telephone Corporation (NTT) Group. To overcome the limitations of the existing communication systems, NTT is working on a new communication infrastructure: the innovative optical and wireless network (IOWN). With this new network, NTT aims to, among other things, to realise a control centre for agriculture that controls hundreds of agricultural machines at the same time. 'We've already succeeded in achieving the stable and smooth self-steering of agricultural machinery with the help of this technology', says R&D Manager Takuya Murayama. In his presentation, he also introduced NTT's other smart agriculture initiatives: 'Our R&D is focused on fully automating agriculture. In addition to the work on the farm, decisions must also be automated.' A practical example that Murayama mentioned here is determining the optimal time and quantity for applying fertilisers. 'Traditionally, farmers decide this from experience, but we want to automate this decision-making process with AI. We have technologies to determine the optimal fertilisation time and quantity on the basis of drone images', explains the R&D manager.

Registering underground tuber development

When reducing fertilisers, the possibility of registering tuber development in the ground with electrical impedance could also be useful, says Jan Willem de Wit, Electronic System Engineer at OnePlanet Research Center, in turn. In his video presentation, he answers the question 'What if we could see crops growing in the ground?'. 'With robotic machines scanning fields, we can reduce the amount of fertiliser and water and increase yields', he says. 'With electric impedance tomography, we can create images of potatoes developing in the ground. In this technique, already known in agriculture, different algorithms are used to obtain information about the development of the potatoes and the structure of the roots, which tell a lot about the health of the plant. By keeping a close eye on the plants, you can adjust the amount of water and fertiliser more precisely', De Wit explains. For carrying out more research into different soil types and conditions, the option for OnePlanet to do research in the Netherlands with WUR, and in Japan with NARO is a good one. 'We're currently taking measurements in a bucket. First we connect the electronics to the bucket, then we bury the potatoes at a random spot in the bucket and then we carry out a measurement. Based on this data, we use and optimise algorithms to find the potatoes and produce 3D images that we can compare with the actual position of the potatoes in the bucket', describes De Wit. 'The first results of a prototype used in the field are promising, but now we need autonomous machines that can scan entire rows of potatoes', he continues. In this collaboration, the Japanese expertise in robotics can therefore take this project to the next level. 'The possibilities with this are endless. When growers can look into the ground, they'll find many useful applications', concludes the Electronic System Engineer enthusiastically. Moderator Van de Zedde summarises the technique as 'a fine contribution to the understanding of plants.'

Sharing data in a standardised way

The sixth speaker of the session is Peter van der Vlugt, General Manager of the Kubota Innovation Center Europe and Chairman of the Agricultural Industry Electronics Foundation (AEF), which strives, among other things, to build synergy between manufacturers of agricultural machinery. 'Farmers and contractors expect machines to work reliably. As a trade association for interoperability and digitalisation of agricultural machinery, AEF has safe and securely connected

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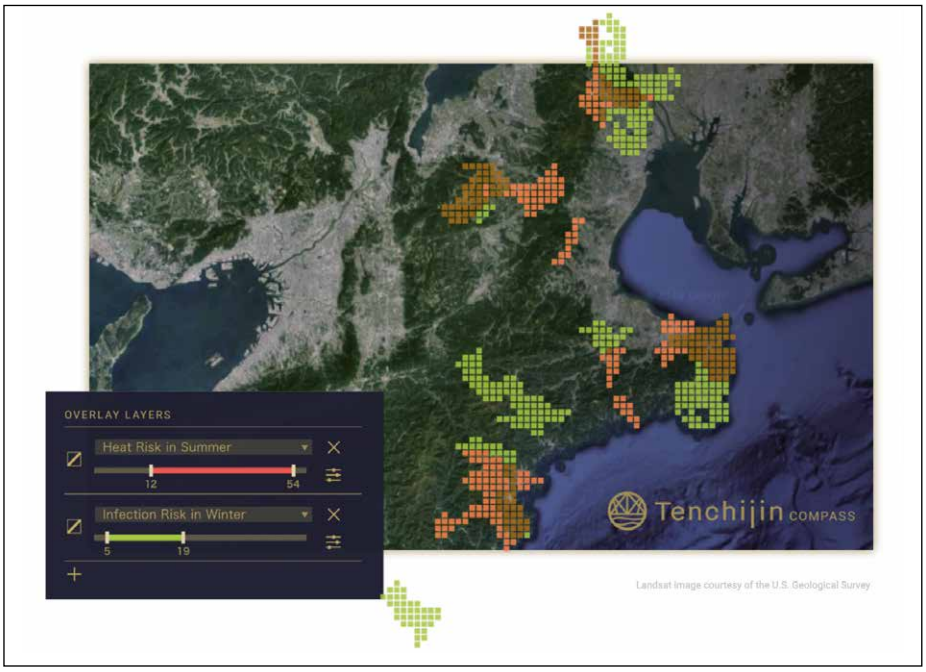

Start-up Tenchijin combines public data with satellite data to find suitable land or crops and identify the risks of pests and insects.

agricultural machines as its objective', Van der Vlugt explains. 'We need to be able to share weather data, sensor data from the field, and sensor information from machines. Ultimately, you want to combine all the data into a decision-support system, and you need communication standards to do this. As an industry, we need to work together to determine the format of data sharing, we need to develop some kind of service architecture to be able to share data in a secure and reliable way', says the AEF president. The initiative for this comes not only from the industry itself, the European Commission is also stimulating the digital economy. 'There's a lot of money available to work on this as an industry. With funding, but also with laws and regulations, the committee aims to ensure that this digital economy is created. In the Netherlands, there's government funding and support for projects such as Precision Farming 4.0 and Transition To A Data-Driven Agriculture (TTADDA), for example through the Top Sectors', Van der Vlugt outlines the government support for these initiatives. And so the Top Sector Agri & Food is once again the subject of the conversation. 'I'm convinced that, with these kinds of projects we can help the sector and innovate together in the potato chain, but I know that COVID-19 won't make it any easier', concludes Van Asselt, Coordinator of International Relations and Cooperation.

Looking for the cultivation location with agri and space tech

It is not only the Corona crisis that is having an impact on agriculture in the world. 'Climate change is also having a significant impact on productivity in agriculture. Yields are expected to decline by 10 to 25 percent due to shifts in suitable crop cultivation environments, changes in the spread of pests, and the increasing frequency of natural disasters. By 2050, 74 percent of the current potato plots in the UK, for example, will be unsuitable for the cultivation of potatoes', Tenchijin's Yuhei Urabe told Potato World magazine during a one-on-one video interview, referring to a 2019 report by the British organisation The Climate Coalition. Tenchijin, one of the Japanese participants in the trade mission, is a start-up of the Japanese space agency JAXA and combines knowledge from agri-tech and space-tech to analyse fields and the environment with the help of satellite data and AI. 'It's one of our missions to support farmers in adapting their activities to climate change. We offer three solutions for this: we support growers by finding suitable land, choosing suitable crops, and identifying the risks of pests and insects. The latter is especially important now that climate change is shifting the trend in the risk of pests and insects', Urabe says. To this end, Tenchijin combines various public data, such as information about the soil and the land ownership of the Japanese government and research institutions, with satellite data related to the environment, such as the temperature and the amount of sunshine and rain. 'We're involved in various activities with key players in the agro-business, such as Zespri Fresh Produce and the Japanese rice distributor Shinmei', says Urabe. 'For us, the most suitable customer is a global distributor who is looking for the best place to grow a crop. If a customer tells us that his potato variety needs a specific type of weather and specific soil characteristics, we can help find suitable land', he concludes invitingly. ●

Zindziwe Janse