June 2022
Volume CXXIV Issue No. 1482

IHS Markit® now a part of S&P Global

International Sugar Journal

FOCUS: Sugar beet production – cultivar development, disease and weed control, ICUMSA 45

internationalsugarjournal.com

The quest for resilience – future-proofing sugar beet varieties

Rob van Tetering – CEO SESVanderHave, Belgium

Introduction

Today, agriculture faces enormous challenges. The world population has exploded and is still growing; increased food production, food security and energy are all competing for critical demands. Land, energy, and water use add complexity to the equation. Climate change simply accelerates and amplifies the pressures, with stricter legislation on the use of plant protection, plant nutrition and genetic technologies. The need to reconcile more sustainable agriculture with the pressure to guarantee food supply is imperative for many countries and is captured in the Farm-to-Fork strategy and the Common Agricultural Policy (CAP) of the European Union, or the US Farm Bill.

To make this agro-ecological transition happen, at SESVanderHave, we integrate these competing needs into our R&D pipeline to design and deliver new sugar beet varieties, tested extensively in dedicated field trial platforms to verify natural field performance. To achieve this goal, we continuously invest to keep our R&D capacity at the forefront of our industry and ensure it is in tune and anticipating such trends. Therefore, state-of-the-art breeding technologies, big data analyses, bioinformatics, use of remote sensing technologies and good, old-fashioned field work are key.

Our main target is delivering new sugar beet varieties with higher yields, a smaller environmental footprint and higher resistance to pests and diseases such as Cercospora leaf spot, beet cyst nematode, virus yellows, syndrome 'basses richesses' and many more. **The next generation of sugar beet varieties will also have to be robust**, adapted to multiple environmental stresses like drought, saline and heat, while resilient enough to deliver yield under lower input regimes (e.g. nitrogen).

Our R&D department will play a crucial role in our ability to deliver innovative, robust and resilient varieties and solutions against many of these threats. Future solutions will need to combine strong genetics, crop protection and agronomic measures.

Coping with climate change

Water shortage is expected to become one of the significant issues for agriculture. Climate change causes more extreme weather conditions with more intense and extended periods of heat and drought impacting yields and food security globally. The unpredictability of climate events and their increased frequency makes it imperative to breed varieties that can cope with everything nature throws at them. Enabling growers to choose varieties that can tolerate water shortage is pivotal. Our sugar beets can already deliver this trait. Equally, breeding for severe heat complements breeding for drought since beet stop growing above 35°C. Water demand for the crop is highest in summer, as soon as the ground is covered, and peaks in July and August. Despite these dual threats, SESVanderHave's breeding strategies are now beginning to show concrete and measurable results. Given the growing frequency of water stress experienced in recent campaigns, this demonstrates the importance of a forward-facing breeding programme to foresee and address these threats.

Unfortunately, there is no 'major gene miracle solution' because the plant's strategy to drought will always depend on the type of drought encountered and how it adapts to its wider environment. Furthermore, drought tolerance is a highly complex physiological trait that involves multiple mechanisms in the plant and, therefore, potentially numerous genes: modification of the rooting system, the leaf surface and the stomatal opening mechanism are just a few examples. Nevertheless, to alleviate the effects of drought, plants have developed strategies which we can complement with our breeding strategies and practical adaptations to agronomic practice and seed technologies.

Under moderate water stress, the maintenance of leaf growth promotes photosynthesis and therefore yield. Conversely, under more severe and prolonged drought conditions, this leads to high evapotranspiration, depleting the plant's water reserve, making it more difficult for the plant to survive, let alone thrive.

During breeding, we consider the overall response of plants facing water deficits in each environment. For hybrids to deliver yields, they need a high level of transpiration, so we will have to find a trade-off between protection and productivity.

This criterion has always been considered during the breeding process using SESVanderHave's dedicated testing platforms across Europe. Today, we have expanded our testing network. As a result, we can more **reliably screen all our genetics for drought tolerance** to create new, more robust and resilient varieties to assess the response to drought of more potential new varieties.

Root-knot nematodes

In addition to drought, SESVanderHave also wants to focus on diseases that affect the sugar beet or, in the case of root-knot nematodes, the other crops in the rotation so growers can maintain the commercial and technical benefit of a mixed crop rotation. Biodiversity is central to sustainable agriculture, so we can disrupt weeds, pests and diseases in our crops and extend our crops' durability.

Remote sensing – Sense of Field

In 2016, SESVanderHave and VITO started working together on several drone-based phenotyping projects for disease monitoring, including the BELSPO-funded BEETPHEN project. Recently SESVanderHave, VITO and Biometris (a spin-off of the University of Wageningen) started a collaborative project called 'Sense of Field' which is supported by VLAIO (Vlaams Agentschap Innoveren & Ondernemen). SESVanderHave already has a large set of data containing genetic, genomic and phenotypic information from numerous years of field trials in different environments. With the help of remote sensing technologies such as drones, weather stations and soil probes in the field, SESVanderHave experts can identify precisely what is driving genetic performance between sowing and harvest. This means we build algorithms that model the performance of individual genetics to accelerate selection. SESVanderHave can use methodologies such as genomic selection to predict what type of sugar beet they should develop for a particular market while considering factors such as heat and drought.

The Sense of Field project aims is to combine data obtained from weather stations, soil sensors and UAV imaging in genomic selection models to integrate environmental data into our prediction models. These insights will be applied to genomic selection models to increase yield performance and environmental adaptability of the SESVanderHave product portfolio. This data-driven predictive breeding approach will provide the required insights to face climate change related challenges during the following decades.

In December 2021, SESVanderHave launched the variety **REDUKTO** in the Netherlands. This **variety combines beet cyst nematode resistance with very strong root-knot nematode resistance**. REDUKTO reduces the root-knot nematode populations to levels similar to what can be reached with black fallow without the use of chemicals and without the disadvantages of the techniques mentioned above. Appropriate use of this root-knot nematode-resistant variety in the rotation greatly reduces the potential impact on sensitive crops, helps to sustain rotations, and preserves farmers' incomes.

Root-knot nematodes are a specific group of nematodes belonging to the Meloidogyne species. Amongst them, we find *Meloidogyne chitwoodi* and *Meloidogyne fallax*. Both are considered quarantine organisms, subject to particular regulations. Many valuable agricultural and horticultural crops, such as potatoes and carrots, are root-knot nematode sensitive. Detection of basic plant material or damage to commercial crops leads to high economic losses. A broad host plant range, including conventional sugar beet and a significant variation of weeds, makes it difficult to control them. Currently, available control options include black fallow, flooding and the use of nematicides. Black fallow strongly reduces the nematode populations but requires chemical weed control or several mechanical weed control passages that harm the environment. Non-cropped fields are sensitive to erosion and don't provide an income for the farmer. Flooding is another efficient control method but requires flat fields, a local water source, is costly (3000 €/ha) and impacts soil structure. Nematicides have limited efficacy as they just postpone population development, and they can heavily impact soil life.

Syndrome basses richesses (SBR)

Climate change, combined with reduced access to crop protection, will increase new and existing biotic threats and new, more exotic ones. These will have a massive impact on breeders, growers, and processors across Europe. An example of such a threat is the development of the 'Syndrome Basses Richesses' or shortly SBR.

The development of genetic solutions against these threats requires an extensive genetic library to draw from. Fortunately, SESVanderHave's extensive genetic portfolio gives us plenty of choices and has allowed us to offer the first genetic solution to SBR. The **variety FITIS** was registered in Germany in February 2021 **and combines beet cyst nematode resistance with strong tolerance to 'Syndrome Basses Richesses'**.

SBR is caused by two bacteria transmitted by a planthopper vector (*Pentastiridius leporinus*). The disease is known for reducing sugar content by up to 5% absolute and root yield by 25%. Therefore, SBR is a real threat to the continuity of sugar beet growing in infected regions such as Germany and Switzerland.

The reduced availability of plant protection products in combination with climate change will lead to more direct and indirect damage caused by insects. One example is the resurgence in Germany of the 'Syndrome Basses Richesses' (SBR), caused by pathogens transmitted by leafhoppers.

Virus Yellows

Since the NNI ban, virus yellows (VY) have become a major challenge in many growing regions in the North-West of Europe. Varieties with significant VY tolerance are not yet available. It is highly challenging as VY disease comprises at least four viruses (BYV, BMYV, BChV and BMtV) and at least 3 airborne vectors. Resistances to all viruses must be combined to provide a durable solution.

Over the last decade, SESVanderHave anticipated the threat, being one of the first to start breeding for VY before a NNI ban was even considered. However, investment in our research capacities in virus yellows, their vectors and a range of methodologies detection tools, phenotyping platforms, virus production capacities and academic collaborations show the complexity and scale of the challenge.

We combine this approach with our broad germplasm base. We have tested the behaviour of several thousand of SESVanderHave accessions in the field, and greenhouse. Several sources of resistance have been identified, which continue to be integrated into our commercial breeding programs.

We should be able to deliver **our first VY tolerant varieties in 2024**. We advocate **combining them with other control measures** to extend their durability to create an integrated solution against VY (genetic, agronomic and chemistry). High yielding varieties with a higher level of tolerance coming from a dedicated VY breeding program will arrive in a second phase.

Sustainability & resilient varieties

To conclude, many of these traits overlap; whilst we can breed for a single target, in nature and on the farm, we all acknowledge that a broader, more resilient approach will be necessary for the future. Nowadays, farmers are facing more and more pressure from multiple severe threats (CLS, VY, drought, fuel and fertilizers price, etc.), driven by climate change and political demands to reduce the use of chemicals, fertilizers, fossil energy or water. This is a major difference compared to the past. The, when a new disease broke out once every decade, plant protection products were more numerous and effective in a much more predictable and controlled environment.

With the cost of discovering and registering new crop protection products diminishing every year, the importance of breeding solutions is apparent to all and a challenge everyone at SESVanderHave is embracing.

For the beet sugar industry, which needs to secure raw material supply and deal with increased competitiveness of other crops, this has significant consequences:

- There is no single solution to a threat that is 'in essence', multiple. The institutes and the industry must promote **a more integrated approach** that exploits genetics, crop management and the next generation of plant protection products. As part of this new approach, breeding investment is essential to deliver more resilient crop varieties

- Today, variety trials networks focus on evaluating yield and particular pest & disease traits in highly controlled and optimized environments. We are working closely with the sugar factories and institutes/officials to look more holistically, monitor for new threats and work with us to develop integrated solutions that combine durability, resilience and above all, profitability for all. Doing so will ensure a **robust low input crop**, which has become a must in this new and challenging context.

Many challenges lie ahead for the sugar beet crop for all stakeholders in our sector. At SESVanderHave, we have the tools, the creativity and above all, the team to tackle many of them.

Flavie: a new kind of collaborative project set up by five plant breeders

Flavie is a new kind of collaborative project that aims to provide an answer to the challenge faced by the French sugar beet industry. Flavie is a voluntary process that brings together five of the largest seed producers in the French market: Betaseed, Florimond Desprez, KWS, DLF Beet Seed and SESVanderHave. The Flavie project is an integral part of PNRI and focuses on genetic solutions. In addition to the work carried out by each plant breeder over several years, the Flavie project pools everyone's experiences, resulting in an unprecedented research capacity. The aim is to determine the yield potential of varieties tolerant to yellowing after inoculation.

In 2021, observations were carried out in six trial plots comprising 1800 microplots, and the behaviour of the hybrids was analysed in the presence of three viruses. The methodology developed in the context of Flavie meets all the partners' requirements. It makes it possible to identify how each type of genetic material behaves in the presence of each virus.

