IIRB

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Advancing Sugar Beet in a Dynamic Environment

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ABSTRACTS OF POSTERS

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Poster presentations
1 Agricultural Engineering

1.0 TILL ROSE, FINN GROßMANN, HENNING KAGE
Kiel University, Agronomy and Crop Science Group, Hermann-Rodewald-Str. 9, D - 24118 Kiel

QUANTIFYING FUNCTIONAL YIELD COMPONENTS IN SUGAR BEET GENOTYPES USING A HIGH-THROUGHPUT SPECTRAL REMOTE SENSING WORKFLOW

Future progress in sugar beet breeding and crop management requires a deeper understanding of physiological processes driving yield across environments. Conventional field phenotyping is constrained by low throughput and labor-intensive measurements, especially for traits such as leaf area index (LAI). To address this, we developed a high-throughput workflow combining UAV-borne multispectral imagery, environmental data, and harvest measurements to quantify functional yield components in sugar beet.

The workflow enabled robust estimation of LAI, radiation interception efficiency (RIE), radiation use efficiency (RUE), harvest index (HI), and sugar harvest index (Sugar HI). A calibrated multispectral model predicted LAI with high accuracy in an independent dataset (R^2 = 0.93, MAE = 0.3 m^2 m^{-2}), and dynamic LAI trajectories allowed precise calculation of seasonal radiation interception. Across three large-scale genotype trials (171 genotypes, two irrigation levels, 1352 plots) in Germany and Italy, cumulative effective radiation interception was strongly correlated with total dry matter production (R^2 = 0.81).

Variance decomposition showed that sugar yield variation was mainly explained by source-related traits: RIE under non-irrigated conditions (0.65) and RUE under irrigation (0.46). Allocation traits (HI and Sugar HI) contributed only marginally. These findings highlight the predominance of source limitation in sugar beet yield formation across environments.

1.1 JULIA MÜLLER[1], JONAS BÖMER[1], DIRK KOOPS[1], LASSE KLINGBEIL[2], CLEMENS BECKER[3], FRANZISKA HAGEMANN[3], ANNE-KATRIN MAHLEIN[1]

[1]Institute of Sugar Beet Research, Holtenser Landstraße 77, D - 37079 Göttingen
[2]Institute of Geodesy and Geoinformation, University of Bonn, Nußallee 17, D - 53115 Bonn
[3]Sugar beet grower association Central Lower Saxony e.V., Am Flugplatz 6, D - 31137 Hildesheim

UAV-BASED PHOTOGRAMMETRY FOR SUGAR BEET CLAMP VOLUME ESTIMATION: METHOD VALIDATION AND PRACTICAL APPLICATION

Field storage of sugar beet in clamps represents a critical phase in sugar production, where accurate volume estimation directly impacts inventory management and economic planning for sugar factories. Currently, clamp volumes are estimated based on field size and potentially sugar beet yield, with actual mass determined only after transport to the factory.

This study investigates whether uncrewed aerial verhicles (UAV) -based photogrammetry can provide reliable volume estimates directly in the field, using terrestrial laser scanning (TLS) as a geometric reference. The approach involves two processing steps: surface reconstruction from overlapping photographs, and volume derivation from the resulting three-dimensional data. Two approaches are compared: a raster-based method using digital elevation models (DEM), which calculates volume as the difference between surface and ground elevation, and a mesh-based method using triangulated 3D models, which computes volume from closed polyhedra. The study follows a four-part transitive validation approach using TLS as a geometric reference. In Part I, processing parameters are optimized by comparing 48 dense clouds setting from UAV-data against TLS reference volumes on a single clamp. Part II quantifies method-related differences by comparing volume calculations in two different 3D reconstruction softwares: CloudCompare (raster-based, using interpolated ground surfaces) and Metashape (mesh-based and DEM-based approaches). In Part III, the best-performing configurations from the previous experiments are validated on six additional TLS scanned clamps to assess transferability across varying clamp sizes and shapes. Finally, Part IV evaluates practical applicability across all 41 uncovered and 31covered clamps from the 2025 harvest campaign, enabling the development of density-based conversion factors.

This study provides practical recommendations for accurate clamp volume estimation using airborne photogrammetry and establishes a validated workflow balancing measurement accuracy with operational efficiency.

1.2 JULIANE STREIT[1], HAMDI MAKTOUF[1], BETTINA MÜLLER[1], CARLO MARZINI[1], CHRISTIAN HÜGEL[2]

[1]Strube D&S GmbH (RAGT Group), Hauptstrasse 1, D - 38387 Söllingen
[2]Fraunhofer-Institut für Integrierte Schaltungen IIS, Flugplatzstrasse 75, D - 90768 Fürth

FIELD ROBOTICS IN SUGAR BEET TRIALING - COMBINING PHENOTYPING AND MICROPLOT THINNING WITH THE BLUEBOB

Field phenotyping can accelerate the breeding progress by analysing canopy coverage and improving disease scoring. Moreover, thinning is a necessary but labour-intensive step in official trialing systems (e.g. CTPS in France) and breeding microplots with a high seeding density. Typically, after final field emergence, microplots are thinned manually to reach final distance.

The BlueBob is an autonomously navigating field robot combining these two tasks. The robot detects and classifies sugar beet with artificial intelligence (PhenoBob system) at RTK precision. Non-invasive spectral measurements are performed from field emergence until row closure resulting in sugar beet plant count and single plant leaf area. Originally designed for mechanical weed management, the BlueBob was further developed to remove excess (specific) sugar beet plants within the rows. The plant positions before thinning are recorded with a drone due to time constraints. This data is processed to select certain sugar beet plants and achieve homogeneously distributed, equidistant plants at final distance. Afterwards, the excess sugar beet plants are removed with the BlueBob with electrically driven active weeding tools. Two plots with three rows each are managed simultaneously. With a maximum speed of 2.8 km/h, the BlueBob capacity for thinning is 880 plots per hour (6.4 m trialing plots). Robotic thinning is a more standardized and objective method than manually managed systems and has the potential to reduce trialing costs and increase personnel capacity in sugar beet research.

1.3 BETTINA MÜLLER[1], THOMAS MALZER[2], MARIA KÖHLER[1], PETER PIETRZYK[2], GÜNTER LEHRETZ[2], STEFAN GERTH[2], CHRISTIAN HÜGEL[2], MICHAEL STANGE[1]

[1]Strube D&S GmbH (RAGT Group), Hauptstrasse 1, D - 38838 Söllingen
[2]Fraunhofer-Entwicklungszentrum Röntgentechnik EZRT, Flugplatzstraße 75, D - 90768 Fürth

AUTOMATED HIGH-THROUGHPUT PLANT PHENOTYPING WITH X-RAY AND OPTICAL IMAGING FOR ABOVE- AND BELOWGROUND TRAIT EVALUATION OF SUGAR BEET UNDER DROUGHT STRESS

High-throughput plant phenotyping has become an essential tool for deepening our understanding of plant responses to environmental aspects and for optimizing crop breeding strategies.

Drought is an increasingly significant problem for crops worldwide, including sugar beet, affecting both leaves and roots. However, the dynamics of sugar beet tap root growth under drought stress are poorly understood, due to a lack of feasible non-destructive technologies for the investigation of underground storage organs. X-ray computed tomography (XCT) combined with image processing algorithms enables an automated segmentation of the tap root and quantification of tap root growth traits (e.g. width, length, volume, density and virtual biomass dynamically) over time. In combination with 2D and 3D optical imaging of the shoot we can merge these data into a 3D model of the entire plant enabling a combined analysis of above and belowground trait development. The experiment was performed in fully automated climate chambers, equipped with a conveyor belt system transporting the plants to phenotyping chambers equipped with optical and X-ray sensors. Five genotypes were tested with replications under different water regimes over a time frame of four months in the automated climate chambers. Data analysis showed significant phenotypic differences between treatments as well as genotypes. Combining all this information offers the possibility to transfer the gained information from the climate chamber to the field and to search for drought indicators in the field.

1.4 KATJA KEMPE[1], BETTINA MÜLLER[1], MEETKUMAR PATEL[1], MARINA AMELIN[1], NICOLE RAVEN[2], ANDREAS SCHIERMEYER[2], STEFANO DI FIORE[2], SRUTHY MARIA AUGUSTINE[3], HANS-PETER PIEPHO[4], MOHAN SAIRAM PEDDU[4], STEFAN PAULUS[5], JONAS BÖMER[5], ANDREAS MÜLLER[1]

[1]Strube D&S GmbH (RAGT Group), Hauptstrasse 1, D - 38838 Söllingen
[2]Department of Plant Biotechnology, Fraunhofer Institute for Molecular Biology and Applied Ecology (IME), Forckenbeckstraße 6, D - 52074 Aachen
[3]Department of Plant Breeding, Justus Liebig University Gießen, Ludwigstraße 23, D - 35390 Gießen
[4]Institute of Crop Science, Biostatistics Unit, University of Hohenheim, Fruwirthstrasse 23, D - 70599 Stuttgart
[5]Institute of Sugar Beet Research, Holtenser Landstraße 77, D - 37079 Göttingen

BEETADAPT: ADAPTING SUGAR BEET FOR CLIMATE RESILIENCE

Sustainable sugar beet cultivation is threatened by various plant diseases and pests. The threat posed by plant pests is exacerbated by the ban on certain plant protection chemicals (e.g., neonicotinoids). In addition, climatic change is expected to improve the conditions for these insect infestations. From an economic point of view, the most important sugar beet pests at present are beet cyst nematodes, yellowing viruses transmitted by insects and SBR caused by certain pathogenic bacteria carried by leafhoppers. The yield losses caused by these biotic threats as well as increasing stress caused by extreme abiotic challenges demand urgent action.

The BeetAdapt project aims to develop a novel toolbox of new plant breeding technologies and combinatorial phenotyping approaches to accelerate the generation of pathogen-tolerant and climate-smart sugar beet cultivars. Within BeetAdapt we will work towards the improvement of two biotic traits, i.e. tolerance to nematodes and SBR, and two abiotic traits, namely drought tolerance and bolting tolerance. For this, an innovative potentially DNA-free transfection protocol for sugar beet will be developed based on novel site-specific endonucleases and a laser-induced shockwave transformation technology. In addition, we will combine innovative RGB, thermal and multispectral imaging technologies with unmanned aerial vehicles and novel artificial intelligence-based models and biostatistical prediction approaches for the phenomic selection of elite varieties, autonomous disease scoring, and yield forecasting.

BeetAdapt will provide a roadmap to transfer new technologies into current accelerated breeding programs and thereby increasing the security of agricultural product supply chain.

1.5 FRANÇOIS JOUDELAT[1], DAVID SHEEREN[2]
[1]Institut Technique de la Betterave (ITB), 45 rue de Naples, F - 75008 Paris
[2]UMR DYNAFOR, 24 Chemin de Borde-Rouge, F - 31326 Castanet

A SATELLITE TOOLBOX FOR SUGAR BEET MONITORING

Remote sensing and image processing techniques promise many exciting monitoring applications for sugar beet. Recently, ITB has integrated Copernicus data to harness the capabilities of Sentinel-1 and Sentinel-2 imagery. Recent advancements now enable sugar beet crop detection and segmentation at the national scale, all while keeping data and time footprints manageable. In parallel, ITB is collaborating with research partners to refine phenotyping traits, with a focus on yellows disease.

1.6 FRANÇOIS JOUDELAT
Institut Technique de la Betterave (ITB), 45 rue de Naples, F - 75008 Paris

USING ARTIFICIAL INTELLIGENCE IN AGRONOMY

Since the early days of agronomic research, field expertise has been essential for identifying and overcoming the factors that limit agricultural production. Today as ever, these challenges persist with new threats, such as the overwhelming beet yellows.

Agronomists at ITB and their collaborators can now also rely on larger and more diverse datasets and efficient machine learning tools. Many different methods exist to identify explanatory variables and highlight how they relate to the occurence of the disease.

While the results obtained by these tools require further field validation, they complement traditional expertise to find effective solutions against beet yellows more rapidly.

1.7 THOMAS LEBORGNE
Institut Technique de la Betterave (ITB), 45 rue de Naples, F - 75008 Paris

PRÉVIBEST: A TOOL TO UNDERSTAND AND APPREHEND THE RISK OF SOIL COMPACTION DURING BEET HARVEST

During the last IIRB congress, an oral presentation has been held about the Prévibest project and its different objectives. The tool is now working and available for beet growers that allow them to apprehend the risk of soil compaction during their beet harvest. This poster proposes to highlight the different results we obtained with this tool (regarding historical results) and how farmers are using it to reduce the risk of soil compaction to preserve their soil fertility.

1.8 THOMAS LEBORGNE
Institut Technique de la Betterave (ITB), 45 rue de Naples, F - 75008 Paris

FARMDROID IN ORGANICAL SUGAR BEET: TECHNICAL AND ECONOMICAL ANALYSIS

During the last years, ITB conducted many experimentations with the Farmdroid robot in organic sugar beet fields. This robot is fully autonomous regarding the sowing and the weeding, and is now used by almost 50 organic beet growers in France. ITB tested a lot of different settings to see which are the best to optimize the weeding. This poster presents the different experimentations results and also how the Farmdroid is mainly used in French sugar beet fields regarding farmers testimonials. An economic analysis will be also presented to highlight the advantage of this technology regarding the cost of manual weeding in organic fields.

1.9 SAMI TALOLA, SUSANNA MUURINEN, ARVO EKMAN
Sugar Beet Research Centre (SjT), Meltolantie 30, Finland

THE PEDRO PROJECT: EVALUATING ROBOTIC AND PRECISION FARMING TECHNOLOGIES FOR SUGAR BEET PRODUCTION UNDER FINNISH FIELD CONDITIONS

Recent advances in agricultural robotics and precision farming technologies have created new opportunities to improve sugar beet establishment, weed management, fertilization, and irrigation efficiency. The PeDro project was launched to evaluate the applicability of robotic and drone-based technologies under practical field conditions and to develop cost-effective solutions for their adoption.

Field trials were conducted at the experimental site (4 ha, clay soil) in Paimio, Finland, where sugar beet was sown in April 2025 using three machine systems: the FarmDroid FD 20 robotic seeder, the AgXeed robotic tractor-Väderstad Tempo combination, and a tractor-Monosem combination. Fertilization treatments included mineral fertilizer and cattle slurry.

Cold spring conditions delayed emergence, while heavy rainfall caused soil crusting. The in-row and inter-row weeding function of the FarmDroid FD 20 effectively disrupted the crust, and slurry application improved emergence conditions. The project is structured into four work packages: (i) testing the FarmDroid FD 20 for mechanical and chemical weed control vs. tractor based operations, (ii) evaluating mineral and organic fertilization strategies for robotic application, (iii) assessing drone-based crop monitoring and fertilization, iv) developing cost-effective operational models for integrated drone-robot systems.

2 Beet Quality & Storage

2.0 JOAKIM EKELÖF

Nordic Beet Research Foundation, Borgeby Slottsväg 11, S - 237 91 Bjärred

INNOVATIVE COVERING MATERIALS FOR FROST PROTECTION IN SUGAR BEET STORAGE

Frost protection during winter storage remains one of the most critical challenges in sugar beet cultivation. This study, conducted by Nordic Beet Research (NBR), evaluates new materials and methods aimed at simplifying frost protection while maintaining crop quality. Two promising solutions were tested: a lightweight, rubber-coated fiber fabric called Polyfelt, and a food-grade foam developed by Frosco. Polyfelt, available in stitched configurations with Toptex, demonstrated good frost resistance and could be deployed mechanically even under windy conditions. Frosco's foam, designed to form an insulating layer upon freezing, showed potential but required further development in application technology. Observations from the 2023 season revealed that beets on the wind-exposed western side of clamps exhibited better frost tolerance, possibly due to prior dehydration. These findings suggest that both material choice and microclimatic factors influence frost resilience. Continued refinement of these technologies aims to provide growers with reliable, easy-to-use solutions for protecting valuable harvests. Two year results will be presented at the conference.

2.1 HEIKO NARTEN, WERNER BEYER, ISABEL FRANKE, ELKE HILSCHER
KWS SAAT SE & Co. KGaA, Grimsehlstr. 31, D - 37574 Einbeck

MARC CONTENT OF SUGAR BEET – LONG-TERM INVESTIGATIONS OF A HIGHLY HERITABLE TRAIT

Marc content is, after sugar, one of the key substances contributing to the dry matter of sugar beet. The role of the marc content in context of robustness of beet, storability but also processability has been and still is investigated by researchers and sugar industry.

In a long-term analysis of KWS experimental hybrids over more than ten years (2010-2022) we found highly variable marc contents depending on years, locations, and environmental conditions. The marc content is, like sugar content, a highly heritable trait, i.e. depends on the genetic constitution of the sugar beet hybrid. Although genotypic variation amongst hybrids is heritable, the absolute marc contents and ranges strongly depend on environmental conditions.

Marc content of sugar beet ranges between 3 and 5 percent of the total biomass of sugar beet; this range has not dropped over a long-year period in our germplasm. This finding is partly contradictory to earlier publications which described significant reduction of marc content when comparing old and more recent sugar beet varieties in a smaller set of genotypes.

Breeders and seed companies describe marc content well with wetlab and NIR spectroscopy, and they consistently integrate all traits for selecting new varieties. The implication of a defined minimum marc content, but also the limit of defined contents based on strong environmental impact as we have found them in our study of this trait, is to be discussed in context of biotic and abiotic challenges as well as processability of sugar beet in the factories to meet sugar industry demands.

2.2 LJUDMILLA BORISJUK[1], SIMON MAYER[1], ELKE HILSCHER[2], ISABEL FRANKE[2], TORBEN ERICHSEN[2], HEIKO NARTEN[2], BENJAMIN GRUBER[2], HARDY ROLLETSCHEK[1]

[1]Institute of Plant Genetics and Crop Plant Research (IPK), Corrensstr. 3, D - 064664 Seeland-Gatersleben
[2]KWS SAAT SE & Co. KGaA, Grimsehlstr. 31, D - 37574 Einbeck

RESOLVING INHOMOGENEOUS SUGAR ACCUMULATION IN INTACT SUGAR BEET TAPROOTS USING ADVANCED MAGNETIC RESONANCE IMAGING

Various high-resolution technologies have been applied to quantify sugar levels in sugar beet tissues, analyze tissue structure, and characterize this strategically important crop at molecular and physiological levels (Hilscher *et al.*, Sug. Ind., 2019; Nause, N. *et al.*, Plant Methods, 2023). However, due to the limitations of conventional, largely destructive methods, the in situ/in vivo distribution of sugars within the beetroot has remained unresolved.

We applied here a novel magnetic resonance imaging (MRI) approach that enables non-invasive access to sugar metabolism in intact plant organs (Mayer *et al.*, Sci. Adv., 2024). Using Chemical Exchange Saturation Transfer (CEST) MRI, we visualized sucrose distribution in intact sugar beet taproots sampled between June and October 2024 (Serenada KWS from GER and FRA). The resulting 3D sugar maps provide direct evidence for heterogeneous sucrose accumulation during taproot development. The method links structural and biochemical features, highlighting the characteristic ring-like tissue organization. Furthermore, the MRI datasets also allowed us to model how sample preparation influences sucrose quantification in conventional assays. From an applied perspective, this novel CEST MRI technology might open new avenues for advanced sugar beet analysis and optimization of screening in biotechnology and beet processing industry.

2.3 SHYAM L. KANDEL[1], MALICK BILL[1,2], SABINA KC[1,2]

[1]USDA-ARS, Edward T. Schafer Agricultural Research Center, Sugarbeet Research Unit, Fargo, USA - ND 58102

[1,2]Department of Plant Pathology, North Dakota State University, P.O. Box 6050, Fargo, USA - ND 58108

MICROBIOLOGY OF SUGARBEET RAW DIFFUSION JUICE FROM THE FACTORY PROCESSING

Sugarbeet (*Beta vulgaris* subsp. *vulgaris*) is an important crop for industrial production of crystalline sucrose (table sugar) besides sugarcane worldwide. Some of the most significant financial losses for the sugarbeet industry occur after the growing season when sugarbeet roots enter the factory. This is due in large part to microbial contamination in processing streams that consume sucrose and add technical challenges during juice purification and crystallization. To date, very limited information is available on the microbial contamination of sugarbeet raw diffusion juice. In this study, we used Oxford Nanopore long-read amplicon sequencing technology to profile the entire bacterial and fungal microbiomes in raw diffusion juice samples received from nearly all sugar factories across the United States and Canada. Firmicutes was the dominant phylum in raw diffusion juice samples and comprised 85.5% of total bacterial population. Lactic acid bacteria such as Leuconostoc and Lactobacillus were among the core genera which also dominated the bacterial community in raw diffusion juice. On the other hand, diverse fungal communities were present in sugarbeet diffusion juice with Basidiomycota and Ascomycota being dominant phyla. Previously known sugar fermenting yeast genera such as Mrakia, Pichia and Candida and storage rot causing fungi; Tausonia and Geotrichum were identified as the dominant fungal contaminants. This finding is important for deciphering microbial growth dynamics in raw diffusion juice that can be useful in minimizing sucrose loss during the factory processing.

3 Communication Techniques

3.0 Florence Bourdeaux
Institut Technique de la Betterave (ITB), 45 rue de Naples, F - 75008 Paris

From research to the field: Communicating PNRI outcomes to growers for managing sugar beet yellows

The French National Research and Innovation Program (PNRI) was launched to develop alternative solutions to neonicotinoid seed treatments, used to control sugar beet yellows. For these innovations to be effective, farmers and technicians need practical and reliable information to guide decision-making and encourage the adoption of sustainable strategies.

A multi-channel communication strategy was implemented to achieve this goal, thanks to technical publications, events such as field demonstrations, trade fairs, and conferences, digital communication including webinars, interviews, and social media, and collaborative networks with the whole sugar industry.

These efforts enabled broad dissemination of PNRI outcomes, reaching a large audience of farmers and advisors. Some growers adopted innovative practices such as companion plants, flower strips, or reservoir management. However, the transfer of the results to sugar beet growers is still limited by technical, biological, economic, and regulatory constraints.

3.1 STEPHANIE COENEN, ANDRÉ WAUTERS
IRBAB-KBIVB, 45 Molenstraat, B - 1300 Tienen

NATIONAL OBSERVATION AND ADVISORY NETWORK FOR SUGAR BEET CROPS

The IRBAB-KBIVB observation network is a long-established, nationwide system supporting sugar beet growers throughout Belgium. For many years, it has relied on loyal observers, providing extensive and consistent data that farmers can trust. This strong foundation makes the network a unique decision-support tool across the beet-growing region, offering advice and warnings in line with Integrated Pest Management strategies. Traditionally focused on leaf diseases, the network was expanded in 2019 due to the ban on 3 neonicotinoïds, to include insect pests, with aphids as a major focus.

Each week, about 100 fields are monitored from early germination until mid-September by the IRBAB-KBIVB team, sugar industry agronomists, and external contributors such as farmers. The strength of this collaboration lies in its wide coverage, continuity, and clear purpose: to help farmers make informed decisions on whether or not to apply phytosanitary treatments.

Data are shared through maps on the IRBAB-KBIVB website, together with Newsletters informing farmers about pest and disease pressure and offering practical recommendations.

Thanks to its many eyes, the network contributes to the early detection of new pests and diseases. Moreover, its long-term dataset, is a valuable resource for research, helping to refine strategies, guide studies, and better understand annual trends and their links with climatic conditions.

3.2 Francesca Broom
British Beet Research Organisation (BBRO), Centrum, Norwich Research Park, Norwich, UK - NR4 7UG

BBRO Communications – Fit for the future

Each research project conducted by BBRO will generate at least one learning point and message for growers on-farm. However, translating project outputs into key actionable on-farm actions can be quite a challenge.

With the introduction of new modelling and risk forecasts we were excited to promote the work we had achieved but at the same time we were aware that many of our previous messages had missed their mark, such as the importance of on-farm hygiene.

With exciting plans to overhaul BBRO Communications with a new website, reference material, interactive tools and mobile app, we first needed to know how to engage with those who appeared as disengaged.

In 2025 BBRO undertook a project to understand in what formats growers receive information and who they view as 'trusted' sources. With what seems a continuous bombardment of online feed-back surveys we needed to find a different way to engage with growers, particularly those that do not normally engage with us. We revisited an old tried and tested route called the telephone! Whilst this may sound a backward step in these days of increased technology, we realized that only those already engaged with us were accessing and responding to our messaging so we opted for a direct approach, with two distinct purposes.

1. Engaging with individuals and building relationships

2. Understanding what and how growers which to receive our messaging in future

It was an interesting exercise, leading to greater understanding not only of growers in the UK but also the role of allied industries, such as agronomists, breeders and the 'neighboring farm' all of which contribute to changes within the sugar beet industry.

4 Genetics & Breeding

4.0 RACHEL NAEGELE[1], WYATT BOGENRIFE[2], AIDEN DENEEN[3], DAN CHITWOOD[4]

[1]United States Department of Agriculture Agricultura Research Service 1066 Bogue St., 48824 East Lansing, USA - Michigan
[2]Michigan State University, Plant Soil and Microbial Sciences Department, 1066 Bogue St., 48824 East Lansing, USA - Michigan
[3]Michigan State University, Department of Plant Biology, 1066 Bogue St., 48824 East Lansing, USA - Michigan
[4]Michigan State University, Department of Horticulture, Department of Computational Mathematics, Science & Engineering, 1066 Bogue St., 48824 East Lansing, USA - Michigan

USING 2D AND 3D MODELING AND SNP-BASED MARKERS TO PREDICT PLANT ARCHITECTURE AND LEAF MORPHOLOGY IN *BETA* SPP.

Sugar beet leaf morphology and plant architecture has largely been unselected over the past 150 years of breeding. Yet leaf characteristics and plant architecture have an impact on canopy closure and air flow, light capture, and ultimately sucrose accumulation in roots. Using greenhouse grown plants, we evaluated leaf morphology [e.g. color, size, and shape] for 700 sugar beets representing 150 heterogenous accessions from the USDA ARS East Lansing sugar beet breeding program. Significant variability was observed within and among beet accessions and families for total leaf area, width, length, shape, and color. Using a genome-wide association approach, large and small effect SNPs associated with leaf area, shape, color, and crinkled edges and blades were identified. Major SNPs associated with shape were associated with chromosomes 1, 5, and 8, with color traits on chromosomes 1, 3, 4 and 7, and leaf crinkles (edges or blades) on chromosomes 4, 6, and 9. For a subset of 480 individuals representing 120 heterogenous accessions, plant architecture (openness, height, height:width ratio) data based on 3D scans was collected or predicted (2D scans). Light capture (leaf placement and number) efficiency was modelled and predicted values compared to observed photosystem efficiency values.

4.1 JINQUAN LI, CAPISTRANO GINA, MOHSIN ALI MICHAEL STANGE, ELENA ORSINI
Strube D&S GmbH (RAGT Group), Hauptstraße 1, D - 38387 Söllingen

GENOMIC SELECTION FOR YIELD AND DISEASE RESISTANCE IN SUGAR BEET

Genomic selection (GS) for root yield and sugar content is a powerful tool that enables breeders to identify superior lines before field testing, reduces costs and increases efficiency across breeding cycles. This approach is particularly advantageous when high prediction accuracy can be achieved for a trait with low heritability.

As climate change intensifies pest pressures and pesticide restrictions limit chemical control options, genetic resistance becomes increasingly critical to safeguard sugar beet yields. Major diseases such as Rhizoctonia solani and Cercospora leaf spot cause substantial losses and are quantitatively inherited, making marker-assisted selection (MAS) based on a few candidate genes insufficient. Integrating GS for high yield with genomic prediction (GP) of secondary oligogenic traits for disease resistance offers a more effective strategy.

This study illustrates the utility of integrating GS and GP to develop high-yielding, disease-resistant sugar beet varieties. Several QTL mapping approaches were applied to identify informative markers for predictions, including linkage mapping, genome-wide association study (GWAS), joint linkage analysis, and EigenGWAS.

Joint linkage analysis and GWAS in 21 multiple parents segregating (F3) populations detected 149 SNPs significantly associated with Rhizoctonia resistance across all the nine chromosomes. Linkage mapping in two segregating (F2) populations revealed QTLs for Cercospora resistance on chromosomes 2, 3, 4, 8, and 9. EigenGWAS applied to diverse breeding material identified 47 candidate genes for disease resistance underlying the selection sweeps. An empirical GP approach was applied in our breeding program. Predictions for Rhizoctonia resistance were phenotypically validated in 93% of the 1320 plants in 62 out of 66 pedigrees. These results provide breeders with a robust framework for simultaneously improving yield and resistance to major diseases in sugar beet. The strategy presented here can be applied not only in sugar beet but also in other crops where GS for yield is established and prediction of secondary oligogenic traits is required.

4.2 EVAN M. LONG

Northwest Irrigation and Soils Research Laboratory, United States Department of Agriculture - Agricultural Research Service, Kimberly, ID, USA - 83341

MUTATIONS AND ADAPTATIONS: A METAGENOMIC ANALYSIS OF WHOLE GENOME SEQUENCE IN *BETA VULGARIS*

The genetic landscape of *Beta vulgaris* (beet) offers a unique opportunity to explore the effects of domestication and environmental adaptation, especially considering the relative recent development of sugar beet (~200 years). This study aims to elucidate the differences in deleterious mutation accumulation between cultivated sugar beet (*Beta vulgaris* ssp. *bulgaris*) and its wild counterpart, sea beet. We integrated multiple datasets of *Beta vulgaris* and employed two distinct methods to detect deleterious mutations. The first method relied on multiple sequence alignment and conservation across approximately 80 species within the Caryophyllales order. The second method utilized PlantCadaceus, a deep learning model specifically trained to identify deleterious mutations in plants. Our analysis revealed that domesticated sugar beets contain significantly fewer deleterious mutations compared to wild sea beets. This suggests that these mutations may have been indirectly targeted during the domestication process. Furthermore, we investigated geographic and environmental adaptations in wild beets, identifying genetic variations that may contribute to local adaptation. The findings highlight the genetic mechanisms underlying domestication and adaptation in *Beta vulgaris*. The reduced accumulation of deleterious mutations in domesticated sugar beet points to potential indirect selection pressures during breeding. Additionally, the identified genetic variations in wild beets provide insights into their environmental adaptability. These results have significant implications for future breeding and conservation strategies.

4.3 MYO WAI[1], AMANDA CAVANAGH[2], PALLAVI SINGH[3], GEORGINA BARRATT[3], JOHN FERGUSON[1]

[1]School of Life Sciences, University of Essex, UK - CO4 3SQ
[2]British Beet Research Organisation (BBRO), Centrum, Norwich Research Park, Colney Lane, Norwich, UK - NR4 7UG

EVALUATING DROUGHT TOLERANCE IN SUGAR BEET (*BETA VULGARIS*): A MULTIMODAL PHENOTYPING AND PHYSIOLOGICAL ANALYSIS

Sugar beet (*Beta vulgaris*) is a key crop in the United Kingdom, but its productivity is increasingly at risk from drought stress, a challenge that is expected to intensify with climate change. While sugar beet can withstand moderate water limitation, prolonged dry conditions can significantly reduce growth and yield. This study aimed to identify varieties with strong drought tolerance and water use efficiency (WUE) during the seedling and early vegetative stages. Thirteen varieties were grown for 8 weeks under controlled conditions targeting early growth stages with severe drought defined as ≤15% volumetric water content (VWC) and moderate drought as ≥22% VWC.A multimodal phenotyping approach was applied, combining high-throughput 3D canopy scanning (Phenospex PlantEye), gas exchange measurements (LI-COR 600 and 6800), and field spectroscopy. These methods enabled the integrated assessment of morphological traits (e.g., digital biomass), physiological parameters (e.g., Vcmax and Jmax), and spectral indices (e.g., NDVI), providing a comprehensive evaluation of varietal responses to drought. Significant treatment effects were observed across varieties ($p < 0.001$). Some maintained comparatively higher root biomass under drought, suggesting stronger tolerance, while others exhibited stable NDVI trends across both stress levels, indicating consistent canopy development under varying water availability. WUE measurements further revealed substantial varietal differences, with certain varieties achieving higher efficiency under severe drought and demonstrating the capacity to sustain biomass with limited resources. These findings highlight considerable genetic variation in drought response within UK sugar beet and underline the value of integrating morphological, physiological, and spectral data for identifying stress-resilient varieties. This work provides a basis for breeding and management strategies to improve sugar beet resilience in increasingly dry growing conditions.

4.4 LUDMILLA DAHL, CHRISTIAN JEßBEN, CHRISTOPH FRITZSCH, HANNA WILDHAGEN, CHRISTOPHER WRAY

KWS SAAT SE & Co. KGaA, Grimsehlstraße 31, D - 37574 Einbeck

ADVANCING DIGITAL PHENOTYPING: INFRASTRUCTURE AND INNOVATION FOR FUTURE SUGAR BEET BREEDING

Digital phenotyping is revolutionizing plant breeding, offering new tools and perspectives for sugar beet improvement. By collecting high-resolution, non-invasive measurements, breeders can monitor trials more accurately, assess disease progression, and select traits suited for future environments.

At KWS SAAT SE, we utilize a range of measurement systems that offer varying temporal and spatial resolutions — from high-resolution greenhouse facilities for in-depth physiological analysis to drone based approaches focusing on breeding relevant characteristics to satellite imagery or data collection via harvesting machinery. These tools provide complementary insights into crop performance and response mechanisms. We generate research-level insights using the PhenoFactory, an automated greenhouse facility that moves plant pots by autonomous transport vehicles and measures them with sensors — ranging from RGB to HSI.

To enhance efficiency and throughput in next-generation field phenotyping, KWS SAAT SE has introduced two core systems: a) FieldEXPLORER facilitates geo-referenced data capture through integrated hardware and mobile apps, enabling smooth field-to-office data transfer and intuitive visualization for breeders and technicians. b) PhenoPro offers fully automated image processing, encompassing both standard procedures and advanced AI models. It integrates decentralized data processing with centralized data storage and access for enhanced efficiency and control.

4.5 AUGUSTIN DESPREZ [1,2], KARINE HENRY[3], BRUNO DESPREZ[2], PIERRE DEVEAUX[2], ALAIN CHARCOSSET[1], MAUD TENAILLON, LAURENCE MOREAU[1]

[1]GQE - Le Moulon, INRAE, CNRS, AgroParisTech, Université Paris-Saclay, 91190, F - Gif-sur-Yvette
[2]Florimond Desprez Veuve & Fils SAS, BP 41, 59242, F - Cappelle-en-Pevele
[3]United Beet Seeds (UBS), Industriepark 15, B - 3300 Tienen

TWENTY-ONE YEARS OF THREE-WAY HYBRID BREEDING SHAPED DIVERSITY AND COMPLEMENTARITY OF MALE AND FEMALE GENE POOLS IN SUGAR BEET

Three-way hybrid breeding has been used in several major crops to increase seed yield and manage heterosis. Sugar beet (*Beta vulgaris* ssp. *vulgaris*) breeding relies exclusively on it and combines cytoplasmic male sterility (CMS) and monogermity to exploit heterosis by combining male and female parental pools. The genomic consequences of this breeding scheme remain poorly characterized. We assembled a unique dataset comprising 1,274 accessions spanning 21 years of selection within a breeding program, genotyped for 10,033 SNPs, to investigate genetic structuring and selection dynamics. Principal component and admixture analyses revealed a clear differentiation between parental pools. Over 21 years, males displayed a significant decline in within-pool diversity, accompanied by a slight rise in inter-pool differentiation. Linkage disequilibrium decreased rapidly in recent male lines, reflecting breeding practices that increase allele shuffling. Selection scans identified 174 outlier SNPs differentiating pools. Outliers clustered into seven haploblocks, including a region encompassing a rhizomania resistance gene (Rz1) and, more surprisingly, a region encompassing the domestication bolting locus B (BvBTC1). These results demonstrate that three-way hybrid breeding structured sugar beet heterotic pools, balancing diversity erosion with functional differentiation. Our study provides new insights to optimize parental diversity in future sugar beet breeding programs.

4.6 ANTONIO NOGUEIRA JUNIOR, NILS KLINGEMANN, PHILIPP KÄETHE, MARIO SCHUMANN, NINA BEHNKE, WOLFGANG LUEDERS

KWS SAAT SE & Co. KGaA, Grimsehlstraße 31, D - 37574 Einbeck

INSIGHTS FROM MULTI-YEAR KWS VIRUS YELLOWS MANAGEMENT TRIALS IN SUGARBEET: TOWARDS AN INTEGRATED CONTROL STRATEGY

Since 2021, KWS has a strategic and science-driven effort to develop a solution for controlling Virus Yellows (VY) in sugarbeet. One important activity to reach this goal is a series of robust management trials. These trials have evolved into a multi-year & multi-country initiative aimed at identifying the most effective combination of genetics, seed treatments, and foliar insecticide applications to control aphid-transmitted viruses.

The program tested different genetics as VY tolerant standards and newest genetics coming from KWS breeding. Different viruses (BYV, BChV and BMYV) and inoculation densities were tested across Germany, France, and the UK. From 2023 to 2025, 18 trials evaluated different seed treatments and early/late foliar sprays against BYV, BMYV, and BChV and the combination of the viruses.

While a genetic solution remains our primary focus, we also supplemented by other strategies to form a high-efficacy integrated solution. Our insights show that tolerant varieties showed higher yield than susceptible varieties even without foliar spray, while in development seed treatments consistently preserved yield across all varieties. Foliar sprays increased yield in inoculated plots. Combining seed and foliar treatments offers the best yield protection, and regular aphid monitoring is essential to guide spray timing.

4.7 JENS LOEL, KONSTANTIN BEZGIN, INGKE DEIMEL-KUNKEL, ALEXANDER BEESLEY
Betaseed GmbH, Friedrich-Ebert-Anlage 36, D - 60325 Frankfurt am Main

NOVEL SEED TREATMENTS TO IMPROVE CROP VIGOR AND PRODUCTIVITY

The optimization of sugar beet (*Beta vulgaris* L.) cultivation requires innovative approaches to enhance seedling establishment, stress resilience, and overall crop productivity. This study has been conducted in two environments: in greenhouse and in the open field environment. It evaluated four treatments representing distinct enhancement strategies: laser stimulation; 01-BIO; water absorber; nutrients. Each treatment was applied on the seed pill, and plant responses were monitored at the harvest time under open environmental conditions. Key parameters included rate of emergence and vigor at early stage as well as final root yield and the sugar content. Results indicated treatment-specific effects, with optical and biological enhancements. Comparative analysis highlights the potential of integrated approaches combining technical, biological, and chemical methods to improve sugar beet establishment and yield stability. These findings provide valuable insights for the development of sustainable crop management practices under increasingly variable climatic conditions.

4.8 JENS LOEL[1], HADRIEN LURO-BRANA[2], ALEXANDER BEESLEY[1], INGKE DEIMEL-KUNKEL[1], KONSTANTIN BEZGIN[1]

[1]Betaseed GmbH, Friedrich-Ebert-Anlage 36, D - 60325 Frankfurt/Main
[2]Betaseed France, 957 Rue de l´Horlogerie, F - 62 403 Béthune

IMPACT OF HARVEST DATE ON SUGAR BEET HYBRIDS WITH DIFFERENT LEVELS OF CERCOSPORA PROTECTION

Foliar diseases of sugar beet (*Beta vulgaris* L.) strongly affect both yield and quality and thus sugar production. Field experiments were conducted to compare the performance and yield of hybrids with high level of protection against *Cercospora beticola* L. and classical hybrids with a medium level of protection at different harvest dates. It was hypothesized that hybrids with high Cercospora protection, due to their prolonged canopy longevity and photosynthetic activity, would not only maintain but further expand their yield advantage with later harvest dates. Preliminary results support this assumption, showing that varieties with high Cercospora protection exhibited a more pronounced increase in root yield and sugar accumulation at delayed harvest dates compared to classic hybrids. These findings highlight the importance of variety selection and optimizing harvest strategies to maximizing sugar yield potential.

4.9 ANNA-MARIE ILIC[1], RAFAEL TOTH[1], MARK VARRELMANN[2], MICHAEL KUBE[1]

[1]University of Hohenheim, Garbenstr. 30, D - 70599 Stuttgart

[2]Institute of Sugar Beet Research, Holtenser Landstraße 77, D - 37079 Göttingen

16SRXII-P SUBGROUP PHYTOPLASMA GOE INFECTING SUGAR BEET IN GERMANY

'*Candidatus* Phytoplasma solani' strains belonging to 16SrXII subgroups A and P pose an increasing threat to sugar beet and potato production. Genome data are essential for understanding the pathogen-host interaction through in silico functional reconstruction. A comprehensive analysis of the complete '*Ca*. P. solani' genomes has been performed to determine the putative key genes involved in host-dependent metabolism and symptom formation. Complete genomes were determined, de novo assembled, annotated, manually curated, and functionally reconstructed. In contrast to sugar beet in general and the phloem sap in particular, metabolic reconstruction of these phytoplasmas highlights only an indirect link to sugar parasitism. '*Ca*. P. solani' strains share a widely conserved repertoire of virulence factors that enable efficient host manipulation, despite a clear separation of 16SrXII subgroups A and P in phylogenetic analysis. Furthermore, strain GOE from subgroup 16SrXII-P exhibits an exceptional characteristic among phytoplasmas in that it encodes a complete transposon representing a pathogenicity island which encodes the majority of effector proteins linked to symptom formation in sugar beet.

4.10 PIERRE LONGERSTAY, BRITT-LOUISE LENNEFORS, HENDRIK TSCHOEP
United Beet Seeds, Industriepark 15, B - 3300 Tienen

NEW INSIGHTS ON PARTIAL RESISTANT/TOLERANT SUGAR BEET VARIETIES TO THE SBR/RTD DISEASE COMPLEX

During the recent years different phloem-restricted plant pathogenic bacteria causing the diseases Syndrome 'Basses Richesses' (SBR) and Rubbery Tap Root Disease (RTD) have caused significant losses in the sugar beet crop in several European countries. There are indications that both diseases continue to spread to new sugar beet growing areas.

The breeding company United Beet Seeds have identified genetic tolerance/partial resistance to both diseases and intensive work is ongoing to bring high yielding varieties to the market. During this process, various molecular and phenotypic tools are employed to evaluate genetics on a large scale. The aim is to elucidate the physiology of plant-pathogen interactions and ultimately uncover the genetic mechanisms underlying tolerance and resistance to pathogens responsible for SBR/RTD.

The presentation will discuss the use of genetically tolerant or resistant sugar beet varieties as a means to sustain crop production in regions affected by SBR and RTD. It will provide an overview of the current situation, outline the forthcoming steps in the breeding process, and highlight anticipated developments in the coming years.

4.11 ADRIAN ROGGEN[1], MOHSIN ALI[2], GINA CAPISTRANO-GOSSMANN[2], ANNIKA HENNEKE[2], BETTINA MÜLLER[2], MICHAEL STANGE[2], ELENA ORSINI[2], SANDRA OTTE[2]

[1]Deleplanque & Cie, 35 bis rue des Canus, F - 78600 Maisons-Laffitte
[2]Strube D&S GmbH (RAGT Group), Hauptstraße 1, D - 38387 Söllingen

EXPLOITING GENETIC RESOURCES FOR IDENTIFICATION OF SBR RESISTANCE IN SUGAR BEET

The planthopper-transmitted "Syndrome Basses Richesses" (SBR) has emerged as a severe and rapidly expanding threat to the cultivation of sugar beet in Europe. The disease was primarily associated with infection by the γ-proteobacterium "*Candidatus* Arsenophonus phytopathogenicus". Although initially rare, mixed infection with the stolbur phytoplasma "*Candidatus* Phytoplasma solani" leads to more severe symptoms. This multi-year project focuses to identify and map novel sources of resistance to strengthen ongoing breeding programs. Building on initial findings from pre-existing breeding populations, a Strube diversity panel composed of several hundred elite lines, genetically broad breeding material and genetic resources is currently being genotyped and phenotyped under natural infection pressure in several SBR and stolbur hotspot regions in Southern Germany.

Disease progression is monitored weekly through high-throughput phenotyping (HTP), which combines drone-assisted imaging with an AI-based algorithm developed in-house. In parallel, yield trials are conducted to assess SBR and stolbur tolerance under agronomic conditions, thereby providing short-, medium-, and long-term solutions for sustainable breeding. Preliminary results indicate clear benefits from the increased variation provided by genetic resources. This offers valuable insights into the genetic basis and the inheritance of resistance in the context of SBR. This knowledge enables accelerated and more precise breeding approaches, including genomic selection and the application of new breeding technologies, thereby reinforcing the central role of genetic resource exploitation for sustainable disease management strategies for sugar beet cultivation.

5 Pests & Diseases

5.0 ELMA RAAIJMAKERS
Institute of Sugar Beet Research (IRS), P.O. Box 20, NL - 4670 AA Dinteloord

IIRB STUDY GROUP PESTS & DISEASES

The main focus of the study group Pests & Diseases is the crop protection of sugar beet, with the aim to improve productivity and to minimise an environmental impact. This group covers all areas of phytopathology, virology, zoology and germplasm and pathogen resistance. This includes the development of common methodologies and the evaluation of new products, application techniques and control strategies in the entire rotation.

The current focus of work and research is as follows:

- Aphids, cicades and grasshoppers transmitted pathogens (e.g. SBR; Virus Yellows)
- Leaf diseases (e.g. Cercospora leaf spot)
- Pathogen resistance & control strategies

Chair of the study group: E. Raaijmakers (IRS, NL)

Vice Chair of the study group: M. Varrelmann (IfZ, D)

5.1 SAI ADAPA MANOGNA[1], EMMA HOOPES1, OLIVIA E. TODD[2*], KEVIN M. DORN[2], PHUONG DAO[3]

[1]Colorado State University, Department of Agricultural Biology, USA
[2]USDA-ARS Fort Collins, Soil Management and Sugarbeet Research Unit, USA
[3]Univeristy of Texas at Austin, Department of Integrative Biology, USA

ELUCIDATION OF HYPERSPECTRAL SIGNATURES FOR EARLY DETECTION OF RHIZOCTONIA ROOT AND CROWN ROT RESISTANCE IN SUGAR BEET PREBREEDING FIELDS

Rhizoctonia root and crown rot (RRCR), caused by *Rhizoctonia solani* AG-2-2, causes 20-50% yield losses on sugar beet when uncontrolled in the U.S. Current disease assessment within USDA-ARS relies on destructive visual rating, which is late-stage, subjective, and labor-intensive. Early detection before irreversible root damage is critical for both breeding programs and precision disease management, yet existing methods detect disease only after symptoms appear. We evaluated hyperspectral sensing across four measurement scales to enable pre-symptomatic detection of RRCR severity: (1) aerial imaging via UAS-mounted HySpex Mjolnir VS-620, (2) ground-based canopy measurements with SVC HR-1024i spectroradiometer, (3) fresh leaf spectra, and (4) lyophilized tissue spectroscopy. Disease severity was assessed using a 0-7 ordinal scale over a period of 4 weeks post-inoculation, with one timepoint occurring 1 week pre-inoculation. We assessed four commercial genotypes spanning a resistance gradient under inoculated and uninoculated treatments. Machine learning models (Random Forest, ordinal logistic regression) with scale-optimized preprocessing achieved pre-symptomatic detection at 1 week post-inoculation (AUC = 0.78-0.82 depending on scale). Short-Wave Infrared (SWIR) biomarkers for water stress (1570 nm), cellulose degradation (2165 nm), and protein changes (2441 nm), outperformed traditional vegetation indices by 60-80%, with water absorption (1570 nm) enabling the earliest detection signal. Genotype-specific analysis revealed that susceptible genotypes were easier to detect early (AUC = 0.84) than resistant genotypes (AUC = 0.64). This study demonstrates that SWIR-based hyperspectral sensing enables reliable pre-symptomatic detection of root disease across multiple measurement scales. The detection window provides an opportunity for breeding programs to accelerate within-season selection cycles and for targeted intervention research related to precision agriculture while plants may be salvageable.

5.2 RAJTILAK MAJUMDAR, EVAN M. LONG, CARL A. STRAUSBAUGH

Northwest Irrigation and Soils Research Laboratory, United States Department of Agriculture - Agricultural Research Service, Kimberly, ID, USA - 83341

MICROBIOME AND METABOLOME ANALYSIS IDENTIFY KEYSTONE GROUPS PUTATIVELY ASSOCIATED WITH RESISTANCE IN A SUGAR BEET MUTANT LINE RESISTANT TO RHIZOMANIA

Rhizomania in sugar beet caused by beet necrotic yellow vein virus (BNYVV) and vectored by *Polymyxa betae*, significantly reduces root yield and sugar production. Resistance in commercial cultivars is primarily dependent upon the use of Rz1 and Rz2 resistant genes. The role of root associated microbiome and metabolites in resistance in a non-Rz resistant background is not fully understood. Using an EMS mutant resistant (R) line and susceptible (S) lines, natural infection in the field, 16S sequencing, and metabolome analysis, putative roles of bacteriome and metabolites against rhizomania disease severity were investigated. The rhizosphere of R line (vs. S) showed higher abundance of bacterial genera such as Enterobacter, Chryseobacterium, Stenotrophomonas, and Pseudomonas at pre-symptomatic stage and Nocardioides, Arthrobacter at symptomatic stage. Metabolome analysis of the rhizosphere exhibited enrichment of pathways and metabolites associated with sesquiterpenoid and triterpenoid at pre-symptomatic, and linoleic acid metabolism at symptomatic stages that were higher in the R vs. S lines. Root metabolome analysis revealed enrichment of pathways and metabolites associated with specific alkaloids and amino acids that were higher in the R line. Higher abundance of genera such as Nocardioides, Ramlibacter, Caulobacteraceae in the rhizosphere of R line at symptomatic stage showed strong positive correlations with L-methionine, isoleucine, and lauric acid respectively in the roots that were higher in the R line. Our results indicate that root metabolites may play a role in restructuring rhizosphere bacteriome thereby contributing to rhizomania resistance.

5.3 ELEANOR TOWLER
British Beet Research Organisation (BBRO), Centrum, Norwich Research Park, UK - NR47UG

INFORMING COVER CROP DECISIONS- VIRUS HOST RISK

The use of cover crops before sugar beet is becoming increasingly popular in the UK. With government schemes available and sustainability in the spotlight more farmers are considering using a cover crop or cover crop mix. It is important to consider the risks as well as the benefits associated with this change in practice. One such consideration is the ability of the cover crop species to host Virus Yellows. Although timely destruction is strongly encouraged the risk of green bridging into sugar beet is a serious one. Aphids are able to survive the milder winters the UK is more frequently experiencing in recent years. This overwintering risk is heightened by the increase of cover crops which provide aphids with a winter host plant into the following sugar beet season. Any green matter remaining post destruction also provides an opportunity for virus present in nearby plants when aphids migrating into the crop arrive. As such virus could be acquired and quickly transferred to infect young sugar beet. This early infection could result in widespread Virus Yellows infection and subsequent yield losses of up to 50%.

Following a grower wide survey in 2023 the most commonly used cover crops were identified and selected for testing. Plants were inoculated with aphids carrying each of the yellowing viruses, BYV, BMYV and BChV, and subsequently tested using ELISA. Each species was also visually assessed for its aphid hosting risk to better understand the likelihood of its virus hosting status affecting the following sugar beet crop. From this testing a scoring system was developed to be included in a cover crop guide available to growers to aid decision making on farm.

5.4 ELEANOR TOWLER

British Beet Research Organisation (BBRO), Centrum, Norwich research Park, UK - NR47UG

MONITORING BEET MOTH IN THE UK CLIMATE

Beet moth incidence in the UK has increased dramatically following its first impact in 2022. Hot dry summers are becoming more common due to climate change and as a result pests such as beet moth are now being found in the UK. Drought symptoms induced by changes in weather pattern result in a compromised canopy which favours beet moth and makes the crowns more accessible and vulnerable to damage. Increased temperature exacerbates this by accelerating the moth's lifecycle resulting in more generations occurring in the season. Beet moth larvae hatch in spring and burrow into the heart of the plant causing blackening. As more larvae emerge damage worsens, the heart leaves are lost and burrowing into the crown is evident. Eventually significant leaf loss can occur leaving the sugar beet vulnerable to frost damage and root rot. Beet have been seen to recover between generations when the populations dip, but this likely reduces sugar levels in the root- particularly when regrowth occurs late in the season.

Multiple generations are thought to occur in the UK, to understand these further BBRO has been monitoring beet moth numbers using pheromone traps across the beet growing area. Since monitoring began in 2023 incidence and impact of beet moth infestations have both increased year on year. Pheromone traps were placed at 20 sites and catch numbers recorded weekly between April and October. A scoring system has also been developed in partnership with British Sugar to record damage to the crop and monitor its progression. The data from these and ongoing research into beet moth behaviour, emergence and impact in the UK is presented here.

5.5 LEVINE DE ZINGER[1], ANDRÉ WAUTERS[2]

[1]Institute of Sugar Beet Research (IRS), Kreekweg 1, NL - 4671 VA Dinteloord
[2] IRBAB-KBIVB, Molenstraat 45, B - 3300 Tienen

BEET MOTH RESEARCH IN BELGIUM AND THE NETHERLANDS

Due to climate change, pests originating from South-East Europe are increasingly able to survive in Western Europe. In the past couple of years, beet moth (*Scrobipalpa ocellatella*) were found in high numbers in Belgium and the Netherlands. The first generation of the beet moth emerges in spring. Pupae and larvae overwinter in the surface layer of the soil, in fields where sugar beet was grown in the previous year. The eggs are mainly laid on the petiole of sugar beet leaves. After hatching, the larvae penetrate and tunnel the heart of the plant. Multiple generations can occur simultaneously. Symptoms include black hearts and root rot. In combination with drought and heat, symptoms can worsen. Additionally, secondary infections by microorganisms can further damage the beets. This can accelerate root rot during storage.

In 2024 and 2025, monitoring was conducted at three locations in the Netherlands with different trapping systems. In 2025, a field trial was carried out to test the efficacy of different insecticide spray applications on the number of beet moth larvae. In Belgium, monitoring was carried out in 2024 at seven locations and in 2025 at four locations.

Results of beet moth monitoring and results of the insecticide field trial will be presented.

5.6 MARK MCMULLAN
Earlham Institute, NR4 7UZ, UK - Norwich

HARNESSING WILD CROP RELATIVES TO UNCOVER NOVEL RESISTANCE AND PATHOGEN VIRULENCE IN SUGAR BEET

Wild crop relatives represent a valuable but underutilized resource for understanding plant resistance and pathogen adaptation. Here, we use cultivated sugar beet and its wild progenitor, sea beet (*Beta vulgaris* subsp. *maritima*), to investigate how pathogens evolve to overcome resistance and how wild relatives may harbour untapped genetic defences.

Because sugar beet was domesticated relatively recently, many pathogens can infect both the crop and its wild ancestor. This overlap provides a unique opportunity to detect resistance traits in wild populations that can improve crop resistance. We focus on the beet-rust (*Uromyces beticola*) interaction as a model pathosystem for resistance gene discovery and virulence surveillance.

Using wild sea beet populations, we apply genome-wide association (GWAS)-like approaches to identify novel resistance loci against beet rust. In the rust pathogen, we assess genetic differentiation from the crop population to pinpoint candidate virulence factors involved in host adaptation. Our goal is to develop this system into a model for integrated air-based pathogen surveillance and the identification of durable resistance genes, directly from natural populations.

5.7 LARS PERSSON[1], MARIANN WIKSTRÖM[2], JAMSHID FATEHI[3]

[1]Brandsberga Gård AB/Agri Science Sweden AB, Brandsberga Gård 210, S - 264 53 Ljungbyhed
[2]Agro Plantarum AB, Kärrarpsvägen 410, S - 265 90 Åstorp
[3]Lantmännen BioAgri, Fågelbacksvägen 3, S - 756 51 Uppsala

APHANOMYCES MACROSPORUS CAUSING ROOT ROT IN SUGAR BEET, SPINACH AND BARLEY

A new root rot disease in barley, caused by an Aphanomyces species, was found in field surveys in Southern Sweden and Denmark. In pathogenicity tests isolates infected both barley, sugar beet and spinach, indicating a broad plant host range. The symptoms on sugar beet and spinach resembled those induced by *Aphanomyces cochlioides*. The symptoms in barley included yellowing of leaves, brown coleoptiles, and discoloration of roots. Soil wetness after high rainfall favored the disease, resulting in yellow patches, which could extend to entire fields, with significant yield losses. Oospores were found in the fine roots, and Aphanomyces isolates were obtained from these roots. Morphological and molecular analyses clearly separated and distinguished these isolates from other known Aphanomyces species, and Aphanomyces macrosporus has been described as a new plant pathogenic species. This new pathogenic Aphanomyces species is most probably a member of the group of pathogens causing damping off and root rot in sugar beets. The impact of this finding on crop rotation planning and sequences of crops must be investigated.

5.8 Maria Köhler[1], Lars Persson[2], Magnus Karlsson[3], Marco Thines[4]

[1]Strube D&S GmbH (RAGT Group), Haupstr. 1, D - 38387 Söllingen
[2]Nordic Beet Research Foundation, Borgeby Slottsväg 11, S - 23791 Bjärred
[3]Department of Forest Mycology and Plant Pathology, Swedish University of Agricultural Sciences, Box 7026, S - 75007 Uppsala
[4]Senckenberg Biodiversity and Climate Research Centre, Senckenberganlage 25, D - 60325 Frankfurt am Main

Characterisation of isolates of the pathogen *Aphanomyces cochlioides* in Europe to ensure the production of healthy sugar beet

Aphanomyces cochlioides is a pathogen that infects sugar beet and can significantly reduce sugar yield. The soil-borne oomycete causes damping-off on young plants as well as chronic root rot on older sugar beets. The manifestation of the symptoms varies between the affected regions, despite the same varieties. This suggests an intraspecific genetic differentiation that has only been insufficiently investigated. Eighty-two strains from Germany, Sweden, Denmark and Poland were collected and characterized, with most producing abundant oospores and zoospores. Phenotypic assays showed uniform growth across isolates, with an optimum near 25°C and no detectable differences in medium preferences. A bioassay was successfully carried out, demonstrating primarily quantitative resistance in sugar beet. While reproducibility was high within laboratories, inter-laboratory variation suggested a strong influence of greenhouse conditions such as lighting or soil composition. Whole-genome sequencing of 45 isolates, including a high-quality chromosome-level reference genome (64.5 Mb, ~25,600 genes), revealed extensive genetic diversity. Phylogenomic and population genomic analyses showed that there is no correlation whatsoever between origin, pathogenicity and membership of a cluster, suggesting that sugar beet is not the primary host. Instead, sugar beets predominantly recruit the locally available pool of Aphanomyces, which presumably originates from infections of other Chenopodiaceae. These findings provide critical insights for disease management strategies, including targeted weed control beyond cropping years.

5.9 LOUISE HOLMQUIST
Nordic Beet Research Foundation, Borgeby Slottsväg 11, S - 237 91, Bjärred

QUANTIFYING THE IMPACT OF APHANOMYCES INFECTION ON SUGAR BEET QUALITY AND SUGAR CONTENT DURING STORAGE

Sugar beets are a vital crop in Sweden, contributing significantly to the agricultural economy. However, their cultivation is severely threatened by *Aphanomyces cochlioides*, which causes damping-off in young plants and chronic root rot in older plants. In some years, this disease significantly decreases yield, and understanding the extent of yield loss caused by this devastating pathogen is crucial. The impact of Aphanomyces is twofold: it affects yield during the growing season and continues to cause problems during the storage of infected roots. To quantify these yield losses, we have conducted controlled storage trials. These trials involve beets with varying levels of infection (healthy, moderately infected, severely infected) from different varieties, stored under controlled conditions. The trials assess root weight loss, disease progression, and sugar content of the beets at defined storage times. The results provide insights into sugar losses associated with Aphanomyces infection and highlight potential differences between varieties. This data is crucial for optimizing post-harvest handling and prioritizing the delivery order of infected beets.

5.10 LOUISE HOLMQUIST

Nordic Beet Research Foundation, Borgeby Slottsväg 11, S - 237 91, Bjärred

INNOVATIVE AI SOLUTIONS FOR APHANOMYCES MONITORING IN SUGAR BEET AGRICULTURE

Aphanomyces cochlioides is a serious threat to sugar beet cultivation in Sweden, causing damping-off in young plants and chronic root rot in older plants. Due to the absence of visible symptoms above ground, many farmers remain unaware of the issue. In 2024, a year marked by a high incidence of Aphanomyces damage, approximately 25% of all delivered samples in Nordic Sugar's beet campaign exhibited signs of infection. NBR aims to develop an AI-based automatic image analysis method to monitor the spread of Aphanomyces in sugar beet cultivation. This innovative approach involves capturing images of beet samples at the factory and employing deep learning models to classify the extent of Aphanomyces damage. Utilizing thousands of images from 2024, the models will be trained to accurately recognize Aphanomyces symptoms. The automated classification will provide objective annual data on the degree of infestation and geographical mapping of delivered beets. This data can be translated into targeted advice for affected growers, such as soil improvement and variety selection. The ultimate goal is to enhance the sustainability and profitability of sugar beet production by reducing disease-related yield losses and improving raw material quality.

5.11 OLIVER NEHER[1], LOUISE HOLMQUIST[2]

[1]Amalgamated Sugar Company, 105 E Main St., US - OT 97913, Nyssa
[2]Nordic Beet Research Foundation, Borgeby Slottsväg 11, S - 237 91, Bjärred

IIRB PROJECT GROUP LEAF DISEASES

The project group Control of Leaf Diseases was established in 2025. The aim of the group is to foster the exchange of knowledge on foliar diseases and discuss possible solutions.

The current focus of work and research is as follows:

- Cercospora leaf spot (Fungicide efficacy – control strategies)
- Monitoring – updating forecast models
- Fungicide resistance
- RGB sensors – drones – disease monitoring
- Survival of inoculum – seed-borne infections

Chair of the Projectgroup: Oliver Neher (Amalgamated Sugar Company, US)

Vice Chair of the Projectgroup: Louise Holmquist (NBR, S)

5.12 CARL-HUGO JONSSON
Nordic Beet Research Foundation, Borgeby Slottsväg 11, S - 237 91, Bjärred

ADDRESSING THE INCREASING PRESSURE *OF CERCOSPORA BETICOLA*: MANAGEMENT AND RESISTANCE MONITORING FOR SWEDISH AND DANISH SUGAR BEET FARMERS

Cercospora leaf spot (CLS), caused by the fungus *Cercospora beticola*, is a globally recognized threat to sugar beet (-*9). Historically, the disease has not been a major threat in Swedish and Danish sugar beet production. However, recent growing seasons have shown a significant shift, with earlier and more severe outbreaks reported in the Nordic region. To address this emerging challenge, Nordic Beet Research (NBR) has implemented methodologies to improve disease management and monitoring.

This study outlines the implementation of new protocols, including the establishment of inoculated field trials to evaluate cultivar resistance and fungicide efficacy. Furthermore, laboratory frameworks have been standardized to monitor fungicide resistance. These include agar plate assays for isolate cultivation and microtiter plate methods for high-throughput sensitivity screening of collected *C. beticola* isolates. Additionally, DNA sequencing was performed on isolates to identify molecular markers of resistance, specifically targeting the G143A mutation (QoI resistance) and alterations in the CYP51 gene (DMI resistance).

5.13 JONATHAN NEUBAUER[1], RAJ HAZRA[2], MOHI QUADIR[2], CHENGGEN CHU[1], MELVIN BOLTON[1], LONG JIANG[2]

[1]United States Department of Agriculture, Fargo, USA - ND
[2]Department of Mechanical Engineering, North Dakota State University, Fargo, USA - ND 58108

A NOVEL NANOTECHNOLOGY APPROACH: CELLULOSE NANOFIBER-COPPER COMPOSITES FOR CERCOSPORA LEAF SPOT MANAGEMENT IN SUGAR BEET

Cercospora leaf spot (CLS) of sugar beet is a devastating disease caused by the fungal pathogen *Cercospora beticola*. While the timely application of fungicides remains the primary strategy for managing CLS, a significant challenge arises from the widespread resistance of *C. beticola* populations to most fungicide classes globally. Therefore, the objective of this study was to use cellulose nano fibers (CNFs) to enhance efficacy of fungicide for disease management. Five treatments were used; inoculum only, CNF-Cu at 2 mg/ml, CNF-CU at 1mg/ml, CNFs and buffer only. These treatments were applied to 5-week-old sugar beet plants. Three days later, *C. beticola* was inoculated at 10^5 spores per ml and disease severity was evaluated two weeks later to evaluate efficacy of CNF-Cu treatments. Disease inoculation of all CNF-Cu treated plants showed significantly less CLS than non-treated plants or plants treated with CNF or buffer alone, which suggests CNF-Cu can inhibit disease development on sugar beet leaves. An additional potential benefit of using CNF-Cu is the nano scaled cellulose fibers can tightly adhere to plant leaves and therefore may avoid rainfall wash off to provide longer defense against fungus. Future greenhouse experiments will investigate a range of CNF-Cu concentrations, incorporate simulated rainfall events, and dew events. This expanded scope aims to provide valuable insights for future field applications. This study suggests that CNF-based nanotechnology holds promise as an effective management strategy for Cercospora leaf spot.

5.14 KATE ORMAN, ELEANOR TOWLER, ALISTAIR WRIGHT

British Beet Research Organisation (BBRO), Centrum, Norwich Research Park, Colney Lane, Norwich, UK - NR4 7UG

CROPWATCH: INTEGRATING BROAD PERSPECTIVES FOR IN-DEPTH INSIGHT INTO THE UK SUGAR BEET CROP

With ever increasing pressures on the UK sugar beet crop – from narrowing economic margins, changing regulation, and evolving environmental conditions – an integrated approach to sugar beet agronomy is essential.

To provide the best data for UK growers, BBRO has implemented a monitoring network including up to twenty sites across the UK sugar beet growing area. This expands our previous virus yellows monitoring network to include a broader range of pests and diseases – including aphids, beet moth, and foliar fungal diseases such as Cercospora Leaf Spot and rust. This is coordinated with monitoring of environmental conditions, abiotic stresses, soil health, and agronomic practices.

Data is collected by a range of industry partners weekly throughout the season which allows for real time sharing of key information such as incidence of pests and diseases. The broad scale of the network means that all major growing regions have a local site which can be used as an early warning or benchmark for their own crops.

As well as live reporting to the UK industry, the longitudinal nature of this monitoring allows for more in-depth analysis of the effects of different agronomic practices, and informs new avenues BBRO research.

5.15 KATE ORMAN, ALISTAIR WRIGHT

British Beet Research Organisation (BBRO), Centrum, Norwich Research Park, Colney Lane, Norwich, UK - NR4 7UG

SPORE PATROL: TRACKING AND TACKLING THE RISE OF CERCOSPORA LEAF SPOT IN UK SUGAR BEET

Over the last 10 years, Cercospora Leaf Spot (CLS) has gone from a novel and occasional disease to a ubiquitous threat to the UK sugar beet crop – and one which presents the most challenges for control.

Having observed this increase in incidence and spread of CLS in the UK, particularly since 2020, BBRO have instigated a broad range of research and monitoring work which aim to test strain variation in the UK, to understand whether UK strains have adapted British conditions, to assess varietal tolerance to CLS, and to optimise fungicide programmes.

To achieve this, a UK *Cercospora beticola* isolate collection has been established, from which work is being undertaken to understand the optimal growing conditions for UK strains, as well as monitoring fungicide resistance. A network of up to 20 Spornado spore traps have been deployed across the UK sugar beet growing area since 2023 to monitor patterns of spore dispersal. This is integrated with monitoring of local weather conditions and disease progression at a local scale to give a better understanding of the dynamics of CLS in the UK.

This integrated approach will inform more effective CLS magement strategies, with findings actively communicated to growers to support timely, evidence-based decisions for protecting the UK sugar beet crop.

5.16 DORIEN VANDERVEKEN, CHLOÉ DUFRANE, WOUTER VANPARIJS
IRBAB-KBIVB, 45 Molenstraat, B - 3300 Tienen

TOWARDS AN OPTIMIZED FUNGICIDE STRATEGY: INVESTIGATING NUMBER, TIMING AND FREQUENCY OF FUNGICIDE APPLICATIONS FOR AN ENHANCED *CERCOSPORA BETICOLA* CONTROL

Cercospora leaf spot, caused by the fungus *Cercospora beticola*, is the most economically important foliar disease of sugar beet. In recent years, the disease has expanded in both range and severity, making it important and urgent to optimize its control. To date, fungicide applications remain the primary and most effective control method. Compared to some years ago, when a single fungicide application was often adequate, increased disease pressure and reduced efficacy of individual treatments now require multiple applications for sufficient disease control. This evolution has raised questions among researchers and farmers regarding the optimal number, timing and frequency of fungicide use. To address this issue, IRBAB has conducted field trials in Belgium in 2024 and 2025 to investigate different strategies of fungicide treatments, to find a durable solution that strikes a balance between keeping the leaves healthy and limiting fungicide use. In addition to the number of treatments, the interval between treatments is a topic of discussion and was also investigated in this trial. Intervals were either fixed (2, 3 or 4 weeks) or based on treatment thresholds derived from observations in the field. Another interesting question is whether or not a preventive fungicide treatment has significant added value in delaying the appearance of Cercospora symptoms. Lastly, predicting fungal infection can be an important tool in controlling disease pressure. Therefore, timing of fungicide applications based on a prediction model, Agromet, which relies on meteorological data, was also tested. All objects were assessed on leaf health, yield and sugar content of the sugar beets.

5.17 LISA PONET, STEPHANIE COENEN, ISABELLE STOCKMANS, DOMIEN MEES, ANDRÉ WAUTERS

IRBAB-KBIVB, 45 Molenstraat, B - 3300 Tienen

COMPARING *CERCOSPORA BETICOLA* FIELD INOCULATION METHODS FOR ASSESSING VARIETAL TOLERANCE IN SUGAR BEET

Cercospora leaf spot (CLS), caused by the fungus *Cercospora beticola*, is the most widespread and economically significant foliar disease of sugar beet, posing a serious threat to sugar yield worldwide. Depending on the disease pressure, repeated fungicide applications are usually required for effective CLS control. Tolerant or resistant varieties are therefore a key component of integrated management of CLS at they reduce reliance on fungicides and help slow down the development of fungicide resistance.

To reliably assess the tolerance of new and commercial sugar beet varieties under field conditions, a robust inoculation method is needed that produces a strong and homogeneous infection representative of natural disease development. In 2025, IRBAB conducted a field trial in Belgium to compare two different methods for artificial inoculation with *C. beticola*: (i) application of a mixture of dried, *C. beticola* infected leaves and semolina, using a spreader, and (ii) spraying with a suspension of *C. beticola* spores. Both methods were tested on sugar beet varieties differing in tolerance/susceptibility levels, and compared with natural infection conditions. Disease progression was monitored weekly by assessing leaf health.

5.18 GIOVANNI CAMPAGNA
CopRob; IZ Agronomo, via giovanni xxiii 23, I - 40061 Minerbio

LEAF MANAGEMENT STRATEGIES WITH PARTICULAR FOCUS ON "CERCO-STRESS"

Managing sugar beet leaves in Italy is becoming increasingly difficult due to climate change and the banned fungicides to control the most harmful fungus: cercospora leaf spot.

Climate change is directly impacting the timing of cercospora attacks and the severity of the disease, as well as the level of crop stress caused by high temperatures. Index-stress have progressively increased in the new millennium, becoming the norm compared to the exceptional situation of 25 years ago. This has a significant impact on the health of sugar beet, which progressively accelerates senescence, favoring the loss of polarization (retrogradation sindrome). Weight no longer compensates for the loss of polarization, and sucrose is lost during the second part of the harvest season. This requires revising strategies with new fungicides (fenpicoxamid, fluopyram, fluxapyroxad, mefentrifluconazolo, protioconazolo) mixed with dual use biostimulants (e. g. copper proteinate), bringing forward the start of treatments, reducing nitrogen fertilization doses, choosing new-generation sugar beet varieties, and advancing the harvest date.

5.19 GIOVANNI CAMPAGNA
CopRob; IZ Agronomo, via giovanni xxiii 23, I - 40061 Minerbio

NEW STRATEGIES FOR LIXUS CONTROL

The neonicotinoids banned and climate change have led to a significant spread of the Lixus and a change in its habits.

Attacks have become more severe, adults lay eggs in roots as well as leaf petioles, and larvae are more frequently found in roots, where natural parasitization is more difficult. This also leads to a possible increase in the number of generations per year and requires further studies on the cycle and feeding behavior. Furthermore, defense strategies require new effective insecticides (acetamiprid, cyantraniliprole, flupyradifurone, etc.) in a European context where it is increasingly difficult to obtain new authorizations. Another important aspect is the study of the increase in attacks by beneficial antagonistic insects, which, within 2-3 years of the arrival of the Lixus, allow a new balance to be achieved, benefiting from a reduction in attacks.

5.20 DAVID JONES[1], DAVID CLARKE[2], GEORGINA BARRATT[3], PENNY OAKES[4], PETER WRIGHT[5], ALISTAIR WRIGHT[3,5]

[1]Morley Farms Limited, Wymondham, UK - Norfolk NR18 9DF
[2]Niab Eastern Trials Centre, Morley Farm, Wymondham, UK - Norfolk NR18 9DF
[3]British Beet Research Organisation (BBRO), Centrum, Norwich Research Park, Norwich, UK - Norfolk, NR4 7UG
[4]Robinson Farms (Carbrooke Ltd), Lugden Hill Farm, King's Lynn, UK - Norfolk, PE31 8PG
[5]Wrights of Brettenham, Brettenham Manor, Thetford, UK - Norfolk, IP24 2RP

FARM SCALE USE OF ENDOPHYTE GRASSES AND STRIP TILLAGE FOR RESILIENT SUGAR BEET

In Eastern England, Sugar beet is an important break-crop to many farmers, with the sector worth over £368 million each year. Since the withdrawal of neonicotinoid seed treatments, virus yellows, a disease spread by aphids, poses a growing threat, with growers having limited control options and novel solutions to tackle virus are needed.

Funded by DEFRA's ADOPT programme, this project is investigating the use of an endophyte grass cover crop (Barrier U2 Green solutions meadow fescue from CropMark Seeds in New Zealand) which produces lolines (alkaloids) which, when absorbed by the roots of the sugar beet, can protect the plant from insect and nematode pests. The project also incorporates strip tillage to allow 60% of the field to maintain natural soil cover and root system structure with the desiccated grass potentially providing soil resilience to harvest operations.

This ADOPT project collaborates with Niab and BBRO to support soil and crop monitoring as the grass grows and into the following sugar beet crop. Replicated tramline trials at Morley Farms are assessing the benefits of strip tilling sugar beet into an endophyte grass cover crop for integrated pest management and building soil resilience compared to current farm practice. The project is also working alongside two collaborator farms to assess the endophyte grass efficacy for free living nematode control and viability for seed production in the UK.

5.21 REBECCA LAWSON[1], GEORGINA BARRATT[2], ALISTAIR WRIGHT[2]

[1]Fera Science, York Biotech Campus, Sand Hutton, York, UK - YO41 1LZ
[2]British Beet Research Organisation (BBRO), Centrum, Norwich Research Park, Norwich, Norfolk, UK - NR4 7UG

NEMATODES AS BIOINDICATORS: ASSESSING THE IMPACT OF SUGAR BEET CULTIVATIONS

It is usual to consider nematodes as threats to crops. However, the vast numbers of nematodes in our soils are important players in processes such as nutrient cycling and maintaining healthy soils. By investigating these other types of nematodes, we can get an idea of how stable and resilient a soil is. Quantifying the array of nematodes in soil provides an opportunity to gain valuable insights into the functionality of our fields and the impact of growing sugar beet.

BBRO has been undertaking field-scale trials to see how reduced tillage intensities may impact crop yield and soil physical and chemical properties. However, a method to easily and comprehensively assess soil biology and soil function was needed. Therefore, BBRO collaborated with Fera Science in 2024 to submit soil samples to be assessed via their nematode bioindicator service. Nematodes are extracted from soil, analysed and classified according to their trophic groups and the findings reported back to the end user to understand the status of their soil. Analysis found a close relationship between the varying levels of tillage and the make-up of the nematode communities. Soils which were less-intensively cultivated showed greater numbers of nematodes which provide important ecosystem services.

In 2025 the research was expanded further as BBRO have collected further samples. This year, samples have been collected from across the UK's sugar beet growing region to investigate the impact of cultivations across a range of soil types. This work will be presented alongside the preliminary findings to show

5.22 EWA MOLISZEWSKA[1], MAŁGORZATA NABRDALIK[1], ROBERT NELKE[2], MIROSŁAW NOWAKOWSKI[2], KATARZYNA POKAJEWICZ[3]

[1]University of Opole, Institute of Environmental Engineering and Biotechnology, Faculty of Natural Sciences and Technology, ul. Kominka 6a, PL - 45-032 Opole
[2]Plant Breeding and Acclimatization Institute — National Research Institute in Radzików, Bydgoszcz Division, Root Crop's Cultivation and Fundamental Breeding Department, Al. Powstańców Wielkopolskich 10, PL - 85-090 Bydgoszcz
[3]University of Opole, Institute of Chemistry, Faculty of Chemistry and Pharmacy, ul. Oleska 48, PL - 45-052 Opole

PLEUROTUS OSTREATUS MYCELIUM – A GOOD BIOCONTROL WEAPON AGAINST *HETERODERA SCHACHTII*

Pleurotus ostreatus (oyster mushroom) is one of the most widespread mushrooms in the world. In nature, its mycelium produces hyphal knobs with toxic droplets called toxocysts, which paralyze soil nematodes, and among them also plant pathogenic nematodes. One of the most important and destructive nematodes is *Heterodera schachtii*, a cyst nematode pathogenic to sugar beet crops, and also to some weeds. In many countries, such as Poland, there are no registered chemical preparations for nematode control. The opportunity to create a good and effective method comes from vegetative mycelia of *P. ostreatus*, which produces 3-octanone in toxoxysts. Nematodes, after contact with toxocysts, became paralyzed. In the next step, mycelium penetrates inside the nematode body and overgrows it. Finally, mycelium digests and uses nematodes' bodies as a source of nutrients. In our research, we tested many strains of *P. ostreatus* mycelia against a model nematode *Caenorhabditis elegans* and *H. schachtii*. Tests were carried out as laboratory and pot experiments, and also in field research. The results clearly showed that *P. ostreatus* mycelium is a good weapon against nematodes, including *H. schachtii*. The effectiveness of the tested mycelia was at an average level, resulting in a 60% reduction of the *H. schachtii* soil populations, depending on the test type (e.g., pot or field). The mode of action against nematodes depended on their type, showing that *C. elegans* nematodes were mostly paralyzed by toxocysts, while *H. schachtii* cysts were coiled by the mycelium. The mycelium activity was not directly correlated with the toxocysts and 3-octanone production by the mycelium.

5.23 HENNING EBMEYER[1], OLAF CZARNECKI[1], CARSTEN STIBBE[2]
[1]KWS SAAT SE & Co. KGaA, Grimsehlstraße 31, D - 37574 Einbeck
[2]KWS SAAT SE & Co. KGaA, Siedlung 2, D - 97279 Seligenstadt

IMPACT OF SOWING AND HARVEST DATE ON SBR-RTD DISEASE SEVERITY AND YIELD LOSSES IN SUGARBEET

The two sugarbeet diseases, ‘Syndrome des Basses Richesses’ (SBR) and ‘Rubbery Taproot Disease’ (RTD), are spreading in specific regions of Western and South-East European countries. Both diseases are transmitted by planthoppers, e.g. *Pentastiridius leporinus*, *Reptalus quinquecostatus* or *Hyalesthes obsoletus*, whose distribution varies across Europe. They serve as vectors for two bacterial pathogens, the proteobacterium ‘*Candidatus* Arsenophonus phytopathogenicus’ and/or the phytoplasma ‘*Candidatus* Phytoplasma solani’.

Different sowing and harvest dates could influence growth stage of sugarbeet, duration and timepoint of initial planthopper exposure. Thereby, the effect of timing and duration of infestation on disease severity and yield reduction is unclear. Together with that, the comparability of variety trials across different locations and years needs to be investigated. In case of an interaction of these factors, it needs to be investigated if sowing and harvest dates could be an agronomic measure to reduce the impact of SBR-RTD in commercial fields.

Therefore, the effect of different sowing and harvest dates on SBR-RTD disease severity and yield reduction was investigated in sugarbeet field trials at the KWS Breeding Station Seligenstadt, Germany.

5.24 FRANCISCO E. MENDEZ CASTRO, MARIO SCHUMANN, ANTONIO NOGUEIRA JUNIOR, HENNING EBMEYER, NILS KLINGEMANN, DANIEL GONZALEZ CABALLERO, WERNER BEYER, KERSTIN KRÜGER

KWS SAAT SE & Co. KGaA, Grimsehlstraße 31, 3D - 7574 Einbeck

DIGITAL EYES ON SUGARBEET PESTS: MONITORING APHIDS AND PLANTHOPPERS WITH SCALABLE TECHNOLOGIES

With fewer chemical options available sustainable strategies, such as insect monitoring, are essential for managing pests and diseases in sugarbeet. Traditional monitoring methods are labor-intensive. Therefore, KWS has developed digital protocols for scalable, real-time data collection. These tools strengthen Product Management, AgroService, Phytopathology, and breeding programs through continuous insect monitoring.

Two complementary technologies are currently in use. Each is tailored to specific insect targets. LED sensors are used for the aphid species *Myzus persicae* (green peach potato aphid) and *Aphis fabae* (black bean aphid) in high-pressure regions across Germany, France, and the UK. These sensors detect insect movement and presence, offering a novel and exclusive approach for aphid surveillance. Ground truthing is performed using traditional trapping methods to validate species detection and ensure data accuracy.

In parallel, camera-based image analysis is used to monitor the planthopper *Pentastiridius leporinus*, a vector of Syndrome Basses Richesses (SBR) and Rubbery Taproot Disease (RTD). Stationary camera traps capture images of sticky traps installed in sugarbeet fields. These images are analyzed by machine learning classifiers to identify *P. leporinus* adults. As part of the technology development, the number of specimens identified is then correlated with manual counts of insects observed on the yellow cards.

The digital monitoring network, with the technology tested, is effective in capturing the daily aphid and planthopper counts and population dynamics over time. KWS's digital insect monitoring protocols support internal research such as field trials, and targeted application of control measures in seed production and commercial fields. The digital monitoring developed enhances pest management and breeding decisions.

5.25 Francisco E. Mendez Castro, Mario Schumann, Antonio Nogueira Junior, Henning Ebmeyer, Nils Klingemann, Werner Beyer, Kerstin Krüger
KWS SAAT SE & Co. KGaA, Grimsehlstraße 31, D - 37574 Einbeck

Tracking the Threat: KWS sugarbeet pathogen monitoring across Europe

Bacterial diseases like Syndrome Basses Richesses (SBR) and Rubbery Taproot Disease (RTD) have recently emerged as major threats to sugarbeet cultivation. In addition, Virus Yellows (VY), caused by a complex of viruses, remains a persistent challenge due to mixed infections that complicate diagnosis and resistance breeding. These combined pressures highlight the urgent need for integrated breeding strategies targeting multiple pathogens.

KWS is focused on breeding sugarbeet varieties with durable resistance, beginning with understanding pathogen dynamics, such as distribution, dominance, and coinfection patterns across markets, to align trait development with observed disease pressures. To support this, KWS has established a molecular monitoring network across Europe, combining standardized field sampling and advanced diagnostics.

Thousands of samples have been analyzed, enabling precise tracking of pathogen prevalence and regional trends. The results elucidate trends in virus dominance, such as the prevalence of BYV in the samples from UK and France and BChV prevalence in German samples in the last years. The SBR-RTD disease complex mainly appears as simple infections with *C. Phytoplasma solani* in South-Eastern Europe, whereas for Germany the monitoring data indicate that the proportion of mixed infections has increased over the last few years. These insights are already informing our breeding decisions and helping to prioritize resistance traits that are most relevant to growers in different regions.

By combining molecular surveillance with strategic breeding, KWS aims to deliver sugarbeet varieties that are not only high yielding but also resilient to biotic stress in a changing environment. Our work demonstrates the value of integrating pathology, diagnostics, agronomic consulting, and breeding to secure the future of sugar beet cultivation in Europe.

5.26 Nishant Niteshbhai Bagsariya, Carolin Kunz, Nora Temme, Dirk Niemann, Carsten Stibbe, Henning Ebmeyer, Mario Schumann

KWS SAAT SE & Co. KGaA, Grimsehlstraße 31, D - 37574 Einbeck

BREAKING THE CYCLE: INSECTICIDE SEED TREATMENT IN WINTER WHEAT AFFECTS THE SURVIVAL OF *PENTASTIRIDIUS LEPORINUS*

The two sugarbeet diseases, 'Syndrome des Basses Richesses' (SBR) and 'Rubbery Taproot Disease' (RTD), are spreading in specific regions of Western and South-East European countries. Both diseases are transmitted by different glass-winged planthoppers whose distribution varies across Europe. In Germany *Pentastiridius leporinus* is associated as the main planthopper for disease infestation.

The lifecycle of *Pentastiridius leporinus* is very well adapted to the typical sugarbeet-winter wheat crop rotation. After sugarbeet harvest in autumn, winter wheat is directly sown so that the nymphs can continue their lifecycle until spring. The nymphs then develop to mature planthoppers and emigrate from wheat fields into new sugarbeet fields. Besides switching crop rotation from winter wheat to spring crops to interrupt the planthopper lifecycle, it is not known if insecticide seed treatment in winter wheat could reduce the number of nymphs and with that the planthopper population. Therefore, the effect of different insecticide seed treatments on mortality of nymphs and planthopper emergence was investigated in lab trials as well as in field trials with emergence tents.

5.27 LASZLO POTYONDI[1], JANOS KIMMEL[1], FERENC CSIMA[2]

[1]BETA RESERCH INSTITUTE Nonprofit Ltd.,Fő utca 70., H - 9463 Sopronhorpács
[2]Magyar Cukor Zrt., Kaposvár, Pécsi út 10-14., H - 7400 Kaposvár

SUMMER ROOT ROT (SBR AND RTD) IN HUNGARY

The syndrome brasses riches disease (SBR) was first found in Hungary in 1998 in the eastern sugar beet growing regions. Nearly 20 relative % decrease was experienced in the extractable sugar content as a result of the disease. Ribosomal RNA research has revealed that the symptoms were caused by *Candidatus* Phlomobacter betae, later known as *Candidatus* Arsenophonus phytopatogenicus (Microb Ecol (2012) 63:628–638). *Reptalus quinquecostatus* and *Reptalus panzeri* cicadas have been identified as transmission vectors of this pathogen. The disease did not cause significant destruction of plants and did not cause any remarkable damage to domestic sugar beet production due to the rearrangement of production areas.

However, the rubery tap root disease that appeared in 2023, linked with macrophomina infections, made crops unharvestable in large areas. Research into the primary causes of rot symptoms is still ongoing. In collaboration with Serbian and Austrian researchers, we found a stolbur phytoplasma (*Candidatus* Phytoplasma solani), which causes similar symptoms elsewhere in Europe as well. So far, we have identified the same Reptalus species as in the case of SBR, and *Hyalestes obsoletus* as transmission vectors. Based on research and experience we developed recommendations for sugar beet growers to control the disease. These include area selection, nutrient supply, use of antagonist fungi and bacteria, control with insecticides, irrigation and harvest organization.

5.28 ANDREA KOSOVAC[1], YANN GALEIN[2], ALEKSANDRA DELIĆ[3], ŽIVKO ĆURČIĆ[3]

[1]Institute of Pesticides and Environmental Protection, Banatska 31b, SR - 11000 Belgrade
[2]Florimond Desprez BE, Industriepark Fred Chaffardlaan 37-39, B - 3300 Tienen
[3]Institute of Field and Vegetable Crops, Maksima Gorkog 30, RS - 21000 Novi Sad

SUNFLOWER AS AN IN-FIELD SOURCE OF '*CANDIDATUS* PHYTOPLASMA SOLANI' WITH MAJOR IMPLICATIONS FOR RTD IN SUGAR BEET

Nymphal development of planthoppers on crop plants is a critical component of '*Candidatus* Phytoplasma solani' (CaPsol, 16SrXII-A subgroup) disease cycles, as crops serve as infection sources. Recent epidemiological studies on RTD in sugar beet in Serbian agroecosystems revealed that sunflower supports oviposition and nymphal development of *Reptalus quinquecostatus* (sensu Holzinger et al. 2003), a confirmed CaPsol vector to sugar beet. Sunflower is harvested by mid-September, with roots and basal stalk residues remaining in the soil until tillage in early November. Fourth-instar R. quinquecostatus nymphs collected from these residues were infected with CaPsol, indicating sunflower as an inoculum source. Sunflower field samples from plots where adult *R. quinquecostatus* were observed in June, and nymphs on roots in September/October, tested CaPsol-positive. Transmission trials showed high efficiency: *R. quinquecostatus* achieved 100% CaPsol infection in individual sunflower plants, and up to 40% in cage experiments. Additional trials with *H. obsoletus* from *Convolvulus arvensis* induced 100% sunflower infection, suggesting it may enhance CaPsol inoculum later exploited by *R. quinquecostatus* nymphs. The identification of sunflower as an in-field inoculum reservoir provides novel epidemiological evidence for RTD dynamics. Given sunflower's central role in Serbian crop rotations and its status as a leading oilseed in Central and Eastern Europe, these findings highlight new challenges for the management of CaPsol-induced diseases across crops, including the RTD in sugar beet.

5.29 Manuela Schieler[1], Rinklef André [2], Paolo Racca[1]

[1]Central Institute for Decision Support Systems in Crop Protection, Rüdesheimer Str. 60-68, D - 55545 Bad Kreuznach
[2]Fraunhofer Institute for Molecular Biology and Applied Ecology IME, Ohlebergsweg 12, D - 35392 Gießen

THE EXTENSION OF THE DECISION SUPPORT SYSTEM SIMPENTA TO CONTROL THE SUGAR BEET PEST *PENTASTIRIDIUS LEPORINUS*

Pentastiridius leporinus, serving as a vector of the phytopathogenes ‚*Candidatus* Arsenophonus phytopathogenicus‘ (ARSEPH) and ‚*Candidatus* Phytoplasma solani‘ (PHYPSO) can cause severe damages in sugar beet, e. g. reduced sugar content and rubbery tab roots. Additionally, in potato, as well as many other vegetables, it can cause damages on leaves and especially on tubers and roots.

Within the projects NIKIZ and EntoProg, we monitored the different development stages of *Pentastiridius leporinus* in sugar beet over the last six years. We monitored the flight activity by sticky traps and the occurrence of nymphs by digging in the soil. Additionally, laboratory trials were conducted at the Fraunhofer Institute IME to collect data about the life cycle.

It is important to control the vector *P. leporinus* at the optimum point of time. Therefore, we developed the Decision Support System (DSS) SIMPenta to calculate the proportion of the population of each development stage based on site-specific weather data for the current date of the season. Different calls of action and events can be implemented in the DSS, like at the moment, the start of the monitoring and percentage of occurrence of the adult stage. Additionally, we added further development stages to the DSS based on the climate chamber and field data, to get the chance to control those stages at the right point of time. The validation of two events with the data of 2024, flight start and 50% occurrence of adults, showed 82 and 79% correct results of the DSS, which was a difference of ±7 days between the model and monitoring. As a next step, the DSS needs to be tested, if further adjustments are necessary so it can be used for other crops.

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5.30 YANN GALEIN[1], DORIEN VANHEES[1], SARAH ENGELEN[2], BRITT-LOUISE LENNEFORS[2]

[1]Groupe Florimond Desprez, Industriepark 15, B - 3300 Tienen
[2]United Beet Seeds, Industriepark 15, B - 3300 Tienen

SURVEILLANCE OF CIXIIDAE POPULATIONS AND ASSOCIATED SBR/RTD DISEASE SEVERITY

This study focuses on monitoring Cixiidae populations, recognized vectors of different phloem-restricted plant-pathogenic bacteria causing Syndrome ‘Basses Richesses’ (SBR) and Rubbery Taproot Disease (RTD), across multiple European regions including Slovakia, Germany, Italy, and France.

Sticky trap sampling in field trials enabled species identification, mixed populations observation and flight peak determination of *Pentastiridius leporinus*, *Reptalus quinquecostatus*, *Reptalus panzeri*, as well as other Cixiidae such as *Reptalus cuspidatus* and *Hyalesthes obsoletus*. In parallel, the incidence of the bacteria causing SBR and RTD within each insect population is being evaluated to quantify regional disease pressure on sugar beet and potatoes, while also providing insights into RTD pathogen diversity across regions. In addition to these field-based studies, efforts are underway to improve recognition methodologies to strengthen long-term monitoring and surveillance capacities.

5.31 SEBASTIAN LIEBE, DANIEL LAUFER, CHRISTINE KENTER
Institute of Sugar Beet Research, Holtenser Landstraße 77, D - 37079 Göttingen

VARIETY TESTING UNDER SBR INFESTATION – CURRENT STATUS AND CHALLENGES

The bacterial disease SBR is currently the greatest threat to German sugar beet cultivation. An important component of this is the cultivation of tolerant varieties. Since 2020, the IfZ has been coordinating variety trials in SBR infested regions in cooperation with the sugar industry, breeding companies and the Federal Plant Variety Office in order to describe the tolerance of varieties to SBR. This data set was used to analyse the yield effects of SBR and to describe the current status of variety tolerance. The average white sugar yield (WSY) varied between 10,7 and 13,9 t/ha in the years 2020-2024, with the lowest yields measured in the heavy infestation year 2023. In particular, the combination of low beet yield and sugar content had the most serious impact on the BZE. The two molasses formers sodium and amino nitrogen tended to increase under high disease pressure, but the correlation was only very weak. In general, all tested varieties showed a negative yield response depending on the infection pressure. When comparing variety performance in trial series with and without SBR, the differences in WSY varied between 2.3-7.2 t/ha. Compared to a susceptible indicator variety, the approved tolerant varieties showed considerable additional yields, which amounted to up to 50% at individual locations. Nevertheless, the current tolerance characteristics are not sufficient and must be further improved in the future. The dynamic epidemiology of the disease caused by two bacterial pathogens and a mobile vector will pose further challenges for variety characterization.

5.32 Rico Leiser[1], Patrick Schwinges[1,2], Anna Kleineberg[1], Alina E. Maas[1], Linda Werner[2], Sina Schultes[2], Gerold Beckers[1,2], Andreas Krumholz[3], Johann Maier[3], Uwe Conrath[1,2], Caspar Langenbach[1,2]

[1]RWTH Aachen University / Plant Physiology, Worringer Weg 1, D - 52074 Aachen
[2]AgPrime GmbH, Arnold-Sommerfeld-Ring 2, D - 52499 Baesweiler
[3]Südzucker AG, Maximilianstraße 10, D - 68165 Mannheim

Improving stress resilience of sugar beet

Sugar beet production is increasingly constrained by a range of biotic and abiotic stresses, including drought as well as fungal and bacterial diseases. Among the most severe current threats are Syndrome Basses Richesses (SBR) and Rubbery Taproot Disease (RTD). Effective control strategies are urgently needed to safeguard yield and quality. However, the discovery of synthetic and biological agents active against these diseases is impeded by the inability to cultivate the causal pathogens, ARSEPH and PHYPSO, under axenic conditions. Here, we present innovative screening approaches that enable the identification of microbial antagonists and natural compounds enhancing sugar beet health under SBR and RTD pressure, reduce the severity of Cercospora leaf spot (CLS) and alleviate drought stress under water-limited conditions. The implementation of these technologies in agricultural practice holds strong potential to support sustainable stress management in sugar beet and beyond.

5.33 MARTIN BENZ, MARIE WENDT, ALEXANDER UNGRU

Pfeifer & Langen – Landwirtschaftlicher Informationsdienst Zuckerrübe (LIZ), Aachener Str. 1042 a, D - 50858 Köln

TWO YEARS OF SBR MONITORING IN GERMAN BORDER REGIONS – VECTOR AND PATHOGEN SPREAD BEYOND VISIBLE SYMPTOMS AND YIELD LOSS CALLS FOR PREVENTIVE ACTION

The SBR complex has become a major emerging threat in German arable farming, affecting sugar beet potato and vegetable production. The disease is no longer restricted to established hotspot regions of southern Germany. Monitoring in 2024 and 2025 in border and transition regions, including sugar beet growing areas of North Rhine-Westphalia and Saxony-Anhalt, shows that vector presence and pathogen detection reveal a more advanced spread than field symptoms would suggest, even before major sugar losses and processing problems occur.

This poster presents an integrated monitoring approach combining vector monitoring, symptom assessments and pathogen diagnosis in vectors, sugar beets and beet pulp samples. The combined datasets improve early detection of newly affected areas and help to identify regions where preventive intervention is needed before major economic damage occurs.

The relevance of these findings extends beyond Germany. Recent monitoring and expert exchange reveal that *Pentastiridius leporinus* and the SBR complex have become a wider European challenge threatening sugar beet production of neighboring countries. This makes border regions strategically important: they are the places where spread can still be recognized early enough for containment.

We conclude that stronger investment in research, surveillance and effective control options for border regions of infestation is urgently needed. Preventive action is essential not only to protect high-yield sugar beet areas, but also to limit further spread across Europe and reduce the future risk of additional pathogen transmission by *Pentastiridius leporinus*.

5.34 VINCENT KLINK, NADIM ALKHAROUF

[1]Department of Biological Sciences, Mississippi State University, Mississippi State, USA - MS 39762
[2]Department of Computer and Information Sciences, Towson University, Towson, USA - MD, 21252

THE SUGAR BEET ROOT MAGGOT GENOME AS A TOOL FOR ITS CONTROL

B. vulgaris is one of two plants, globally, from which sugar is widely produced with a worldwide value of $4.6 B and $1 B U.S., harvested from 1.14 million acres of land. The native U.S. insect sugar beet root maggot (SBRM) pathogen, *Tetanops myopaeformis* is capable of completely eradicating a sugar beet crop through its pathogenic activities on roots where larvae feed. The *T. myopaeformis* genome has been sequenced, having a size of 509 mB determined from a coverage of 94x from 396 contigs. Samples were obtained from the SBRM-susceptible L19 and F1010 and SBRM-resistant F1016 and F1024 B. vulgaris genotypes at 0, 24, 48, and 72 hours after infection. The RNA-seq analysis has identified a range in total processed reads per sample of 37,947,020 to 46,319,624 in total assembled (used) reads per sample of 25,883,749 (66.16%) to 29,385,047 (70.67%) and a range in total unassembled reads per sample of 10,538,861 (26.64%) to 12,303,540 (29.07%). The range in average used reads per time point was 23,246 (L19 resistant, 24 hpi) to 24,525 (F1010 resistant, 72 hpi), 5.22% therefore, the sample read quantity is similar between the different samples. The analysis identified a number of proteins relating to pathogenicity and how a sugar beet protein may overcome their activity.

5.35 Hannah Adam, Christian Lang, Eric Schall, Jana Stohl, Peter Fedorenko

Verband der Hessisch-Pfälzischen Zuckerrübenanbauer e.V., Rathenaustraße 10, D - 67547 Worms

KumbIT – Cross-crop monitoring and control strategies for the reed planthopper: research with practice and digital advisory services for sustainable agriculture

The planthopper (*Pentastiridius leporinus*) is one of the most serious threats to sugar beet and potato production. By transmitting the bacterial pathogens *Candidatus* Arsenophonus phytopathogenicus and *Candidatus* Phytoplasma solani, it causes severe yield and quality losses. These diseases jeopardize farm profitability and threaten entire regional value chains.

The project KumbIT addresses this challenge by developing integrated management strategies in close collaboration with farmers, advisory services, research institutions, and industry. Its interdisciplinary and practice-oriented approach ensures that scientific results are rapidly translated into effective solutions for everyday farming. Key components include optimizing crop rotations, using cover crops, adapting harvest dates in combination with soil management, and systematically screening control agents. These measures aim to reduce planthopper populations while supporting sustainability. At the core of KumbIT is a digital cultivation advisor that consolidates findings, processes them systematically, and makes them publicly available in real time. This tool provides farmers and advisors with immediate access to reliable, up-to-date knowledge, thereby strengthening informed decision-making. In addition, KumbIT promotes active knowledge transfer through field days, training, professional events, and publications. By linking research and practice with modern IT-based advisory services, the project sets new benchmarks in sustainable pest and disease management.

5.36 MAXIMILIAN WIMMER[1], HELMUT RING[2], HEINZ BERNHARDT[1], JOHANN HAUSLADEN[3]

[1]Technical University of Munich, Dürnast 10, D - 85354 Freising
[2]Verband Bayerischer Zuckerrübenanbauer e.V., Sandstraße 4, D - 93092 Barbing
[3]Technical University of Munich, Emil-Ramann-Straße 2, D - 85354 Freising

EFFECTS OF *BEAUVERIA BASSIANA* AND CALCIUM CYANAMIDE ON THE EMERGENCE OF *P. LEPORINUS*

The emergence of Syndrome Basses Richesses (SBR) and Stolbur poses a major threat to sugar beet production across Europe. The diseases are caused by the phloem-limited pathogens *Candidatus* Arsenophonus phytopathogenicus and *Candidatus* Phytoplasma solani. Their primary vector is the polyphagus planthopper *Pentastiridius leporinus*.

Effective management of these pathogens relies on controlling the vector. However, prolonged influx of adult planthoppers over a four-month period limit the effectiveness of insecticide applications. Additionally, the suppression of soil-dwelling nymphal stages plays a crucial role in population management.

This study aimed to evaluate whether applications of *Beauveria bassiana* and calcium cyanamide into the soil before sowing maize, cultivated after sugar beet, can reduce the emergence of adult planthoppers in spring and summer. Furthermore, the trial investigated whether regulation of *P. leporinus* nymphs is achievable without the use of synthetic chemical insecticides.

5.37 STEFAN GEITZ
Südzucker AG / ldw. Forschung, Maximilianstraße 10, D - 68165 Mannheim

INTEGRATING BIOLOGICAL CONTROL INTO IPM FOR SUGAR BEET: THE EU PROJECT SAGROPIA

The EU-funded research project SAGROPIA addresses the development of innovative crop protection strategies with a particular focus on sugar beet production systems (and potatoes), aiming to reduce the use of chemical plant protection products through the integration of biological and low-risk solutions into Integrated Pest Management (IPM). The project targets key pests and diseases in sugar beet, for which the availability of effective and sustainable control options is increasingly limited due to regulatory restrictions on chemical active substances, including Candidates for Substitution (CfS). Within SAGROPIA, biological and low-risk plant protection solutions, based on plant-derived compounds and microbial agents, are evaluated for their efficacy and compatibility with sugar beet agronomy under controlled and semi-controlled conditions. Based on these assessments, alternative IPM strategies are developed that combine biobased products with preventive and cultural measures tailored to sugar beet cropping systems. A multi-actor approach, involving researchers, farmers and advisors, supports the validation of these strategies in participatory field trials across major European sugar beet growing regions. Furthermore, the environmental, economic and social sustainability of the proposed IPM concepts is assessed. The results of SAGROPIA aim to provide scientifically sound and practice-oriented solutions that contribute to resilient, sustainable and competitive sugar beet production in Europe.

5.38 ANDREAS KRUMHOLZ, ACHIM JESSER, STEFAN GEITZ, JOHANN MAIER
Südzucker AG, Maximilianstr. 10, D - 68165 Mannheim

COMPARISON OF SMALL-PLOT DESIGN AND ON-FARM TRIAL DESIGNS FOR THE DEVELOPMENT OF SYNDROME BASSES RICHESSES (SBR) STRATEGY

SBR is a serious sugar beet disease caused by two pathogens *Ca.* Arsenophonus phytopathogenicus (ARSEPH) and *Ca.* Phytoplasma solani (PHYPSO) with symptoms like wilting, yellowing of leaves and rubbery taproots and reduced sugar content. In severe cases it can cause yield losses of up to 70%. SBR is mainly transmitted by the phloem-sucking planthopper *Pentastiridius leporinus* which is highly mobile, adapted to cropping rotations and abundand in severely affected areas. Overall, this disease leads to large economic losses.

In the past, most trials aimed at developing control strategies (mainly small-plot design) with no clear tendency or significant improvements in yield or quality. We mainly assign this to the immense amount of the planthoppers at the trial locations. New concepts were developed and adapted to the pest and disease.

In order to develop control strategies, we claim that three of four conditions must be met like larger trial plot sizes, combination of plant protection products, multiple applications of the same product and controlling plant hopper exposure to a tolerable amount.

In our coordinated large-scale strip trial is running on working farms. Every field is divided in 3 parts: the control area with approx. 1 hectare and two variants (A and B) with each minimum 2 hectares in size. To ensure practicability for farmers, there are no repetitions on site. However there is a large number of trial sites to ensure statistical reliability of the results. At the end of the trial year the 5 harvesting plots per variant were selected using yield maps and drone imagery in order to minimize the influence of heterogeneity.

We have also adopted small-plot trial design. Based on the well-known complete randomized blocks, insecticides in the remaining parts of the field are used to ensure the small plots are not overwhelmed by the influx of planthoppers.

For insecticide trials, the first application in the small-plots is done when planthoppers first appear – natural planthopper infestation is required. The remaining part of the field is not treated to enable planthopper infestation. This part will only be treated if planthoppers continue to appear and numbers are rising - at the earliest 10 days after the first application.

To test biostimulants, foliar fertilizers or products that strengthen the plant immune system, the entire trial is treated with insecticides. This application is a necessary step because high numbers of planthoppers in insecticide-free control strategies are not feasible. However, even with the new trial design it is important to repeat the trial at multiple locations.

The results of the first year 2025 indicate that the adapted trial concepts leads to clear results and can be used to develop control strategies for affected growers.

5.39 WITOON PURAHONG, ANTONIO NOGUEIRA JUNIOR, NILS KLINGEMANN, KERSTIN KRÜGER, WOLFGANG LÜDERS

KWS SAAT SE & Co. KGaA, Grimsehlstraße 31, D - 37574 Einbeck

BRINGING THE LABORATORY TO THE FIELD: INNOVATIVE RAPID IN-FIELD MOLECULAR DIAGNOSTIC TESTS FOR DISEASES IN SUGARBEET

The KWS Rapid Test is an in-field molecular diagnostic tool designed to detect major plant pathogens in sugarbeet, including *Cercospora beticola* and Virus Yellows (BYV, BMYV and BChV). It uses LAMP (Loop-mediated Isothermal Amplification), a molecular technique that amplifies DNA/RNA at a constant temperature (65°C), eliminating the need for thermal cycling or sophisticated lab equipment. The test workflow includes a simple DNA / RNA extraction step, a 30-minute incubation, and result visualization via lateral flow strips. This allows for accurate pathogen detection even during early symptom development, supporting early control strategies for diseases like Cercospora leaf spot, and guiding precise fungicide applications.

The system is optimized for field conditions, requiring no pipetting step, no refrigeration, and can be stored and used directly on-site. Results are available in under 35 minutes, making it a practical tool for agronomists or farmers. Based on 400 field tests in 2025, the prototypes of KWS Rapid Tests have demonstrated comparable accuracy (95 to 99%) to real-time PCR tests. The specificity of the KWS Rapid Tests ranges from 96% to 100%. This innovation marks a significant advancement in crop protection and stewardship for KWS traits. While initially developed for KWS applications, the test is also intended for broader availability to support disease monitoring and decision-making across the industry.

5.40 BENEDICT WIETERS, NICOL STOCKFISCH
Institute of Sugar Beet Research, Holtenser Landstr. 77, D - 37079 Göttingen

COMPANION PLANTS FOR INTEGRATED APHID MANAGEMENT IN SUGAR BEET

Sugar beet production faces significant threats from aphid infestations, which act as key vectors for yellowing viruses. The effectiveness of chemical control options has been reduced due to the limited availability of insecticides and potential aphid resistances, highlighting the urgent need for alternative pest management strategies. Conservation biological control, which utilizes and enhances natural enemy populations, is a promising approach for the sustainable management of aphids and associated viruses. While flower strips can promote beneficial arthropods and reduce aphid pest pressure, their implementation is often constrained by high cost and area requirements. Companion plants, meaning other plants grown between sugar beet rows, may offer a more resource-efficient alternative. Mechanisms contributing to aphid suppression could be masking beets from pests via visual or olfactory cues, reducing virus spread within fields, serving as a more attractive host, or supporting aphid predators. Within the BetaCompP project, we systematically assess the impact and underlying mechanisms of companion planting in sugar beet. Field experiments conducted at two sites in 2025 and 2026 will compare beet crops with and without different companion plants regarding aphid and insect abundance, virus yellows incidence and yield. This research aims to provide effective and practical strategies for integrated pest management and ecologically responsible sugar beet cultivation.

5.41 AUDREY FABAREZ, PAUL TAUVEL, FABIENNE MAUPAS
Institut Technique de la Betterave (ITB), 45 rue de Naples, F - 75018 Paris

APHID-ARRESTING BEET VARIETIES TO MANAGE BEET YELLOWS DISEASE?

Identifying solutions to control aphid vectors of beet yellows disease is a major challenge for the French sugar beet sector. Based on previous studies, the ANR-AGIR project (2024–2026) has an original and still underexplored objective: to identify beet varieties that are arresting for the main vector *Myzus persicae*, i.e., varieties that limit aphid colonization and feeding behavior. The final aim is to combine these varieties with companion plants to reduce both beet attractiveness and viral transmission. Variety selection relies on high-throughput video phenotyping, electropenetrography, and viral transmission assays conducted under controlled conditions. Combinations of beet varieties and companion plants are evaluated using choice assays and experimental plot trials. Identification of volatile organic compounds (VOCs) and non-volatile metabolites affecting aphid behavior will help explore new avenues for developing control strategies. By focusing on indirect, prophylactic control through inhibition of virus spread rather than direct elimination of aphids, this approach supports a sustainable transition in sugar beet protection against aphids and beet yellows disease.

5.42 LÉONIE CHALLANT, THOMAS HECKY, LAURINE AMBEZA, TAREK DARDOURI, CORENTIN DAUGAN, FABIENNE DUPUY, AMBROISE GARNIER

Agriodor, 6 Rue Pierre-Joseph Colin, F - 35000 Rennes

METHODOLOGICAL AND EXPERIMENTAL CHALLENGES TO DEVELOP AN OLFACTORY STRATEGY FOR CONTROLLING *MYZUS PERSICAE*: A REVIEW OF 4 YEARS OF IN-FIELD TRIALS

Yellowing disease transmitted by aphids – with *Myzus persicae* being the most important vector – remains a threat to sugar beet production. The withdrawal of neonicotinoid products and the limited range of aphicides have placed growers in a critical situation.

Agriodor has developed an innovative biocontrol solution based on volatile organic compounds (VOCs) capable of altering the behavior of *M. persicae* through repellency, reduction of reproduction, and disruption of its feeding behavior.

Optimized VOC blends were incorporated into a bio-based granular matrix, resistant to climatic conditions and compatible with existing agricultural equipment, enabling long-lasting field release.

Over 5 years trials conducted from laboratory to microplots and then large-scale field experiments in diverse agricultural environments (2021–2025) demonstrated significant reductions in aphid populations, reaching up to 51%.

From the Proof of Concept to the large-scale evaluation with farmers, these large-field trials required adjustments fit assessments protocols to the specificity of odors technologies: buffer-zones, in-field monitoring of VOC diffusion, population evaluation on marked plants to approach aphid-based risk of transmission. This research has not only led to the development of Agriodor volatile-based product now commercially available, but also to new methodological cues which could be remobilized for future olfactory strategies.

5.43 DANIELA WÖBER[1,2], MATTHIAS WERNICKE[3], KATHARINA WECHSELBERGER[3], STEPHAN MANHALTER[3], KARIN HANSEL-HOHL[1], FRANCISCO CERQUEIRA[1], EVA M. MOLIN[1]

[1]AIT Austrian Institute of Technology GmbH, Center for Health & Bioresources, Unit Bioresources, A - 3430 Tulln
[2]BOKU University, Institute of Computational Biology, A - 1180 Vienna
[3]Austrian Agency for Health and Food Safety, Institute for Sustainable Plant Production, A - 1220 Vienna

INTESTINAL MICROBIOME INTERACTIONS INFLUENCE METARHIZIUM-BASED BIOCONTROL EFFICACY AGAINST THE SUGAR BEET WEEVIL

The sugar beet weevil (*Asproparthenis punctiventris*) is considered one of the most economically important pests in sugar beet cultivation. A promising biological control strategy involves the natural interaction between entomopathogenic fungi, particularly *Metarhizium* spp. and arthropods. The application of *M. brunneum* against insects has already been demonstrated resulting in lethal mycosis. However, the efficacy of this strain is affected by various factors, including a host’s microbiome. The intestinal microbiome of insects harbours beneficial microbes that possess various functions, including defence mechanisms. This study investigated whether intestinal microbial interactions modulate insect susceptibility and influence mycosis caused by *M. brunneum* and *M. robertsii*. We analysed the intestinal microbiome of both treated and untreated sugar beet weevils, distinguishing between mycotic and non-mycotic individuals at the time of death. A significant reduction in microbial diversity was observed in the intestines of mycotic individuals with Pantoea and Enterobacter as potential Metarhizium-antagonist. In contrast, healthy weevils harboured diverse microbial communities that may provide a protective barrier against entomopathogens. The intestinal microbiome of non-mycotic specimens also contained genera with presumed insecticidal properties, including Serratia, Penicillium and Cladosporium. The latter two were observed in the intestines of male individuals, which were generally at a higher risk of rapid mortality. Further investigation is needed to confirm their insecticidal potential and their ability to enhance the efficacy of Metarhizium-based biocontrol against the sugar beet weevil.

5.44 Daniela Wöber[1,2], Laura Bernadó[3], Francisco Cerqueira[1], Martina Dokal[4], Karin Hansel-Hohl[1], Marion Seiter[4], Jasmin Lampert[3], Eva M. Molin[1]

[1]AIT Austrian Institute of Technology GmbH, Center for Health & Bioresources, Unit Bioresources, A - 3430 Tulln
[2]BOKU University, Institute of Computational Biology, A - 1180 Vienna
[3]AIT Austrian Institute of Technology GmbH, Center for Digital Safety & Security, Unit Data Science & Artificial Intelligance, A - 1210 Wien
[4]AGRANA Research & Innovation Center GmbH, A - 3430 Tulln

Machine learning approaches to forecast sugar beet weevil infestation dynamics

Pest calamities represent a major threat to agricultural productivity, with severe economic and ecological consequences. In Austria, the sugar beet weevil (*Asproparthenis punctiventris*) has caused significant yield losses in recent years. Despite its devastating impact, no reliable forecasting system for calamities currently exists. Earlier approaches have relied on simple linear regression models using a limited set of climatic features, such as temperature and precipitation, but their predictive power has remained low.

In this study, we expand upon these initial attempts by incorporating a broader spectrum of parameters. In addition to weather-related features, we include soil-related characteristics and microbial community composition, obtained through targeted soil sampling and analysis. Furthermore, life cycle–based movement patterns of the sugar beet weevil are integrated into the modelling framework to capture pest dynamics more realistically. A range of machine learning algorithms is evaluated to identify the most influential determinants and to refine predictive accuracy. By systematically comparing different model architectures, we aim to build a robust framework capable of providing field-specific risk assessments. The final model will allow farmers to anticipate sugar beet weevil calamities at an early stage, enabling timely countermeasures and more targeted use of crop protection strategies. This not only reduces pesticide application but also contributes to more sustainable, economically viable, and environmentally friendly sugar beet production.

5.45 EMILY RUSSAVAGE[1], CHENGGEN CHU[1], MARK BOETEL[2], STEPHANNIE SENG[3], PUNYA NACHAPPA[3], VAMSI NALAM[3]

[1]USDA-ARS / Sugar Beet Unit / Edward T. Schaffer Agricultural Research Centre, 1616 Albrecht Blvd N, USA - 58013 Fargo
[2]North Dakota State University / School of Natural Research Science, 1300 Albrecht Blvd, USA - 58103 Fargo
[3]Colorado State University / Department of Agricultural Biology, 301 University Ave, USA - 80523 Fort Collins

SOMETHING SMELLS: USING PLANT ODOR CHEMICALS TO MANAGE INSECT PESTS IN SUGAR BEETS

With several insecticides being phased out of use and insecticide resistance being detected in pest populations, it is increasingly important to find alternative control strategies. For instance, plant-derived chemical repellents and attractants can be used for monitoring, trapping, or minimizing plant damage. Using analytical chemistry techniques, our work has identified chemical compounds that affected the behaviour of major insect pests in the United States, such as Lygus bugs (*Lygus lineolaris*), sugar beet root maggot (*Tetanops myopaeformis*), and beet leafhopper (*Circulifer tenellus*). Here, we show the results of insect behavioural tests and chemical extractions from sugar beets, sea beets, and weed plants.

6 Plant & Soil

6.0 ANDRÉ VAN VALEN[1], GEORGINA BARRATT[2]

[1]Institute of Sugar Beet Research (IRS), P.O. Box 20, NL - 4670 AA Dinteloord
[2]British Beet Research Organisation (BBRO), Centrum, Norwich Research Park, Norwich, Norfolk, UK - NR4 7UG

IIRB STUDY GROUP PLANT & SOIL

The study group Plant & Soil focuses on the combined effects of factors and processes in the seed-plant-soil system on the growth and yield formation of sugar beet. This includes topics from soil science, plant nutrition, irrigation, agronomy and crop physiology.

The current focus of work and research is as follows:

- CO_2 emissions and carbon footprint in sugar beet cultivation
- The impact of cropping systems on soil cultivation (e.g. effect of sugar beet grown as rotational crop on soil carbon)
- Joint database about crop r residues
- N_2O emissions from sugar beet tops
- Fertilization recommendations
- Biostimulants and foliar applications

Chair of the study group: A. van Valen (IRS, NL)

Vice Chair of the study group: G. Barrat (BBRO, UK)

6.1 ANDRÉ VAN VALEN
Institute of Sugar Beet Research (IRS), P.O. Box 20, NL - 4670 AA Dinteloord

EFFECTS OF CROP RESIDUE MANAGEMENT AND CATCH CROPS ON SOIL MINERAL NITROGEN AND LEACHING AFTER SUGAR BEET CULTIVATION

In some regions of the Netherlands, groundwater nitrate concentrations exceed the limit set by the EU Nitrate Directive. This is mainly occurring on arable land on sandy soils. Although sugar beet is classified by the Dutch government as non-susceptible to nitrate leaching, crop residues are a potential risk for nitrate leaching in autumn and winter.

To quantify this risk, field trials were conducted in 2024 and 2025 on a sandy soil. At these trials, sugar beets were harvested in September, October and November. After each harvest, crop residues were either removed, directly incorporated into the soil, or left on the surface to be incorporated before winter. Additionally, winter rye was sown as a catch crop after each harvest. Monthly measurements of soil mineral nitrogen (SMN), root and aboveground biomass, and nitrogen uptake were taken during the growing season. After the harvest, SMN measurements were continued up to 90 cm depth until the end of winter. During winter, the nitrate content in the upper groundwater was also measured. This data provides a valuable insight into the effects of harvest timing and crop residue management on nitrate leaching risks.

The results will be presented on a poster during the congress.

6.2 JURGEN MAASSEN[1], ANDRÉ VAN VALEN[1], ARJEN BRAK[2]

[1]Institute of Sugar Beet Research (IRS), P.O. Box 20, NL - 4670 AA Dinteloord
[2]Groeikracht Cosun, P.O. Box 3411, NL - 4800 MG Breda

GROUNDWATER NITRATE MITIGATION THROUGH EVIDENCE-BASED NITROGEN MANAGEMENT IN DUTCH AGRICULTURE

In several regions across the Netherlands, groundwater nitrate concentrations exceed the threshold of 50 mg/L, thereby surpassing the limits set by the EU Nitrate Directive (91/676/EEC). In response, the Dutch government has proposed generic mitigation measures aimed at reducing nitrate leaching from agricultural sources. To provide growers with actionable insights and support compliance with EU regulations, Groeikracht Cosun launched a large-scale soil mineral nitrogen (SMN) monitoring program in autumn 2024. This initiative targets Cosun crops—potatoes, sugar beet, and inulin chicory—and involves systematic SMN measurements in the 0-90 cm soil profile. The primary objective is to enhance nitrogen use efficiency while minimizing environmental impact.

A key outcome has been increased awareness among growers regarding nitrogen dynamics. In 2025 and 2026, Groeikracht Cosun expanded the initiative to promote spring sampling in the 0–60 cm layer, enabling sugar beet growers to fine-tune nitrogen applications. The spring sampling gave farmers insight in the actual soil nitrogen availability, whereas autumn measurements serve as indicators of potential nitrate leaching.

The poster will present the actions, tools, and results of the Groeikracht Cosun project, highlighting the role of targeted communication, grower engagement, and farm-level data collection in driving behavioral change and improving groundwater quality through informed nitrogen management.

6.3 MAARTEN SCHUT
Institute of Sugar Beet Research (IRS), Kreekweg 1, NL - 4754AP Dinteloord

SUGAR BEET FERTILISATION STRATEGIES FOR REDUCED GREENHOUSE GAS EMISSIONS

Approximately two-thirds of the greenhouse gas (GHG) emissions in Dutch sugar beet cultivation are related to fertilisation. This is primarily caused by nitrous oxide (N_2O) emissions, indicating the importance of reducing these emissions. One way to reduce N_2O-emissions is to use nitrification inhibitors, which leads to a reduction in N_2O-emissions by 36-38% in cropland (Gilsanz, 2016). The addition of nitrification inhibitors improves the availability of nitrogen over the growth period. This may facilitate a reduction in fertilizer input without compromising yield, thereby lowering emissions. Another way to reduce emissions could be to use processed manure (RENURE) as an alternative to synthetic fertilisers. A field trial was set out on a sandy soil in Vredepeel, the Netherlands. Sugar beet plots were fertilised with mineral concentrate and ammonium sulphate as processed manure, and synthetic fertiliser. Furthermore, cattle manure and sugar beet digestate were applied at two N-levels, with and without nitrification inhibitors. Sugar beet yield and quality parameters were assessed, as well as nitrogen levels in the foliage and roots. Results and impact on GHG-emissions will be presented on a poster.

6.4 Georgina Barratt

British Beet Research Organisation (BBRO), Centrum, Norwich Research Park, Colney Ln, UK - NR4 7UG - Norwich

Assessing drought tolerance in UK sugar beet varieties

Hotter and drier summers are getting more frequent in the UK with notable drought periods as recently as 2022 and 2025. Previous studies have shown that the UK sugar beet crop can experience yield loss of around 10% due to water deficit with this increasing to 25% in the driest years. Sugar beet is not commonly irrigated in the UK as higher value crops are prioritised. For this reason, varieties that perform well under drought are important to ensure yields are maintained under water stress. It is also important that varieties have high yield potential in the absence of water stress as the crop needs to perform well in years where water isn't limiting. To ensure yield stability for growers it is important to recognise if there are differences in drought tolerance between varieties currently available to UK growers, as well as those being considered for the UK market.

To answer this question a drought trial was undertaken in 2022, 2024 and 2025 utilising spanish polytunnels and a drip irrigation system to manage water deficit. The approach was refined over the three-year study resulting in more realistic conditions and better control of water deficit. Assessments of transpiration, canopy cover and yield were undertaken and the drought tolerance index calculated (DTI). DTI is the percentage yield maintained under drought compared to the control plots that are kept irrigated. Results from all three years will be presented alongside an overview of the development of the approach.

6.5 GEORGINA BARRATT

British Beet Research Organisation (BBRO), Centrum, Norwich Research Park, Colney Ln, UK - NR4 7UG - Norwich

EXPLORING THE USE OF ORGANO-MINERAL FERTILISERS FOR SUGAR BEET NUTRITION

Ammonium nitrate fertiliser (AN) emissions account for 10.6% of global emissions from agriculture. AN is now available that has been manufactured using renewable energy. This can reduce carbon emissions by up to 90% compared to using fossil fuels. However, renewable energy AN is expensive and not yet readily available so other alternatives need to be considered. One option is organo-mineral fertilisers. These offer a lower carbon alternative as they are manufactured using recycled materials or are sourced from materials that do not require energy intensive processing to be useable as fertiliser. These fertiliser products can also help reduce N_2O emissions through slower release of nutrients compared to AN. This makes them more stable than AN hence reducing the amount of volatilisation. Some of these products claim to reduce volatilisation and leaching by up to 80% compared to AN.

Organic matter-based fertilisers raise questions as they release nitrogen (N) slowly. With sugar beet requiring all of its N early to support rapid canopy growth to maximize yield as well as resistance to pests and diseases there could be challenges in late season N uptake. This can lead to oversized canopies at the expense of root growth as well as suppressing sugars through increased impurities and reducing yield. This research aims to identify if alternative lower emission N products are viable to use in sugar beet crops. Data from two years of field trials will be shared.

6.6 ABHISHEK TANWER[1], IAIN GOULD[1], SHAUN COUTTS[1], GEORGINA BARRATT[2]

[1]Lincoln Institute for Agri-Food Technology, University of Lincoln, UK - Lincoln
[2]British Beet Research Organisation (BBRO), Centrum, Norwich Research Park, Norwich, UK - NR4 7UG

THE IMPACT OF COVER CROP MIXES ON SOIL CARBON AND NITROGEN DYNAMICS IN SUGAR BEET

With climate change intensifying, the need for sustainable carbon management is more urgent than ever. Agricultural systems are increasingly recognised as vital platforms for carbon sequestration, offering practical, nature-based solutions to reduce greenhouse gas emissions. Among potential crops, sugar beet (*Beta vulgaris*) stands out due to its rapid growth, high biomass production, and deep root system, which support carbon capture both above and below ground. Sugar beet has potential within regenerative agriculture and low-emission food systems, as its ability to enhance soil organic carbon (SOC) through root exudation, residue return, and microbial stimulation is significant. However, the soil disturbance associated with harvesting presents challenges that must be carefully managed. This study investigates how sugar beet can be integrated into sustainable crop rotations to enhance carbon sequestration and improve soil nitrogen dynamics. Here, we present an experimental study measuring the impact of different cover crop mixes prior to beet planting to improve soil structure and boost nutrient availability. As part of the trial, decomposition experiments were conducted to assess how above and belowground residue breakdown affects SOC levels, greenhouse gas emissions, and residual nitrogen in the soil. Root measurements were undertaken to assess whether different cover crop mixtures promote subsequent deeper rooting in beet, with the aim of enhancing belowground carbon inputs and supporting long-term soil carbon sequestration. Carbon and nitrogen flows are being monitored across the season to understand how these processes interact within the system. In Phase 2 of the trial, we will measure the decomposition rates, and carbon turnover, of above-and below-ground sugar beet residues in the following crop, alongside assessing the depth of beet roots following different cover mixes., We aim to share insights into how sugar beet-based systems can support climate-neutral goals while maintaining agricultural productivity.

6.7 JOAKIM EKELÖF

Nordic Beet Research Foundation, Borgeby Slottsväg 11, S - 237 91 Bjärred

PHOSPHORUS PLACEMENT SIGNIFICANTLY ENHANCES SUGAR BEET YIELD UNDER LOW SOIL P CONDITIONS

This study investigates the impact of phosphorus fertilization techniques on sugar beet yield across twelve field trials conducted between 2021 and 2024. The trials compared broadcast and banded (placed) phosphorus applications at varying rates on soils with different phosphorus availability (P-AL levels). Results show that banded phosphorus—especially under dry conditions and low P-AL soils—can increase sugar yield by over 50% compared to unfertilized controls. Even low rates of placed phosphorus (15 kg/ha) outperformed high rates of broadcast phosphorus (120 kg/ha), highlighting the importance of placement over quantity. The yield response was primarily driven by increased root mass and sugar concentration, with strong correlations observed between leaf phosphorus concentration and sugar yield. These findings underscore the importance of strategic phosphorus placement in optimizing sugar beet production, particularly in soils with limited phosphorus availability and during dry growing seasons.

6.8 GEREON HELLER
AGRANA Research & Innovation Center GmbH, Josef-Reither-Strasse 21-23, A - 3430 Tulln

SOIL SILICON APPLICATION AS A STRATEGY TO IMPROVE DROUGHT RESILIENCE IN SUGAR BEET (*BETA VULGARIS* L.) UNDER CENTRAL EUROPEAN CONDITIONS

Sugar beet (*Beta vulgaris* L.) is a major sugar crop in Europe, yet highly susceptible to drought stress, which is expected to intensify due to climate change. While foliar silicon (Si) application has shown promise in mitigating drought impacts in arid regions, little is known about the effectiveness of soil-applied Si under temperate Central European conditions. This study aimed to evaluate whether soil application of a commercially available granular Si fertilizer improves Si uptake, yield, and quality of sugar beet under drought and non-drought conditions. Field trials were conducted at three sites in Austria and Germany in 2024 using different cultivars and Si application rates. Results indicate that soil-applied Si did not increase Si concentration in plant tissues, suggesting limited plant availability of the tested fertilizer. Nevertheless, under drought stress, Si fertilization significantly increased net sugar yield by up to 18%, likely due to improved water status through osmotic adjustment and/or enhanced root development. No negative effects on quality parameters were observed. In contrast, no Si-related yield effects were found under well-watered conditions. These findings support soil Si application as a potential strategy to improve drought resilience in sugar beet, although its effectiveness appears highly context- and cultivar-dependent. Further research is needed to identify more soluble Si sources and to understand genotypic differences in Si uptake and drought response.

6.9 PRZEMYSŁAW BARŁÓG, REMIGIUSZ ŁUKOWIAK, WITOLD GRZEBISZ

Poznan University of Life Sciences, Department of Agricultural Chemistry and Environmental Biogeochemistry, Wojska Polskiego 28, PL - 60-637 Poznań

SUGAR BEET YIELD AND NITROGEN USE EFFICENCY IN RESPONSE TO POTASSIUM REPLACEMENT WITH SODIUM

Nitrogen (N) is a crucial mineral nutrient that influences both the yield and quality of sugar beet. However, its effectiveness can be significantly modified by the application of other nutrients, particularly potassium (K). This study hypothesized that replacing K with sodium (Na) would not significantly affect sugar beet yield or quality and, consequently, would not diminish the effectiveness of nitrogen fertilization. To test this hypothesis, field experiments were conducted in central Poland, examining the effects of two factors: (i) sugar beet cultivar (Olson, Batory) and (ii) varying K and Na rates. The second experimental factor included the following treatment levels: control (O); 100% of the K-fertilizer requirement (K1); replacement of 25% of K with Na (K0.75+Na0.25); 50% replacement (K0.5+Na0.5); 75% replacement (K0.25+Na0.75); and full replacement of K with Na (Na1). The application rates of K and Na (in the form of KCl and NaCl) were determined based on a constant number of moles of cations applied per hectare, regardless of the element. In each year and in each plot, the total cation charge applied was 3405 moles ha-1. The nutritional status of the plants was assessed at two stages: at row closure and before harvest. Macro- and micronutrient concentrations in plant tissues were determined. Storage roots were subjected to standard sugar analysis, including the measurement of sucrose content and molasses-forming components. Potassium and sodium fertilization increased sugar beet yield compared to the control, regardless of the K:Na ratio in the fertilizers. The effects of different K:Na ratios depending on the year and soil chemical properties. Overall, substituting K with Na did not negatively affect sugar beet yield and nitrogen use efficiency (NUE).

6.10 YANNICK BIEMANS, FRANÇOIS HUYTTENS, ANDRÉ WAUTERS
IRBAB-KBIVB, Molenstraat 45, B - 3300 Tienen

ROW APPLICATION OF MINERAL NITROGEN IN SUGAR BEET PRODUCTION: ADVANCING NITROGEN USE EFFICIENCY UNDER CAP NUTRIENT REGULATIONS

The implementation of the European Green Deal (2019) and the Farm to Fork strategy (2020) has intensified efforts to reduce fertilizer inputs in agriculture. Coupled with stricter nutrient regulations under the Common Agricultural Policy (CAP) and recent fertilizer price spikes, these developments are driving farmers to seek strategies for lowering fertilizer use.

Nitrogen, a key nutrient for crop growth, is particularly targeted due to its significant greenhouse gas emissions during production and its central role in environmental policies. One of the more prominent focuses, is on improving Nitrogen Use Efficiency (NUE) through optimized application methods. Early 90th, it has been demonstrated that the row application of mineral nitrogen in sugar beet can reduce the total amount of nitrogen on the field by about 30% with similar yields. But is this technique still valuable in the context of 2025?

This poster will discuss trial result of the row application of nitrogen for sugar beet as well as its implications on carbon emissions, yield and costs.

6.11 CÉLINE GOUWIE

Institut Technique de la Betterave (ITB), 45 rue de Naples, F - 75008 Paris

A NEW APPROACH TO ANALYZE CULTURAL PRACTICES

In order to gain a deeper insight into the French sugar beet farming practices, ITB has switched preference in favor of French Department of Agriculture formal surveys. They have the advantage of being more representative, based on a sampling design. ITB has been authorized to access the raw data of the arable crops' surveys with a secured access and to extract syntheses on condition to respect statistical confidentiality and secrecy. ITB has been able to analyze the variation of technical aspects of 559 sugar beet plots in 2021, 682 plots in 2017 and 854 plots in 2011, and to produced reference indicators in-company and for sugar beet sector.

6.12 ANDRÉ VAN VALEN[1], ANDRIUS HANSEN KEMEZYS[2], YANNICK BIEMANS[3], ANDRÉ WAUTERS[3], HEINZ-JOSEF KOCH[4], ANNA JACOBS[4]

[1]Institute of Sugar Beet Research (IRS), P.O. Box 20, NL - 4670 AA Dinteloord
[2]Nordic Beet Research Foundation (NBR), Højbygårdvej 14, DK - 4960 Holeby
[3]IRBAB-KBIVB, Molenstraat 45, B - 3300 Tienen
[4]Institute of Sugar Beet Research, Holtenser Landstraße 77, D - 37079 Göttingen

THE EFFECTIVENESS OF BIOSTIMULANTS IN SUGAR BEET CULTIVATION IN NORTH-WESTERN EUROPE

The European market is flooded with a wide range of biostimulants. Many of these biostimulants have in common that they can be used on a wide range of crops. They vary in composition, but are all defined as products that stimulate plants' natural nutrition processes. According to Regulation EU 2019/1009, biostimulants improve the nutrient use efficiency, tolerance to abiotic stress, quality traits or the availability of confined nutrients in the soil or rhizosphere. Within the COBRI institutes (IRBAB, NBR, IfZ and IRS) several field trials were carried out with different types of biostimulants in recent years. This resulted in a large dataset of yield and quality data as well as other parameters which can be used to evaluate the effectiveness of biostimulants. An overview of these results will be presented on a poster.

6.13 IVANA BAJIĆ, ALEKSANDRA DELIĆ, ŽIVKO ĆURČIĆ

Institute of Field and Vegetable Crops, 30 Maksima Gorkog, RS - 21000 Novi Sad

OPTIMIZING SUGAR BEET YIELD THROUGH SOWING AND HARVEST TIMING

Climate change poses increasing challenges to crop production across Europe, particularly in the southern and central regions where sugar beet cultivation is highly sensitive to environmental fluctuations. Among the most frequently applied adaptation strategies are modifications of sowing and harvesting dates, which directly influence both yield potential and crop stability.

The objective of this study was to evaluate the interactions between sowing date, harvest date, and genotype performance in sugar beet, and to recommend the optimal vegetation period for specific hybrid types. To address this, we analyzed the sugar yield of eight genotypes across three sowing dates and five harvesting dates. Yield data were subjected to three-way ANOVA to assess main effects and interactions.

Results demonstrated that sowing date, harvest date, and genotype, as well as their interactions, significantly affected sugar yield. Early sowing favored high-yielding NZ-type hybrids, whereas Z-type hybrids, characterized by higher sugar content, showed greater stability and better performance under shorter vegetation periods. Furthermore, delaying the harvest reduced differences in sugar yield among sowing dates, with later harvests resulting in similar yield levels regardless of planting time.

These findings highlight the importance of adjusting both sowing and harvesting dates as a key adaptation strategy to climate variability in sugar beet production. By aligning hybrid selection with optimal vegetation periods, farmers can improve yield stability and maintain productivity under changing environmental conditions.

6.14 Naveen Kumar Ganga Raju[1], Deepthi Konche[2], Onno Muller[2], Anna Jacobs[1]

[1]Institute of Sugar Beet Research, Holtenser Landstraße 77, D - 37079 Göttingen
[2]Forschungszentrum Jülich GmbH, Wilhelm-Johnen-Straße, D - 52428 Jülich

Impact of elevated atmospheric CO_2 on sugar beet yield and carbon allocation

Increasing atmospheric CO_2 concentrations is expected to have a significant impact on sugar beet yield. However, results from field experiments are scarce. Therefore, a field experiment was conducted in 2023 and 2024 at the University of Bonn's Campus Klein-Altendorf using a free-air carbon-dioxide enrichment (FACE) installation. Two sugar beet varieties (A and B) were tested under two CO_2 concentrations: (i) ambient level and (ii) 600 ppm (eCO_2). In 2023, taproot yield of variety A and B were 1.1 and 1.2 times, respectively, higher under eCO_2 compared to ambient. In 2024, taproot yield of both varieties under eCO_2 was 1.4 times higher than ambient. Sugar content in taproots under eCO_2 was slightly higher in both varieties in 2023, whereas in 2024, it was slightly lower. To investigate the fate of newly assimilated carbon under eCO_2, $13CO_2$ pulse labelling was conducted on variety A at 985°Cd and 1915 °Cd after sowing in 2024. After two hours of labelling, the concentration of 13C in taproots was lower under eCO_2, whereas it was higher in leaves. Relative carbon allocation to taproot was 1.3 times lower under eCO_2 compared to ambient, while carbon allocation to older leaves and their petioles was 1.4 times higher, indicating a slowed allocation of carbon to taproots under eCO_2.

6.15 Dennis Grunwald, Heinz-Josef Koch, Anna Jacobs
Institute of Sugar Beet Research, Holtenser Landstraße 77, D - 37079 Göttingen

The pre-crop value of sugar beet for subsequent wheat compared to other crops

On the majority of German sites, sugar beet cultivation is followed by winter wheat. However, only few studies so far analysed the pre-crop effect of sugar beet on winter wheat compared to other crops. In a long-term crop rotation field experiment near Göttingen, Germany, winter wheat is grown after four different crops: sugar beet, silage maize, winter oilseed rape and winter wheat. In the study years 2023/24 and 2024/25, the above- and belowground crop residues of the pre-crops were analyzed as well as the above- and belowground plant development of subsequent winter wheat and the dynamics of soil mineral nitrogen.

First results show a high residual N amount in the beet leaves compared to the other crop residues, yet a low belowground residual biomass. Soil mineral nitrogen at wheat sowing was clearly lower after sugar beet than after wheat and oilseed rape which partially remained so until spring fertilization. In 2024, wheat roots by April were increased in the topsoil after sugar beet, yet by June wheat rooting was similar for all pre-crops. Aboveground biomass growth of wheat was initially slowed down after sugar beet yet caught up to the level of the other pre-crops over the growing season.

Final grain yield was in one year similar after wheat, maize, and sugar beet, all of which were lower than after oilseed rape, while in the other year, yield after sugar beet was higher than after wheat while still lower than after oilseed rape, which is comparable to long-term results from the field trial. Overall, sugar beet showed no particular advantage for subsequent wheat despite the high N residues which do not appear to benefit the succeeding crop.

6.16 SUSANNA MUURINEN, RUSKA KAIPAINEN, SAGA MELKKILÄ
Sugar Beet Research Centre (SjT), Meltolantie 30, FIN - 21510 Hevonpää

EFFECTS OF DIFFERENT TYPES OF ORGANIC FERTILIZERS ON GREENHOUSE GAS EMISSIONS FROM SUGAR BEET SOILS

Reduction of chemical fertilizers and effective use of organic fertilizers constitutes a sustainable strategy to recycle nutrients, increase soil carbon stocks and mitigate climate change. However organic fertilizers strongly influence microbial processes leading to the release of nitrous oxide (N_2O). The purpose of this study was to estimate the differences between the different organic amendments (manure, compost, digestate). Greenhouse gas emissions for carbon dioxide (CO_2) and N_2O were measured using a static chamber method using a Gasmet FTIR field analyzer (GT5000 Terra). At the beginning of the growing season, a permanent 60 x 60 x 20 cm steel collar was embedded in the soil of each experimental member to a depth of approximately 10 cm. During the measurements, a 60 x 60 x 40 cm steel cover was placed on top of the collars, and the gas accumulation in the chamber was measured for 5–10 minutes. Measurements were made once a week during the growing seasons. The study was done on seasons 2022-2025. The greenhouse gas fluxes were calculated from the linear rate of change of the gas accumulated in the chamber and were reported in mmol CO_2 m^{-2} h^{-1} and µmol N_2O m^{-2} h^{-1}. Cumulative emissions for greenhouse gases were calculated for nitrogen and carbon by interpolating emissions between different measurement times, i.e. it was assumed that the amount of emissions would increase/decrease linearly between measurement times. The emissions for each day were then added together, resulting in cumulative emissions for the entire growing season

6.17 Susanna Muurinen[1], Katja Kauppi[1], Ruska Kaipainen, Arvo Ekman, Jaakko Jussila, Saga Melkkilä, Sami Talola

[1]Sugar Beet Research Centre (SjT), Meltolantie 30, FIN - 21510 Hevonpää

Long-term crop rotation trial in Finland part of MultiSoil-project

Long-term effects of different cropping systems on soil health are tested with sugar beet in MultiSoil project. MultiSoil contributes to Horizon Europe's Mission "A Soil Deal for Europe" specific objectives by reducing soil pollution enhancing restoration and improving soil structure to enhance soil biodiversity and crop production. Soil organic amendments, microbial inoculants, and diversified cropping systems are co-developed with local actors into innovations to complement Integrated Pest Management (IPM) practices. Their site-specific effectiveness is analyzed, and sustainability is assessed in experimental field trials and demonstration sites in 7 countries. Sugar Beet Research Centre (SjT) in Finland is one of these sites. SjT has continued on-going long-term crop rotation trial with 14 different crop rotations including sugar beet since 2015. The aim is to assess the value of sugar beet as a pre-crop to build a model on how the other crops affect sugar beet and to monitor the soil microbial activities, biodiversity and soil quality after different crops and rotation schemes. The MultiSoil project started on the first of September of 2025. However, some preliminary results from the long-term crop rotation trial have been collected already in 2023. Comparison of two monocultures sugar beet and spring wheat indicates that the alive microbial biomass (mg C/kg) measured by near infrared spectroscopy (NIRS) technique was remarkably higher on sugar beet than on spring wheat. However, when the intensity of the crop rotation increased the microbial biomass decreased. Whereas the microbial activity (mg N/kg) increased by rotation cycles.

6.18 YANNICK BIEMANS, FRANÇOIS HUTTENS
IRBAB-KBIVB, Molenstraat 45, B - 3300 Tienen

THE EVOLUTION OF CAP EROSION REGULATIONS IN BELGIUM

The 2023 reform of the Common Agricultural Policy (CAP) introduced new mandatory regulations on soil erosion across the European Union. While Flanders was already largely compliant, Wallonia faced major adjustments as its erosion control framework had previously relied on voluntary, farmer-led, and local initiatives. In response, Wallonia responsible for erosion in his region launched a plan in 2023 based on an erosion sensitivity map, requiring farmers in high-risk zones (red, purple, black) to implement erosion control measures. However, the plan failed due to several shortcomings:

- insufficient recognition of existing on-farm practices
- a limited range of available measures
- very restrictive obligations for farms in extreme risk zones
- the lack of consideration for erosion reduction efforts already undertaken by farmers.

Following this failure, significant revisions were initiated to introduce greater flexibility and to align requirements with farm-specific circumstances. Developed in consultation with agricultural institutions and farmers, these adaptations are intended to create a more practical and effective framework, scheduled for implementation in 2026–2027, with final details expected in July 2026. (the new regulations will also be part of the poster)

6.19 BERT SMIT[1], YOUSSEF WANG-TOURI[2]

[1]Wageningen Social & Economic Research, c/o Edelhertweg 1, NL - 8219 PH Lelystad
[2]Wageningen University, Chair of Business Economics, Hollandseweg 1, NL - 6706 KN Wageningen

OPPORTUNITIES FOR IMPROVING SOIL HEALTH, ECOSYSTEM SERVICES AND FARM INCOME IN SUGAR BEET GROWING

In the Horizon Europe-project ‘SoilValues’, we explore opportunities to develop soil health business models (SHBMs) that can benefit soil health, ecosystem services (ESs), and farmers’ income. Soil health is considered a prerequisite for maintaining or improving crop yields as it can prevent yield losses caused by soil compaction, soil-borne diseases, low soil fertility, and inadequate water storage or infiltration. In the dynamic face of climate change — marked by longer periods of severe drought and heavy rainstorms — and new policies limiting chemical use, addressing these challenges become increasingly important for all farmers throughout Europe.

Measures to improve soil health in sugar beet growing could be harvesting early (before the wet season), adapting tire pressure, growing catch and cover crops, reducing tillage and widening narrow rotations. While such measures might benefit long-term farm income through the beneficial effects of soil health on crop yield, they might cost money on the short term. To overcome short-term income losses, it is necessary to develop SHBMs that simultaneously maintain/improve soil health and farm income. One way to develop such a model is to prioritise measures that simultaneously generate additional EEs for which payments could be received.

Examples of ESs are (improved) water quality, carbon sequestration, biodiversity, and nutrient use efficiency. Such payments could come from the EU (CAP-subsidies) but also from stakeholders that benefit from higher ES-levels, like increased carbon sequestration, who may compensate such efforts with a price premium.

Our presentation will focus on the opportunities to develop SHBMs that simultaneously improve soil health and ESs with the potential to also improve farmer’s income.

7 Weed Control

7.0 ANNE LISBET HANSEN[1], SJEF VAN DER HEIJDEN[2]

[1]NBR (Nordic Beet Research), Denmark,
[2]IRS (Institute of Sugar Beet Research), The Netherlands,

IIRB STUDY GROUP WEED CONTROL

The Weed Control study group evaluates new and existing weed control strategies in the sugar beet crop with considerations to the entire rotation. Monitoring and effect on the weed flora, development of herbicide resistance as well as herbicide phytotoxicity are of special interest. The aim is to develop sustainable solutions for weed control. This includes evaluations of new products, application techniques and control strategies in the sugar beet crop.

The current focus of work and research is as follows:

- Resistance monitoring and management (e.g. ALS, ACC)
- Results and discussion of (joint) field trials of herbicide use and effects
- Mechanical and physical weed control
- Integrated weed management

Chair of the study group: A. L. Hansen (NBR, DK)

Vice Chair of the study group: S. van der Heijden (IRS, NL)

7.1 SJEF VAN DER HEIJDEN
Institute of Sugar Beet Research (IRS), Kreekweg 1, NL - 4671 VA Dinteloord

INTEGRATED WEED MANAGEMENT: CONTROL OF RESISTANT WEEDS IN CROP ROTATION

The development of resistant weeds in current agriculture is problematic. In principle, every grower faces this challenge. Thanks to herbicides, growers could effectively control them for extended periods. The main modes of action with a high risk of resistance are groups A, B, and C, these groups are also used in sugar beet. Due to the frequent use of these products in various crops, weeds are increasingly emerging that no longer respond to conventional products, as they did in the past.

New innovative herbicides become increasingly limited. Furthermore, important herbicides regularly disappear from the market. Therefore, the herbicide portfolio continues to shrink. In practice, this requires not relying solely on chemical measures.

This presentation provides practical advice for awareness of growers and implementing solutions for the control of resistant weeds in crop rotations with sugar beet. Tackling resistant weeds is not a theoretical concept, but a practical derivative. By consciously choosing variety, monitoring, and an integrated approach, growers can prevent, reduce, and mitigate the development of resistant weeds. It requires knowledge, commitment and sometimes existing routines are lost, but it pays off in the long run.

7.2 PETER RISSER[2], SONJA C. PFISTER[1], RAINER OPPERMANN[1]

[1]Institute for Agroecology and Biodiversity (Ifab), Böcklinstraße 27, D - 68163 Mannheim
[2]Südzucker AG, Research Farm Kirschgartshausen, Der Hohe Weg zum Rhein, 12, D - 68307 Mannheim

INTEGRATED FLOWER STRIPS TO ENHANCE BIODIVERSITY IN SUGAR BEET – RESULTS FROM 8-YEAR FIELD EVALUATIONS

Since 2018, annual and perennial flower strips sown in spring and autumn were integrated into sugar beet fields on the Südzucker's experimental farm Kirschgartshausen (Baden-Württemberg/ Germany). From 2018 to 2022 the direct effects of the flower strips on biodiversity and on beneficial insects (for pollination and pest control) in the flower strips and adjacent sugar beet fields were measured with standardized sweep-net samples (May to September). Further, mid-term effects on insects in the wider area were measured with combi traps from 2018 to 2025.

In the flower strips, 7 times more invertebrate biomass and 3 times more individuals were captured than in sugar beet fields. Pollinators were mainly recorded in the flower strips (sweep-net samples) and more abundant there than in other herbaceous and woody habitats (combi traps). Natural enemies were 4 times more abundant in flower strips than in sugar beet fields and were also much more diverse there. In flower strips sown in autumn more natural enemies were recorded than in strips sown in spring, and in a split flower strip with parts sown in autumn and spring more natural enemies and less potential pests were recorded than in flower strips sown in spring or autumn. Some natural enemies prefer strips sown in autumn and others strips sown in spring (results from sweep net samples). Furthermore, the number of pollinators and natural enemies has increased since 2018. Cicadas, the main pest in sugar beet fields, were less abundant in the flower strips than in sugar beet fields.

Overall, flower strips increase biodiversity. Subdivided perennial flower strips with staggered maintenance that offer habitat and refuge for insects in every season have proven successful.

7.3 PETER RISSER

Südzucker AG / BU Agriculture, Research Farm Kirschgartshausen, Der Hohe Weg zum Rhein 12, D - 68307 Mannheim

ROBOTIC WEEDING IN SUGAR BEET – ARE AUTONOMOUS SYSTEMS READY FOR PRACTICAL USE?

In organic farming weed control is critical to achieve high and stable yields. Sugar beet as a row crop is very sensitive against weed pressure from emergence until row closure. Traditional mechanical weeding with hoing is focusing on weed between the row, but weeding effect within the row is quite low. You need hand hoe to control all weeds effectively. Due to lack of temporary workers, robotic solutions - like the sowing and weeding robot Farmdroid FD 20 as well as farming GT from farming revolution - are getting more and more interesting in organic farming. Whereas Farmdroid is a GPS-based system, farming GT uses camera information and artificial intelligence to navigate and to define weeds and crop species to selectively weed all around the crop.

Südzucker’s Research Farm Kirschgartshausen close to Mannheim started to test robotic solutions in sugar beet to evaluate weed control as well as crop saving and to give recommendations to our farmers. More than 90 % of weeds present in the field were detected and could be removed by InRow Weeding using robotics. Plant density was close to untreaded control, indicating high precision of the weeding tools. Hand labour was significant lower in robotic weeded plots than in the untreated variants.

The combination of robotic weeding and SpotSpray just around the crop allows pesticide reduction of up to 90 % depending on sowing distance. The weeding efficiency is high and with 98 % close to full area treatment with herbicides. Up to now the SpotSpray solution is too slow and too expensive to compete with full area sprayers. There is a risk of late weed infestation due to the missing soil herbicide application on most of the field.

As a conclusion: Robotic weeding is working well under even field conditions, with less organic material on top and without stones. It is an economic solution in organic farming, in conventional farming costs are too high and the weeded acerage per day is with 3-4 ha too low.

7.4 PAMELA A CHAMBERS[1], SARAH COOK[2]

[1]British Sugar, 1 Samson Place, London Road, UK - Peterborough, PE7 8QJ
[2]ADAS Boxworth, Battle Gate Rd, UK - Cambridge CB23 4NN

THE CHANGING WORLD OF WEEDS IN THE UK SUGAR BEET CROP

The emergence of 'new' weeds combined with evolving problems in existing species is reflected across the arable rotation. When herbicide actives are not renewed or no longer marketed then weeds previously well controlled may become more apparent. On the other hand, the weed spectrum observed may change with the introduction of new herbicide actives. As game cover, wild flower mixes and cover crops gain popularity, 'new' weed species can be introduced. Reduced cultivations have also become more popular in recent years which also affects weed species.

British Sugar conducts a National Crop Survey (NCS) of about 300 farms annually, which provides an opportunity to observe changes in the weed species found in the sugar beet crop.

Weeds such as Italian ryegrass (*Lolium multiflorum*), barnyard grass (*Echinochloa crus-galli*), thorn apple (*Datura stramonium*) and mugwort (*Artemisia vulgaris*) have increased in frequency in recent years, while the presence of black grass (*Alopecurus myosuroides*) and brome species is widely known. The appearance of weeds resistant to acetolactate synthase (ALS) chemistry is now also apparent in the beet crop.

This poster highlights some of the weeds that have grown increasingly prevalent in the sugar beet crop and the UK's arable rotation along with potential management difficulties.

7.5 PAMELA A. CHAMBERS[1], HUGH GUINAN[2], ALISTER MCROBBIE[2]

[1]British Sugar, 1 Samson Place, London Road, UK - Peterborough, PE7 8QJ
[2]Corteva Agriscience UK Limited, Unit H4, Building H, Melbourn Science Park, Cambridge Road, Melbourn, UK - Cambridgeshire, SG8 6HB

FLORPYRAUXIFEN-BENZYL, A NEW POST EMERGENCE HERBICIDE FOR THE CONTROL OF BROAD-LEAVED WEEDS IN SUGAR BEET

The active florpyrauxifen-benzyl is a synthetic auxin herbicide (Group 4), currently under evaluation by regulatory authorities in Europe and Great Britain (GB) for sugar-beet weed control. Under the active name Rinskor™ it holds over 90 registrations in more than 40 countries on crops such as rice and has won many awards worldwide for its favourable sustainability and ecological profile.

Efficacy trials were carried out in GB by BBRO and Corteva in 2024 and 2025 on a range of soil types to evaluate the performance of Rinskor™ on a range of different weed species.

The trials evaluated the efficacy of Rinskor™ in combination with other tank-mix partners. Triflusulfron-methyl was not included because it has recently been withdrawn in Europe and is awaiting evaluation in the UK.

This paper/poster presents the key weed control attributes of the active ingredient and is based on data generated by BBRO and Corteva in the last two years.

7.6 GIOVANNI CAMPAGNA

CopRob; IZ Agronomo, via giovanni xxiii 23, I - 40061 Minerbio

NEW WEED CONTROL STRATEGIES FOR CONVENTIONAL SUGARBEET CULTIVATIONS

Triflusulfuron-methyl and S-metolachlor have recently been banned for sugar beet weed control with significant difficulties in weed control. This has required the development of new management strategies.

The request for the exceptional 120-day use of Rinpode (rinskor active or florpyrauxifen-benzyl) and Tanaris (dimethenamide-P + quinmerac) has allowed sustainable weed control to be restored, although the problem remains largely unresolved, particularly for Crucifereae weeds (e.g. *Sinapis arvensis*).

Rinpode helps to contain the most sensitive and widespread infestations of *Abutilon theophrasti* and *Ammi majus*, improving effectiveness against Chenopodiaceae weeds. Tanaris mainly compensates the S-metolachlor banned, unlike Rinpode, which replaces the triflusulfuron-methyl banned. When applied post-emergence, Tanaris (in the dimethenamide-P component) helps to control grass infestations in the early stages of development, or better yet, during emergence, including ALS and ACCase-resistant populations. When used in conjunction with metamitron and (phenmedifam + ethofumesate), it also improves the control of Amaranthaceae weeds, including ALS-resistant populations. Quinmerac, applied post-emergence to spring-sown sugar beet, has a limited spectrum of activity, primarily against Umbellifereae (e.g., *Ammi majus*). Its spectrum of activity is more effective against autumn-spring weeds in autumn-sown sugar beet.

7.7 GIOVANNI CAMPAGNA
CopRob; IZ Agronomo, via giovanni xxiii 23, I - 40061 Minerbio

MANAGEMENT OF ALS-RESISTANT POPULATIONS OF *AMARANTHUS* SPP.

The first reports of ALS-resistant populations of *Amaranthus* spp. were made in the 1990s, particularly *Amaranthus hybridus* on soybeans in Veneto region. In the new millennium, new ALS-resistant populations of Amaranthus were reported in the Po Valley following imported seed batches infested with *A. rudis* (=*A. tuberculatus*) and *A. palmeri*.

The revision of soybean control strategies has allowed the sustainable cultivation, but the ALS-resistant populations remain increasingly marked. The use of the Conviso Smart sugar beet variety has allowed to map the spread and severity of the problem. The ban of S-metolachlor on sugar beet has aggravated the situation, as its pre-emergence application in a mixture with metamitron allowed sufficient control of the Amaranthaceae weeds.

Testing new strategies with alternative products has allowed the use of a mixture of dimethenamide-P + quinmerac (Tanaris) in post-emergence with a 120-day. However, pre-emergence dimethenamide-P must be used to increase efficacy, after checking the dosage to avoid phytotoxicity. Rotation with other crops where effective herbicides against *Amaranthus* spp. can be used is essential to contain these dangerous infestations

7.8 JANOS KIMMEL[1], LASZLO POTYONDI[1], DOMONKOS LUKACS[2], FERENC CSIMA[3]
[1]BETA RESERCH INSTITUTE Nonprofit Ltd.,Fő utca 70., H - 9463 Sopronhorpács
[2]Corteva Agriscience, Boldizsár utca 4. H - 1112 Budapest
[3]Magyar Cukor Zrt., Kaposvár, Pécsi út 10-14., H - 7400 Kaposvár

WEEDCONTROL OPTIONS AGAINST SOME HARD-TO-CONTROL WEEDS IN SUGAR BEET IN HUNGARY

In Hungary, Smart varieties are grown on more than two-thirds of the sugar beet growing area, and their proportion is expected to increase in the future. The use of Conviso One is permitted at a single application with 1 l/ha dose. When for some reason the timing of the spraying is not perfect, more less plants from the most common weed in beets, *Chenopodium album*, remains in the areas. (This is unfortunately very common).

In addition, species that are already resistant to ALS-inhibiting herbicides (*Ambrosia artemisiifolia*, *Erigeron canadensis*, *Amaranthus retroflexus*, *Amaranthus blitoides*, *Sorghum halepense*, *Cirsium arvense*, etc.) may also occur on the fields.

In the remaining sugar beet area, in the traditional varieties, the weed that causes the most problems is *Abutilon theophrasti*. So far, only triflusulfuron-methyl has been effective against it, but it has already been banned, although it could still be used with an emergency permit in 2025. Its damage is not only the usual competitive weed damage, but also makes harvest very dificult.

Among the problematic weeds, we tested the effectiveness of control against *Chenopodium album*, *Ambrosia artemisiifolia*, *Amaranthus blitoides* and *Abutilon theophrasti* in a greenhouse in 2025. For each weed, only the herbicides known to be the most effective against it and some mixtures of these were tested, as well as a new active ingredient, florpyrauxifen-benzyl.

Our most important of result was the excellent effect of Rinpode against Abutilon and ALS inhibitor-resistant Ambrosia.

7.9 Daniel Gonzalez Caballero, Mehmet Senbayram, Majid Abdul, Christina Wellhausen, Belal K. Raza, Kalyan Yalamanchili, Maja Smajic
KWS SAAT SE & Co. KGaA, Grimsehlstraße 31, D - 37574 Einbeck

CONVISO® SMART SPRAY MANAGER:
PHENOLOGY-DRIVEN MODELLING OF *CHENOPODIUM ALBUM* TO OPTIMIZE HERBICIDE APPLICATION TIMING

Optimizing the timing of herbicide application is critical for effective weed control in sugar beet cultivation. Although the CONVISO® SMART system provides more flexibility in application timing than classic herbicides, respecting the correct growth stage of the target species *Chenopodium album* is key for high efficacy. The CONVISO® SMART Spray Manager is a digital decision-support tool that models early *C. album* growth to identify optimal spray windows for farmers.

The model processes environmental data with field-specific parameters (tillage and sowing date) to forecast emergence waves and phenology, there by targeting the 2-4 true leaf stage of *C. album*, where herbicide efficacy is highest and supports integrated weed management.

The model was developed through a combination of field trials conducted over multiple seasons and locations. It has since been validated under diverse agronomic conditions and integrated into a user-friendly interface for practical use in the field.

Initial feedback from testing and commercial use in specific countries has shown robustness of the model and relevance of the tool for farmers.

While the current version focuses on the first application and is tailored to non-irrigated fields, further development is ongoing.

This work demonstrates the potential of predictive modeling and digital tools to enhance precision in crop protection and support stewardship.

7.10 CHRISTINA WELLHAUSEN[1], DMYTRO SHARAPOV[1], ALICE RASSINGER[2], CHIARA DE LUCCHI[3], JOSEF SUCHÁNEK[4], WALDEMAR JANIAK[5]

[1]KWS SAAT SE & Co. KGaA, Grimsehlstr. 31, D - 37574 Einbeck
[2]KWS Austria Saat GmbH, Landstraßer Hauptstraße 71/1/205, A - 1030 Wien
[3]KWS Italia S.p.A., Via Secondo Casadei 8, I - 47122 Forli
[4]KWS Osiva s.r.o., Pod Hradbami 2004/5, CZ - 594 01 Velké Meziříčí
[5]KWS Polska Sp. z o.o., ul. Głogowska 151, PL - 60-206 Poznań

HERBICIDE APPLICATION STRATEGIES TO CONTROL ALS-RESISTANT WEEDS IN SMART SUGAR BEET

The increasing appearance of weeds resistant to acetolactate synthase (ALS)-inhibiting herbicides has become a significant challenge in modern agriculture. This development is primarily due to the widespread use of ALS herbicides throughout many crops over the past decades, creating a strong selection pressure. The introduction and widespread adoption of herbicide tolerant CONVISO® SMART sugarbeet has made the existing resistance issues more visible, particularly in the problematic Amaranthus species.

To continuously provide efficient weed control strategies in sugarbeet, we conducted small plot trials in four different countries with a focus on control of ALS-resistant weeds *(Amaranthus* sp., *Chenopodium album*). The tested herbicide strategies included a local classic sugarbeet herbicide standard compared to different combinations of non-ALS active ingredients with CONVISO® ONE, either in mixture or applied as a sequence. Application timing, especially for *Amaranthus* sp., was one of the key elements determining sufficient efficacy, as the time of emergence varied significantly between countries. Our findings provide valuable insights into managing ALS-resistant weeds and highlight the importance of integrated weed management practices.

7.11 MARTIN WEGENER[1], DMYTRO SHAPIROV[2], ERIC DUBERT[3], JENS LOEL[4]

[1]Bayer AG, Division CropScience, Alfred-Noble Str. 50, D - 40789 Monheim
[2]KWS SAAT SE&Co. KGaA, Grimsehlstr. 31, D - 37574 Einbeck
[3]United Beet Seeds, Industriepark 15, B - 3300 Tienen
[4]Betaseed GmbH, Friedrich-Ebert-Anlage 36, D - 60325 Frankfurt am Main

CONVISO® SMART – JOINT STEWARDSHIP APPROACH FOR THE LONG-TERM DURABILITY OF THE SYSTEM

CONVISO® SMART technology has been launched in the first countries 2018 and still represents a recent innovation in sugar beet (*Beta vulgaris* L.) cultivation, integrating a novel herbicide-tolerant trait with a targeted weed management system. The approach relies on sugar beet hybrids carrying a conventionally bred, non-transgenic mutation in the acetolactate synthase (ALS) gene, which confers tolerance to ALS-inhibiting herbicides. When combined with the complementary herbicide formulation CONVISO® ONE, this system enables effective post-emergence control of a wide spectrum of broadleaf and grass weeds, and volunteer sugar beets.

However, the emergence of ALS-resistant weed populations in specific locations highlights the importance of proactive stewardship and integrated weed management. In this presentation, we will present how to preserve the long-term efficacy of the technology by implementing stewardship measures such as the integration of mixing partners with alternative modes of action, use of alternative modes of actions across the crop rotation, and agricultural practices must be consistently applied.

These strategies not only mitigate resistance risks but also reinforce the sustainability of the CONVISO® SMART system. BAYER and KWS as developers of this technology, as well as all licensees, are committed to supporting and promoting these stewardship principles.

7.12 ALIX HUBAUX, CYRILLE CRISMER, WOUT JORIS
IRBAB-KBIVB, Street, 45 Molenstraat, B - 1300 Tienen

STUDY OF HERBICIDE RESISTANCE DEVELOPMENT IN CAMOMILE POPULATIONS FROM CONVISO® SMART SUGAR BEET FIELDS

Since 2020, the herbicide Conviso® One has been approved in Belgium for use in sugar beet with ALS-tolerant varieties. The Conviso® system consists of two applications of 0.5 l/ha of Conviso® One, combined with other active ingredients (ethofumesate, phenmedipham) to reduce the risk of weed resistance to ALS inhibitors. It controls a broad weed spectrum, helps eliminate wild beets, and is particularly effective in fields with difficult flora such as knotweed (*Polygonum aviculare*) and chamomile (*Matricaria chamomilla*).

During the 2024 season, however, several cases of poor control were reported to IRBAB, mainly on chamomile and ragwort (*Senecio vulgaris*). Possible explanations included under-dosing, poor spraying conditions, advanced weed growth stage at treatment, or resistance development.

To test these hypotheses, chamomile seeds from fields with good and poor control were used in climate-chamber trials: (1) a dose-response trial comparing 0.5 l/ha and 1 l/ha to assess under-dosing vs. resistance, and (2) a growth stage trial to evaluate the impact of late treatment. Spraying and growth conditions were carefully controlled.

Results obtained three weeks after spraying indicate resistance development in chamomile populations. Further analyses are underway to characterize the specific resistance mechanisms. This poster presents the protocols and discusses the findings.

7.13 CÉDRIC ROYER
Institut Technique de la Betterave (ITB), 45 rue de Naples, F - 75008 Paris

GRASS MANAGEMENT IN SITUATIONS OF RESISTANCE IN FRANCE

The management of rye-grass and blackgrass is becoming increasingly difficult. Many fields are infested with grasses that are resistant to traditional modes of action applied in different crops of the rotations. In recent years, weed control failures have been observed in these fields, and weed populations are tending to increase. In 2025, the disappearance of the S-metolachlor active substance made weed control even more difficult in sugar beet. Not all French beet-growing regions are affected to the same extent, but it is necessary to adapt practices to contain the spread of these weeds.

Ploughing can be an interesting lever in situations where no plough farming is practised. For chemical treatments, effectiveness must be optimised (use of clethodim, suitable adjuvants, grass growth stage and favourable weather conditions). Today, these costly chemical programmes must be complemented by mechanical weeding.

The use of Smart technology with Conviso One is not necessarily a solution, since this mode of action has been widely used in the rotation for many years and grasses are already resistant.

Agronomic control combined with research into the effectiveness of chemical treatments is currently the best control strategy.

7.14 QUENTIN TILLOY, MICHAEL DENIZET
Cristal Union, Route d'Arcis-sur-Aube, F - 10700 Villette-sur-Aube

LOW INPUTS WEED MANAGEMENT: 5 YEARS OF FIELD TRIALS

Low inputs weed management field trials have been conducted at Cristal Union since 2021. Field trials are located in the Champagne area near Arcis-sur-Aube. The aim is to compare the efficacy and the environmental impact of several weed control management solutions: broadcast spraying and band spraying associated with or without mechanical weeding (inter-row hoeing).

Testing of weed control management are made in block-based trials. A trial sprayer is used for broadcast spraying as well as for band spraying. Mechanical weeding is done with a 6-row hoe pulled by a tractor. A comparison is also made between conventional herbicide and Conviso One® herbicide. Therefore, the same sugar beet variety is used for the entirety of the trial each year.

The results show an interest in using band spraying by reducing IFT (Index of Frequency of Treatments) from an average of 4,3 IFT (Conventional herbicide broadcast sprayed) to 2,5 IFT (Conventional herbicide band sprayed). Band spraying is also interesting to reduce phytotoxicity of herbicide with an improved yield of 1,7%. Introduction of mechanical weeding also shows a benefit. The two techniques combined show an improvement of 4,9% on average. Mechanical weeding alone enabled an improved sugar beet production by 3,2% on average.

Conviso One® herbicide is mixed with other herbicide partners. With this weed control technique, the IFT is reduced from 4,3 to 1,7. The results also show that band spraying and hoeing pair well with the Conviso smart® technology as there is an increase in yield by 3,4% in comparison to broadcast sprayed Conviso One®. In this case the IFT is reduced to only 0,6 as only 35% of the area is sprayed.