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Agroscope, Route des Eterpys 18, 1964 Conthey

Innovation und Technologie im Dienste der Spezialkulturen
L'innovation et la technologie au service des cultures spéciales
Innovation and technology for horticultural crops

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Innovation und Technologie im Dienste der Spezialkulturen

Spezialkulturen bieten einzigartige Nährstoffvorteile und spielen eine wichtige Rolle für die menschliche Gesundheit. Sie tragen auch zur landwirtschaftlichen Biodiversität bei und sind häufig Nischenprodukte mit hoher Wertschöpfung. Angesichts der steigenden Nachfrage nach spezifischen, hochwertigen und umweltfreundlichen Produkten ist Innovation mehr denn je erforderlich, um diesen Anforderungen gerecht zu werden. Die Agrarforschung spielt eine Schlüsselrolle bei der Weiterentwicklung und Nachhaltigkeit von Agrarsystemen, insbesondere angesichts der Herausforderungen durch den Klimawandel. Die Vorträge an diesem Tag werden aufzeigen, wie moderne Technologien diese Kulturen so umgestalten können, dass sie widerstandsfähig werden und gleichzeitig wirtschaftlich interessant bleiben. Der Schwerpunkt wird auf Präzisionslandwirtschaft, integriertem Management und der Züchtung neuer Sorten liegen. Wir werden auch sehen, wie die Digitalisierung und die Nutzung von Daten den Landwirten helfen können, ihre Praktiken zu optimieren. Gemeinsam werden wir innovative Lösungen entdecken, um den Wert von Spezialkulturen zu sichern und den wachsenden Anforderungen einer nachhaltigen und widerstandsfähigen Landwirtschaft gerecht zu werden.

L'innovation et la technologie au service des cultures spéciales

Les cultures spéciales apportent des bienfaits nutritionnels uniques et jouent un rôle important dans la santé humaine. Elles contribuent également à la biodiversité agricole et sont souvent des produits de niche à haute valeur ajoutée. Dans un contexte où la demande pour des produits spécifiques, de qualité supérieure et respectueux de l'environnement ne cesse de croître, l'innovation est plus que jamais nécessaire pour répondre à ces exigences. La recherche agricole joue un rôle clé dans le développement et la durabilité des systèmes agricoles, surtout face aux défis posés par les changements climatiques. Les conférences de cette journée exploreront comment les technologies modernes peuvent transformer ces cultures pour les rendre résilientes tout en les maintenant économiquement intéressantes, en mettant l'accent sur l'agriculture de précision, la gestion intégrée et la sélection de nouvelles variétés. Nous verrons également comment la digitalisation et l'utilisation des données peuvent aider les agriculteurs à optimiser leurs pratiques. Ensemble, nous découvrirons des solutions innovantes pour assurer la prospérité des cultures spéciales et répondre aux besoins croissants d'une agriculture durable et résiliente.

Innovation and technology for horticultural crops

Horticultural crops provide unique nutritional benefits and play an important role in human health. They also contribute to agricultural biodiversity and are often niche products with high added value. As the demand for specific, high-quality and environmentally-friendly products continues to grow, innovation is more necessary than ever to meet these requirements. Agricultural research plays a key role in the development and sustainability of farming systems, especially in the face of the challenges posed by climate change. Today's lectures will explore how modern technologies can transform these crops to make them resilient while keeping them economically attractive, with a focus on precision farming, integrated management and the breeding of new varieties. We will also see how digitalisation and the use of data can help farmers to optimise their practices. Together, we will discover innovative solutions to ensure the prosperity of horticultural crops and meet the growing needs of sustainable and resilient agriculture.

Programm - Programme - Program

08:45 - 09:15 **Registrierung und Kaffee - Enregistrement et café - Registration and coffee**

09:15 - 09:20 **Eröffnung wissenschaftliche Tagung - Ouverture de la réunion scientifique - Opening of the scientific meeting** (Katja Jacot, Präsidentin SGPW)

Übersichtsreferate - Exposés généraux - Keynotes (Lea Frey, SGPW)

09:20 - 09:40 **Current and future strategies and tools to breed resistant apple cultivars** (Andrea Patocchi,Agroscope)

09:40 - 10:00 **LIDO - the digital apple orchard of the future** (Walter Guerra, Laimburg Research Station, Italy)

10:00 - 10:20 **How AI- and robotics-driven innovations will shape the future of berry production** (Josie Hughes, EPFL)

10:20 - 10:25 **Kurze Pause - Petite pause - Short break**

10:25 - 10:45 **Biocontrôle en cultures spéciales : état des pratiques et perspectives de la recherche** (Samuel Stüssi, Andermatt Biocontrol)

Aktuelle Forschungsprojekte - Projets de recherche actuels - Current research projects (Raphaël Charles, SGPW)

10:45 - 12:00 **Flashpräsentationen à 3 Min. - Présentations flash de 3 min. - Flash presentations of 3 min.**

1. *Assessing nitrogen budgets in long-term organic and conventional tea cultivation systems in Sri Lanka* (Mashita Chiewattanakul, ETH Zurich)
2. *Couverts végétaux temporaires en inter-rang pour une meilleure résilience des vergers* (Robin Sonnard, FiBL)
3. *Bekämpfung des Rapserdflohs ohne Pyrethroide* (Olivia Michels, BFH)
4. *Optimizing Agri-PV: Can Solar Panels Enhance Farming Without Trade-offs?* (Jocelyn Widmer, Agroscope)

5. Monilinia laxa*: Symptoms, associated microbiota, and bio-control on* Prunus *spp.* (Samuel Koechli, Agroscope)
6. *Horticulture is the opportunity* (Lukas Bertschinger, Müller-Thurgau Stiftung)
7. *Survey of parasitoids of* Drosophila suzukii *in Switzerland* (Pamela Bruno, Agroscope)
8. *Innovative methods to limit the fungal diseases on apples and pears during storage* (Marie Cachat-Terrettaz, Agroscope)
9. *Comparison of Selected Ecosystem Services and Functions of Organic and Conventional Tea Cultivation Systems in Uva, Sri Lanka* (Jananey Balasubramaniam, University of Peradeniya, Sri Lanka)
10. *FRUCTUS-40 Jahre Engagement für die Obstgenressourcen* (Markus Kellerhals, Fructus)
11. *Identification of Apple Scab on fruit using YOLOv11: A Deep Learning Approach* (Fernanda Leiva Sandoval, Agroscope)
12. *Anbautechnik Silosorghum? Einfluss der Sorte, der Saatdichte und des Reihenabstandes auf Ertrag und Futterqualität* (Sophia Bohländer, Agroscope)
13. *Developing new tools for resistance breeding in pears* (Damien Tschopp, Agroscope)
14. *From apple to pear: Constructing a reference population* (Michaela Jung, Agroscope)
15. *Hydroponic crop production with high nutrient use efficiency from organic waste for space applications* (Icíar Giménez de Azcárate Bordóns, ETH Zurich)
16. *A smartphone app to monitor pests and diseases* (Janique Koller, Agroscope)
17. *A method for transgene-free genome editing in apple using cell-penetrating peptides* (Jonathan Ohnmacht, ETH Zurich)
18. *Nitrogen (N) balance and N use efficiency in selected organic and conventional tea (*Camellia sinensis *(L.) O. Kuntze) cultivation systems in Uva, Sri Lanka* (Srimal Rathnayaka, University of Peradeniya, Sri Lanka)
19. *Enhancing crop pollination monitoring using automated field camera traps* (Thibault Costaz, Agroscope)
20. *Prediction accuracy of genomic versus phenotypic selection in winter wheat* (Samuel Knapp, Agroscope)

12:00 - 12:30 **Busfahrt nach Conthey - Trajet en bus pour Conthey - Bus trip to Conthey + Lunch**

12:30 - 13:30 **Diskussion mit Autor:innen - Discussion avec les auteurs - Discussion with the authors**

13:30 - 14:00 **Mitgliederversammlung - Assemblée générale - General assembly**

Besuch der Agroscope-Versuche in Conthey - Visite des essais Agroscope à Conthey - Visit of Agroscope trials in Conthey
(Séverine Gabioud, SGPW)

14:00 - 14:20 **Beeren und Medizinalpflanzen - Baies et plantes médicinales – Berries and Medicinal plants**
Louis Sutter, Agroscope

14:20 - 14:40 **Obstbau – Arboriculture – Fruit production**
Danilo Christen, Agroscope

14:40 - 15:00 **Gewächshauskulturen - Cultures sous serre – Greenhouse crops**
Cédric Camps, Agroscope

15:00 - 15:50 **Weinbau und Verkostung von neuen Rebsorten - Viticulture et dégustation des nouveaux cépages – Viticulture and tasting of new grape varieties**
Vivian Zuffrey, Agroscope

15:50 - 16:00 **Synthese - Synthèse - Summary**
Séverine Gabioud, SGPW

16:00 **Ende der Tagung - Fin de la réunion - End of meeting**

Inhalt

Übersichtsreferate - Exposés généreaux - Keynotes

Current and future strategies and tools to breed resistant apple cultivars

Andrea Patocchi[1]

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While apple is not traditionally considered a model crop, the extensive breeding research conducted on it surpasses that of most other fruit species, positioning it as a model within the field of fruit breeding. This talk will provide an overview of the achievements in apple breeding research, with a focus on the development of tools that have enhanced breeding efficiency.

We will begin by reviewing the evolution of resistance gene mapping and presenting the molecular markers currently available for selecting genotypes carrying pyramided resistance genes. Using apple scab resistance genes as a case study—alongside an overview of the VINQUEST initiative—the talk will illustrate how resistance genes can be prioritized for incorporation into resistance pyramids. Furthermore, methodologies established at Agroscope that contribute to the efficient breeding of apples with durable resistance will be discussed, including the low-input fast-track breeding approach and the fully outsourced marker-assisted selection (MAS) pipeline.

Successful apple cultivars not only need to be disease resistant, but also possess superior fruit and tree characteristics. As these traits are often polygenic, they cannot be effectively selected using MAS; instead, genomic selection is the preferred approach. To enable its implementation in apple breeding, the apple REFPOP was developed. The outcomes and insights gained from eight years of intensive collaboration on the apple REFPOP initiative will be presented.

Finally, the application of new breeding technologies in apple, such as cisgenesis and early flowering, will be described, highlighting their potential to further accelerate and refine the breeding process.

LIDO - the digital apple orchard of the future

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The use of digital technologies, such as sensors, robots and automated systems, is becoming increasingly significant in fruit growing. Laimburg Research Centre has established an open-air digital laboratory (LIDO - Laimburg Integrated Digital Orchard) to test and demonstrate new technologies under real conditions. LIDO was created in 2022 with the goal of testing and developing innovative digital technologies in collaboration with industry partners and research institutes, as well as providing practical demonstrations to the public. The orchard with the cultivar Rosy Glow/Pink Lady®, covering 0.5 hectares, is trained with the bidimensional multileader system, which facilitates the future use of vision systems and robots. It is equipped with electricity access and embedded in the provincial RTK system and in a local WLAN network. Sensor data can be transmitted to a database developed by Eurac Research.

One key feature in the orchard is the stationary application of phytosanitary products. The system, called S.O.P.H.I.A., uses pulsating sprinkler irrigators to apply products directly on the trees. In 2024, the first trials with agrobiologicals were conducted.

In 2023, a public call for "smart irrigation management" was published. Sixteen different systems have been tested and demonstrated, including sensors for plant physiological parameters and soil moisture. The Research Centre Laimburg itself developed "FylloClip", a low cost sensor monitoring leaf transpiration and providing real-time data on plant water needs.

In 2024, LIDO added a focus on fruit counting and measurement, with companies testing vision systems and dendrometers to monitor daily fruit growth and develop algorithms for fruit recognition. A total of nine vision systems and five dendrometers have been tested and validated on different various apple varieties.

In collaboration with five partners of the Horizon project PHENET, including Agroscope, Laimburg Research Centre is going to develop an open-source phenotyping and monitoring system for fruits, using LIDAR sensors and RGB cameras.

LIDO attracted over 500 international visitors in 2023, culminating in a successful Open Day. In 2024, this event showcased the latest advances in digital fruit monitoring. In 2025, the topic of smart traps for phytopathogens and insects is going to be launched in a public call. As digitalization and automation continue to transform the industry, Laimburg Research Centre will remain at the forefront of monitoring, testing, and co-developing technologies for precision agriculture, aiming for increased efficiency and sustainability.

How AI- and robotics-driven innovations will shape the future of berry production

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Biokontrolle in Spezialkulturen: Stand der Praxis und Perspektiven der Forschung - Insbesondere im geschützten Anbau

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Um die heutigen Pflanzenschutzstrategien im geschützten Anbau zu verstehen, lohnt sich ein Blick auf die Entwicklungen der letzten 35 Jahre. Ein entscheidender Wendepunkt war die Einführung von Hummeln als Bestäuber. Dadurch konnten die damals weit verbreiteten, breit wirksamen Insektizide nicht mehr eingesetzt werden, was den Weg für den Einsatz von Nützlingen (Makroorganismen) ebnete. Parallel dazu entwickelte sich die Analytik weiter, wodurch Rückstandsanalysen in Lebensmitteln schneller und kostengünstiger wurden. Dies führte zu einer deutlichen Reduktion des Einsatzes nicht zugelassener Wirkstoffe.
Ein weiterer Treiber für die heute verbreiteten biologischen und integrierten Pflanzenschutzstrategien sind Resistenzen gegen verschiedene Aktivsubstanzen. Durch den Wegfall mehrerer Wirkstoffe könnte sich dieser Effekt noch verstärken.

Aktuelle Pflanzenschutzstrategien
Die heutigen Pflanzenschutzmassnahmen im geschützten Anbau basieren primär auf dem gezielten Einsatz von Nützlingen, deren Auswahl und Freilassungszeitpunkte an die jeweiligen Kulturen angepasst werden. Die Unterschiede zwischen biologischer und integrierter Produktion sind in der Schädlingsbekämpfung mittlerweile gering. In vielen Fällen kann vollständig auf Insektizide verzichtet werden. Neue Schadorganismen, wie beispielsweise Wanzen, stellen jedoch eine Herausforderung für etablierte Systeme dar. Bei unerwartetem, starkem Schädlingsauftreten werden, sofern möglich, selektiv wirkende Pflanzenschutzmittel eingesetzt. In Ausnahmefällen ist der Einsatz nicht selektiver Mittel erforderlich, was oft zur Folge hat, dass bis zum Kulturende regelmässige Behandlungen notwendig werden da die Wirkung der vorhandenen Mittel unzureichend ist.
Pilzkrankheiten lassen sich im geschützten Anbau durch eine gezielte Klimasteuerung besser regulieren als im Freiland. Zudem ergänzen verschiedene Fungizide auf Basis von Grundstoffen, Resistenzinduktoren und Pflanzenextrakten die Pflanzenschutzstrategien.

Zukunft der Forschung und Weiterentwicklung
Die angewandte Forschung konzentriert sich derzeit auf mehrere Herausforderungen. Der Einsatz spezifisch wirksamer Verfahren erfordert ein intensives Monitoring der Kulturen, das sehr zeitaufwendig ist und qualifiziertes Personal benötigt – eine Ressource, die schwer zu finden ist. Deshalb werden derzeit automatisierte bildgebende Verfahren sowie Methoden der Elektrophysiologie erprobt, um diese Aufgabe künftig teilweise zu übernehmen.
Darüber hinaus gilt es, bestehende Lücken in den Pflanzenschutzstrategien zu schliessen. Neben der Züchtung resistenter Sorten ist die Suche nach neuen Nützlingen, etwa gegen Wanzen und Essigfliegen, ein wichtiger Baustein. Diese „neuen" Nützlinge müssen jedoch auch massenzuchttauglich sein, um einen nachhaltigen und wirtschaftlichen Einsatz zu ermöglichen.

Biocontrol in horticultural crops: current practices and research perspectives with focus on protected cultivation

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To understand today's plant protection strategies in protected cultivation, it is worth looking at the developments of the last 35 years. A decisive turning point was the introduction of bumblebees as pollinators. This made it impossible to use the then widespread broad-spectrum insecticides, paving the way for the use of beneficial organisms (macroorganisms). At the same time, analytical methods advanced, making residue analysis in food faster and cheaper. This led to a significant reduction in the use of unauthorized substances. Another driver for today's widespread biological and integrated plant protection strategies is resistance to various active substances. The elimination of several active substances could further aggravate this situation.

Current plant protection strategies
Today's plant protection measures in protected cultivation are primarily based on the targeted use of beneficial organisms, whose selection and release times are adapted to the respective crops. The differences between organic and integrated production in pest control today are minimal. In many cases, insecticides can be

completely avoided. However, new pests, such as true bugs, pose a challenge to established systems. In the event of unexpected, severe pest infestations, selectively acting plant protection products are used if possible. In exceptional cases, the use of non-selective agents is necessary, often resulting in regular treatments until the end of the crop cycle due to the insufficient effectiveness of the available agents. Fungal diseases can be better regulated in protected cultivation through targeted climate control than in the open field. In addition, various fungicides based on basic substances, resistance inducers, and plant extracts complement plant protection strategies.

Future Research and Development

Applied research is currently focusing on several challenges. The use of specifically effective methods requires intensive monitoring of crops, which is very time-consuming and requires qualified personnel – a resource that is hard to find. Therefore, automated imaging methods and electrophysiology techniques are currently being tested to partially take over this task in the future. Furthermore, existing gaps in plant protection strategies need to be closed. In addition to breeding resistant varieties, the search for new beneficial organisms, such as against bugs and vinegar flies, is an important component. These "new" beneficial organisms must also be suitable for mass rearing to enable sustainable and economical use.

Aktuelle Forschungsprojekte - Projets de recherche actuels - Current research projects

Assessing nitrogen budgets in long-term organic and conventional tea cultivation systems in Sri Lanka

Mashita Chiewattanakul[1*], Srimal Rathnayaka[2*], Ramon Reimann[1], Deepthi Amarasena[3], Astrid Oberson[1], Keerthi Mohotti[3], Janaki Mohotti[4], Emmanuel Frossard[1]

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In October 2019, member states of the United Nations came together and endorsed a proposed roadmap for action on sustainable nitrogen (N) management. This signing of the 'Colombo Declaration' was a first of its kind whereby governments agreed to work together towards the ambitious goal of halving N losses by 2030. The movement was led by Sri Lanka, where tea is the top agricultural export, bringing in a revenue of 1.3 billion USD annually. Accordingly, N fertilisation is vital in reaching target leaf yields and quality. Nevertheless, challenges regarding the high costs of N fertilisers and their perceived health and environmental risks remain. Quantitative insights evaluating actual N inputs and outputs of a tea cultivation system within the island, however, represent a lesser-known aspect. Moreover, while organic production practices are considered an emerging solution to reduce nutrient losses and improve nutrient use efficiency, a comprehensive study of N budgets within such systems is necessary to justify optimal crop production while avoiding N oversupply.

To address these gaps, we assessed N budgets in conventional and organic tea cultivation systems in Sri Lanka at different spatial scales. At the macro level, soil surface budgets were evaluated in a long-term experimental tea field (TRIORCON), composed of three organic and one conventional treatment. Each plot has received N as reclaimable tea, neem oil cake, compost or urea since 2000. Here, preliminary calculations assessing fertiliser input against the output of made tea revealed similar positive balances of 224 ± 139, 272 ± 111 and 203 ± 50 kg N ha^{-1} yr^{-1} in plots receiving reclaimable tea, compost and urea, respectively. The corresponding N use efficiencies (NUE) calculated as the ratio between N in the exported leaves to N added as fertilisers were 20 ± 13 %, 18 ± 11%, and 20 ± 8

%. The neem oil cake treatment had less N input and yield, resulting in a smaller balance of 142 ± 94 kg N ha^{-1} yr^{-1} and a higher NUE of 25 ± 16 %. Nevertheless, the generally high N surpluses and low NUE observed in this trial indicate inefficient N fertiliser use and suggest high N losses.

Accordingly, microplots were installed to further quantify precise N uptake and losses from fertilisation at the tea plant-soil level. We utilised ^{15}N-labelling techniques to determine N uptake by the tea plant from crotalaria residues (at 2 atom% ^{15}N) compared to mineral urea fertiliser (at 5 atom% ^{15}N) added in systems which had been previously cropped under organic or conventional practices. Where necessary, phosphorus (P) and potassium (K) were also supplied to compensate for the amounts contained in the ^{15}N-crotalaria. The incorporation of ^{15}N from the amendment into the plant, soil N pools (total N, mineral N, microbial biomass) and soil solution was followed for ten months. Combined total ^{15}N recoveries in the tea soil-plant system are hypothesised to be higher in the crotalaria residue treatment, which is less prone to leaching and volatilisation losses. First estimations of N balance, use efficiency and losses from these microplots will be presented at the conference.

Couverts végétaux temporaires en inter-rang pour une meilleure résilience des vergers

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La couverture du sol en arboriculture fruitière est l'un des principaux défis et un verger contient une surface non productive notable. Cependant, elle est souvent reléguée au second plan tant les défis sont nombreux. La plupart du temps, un couvert de type « mulching » est semé après une nouvelle plantation ; or, ce type de couverture nécessite des fauches répétées et est peu propice à la biodiversité fonctionnelle. Les producteurs sont pourtant incités à promouvoir d'une part la fertilité et la vie du sol et d'autre part la biodiversité pour faire face aux enjeux actuels.

Les couverts végétaux temporaires ont fait leurs preuves depuis longtemps en grandes cultures et plus récemment en maraîchage et en viticulture. Les avantages conférés à l'arboriculture sont notamment la protection du sol contre les atteintes physiques en améliorant le sol après une nouvelle plantation, en créant un paillage protecteur contre la sécheresse et la canicule et en favorisant la biodiversité (y compris fonctionnelle). De plus, l'effet fertilisant ainsi que l'augmentation de la matière organique sont des facteurs non négligeables.

Quatre mélanges de couverts végétaux temporaires ont été mis en place sur une parcelle nouvellement plantée de pommiers à Valeyres-sous-Ursins (VD) :

- **Legu Fit** : grandes cultures, espèces annuelles ;
- **Wolff** : grand nombre d'espèces, annuelles et vivaces, engrais vert et biodiversité ;
- **Viti Fit été + relais** : (créé et adapté par le FiBL), maximiser les avantages des mélanges purement annuels et de ceux contenant énormément d'espèces favorisant la biodiversité mais qui ont un coût élevé ;
- **Mulching** : référence, occupe rapidement l'espace et fauché comme une pelouse.

Les semis ont été réalisés le 26.04.2024 à la volée, sans enfouissement et sans roulage après un broyage et hersage le même jour. Deux roulages de « destruction » ont été effectués début et fin août 2024.

Des relevés de biomasse ont été opérés le 31.07.2024 selon la méthode MERCI (Méthode d'Estimation des Restitutions par les Cultures Intermédiaires). La restitution d'azote et de phosphore au sol présumée ainsi que l'estimation de l'évolution de la matière organique pour la contribution au stockage de carbone dans le sol sont. Des relevés botaniques ont également été réalisés à trois reprises afin de suivre le développement des couverts.

Les résultats obtenus, bien qu'il s'agisse d'estimations, sont très satisfaisants vis-à-vis de la fertilité du sol et encouragent la poursuite des essais dans le but d'affiner les paramètres de semis (période, espèces, préparation du sol, etc…) et l'itinéraire à adopter pour l'entretien et la destruction du couvert. Les aspects liés à la résilience du sol face aux aléas climatiques et à la biodiversité n'ont pas été mesurés en cette première année d'essai. Le principal frein à la mise en place de ce type de couverts demeure le campagnol avec lequel il est très difficile de composer en tout cas durant les trois premières années.

Bekämpfung des Rapserdflohs ohne Pyrethroide

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Der Rapserdfloh (*Psylliodes chrysocephala* (Linnaeus 1758)) ist der erste wichtige Rapsschädling nach der Aussaat. Bereits auf den Keimblättern können grosse Frassschäden zu hohen Ernteverlusten, sogar Teilausfällen führen. Im konventionellen Anbau sind Insektizide aus der Gruppe der Pyrethroide bislang zugelassen, können jedoch nur mit einer Sonderbewilligung ausgebracht werden. Pyrethroide zählen zu den giftigsten Insektiziden für Wasserorganismen. Minimale Konzentrationen im Nano- oder gar Pikogrammbereich können sich bereits nachteilig auf Wasserorganismen auswirken. Daher ist die Evaluierung von umweltschonenden Alternativen für den nachhaltigen Anbau von Raps essenziell.

Über einen Zeitraum von drei Jahren wurde an 30 Standorten der Einfluss einer Push-Pull Methode auf den Rapserdfloh getestet. An allen Standorten wurde der Raps betriebsüblich mit Pyrethroid nach Bekämpfungsschwelle und ohne Untersaat angebaut. Zusätzlich wurde am Feldrand ein Rübsenstreifen angesät und innerhalb des Rapsfeldes jeweils ein Streifen mit Untersaat ohne Pyrethroide angelegt. Der Schädlingsdruck wurde mit Gelbschalenfängen und Blattfrass der adulten Käfer im Herbst sowie passiver Berlese der Larven im Frühjahr erhoben. Die Zahl der Schädlinge im Rübsenstreifen und im Streifen mit Untersaat wurde mit jener aus der betriebsüblichen Behandlung verglichen. Die Anzahl adulter Rapserdflöhe im Rübsenstreiben war jeweils signifikant höher als diejenige im Rapsfeld mit Untersaat. Der Blattfrass war am ausgeprägtesten im Rübsenstreifen, gefolgt von dem betriebsüblichen Verfahren und dem Streifen mit Untersaat. Auch die Anzahl Rapserdfloh Larven (pro Gewicht pflanzlicher Biomasse) war jeweils am höchsten im Rübsenstreifen.
Die anziehende Wirkung des Rübsenstreifens auf den Rapserdfloh konnte somit bestätigt werden, ebenso wie eine hemmende Wirkung der Untersaat auf den Blattfrass im Keimblattstadium. Wie sich diese Dynamik auf den finalen Rapsertrag auswirkt, bleibt aber zu klären. In Jahren mit geringem Schädlingsdruck sind die Erträge aus dem Streifen mit Untersaat und dem Streifen mit betriebsüblicher Behandlung vergleichbar. In Jahren mit hohem Schädlingsdruck gilt dies nur noch bedingt auf Grund der grossen Variabilität zwischen den einzelnen Standorten. Neben dem Schädlingsdruck und dem Verfahren scheint der Standort ein wesentlicher Faktor zu sein für den Rapsertrag.

Optimizing Agri-PV: Can Solar Panels Enhance Farming Without Trade-offs?

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In Switzerland, around one third of strawberries (*Fragaria x ananassa* Duch.) and three quarters of raspberries (*Rubus idaeus* L.) are grown under rain covers, plastic tunnels or greenhouses, to protect them from adverse external factors. The benefits of these systems, such as longer production seasons and higher fruit quality, are now being threatened by climate change. Rising summer temperatures are increasingly leading to a decline in both yield and fruit quality. There are a number of solutions to reduce high temperatures, such as increasing shade during fruiting, regular spraying of crops or encouraging grass cover in crops. In recent years, agrivoltaic solutions have also emerged as a promising response to climate change, offering an innovative approach to berry production that not only mitigates the effects of rising temperatures, but also meets the growing demand for renewable energy.

In 2024, the project 'Agri-PV Living Lab' was launched. Taking place on bioschmid GmbH farm in Gelfingen (LU) and in partnership with Megasol Energie AG, Insolight SA, Oberfeld Energie GmbH, Berner Fachhochschule BFH and Agroscope. The aim of this three-year project is to demonstrate the feasibility of combining agriculture and photovoltaics over an organic raspberry crop. Three different photovoltaic systems are compared with each other and a reference zone. Two of the systems are dynamic, i.e. it is possible to regulate the intensity of the shade cast on the plants, while the third is static and the shade for the raspberries varies solely according to the course of the sun. Each PV zone has a surface area of at least 2000 m^2. As part of this project, Agroscope Conthey is evaluating the effects of different solar installations on several agronomic criteria in comparison with the control. The main points studied are (1) the climate, (2) the yield of the raspberries, (3) the fruit quality and (4) the development of the plants. Thanks to the protection of the solar panels, it is expected that the climate in the photovoltaic systems will be more favourable for the plants and that the yield obtained will be comparable to the control despite the decrease in light.

This study represents an innovative approach that integrates digitalization and agrivoltaics, contributing to a more sustainable and resilient agricultural system.

Monilinia laxa: Symptoms, associated microbiota, and biocontrol on *Prunus* sp.

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Monilinia laxa is a highly complex stone fruit pathogen. Its ability to infect all tree organs and to perform multiple asexual life cycles in a single year makes it difficult to control, especially in organic agriculture. Despite all the active measures to control it, active removal of infected organs, tolerant varieties and chemicals treatments, *M. laxa* is still causing massive losses in the fruit tree industry. Biocontrol agents (BCAs) can be part of the solution. However, the efficacy and specificity of the currently available BCAs are low. Wild species seem to be more tolerant to *M. laxa* than cultivated species and can be a promising source of BCAs. This work aimed first to have a better understanding of *M. laxa* life cycle. Second to determine the impact of phyllosphere communities of *Prunus* spp. on *M. laxa* presence. Thirdly to isolate and screen for BCAs effective in the phyllosphere environment against *M. laxa*.

To this purpose, we selected two wild species of *Prunus* (*P. spinosa* and P. mahaleb) and two cultivated varieties of *P. armeniaca*, showing different tolerances to *M. laxa*. These trees were first used to identify the symptoms created by *M. laxa* infection. At the same time, healthy tree organs were sampled to isolate and identify antagonistic strains or consortia and to perform microbial community characterization with Next-generation sequencing. Single strains or consortia were selected directly in confrontation with *M. laxa*. Then, to select BCAs that will be effective under field conditions, the following criteria were assessed in vitro: inhibition consistency at different C: N ratios, range of growth temperature, light tolerance, and inhibition of conidia germination.

The isolation and the screening enabled us to obtain one consortium composed of *Pantoea* spp. Moreover, the amplicon sequencing reveals its antagonistic interactions with *M. laxa* in the phyllosphere of *Prunus* spp.. However, this consortium needs further analyses to determine its interaction with apricot trees (commensal, pathogen). This study reveals the complexity of the life cycle of *M. laxa* and its interactions with bacteria and fungi from the phyllosphere communities that can be used to biocontrol this pathogen.

Spezialkulturen schaffen Zukunft

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Spezialkulturen geben der Land- und Ernährungswirtschaft eine Perspektive. Auf ca. 3.5% der landwirtschaftlichen Nutzfläche erwirtschaften sie mit ca. 2.5 Mrd. CHF einen Anteil von rund 23-24% an der gesamten Wertschöpfung der Schweizer Landwirtschaft (Primärproduktion inkl. Vorleistungen). Sie sind unverzichtbar für eine gesunde Ernährung und stärken die Biodiversität. Damit haben sie verschiedene Trümpfe in der Hand gerade in Anbetracht der komplexen und herausfordernden Rahmenbedingungen der Land- und Ernährungswirtschaft, wie bespielweise die steigenden Produktionskosten, der Druck auf der Wertschöpfung, der Biodiversität und den Landressourcen sowie der Anpassungsbedarf an den Klimawandel. Auch der zunehmende gesellschaftliche Stellenwert einer gesunden Ernährung (siehe nationales Forschungsprogramm "Gesunde Ernährung und nachhaltige Lebensmittelproduktion") und der Versorgungssicherheit müssten die Spezialkulturen stärken. Warum verdienen sie aber nicht mehr Beachtung im öffentlichen, forschungs-, bildungs- und agarpolitischen Diskurs? Der Kanton Luzern hat zwar die Situation erkannt und fördert mit dem Projekt "Offensive Spezialkulturen" gezielt den Anbau von Obst, Gemüse und anderen Spezialkulturen als Alternative zur Tierhaltung. Er ist damit aber bis jetzt alleine. Der Verdacht liegt nahe, dass die Überlegungen oft einer flächen- und betriebsanzahlgetriebenen Bedeutungslogik folgen, was eine weitsichtige Innovationsperspektive nicht unbedingt stärkt. Möglicherweise ist es aber auch eine Frage des mangelnden Bewusstseins für die zu Grunde liegenden Zusammenhänge, in der Öffentlichkeit wie auch in der Fachwelt. Es muss darum ein Ziel sein, das nötige Bewusstsein zu schaffen, um dann die Kräfte bündeln und intensivieren zu können.

Der 175. Geburtstag von Hermann Müller-Thurgau bietet eine einzigartige Gelegenheit, bedeutende Errungenschaften der Vergangenheit im Bereich der Spezialkulturen bewusst zu machen und zu würdigen sowie den Kontext für erfolgreiche Innovationen zu verstehen und darauf aufbauend für die Zukunft zu nutzen. Müller-Thurgau war der Züchter der weltweit bedeutendsten, modernen Rebensorte für Weisswein. Jährlich generiert das geschätzte 1-2 Mrd. CHF an Wertschöpfung, weltweit. Er war aber beispielsweise auch der Erfinder des Verfahrens zur Herstellung alkoholfreier Obst- und Traubensäfte, was heute einer jährlichen Wertschöpfung von geschätzten 50-100 Mrd. CHF entspricht. Allerdings weiss das niemand mehr. Auch weitere bahnbrechende pflanzenbauliche und lebensmitteltechnische Innovationen von Müller-Thurgau sind in Vergessenheit geraten, obwohl verschiedene Branchen heute davon ganz wesentlich profitieren. Im Müller-Thurgau Jubiläumsjahr 2025 verdienen darum die Veranstaltungen des Vereines ErlebnisMüllerThurgau (www.erlebnismuellerthurgau.ch) für die Öffentlichkeit und Fachwelt besondere Aufmerksamkeit. Sie klären einfach und verständlich auf. Sie beleuchten nicht nur die Forschungsgeschichte, sondern regen auch zum Blick in eine nachhaltige Zukunft an.
Im Moment wecken augmented farming und nachhaltige regenerative Praktiken Hoffnung für die Bewältigung der Herausforderungen der Land- und Ernährungswirtschaft. Entsprechende, praktikable Innovationen sind aber nicht garantiert. Es wäre an der Zeit, inspiriert von Müller-Thurgaus interdisziplinärem und anwendungsgetriebenen Innovationsgeist eine umfassende Leuchtturminitiative zu lancieren, nicht um zu belehren, aber um von der Innovationsgeschichte der Spezialkulturen zu lernen und Letztere zu stärken bei der Bewältigung der anstehenden Herausforderungen: Verbesserung der Rahmenbedingungen, Bündelung der Kräfte sowie Förderung der Innovationskraft und nicht zuletzt einer attraktiven Aus- und Weiterbildung.

Créer l’avenir – avec les cultures speciales

Les cultures spéciales donnent des perspectives au secteur agroalimentaire. Sur environ 3,5% de la surface agricole utile, elles génèrent environ 2,5 milliards de CHF, soit une part d'environ 23-24% de la valeur ajoutée totale de l'agriculture suisse (production primaire, y compris les consommations intermédiaires). Elles sont indispensables à une alimentation saine et renforcent la biodiversité. Elles ont donc plusieurs atouts en main, compte tenu notamment des conditions-cadres complexes et exigeantes du secteur agroalimentaire, comme l'augmentation des coûts de production, la pression sur la valeur ajoutée, la biodiversité et les ressources terrestres ainsi que le besoin d'adaptation au changement climatique. L'importance croissante accordée par la société à une alimentation saine (voir le programme national de recherche « Alimentation saine et production alimentaire durable ») et à la sécurité de l'approvisionnement

devrait également renforcer les cultures spéciales. Mais pourquoi ne méritent-elles pas davantage d'attention dans le discours public, en matière de recherche, d'éducation et de politique agricole ? Le canton de Lucerne a certes reconnu la situation et encourage de manière ciblée, avec le projet « L'offensive des cultures spéciales », l'arboriculture, les cultures maraîchères et d'autres cultures spéciales comme alternative à l'élevage. Mais il est seul à le faire jusqu'à présent. On peut soupçonner que les réflexions suivent souvent une logique de signification axée sur la surface et le nombre d'exploitations, ce qui ne renforce pas forcément une perspective d'innovation clairvoyante. Mais il se peut aussi qu'il s'agisse d'une question de manque de conscience des relations sous-jacentes, tant dans le public que dans les milieux spécialisés. L'objectif doit donc être de créer la prise de conscience nécessaire afin de pouvoir ensuite rassembler et intensifier les forces.

Le 175e anniversaire de Hermann Müller-Thurgau offre une occasion unique de prendre conscience et d'honorer les acquis importants du passé dans le domaine des cultures spéciales, de comprendre le contexte des innovations réussies et de s'en servir comme base pour l'avenir. Müller-Thurgau a été l'obtenteur de la plus importante variété de vigne moderne pour le vin blanc au monde. Chaque année, cela génère une valeur ajoutée estimée entre 1 et 2 milliards de CHF, à l'échelle mondiale. Mais il a aussi été, par exemple, l'inventeur du procédé de fabrication de jus de fruits et de jus de raisin sans alcool, ce qui représente aujourd'hui une valeur ajoutée annuelle estimée à 50-100 milliards de CHF. Mais personne ne le sait plus. D'autres innovations révolutionnaires de Müller-Thurgau dans le domaine des cultures et de la technique alimentaire sont également tombées dans l'oubli, bien que différentes branches en profitent aujourd'hui de manière très importante. En 2025, année du centenaire du Müller-Thurgau, les manifestations organisées par l'association ErlebnisMüllerThurgau (www.erlebnismuellerthurgau.ch) à l'intention du public et des professionnels méritent donc une attention particulière. Elles apportent des explications simples et compréhensibles. Elles ne se contentent pas d'éclairer l'histoire de la recherche, mais incitent également à se projeter dans un avenir durable.

En ce moment, l'agriculture augmentée et les pratiques régénératives durables suscitent l'espoir de relever les défis de l'agriculture et de l'alimentation. Des innovations correspondantes et réalisables ne sont toutefois pas garanties. Il serait temps, en s'inspirant de l'esprit d'innovation interdisciplinaire et appliqué de Müller-Thurgau, de lancer une initiative phare globale, non pas pour donner des leçons, mais pour tirer des enseignements de l'histoire de l'innovation des cultures spéciales et pour renforcer ces dernières dans la maîtrise des défis à venir : Améliorer les conditions-cadres, regrouper les forces et promouvoir la capacité d'innovation, sans oublier une formation attrayante.

Horticulture is the opportunity

Horticulture offers a perspective to the agricultural and food sector. On approx. 3.5% of the agricultural land, they generate approx. CHF 2.5 billion, or an estimated 23-24% of the total value added in Swiss agriculture (primary production including intermediate inputs). They are indispensable for a healthy diet and strengthen biodiversity. This means they have several advantages, especially in view of the complex and challenging setting within which the agricultural and food sector operate, such as rising production costs, pressure on value creation, biodiversity and land resources, and the need to live with and adapt to climate change. The increasing social importance of a healthy diet (see national research program "Healthy nutrition and sustainable food production") and security of supply should also strengthen special crops. But why do they not deserve more attention in public, research, education and agricultural policy discourse? The canton of Lucerne grasped the situation and is promoting now the fruit production, vegetable production and other horticulturla crops as an alternative to animal husbandry with the "Push Horticulture" project. However, it remains alone in doing so so far. It may be suspected that the rationale often follows a logic of significance driven by area and number of farms, which does not necessarily strengthen a far-sighted innovation perspective. But it may also be a question of a lack of awareness of the underlying relationships, both in the public and in the professional world. The goal must therefore be to create the necessary awareness in order to then be able to combine and intensify forces. The 175th anniversary of Hermann Müller-Thurgau offers a unique opportunity to raise awareness of and appreciate significant achievements of the past in horticulture, as well as to learn from the contexts of successful innovations for building the future accordingly. Müller-Thurgau was the breeder of the world's most important, modern grape variety for white wine. It creates an estimated CHF 1-2 billion in added value every year, worldwide. He was also, for example, the inventor of the procedure for producing non-alcoholic fruit and grape juices, which today corresponds to an estimated annual added value of CHF 50-100 billion. However, no one knows this anymore. Other groundbreaking plant cultivation and food technology innovations by Müller-Thurgau have also been forgotten, although various industries are now benefiting significantly from these. In the Müller-Thurgau anniversary year of 2025, the events organized by the association ErlebnisMüllerThurgau (www.erlebnismuellerthurgau.ch) deserve special attention from the public and experts. They provide information in a simple and understandable way. They not only shed light on the history of innovation, but also encourage people to look into a sustainable future.

Actually, augmented farming and sustainable regenerative practices create expectations of overcoming the challenges of the agricultural and food sector. However, appropriate, practical innovations are not guaranteed. This is the right time to launch a comprehensive lighthouse initiative, inspired by Müller-

Thurgau's interdisciplinary and application-driven spirit of innovation, not to lecture, but to learn from the innovation history of horticulture and to strengthen the latter in overcoming the challenges ahead: improving the setting and general framework, pooling forces and promoting innovative strength and, last but not least, attractive training and education.

Survey of parasitoids of *Drosophila suzukii* in Switzerland

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Drosophila suzukii is a major pest in fruit production, causing significant economic losses. The parasitoid *Ganaspis kimorum* has been identified as a promising candidate for classical biological control due to its high specificity to *D. suzukii*, minimizing risks to non-target species. Release trials of *G. kimorum* have been conducted in northern Italy, Ticino, and Jura, raising the possibility that this exotic parasitoid might have already established on its own. Another potential classical biocontrol agent, *Leptopilina japonica*, has a broader host range but could still play an important role in reducing *D. suzukii* populations.
This study aimed to survey the parasitoid wasps present in different regions of Switzerland that infect *D. suzukii* flies in fruit crops. During the 2024 harvest season, we collected *D. suzukii*-infested fruits from various cantons to identify emerging parasitoids. Genetic sequencing of selected specimens allowed species identification. Although *G. kimorum* was not detected, we surprisingly found *L. japonica* widely distributed across cantons and crops, indicating that it is already established in Switzerland. Further research should assess its biocontrol efficacy and interactions with other parasitoids to optimize sustainable *D. suzukii* management strategies.

Innovative methods to limit the fungal diseases on apples and pears during storage

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Apples and pears are living products whose quality deteriorates after harvest, particularly under the effect of respiration, ethylene production, and physiological and fungal diseases. Rot is particularly problematic because pathogens, undetected at harvest, can cause considerable losses during storage. In a context of climatic changes and absence and/or reduction of synthetic fungicides, innovative solutions to reduce losses during storage of pome fruits are needed. The 'INNOSTOCK' project aimed at identifying, testing and validating new approaches to limit losses on apples and pears during storage. Experiments were conducted in both experimental trials and on-farm conditions, using combined or separate pre- and post-harvest methods. Methods such as pruning, antagonist applications, biological product treatments, and kaolin were tested in the orchards. After harvest, various treatments were evaluated, including hot water, edible coatings and ozone. Additionally, air purification using an ionization system and an innovative air-cooling technology were tested. The firsts results showed that postharvest treatments, and in particular hot water and ozone treatment were more effective to limit the development of rot such as bull's eye rot than pre-harvest methods. Ionization system allowed a reduction of wound pathogens such as *Botrytis cinerea* but was not effective on bull's eye rot. The tested edible coating showed no influence. Given the significant influence of climatic conditions, further tests are ongoing to assess the relevance of the different methods in various conditions.

Comparison of Selected Ecosystem Services and Functions of Organic and Conventional Tea Cultivation Systems in Uva, Sri Lanka

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Tea (*Camellia sinensis* (L.) O. Kuntze) is a highly valuable crop in Sri Lanka, where it is cultivated under organic and conventional systems on smallholder and medium to large plantations. It is cultivated in an agroforestry set up where it integrates tea, legume and non-legume trees and provides various ecosystem services, functions and environmental benefits in supporting, regulating, and provisioning and economic services. In this study, we investigated the effects of cultivation systems (conventional vs organic) on some of the indicators of soil ecosystem services; plant and soil microarthropod diversity (supporting services); carbon stock in plants and soil (regulating services) which have not been studied so far in Sri Lanka and elsewhere. This study was conducted in Uva, a major tea-growing region with small (SH), medium, and large (LP) plantations, including 10 organic (7 SH-ORG and 3 LP-ORG) and 7 conventional plots (5 SH-CONV and 2 LP-CONV). For the measured indicators of supporting and regulating ecosystem services, results typically did not differ between conventionally and organically managed systems, except for notable variations observed between SH and LP.

This study showed that the calculated Gini-Simpson (SDI, for species evenness) and Shannon Weiner's diversity indices (SWDI, for species richness) for trees ranged from 0.107-0.815 and 0.248 to 2.037, respectively between the different cultivation systems and the average SWDI and SDI for LP-ORG were 1.425 and 0.711, respectively. Besides, the aboveground C stock in the trees were highest in LP-ORG plots (48.2±23.3Mg C/ha). The findings further revealed no significant

differences in the abundance of microarthropods between the organic and conventional cultivation systems under investigation. However, total density of microarthropods was significantly higher in LP-ORG (4136±1739 individuals/m²) in comparison to in SH-ORG ($p<0.05$). Microarthropods community in each system was dominant with predatory species. The SWDI for microarthropods ranged between 0.330 to 1.286. Soil organic matter content ranged between 2.7-5.2% (in 0-15cm soil depth) and were 5.2% ± 0.4 in LP-ORG and 3.9% ± 0.2 in LP-CONV. Exclusive of carbon stock in trees, other indicators did not show significant differences between cultivation systems. This contrasts with findings from other studies, which reported higher levels of ecosystem services in organically managed soils, may be attributed to frequent disturbances in the top soil in SH plots, variability of the composition of the litter, farmers' intention in planting trees, etc. Thus, in order to ensure sustainability criteria in agriculture, it is needed to focus on integrating specific farming practices, than broad categorization as 'conventional' and 'organic'.

FRUCTUS – 40 Jahre Engagement für die Obstgenressourcen

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FRUCTUS ist ein schweizweit tätiger Verein, der sich wissenschaftlich fundiert für die Obstsortenvielfalt und den Hochstamm-Obstbau in der Schweiz einsetzt. Gegründet wurde FRUCTUS 1985 von Karl Stoll, ehemaliger Mitabeiter der damaligen Forschungsanstalt Wädenswil im Bereich Nachernte und Roger Corbaz von der SOTA (Gesellschaft für den einheimischen Tabak) und später Phytopathologe bei Agroscope in Changins. Durch massive Verminderung der Schweizer Obst-Hochstammbestände nach dem 2. Weltkrieg infolge des wirtschaftlichen Drucks und gesellschaftlicher Veränderungen beim Konsum von Obstprodukten, wurden zahlreiche Feldobstbäume mit Unterstützung der Eidg. Alkoholverwaltung gerodet. Stoll und Corbaz erkannten, dass dies auch eine Bedrohung für die Obstgenressourcen darstellt. Von staatlicher Seite wurde deren Erhaltung damals noch nicht sichergestellt. So konnten bereits erste Sammlungen mit Sorten auf privater Basis angelegt werden, die für die wichtigsten Obstarten wohl geeignetste Form der Erhaltung.

Von der Inventarisierung zur Nutzung

Mit der auf der Konferenz von Rio, 1992, fussenden Biodiversitätskonvention (CBD), wurde ein globaler Aktionsplan entwickelt und darauf basierend in der Schweiz ein Nationler Aktionsplan für pflanzengenetische Ressourcen in Ernährung und Landwirtschaft (NAP-PGREL). Dieser ermöglicht dem Bund (BLW), Projekte zu unterstützen. So konnte FRUCTUS in den Jahren 2000 bis 2005 eine grosse schweizweite Inventariserung der noch vorhandenen Obst-Genressourcen systematisch durchführen. Damit konnten die bereits bestehenden dezentralen Erhaltungs-Sammlungen ergänzt werden. Als nächster Schritt begann die Beschreibung der Obstgenressourcen anhand eines definierten Deskriptorenhandbuchs. Die Beschreibungsprojekte von FRUCTUS in Zusammenarbeit mit Agroscope ermöglichten es, viele Synonyme bei den Akzessionen zu erkennen und die Erhaltung zu rationalisieren. In den letzten Jahren kam die Nutzung der Obstgenressourcen in der Züchtung, für ökologische Anliegen und für Produkte stärker in den Fokus.

Vielfalt sichtbar machen

FRUCTUS ist national und international gut vernetzt und stellt mit Sortenausstellungen, Beratung, Kursen, Anlässen und der Obstsorte des Jahres das erarbeitete Wissen der Fachwelt und der breiten Bevölkerung zur Verfügung.

Identification of Apple Scab on fruit using YOLOv11: A Deep Learning Approach

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Apple scab, caused by the fungal pathogen Venturia inaequalis, is one of the most significant diseases affecting apple (Malus spp.) worldwide, negatively impacting fruit quality and leading to considerable yield losses. Conventional apple scab management relies on visual and manual assessments to identify affected fruit. However, these methods are labor-intensive, time-consuming, non-reproducible, and subjected to inconsistencies, particularly in processes such as apple grading after harvest or after storage, where rapid and accurate evaluation is essential. To address these limitations, this study proposes a non-destructive deep learning-based approach for detecting and assessing apple scab severity on fruit. A YOLOv11m-seg (You Only Look Once version 11 for segmentation) model was fine-tuned using RGB images of apples captured under both outdoor and indoor conditions. The resulting model demonstrated a classification accuracy of 90% in distinguishing between healthy and unhealthy apples. In detecting and segmenting scab lesions and other unidentified diseases 75% accuracy was achieved, providing a severity score based on the relative infected area. These findings highlight the potential of YOLO-based models in replacing traditional assessment methods to offer a more efficient and scalable solution for evaluating apple scab on fruit. Future research could expand the capabilities of the model by incorporating other apple diseases such as bull's eye rot, this way enhancing its applicability in precision agriculture and automated disease monitoring.

Anbautechnik Silosorghum – Einfluss der Sorte, der Saatdichte und des Reihenabstandes auf Ertrag und Futterqualität

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Sorghum bicolor (L.) Moench stammt ursprünglich aus Afrika und ist in der Schweiz noch wenig bekannt. Vor dem Hintergrund des Klimawandels könnten die besonderen Eigenschaften dieser Pflanze jedoch dazu beitragen, die zukünftigen Herausforderungen zu bewältigen. Sorghum ist wie Mais eine C4-Pflanze, die an trockene Bedingungen angepasst ist. Sie besitzt ein hohes Biomassepotenzial und eignet sich sowohl als Futtermittel als auch als Nahrungsmittel. Da Sorghum kein Gluten enthält, kann es von Menschen mit Zöliakie bedenkenlos verzehrt werden.

Im Rahmen eines dreijährigen Versuchs (2022–2024) wurden vier Sorghumsorten (CSSH-45, ES Athena, ES Biomass, KWS Zerberus), eine Maissorte (P8834) und eine Mais-Sorghum-Mischung mit drei unterschiedlichen Reihenabständen (37.5 cm, 50 cm, 75 cm) und drei Saatdichten am Standort Zürich untersucht.
Ziel der Studie war es, die Reaktion der Sorghumsorten auf unterschiedliche Reihenabstände und Saatdichten anhand der Erhebung von verschiedenen agronomischen Parametern wie Standfestigkeit, TS-Ertrag und der Qualität des Erntegutes zu evaluieren und mit Mais zu vergleichen.

Die Ergebnisse zeigen, dass die Sortenwahl den größten Einfluss auf den TS-Ertrag und die Futterqualität hat. Biomassesorten wie ES Biomass und KWS Zerberus erzielten zwar höhere Trockensubstanzerträge als die Sorten CSSH-45 und ES Athena, wiesen jedoch im Vergleich zu CSSH-45 und ES Athena niedrigere NEL-Werte und eine geringere Verdaulichkeit der organischen Substanz (vOS) auf. Die Erhöhung der Saatdichte führte zu höheren TS-Erträgen, allerdings auf Kosten der Standfestigkeit. Die Veränderung des Reihenabstandes hatte weder einen signifikanten Einfluss auf den TS-Ertrag noch auf die Futterqualität (NEL, vOS).

Die finanzielle Unterstützung durch Bio Suisse hat entscheidend zur erfolgreichen Durchführung dieser Versuche beigetragen.

Developing new tools for resistance breeding in pears

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As of today, four main pear cultivars account for 80% of the Swiss pear production. These cultivars were all released in the 19th century, whereas promising new cultivars represent just 10% of the total planted surface. Yet, after years of transitions, pear production is on the rise both in Switzerland and abroad. Simultaneously, the industry increasingly faces production challenges, which calls for new high-quality cultivars with early and regular fruit set, good storage potential, and high disease tolerance. Agroscope has decided to develop its pear breeding program to address this innovation gap in alignment with the Swiss government's "Plant Breeding Strategy 2050". However, the available resistance sources for the main diseases, scab and fire blight, are yet scarcely described and the methods available for efficient breeding are limited. The ToolsRoBiS project was designed to close this knowledge gap with the following four key objectives:

1. Identification of new sources of resistance to fire blight (*Erwinia amylovora*) among others in Swiss wild pear (*Pyrus pyraster*) accessions, development of molecular markers for known resistances and evaluation of whether the combination of these resistances enhances overall resistance.
2. Establishing a high-throughput screening method to assess the susceptibility of large numbers of seedlings or accessions to pear scab (*Venturia pirina*).
3. Development of a "fast-track" protocol to shorten the generation cycle in pear breeding.
4. Establishment of a pear reference population to establish GWAS in pear breeding.

From apple to pear: Constructing a reference population

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Breeding fruit crops is essential for developing new varieties that can withstand emerging diseases, meet consumer preferences, and adapt to environmental stresses. Despite its consumer popularity, pear (*Pyrus communis* L.) has received fewer breeding resources than other fruit crops, such as apple (*Malus domestica* Borkh.). As a result, the molecular tools available for pear breeding are limited. Research on apple has shown that genetic information on quantitative traits, accumulated over years of study, can be effectively rediscovered through a single study utilizing datasets from the apple reference population (apple REFPOP). This population additionally provided valuable insights into the genetic architecture of quantitative traits, novel marker-trait associations, and estimates of the predictive ability of genomic selection models. Building on the success of the apple REFPOP, we propose establishing a pear reference population (pear REFPOP) to bridge the long-standing gap in pear genetic research in a single step. For the pear REFPOP, up to 350 genetically distinct accessions will be selected from previously characterized germplasm, which was assessed for genetic uniqueness using molecular marker analysis leading to the assignment of *Pyrus* unique genotype codes (known as PUNQ). The chosen accessions will represent the broad genetic diversity available in pear. The selection process will also account for the distribution of quantitative traits among accessions obtained through database scraping to reduce associations with low minor allele frequencies in genome-wide association studies. The selected accessions will be replicated in a nursery and planted in a randomized complete block design across up to six locations in Europe. Establishing the pear REFPOP will advance knowledge of quantitative traits in pear across environments, enable the development of molecular breeding tools, and ultimately contribute to the selection of high-yielding, tasty, and resilient pear varieties.
This study is part the project "Entwicklung von Tools für die Züchtung von robusten Birnensorten" (Tools-RoBiS), which is funded by the Federal Office for Agriculture (FOAG).

Hydroponic crop production with high nutrient use efficiency from organic waste for space applications

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The integration of crops as part of Bioregenerative Life Support Systems (BLSS) for extended space missions is considered by most space agencies to minimise the need for costly resupply of essential resources from Earth. Plants can provide food, clean water and oxygen to the crew, whilst simultaneously removing CO_2 from the atmosphere. The successful growth of plants in BLSS is dependent on the provision of optimal nutrient supply, which needs to be achieved through the recycling of nutrients from organic waste into water-soluble ionic forms. Insufficient or imbalanced nutrition can result in diminished crop yield, whilst excess nutrition can lead to the accumulation of unused nutrients within the BLSS, resulting in the inefficient use of scarce resources. The variable and heterogeneous nutrient composition of waste sources, such as human urine and inedible parts of plants, in conjunction with the presence of toxic elements to many plants such as sodium (Na) and chloride (Cl), poses a significant challenge in optimizing crop nutrition. The objective of this study is to ascertain whether it is feasible to formulate a nutrient-efficient solution from waste that does not compromise plant growth. To this end, a comparative analysis of the yield, nutrient balance and nutrient use efficiency of lettuce (*Lactuca sativa* var. Frillice) cultivated in hydroponics using a waste-based nutrient solution is undertaken, in contrast to a nutrient-efficient and balanced control solution. The waste-based solution, consisting of a blend of three waste sources derived from urine and inedible soybean parts, was optimized by the least squares method to achieve the best possible approximation to the composition of the control solution. Finally, we will provide recommendations for the optimisation of recycling strategies applicable to any closed systems, for testing the growth of different plant species with alternative waste sources.

A smartphone app to monitor pests and diseases

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In high-value crops, early detection and precise monitoring of pests and diseases are essential for targeted and effective plant protection. Indeed, late detection and inaccurate assessments (i.e. misidentification, unrepresentative counting) can result in significant economic losses and unwarranted use of plant protection products. However, monitoring pests and diseases is a time-consuming task that requires specific knowledge and solid experience. Currently, growers often rely on a few qualified employees, a strategy that is both expensive and risky. Automating pest and disease surveillance would reduce this reliance and make crop scouting more accessible to all.

Andermatt Biocontrol Suisse, CSEM and Agroscope are developing an app using standard smartphone cameras and AI to monitor arthropods and plant diseases in vegetable and fruit production. Therefore, algorithms are being developed 1) to detect and identify different species of arthropods and pathogenic fungi on sticky traps and/or directly on plants, and 2) to count them or measure the extent of their symptoms. Population models predicting pest populations and assessing the efficacy of planned or implemented biocontrol strategies should also be integrated to the app.

A method for transgene-free genome editing in apple using cell-penetrating peptides

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For apple (*Malus domestica* Borkh.), a wide variety of cultivars exists but only a few meet the high expectations of producers, consumers and retailers. Crossbreeding of apple cultivars leads to a reshuffling of characteristics, rendering the breeding process laborious when introducing favorable traits into a commercially established apple cultivar. Targeted mutagenesis could enhance existing cultivars by disrupting specific gene function through knockout mutations or by allele replacement. Genome editing with CRISPR/Cas allows for sequence-specific mutation but typically relies on the genomic integration of transgenes encoding the Cas protein and guide RNA. In contrast to integrating transgenes, genome editing components can be delivered into cells as plasmid DNA or as a pre-assembled ribonucleoproteins (RNPs), which include Cas protein and guide RNA. Regeneration of plants from the transfected single cells with RNPs or plasmid DNA would enable transgene-free genome editing applications. However, there is a trade-off between transfection efficiency and the ability to regenerate apple plants from single cells. Apple cells without a cell wall are readily transfected but fail to regenerate into plantlets, whereas single cells with a cell wall regenerate into apple plantlets but are challenging to transfect. To overcome these limitations, cell-penetrating peptides (CPPs) can be employed to transport cargo molecules into plant cells with a cell wall. We tested the ability of a newly engineered CPPs (dTAT-Sar-EED4) to transfect apple single cells containing a cell wall with fluorescent RNPs. Single cells treated with the CPP-RNP complex exhibited fluorescent signals inside the cells, unlike cells treated only with fluorescent RNPs. Combined with regeneration protocols, CPP-mediated single cell transfection presents a promising method for achieving transgene-free genome editing in apple. This approach has the potential to enhance existing apple cultivars by improving beneficial traits for producers, consumers and retailers.

Nitrogen (N) balance and N use efficiency in selected organic and conventional tea (*Camellia sinensis* (L.) O. Kuntze) cultivation systems in Uva, Sri Lanka

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Tea (*Camellia sinensis* (L.) O. Kuntze) is an important cash crop in Sri Lanka. Use of nitrogen (N) in tea cultivation systems needs to be optimized to minimize N losses while maintaining quality and quantity of tea flush harvest. Budgeting of N is a reliable approach to understand N utilization at field level. This study was conducted to investigate N balance and N use efficiency (NUE) using soil surface budgeting in selected organic and conventional tea cultivation systems in Sri Lanka. Seven smallholder organic (SH-ORG), 3 larger-scale organic (LP-ORG), 5 smallholder conventional (SH-CONV) and 2 larger-scale conventional (LP-CONV) plots were selected from the Uva region in Sri Lanka. The N fertilizers (i.e., synthetic or organic amendment) and N outputs (i.e., tea flush and harvest from other agricultural crops) removed from each selected tea plot were monitored from January 2023 to June 2024. The amount of N fixed by leguminous tree species, N stocks of tea plant and soil at depth of 0-45 cm were estimated. The N balance (N inputs with fertilizers and N_2 fixation – N outputs exported with tea flush and other agricultural harvests) and NUE in percentage ((N outputs /N inputs) × 100%) were determined. Compost and urea were the main N inputs in selected organic and conventional tea cultivation systems, respectively. The amounts of N received by fertilizers were 243±168 kg N ha^{-1} yr^{-1} in SH-ORG, 15±2 kg N ha^{-1} yr^{-1} in LP-ORG, 474±141 kg N ha^{-1} yr^{-1} in SH-CONV and 203±61 kg N ha^{-1} yr^{-1} in LP-CONV. The estimated biological N_2 fixation was 14±8 kg N ha^{-1} yr^{-1} in SH-ORG, 3±3 kg N ha^{-1} yr^{-1} in LP-ORG, 9±8 kg N ha^{-1} yr^{-1} in SH-CONV and 3±2 kg N ha^{-1} yr^{-1} in LP-CONV. The amounts of N exported with tea flush harvest were 97±34 kg N ha^{-1} yr^{-1} in SH-ORG, 16±23 kg N ha^{-1} yr^{-1} in LP-ORG, 95±50 kg N ha^{-1} yr^{-1} in SH-CONV and 65±9 kg N ha^{-1} yr^{-1} in LP-CONV. The amounts of N exported with other agricultural harvests were 2.8±3.8 kg N ha^{-}

^{1} yr^{-1} in SH-ORG, 3.3±5.7 kg N ha^{-1} yr^{-1} in LP-ORG and 0.1±0.2 kg N ha^{-1} yr^{-1} in SH-CONV. The selected LP-CONV plots did not produce any other agricultural harvest. The N balances were 157±153 kg N ha^{-1} yr^{-1} in SH-ORG, -34±21 kg N ha^{-1} yr^{-1} in LP-ORG, 388±144 kg N ha^{-1} yr^{-1} in SH-CONV and 141±50 kg N ha^{-1} yr^{-1} in LP-CONV. The highest NUEs were observed in LP-ORG (284±109%), indicating depletion of already existing soil N stocks due to higher N exports over N inputs. The NUEs of SH-ORG, SH-CONV and LP-CONV plots were 50±24%, 21±11% and 32±5%, respectively. The estimated tea plant N stocks (276±231 kg N ha^{-1}) were comparable among the tea cultivation systems. The estimated soil N stocks were 125±44 Mg N ha^{-1} in LP-ORG, 68±19 Mg N ha^{-1} in SH-ORG, 78±21 Mg N ha^{-1} in SH-CONV and 112±7 Mg N ha^{-1} in LP-CONV. This indicates higher potentials of soil in LP-ORGs to supply N to sustain productivity even under the negative N balances. This study revealed higher variability of NUEs and N balances among the studied tea cultivation systems. Overall, the SH-ORG tea cultivation systems, in comparison to the rest, were more sustainable in terms of N management due to the highest N outputs (productivity), higher NUEs, and moderate positive N balances while maintaining moderate tea plant and soil N stocks.

Enhancing crop pollination monitoring using automated field camera traps

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Sufficient insect-mediated pollination is crucial to ensure good yield in managed horticultural crop. The quality of pollination in a crop is closely linked to the transportation and deposition of pollen between flowering plants. This process is influenced by the insect body size, hairiness, behaviour, visitation rates and duration. While managed pollinators like honeybees and bumblebees provide substantial crop pollination, species diversity in insect pollinators significantly enhances pollination efficiency. Understanding pollination behaviour to adapt managed orchards becomes crucial in the face of climate change and environmental risks associated with anthropogenic activities.

Nevertheless, assessing pollination efficiency and species diversity of effective crop pollinators in the field is challenging due to limitation in sampling effort as direct observations are time-consuming and difficult to carry over large spatiotemporal scales. However, the increased availability of camera traps and automated video recording systems, driven by advances in machine learning, presents new opportunities for monitoring pollinator insects and their associated pollination services. Using a low-cost insect camera trap, we aim to develop a program using machine learning and neural network tools to monitor the diversity of insect pollinators, as well as visitation rates and durations, which are important indicators of pollination quality. In addition, we will collect pollination behaviour data from a range of horticultural crops to evaluate the system accuracy and its potential for field application in monitoring pollination efficiency. The development of such automated tools for field monitoring will aid in the management and design of fields to enhance crop pollination quality and support wild pollinator diversity.

Prediction accuracy of genomic versus phenotypic selection in winter wheat

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In early yield trial generations, selection decisions are often based on results from a single year and several locations. However, due to G x E interaction and variation in yearly conditions, phenotypic results from single years are only partly representative of any future years. Genomic selection (GS) can predict the performance of line based on its genome. However, comparisons of GS to the prediction accuracy of real breeding selection accuracies are still lacking. To this end, we compare the performance of GS to phenotypic selection based on one year field assessment. Furthermore, we compare the combination of both data basis, through updating the GS model with phenotypic observations of the lines that shall be predicted.

We compared three different selection scenarios for grain yield in the first year of multi-location yield trials (YT1) of our breeding program:
(A) Phenotypic selection based on only the results from the yield trails (YT1).
(B) Genomic selection based on only GS predictions, without any previous observations of the test lines included in the training model.
(C) Genomic selection with updated model after harvest based on GS predictions after updating the model with results from the yield trials (YT1).

To assess, the efficiency of selection, we correlated the predictions from the different scenarios with the mean yield of the two following years (YT2 and YT3, including only selected lines), representing the best available estimate of performance in other years than the selection year.

Data were taken from the winter wheat breeding program of Agroscope and DSP. Yield trials are performed as lattice designs with 25 or 36 entries over three generations (YT1 ca. 250 lines, YT2 ca. 75 lines, YT3 ca. 30 lines). Trials are conducted in 4 to 5 locations across Switzerland with 2 (YT1 and YT2) to 3 (YT3) replications. Lines were genotyped with the 25k SGS - TraitGenetics SNP array. Means over replicates were first calculated per lattice within each location and year. Subsequently, means were calculated across locations (and years) with a mixed model with genotype and lattice as random effect. Genomic selection models were performed as GBLUP with the rrBLUP package in R. YT data from

the breeding program were used as training data and consisted of about 1600 to 1800 lines, depending on YT1 year and prediction scenario.

Over all years, predictions based on only phenotypic observations (A) were slightly better than prediction from genomic selection (B) (r=0.58 for (A) vs r=0.51 for (B), average over all years).

Although slightly better, phenotypic prediction (A) showed to be less stable across years than genomic selection (B) as indicated by a greater variation of the prediction accuracies. In some years, the prediction accuracy of phenotypic selection was very low (e.g. 2019 and 2021). In these years, genomic selection would have been more precise.

Lastly, genomic selection with updated model after harvest (C), showed better prediction accuracies than pure phenotypic selection (A) or pure genomic selection (B) across all investigated years.

The slight increase in prediction accuracy from r=0.51 to r=0.58 from genomic to phenotypic selection has to be seen in relation to the cost of yield trials and limited number of lines that can be tested. However, new field trials are still needed to update the GS model to new genetic material and climatic conditions.

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