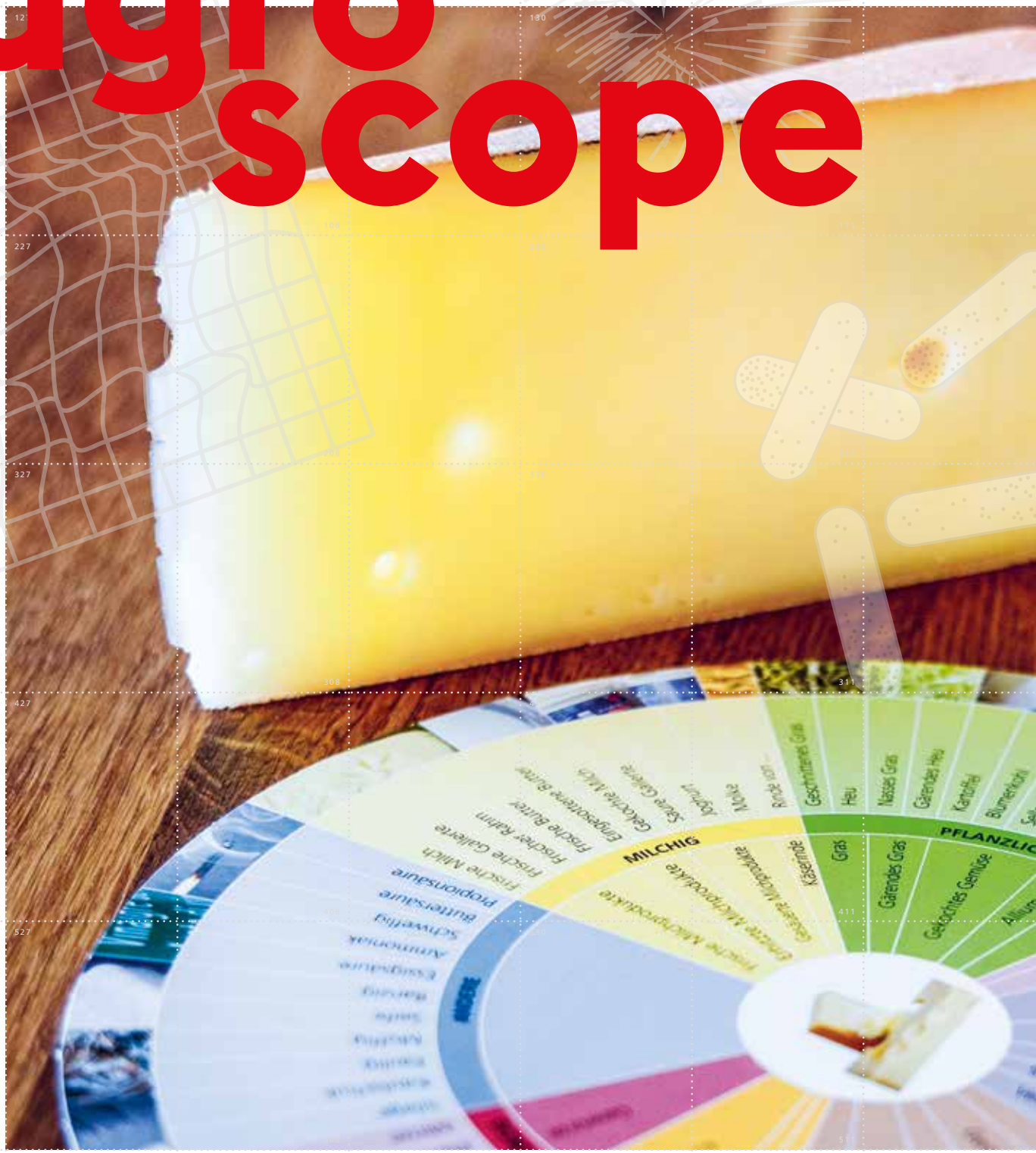
November 2022

agroscope



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Swiss Confederation

Federal Department of Economic Affairs, Education and Research EAER
Agroscope

Agroscope good food, healthy environment

The Swiss Centre of Excellence for Raw-Milk Products at Agroscope tests the popularity of various raw-milk cheeses in order to better exploit the market potential.

Dear Readers,

2022 was another year of weather extremes, with alternating heat, drought, storms and floods. Two articles in this issue deal both with the effects of climate change on agriculture and with solutions for ensuring continued food production in future. In the first, Agroscope and the Swiss Farmer's Union SBV show that up to 25% of total Swiss roughage production can be lost in dry years. Read about how this can be counteracted on page 16. The second article describes how Agroscope researchers have tested African sweet grass in order to maintain high yields on meadows and pastures during dry summers (page 18).

It is not just weather extremes that cause problems. New diseases and pests are also emerging in Switzerland while the sector aims to reduce the use of plant-protection products. Agroscope experts compared different plant-protection strategies for apple production (page 6). Among other things, the study shows that reducing the use of plant-protection products also lowers the risk of weeds building resistance. Herbicide-resistance monitoring in Switzerland is meant to contribute to a better understanding of this problem and to offer practical solutions (page 22).

Over the past few years, Agroscope has launched several experi-mental experimental stations (such as the one for vegetable production in Ins (page 4)) and centres of excellence, in order to carry out research jointly with practice. The Centre of Excellence for Raw-Milk Products is one such new competence centre. Researchers from Agroscope and from the Grangeneuve Agricultural Institute IAG questioned consumers on the popularity of Vacherin Fribourgeois PDO cheese in order to better exploit market potential (page 20).

As you can see, Agroscope and its partner institutions research within the agricultural and food system, ensuring co-creation and sharing of knowledge with practice, and always with an eye to the challenges of the future – including those posed by consumers.

Happy reading,
Lutz Merbold

Head of the Agroecology and Environment Research Division
and the Integrative Agroecology Research Group

Other themes

Agroscope Future Project
Agricultural Economics
Environment
Animal Production
Food
Plant Production

Agroscope is the Swiss Centre of Excellence for Agricultural Research, and is affiliated with the Federal Office for Agriculture (FOAG). Agroscope makes an important contribution to a sustainable agriculture and food sector as well as to an intact environment, thereby contributing to an improved quality of life.

Practice and Research Join Forces in Seeland

Seeland's fertile soils are particularly well-suited to growing vegetables, but also favour weeds, pests and diseases. At the Vegetable Production Experimental Station, research and practice are working together for better plant protection and sustainable production.

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Gaining a Better Understanding of Herbicide Resistance

Herbicide-resistant weeds are a growing problem throughout the world. Monitoring herbicide resistance in Switzerland allows us to understand the mechanisms behind it and to better manage the use of herbicides.

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Vacherin Fribourgeois PDO: Consumer Study Shows Popularity of Raw-Milk Cheeses

At the new Centre of Excellence for Raw-Milk Products, Agroscope and Grangeneuve interviewed test subjects about the popularity of Vacherin Fribourgeois PDO cheeses made from raw and thermised milk. The study showed that the market potential of raw-milk cheeses has not yet been exhausted.

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A Look into the Archive

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Crop Protection in Apple Production: Environmental and Economic Impacts of Different Strategies

Agroscope compared crop protection strategies in apple production. Reducing the use of plant-protection products lowered the local ecotoxicological risks, but resulted in trade-offs between environmental and economic performance.

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Drought-Tolerant Sorghum to Combat Forage Scarcity

Agroscope is testing the agronomic properties of sorghum, an African grass from the family Poaceae, and its quality as a forage. Sorghum has great potential for guaranteeing the availability of forage during hot, dry summers, as well as in winter as conserved forage.

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Average Grassland Yields in Switzerland Affected by Summer Drought

Dry summers can see a loss of up to 25% of total Swiss roughage production. This is because grassland yields are strongly correlated with summer drought, as shown by a new analysis conducted by Agroscope and the Swiss Farmers' Union.

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Events

1 Dec 2022, Joint meeting of Agroscope, FiBL and Bio Suisse, Olten

National Organic Research Forum

Climate-Friendly Animal Production – Opportunities, Possibilities and Limits

8 Dec 2022, Agroscope Tänikon

3rd Food Sector Innovation Forum

Circular Economy as a Solution

12 Jan 2023, Biel

10th National Field Crops Conference – Soil as a Functional Unit

Conference organised by the Arable Crops Platform Switzerland PAG-CH

13 Jan 2023, Biel

Agroscope 'Plant Protection in Field Crops' Conference

26 Jan 2023, Agroscope Reckenholz and online

10th Agroscope Sustainability Conference

20 April 2023, Agroscope, Swiss National Stud Farm SNSF

Annual Conference – Swiss Equine Research

All Agroscope events that are open to the public are advertised on our website.

Practice and Research Join Forces in Seeland

Seeland's fertile soils are particularly well-suited to growing vegetables, but also favour weeds, pests and diseases. At the Vegetable Production Experimental Station, research and practice are working together for better plant protection and sustainable production.

Since November 2021, all partners at the Vegetable Production Experimental Station (Vegetable Producers' Association of the Cantons of Bern and Fribourg GVBF, the Cantons of Bern and Fribourg and Agroscope) have been working on joint projects.

For nearly a year now, the Vegetable Production Research Station has been conducting agronomic trials in the Seeland region in close cooperation with practice and extension. The aim is to pool the strengths and competencies of all those involved in order to tackle the numerous medium- and long-term challenges of the vegetable-production sector together. It should also be possible for producers to implement the solutions developed here in other growing regions, thus benefiting the whole of Switzerland. On Monday 12 September, the partners gathered in Ins (Canton of Bern) to take stock of the first season of the Vegetable Production Research Station.

Fertile soils – for weeds too

Created from drained bogs, Seeland soils are especially productive – but there are special plant-protection problems emerging here that require appropriate research. The fertile black earth prevalent in the region not only encourages beneficial plants to grow well but also causes weeds to spread quickly. These weeds are especially problematic in onion, carrot and celery crops. Weed control must therefore be improved.

Increased pressure from pests and diseases

Besides weeds, the wide variety of vegetable crops in Seeland also encourages pests and diseases. This makes crop protection an especially labour-intensive endeavour. Thrips, whitefly and downy mildew are particularly virulent in this region. The long-term maintenance of soil fertility and dealing with climate change are also key concerns for producers.

Alternative strategies to chemical control

Research looks to alternatives to chemical products and to innovative fertilisation and growing strategies in order to protect natural resources. Systemic approaches are required in order to develop new production systems that are up to the challenges. The use of green manures, for example, is one of the studied approaches for suppressing soil-borne fungal diseases while improving soil fertility.

Involvement of all stakeholders

In view of the increasing complexity of this challenge, the involvement of all affected stakeholders is essential for promoting creativity and taking advantage of all available skills and knowledge. For this, the Experimental Station uses the 'co-creation' method and promotes this collaborative approach. The Station sees itself as a catalyst for new ideas, new knowledge and sector-wide exchange.

It is planned to run the Vegetable Production Experimental Station until 2028, depending on what projects are proposed and whether the partners are able to execute them. An extension until 2032 is possible. The Experimental Station is available to all partners who wish to contribute specific ideas and skills and to take an active part in reflection, discussion and research.

Further information on the Experimental Stations

A Closer Look at Swiss Alpine Pastures

How many animals can graze on an alpine pasture without overusing it? It all depends on the forage supply as well as the surface area. Climate change influences the amount and quality of forage. A study in fourteen representative alpine areas has recently been reviewing the guidelines on stocking density.

Reducing water consumption in winemaking

From the vine to the bottling process, winemaking requires a lot of water. The Viticulture and Oenology Experimental Station in the Canton of Valais is investigating simple ways of conserving this natural resource in winemaking.

Further information on the Experimental Stations

Crop Protection in Apple Production: Environmental and Economic Impacts of Different Strategies

Agroscope compared crop protection strategies in apple production. Reducing the use of plant-protection products lowered the local ecotoxological risks, but resulted in trade-offs between environmental and economic performance.

Marcel Mathis, Judith F. Blom, Thomas Nemecek, Esther Bravin, Philippe Jeanneret, Otto Daniel, Laura de Baan

Plant protection products (PPPs) are used to protect crops from harmful organisms and thus ensure crop yields and quality. The use of PPPs may also have undesirable effects on the environment, however. Apple orchards produce high yields, but apples are also one of the crops with the highest treatment intensities and the highest amounts of PPPs applied per hectare. This is due on the one hand to the higher risk of infestation in perennial crops, and on the other to the need for a long shelf life, as dessert apples are stored for several months. In addition, the quality expectations of the commercial sector and consumers are quite high. Alternative crop-protection measures are thus necessary for reducing the use and risks of PPPs in apple production. Recent developments in innovative crop protection strategies include, for example, covers to protect apple plantations from rain (and thus fungal diseases) and

	TFI	treatment frequency index
local risks	SF	risks to organisms of surface water
	SO	risks to soil organisms
	OC	risks to organisms of terrestrial off-crop-habitat
life cycle assessment	FE	freshwater ecotoxicity
	GWP	global warming potential
	RS	resource use
	EP	eutrophication potential
	BD	terrestrial biodiversity
economy	FW	farmer's hourly wage
	CI	capital invested
	LI	labour input
	YF	yield fluctuations

Multi-criteria assessment: Performance of the strategies in comparison with the reference strategy (pink circle) for the 13 examined indicators from four areas: 'PPP use', 'local risks', 'life cycle assessment' and 'economy'. Each circle represents a level of the comparison with the reference strategy – the longer the segment, the better the strategy's performance. Grey and white areas represent worse or better performances compared to the reference strategy.

insect nets to keep pests out of the orchard. Nevertheless, some alternative crop protection measures require a higher use of materials, energy, labour and financial resources, which potentially leads to other environmental impacts and higher financial costs. Furthermore, alternative crop protection measures are often less effective than chemical approaches, which can lead to lower yields or poorer fruit quality.

Trade-offs between environmental and economic performance in apple production

To identify potential trade-offs in Swiss apple production, three exemplary crop protection strategies were compared with a reference strategy:

Reference strategy: Average production in Switzerland in 2018 according to the Proof of Ecological Performance (PEP) guidelines;

Innovative strategy: Reduced use of PPPs with no yield losses, using robust varieties, rain cover, insect netting, alternative PPPs and mechanical weed control;

Conventional strategy: Maximisation of yields via additional use of PPPs, fertilisers and irrigation;

Organic strategy: Production according to organic guidelines in terms of PPP and fertiliser use, with yields around one-third lower but double the producer prices for apples.

The comparison of crop protection strategies is based on the calculation of 13 indicators covering both ecotoxicological risks as well as environmental and economic impacts.

- The innovative strategy enabled a reduction in the use of and risks from PPPs compared to the reference strategy. However, it also led to higher global warming potential and a lower hourly farmer's wage, mainly due to costs and emissions associated with the rain cover and insect netting.
- The conventional strategy achieved a higher hourly farmer's wage, but also resulted in higher global warming potential (primarily due to irrigation) and reduced biodiversity.
- The organic strategy enabled a reduction in the use of and risks from PPPs, and achieved a higher hourly farmer's wage. However, it also led to higher environmental impacts per kg of apples, mainly due to the lower yields.

Conclusions

- The examined crop protection strategies in apple production exhibited different advantages and drawbacks in terms of ecotoxicological risks, global environmental impacts and economic impacts.
- None of the examined crop protection strategies performed better than all other strategies for all of the indicators considered.
- The multi-criteria assessment approach shows which indicators must be improved in the individual strategies to make crop protection in apples more sustainable.
- Significant reductions in local ecotoxicological risks can be achieved with the 'innovative' and 'organic' strategies; however, this is sometimes achieved at the cost of other environmental and economic impacts.
- A reduction in PPP use with the help of a rain cover and insect netting ('innovative strategy') is only profitable with additional incentives, such as higher selling prices for apples.
- Forgoing the use of fossil fuels could significantly reduce the global warming potential of the 'innovative strategy'.
- Generally, when optimising crop protection strategies, it makes sense to consider several criteria, instead of focusing on individual aspects.

Scientific article in Sustainable Production and Consumption 31, 512–528, 2022

A New Cheese from the Milk of Simmental Cows

On 14 September the 'Original Simmentaler' Association launched its new cheese of the same name. Agroscope was instrumental in the development of 'Original Simmentaler', the first cheese with a mild propionic acid fermentation.

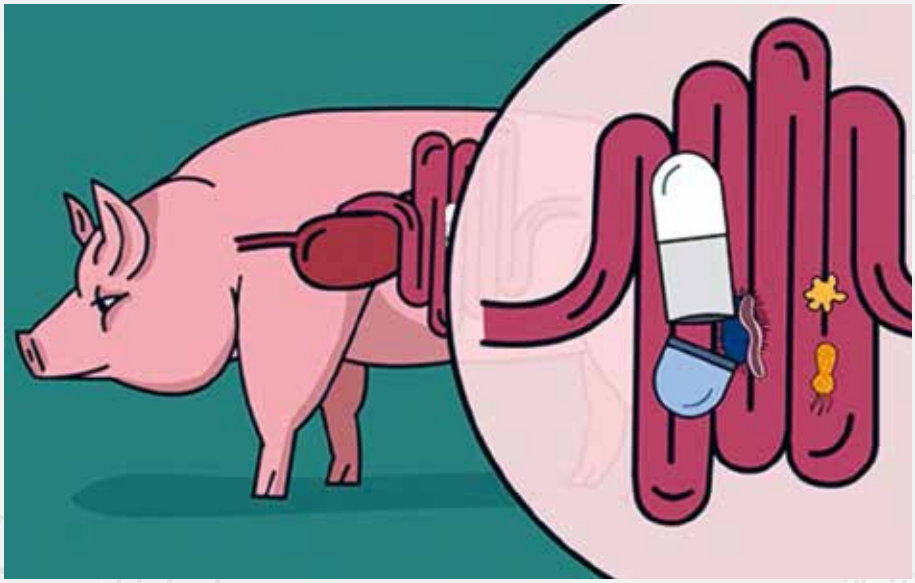
Regeneration of Compacted Subsoils

A video gives a brief explanation of the problem of compacted subsoils and introduces the ROCSUB Project which studies different ways of regenerating a severely compacted subsoil.

→ Video

Strawberries 'Remember' Heat

An Agroscope study shows that heat and other stress situations influence the DNA of woodland strawberry. The resulting changes can help forearm strawberries against subsequent stress situations – they 'remember'.



Agroscope Capsule Collects Gut Microbiome

Researchers from Agroscope have developed a capsule which can take a gut sample unobtrusively from a live pig. This animal-friendly invention has revolutionary implications for microbiome research.

→ Video

Why Farm Managers Invest in a Milking System

The main reasons for investing in a milking system are to reduce workload and physical strain. With milking parlours, the expansion of the farm also plays a key role, as does the improvement of working hours in the case of automatic milking systems.

Promoting Soil Organisms for Good Yields

A wide variety of creatures live in the soil: invertebrates as well as bacteria and fungi. Besides improving soil structure and composition, they can be of direct benefit to crops by making nutrients available to them or by attacking pathogens.

Flavescence Dorée Vine Disease Genome Decoded for the First Time

Agroscope researchers have succeeded in cracking the genome of a quarantine grapevine disease, flavescence dorée, which had proven virtually impossible to combat to date. The decoding will enable us to identify the weak points of the pathogen so that it can be fought more effectively.

Scoring Points with Plant Protection in Vegetable Crops

Agroscope has developed a scoring system for plant protection in vegetable crops. The system enables the creation of incentives for reducing the use and environmental risks of plant-protection products and promoting preventive and non-chemical measures.

Buried Underwear Shows that Humus Promotes Soil Life and Protects against Drought

The aim of the 'Proof by Underpants' project was to obtain in-depth information on the soil quality of gardens and farms, for the first time with the help of the general population. Initial results show that humus plays a key role in the soil, helping it cope better with climate-induced drought.

→ Video

Improving Swiss Agricultural Production through Digitalisation

Weed control in fields using smart technology: this is the goal of an Innosuisse project run by five partners. The aim is to eliminate dock, an invasive plant which is difficult to eradicate in normal circumstances.

→ Video

Smart 'Home Garden' at Agroscope

Agroscope has set up a 'Home Garden' pilot plant on its Conthey site to transfer its expertise in indoor-farming research to the 'Home Garden' system developed by the Zurich-based company Pleasant Plants.

→ Further information on these topics

"A good deal of knowledge is available on how to reduce nutrient losses"

The Swiss Federal Council and Parliament are calling on the agricultural sector to significantly reduce nitrogen and phosphorus nutrient losses over the next few years. Head of Agroscope Eva Reinhard explains how research is supporting the agricultural and food sector on this path.

Why are nitrate and phosphorus losses a problem in agriculture?

After the mid-20th century, the use of fertilisers and imported concentrates rose sharply in agricultural production. The result was bigger crop harvests and improved livestock performances, and hence an increase in overall production. However, there were also undesirable side-effects – for example, nutrient emissions into the environment increased and contributed to various environmental problems.

The measures concerning the so-called 'nitrogen and phosphorus reduction pathways' adopted by the Swiss Federal Council form part of the package of directives relating to Parliamentary Initiative 19.475, part of which will come into force soon – on 1 January 2023.

What approach is Agroscope pursuing in its research to support farmers on this path?

Research has long been concerned with the issue of nutrients. The subject is not a new one. There are numerous findings available on how we can reduce nutrient losses. However, an integrated systems approach across livestock and plant production is essential: there is a risk that individual, uncoordinated measures in one area will result in the loss of improvements achieved elsewhere. We study the reduction target starting with plant production, progressing through animal feed and the manure cascade all the way to fertiliser spreading and the soil processes in the system. In other words, we consider the total nutrient cycle in agriculture.

What concrete action is Agroscope taking?

We are in the process of succinctly summarising the current and earlier findings of research activities on nutrients and their potential points of loss. This includes drawing up a catalogue of possible measures and actions that are already known at present. This is being done in close consultation with other institutions. The findings are meant to serve as decision-making bases for further measures – for practice, extension and policy-makers.

1 Agroscope develops resilient varieties for sustainable Swiss fruit production. | 2 Soil samples are collected for the Swiss Soil Monitoring Network NABO at 110 sites and analysed.
3 Tomato growth can be optimised remotely via special sensors.

Archive image of grape harvest.

1 The ‘Alpine and Mountain Farming’ Experimental Station develops practical solutions for farms in the mountain region.
2 Laboratory analyses are a key component of many Agroscope research projects.
3 Sampling the tidal air of dairy cows.
4 The ‘Vegetable Production’ Experimental Station in the Bernese Seeland develops holistic strategies for profitable and sustainable vegetable production.

5 Agrophotovoltaics use light for vegetables in the greenhouse while simultaneously generating electricity.
6 The current and future challenges of alpine and mountain farming are also researched at Agroscope.
7 Agroscope researches sustainable plant-protection strategies for controlling pests like aphids.
8 Irrigation of Agroscope's breeding garden at Zurich-Reckenholz.

Average Grassland Yields in Switzerland Affected by Summer Drought

In dry summers, up to 25% of total Swiss roughage production can be lost. This is because grassland yields are strongly correlated with summer drought, as shown by a new analysis conducted by Agroscope and the Swiss Farmers' Union.

Pierluigi Calanca, Chloé Wüst-Galley, Silvano Giuliani, Daniel Erdin

Roughage production took a nosedive in Switzerland In the dry summer of 2018.

Swiss grassland covers a substantial proportion of domestic feed demand. In recent decades, the growth of meadows and pastures has often been adversely affected by water scarcity during the summer months. A better understanding of the effects of summer drought on Swiss grassland productivity can help the agricultural sector to prepare for future challenges.

We investigated the extent to which summer drought accounted for variations in the roughage yields for the years 1990 to 2021 according to the calculations of the Swiss Farmers' Union. The extent of the summer drought was assessed by calculating relative evaporation, an internationally used benchmark for crop water requirement, based on the spatial climate analyses of the Federal Office for Meteorology and Climatology. We grouped our results for the three grassland categories of temporary leys, meadows and pastures outside of the summer grazing areas and summer-grazing pastures.

Strong impact of drought on grassland yields

The results show that for all three grassland categories, summer drought accounts for 50 to 60% of the fluctuations in yield. Furthermore, persistent water shortages during the summer months can cause yield losses of around 30 to 40% in extreme years. Distinct productivity shortfalls at national scale occurred in 1998, 2003, 2006, 2015 and 2018 in particular.

With a total Swiss production of around 5.5 million tonnes dry matter per annum, production losses of up to 1.2 million tonnes dry matter (compared to the long-term average) are possible in unfavourable years. This is far more than the approx. 250,000 tonnes of feed imported in a year like 2018. These figures underscore the vulnerability of feed production to extreme climate events.

Temporary leys hit hardest

Temporary leys as well as meadows and pastures below 1000 to 1500m above sea level are particularly affected by summer drought. With temporary leys in particular, water shortages cause steep declines in productivity. On the one hand, this could be due to the fact that, as part of the rotation, temporary leys are created afresh, and in the first year do not possess a fully developed root system which would cushion against temporary water scarcity. On the other hand, temporary leys are almost exclusively found in the low altitudes of the Swiss Central Plateau, where the dynamic and intensity of drought periods has been strongest in the past.

Regional differences

Maps of the spatial distribution of drought reveal regional differences caused by the dissimilar weather patterns. Whereas in 1998 only West Switzerland and in 2003 Northwest Switzerland as well as the area between Lake Neuchâtel and Lake Geneva had to contend with extreme drought, in 2015 and 2018 much of the Central Plateau and part of the Canton of Grisons were affected.

Conclusions

- Relative evaporation, a measure of crop water requirement, can be used to investigate the effects of summer drought on Swiss grassland yields and to identify spatial patterns.
- Summer drought alone accounts for up to 60% of the fluctuations in average grassland yields observed in Switzerland between 1990 and 2021.
- In extreme years, yield losses of around 30 to 40% at the national level are possible.
- Given a possible future increase in extreme drought conditions, the results underscore the necessity of adaptive measures.

Scientific article in Swiss Agricultural Research 13, 135–144, 2022.

Drought-Tolerant Sorghum to Combat Forage Scarcity

Agroscope is testing the agronomic properties of sorghum, an African grass from the family Poaceae, and its quality as a forage. Sorghum has great potential for guaranteeing the availability of forage during hot, dry summers, as well as in winter as conserved forage.

Bastien Hayoz, Elisa Manzocchi, Rainer Frick, Jürg Hiltbrunner, Tiziana Vonlanthen, Nicole Bütikofer, Pierluigi Calanca, Annelie Holzkaemper

Last summer's hot spells turned many meadows and pastures at Agroscope's Posieux site yellow. Not so, however, those sown with multi-cut sorghum.

In drought years such as 2022, grass and maize growth declines drastically, especially in the months of July and August. This can lead to significant forage shortages, which impact the year's reserves. Sorghum has great potential for preventing a drought-related forage shortage in that it is either fed green or conserved as silage. Fodder sorghum can be an important food source for ruminants owing to its drought tolerance and high yield potential.

Mixtures for higher fodder quality

Certain varieties of sorghum produce large amounts of biomass but are generally of relatively low nutritional value. Sorghum was therefore sown in Posieux in combination with various fodder plants such as crimson clover *(Trifolium incarnatum),* berseem clover *(Trifolium alexandrinum)* and Westerwold ryegrass (*Lolium multiflorum* Lam. Var. *westerwolidicum* Mansh.) with the aim of increasing the energy and protein content of the forage and improving the growth of the sorghum.

Multi-cut fodder sorghum tested in Posieux

Since there can be distinct differences between the varieties, the agronomic characteristics and nutritional value of five different sorghum varieties were tested this year. Moreover, during its growth sorghum produces hydrocyanic acid, which is dangerous for ruminants in too-high concentrations. It is therefore important to compare the varieties to determine their differences in this respect. Chemical analyses will also investigate the quality of the different varieties as conserved forage. Agroscope plans to conduct a feeding trial with fresh sorghum in 2023 to investigate in greater detail the ingestion of low amounts of hydrocyanic acid-forming substances and their effects on the animals. A further trial will determine the digestibility of the organic matter and nutrients of multi-cut sorghum to allow an estimation of its nutritive value for ruminants.

Sorghum types and varieties differ distinctly in terms of their agronomic properties and nutritional value.

Single-cut fodder sorghum tested in Zurich

In addition to multi-cut varieties, single-cut sorghum varieties were tested in field trials, with researchers recording agronomic characteristics such as resistance to lodging, yield and dry-matter content. They also analyzed the constituents of fodder samples and are currently developing an equation based on near-infrared spectra to estimate proximate composition.

Map to show possible cultivation areas

Since sorghum is somewhat more demanding than maize in terms of temperature, another project aims to show on a map of Switzerland regions suitable for the cultivation of grain and silage sorghum.

Sorghum (*Sorghum bicolor* (L.) Moench)

Conclusions

- Tests conducted to date show that due to its qualities and the changing environmental and production conditions, sorghum could in future gain in importance in Switzerland and could help to bridge forage shortages in hot and dry years/regions.
- Since sorghum produces hydrocyanic acid, in addition to the quality assessment, attention should be focused specifically on hydrocyanic-acid content to allow its suitability as ruminant feed to be assessed. Here, the choice of variety and timing of sorghum use as well as whether it is fed as conserved forage play a key role, in addition to the environmental factors.

Vacherin Fribourgeois PDO: Consumer Study Shows Popularity of Raw-Milk Cheeses

At the new Centre of Excellence for Raw-Milk Products, Agroscope and Grangeneuve interviewed test subjects about the popularity of Vacherin Fribourgeois PDO cheeses made from raw and thermised milk. The study showed that the market potential of raw-milk cheeses has not yet been exhausted.

Hans-Peter Bachmann, Edith Beutler, Charlotte Fleuti, Monika Lüscher Bertocco, Barbara Guggenbühl

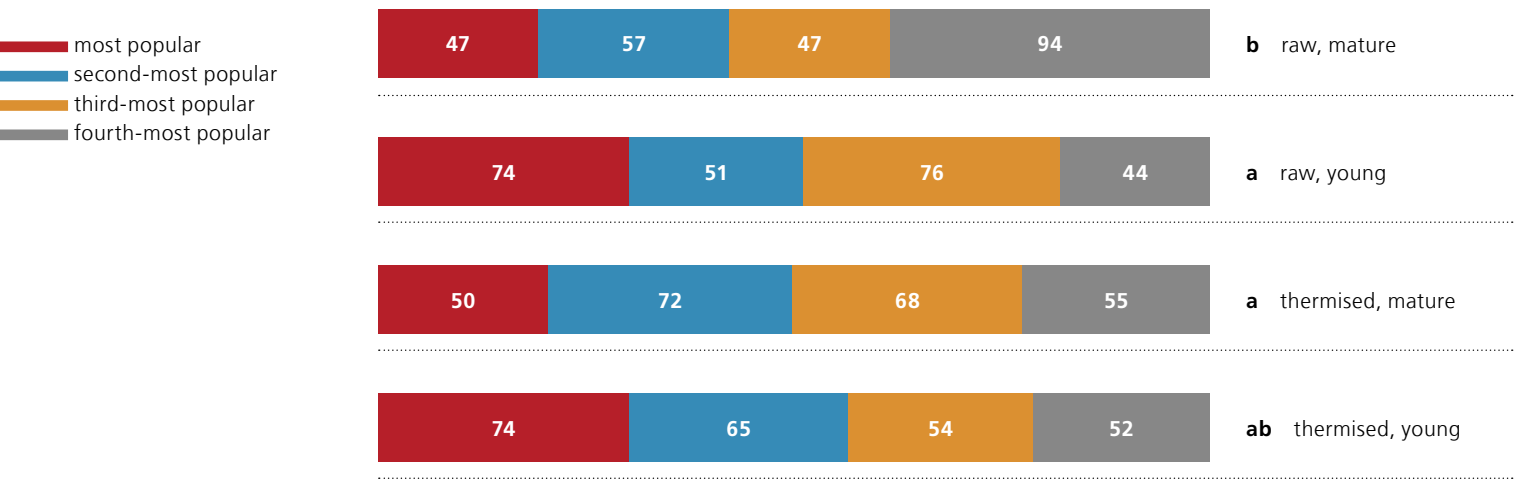
Vacherin Fribourgeois PDO is a semi-hard cheese variety from Switzerland with a longstanding tradition and strong ties to production in the mountain region. Nowadays the milk is usually thermised before being made into cheese. Only around 5% of Vacherin Fribourgeois PDO cheeses are made from raw milk, primarily in the alpine dairies. Today, raw-milk cheeses are generally matured for longer than those made from heat-treated (thermised) milk.

Popularity of cheeses depends more on sensory properties than on ripeness

This study suggests that a longer ripening period is not synonymous with increased popularity with consumers for all cheese varieties. Deviations from the desired sensory properties led to a decrease in popularity not only for the raw-milk cheese, but also for the two thermised cheeses.

A total of 245 people took part in the consumer study on the popularity of Vacherin Fribourgeois PDO cheese made with raw or thermised milk.

Frequency distribution of the popularity rankings (n=245) of the four tested Vacherin Fribourgeois PDO cheeses (different letters = significant difference).



The majority of the test subjects were from the Fribourg region, and were likely to have been familiar with Vacherin Fribourgeois PDO. Sex and age of the subjects had no significant effect on the sensory assessment; however, Vacherin Fribourgeois PDO was significantly more popular with the French-speaking test subjects than with the German-speaking ones. In all likelihood, results would have been somewhat different for test subjects with a different cultural background, and if consumer tests had been conducted in another region. —

Scientific article in Swiss Agricultural Research 13, 145–150, 2022.

Conclusions

- Almost half of the participants rated one of the two raw-milk cheeses as their favourite.
- With a share of about 5% of the cheese produced, the market potential of Vacherin Fribourgeois AOP made from raw-milk is not yet fully exhausted.
- Because young raw milk cheese was very popular, consideration should be given to limiting the ripening time of raw-milk Vacherin Fribourgeois.

Gaining a Better Understanding of Herbicide Resistance

Herbicide-resistant weeds are a growing problem throughout the world. Monitoring herbicide resistance in Switzerland allows us to understand the mechanisms behind it and to better manage the use of herbicides.

Marie Fesselet, Frédéric Tschuy, Judith Wirth

Glyphosate-resistant *Conyza canadensis* (blood stanch) in a Swiss vineyard.

Herbicide resistance has currently been identified at global level in 267 weed species and affects 165 herbicides in 72 countries. Since 2011, the 'Herbology in Field Crops' research group at Agroscope Changins has been testing weed populations with suspected resistances on a national scale in Switzerland. The plants in question survived a herbicide treatment in the field which should normally have destroyed them.

Greenhouse and molecular tests

To detect resistance, greenhouse tests are conducted. For several years now, these tests have been supplemented with molecular tests. Leaves of plants that have survived herbicide treatments in greenhouse trials undergo genotyping and are examined for mutations in relevant target genes. The detection of point mutations in genes encoding protein targets of active ingredients results in the loss of herbicide efficacy. The weed becomes resistant.

Conclusions

- A sound knowledge of herbicide-resistant weed populations and the underlying mutations can help mitigate reduced herbicide efficacy and avoid unnecessary herbicide applications.
- In Switzerland, the level of herbicide resistance is relatively low and resistant weed populations in field crops are generally well controlled.
- Given the increasingly restricted availability of herbicides, Swiss farmers are making ever more use of sustainable weed-management strategies (diversified rotations, undersowing, cover crops, mechanical weeding, etc.)

Weed populations with a survival rate of at least 50% in the greenhouse tests are declared resistant to the tested herbicide. Since 2011, resistances have been confirmed in 131 populations of six weed species in Switzerland. The most affected species is blackgrass, followed by loose silky-bent and Italian ryegrass.

Herbicide-resistant weeds have been detected throughout the Swiss Central Plateau and in Valais, mainly in field crops but also in vineyards. Although the number of resistant populations is steadily increasing, the level of herbicide resistance in weeds detected in Switzerland is low, affecting only six weed species.

Different types of resistance

Molecular tests allow us to differentiate between target site resistance (TSR) and non-target site resistance (NTSR). Most Swiss weed populations exhibit resistance to one mode of action. Herbicide multiple resistance refers to weeds that have evolved resistance to two or three different modes of action.

Multiple resistances conferred by several mutations on different genes are more difficult to manage with herbicides because the choice of herbicide options is limited. It is then necessary to consider non-chemical weed control measures such as mechanical weeding, sowing of grassland, cover crops or regular ploughing. —

Scientific article in Swiss Agricultural Research 13, 125–134, 2022.

Federico Sizzano: Rapid Microbiology in aid of Winemaking

Biologist Federico Sizzano joined the Oenology Research Group a year ago to develop the scope of his activities. The scientist coordinates winemaking research conducted at the 'Viticulture and Oenology' Experimental Station.

Federico Sizzano brings with him his experience in flow cytometry, a technology as yet scarcely applied to winemaking but which is used in spheres as varied as medicine and the agrifood sector. Piedmontese by birth and Milanese by adoption, Sizzano worked alternately in several research centres in Italy (immunology) before moving to Switzerland in 2014 to work at Nestlé's (microbiology).

Promising prospects for oenology

Flow cytometry is a powerful laboratory method enabling the functionality of various micro-organisms to be determined. It opens up promising prospects in wine-making for following and arriving at a thorough understanding of the activity of bacteria and yeasts (favourable to the quality of wine or otherwise) during the various stages of the vinification process. The oenology laboratory at the Changins site is equipped with new devices to support the development of this method and create a pool of microbiological expertise in close collaboration with the UAS Changins. Over the past year, Sizzano has developed flow cytometry protocols for the microbiological monitoring of winemaking at laboratory scale (from 250ml to 2 litres). Thus, flow cytometry was implemented for the microbiological monitoring of vinification trials in 2022 both at the Changins site and at the Viticulture and Oenology Experimental Station in Leytron (Canton of Valais). By way of example, the evolution of the intracellular pH of yeasts during fermentation was visualised by flow cytometry in a project aiming to optimise the use of acidifying yeasts. In the near future, the scientist will work on implementing new cytometry protocols to determine more precisely the metabolic processes that occur during fermentation.

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“There is a good deal of knowledge available about how to reduce nutrient losses in agriculture.”

Eva Reinhard, Head of Agroscope

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