AgroSCOPE

Annual Report 2017

Agroscope good food, healthy environment

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Readers at the hive entrance recognise bees with a chip on their back.

Sustainability

Livestock

Food

Plants

Mission Statement

Swiss Research for Agriculture, Nutrition and the Environment

Agroscope, the Swiss Federal Centre of Excellence for Research in the Agriculture and Food Sector, is affiliated with the Federal Office for Agriculture (FOAG). Agroscope is strategically managed by the Agroscope Council, whilst the Agroscope Executive Board is responsible for its operative management.

Vision

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.

Aim and Purpose

Agroscope researches along the entire value chain of the agriculture and food sector for a competitive and multifunctional agricultural sector, for high-quality food for a healthy diet, and for an intact environment. Our focus is on research and development for the benefit of the agriculture and food sector; the provision of decision-making bases for federal-authority legislation; enforcement tasks within the framework of the legal provisions in the service of agriculture and the general public; and knowledge exchange and technology transfer with practitioners, agricultural extension, industry, science, the teaching sector and the public.

Looking Back and Ahead

At the end of last year, Agroscope concluded its 2014–17 Work Programme. The results were impressive: in a phase characterised by organisational changes, our technical objectives were still largely achieved. This reflects the importance of a Work Programme whose project descriptions form the stable foundation for its research activity.

Standing still is anathema to research. Our vision must be directed ahead, which is where Agroscope has it focused for the next few years. In the new 2018–21 Work Programme we've formulated 17 Strategic Research Fields outlining the most important challenges of the Swiss agriculture and food sector, as well as the associated research tasks and issues. These form the framework within which our research, development and enforcement activity will take place over the next few years. We have supplemented this view with a broad-based survey of the needs of our most important clients. Based on this, 117 research projects have been developed which will make concrete contributions to meeting these challenges.

In this context, digitisation is an important topic. The cover story 'Digitised Bees: Ambassadors for Bee Protection' shows how elegantly Agroscope is able to research colony collapse, thanks to modern technologies.

The article 'Cows in the Digital Era' deals with automatic animal-monitoring systems that are reaching the stage of suitability for practical application, thanks to Agroscope's involvement. In the article 'Viticulture: Towards Zero Treatment', we describe how Agroscope uses modern methods to expedite the breeding of fungus-resistant grape varieties. 'Automated Control of Broad-Leaved Dock' describes how – with the involvement of Agroscope – a device is being developed which independently detects dock plants on a field and destroys them with hot water.

Besides this, in the 'Short Texts' we present examples of each of the 17 Strategic Research Fields, the two Agroscope Research Programmes, and – to close the circle – the essence of the new Work Programme. Come the end of March 2018, I'll be handing over all this to my successor, Eva Reinhard.

Michael Gysi
Head of Agroscope


ZBF

Digitised Bees: Ambassadors for Bee Protection

Bees may ingest small amounts of plant-protection product residues through pollen or nectar. This is often cited as a possible cause of colony collapse disorder. A newly developed test is meant to show whether feeding small, non-lethal quantities of PPPs to bees influences their orientation and memory capacity.

Test bees fly to the hive with a microchip on their back. Their flight behaviour is measured, and provides Agroscope researchers with valuable information. The aim here is to determine the risks of PPP residues and help us answer the question of how they affect bees in their natural habitat. Specifically, we determine how many of the test bees return to the hive from a distance of 1 km after ingesting a feed solution to which a neonicotinoid has been added, and how long it takes them. "Bees that are familiar with the surroundings normally fly straight back to the hive" says Agroscope researcher Lukas Jeker. The return rate and duration of the journey back to the hive provide valuable information on how well the bees are doing, and whether they can still find their bearings.

RFID Technology

For this, RFID (= radio-frequency identification) technology is used. RFID is an automatic, contactless communication technique that can be used for the identification of people, animals, goods, etc. The technology is well known e.g. in warehouses where it is used to protect goods from theft by triggering an alarm when they are illicitly removed. A similar data medium is now being attached to the backs of test bees. When the bee reaches the hive entrance equipped with the reader, the data can be scanned and identified contactlessly from its 'barcode'. RFID works with weak electromagnetic waves that are emitted by the reader. To enable the bees to get used to the reader, the technology was installed on the flight board at the hive entrance a few days before the start of the experiment.

Bee research calls for a light touch

"To allow a bee to fly unimpeded, the data carrier must be attached precisely on the bee's carapace, without adversely affecting its wings or flight musculature." These data carriers – also known as transponders or tags – weigh about 4.5 milligrams. "We had to find a way to attach these tags securely to the bee's back. By now, we're adept at gently sticking them on there with a bit of tooth cement. The cement dries quickly, and holds reliably. It's important that the stress this causes for the bees be kept to a minimum, and that the chip not adversely affect their behaviour" explained Jeker, an ecotoxicologist.

Lukas Jeker is getting ready to attach a chip to the carapace of each bee. The chip must not adversely affect either the wings or the flight musculature of its wearer.

Problems on the flight home

So far, at the highest dose of 1 ng per bee, the tested neonicotinoid has been shown to have an influence on the return rate, with only 60 % of the bees that ingested the highest – and fairly unrealistic – dose flying back to the hive. By contrast, 90 % of the untreated bees, or those exposed only to the low dose, found their way back to the hive. Other countries had similar findings. From this, we can conclude that the orientation or flight capacity of bees is impaired when they ingest a high concentration of the neonicotinoid. The question now arises as to how this affects an entire bee colony.

Participation and co-determination

Conducted by the Bee Research Centre at Agroscope, this study forms part of an international ring test for developing new test procedures for improving PPP risk assessment both in Switzerland and internationally. The ring test is being conducted in twelve laboratories in five countries – Germany, Italy, UK, France and Switzerland – according to the same experimental plan. This means that not only are we studying how technology should be applied in bee research; we are also comparing findings from the different countries in order to test the robustness of the method.

The non-lethal effects of PPPs can be assessed on the basis of the bees' homing ability

The participation of Agroscope – the Swiss Centre of Excellence in this field, and an independent body – in international ring tests is crucial. It enables new methods, the risk assessment of plant-protection products with regard to bees, and the authorisation of said PPPs to be adapted or conducted with the benefit of our input, and improved according to the latest findings. Data from all participating countries is being compared with the aim of creating a new OECD guideline for the authorisation of plant-protection products.

In 2018, the ring test is being conducted one last time before the method is submitted to the OECD as a new guideline and evaluated. The aim is to enable the RFID test to be used for the assessment of non-lethal effects. This would be an important step in improving bee risk assessment ■

Microbial Biodiversity Research Programme

Data collection in several model systems is complete. The data analyses, based on refined or newly developed bioinformatic methods, are well advanced. Examples are: A site-specific differentiation of soil microbiomes is feasible; Pseudomonads that are effective against plant diseases possess potential for use in leaf microbiomes; Fatty whey metagenomes have been sequenced down to strain level. The upshot of this work has been an expansion of knowledge concerning the functions of organisms in agriculturally and nutritionally important ecosystems.
www.agroscope.ch/mikrobielle-biodiversitaet

2018 Conference on Antibiotic Resistance

Antibiotics are increasingly losing their medicinal effect because of resistant bacteria. The Agroscope REDYMO research programme for the 'Reduction and Dynamics of Antibiotic-Resistant and Persistent Microorganisms along Food Chains' investigated three sectors. A number of practical solutions already exist for the production of plant-based foods, dairy farming and pig production. The results will be presented at a conference in autumn 2018.
www.agroscope.ch/redymo

Perennial Ryegrass for Clover-Grass Mixtures

Modern forage production in this day and age would be unthinkable without perennial ryegrass. Agroscope's comparative variety trials offer support for agricultural practitioners faced with the challenge of keeping track of the many varieties of this forage plant, which are bred worldwide. Based on the trial results, out of 62 tested varieties Agroscope now recommends 'Artonis', 'Soronia', 'Araias', 'Koala' and 'Praetorian' for forage production in Switzerland. The first four varieties stem from the Agroscope breeding programme.
www.agroscope.ch/srf01

Guidelines for Fertiliser Application now also Online

The 2017 edition of the 'Principles of Agricultural Crop Fertilisation in Switzerland' ('PRIF': German abbreviation 'GRUD') is available for the first time online as well as in a print version. PRIF now offers fertilisation data for arable, forage and special crops – all combined in a modular publication. The PRIF guidelines (see www.prif.ch) are mainly used by farmers, agricultural advisers, researchers, and policy decision-makers.
www.agroscope.ch/srf02

Identifying the Right Crop Variety for the Right Place

Large-scale prediction of the performance of genotypes is crucial for predicting genotypic performance in specific environments and increasing our knowledge in order to develop future crop varieties. Agroscope has started applying predictive algorithms to mine historical datasets. High prediction accuracies for certain sites and genotypes applying algorithms based on ridge regression and deep learning showed promise for the difficult task of identifying the right variety for the right place.
www.agroscope.ch/srf03

Tannins instead of Antibiotics in Pig Breeding

Piglets weaned from the sow and combined into new groups often develop what is sometimes referred to as 'post-weaning diarrhoea'. Frequently, the whole group of piglets with diarrhoea is treated preventively or therapeutically with antibiotics, which promotes the occurrence of antibiotic resistance. A study conducted at Agroscope showed that chestnut tannins successfully reduce post-weaning diarrhoea, and thus represent a practical alternative to the use of antibiotics.
www.agroscope.ch/srf04

Drones for treating hard-to-reach vines

The use of drones is increasing rapidly in a growing number of fields. In addition to capturing images, drones could be a useful alternative for applying plant-protection products in non-mechanisable and difficult-to-access vineyards. The Vidrone project aims to evaluate the usefulness of drones for PPP treatments, particularly in terms of effectiveness, quality of application and drift control. It also aims to make proposals for a standard authorisation procedure for applications using a drone.
www.agroscope.ch/srf05

Group Housing of Horses Catches On

A representative survey on the housing and use of horses covered over 12,800 equids in Switzerland, and shows that just under half of these are kept in group housing. Half of all equids housed individually are kept in stalls with outdoor access. One-third of all equids already receive their roughage both loose and in a slow-feeding system, which lengthens feeding time and takes account of the animals' natural needs. Adult equids are used for one hour a day on average. Major changes in housing and keeping practices are posing many new challenges for the horse sector.
www.agroscope.ch/srf06

Cows in the Digital Era

Faced with a high workload, increasing numbers of animals and growing farm structures, farmers are investing ever more in automatic animal-monitoring systems. These save time by keeping an eye on all animals, everywhere and at all times. Changes in behaviour and health are detected early on, allowing measures for the benefit of the animals to be taken immediately.

How do we learn about a cow's state of health? We can't ask her, nor can she send us a text from her smartphone. Or can she, actually? At Agroscope she can if she's wearing RumiWatch sensors on her head and leg. Agroscope experts use such sensors to record the feeding and activity behaviour of a cow. The aim is that RumiWatch – the animal monitoring system – will in future send important information on the animals' behaviour and well-being directly to the operator's tablet or smartphone. In addition to animal welfare, this system would also help improve herd management and feeding.

It all began in the barn

Agroscope developed the RumiWatch system together with Vetsuisse (University of Bern) and Itin&Hoch (Liestal, Switzerland). The system consists of a pedometer as well as a noseband sensor incorporated in a halter. The data gathered by the sensors are sent to a computer. The RumiWatch programme records and evaluates the data.

Nils Zehner helped develop RumiWatch. The system allows farmers to keep track of their animals' welfare, even if – unlike Zehner himself – they are not always with them.

At present, the system is primarily used in research in order to investigate various issues to do with ruminant nutrition. For this, it was first necessary to develop a measuring instrument capable of distinguishing the different pressure signals for feeding and ruminating. The improved system also permits the recognition of the swallowing and regurgitation of a bolus.

Refined for the pasture

Ruminants, however, exhibit different feeding behaviour on pasture than in the barn, which is why the RumiWatch system needed to be refined for grazing cows. In particular, the automated estimate of feed consumption is very important in grazing.

RumiWatch allows us to detect changes in the cows without always having to be there with them

That's why the RumiWatch halter can now distinguish between feeding bites and mastication bites. The ratio between the two types of bites might enable us to draw important conclusions about forage quality. This, too, is an important parameter for improving pasture management – for when forage quality declines, it is time for a change of pasture.

Monitoring animal welfare

In addition to gathering feeding data, RumiWatch also gathers information on movement activity for the early detection of disease and the assessment of animal welfare. The pedometer enables the accurate recording of walking, standing and

resting behaviour. The combination of the different data recorded is intended to form the basis for the early detection of future disease or disorders.

In the past, studies were conducted into the automatic detection of lameness. In future, however, particular focus will also be placed on time-series analyses, which among other things are to be used to record the biorhythms of the animals.

Stepping into practice

The RumiWatch system has been used for research purposes since 2012, and around 1500 units are currently in use worldwide. The next step consists in making the technology fit for practice. This presupposes that it is simple to use, and can be offered at a reasonable price.

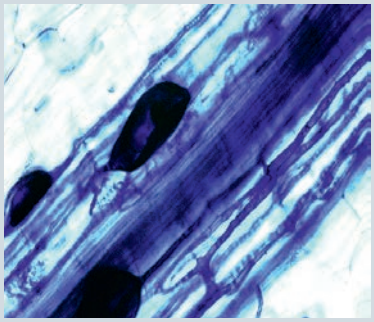
What works for cows could also do the trick for horses, which is why a pilot study was conducted at the Swiss National Stud Farm using an EquiWatch system. Thus, in just a few years' time, cows and horses may be able to inform farmers directly as to how they are doing via text message ■

Weak Larvae Make the Bee Colony Strong

The Varroa mite from Asia is the greatest threat faced by the Western honey bee. Since the attempt to breed resistant bees has so far yielded no practical results, Agroscope investigated the natural resistance strategy of the Eastern honey bee. Surprisingly, it was discovered that the latter's parasitised larvae died more quickly than that of the Western honey bee. The nurse bees remove the parasitised larvae from the brood cell, along with the reproducing parasites, thereby interrupting the multiplication of the parasite and ensuring the survival of the colony.

www.agroscope.ch/srf07

Benefiting from the Jungle beneath our Feet



The soil is one of the most diverse habitats on Earth. Swiss arable and meadow soils teem with living organisms. Thousands of bacteria and up to 200 metres of mycorrhizae can be found in a single gram of soil. Fungi and bacteria in the soil form complex networks. New research findings are now showing that these microbial networks can be promoted and used in a targeted fashion, e.g. to improve the nutrient uptake of plants, or to increase soil fertility.

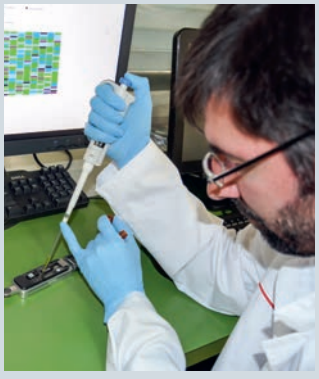
www.agroscope.ch/srf08

Safe Foods without Antibiotic Resistance

Antibiotics are increasingly losing their medicinal effect. This is due to an increase in antibiotic-resistant bacteria occurring in humans and animals as well as on foods. Agroscope is investigating this issue in national and international research partnerships, and looking e.g. at how antibiotic resistance can be transferred to lettuce plants (here, the irrigation water has been identified as a source of contamination). The findings and avoidance measures based on them are summarised in a fact sheet.

www.agroscope.ch/srf09

Nanopores Revolutionise DNA Sequencing



DNA sequencing contributes to the identification of pathogens, the breeding of new varieties and the characterisation of microorganisms. Using the latest technology, which allows DNA to pass through tiny nanopores whilst being read, Agroscope managed to identify quarantine insects and decipher the genomes of the causal agent of fire blight as well as of a yeast which in laboratory tests revealed useful traits for combatting fungal diseases of apples.

www.agroscope.ch/srf10

Viticulture: Towards Zero Treatment

For 50 years now, viticulture breeding has been developing new grape varieties with clear-cut plant-protection objectives, making use of the plants' natural resistances. The marketing of the first grape varieties that allow farmers to dispense totally with fungal treatments is expected in eight to ten years' time.

To this day, over 95 % of Swiss vineyards consist of European grape varieties (*Vitis vinifera*), which are susceptible to both downy and powdery mildew. As a rule, they require from six to ten phytosanitary treatments to guarantee a high-quality harvest, whether they are grown according to integrated or organic production methods. Developing grape varieties with a natural resistance to the main fungal diseases offers the greatest potential for reducing the use of phytosanitary inputs. In particular, by incorporating new technologies, the breeding process allows us to obtain grape varieties with a high level of resistance, and currently pursues the aim of 'zero treatment'.

Stage one: Grape varieties resistant to grey mould

Since 1965, Agroscope has been developing new grape varieties with the aim of creating a high resistance to grey mould (*Botrytis cinerea*), one of the most virulent pathogens in our vineyards. Eight new grape varieties have thus emerged and been made available to practice since 1990. The best-known varieties are Gamaret, Garanoir, Diolinoir, Carminoir, and Galotta. The high resistance of these varieties to grape rot allows growers to dispense with the application of specific anti-botrytis fungicides, the preparations most likely to leave residues in wine. What's more, their high winemaking potential and their adaptive phenotypic plasticity explain their rapid growth in Swiss vineyards. In 2016, there were nearly 900 ha planted with these varietals, i.e. nearly 10 % of Switzerland's range of red varieties. Gamaret thus became the fourth most important red grape variety, and was recently included in the French catalogue.

An exchange between Jean-Laurent Spring and Katia Gindro on the grape varieties currently being bred.

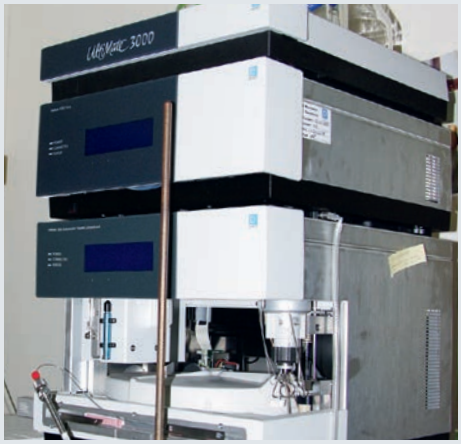
Resistant grape varieties are capable of preventing the growth of the pathogen

Divico and Co.: Resistant to downy and powdery mildew

Since 1996, Agroscope has been creating grape varieties that are also resistant to downy mildew (*Plasmopara viticola*) and powdery mildew (*Erysiphe necator*). In a first stage, the Gamaret grape, a European parent variety that is extremely resistant to grey mould, was crossed with a wide range of grape varieties carrying resistance genes from wild American and Asian vines.

In order to speed up the breeding process and render it more reliable, Agroscope's Mycology Research Group has developed a scientific methodology that includes early testing to select the candidates with a high resistance to downy mildew. Biochemical criteria have been developed on the basis of natural defence mechanisms induced by the vine (stilbene phytoalexins). The synthesis of stilbenes, and more specifically of resveratrol and its oxidised derivatives such as ε- and δ-Viniferin, as well as pterostilbene (a methylated deriv-

ative) is one of the most effective defence mechanisms of the vine against fungal pathogens. Following an infection, resistant grape varieties are capable of synthesising these toxic derivatives and preventing the growth of the pathogen. This approach allowed a first highly resistant red grape variety, Divico, to be marketed in 2013. Divico can be successfully cultivated with a maximum of one to three treatments, depending on disease pressure, using products authorised in organic viticulture. Its high quality potential is sparking considerable interest in the sector, with



22 ha already in production in Switzerland in 2016. A second (white) variety with the same resistance traits will be available from 2019.

A Franco-Swiss project

Since 2009, Agroscope has collaborated on a joint project with the Colmar Inra Research Centre for breeding resistant grape varieties through the pyramidisation of downy-mildew and powdery-mildew resistance genes. This method enables the accumulation of several resistance genes in order to obtain grape varieties with a virtually absolute and stable resistance. Resistance genes from Agroscope lines deriving from wild American (*Vitis rupestris* and *aestivalis*) and Asian (*Vitis amurensis*) species are accumulated by crossing with resistance genes from French lines stemming from the American species *Vitis rotundifolia*. Their joint presence in the crossings is checked by genotyping. Three populations comprising 400 candidates possessing a minimum of two resistance genes against downy and powdery mildew, respectively, are examined on the Agroscope experimental field in Pully and the Inra experimental field in Colmar as to their agronomic and oenological suitability. An initial selection of fifteen or so particularly promising candidates will be tested for certification in France and Switzerland in 2018. The launch of these first grape varieties which will render fungal treatments completely unnecessary is expected eight to ten years from now ■

Locating Cows, Saving Working Hours

The new LoRaWAN (Long-Range Wide-Area Network) radio standard is a reasonably priced technology with a minimal energy requirement and a long range for data transmission. Ten GPS collars with LoRa transmitters were developed by the ZHAW and tested on cows by Agroscope. In addition to creating networks, the technology can also help to save working time spent locating the animals on extensively managed land and to monitor their well-being.

www.agroscope.ch/srf11

Reducing Environmental Pollution with Diet

Consuming less meat and alcohol, eating more plant-based foods such as cereals, potatoes, nuts and fruit, avoiding imported products whose mode of production or transport is particularly polluting, using already-available grassland for milk production and avoiding food loss are strategies with the greatest potential for reducing the environmental impacts of food. At the same time, an environmentally optimised diet of this sort would largely correspond to nutritional recommendations.

www.agroscope.ch/srf12

Efficient Cost Analysis with AgriPerform

A farm-activity analysis is essential on mixed farms in order to introduce cost reductions and define farm strategies. With AgriPerform, financial accounting data can be entered in the Excel spreadsheet in under two hours. Here, the overhead costs are automatically allocated to the different activities of the individual farm based on about 5000 reference farm-activity groups. Thanks to a manual correction option, the results can be refined even further.

www.agroscope.ch/srf13

Reducing Ammonia Emissions from Animal Housing

Livestock husbandry involves undesirable emissions in the form of ammonia and greenhouse gases. In order to achieve agricultural environmental objectives, measures that are both effective and practical are necessary. In the experimental dairy housing for emission measurements, structural, process-engineering and organisational mitigation measures as well as feeding strategies are comparatively investigated and evaluated. Besides emissions, the investigations also cover process engineering, animal behaviour, work economics and costs.

www.agroscope.ch/srf14

Automated Control of Broad-Leaved Dock

"Combining strengths to control broad-leaved dock" is the slogan under which Agroscope works with Dutch, Danish, French and Swiss partners to develop solutions for combatting these undesirable plants. The aim of the European Era-Net/ICT-Agri Project 'DockWeeder' is to develop an autonomous dock-destroying robot that targets *Rumex obtusifolius* plants with hot water.

Controlling broad-leaved dock in organic farming is a time-consuming, manual-labour-intensive process. Weed pressure from docks can lead to farmers abandoning organic production.

In developing the hot-water treatment, Agroscope has created an alternative for chemical-free dock control in grassland which has found its way into practice *inter alia* in the form of (high-pressure equipment manufacturer) Hans Bachmann Hochdruck-Anlagen AG's hot-water dock-control device.

As the next developmental step, automation of control now comes into play. The aim is to accomplish this with an unmanned carrier vehicle that will navigate autonomously on the fields, detect the plants automatically, then treat them with hot water.

In the 'DockWeeder' project, Dutch, Danish and Swiss project partners are working on image recognition of the plants. Two French partners are responsible for the autonomous vehicle and knowledge-transfer-to-practice elements. The hot-water-treatment component is handled jointly by Agroscope and Bachmann AG (Bütschwil, canton of St. Gallen).

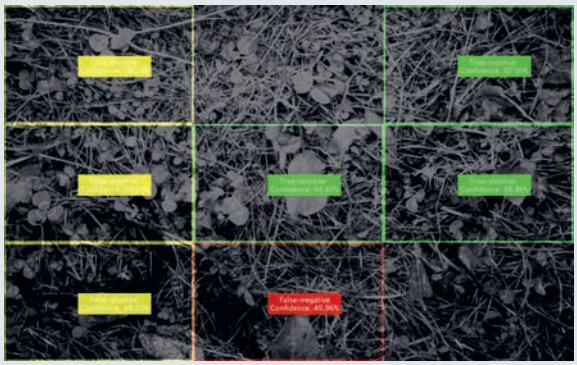
Matthias Hatt tests the nozzle developed by Agroscope in cooperation with a high-pressure-systems manufacturer.

Fault-free detection of the undesirable plant

The Institute of Mechatronic Systems (IMS) of the Zurich University of Applied Sciences (ZHAW) designed an imaging system with three monochrome cameras and a LiDAR (laser) scanner. The system enables synchronised data acquisition with precise time stamps and centimetre-accurate positioning for each data type. The ZHAW-IMS 'MAVERiC' robot was used to collect data on sites in Switzerland, France and the Netherlands. The project partners used this collected data as the basis for the image processing.

We have Agroscope to thank for discovering a reliable, practical and affordable process that allows organic farmers to control broad-leaved dock

Wageningen University & Research (WUR) coordinated the entire project. Furthermore, WUR combined information from two or more sources in order to achieve a more robust detection – e.g. images from cameras could be overlaid with the three-dimensional laser scans. Deviations in the recognition results of the different methods were then combined using estimation techniques, taking into account the uncertainty of the measurement method.



Aalborg University, Denmark (AAU) is responsible for compiling the project's user requirements as well as for part of the weed detection. Self-learning calculation methods were used for dock detection in 2D images. A large number of images with labelled docks were imported to train the algorithms. The detection algorithm then provided results for the individual image segments. This is how the device detects the dock plants.

Building a fully functional robot

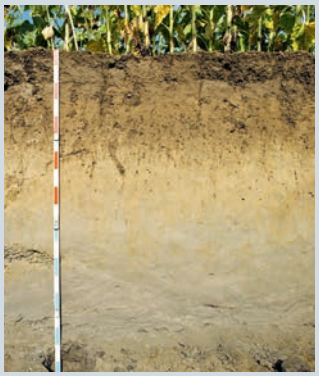
France's largest agricultural cooperative, Terrena, contributed a technical and economic user requirements catalogue of their members to the project. Together with the ZHAW, it organised the imaging campaign. Terrena maintained the project website www.dockweeder.eu. The French also carried out PR activities and represented the consortium at the Space2017 livestock exhibition in Rennes. Moreover, Terrena was the link to Shark Robotics, who supported the consortium by designing an autonomous carrier vehicle.

Agroscope and the Swiss company Hans Bachmann Hochdruck-Anlagen AG were jointly entrusted with the design of the hot-water application – the former as process developers, the latter as manufacturers of hand-guided hot-water dock-control devices. Automated water application to the roots necessitated the redesign of a rotating nozzle unit and the adaptation of the device to the new nozzle. Crossways-sliding linear units enabled the positioning of the new application head above the plant to be treated.

The cross-border cooperation here proved very fruitful. The progress achieved in the various areas lead us to hope that a robot suitable for use in practice will soon be a reality ■

New Humus Balance Calculator now Online

The humus content of a soil, which is dependent upon site characteristics and management, influences a great many soil functions. Calculating the humus balance on the basis of farm data allows us to assess the quality of humus management. The humus balance calculator calculates the humus balance of both the individual plots and the entire farm, even over several years if required. It is available as a web application which can also be used to review improvements in humus management.
www.agroscope.ch/srf15



Bee Pollination also Important for Field Crops

A study on the importance of pollination by honey and wild bees in Switzerland revealed that, in addition to fruits and berries, pollinator-dependent field crops are grown on 14% of the country's arable land. The estimated value of the yield for all crops achieved through pollination is CHF 341 million per year. There are probably not enough honey bees available everywhere to accomplish this pollination, although coverage is good on average. In view of these large figures, the protection of honey bees and wild bees is essential.
www.agroscope.ch/srf16

It Pays to Assess Climate Impacts

Rising temperatures and a decrease in summer precipitation will increase the need for irrigation on Swiss farms in future. This could exacerbate regional water-use conflicts, with e.g. potable-water use being at loggerheads with nature-conservation aims. Model-supported assessments of climate impacts are important to enable the early detection of mismatch risks and to highlight alternatives. It is only in this way that unwise investments and negative environmental impacts can be avoided over the long term.
www.agroscope.ch/srf17

Flexible and Equipped for the Future

To produce high-quality foodstuffs resource-efficiently whilst remaining competitive: this is the current challenge facing the agriculture and food sector. In its new 2018–2021 Work Programme, Agroscope gets to grips with this complex set of conflicting priorities in 17 Strategic Research Fields and 117 projects which aim to develop concrete solutions for practitioners. If changes such as new pests or diseases should occur in the environment, Agroscope needs to be able to respond to these quickly and flexibly.
www.agroscope.ch/wp18-21

State Accounts 2017

Statement of Financial Performance	Accounts 2016	Accounts 2017	Divergence 2017/2016	Divergence 2017/2016
	in CHF	in CHF	in CHF	in %
Functional earnings				
Financially impacting	22,479,015	22,277,485	–201,530	–0.90
Non-financially impacting	–825,777	–268,136	557,641	67.53
Total revenues	***21,653,238***	***22,009,350***	***356,112***	***1.64***
Functional expenditure				
Financially impacting	136,276,490	132,176,576	–4,099,914	–3.01
Non-financially impacting	5,154,620	5,533,759	379,139	7.36
Service accounting between offices	51,126,848	49,102,979	–2,023,869	–3.96
Total functional expenditure	***192,557,958***	***186,813,315***	***–5,744,643***	***–2.98***
Statement of Investments				
Investment income	10,755	36,209	25,454	236.67
Investment expenditure	4,280,114	3,642,764	–637,350	–14.89
Reserves				
Creation of earmarked reserves	826,300	1,883,340	1,057,040	127.92
Use of earmarked reserves	380,000	583,500	203,500	53.55
Third-Party Funds				
Acquisition of third-party research funding	14,614,579	15,351,358	736,779	5.04

Sites

Key Figures 2017

898 people on average were employed by Agroscope in 2017, based on financially impacting expenditure.

394 of these were women corresponding to a 44% share.

50 trainees were employed.

–

1262 items were published in 2017.

–

2040 classes and lectures were given in total by Agroscope staff at universities and universities of applied sciences in the year under review.

–

15.3 million Swiss francs of third-party funding for research were acquired by Agroscope in 2017.

Strategic Research Fields (SRFs)

The 17 Strategic Research Fields (SRFs) focus on the most important challenges of the agriculture and food sector, and form the framework of our research and development activities.

SRF 1	Optimising and coordinating multifunctional grassland use and livestock husbandry
SRF 2	Developing resource-efficient cultivation methods and systems for field crops and special crops
SRF 3	Breeding and offering efficient and marketable plant varieties
SRF 4	Optimising protein supply for humans and animals
SRF 5	Developing sustainable, low-risk plant protection
SRF 6	Supporting and promoting animal-friendly husbandry and animal health
SRF 7	Using animal genetics and livestock breeding for site-adapted animal husbandry
SRF 8	Harnessing microbial biodiversity for the agriculture and food sector
SRF 9	Lowering microbial risks and antibiotic resistance for safe food
SRF 10	Promoting quality and product innovation in foods
SRF 11	Optimising production systems through Smart Farming
SRF 12	Highlighting the strategic success positions of the Swiss agriculture and food sector in open markets
SRF 13	Recognising potential for improving the competitiveness of farms
SRF 14	Assessing sustainability and eco-efficiency in agriculture and highlighting potential for improvement
SRF 15	Protection and location-appropriate use of the soil
SRF 16	Preserving and harnessing the species and habitat diversity of the agricultural landscape
SRF 17	Making agriculture climate-change-proof and reducing its contribution to climate change

Organisational Chart

Agroscope Council

Agroscope
Michael Gysi (up to 31-3-2018)
Eva Reinhard (as of 1-4-2018)
Deputy CEO Michael Weber

Corporate Communication CCA
Christine Caron-Wickli

Corporate Strategy CSA
Michael Weber

Competence Divisions

Animals and Products of Animal Origin
Walter Stoll

- Feed Control
- Horse Breeding and Proper Housing
- Research Contracts Animals
- Posieux Experimental Farm
- Horses Avenches
- Processing Technology
- Biotechnology
- Production of Cultures

Plants and Plant Products
Willy Kessler

- Seed Quality
- Varieties and Production Techniques
- Plant-Protection Chemistry
- Ecotoxicology
- Phytosanitary Service
- Fruit-Production Extension
- Vegetable-Production Extension
- Viticulture Extension
- Product Quality and Innovation

Method Development and Analytics
Corinne Jud Khan

- Animal Biology
- Feed Biology
- Feed Chemistry
- Wine Quality
- Biochemistry of Milk and Micro-organisms
- Fermentation Organisms
- Ingredients
- Environmental Analytics
- Molecular Ecology
- Molecular Diagnostics, Genomics and Bioinformatics

Strategic Research Divisions

Plant Breeding
Michael Winzeler

- Field-Crop Breeding and Genetic Resources
- Fruit Breeding and Genetic Resources
- Fodder-Plant Breeding
- Breeding Research

Plant Production Systems
Christoph Carlen

- Field-Crop Systems and Plant Nutrition
- Greenhouse Crops
- Berries and Medicinal Plants
- Fruit Crops in the Alpine Region
- Herbology in Field Crops and Viticulture
- Viticulture
- Œnology

Plant Protection
Alain Gaume

- Phytopathology and Zoology in Fruit and Vegetable Production
- Plant Protection South of the Alps
- Mycology and Biotechnology
- Entomology in Field Crops and Viticulture
- Virology, Bacteriology and Phytoplasmology
- Ecological Plant Protection in Field Crops

Animal Production Systems and Animal Health
Hans Dieter Hess

- Ruminants
- Pigs
- Grazing Systems
- Farm-Animal Welfare
- Bees
- Forage Production and Grassland Systems
- Swiss Institute of Equine Medicine (ISME)

Food Microbial Systems
Fabian Wahl

- Microbiology of Plant Foods
- Cheese Quality and Authenticity
- Cultures, Biodiversity and Terroir
- Risk Evaluation and Risk Mitigation
- Functional Nutritional Biology
- Human Nutrition, Sensory Analysis and Flavour
- Microbiological Safety of Foods of Animal Origin

Agroecology and Environment
Robert Baur

- Climate and Agriculture
- Water Protection and Substance Flows
- Soil Fertility and Soil Protection
- Swiss Soil Monitoring Network
- Plant-Soil Interactions
- Agricultural Landscape and Biodiversity
- Life-Cycle Assessments
- Biosafety

Competitiveness and System Evaluation
Nadja El Benni

- Socioeconomics
- Farm Management
- Automation and Labour Organisation
- Digital Production

Resources Unit
Daniel Guidon

- Human Resources
- Finances
- Information Technology
- Infrastructure and Safety
- Publishing
- Procurement Management
- Controlling
- Quality Management

← Organisational Chart

Masthead

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Editorial Board	Carole Enz (Project Manager), Claire Bussy Pestalozzi and Ariane Sotoudeh
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