Versuchszentrum
Centro di Sperimentazione
Research Centre

LAIMBURG

NATURE & SCIENCE: HAND IN HAND

EN

LAIMBURG REPORT

2018 – 2019

Research and innovation at Laimburg Research Centre

AUTONOME PROVINZ BOZEN - SÜDTIROL
PROVINCIA AUTONOMA DI BOLZANO - ALTO ADIGE
PROVINZIA AUTONOMA DE BULSAN - SÜDTIROL

INDEX

FOREWORD

Dear Readers,

the goal of the Laimburg Research Centre is to support South Tyrolean companies in the food sector with **research and experimental activities** to ensure the quality of agricultural projects and increase the competitiveness of the companies.

On the experimental areas and in the laboratories, our **more than 150 employees work on more than 340 projects and activities** in order to develop rapidly implementable solutions to current problems, to bring innovations to agriculture, and to tackle fundamental topics of strategic importance for the future of South Tyrolean agriculture and food processing.

A great deal was accomplished in 2018 and 2019:

p. 34 The **Brown Marmorated Stink Bug *(Halyomorpha halys)***, an invasive pest from Asia, threatens the harvest in many European countries. At the Laimburg Research Centre, the biology and behaviour of this pest is being studied in order to develop possible strategies to combat it. The use of natural antagonists will play a decisive role: For example, the Samurai Wasp (*Trissolcus japonicus*), also a native of Asia, attacks the eggs of the stink bug and could thus be used to neutralize this pest in a natural manner.

During a period of **climate change**, it is important to make a targeted use of available resources. In the p. 19 **"Smart Land South Tyrol"** project, the Laimburg Research Centre – together with Alperia and the South Tyrolean Advisory Service for Fruit and Wine Growing – is investigating how irrigation in fruit and wine growing can be optimised. Using soil moisture sensors and the latest data transmission technology, in the future, agricultural undertakings will be able to view real-time sensor data on their smart phones and thus react to a lack of water in a timely fashion.

And there is also good news for pollen allergy sufferers: In the Interreg V-A Italy–Austria project **AppleCare**, the Laimburg Research Centre and the South Tyrolean healthcare organisation, together with partners from Tyrol state (Austria), have developed a therapy against **birch pollen allergy**. p. 42 This therapy is based on the consumption of apples, and represents a simple, prescription-free, and cost-effective alternative to the usual long-term immunotherapy.
To maintain competitiveness on the worldwide fruit market, it is necessary to choose the right varieties of fruit, in dependence upon local pedoclimatic conditions. That's why the Laimburg Research Centre has focussed, from the very beginning, on testing varieties and, since 1997, on breeding varieties. In 2019, a major milestone was achieved: It was possible to provide South Tyrolean fruit growers with the findings of the **Laimburg Apple Variety Breeding Programme**.

Those are just four brief examples of current practical issues which the Laimburg Research Centre is focussing on.

With this biennial scientific report, we would like to give you an insight into our **research and experimental activities in the years 2018–2019** and to present our findings.

We wish you exciting reading!

Arnold Schuler
Provincial Councillor for Agriculture, Forestry, Tourism, and Civil Protection

Michael Oberhuber
Director of the Laimburg Research Centre

THE LAIMBURG RESEARCH CENTRE

Our Mission

The Laimburg Research Centre is the research centre for **agriculture** and **food quality** in South Tyrol. We are a dependent body of the Autonomous Province of Bolzano and our own legal entity.

Through scientifically sound experimentation and research, we develop know-how, solutions to problems, and innovations for the South Tyrolean agriculture and food processing sectors. With our research, we ensure the cultivation and production of high-quality agricultural products in South Tyrol and make a concrete contribution to securing the continued survival and development of local operations.

Our **target groups** are South Tyrolean agricultural and food processing companies, research, training and consulting institutions, agricultural and food industry associations, and the general public.

Our programme of activities

p. 12 We coordinate our programme of activities in Advisory Board meetings with representatives of the South Tyrolean agricultural and food processing sectors on an annual basis. This ensures that our research and experimental programme directly addresses the concrete needs of agricultural practice in South Tyrol.

Each year, our more than 150 employees work on **approximately 350 research and experimental projects** pertaining to all areas of South Tyrolean agriculture, from fruit and wine growing to special crops such as vegetables and berries, mountain agriculture, food processing and quality, as well as product innovation for companies operating in the food sector. This enables us to cover the entire food production chain, from cultivation to the finished product.

Our field tests take place on experimental areas with different pedoclimatic conditions located all over South Tyrol. In our specialised laboratories, reliable analyses are carried out for research projects on the one hand, but also as services for private individuals on the other.

Our research findings

We attach great value to quickly and efficiently distributing our research findings to agricultural practice so that local business benefit.
This is why we pass on new scientific findings to our target groups through consulting organisations, schools, lectures and workshops, as well as through publications and demonstration experiments on our pilot stations.
We inform our stakeholders and the general public in an application- and target group-oriented manner, via print media, radio, online media, as well as at events and via our website **www.laimburg.it**

In close coordination with schools and universities, we ensure the integration of new knowledge into training and further education.

With our open-access strategy and our own open-access **"Laimburg Journal,"** we ensure that our research findings quickly become freely accessible all over the world. *p. 74*

≈ 350
RESEARCH PROJECTS AND EXPERIMENTAL ACTIVITIES PER YEAR

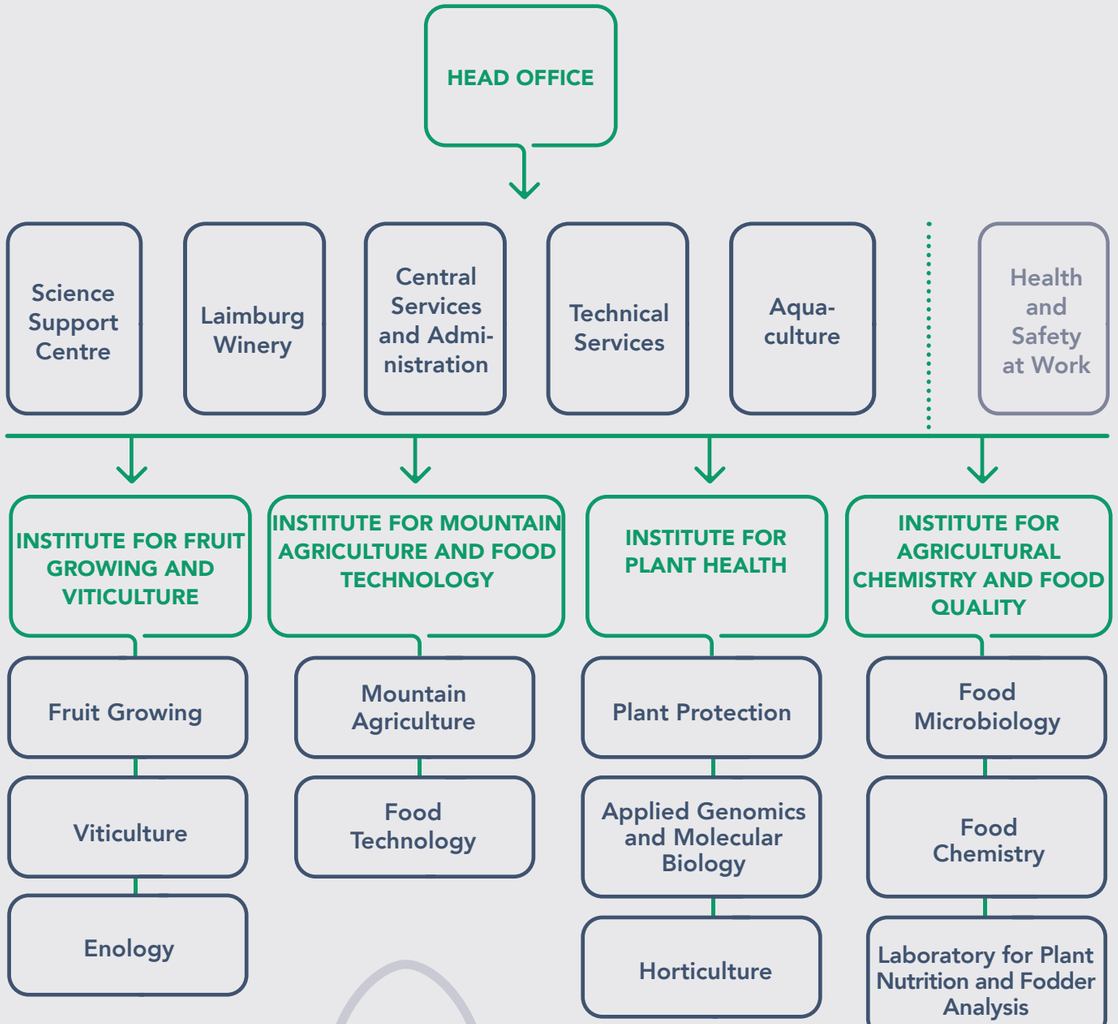
> 300
PRESENTATIONS PER YEAR
Statistically speaking, a Laimburg scientist conducts a presentation on nine out of every ten days of the year.

> 170
PUBLICATIONS PER YEAR

> 9.000
VISITORS PER YEAR (GUIDED TOURS)

> 29.000
LABORATORY ANALYSES PER YEAR

ORGANISATIONAL CHART
(as of 31.12.2019)



TIMELINE

Since 1962
Initial tests with lower tree forms and beginning of clone selection, varieties and rootstock trials in viticulture

1968
Establishment of the first research fields

1972–73
Construction of the experimental fruit storage facility

1975
Official founding of the Laimburg Research Centre for Agriculture and Forestry, in accordance with Provincial Act Number 53, issued November 3rd 1975

1977–79
Rebuilding of Laimburg's former stable in order to create the first offices of the research centre

1978
Renovation of the farmhouse "Mair am Hof" in Teodone (Dietenheim) near Brunico (Bruneck) for experimentation in arable crop and grassland farming

1979
Opening of the Agricultural Chemistry Laboratory

1982
First trials for herb cultivation

1984
Establishment of the reference library

1986–89
Development of a mechanical-biological method for chafer control

1989–90
Construction of the wine cellar through excavation into the mountainside

1990
Construction of a field office in Oris (Eyrs) for research into market gardening, arable crops and grassland farming

1995–2005
Laimburg clone selection: high-quality Lagrein clones Lb 25, Lb 26 and Lb 3 and loose-clustered clones of Sauvignon Blanc Lb 36, Lb 50

1996–99
Renovation of Laimburg's main building and experimental storage facility; construction of the new Plant Protection Building

1997
Beginning of Laimburg's apple variety breeding programme

2002
Initiation of work on the Biomolecular Laboratory and development of the Gene Bank

2003–14
Accreditation of several laboratories of Laimburg Research Centre according to ISO 17025

2005
Fruit storage technology with a dynamically controlled atmosphere (DCA), developed at Laimburg Research Centre, is put into practice.

2010
Definition of the Focus Programme 2010 – 2012 with four pillars of research

2011
Establishment of the Laboratory for Flavours and Metabolites; commencement of activity

2012
Start of construction of a new laboratory building on the site of the former Stadlhof Farm, and completion of excavation of an important Iron Age settlement located there. Some of the earliest evidence of wine production in South Tyrol was also discovered at this archaeological site: grape seeds dating back 2,400 years.

2014
The Laimburg Research Centre takes on responsibility for coordinating the food sciences division of the NOI Technology Park and the establishment of research facilities in the field of Food Technology.

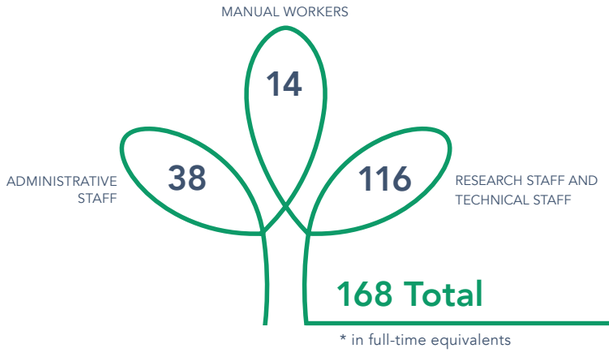
2015
The South Tyrol provincial government adopts the "2016–2022 Action Plan for Research and Training in the areas of Mountain Agriculture and Food Sciences".

2016–17
Reorganisation: Laimburg Research Centre is given a new statute, a new internal organisational structure and can now concentrate on its core task of research and experimental activities.

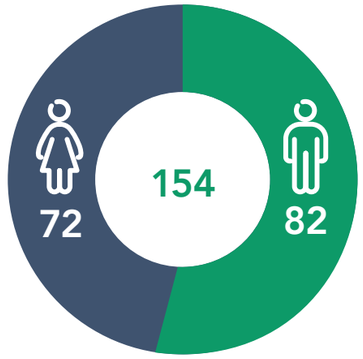
2018
Additional site: The Laboratory for Flavours and Metabolites moves into the NOI Techpark (Bozen/Bolzano).

2019
The first breed numbers of Laimburg's apple variety breeding programme reach market readiness. Invitation to submit bids and award of exploitation rights.

TEAM LAIMBURG 2019

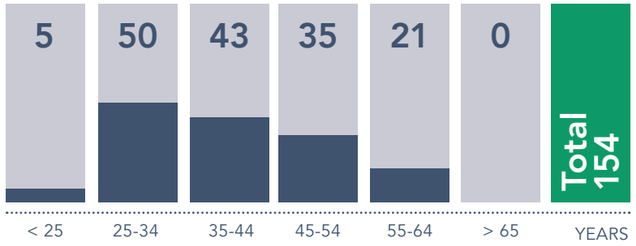


* in full-time equivalents

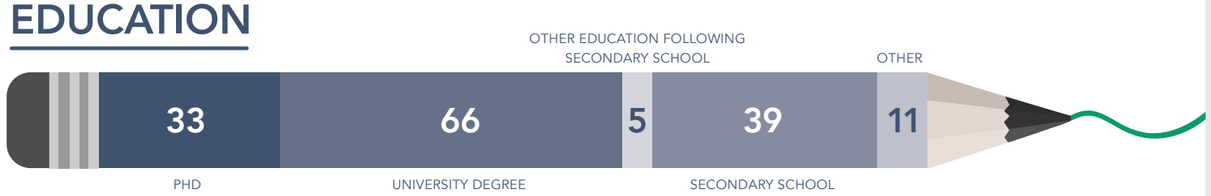


AGE DISTRIBUTION

(SCIENTIFIC AND ADMINISTRATIVE STAFF)



EDUCATION

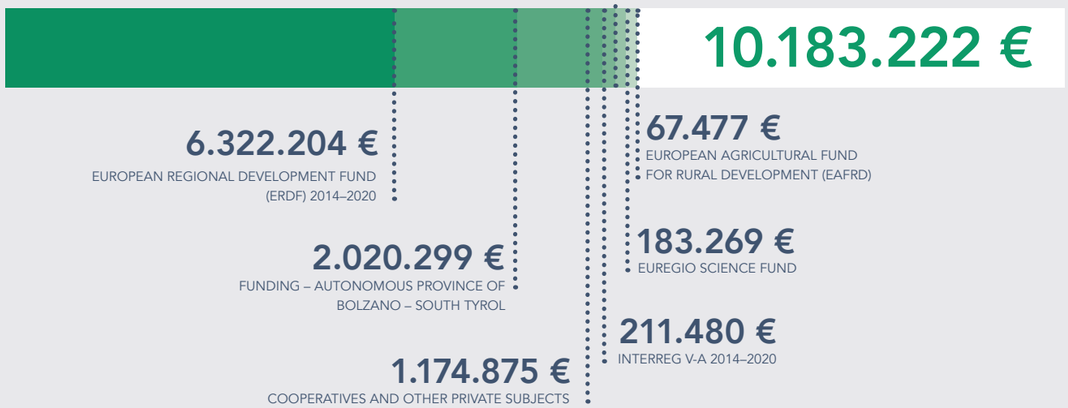


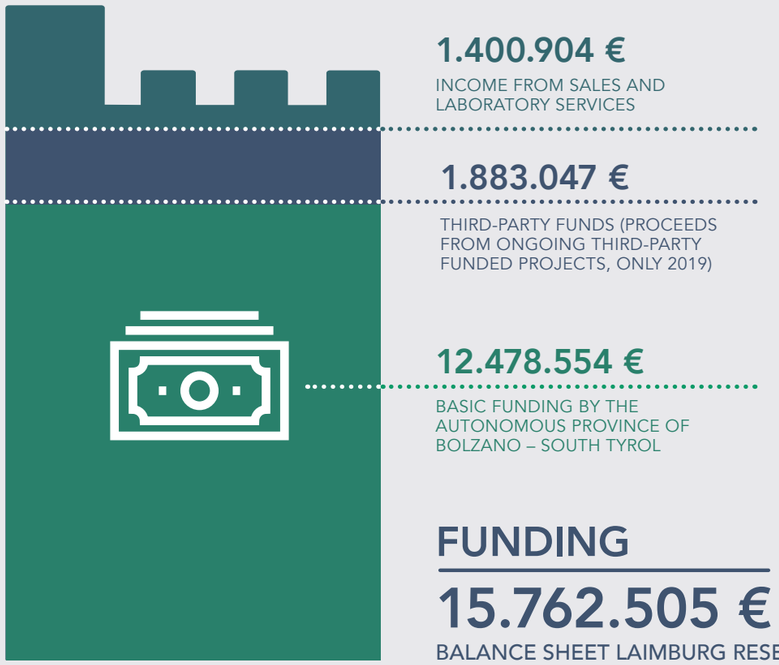
THIRD-PARTY FUNDS

TOTAL BUDGET OF ALL CURRENT THIRD-PARTY FUNDED PROJECTS, AS OF 31.12.2019

*If several project partners are involved, only the share of Laimburg Research Centre is included.

2019





FUNDING

15.762.505 €

BALANCE SHEET LAIMBURG RESEARCH CENTRE

THE RESEARCH NETWORK

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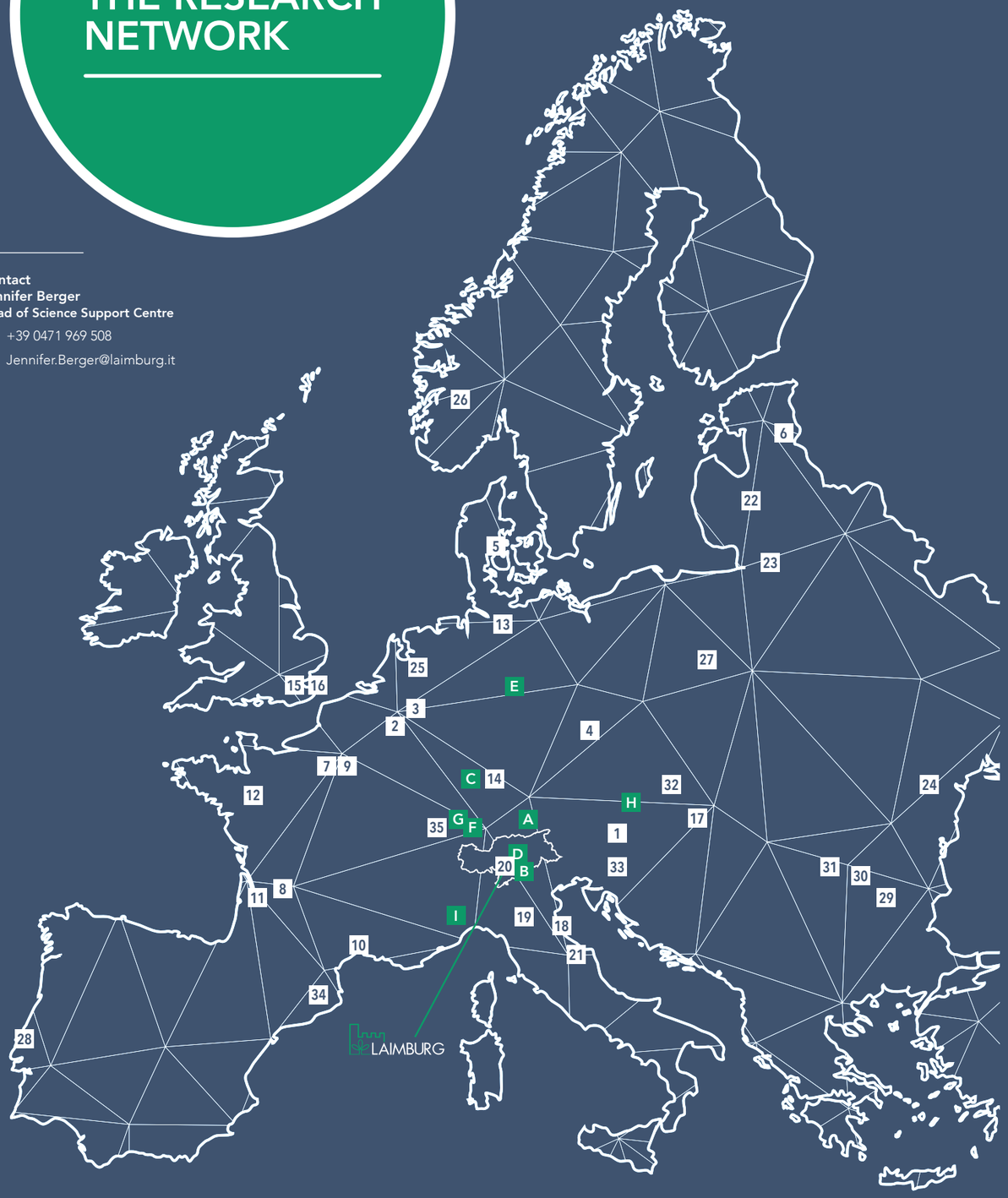


LAIMBURG

RESEARCH PARTNERS OF LAIMBURG RESEARCH CENTRE IN SOUTH TYROL

Free University of Bolzano
Eurac Research
Fraunhofer Italia
Eco-Research GmbH

THE LAIMBURG RESEARCH CENTRE MAINTAINS GENERAL COOPERATION AGREEMENTS WITH:

- A University of Innsbruck (A)
- B Edmund Mach Foundation, San Michele all'Adige (TN)
- C Division 22 (Agriculture, Forestry and Home Economica Training) of the province government and the State Ministry for Rural Areas, Nutrition and Consumer Protection in Baden-Württemberg (D)
- D Free University of Bolzano
- E Julius Kühn Institute, Federal Research Centre for Cultivated Plants (D)
- F Swiss Federal Office for Agriculture (CH)
- G Research institute Agroscope Changins-Wädenswil (CH)
- H Klosterneuburg Federal Higher Institute and Federal Office for Winegrowing and Fruit Cultivation (Austria)
- I Agrion Foundation for Research, Innovation and Technical Development (Piedmont)

eufrin

EUFRIN – EUROPEAN FRUIT RESEARCH INSTITUTES NETWORK

LAIMBURG RESEARCH CENTRE IS A MEMBER OF THE EUROPEAN FRUIT RESEARCH INSTITUTES NETWORK (35 EUROPEAN RESEARCH INSTITUTES).

1. Versuchsstation für Obst- und Weinbau Haidegg; Graz, Austria
2. CRA-W, Department of Life sciences, Unit Breeding and Biodiversity, Wallon Agronomical Research Centre; Gembloux, Belgium
3. Research Center for Fruit Growing (pcfruit vzw); Sint-Truiden, Belgium
4. Research and Breeding Institute of Pomology Holovousy Ltd; Holovousy, Czech Republic
5. Department of Food Science, Aarhus University; Aarslev, Denmark
6. Estonian University of Life Sciences, Polli Horticultural Research Centre; Polli, Karksi Nuia, Estonia
7. Centre Technique Interprofessionnel des Fruits et Légumes (C.T.I.F.L.); Direction Scientifique et Technique Fruits et Légumes; Paris, France
8. Centre Technique Interprofessionnel des Fruits et Légumes (C.T.I.F.L.); La Force, France
9. INRA (Institut National de la Recherche Agronomique; Genetics and Fruit Breeding; Paris, France
10. INRA (Institut National de la Recherche Agronomique), UMR AGAP, équipe AFEF; Montpellier, France
11. INRA Centre de Recherche Bordeaux-Aquitaine (UMR 1332 BFP) ; Bordeaux, France
12. INRA Centre de Recherche Angers-Nantes; Angers, France
13. ESTEBURG Fruit Research Center; Jork, Germany
14. Universität Hohenheim; Stuttgart, Germany
15. East Malling Research; East Malling, Great Britain
16. Natural Resources Institute, University of Greenwich; Great Britain
17. National Agricultural Research and Innovation Centre, Research Institute for Fruit Growing and Ornamentals of Erd; Budapest, Hungary
18. Consiglio per la Ricerca e la Sperimentazione in Agricoltura (CRA), Unità di Ricerca per la Frutticoltura di Forlì, Fruit Tree Research Unit; Forlì, Italy
19. Department of Agricultural Sciences, University of Bologna; Bologna, Italy
20. Laimburg Research Centre; Ora-Auer, Italy
21. Università Politecnica delle Marche; Ancona, Italy
22. Latvian State Institute of Fruit growing; Dobele, Latvia
23. Institute of Horticulture, Lithuanian Research Centre for Agriculture and Forestry; Babtai, Kaunas district, Lithuania
24. State Agrarian University of Moldova; Chişinău, Moldova
25. Wageningen UR – Applied Plant Research – fruit; Zetten, the Netherlands
26. Norwegian Institute for Agricultural and Environmental Research, Bioforsk Ullensvang; Lofthus, Norway
27. Research Institute of Horticulture; Skierniewice, Poland
28. Instituto Superior de Agronomia, Seccao de Horticultura; Lisboa, Portugal
29. Research Center for Integrated Fruit Growing, Faculty of Horticulture, University of Agronomic Sciences and Veterinary Medicine; Bucureşti, Romania
30. Research Institute for Fruit Growing; Piteşti-Mărăcineni, Romania
31. Vâlcea Fruit Research and Development Station, University of Craiova; Râmnicu Vâlcea, Romania
32. National Agriculture and Food Centre – Research Institute of Plant Production; Piešťany, Slovak Republic
33. Agricultural Institute of Slovenia, Department of Fruit Growing, Viticulture and Oenology; Ljubljana, Slovenia
34. Institut de Recerca i Tecnologia Agroalimentàries (IRTA); Catalonia, Spain
35. Research Station Agroscope at Changins; Conthey and Wädenswil (ACW); Wädenswil, Switzerland

COORDINATION BETWEEN SCIENCE AND PRACTICE

This is how the Programme of activities of the Laimburg Research Centre comes about

The Laimburg Research Centre engages in more than 350 projects and activities per year.

But who actually decides what the Laimburg Research Centre researches?

The Programme of activities of the Research Centre is always elaborated and defined in the previous year in close coordination with the stakeholders of the South Tyrol agrifood sector.

Laimburg Research Centre: Increasing the impact of research by involving stakeholders

STEP **1**

PROPOSALS FOR POSSIBLE PROJECTS AND ACTIVITIES

As an institute in the field of applied research, the Laimburg Research Centre attaches particular importance to ensuring that it is aware of the concrete problems of agricultural practice and that its findings reach where they are needed.

To this end, each year, the Research Centre calls upon more than 100 representative organisations of the South Tyrol agrifood sector to address their issues to research and to submit proposals. These external project proposals are collected and integrated with the internal proposals which the scientists of the Research Centre have developed.

STEP **2**

ADVISORY BOARD MEETINGS

From late August till early September of each year, Advisory Board meetings are held at Laimburg Research Centre on all topics that the Research Centre works on.

In these meetings, the respective experts of the Research Centre and the local representatives of the South Tyrol agrifood sector join together to discuss current problems and the submitted proposals for new research projects and activities. All proposals are examined with respect to their feasibility and then prioritised.

A **PRIORITISATION**
Proposals for projects and activities already carried out by the Research Centre, or proposals which can be integrated into activities or projects already in progress

B **PRIORITISATION**
Proposals for new projects and activities which are to be implemented in the following year

C **PRIORITISATION**
Proposals which are important but which, due to a lack of funding, cannot yet be implemented. They will be discussed again in the coming year.

D **PRIORITISATION**
Proposals which cannot be implemented in this form or for which no own attempt is considered necessary or meaningful

STEP **3**

SCIENTIFIC ADVISORY BOARD

The prioritisations made at the Advisory Board meetings are then submitted to the Scientific Advisory Board of the Laimburg Research Centre, which meets in the autumn of each year.

STEP **4**

PROGRAMME OF ACTIVITIES FINALISED

If the Scientific Advisory Board approves the priorities jointly developed in the Advisory Board meetings, the Research Centre's Director prepares the Programme of activities for the following year and coordinates it with the Provincial Councillor.

The agreed-upon Programme of activities is then published on the website of the Research Centre:

Current Programme of activities

Advisory Board

Proposal	Priority
.....	A
.....	C
.....	D
.....	B
.....	B

→ Scientific Advisory Board

Priority
A
B
D
B
C

→ presentation to the Provincial Councillor →

Proposal	Priority	
.....	A	realisable
.....	B	realisable
.....	B	realisable
.....	C	not realisable
.....	D	not realisable

Abb.1: Prioritisation of project proposals

VISION 2020

The Focus Programme at the Laimburg Research Centre

Plant health, quality, agrobiodiversity, mountains and altitude: These are the four key topics or "pillars" upon which the research and experimental work of the Laimburg Research Centre concentrated between 2010 and 2020 in order to make use of available resources as efficiently as possible. Around 75% of the Research Centre's research projects are assigned to one of the four main topics. The remaining 25% address urgent, thematically independent issues. The Focus Programme will expire in the course of 2020; the work on the elaboration of a new Focus Programme for the coming ten years is already in progress. What issues were at the centre of the individual key topics of the Focus Programme now ending and what was accomplished?

THE "QUALITY" KEY TOPIC

The goal of this key topic is to investigate and maintain the quality of agricultural products along the entire added value chain, from raw materials to refined and processed products. To do this, the Research Centre defines quality parameters and develops suitable methods for their determination. The development of innovative products and processes are among the activities of this key topic.

Conclusion

One could measure quality on the basis of the extent to which the expectations regarding an object's properties are met. Besides the external and internal characteristics of a fruit (e.g., of an apple) – such as its lack of blemishes or its overall enjoyment value – safety, environmental compatibility, and sustainability – all play an important part. Indeed, they are present in all phases of production, maintenance, processing, and distribution.

At the Laimburg Research Centre, these considerations have led to an intense interdisciplinary mode of working in which cultivation methods, variety testing and breeding, analytical methods, quality-maximising technologies, and predictive systems are all taken into account.

One goal was to develop a method for determining the quality and degree of ripeness of apples – but also of other agricultural products – in a non-destructive, contact-free, real-time fashion. In the **MONALISA** project, promising innovative technologies were subjected to close scrutiny in order to identify, e.g., changes in internal tissues or to determine other quality markers. Together with our stakeholders, we have examined the extent to which these technologies are suitable for practical implementation.

In order to improve the analytical description of sensory perceptions, we have supplemented "classic" physico-chemical analyses for the determination of textural characteristics with alternative parameters, e.g., acoustic, optical, rheological, etc.

Another goal was to establish a competence centre for sensory science. To this end, a highly specialised Laboratory for Sensory Science was set up and tasting panels formed in the framework of **Capacity Building**. These panels are employed for sensory analysis in internal research activities, but also for services provided to third parties – e.g., for product development, quality evaluation, or the evaluation of raw materials. *p. 67*

With the **establishment of the Laboratory for Flavour and Metabolites**, we have contributed to the goal of developing and introducing new methods suitable for the analytical detection of all relevant aromatic substances, flavours, and health-promoting ingredients. *p. 69*

Moreover, it was possible to demonstrate in the fruit orchard that quality can also be achieved while simultaneously conserving resources. This is done by means of a **strategy for environmentally friendly irrigation**. A compact, user-friendly, and low-cost electronic control unit in combination with soil moisture sensors make it possible to control irrigation in the fruit orchard automatically and according to actual needs.

Angelo Zanella
Coordinator of the "Quality" key topic

MONALISA project

PLANT HEALTH

QUALITY

AGROBIO-DIVERSITY

MOUNTAINS AND ALTITUDE

THE "AGROBIODIVERSITY" KEY TOPIC

Only perfectly matched, carefully selected varieties allow for a maximum high-quality yield and low expenditure on pesticides. For years, Laimburg Research Centre has been performing variety testing, variety breeding and the selection of suitable clones, which together form the backbone of this key topic. Modern molecular biological methods are being used more and more to improve the efficiency of the breeding and selecting of varieties. Important breeding objectives for our new varieties include typical South Tyrolean quality and pest resistance. The renewed appreciation of old local varieties and species as well as the extension of the cultivation spectrum through the use of existing genetic resources is another focus of this key topic.

Conclusion

The Laimburg Research Centre set four clearly defined macro-goals in the "Agrobiodiversity" key topic. On the one hand, the creation of customary market varieties / selections of apples, strawberries, grapes, and the Vinschgau apricot and the use of new breeding techniques had the goal of promoting innovation. On the other hand, the renewed appreciation of old and local varieties is intended to rejuvenate the diversity which has built up over time, while it is expected that the study of crops to supplement apples and viticulture will reveal options of diversification.

More than 70 projects and activities addressed these goals:

Laimburg's apple variety breeding programme registered the varieties Lb 4852 and Lb 17906 for variety protection. Since 2019, a South Tyrolean alliance of bidders – consisting of the VI.P and VOG cooperatives – has been in charge of the commercial utilization of all apple varieties. Since 2013, marker-assisted selection has been implemented in this programme as a new breeding method for the development of multi-resistant varieties.

Four new selections of the eminently important South Tyrolean grape variety Vernatsch were entered into the national register of varieties after intense investigation.

In the **CEREALP** Interreg project, all varieties of winter rye and spelt prevalent throughout the region were characterised according to agronomic principles and a sound knowledge base thus established for their re-use.

By means of the **"Action Plan for Research and Training in Mountain Agriculture and Food Sciences"**, it was possible to intensify the variety-testing of chestnuts, stone fruit, and berries and to launch new experiments with hazelnuts, *Actinidia arguta* (mini-kiwis), table grapes, and inter-species pears. *p. 66*

The findings and information collected and recorded in the "Agrobiodiversity" key topic have found great resonance among practitioners, and represent the basis for further projects in this very topical field of activities.

Walter Guerra
Coordinator of the "Agrobiodiversity" key topic

THE "MOUNTAINS AND ALTITUDE" KEY TOPIC

South Tyrol's mountains represent both an opportunity and a challenge: Mountain farmers can create regional products that have a special "mountain" quality, ensuring added value for the producers and meeting the increasing consumer demand for healthy, local produce. Differing growing seasons at higher altitudes offer special niches – with respect to the time of harvesting, for instance – thus allowing farmers to bring their products to market at competitive prices. Furthermore, the planned usage of a wide range of altitudes offers a way to adapt to climate change.

The task of the Laimburg Research Centre is to develop innovative methods for identifying suitable areas for various crops and for optimising cultivation according to location and climate.

Conclusion

The "Mountains and Altitude" key topic pursues five goals: The establishment of regional mountain products for complementary crops; the meteorological and GIS-assisted identification of suitable areas of cultivation for these crops; the development of meteorological and GIS-assisted tools for optimising cultivation; the optimisation of seed mixtures for mountainous areas; and the optimisation of pasture-based animal husbandry.

During the Programme period, we succeeded, by means of the two **Regiokorn and Regiokorn 2** ESF projects and in cooperation with relevant local actors, to establish a marketing channel for baked goods made with grains cultivated in the region.

The findings of the **VEGEMONT** ERDF project enabled the development of the eponymous web-based geographic information system (Web-GIS) making it possible to estimate the suitability of the mountain area of South Tyrol for the cultivation of seven vegetable crops and strawberries.

In contrast, the **webGRAS** web application provides an estimate of the potential fodder quality of the basic fodder (quality of green herbage prior to fodder conservation) for the first cutting of permanent pastures in South Tyrol. Cost-free reference values were thus made available for the concentration of ingredients and minerals for formulating feed rations.

In the case of drought-affected grassland locations, a seed mixture with tall fescue *(Festuca arundinacea)* was developed and tested; this mixture has been a constituent of the recommended seed mixtures for permanent pastures since 2017.

In the **Inno4Grass** network project funded by the Horizon 2020 EU Framework Programme for Research and Innovation, multi-stakeholder discussion groups examined innovative operations in the area of pasture grazing. The project's main results were innovation analyses of the different management systems. They provide the users with a sound knowledge base for designing their own system. Pasture-based milk production is also investigated in the framework of the "Action Plan for Mountain Agriculture" in the **"System Comparison" project**. *p. 52* *p. 66*

Giovanni Peratoner
Coordinator of the "Mountains and Altitude" key topic

Innovation analyses yielded by the Inno4Grass project

Web-GIS VEGEMONT

webGRAS

THE "PLANT HEALTH" KEY TOPIC

Maintaining the health of our cultivated plants is a fundamental condition for economically and ecologically sustainable production. The idea behind this is our conviction that prevention is more powerful than intervention. Sustainability is thus regarded as a key factor for plant health. The priorities of this subject area are the development of sustainable cultivation methods and strategies for plant protection while husbanding natural resources, as well as the validation and development of methods for the regulation of pests eschewing synthetic chemicals and the promotion of environmentally compatible irrigation.

Conclusion

Sustainable plant protection has the goal of preventing or reducing damages to plants with a consideration of ecological and agronomical aspects. Against this backdrop, the various projects are concerned with **sustainable cultivation techniques**. Examples include the breeding of scab-resistant varieties of apple, the recommendation of varieties on the basis of their resistance to fungal diseases, and agronomical measures in viticulture (e.g., defoliation in the grape zone or the promotion of loose-growing grape bunches).

We have also investigated how the sustainability and environmental compatibility of **direct plant protection strategies** could be improved. For example, we have tested measures for reducing the drift of pesticides, and the resultant findings were directly included in **provincial legislation** (Resolution of the South Tyrolean Provincial Government No. 141 dated March 3, 2020 on provisions pertaining to the sustainable use of plant pesticides).

Before use, pesticides employed to regulate harmful organisms must be validated with regards to their effectiveness and side-effects **under local conditions**. This validation was carried out annually in field trials on about 15 hectares of fruit orchards and 5 hectares of vineyards, with randomised parcels. 350 to 400 parcels of land were evaluated each year, and the findings presented to the advisory organisations and farmers. The results of these trials form the foundation for strategies to preserve the health of plants for food production under the aspect of targeted plant protection measures which take location conditions into account.

In an interdisciplinary cooperation, the "Entomology," "Phytopathology," "Testing Plant Protection Products," and "Organic Farming" working groups examined various **non-synthetic preparations** with respect to their potential use in preserving the health of plants. In the laboratory, greenhouse, and in field trials, a total of 50 methods for regulating harmful organisms were tested and evaluated. In this regard, the **Dromytal** ERDF project, which focuses on the development of a control strategy for the Spotted Wing Drosophila (*Drosophila suzukii*) based on a yeast attractant approach, is especially deserving of mention.

Besides the Spotted Wing Drosophila, other heretofore **unknown invasive pests** have appeared in South Tyrol in recent years and are causing extensive damage in the agricultural sector. For this reason, the "Entomology" working group is investigating the distribution, damage potential, and behaviour of these insects under our local climatic conditions for the purpose of developing possible countermeasures to regulate them. In this context, our experts are currently focussing their attention on the regulation of the **Brown Marmorated Stink Bug** (*Halyomorpha halys*). *p. 34*

The availability of water is another major challenge for plant health, especially in a time of climate change. In recent years, the foundations for strategies for resource-saving irrigation techniques in the area of fruit cultivation have been elaborated. The goal is now to transfer demand-oriented irrigation methods to actual practice on a broad basis – e.g., in the context of the **"Smart Land South Tyrol"** project. *p. 19*

Klaus Marschall
Coordinator of the "Plant Health" key topic

REPORTS FROM THE INSTITUTES

Andreas Wenter, Martin Thalheimer,
"Soil, Fertilisation, Irrigation" working group

Video on the "Smart Land South Tyrol" project

The "Smart Land South Tyrol" project: Demand-driven irrigation by means of sensor-based soil moisture measurement

In the cultivation of fruit and grapes in South Tyrol, the need for irrigation is still often determined on the basis of subjective criteria. Sensors are only partially in use, nor is it common to calculate a water balance based on input and output.

When calculating a water balance, due to small-scale differences in soil characteristics and climatic conditions, it is very difficult to assess the influence of the soil. This complicates the objective determination of the given location's available moisture reserves – which is of eminent importance in attaining demand-driven irrigation.

Modern data transmission technologies

In the digital era, developments in the fields of data transmission and measurement technology are opening up new possibilities to implement large-scale soil moisture monitoring. Such wireless technologies as LoRaWAN make it possible to transmit sensor data to a data server via a wireless network. This allows the sensors to be freely positioned in the field, and obviates the need for data loggers.

The "Smart Land South Tyrol" project

In the "Smart Land South Tyrol" project, the Alperia company, the South Tyrolean Advisory Service for Fruit and Wine Growing, and the Laimburg Research Centre are working together to explore the practicability of measuring, transmitting, and presenting sensor data in the example case of soil moisture. The goal of the two-year project launched in 2019 is to establish a platform of soil moisture sensors and to develop a marketable application solution which could serve as an objective foundation for demand-driven irrigation.

In the 2019 experimental year, 120 tensiometers were installed in fruit orchards and 100 capacitive suction tension sensors (Teros21) were deployed at two soil depths in vineyards. Additionally, a LoRaWAN data transmission network was installed and a database for data management set up.

Perspectives

In the 2020 experimental year, the project partners intend to further develop the sensors on the basis of the experience they gained during the previous year and to develop a marketable app for presenting the measurement data on smart phones.

Fig. 1: Soil moisture sensors installed in a fruit orchard to measure the suction tension in the soil

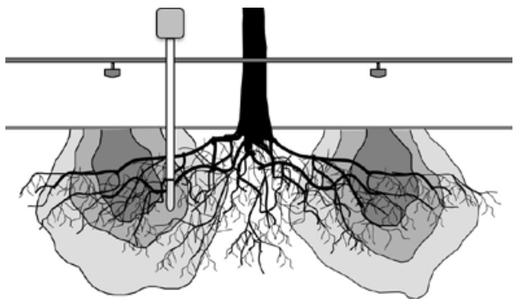


Fig. 2: Schematic depiction of soil moisture measurement using a tensiometer


Christian Andergassen, Daniel Pichler,
"Fruit Physiology" working group

Mechanical defoliation to boost the area of overcolour of apples

In the case of such later-ripening bicoloured varieties as Nicoter/Kanzi®, Scifresh/Jazz®, Braeburn, Fuji, and Cripps Pink/Pink Lady®, the colouring in the lower tree zone is often severely reduced. This is especially apparent on valley floors due to the lack of sunshine and/or high night-time temperatures. Customary practical measures to boost the overcolour include the removal of the trees' shoots (so-called "pruning to increase exposure to sunlight") or the placement of reflective foils. A reduction in colouring can negatively impact a business if the resultant fruit fails to fulfil the minimum requirements set by the cooperatives regarding the area of overcolour.

Can colouring be promoted through defoliation?

To explore this question, the Laimburg Research Centre has been carrying out defoliation trials since 2016. Because manual defoliation is labour-intensive, in 2018, a pneumatic defoliation machine from the Olmi company was tested for the first time (fig. 1). A machine of this kind removes leaves from apple trees using compressed air (fig. 2). A Nicoter/Kanzi® orchard and a Cripps Pink/Pink Lady® orchard located on the valley floor were chosen for field tests. In these orchards, the trees were cultivated in the "slender spindle" training system and pruned to be slender in the usual fashion. A direct comparison of the "pruning to increase exposure to sunlight" method, manual, and mechanical defoliation in the Nicoter/Kanzi® orchard revealed for all variants a significant increase in the area of overcolour in comparison with the untreated control (fig. 3).

Fig. 1: Defoliation machine in operation

Fig. 2: Cripps Pink/Pink Lady® apple orchard: left, defoliated; right, untreated

VARIANT	KG/TREE				
	> 65 mm	> 65 mm < 33% RED	> 65 mm > 33% RED	< 33% RED	> 33% RED
Control	19.0	8.9	10.1	46.7	53.3
Pruning to increase exposure	17.1	5.1	12.1	29.6	70.4
Manual defoliation	15.1	1.6	13.5	10.4	89.6
Mechanical defoliation	16.2	1.6	14.6	9.9	90.1

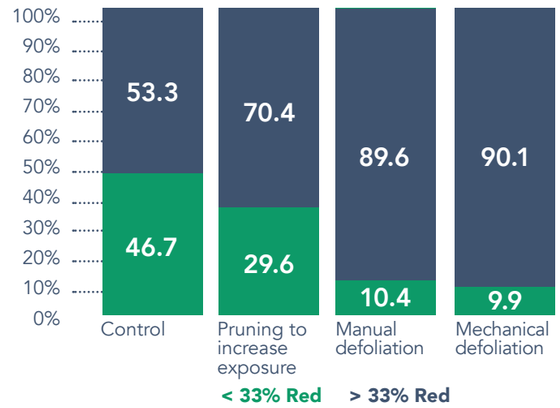


Fig. 3: Ratio of overcolouring for different tested varieties of Nicoter/Kanzi®

VARIANT	KG/TREE				
	> 65 mm	> 65 mm < 40% COLOUR	> 65 mm > 40% COLOUR	< 40% COLOUR	> 40% COLOUR
Pruning to increase exposure	26.9	11.3	15.7	41.9	58.1
Machine set to 0.4 bar	24.0	6.8	17.2	28.4	71.6
Machine set to 0.7 bar	24.5	5.4	19.1	21.9	78.1
Machine set to 1.0 bar	23.4	2.6	20.8	11.2	88.8

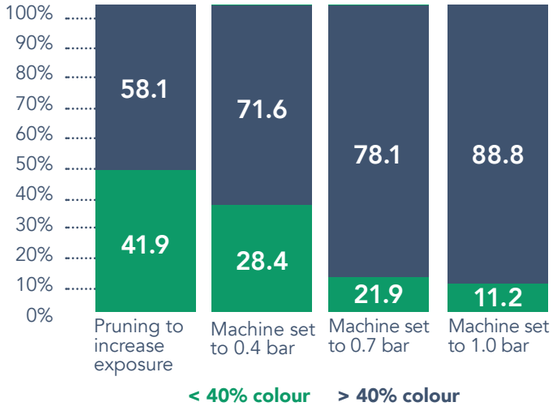


Fig. 4: Ratio of overcolouring for different tested varieties of Cripps Pink/Pink Lady®

Influence of the defoliating air pressure on colouring

In the Cripps Pink/Pink Lady® orchard, the influence of different air pressures on the degree of defoliation and consequently on the colouring and quality of the fruit was tested; this is because only fruit having at least 40% overcolouring meets the quality requirements. Three different levels of compressed air (0.4, 0.7, and 1.0 bar) were used to defoliate; the travel speed and no. of rpm's of the disk were held constant. With the "pruning to increase exposure to sunlight" method, alone, only 58% of the fruit displayed the quality required for Pink-Lady® quality in the 2018 season. Mechanical defoliation at 0.4 bar increased this share to 72%. A pressure of 0.7 bar resulted in 78%, and a pressure of 1 bar in a share of 89% with Pink-Lady® quality (fig. 4).

Influence of defoliation on inner quality characteristics

Regarding the inner quality of the fruit – i.e., sugar and acid content as well as firmness – no significant difference was detected for any of the defoliation tests in the 2016–2018 seasons. In the case of the Pink Lady® trial, slight bruising was observed with the variant with the highest pressure setting. Although these bruises were no longer present at the time of harvest, this trial did reveal possible risks. In none of the trials were significant damages observed.

Conclusion

The defoliation tests conducted in 2018 clearly demonstrate the economic advantages seen especially with the club varieties resulting from the higher ratio of overcolouring. However, there are still many unanswered questions regarding this new technique which must be clarified in further trials.

Thomas Holtz, Markus Kelderer,
"Organic Farming" working group

Website of the DOMINO project

Publications

The DOMINO project: revegetation and green manuring for more-sustainable fruit and wine cultivation

Sustainable agriculture is currently a topic of great relevance, and is of fundamental importance to remain competitive in the global marketplace. The goal of the DOMINO project is to boost the number of species of plants in fruit orchards and vineyards. This is intended to support ecosystem services, reduce the influence of external factors, and yield an overall increase in sustainability.

The selection of suitable plant species

After initial screening – during which suitable plant species ("agroecological service crops") must be identified and tested – the trial programme for the following two years was established. Plans call for several trials in fruit orchards and vineyards to investigate the effects of revegetation and/or green manuring on undesirable neighbouring weeds, on the soil structure, and on the soil quality. The plant species were selected on the basis of such criteria as resistance to drought, competitive behaviour towards crops, the ability to thrive on compact and nutrient-rich soils, relative low demands for sunshine, propagative ability, and other relevant factors. The selected species (fig. 1) were sown in March and April of 2019; some bi-and perennial species were planted in the autumn of 2018.

Effects of the plants on beneficials

In the following years, various parameters were monitored: The amount of plant biomass of the additionally planted plants; the effects on the appearance of undesirable weeds; the competitive pressure on the planted crops; relevant soil parameters; the yield and the quality of the fruit or must, respectively. Furthermore, the impact of the revegetation and/or green manure on predatory mites (a beneficial animal).

Fig. 2: Sowing ground ivy *(Glechoma hederacea)* in a vineyard

Conclusion

The goal of the DOMINO project is to find one or more plant species which suppress undesirable weeds, reduce the amount of labour needed to regulate weeds using conventional methods, and to enhance soil fertility by means of the optimal supply of crops with organic substances and thus nutrients.

FRUIT CULTIVATION ROW

NO.	SPECIES	COMMON NAME
1	*Portulaca oleracea*	verdolaga, red root, or pursley
2	*Tropaeolum majus*	garden nasturtium or monks cress
3	*Potentilla reptans*	creeping cinquefoil
4	*Galium mollugo*	hedge bedstraw or false baby's breath
5	*Fragaria vesca*	wild strawberry
6	*Trifolium resupinatum* var. *Resupinatum*	Persian clover
7	*Portulaca oleracea* + *Achillea millefolium*	pursley + yarrow
8	*Achillea millefolium* + *Galium mollugo* + *Trifolium repens*	yarrow + false baby's breath + white clover
KB	Control + tillage	
K	Control	

FRUIT CULTIVATION TRAMLINE

9	*Secale cereale* + *Trifolium incarnatum*	rye + crimson clover
10	*Canapa sativa* + *Pisum sativum*	hemp + pea
11	*Raphanus sativus* var. *Oleiformis* + *P. sativum*	fodder radish + pea
K	Control	

Fig. 1: Selected species sown in fruit orchards and vineyards

Massimo Zago,
"Berries and Stone Fruit" working group

Comparison of different clones of the apricot variety "Vinschger Marille"

In order to supply the local market with high-quality apricots of the variety "Vinschger Marille," one needs healthy planting material from the best mother trees. As far back as the 1967–75 period, the Laimburg Research Centre had selected six types from the broad population of "Vinschger Marille" and propagated them. Nevertheless, these mother trees were determined – because of their poor state of health and the, in part, atypical method of obtaining scions – to be unsuitable (fig. 1).

Scions from six different sources

For this reason, in subsequent years and following the long-term observation and surveying of old stands of trees throughout the Vinschgau area, selected trees were marked. The scions for obtaining saplings come from six different communities in the area between Kastelbell and Mals. In 2002, these scions were grafted onto virus-free St. Julien rootstocks. To evaluate the quality of the different sources, the parameters "tree yield," "fruit weight," and "tendency towards balding" were investigated:

Tree yield

In 2012 and 2016, considerable drops in yield were recorded throughout South Tyrol due to late frost. This, in turn, had an impact on the average yields of the trees in the field test. With an average production (2004– 2016) of between 8.6 and 9.3 kg, the sources with the codes VM-12, VM-10, and VM-13 delivered the highest tree yields. The source VM-14 trailed, with only 4.9 kg per tree (fig. 2).

Fruit weight

When one considers that the average fruit weight of all of the apricot sources included in this study amounted to 45.1 g, one can easily get an overall picture on the basis of the following data: The fruits from VM-13, VM-18, VM-9, VM-12, VM-7, and VM-14 had a weight of between 46.7 and 52.9 g. The smallest fruits came from VM-4, with a weight of only 38.4 g (fig. 3).

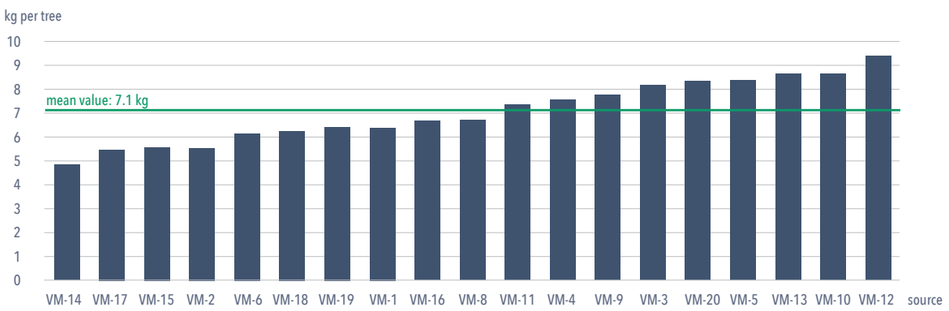


Fig. 2: Average tree yield of verified sources (mean value 2005–2016)

Fig. 4: Ripe "Vinschger Marille" apricot just before harvest-time

Balding

Apricot trees have a strong tendency towards balding – especially in the inner crown area. That means that the tendency of a branch to bear fruit declines. The clones VM-3, VM-10, VM-13, and VM-18 displayed only a very slight to non-existent inclination to bald. The remaining sources were given a negative score due to the stronger tendency to age.

Conclusion

The clones VM-3 and VM-13 displayed good yield, an interesting fruit size, smooth-skinned fruits, and a low tendency to age (fig. 4). Consequently, these two sources were propagated and now stand as mother trees for obtaining genetically identical scions in the Laimburg Research Centre's mother garden in Corzano near Brescia.

Fig. 1: Trees of the variety "Vinschger Marille" in full bloom

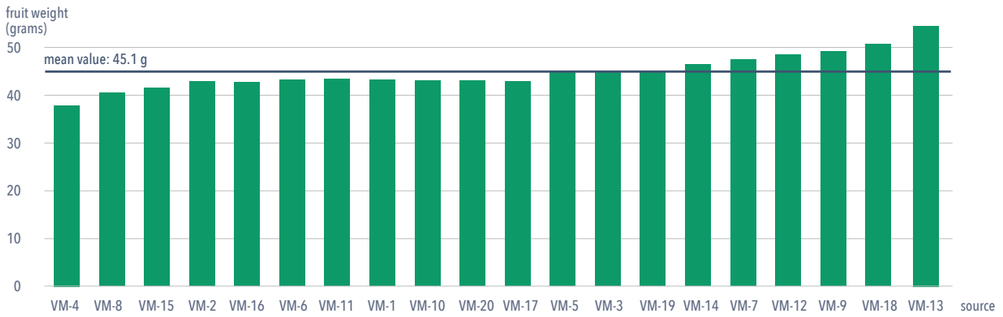


Fig. 3: Average fruit weight of the verified sources (mean value 2005–2016)

Josef Terleth, "Grapevine Varieties and Propagation Material" working group
Martin Höller, "Pomology" working group

The production of healthy and varietally pure propagation material for grapes and apples at the Laimburg Research Centre

The production of certified propagation material for apples has a decades-long history in South Tyrol. In the early 1980s, the production of such material was regulated by provincial legislation; beginning in 2007, it was governed by national certification; since 2017, it has been defined by European guidelines.

The goal of certification is the securing, production, and distribution of healthy, varietally pure propagation material. This is similar to the case in the field of viticulture, where efforts focus on the conservation and pre-propagation of grape clones.

Certification creates added value

In accordance with statutory regulations, the Laimburg Research Centre's task is to conserve its material so that it is not infected by vectors or other pathogens. Certification creates significant added value insofar as not only viruses and phytoplasms, but also a number of known infectious agents are checked for. The use of certified planting stocks is the best possible guarantee for varietal purity and freedom from viruses and forms the basis for the successful, long-term production of material for agriculturalists. For tree nurseries, certification is a voluntary extra to the minimum statutory requirements pertaining to planting stocks. The Laimburg Research Centre is recognized by the Ministry for Agriculture as a centre for conservation and pre-propagation. Furthermore, it is authorised to serve as a quarantine unit for handling goods imported from third countries.

Propagation of apple varieties

Because of the current demand in South Tyrol, the Laimburg Research Centre's activities are confined solely to apples. At present, about 139 different varieties are propagated. A significant portion of those are mutants – especially Gala, Fuji, and Red Delicious. Increasingly, varieties from the Centre's own apple variety breeding programme are being included in the certification process.

Fig. 1: The conservation of so-called "mother trees" under isolation in an insect-proof greenhouse

Pre-propagation of grape clones

In viticulture, the Laimburg Research Centre has protected 18 grape clones of seven varieties. While the material for fruit orchards is sent to the tree nurseries in the form of scions, grafts for wine-growing are prepared to order. The vine nurseries use the "basic planting stock" to establish mother gardens in which scions in the "certified" category can be produced. In Italy, "certified vine material" (i.e., planting stock from grape clones) account for 70% of all such material. All clones at the Laimburg Research Centre are regularly checked and verified to guarantee genetic purity and health.

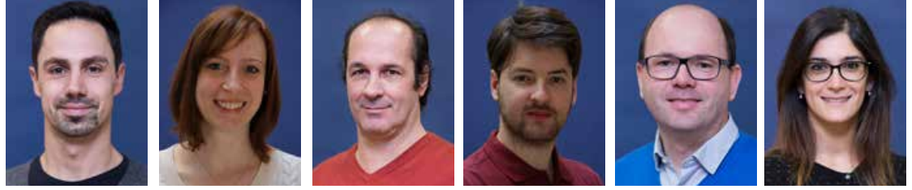
FRUIT ORCHARDS

	CONSERVATION	%	PRE-PROPAGATION	%
Different varieties	42	31	30	32
Laimburg breeds	21	15	14	15
Local varieties	17	12	17	18
Clones	59	42	35	36
Gala	17	12	11	11
Fuji	14	10	6	6
Red Delicious	10	7	6	6
Golden Delicious	9	6	6	6
Pinova	5	4	3	3
Braeburn	4	3	3	3
Varieties in total	**139**		**96**	

VITICULTURE

	NO. OF CLONES	PROTECTED SINCE	CLONES
Edelvernatsch	5	1970	Lb 43, Lb 50, Lb 59, Lb 83, Lb 100
Lagrein	5	1981 / 2009	Lb 509, Lb 511, / Lb 3, Lb 25, Lb 26
Gewürztraminer	2	1981	Lb 14, Lb 20
Pinot blanc	2	1981	Lb 16, Lb 18
Pinot noir	2	1981	Lb 4, Lb 9
Sauvignon blanc	2	2003	Lb 36, Lb 50

Fig. 2: Overview of the certified varieties and clones propagated at the Laimburg Research Centre



Florian Haas, Selena Tomada,
"Physiology and Cultivation Techniques" working group

Ulrich Pedri, Martin Zejfart,
"Enological Processes and Knowledge Transfer" working group

Peter Robatscher, Valentina Lazazzara,
Laboratory for Flavours and Metabolites

The PinotBlanc project: Initial agronomical findings

In South Tyrol, varieties of Pinot blanc display a very high quality. Nevertheless, the wine industry fears that climate change could negatively impact the quality of Pinot blanc wines: The rise in temperature can result in a loss of acidity and flavour in the must and thus reduce the freshness and drinkability of the wine.

An escape to higher altitudes?

In the PinotBlanc project, the Laimburg Research Centre therefore investigated whether the cultivation of Pinot blanc at higher altitudes might be a way to mitigate the negative impact of climate change. In 2017, eight representative Pinot blanc orchards at altitudes of between 230 and 730 metres above sea-level were hence selected for field tests (fig. 1). Because of the differing altitudes, these orchards displayed very different micro-climates. The largest temperature differences (3.4 °C) were measured in the final phase of ripening (at the beginning of harvest-time). The effects of these temperature differences were very evident in the analyses of the must, too: In the lower-altitude orchards, on average a lower malic acid concentration – responsible for the wine's freshness – was measured than at higher elevations.

Phenological surveys

In the case of the phenological surveys, significantly later budding was observed in the two test years already completed; the subsequent growth stages were likewise delayed. At the 2017 harvest, the delay at the highest-elevation orchard amounted to 14 days. In 2018, it was possible to confirm this finding only up to the start of ripening (fig. 2). On average, in 2018, the temperatures at the higher altitudes were 2 °C warmer than in 2017. Consequently, there was an only five-day delay in ripening.

Fig. 1: Experimental orchards of the PinotBlanc project in the community of Tramin

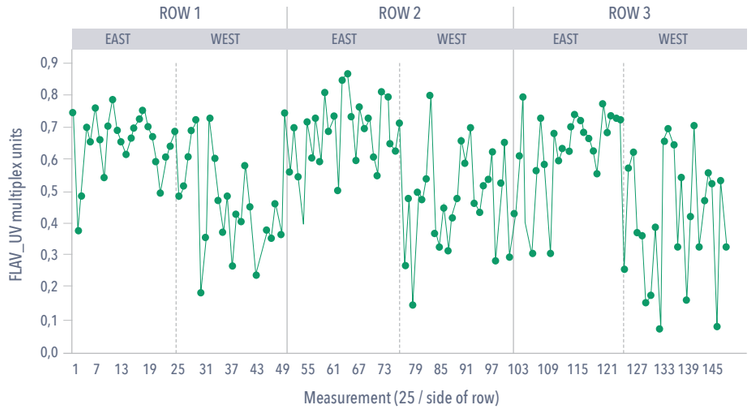


Fig. 3: Phenol concentrations of the grapes from the same experimental orchard, as measured at the two leaf surfaces

Phenol concentration

Warmer air temperatures and increased global radiation lead to higher phenol concentrations in white wine grapes; these higher concentrations can cause undesirable tannins. Surprisingly, it was determined that altitude has an only very small effect on the phenol concentration of the grapes. In contrast, significantly greater differences were observed between the various degrees of exposure and corresponding alignments of the rows (fig. 3).

Initial conclusions and perspectives

The project's initial findings confirm the hypothesis that the freshness of the wines increases with the rising elevation of the orchard. In contrast, wines from the valley floor were sweeter and had the more-intense flavours of ripe fruit.

In the PinotBlanc project, the attempt is being made to establish a relationship between the wine's characteristics, the orchard's climatic characteristics, and the agronomic aspects of the conditions under which the grapes are cultivated. In this fashion, it is hoped that it will prove possible to influence the quality of Pinot blanc during a time of climate change.

The PinotBlanc project is being funded by the European Regional Development Fund (EFRE 2014–2020, "Investments for Growth and Development").

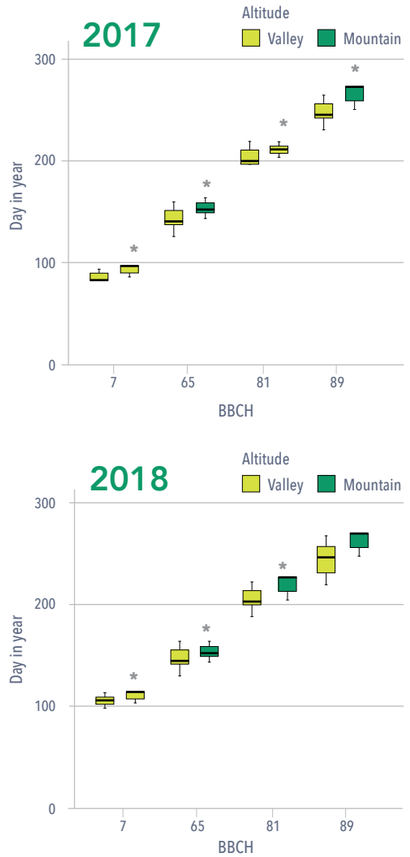


Fig. 2: Phenological surveys

efre·fesr
Südtirol · Alto Adige
Europäischer Fonds für regionale Entwicklung
Fondo europeo di sviluppo regionale
EUROPEAN UNION
AUTONOME PROVINZ BOZEN SÜDTIROL
PROVINCIA AUTONOMA DI BOLZANO ALTO ADIGE


Arno Schmid, Barbara Raifer,
"Viticulture" research area

The REBECKA project: Development of a new model for evaluating the suitability of land for wine cultivation

Climate change is affecting viticulture. While areas currently under cultivation may in the future become too warm for viticulture, it is possible that other regions might only then become more suitable for wine growing. In mountainous regions, such areas might be found at higher elevations. In what alpine areas is the wine growing possible, and how could the cultivated areas change under different climate scenarios?

Transboundary cooperation

Against this backdrop, the goal of the REBECKA project was to create a digital evaluation model for South Tyrol and Carinthia on the basis of which the suitability for growing wine of every individual parcel of agricultural land can be determined. To do this, different climatic data and viticultural information as well as historical data from South Tyrol and Carinthia were compiled and integrated in a statistical evaluation model. The project was coordinated by the Laimburg Research Centre and carried out together with its research partners Eurac Research, Joanneum Research, and the Chamber for Agriculture and Forestry in Carinthia.

Analysis of historical harvest data and agronomical surveys

In a first step, historical harvest data (1997–2016) from various different winery cooperatives was analysed in order to determine those quality parameters responsible for the current typical character of South Tyrolean Pinot noir wines. Furthermore, current data from three vegetation periods on the phenological development and ripening process in 30 Pinot noir vineyards at different altitudes was compiled. In this manner, it was possible to exactly analyse the relationship between climate and ripening process (fig. 1).

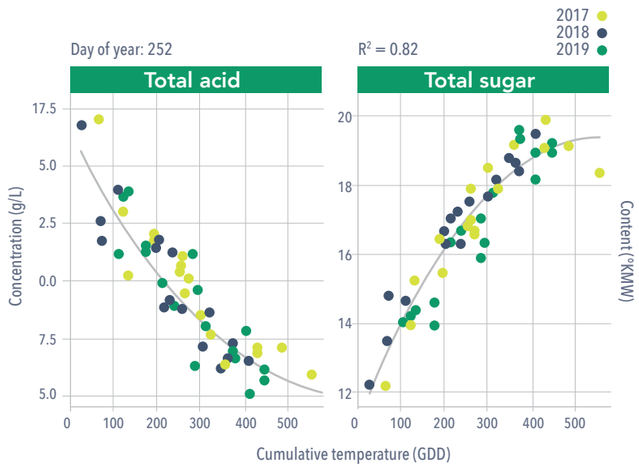


Fig. 1: In the investigated Pinot noir vineyards, a strong correlation between ripening process and temperature was observed during a three-year period.

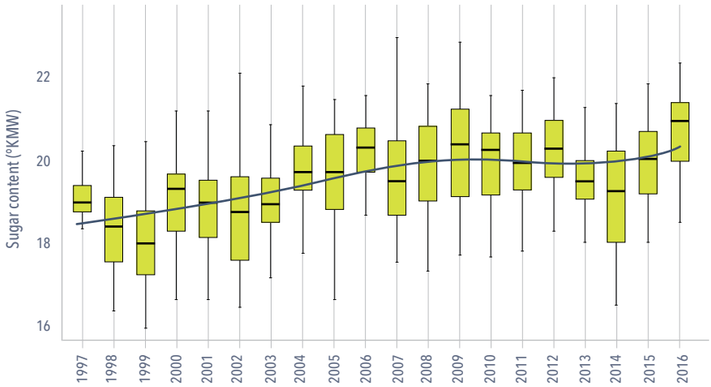


Fig. 2: Historical must data from the winery cooperatives shows that, in the case of Pinot noir, a sugar concentration of at least 18 °KMW is aimed for.

Minimum sugar content and minimum cumulative temperature

The historical data showed that Pinot noir grapes in South Tyrol are harvested with a minimum sugar content of 18 °KMW (fig. 2). A comparison of the ripening process and the climatic parameters indicated that, on average, a minimum cumulative temperature of 1100 degree days (fig. 3) is necessary if the grapes are to attain a sugar content of 18 °KMW. The information obtained in this fashion served as a basis for designing the cumulative temperature-based evaluation model.

Findings made generally accessible

The evaluation model yields information on such objective parameters as temperature, radiation, topography, and degree of cloudiness and thus makes it possible to characterise and compare specific cultivation sites. The model can be continuously updated and improved and thus take into account even future environmental and climatic changes. It can help in making decisions about allocating new land for the cultivation of wine and is available to all research partners, public administration agencies, and the agricultural cooperatives, free of charge.

The REBECKA project was funded by the European Fund for Regional Development in the framework of the 2014–2020 Interreg V-A Italy–Austria Cooperation Programme.

ORCHARD	ELEVATION [m]	CUMULATIVE TEMPERATURE [°C]
1	813	1113
2	822	1109
3	827	1165
4	828	1165
5	873	1189
6	976	1034
7	977	1125
8	1007	993
mean value	**890**	**1112**

Fig. 3: Mean cumulative temperature in border locations

Additional information on the REBECKA project

Viticulture browser of the South Tyrolean Public Administration (based on the evaluation model developed in the REBECKA project)

Interreg Italia-Österreich
European Regional Development Fund
EUROPEAN UNION


Martina Falagiarda, Silvia Schmidt,
"Entomology" working group

Trichopria drosophilae – A natural antagonist to combat the Spotted Wing Drosophila

Fig. 1: *Trichopria drosophilae* (female)

To combat the Spotted Wing Drosophila in South Tyrol, chiefly insecticides and insect protection nets have been used in the past. However, because of the enormous reproductive potential and the broad diet of this species, pest control remains a challenge. Several studies indicate that the pupal parasitoid *Trichopria drosophilae* (Hymenoptera: Diapriidae), a natural adversary of the Spotted Wing Drosophila, could be suitable in combating this pest.

Initial trial release: Parasitisation rate of between 0 and 15.9%

In 2017, an initial trail release was carried out in a cherry-tree orchard at the Laimburg Research Centre in which the ability of *T. drosophilae* to parasitize the pupae of the Spotted Wing Drosophila in the field was investigated. The parasitizing rate amounted to between 0 and 15.9% of the pupae in the soil, while the proportion of pupae parasitized in the fruit amounted to 66.7% (fig. 2).

Trial parasitisation at different altitudes

Because many fruit orchards attacked by the Spotted Wing Drosophila are located in mountainous areas, in 2018, a second trial was carried out in cherry-tree orchards at different elevations; besides Laimburg, releases were also carried out in Lengstein (915 metres above sea-level) and in Kastelruth (1115 metres above sea-level).

	2017	2018		
	LAIMBURG	LAIMBURG	LENGSTEIN	KASTELRUTH
Soil	0–15.9%	0%	0%	0%
Fruit	0–66.7%	0–66.7%	0–72%	0%

Fig. 2: Pupae parasitized by *T. drosophilae* (%) in different evaluation intervals in the individual traps

In contrast to the observations made in the previous year, at none of these three locations were pupae in the soil parasitized. At the Laimburg site, the parasitisation of the pupae present in the fruit was due not only to *T. drosophilae*, but also to other species of parasitoids which prey upon *D. suzukii* present in the cherry-tree orchard. The highest parasitisation rate was recorded in Lengstein, where the fact that the forest was near the hedge promoted the activity of the parasitoids. On the other hand, the lack of parasitisation in Kastelruth indicates conditions which are not very favourable for the proliferation of *T. drosophilae*. At this site, the hedge was not very thick; it was far from the forest, and near an apple orchard.

Conclusion

The use of *T. drosophilae* could be considered in combating *D. suzukii*, especially to delay the development of the first generation in the summer. Prior to releasing the natural antagonist, however, those factors influencing the successful parasitisation of the pupae must be evaluated.

Fig. 3: Parasitoid trap

Silvia Schmidt, Stefanie Fischnaller, Martina Falagiarda,
"Entomology" working group

The Brown Marmorated Stink Bug – Overview of current activities at the Laimburg Research Centre

Fig. 1: The Brown Spotted Stink Bug (*Halyomorpha halys*)

Fig. 2: Image of damages on apples, October of 2019

The Brown Marmorated Stink Bug (*Halyomorpha halys*) was originally at home in the East Asian region (China, Japan, Taiwan, Korea). In the 1990s, it was introduced from there into the United States. Because of its significant potential for proliferation, it has in the meantime spread out into many areas of the northern hemisphere, where it causes considerable damages in the agricultural sector.

Biology and behaviour of the pest

Since 2016, the Brown Marmorated Stink Bug has been a central focus of the research activities at the Institute for Plant Health of the Laimburg Research Centre. In order to develop specific measures to regulate this pest, it is first necessary to procure a basic understanding of the proliferation as well as of the biology and behaviour of this organism in the area of South Tyrol.

Monitoring programme throughout South Tyrol

In order to obtain data on the effective distribution of this insect on a province-wide basis, since 2016, the Laimburg Research Centre – in cooperation with the South Tyrolean Advisory Service for Fruit and Wine Growing, the Plant Protection Service of Bozen/Bolzano, and the South Tyrolean Advisory Service for Mountain Agriculture (BRING) – have been conducting an intense monitoring programme. Selected areas are periodically observed using bait traps and visual checks.

Development of the pest

In 2018, field investigations were carried out on the development of the Brown Marmorated Stink Bug in order to exactly document such important basic data as the begin of egg-deposition or the appearance of fully developed individuals of daughter generations. The insect's development is influenced chiefly by climatic conditions. On the valley floor of the Etsch / Adige River, it is possible for two generations per year to develop, as was observed for 2018; these two generations are then active at the same time in the subsequent vegetation period, which can thus lead to a rapid increase in population within a single year.

Investigations of "wild hosts"

37 tree species at various sites and which border apple orchards were investigated. It was found that the Brown Marmorated Stink Bug can thrive on 28 of the investigated plant species and resides during the vegetation period on 30 different species of trees and shrubs.

Different strategies to combat the pest

The measures to combat the Brown Marmorated Stink Bug focussed on the use of chemical insecticides and the use of insect protection nets. Additionally, more-sustainable strategies such as biological methods with so-called "natural adversaries" were employed.

Various practical trials conducted in 2019 indicated that chemical treatments carried out in strict conformance with the results of the tapping probes show an effect on juvenile organisms at the site and can lead to a reduction in the formation of damages. In contrast, adult Stink Bugs cannot always be captured by means of tapping probes, and treatments with insecticides did not lead in the peripheral row bordering an infested hedge to a marked reduction of fruit infestation.

Effectiveness of pesticides

Laboratory trials and field investigations in various different regions (Friuli, Piemont, Emilia Romagna) indicated that the available synthetic/chemical preparations displayed only a "contact effect," and achieved either no or only a very low residual effect. That means that the Stink Bug must be directly hit by the sprayed agent if it is to be killed. For this reason, further investigations are focussing on the treatment of laid eggs and nymphs.

In this context, the Laimburg Research Centre carried out initial laboratory trials with preparations acting on bug nests via alternative mechanisms. Plans call for a continuation of this approach – also in order to better assess the effect on the development of the nymphs.

The use of protective netting

All available synthetic/chemical agents are effective for an only short time. In order to avoid damages, it is possible to install anti-insect protective netting that prevents adult bugs from flying into the orchard. Beginning in 2020, the Laimburg Research Centre has been carrying out an experiment involving the total coverage with nets of individual parcels of an orchard. The goal is to investigate the advantages – but also drawbacks – of the use of such nets in comparison with the targeted use of "classic" insecticides.

Regulation of the Brown Stink Bug using natural adversaries

In its homeland in Asia, the Brown Spotted Stink Bug is kept in check by natural enemies. Such parasitoids – which attack the eggs of the Brown Spotted Stink Bug – can now be found also in South Tyrol: The so-called Samurai Wasp (*Trissolcus japonicus*), and a second species named *Trissolcus mitsukurii*.

An assessment is now available on the risks of releasing *T. japonicas*. In the framework of an approval procedure, the Laimburg Research Centre was thus tasked with carrying out releases starting in 2020 at selected sites in South Tyrol and to breed the animals needed for this.

One special challenge is to be seen in finding suitable locations with a sufficient number of egg clutches occurring naturally. Such sites are needed if *T. japonicus* is to be permanently settled in South Tyrol.

Fig. 3: The Samurai Wasp (*Trissolcus japonicus*) is a small parasitoid and a natural adversary of the Brown Stink Bug.

Fig. 4: Egg clutch of the Brown Spotted Stink Bug parasitized by the Samurai Wasp

Sabine Öttl,
"Phytopathology" working group

Virus diseases in South Tyrolean cherry cultivation

The commercial cultivation of sweet cherries has increased constantly in the past decade in South Tyrol. In the meantime, approx. 100 ha are now under cultivation. However, in recent times, reports on viral infections in cherry trees in various different areas of cultivation in Europe have been on the rise. For this reason, the "Phytopathology" working group carried out an initial survey on three of the most-important viral diseases in sweet cherry cultivation in South Tyrol, too. The following three viruses were investigated: Apple Chlorotic Leafspot Virus (ACLSV), which is the pathogen responsible for Necrotic Band Mosaic Disease; the Prune Dwarf Virus (PDV), which causes Chlorotic Ringspot Disease; and the Prunus Necrotic Ringspot Virus (PNRSV), which is responsible for Necrotic Ringspot Disease. All three of these diseases can result in considerable losses in yield.

Fig. 1: Fresh flower petals are best suited for detecting the three most-important viral diseases affecting sweet cherries.

Three viral diseases immunologically detected

In cooperation with the South Tyrolean Advisory Service for Fruit and Wine Growing, nine cherry tree orchards in the Vinschgau area were chosen for the investigations. Because the immunological detection of the aforementioned viral diseases is best performed on fresh flower petals, samples are taken when the trees are in full bloom (fig. 1).

In eight of the nine investigated cherry tree orchards, at least one of the viral infections was detected; in one orchard, all three were identified. All in all, about 11% of the 270 examined trees were found to be infected with a virus; four trees displayed a viral load at the detection limit. ACLSV was detected most frequently, with an infection rate of about 5%, followed by PDV (3%) and PNRSV (2%). One tree was found to be infected with both ACLSV and PNRSV (fig. 2).

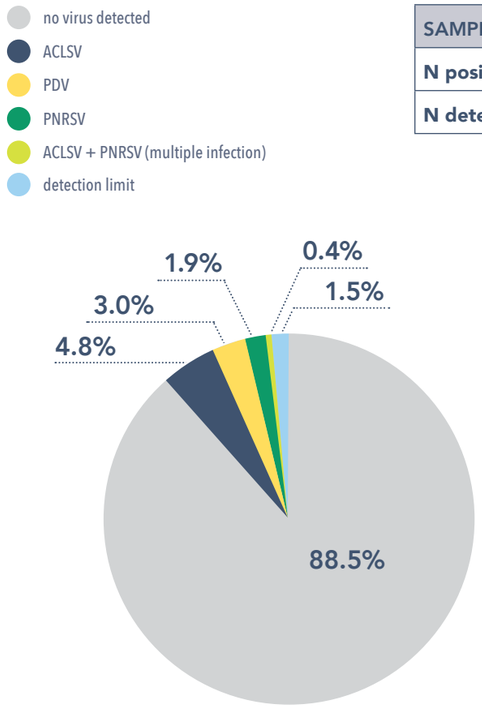


Fig. 2: Findings of the immunological detection of three viral diseases in cherry-tree cultivation in South Tyrol

SAMPLE N°	ACLSV	PDV	PNRSV	TOT	[%]
N positive	14	8	6	28	10.4
N detection limit	1	3	0	4	1.5

	N SAMPLES	[%]
no virus detected	239	88.5
positive	27	10.0
detection limit	4	1.5
N tot	**270**	**100.0**

E03: ACLSV + PNRSV

	N SAMPLES	[%]
no virus detected	239	88.5
ACLSV	13	4.8
PDV	8	3.0
PNRSV	5	1.9
ACLSV + PNRSV (multiple infection)	1	0.4
detection limit	4	1.5
N tot	**270**	**100.0**

Because ACLSV is transmitted solely via infected planting material, it can be assumed that the trees had already been infected at the time of planting. On the other hand, PDV and PNRSV can also be transmitted by pollen or insect vectors in the field. For this reason, it is not always possible to unambiguously identify the cause of the proliferation of these infections.

Conclusions and perspectives

This initial survey confirms the presence of three of the most-important viral diseases in commercial cherry-tree cultivation in South Tyrol. On the basis of this, it will now be possible to carry out expanded investigations on further viral diseases affecting stone fruit which threaten the other cultivation areas of South Tyrol. Supplemental investigations on wild cherry trees bordering commercial orchards could also provide insights on the natural transmission pathways of these viral diseases.

Katrin Janik,
"Functional Genomics" working group

Focus on apple proliferation disease: The APPLClust project

In the APPLClust project, the Laimburg Research Centre was able to gain important knowledge over the course of 2013-2018 about the spread of the apple proliferation disease in South Tyrol.

Five years of intense entomological monitoring and the molecular biological-diagnostic high-throughput analysis of several thousand cicadas and psyllids of different species have not yet led to any conclusive findings proving that – besides *Cacopsylla melanoneura* and *C. picta* – any other insects transmit the phytoplasms responsible for apple proliferation disease. In 2018, the infestation figures as well as the densities of *C. picta* in South Tyrolean apple orchards were again low. All currently available research findings emphasise the central role of *C. picta* in the transmission of the apple proliferation disease. In the future, as well, the regulation of this insect will thus be of eminent importance in preventing another outbreak of this disease. Nonetheless, many aspects of the biology and ecology of the insect vectors for the apple proliferation disease are still unclear for South Tyrol.

Effect of Tau-Fluvalinates

In recent years, an adapted plant protection strategy and the use of Tau-Fluvalinates have raised the question as to whether this treatment may have a negative impact on beneficial fauna and in particular on the density of predatory mites in treated apple orchards. For this reason, the species composition of the predatory mite fauna was analysed in the framework of the project for several years and the possible effect of Tau-Fluvalinate treatments on the densities of predatory mites determined.

External influences

Large-scale data analyses in several hundred apple orchards in the APPLClust project yielded important findings on the presence of insect vectors in apple orchards and their possible winter habitats. Additionally, some external factors were subjected to statistical investigation which could influence the prevalence of insect vectors and the infection rates for apple proliferation disease in South Tyrol. For example, it was determined that targeted plant protection measures against *Cacopsylla melanoneura* and *C. picta* reduce the spread of the apple proliferation disease. Furthermore, a correlation was found between the appearance of *Cacopsylla* species and the proximity of certain forest types. The APPLClust project was carried out in close cooperation with the Edmund Mach Foundation (San Michele All'Adige).

Perspectives

In the future, too, research on the apple proliferation disease will have a high priority at the Laimburg Research Centre. In the APPL3.0 follow-up project, monitoring and the determination of infection rates will continue to be carried out and also applied research and basic research on this topic maintained and expanded.

Fig. 2: Quantification of the proportion of areas for forest types within a radius of r = 2.5 km and 5 km (smaller and larger yellow circle) with the example of an apple orchard (yellow dot)

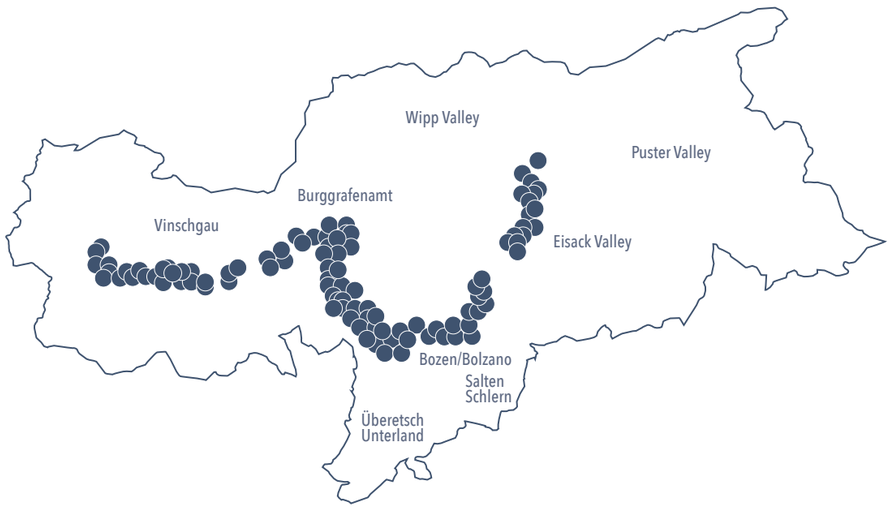


Fig. 1: Survey of the sites for monitoring insect vectors (*Cacopsylla melanoneura* and *C. picta*) which transmit the apple proliferation disease


Elena Zini, Thomas Letschka
"Breeding Genomics" working group

The VITISANA project: Researching the genetic basis for quality in disease-resistant varieties of grapes

EUROPAREGION EUREGIO
Tirol Südtirol Trentino
Tirolo Alto Adige Trentino

Website of the VITISANA project

Fig. 1: Nanovinification of grape vines from resistant varieties

The latest E.U. directives in the field of agriculture aim for the gradual reduction of the use of pesticides. In the area of wine growing, this problem is aggravated by the susceptibility to disease of the European grape vine (*Vitis vinifera*) and the resultant heightened need to use pesticides. The high quality of established wines, which hardly allows for varietal innovation on the wine market, is a further problem.

Breeding goals: Quality and resistance to disease

One feasible approach towards more environmentally compatible wine growing would be the development of new varieties by means of crossbreeding and selection as well as the attempt to maintain excellent organoleptic characteristics of the European grape vine while supplementing it with properties of American or Asian varieties which display a tolerance to disease. This type of crossbreeding is nothing new: Beginning in the second half of the 19th century, right after the appearance of powdery and downy mildew and other pathogens imported from the U.S.A., the hybridisation of European varieties with American (or Asian) wild forms was undertaken; this resulted in the so-called "first-generation hybrids." In view of the suboptimal quality of the wines derived from such hybrids, European wine growers continued experimenting and repeatedly crossed these hybrids with quality grape vines in the hope of diluting the undesirable wild genome while simultaneously retaining the desired resistance. This resulted in wines not only suitable for sustainable cultivation, but also displaying a high level of quality.

The goal of VITISANA: Enhancing the quality of PIWI wines

The goal of the VITISANA project was to identify those parts of the genetic code responsible for undesirable wine components so as to facilitate the breeding of new fungus-resistant grape varieties (so-called "PIWIs", from German "pilzwiderstandsfähig") displaying high quality. To this end, both grapes and the corresponding nano-vinification of more than 100 resistant varieties with different quality characteristics were investigated. In cooperation with the Edmund Mach Foundation (Lead Partner) and the University of Innsbruck, various chemical analytical methods were used to measure those undesirable wine components which are responsible for the formation of negative aromas and flavours which are typical of first-generation PIWIs.

Conclusion and perspectives

In the VITISANA project, the project team was able to determine the genetic foundation for the quality characteristics of resistant varieties. On this basis, it will be possible in the future to use molecular markers to develop new resistant grape varieties in a systematic fashion. This will result in new, high-quality wines derived from low-pesticide cultivation.

Fig. 2: *Vitis amurensis*, a wild Asian species which features an important mildew-resistance mechanism, and which is the ancestor of "Solaris" and other PIWI wines

Thomas Letschka, Valentina Cova
"Breeding Genomics" working group

The AppleCare project: An apple a day keeps the allergy away

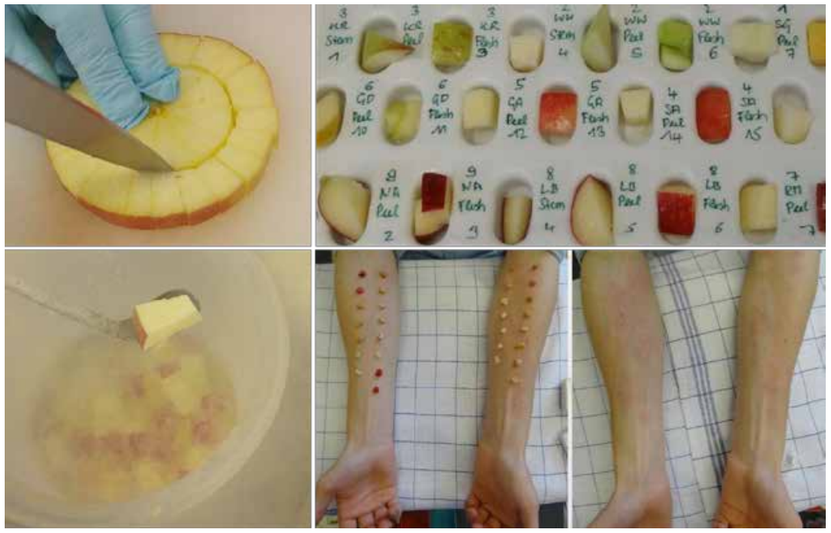


Fig. 1: Prick-to-prick tests with different apple varieties to determine their allergenic potentials

Apples are not only delicious, but also health-giving. They contain lots of vitamins, minerals, fibre, and almost no fats. An investigation carried out by the Laimburg Research Centre on the natural treatment of birch pollen allergy has now shown that they can also be used as a remedy.

Birch pollen allergy

When birches are in bloom, people with allergies can suffer in part severe hay fever treatable only with antihistamines or tedious injection therapies to slowly accustom their bodies to the allergen. This treatment method is uncomfortable and is frequently terminated prematurely. This is the reason why the AppleCare project sought to develop an alternative treatment method in which the patient is accustomed to the birch pollen allergens by administering to him the almost identical apple allergen – and not through injection, but rather by means of the natural consumption of fresh apples.

The AppleCare project

In the AppleCare project, the Laimburg Research Centre was working together with the dermatology departments of the hospitals in Bozen and Innsbruck as well as with the Institute for Organic Chemistry of the University of Innsbruck.

The allergenic potential of an apple depends upon the given variety. For this reason, 23 different apple varieties were tested on more than 50 voluntary patients to determine their suitability for use as a "therapeutic agent" (fig. 1). In the new treatment strategy – also known as the "apple therapy" – the subject first eats a weakly allergenic variety (e.g., Red Moon® or another red-fleshed variety) for three months. The subject then eats a different, moderately allergenic variety (e.g., Pink Lady®) for another three months. Finally, a highly allergenic variety (e.g., Golden Delicious or Gala, fig. 2) is eaten for at least another nine months.

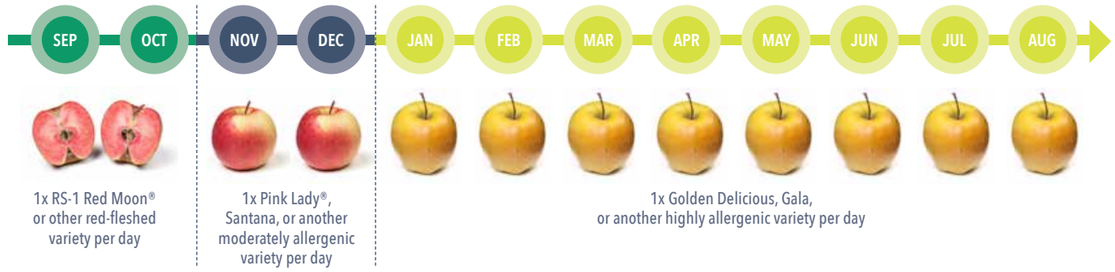


Fig. 2: The "apple therapy" to cure birch pollen allergies

Findings and perspectives

Patients who underwent this cure in a preliminary study not only could then eat apples without any complaints, but also suffered significantly fewer hay fever symptoms in the spring. This indicates that eating a defined quantity of certain varieties of apples for a defined duration and in a specified sequence has a positive effect on birch pollen allergies. The goal is to now confirm these findings in a large-scale clinical study.

The AppleCare project was funded by the European Fund for Regional Development in the framework of the 2014–2020 Interreg V-A Italy–Austria cooperation programme.

Find out how the "apple therapy" works

applecare

Interreg
Italia-Österreich
European Regional Development Fund

EUROPEAN UNION


Andreas Putti, Laura Russo,
"Food Microbiology" research area

MALDI-TOF: A new method of mass spectroscopy for identifying microorganisms in foods

Because of the great diversity of microorganisms present in various foods – and especially in fermented juices and vinification – the identification of these organisms is often a very complex and time-consuming task. For this reason, it is necessary to develop faster and at the same time more-accurate methods to accelerate these processes.

MALDI-TOF

MALDI-TOF technology (Matrix-Assisted Laser Desorption/Ionization Time Of Flight), coupled with mass spectroscopy, is a method of proteomics which was recently introduced into the field of food microbiology. This approach is based on the analysis and comparison of protein profiles and makes it possible to identify bacteria, yeasts, and moulds. Using this technology, one can examine the protein spectrum of a microbiological culture and then compare it with the spectra of known microorganisms recorded in a database. On the basis of this comparison, one can reach conclusions about the species and genus of the microorganisms at hand.

More than 8,200 reference spectra

Since 2018, the Laimburg Research Centre has been using a MALDI-TOF mass spectrometer with a database currently containing 8,220 reference spectra for the identification of microorganisms. In the case of the majority of these reference spectra – the so-called MSPs (Main Spectra) – they are the spectra of bacterial species. MSPs are based on multiple measurements of a defined strain; it thus reflects the actual biological variability of an organism. The identification of an unknown species using the MALDI-TOF mass spectrometer is possible only if the database already contains MSPs of the same species or genus. For this reason, it is important that the greatest possible variety of species be collected in the database. The database can then be expanded by feeding into it the new MSPs from different analyses. At present, only a small portion of the microorganisms (some of them deleterious) found in foods worldwide have been investigated using MALDI-TOF technology. More-comprehensive investigations have been undertaken only for microorganisms occurring in the production of wine and beer.

Conclusions and perspectives

MALDI-TOF technology has been successfully introduced at the Laboratory for Food Microbiology at the Laimburg Research Centre. Our task is now to elaborate and fine-tune this technology and to continue expanding our database in order to be able to investigate relevant microorganisms found in typical South Tyrolean foods and to further accelerate our services.

Fig. 1: The MALDI-TOF mass spectrometer at the Laboratory for Food Microbiology for the identification of microorganisms in foods

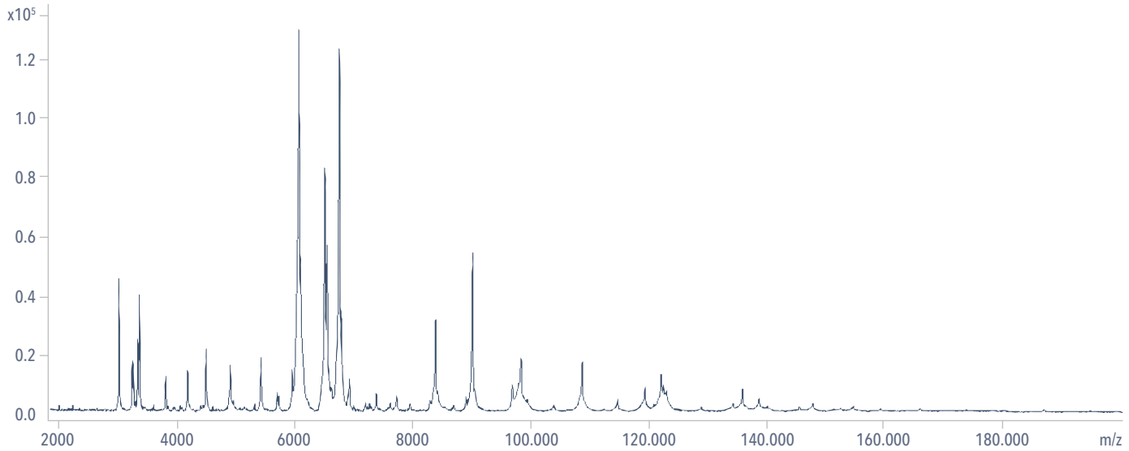


Fig. 2: The reference spectrum for *Hanseniaspora guilliermondii*


Daniela Eisenstecken, Peter Robatscher,
Laboratory for Flavours and Metabolites

The OriginAlp project: Where does my apple come from? Near-Infrared Spectroscopy (NIRS) used to determine the altitude at which South Tyrolean apples were grown

Nowadays, analytical methods for determining the place of origin of foods are standard test tools. However, they are frequently time-consuming, expensive, and destructive. For this reason, modern spectroscopic techniques – quick, non-destructive, and solvent-free – for performing quality-control and traceability have awakened interest in the fruit growing industry.

The OriginAlp project

The goal of the OriginAlp project was to be able to directly measure and/or verify (on the product, itself) the quality and origin of various foods. To this end, the project partners – the University of Innsbruck, the Free University of Bozen-Bolzano, and the Laimburg Research Centre – applied various different scientific test methods. At the Laimburg Research Centre, South Tyrolean apples grown at mountain locations and on valley floors (1,000 and 220 metres above sea-level, respectively) were examined using near-infrared spectroscopy and the resultant data evaluated using chemometric methods. Chemometry employs mathematical and statistical tools to address questions relating to chemistry and thus makes it possible to extract a maximum of information from experimental measurement data.

Near-infrared spectroscopy used to differentiate mountain and valley-grown goods (Golden Delicious)

In near-infrared spectroscopy, light having a wavelength of between 1,000 and 2,500 nm impinges upon apples and is reflected. The reflected light is collected and yields an individual, characteristic spectrum. On the basis of this spectrum, a model for determining the altitude at which the sample apples were grown was elaborated. This model is based upon principal component analysis (PCA): Several measured parameters (approx. 1,500 different wavelengths in the apple spectrum) are bundled together in so-called "principal components" and the individual sample apples described on their basis (fig. 2).

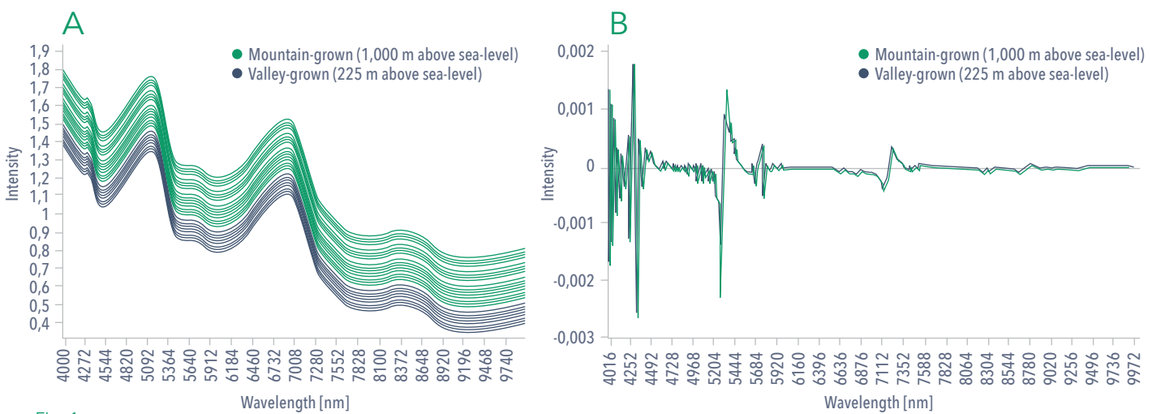


Fig. 1:
A) Raw NIR spectra (no mathematical pre-processing) of the sample apples (2013 harvest) for apples grown in the valley (blue) and in the mountains (green)
B) Normalised and derived NIR spectra of the sample apples (2013 harvest) for apples grown in the valley (blue) and in the mountains (green)

Conclusions

NIR technology has proven to be a promising method to determine – quickly and affordably – the elevation at which South Tyrolean apples were grown. This is an example of real "green science," insofar as no solvents or chemicals are used and the samples are not destroyed. Thus, after an apple has been analysed using this method, it can be eaten without concern. This is because it has been exposed only to harmless infrared light for a few seconds.

Website of the OriginAlp project

Fig. 3: Apples of the Golden Delicious variety

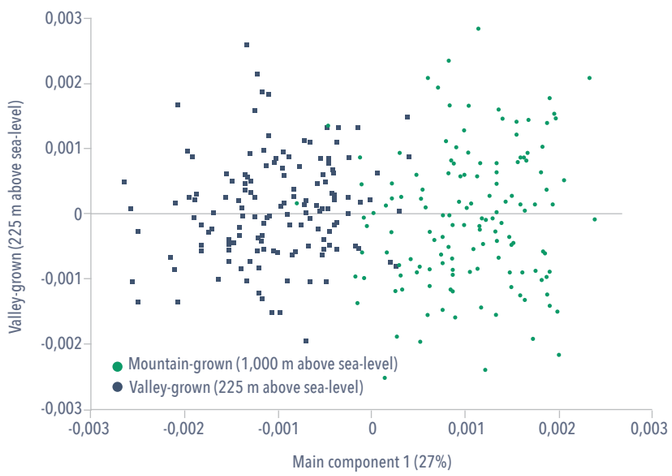


Fig. 2: Two-dimensional representation of the sample apples (blue squares = valley-grown; green dots = mountain-grown) with principal components 1 and 2, which together explain 43% of the information in the spectra

The OriginAlp project received funding from the Interreg-IV-Programme Italy–Austria.


Giulia Chitarrini, Peter Robatscher,
Laboratory for Flavours and Metabolites

What components are responsible for an apple's flavour? Knowledge gained from the analysis of Volatile Organic Compounds (VOCs)

The flavour and aroma of a variety of apple are of decisive importance for its market acceptance. While the apple's flavour is influenced chiefly by the sugar and organic acids present in it, the aroma is due to a complex mixture of Volatile Organic Compounds (VOCs). Each variety of apple has its own unique mixture of VOCs.

Analysis of VOCs

The aroma profiles of eleven old and new apple varieties grown in South Tyrol were analysed by means of mass spectroscopy ("LCH-am-19-6 Aromatic analyses in South Tyrolean apples," fig. 1) for the purpose of better characterizing the varieties and their quality. Using gas chromatographs coupled with a mass spectrometer, it was possible to identify the 38 VOCs most commonly occurring in the investigated apple varieties.

The aroma profiles have many common characteristics: About 80% of the VOCs are classified as esters. The most frequent representative of this class is hexyl acetate, which is responsible for the fruity, sweet scent of green apples. Acids, alcohols, aldehydes, and other substances are present in lower concentrations, but can have a decisive impact upon the apple's aromatic characteristics.

Fig. 1: In the study, the aroma profiles of eleven old and new apple varieties were investigated.

The chemical foundation of the aromas

By means of principal component analysis (PCA), it is possible to visualize the differences between the varieties with respect to their aroma profiles (fig. 2): The position of a particular apple variety in the chart provides information on its aromatic characteristics. Varieties which cluster together are characterized by similar aromatic properties. On the other hand, varieties positioned far away from each other have fundamentally different properties. The Golden Delicious variety occupies a central position; the aroma profile of this variety thus displays no significant differences to those of other varieties. Varieties located in the quadrant at the bottom left have aroma profiles dominated by such compounds as anethole and estragole, which are responsible for an anis-like scent. Those varieties characterized by such compounds as 1-hexanol, hexanal, and 2-hexenal (which are responsible for grass-like scents) are grouped together in the upper left quadrant. The varieties in the lower right-hand quadrant feature acetic acid esters and therefore display fruity, sweet, and banana-like aromas.

Conclusions

The analysis of VOCs provides insight into the chemical properties responsible for the impressive range of aromas displayed by the different varieties of apples. If one combines this fundamental information on the chemical basis of the aromas with knowledge obtained from Sensory Science, one can reach a much deeper understanding of the aromatic properties of apple varieties and how consumers perceive and evaluate them. For this reason, such analyses are useful when it comes to developing or marketing new varieties.

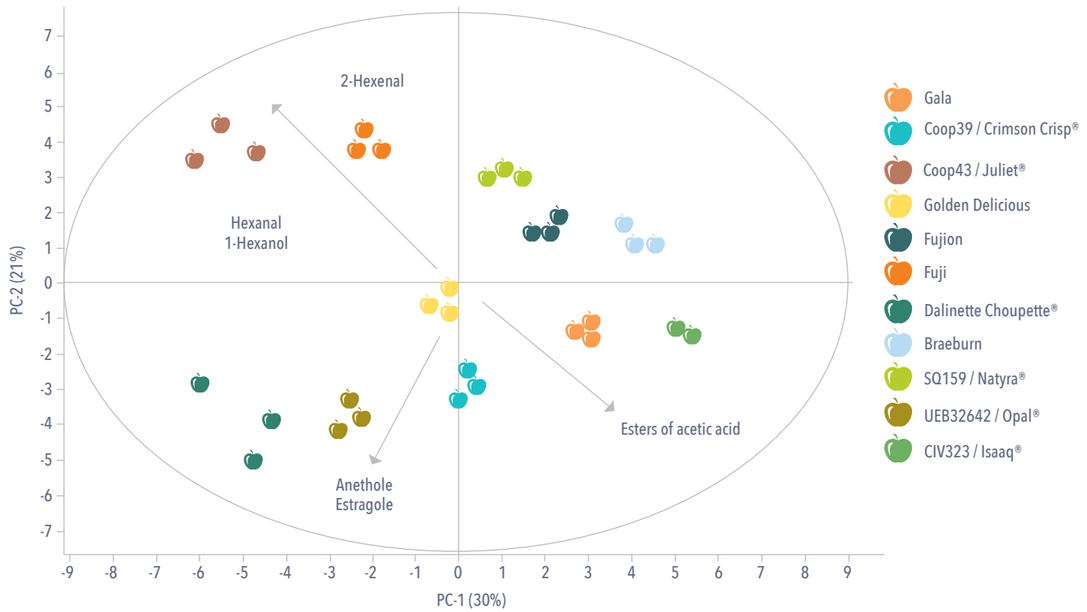


Fig. 2: The principal component analysis of the aroma profiles of the eleven apple varieties under investigation.


Giovanni Peratoner, Martina Querini,
"Grassland Farming" working group

Effort required for the production of fodder in South Tyrol

On South Tyrolean farms, grassland farming is the foundation for feeding livestock (especially cattle, sheep, goats, and horses). It thus represents an important aspect for the production of foodstuffs (milk, meat) and for the job situation in mountain areas. Furthermore, grassland farming helps shape the landscape, and also safeguards other functions (in the context of ecosystem services), including biodiversity and erosion protection, that benefit the entire populace.

Effort required on topographically disadvantaged land

The steeper the land, the more effort required to manage grasslands. In order to objectively assess the amount of work necessary and to properly plan operations, it is of great importance that one understands the work requirements of the farmers. This knowledge is important also to decision-makers in the area of agricultural policies if they are to be able to apply measures to protect grasslands in an objective and efficient manner. In particular extensive grassland management is frequently concentrated on topographically disadvantaged areas characterised by low accessibility, limited mechanisation, and less intensive use. It is precisely these areas that are increasingly threatened by abandonment. The only information on effort requirements comes from such neighbouring countries as Austria, Switzerland, and Germany – but there, important factors such as the average size of the undertakings, climate, and degree of mechanisation differ significantly from the situation in South Tyrol.

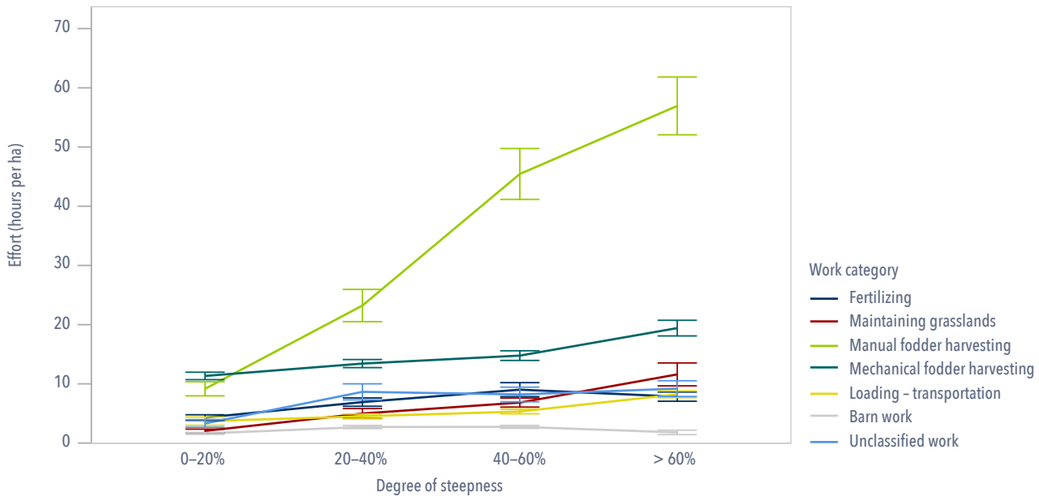


Fig. 1. With increasing steepness, the amount of effort to manage the pastureland rises markedly.

Increasing steepness entails greater effort

On the basis of a survey carried out by the South Tyrolean Farmers' Association, the Laimburg Research Centre has therefore evaluated an already-existent local database, with a focus on work requirements. Work requirements were recorded over a period of three years for about 100 parcels in the Pusteria Valley having a steepness of up to 86%. The various different work tasks were assigned to different macro-categories and then disaggregated by steepness class. The results for pastureland clearly indicate that in particular manual labour associated with harvesting fodder showed a pronounced increase, the greater the steepness (fig. 1). In the other categories, too – e.g., in grassland management and in the loading and transportation of fodder – steepness has a still-significant, though less marked, impact.

Prospects

The reference values presented in the study will thus be available to the various different advisory bodies for a variety of calculations (e.g., designing subsidisation plans) and in formulating their policies (e.g., in comparing different branches of operations, planning investments).



Fig. 2: Working on steep land



Franziska Mairhofer, Philipp Höllrigl, Giovanni Peratoner,
"Grassland Management" working group

The Inno4Grass project – Successful pasturing in mountain areas

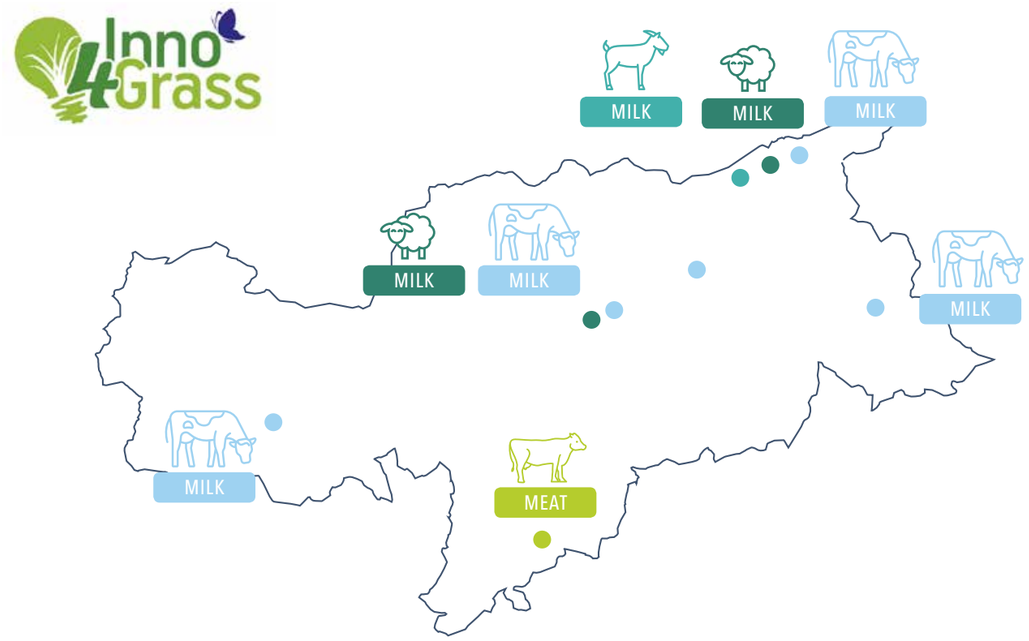


Fig. 1: Location, fauna species, and products of the eight operations participating in the Inno4Grass E.U. project

To identify innovations from actual practice in the area of greenland management, to analyse them in the exchange between practice and research, and to make the resultant findings accessible to potential users – those were the core concerns of the three-year Inno4Grass project (short for: "Shared Innovation Space for Sustainable Productivity of Grasslands in Europe"). In this context, management systems were defined as "innovations" when they were well established and successful on the operational level and also new and unusual in the given region.

The Inno4Grass project

Inno4Grass was conducted between 2017 and 2019 under the coordination of the Centre for Grasslands of Lower Saxony / Bremen. A total of 20 partners from eight European countries participated in the project. Italy was represented by the Italian National Research Council (CNR), the Italian Federation of Breeders, and the Laimburg Research Centre. The Laimburg Research Centre is collaborating at the local level with the South Tyrolean Farmers' Association, the South Tyrolean Advisory Service for Mountain Agriculture (BRING), and professional schools for agriculture.

Fig. 2: Discussion group with experts from highly diverse fields

The eight South Tyrolean project undertakings

The focus of the South Tyrolean part of the project was on the topic of pasturing. To this end, eight undertakings were selected which are forging new paths and focussing on pasturing. In all of the operations, the livestock were kept on grasslands during the entire vegetation period (fig. 1). Six of the undertakings raised cattle, and three sheep or goats. Seven adhered to organic management principles. Five of the undertakings had additional commercial activities (vacationing on farms, vegetable cultivation, etc.), and four had cheese-making operations.

In eight discussion groups (fig. 2), experts from very different areas analysed the prerequisites, strengths, and weaknesses of the undertakings and then compiled the results to elaborate an innovation analysis and corresponding information material.

Conclusions

The innovation analyses showed that while each undertaking did display unique features that set it apart from the other operations, there were nonetheless also numerous common features (fig. 3). The appropriate amount of usable acreage and a learning phase were determined to be especially relevant prerequisites. Advantages were seen in the reduction of the use of concentrated feed additives, the reduction in working times, and in establishing the desired landscape form. In contrast, a certain scepticism on the part of agriculturalists towards pasturing was regarded as a weakness.

Website of the Inno4Grass project

Innovation analysis and corresponding information material

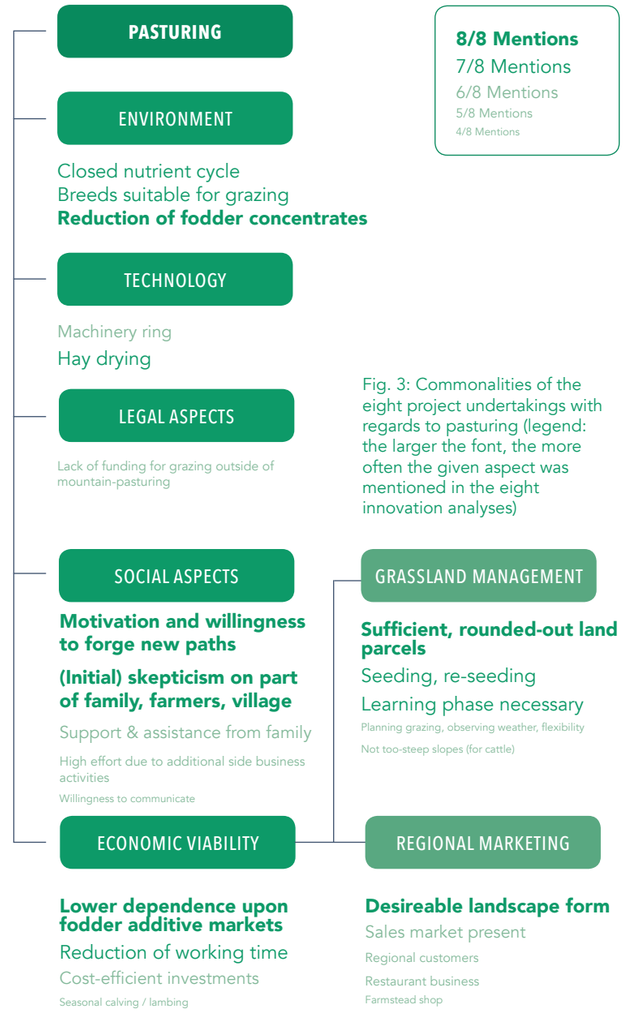


Fig. 3: Commonalities of the eight project undertakings with regards to pasturing (legend: the larger the font, the more often the given aspect was mentioned in the eight innovation analyses)

Manuel Pramsohler, Maximilian Morlacchi,
"Arable Crops and Aromatic Plants" working group

The Re-Cereal project: variety trials with buckwheat and proso millet

PARTNERS PARTICIPATING IN THE RE-CEREAL PROJECT

- Dr. Schär SpA (Lead Partner)
- Laimburg Research Centre
- Università degli Studi di Udine
- University of Innsbruck
- Dr. Schär Austria GmbH
- Kärntner Saatbau

Fig. 1: The experimental field in Dietenheim (Bruneck)

In Central Europe, the cultivation of buckwheat and proso millet has almost entirely vanished – in spite of the fact that both of these species are quite hardy and also display interesting nutritional properties. In particular, their suitability for gluten-free nutrition makes these two plants interesting for cultivation.

In the Re-Cereal project, project partners from the Austrian states of Carinthia and Tyrol, the Italian region of Friuli Venezia Giulia, and the Italian province of South Tyrol are researching the potential uses of buckwheat and proso millet in their respective project regions. The collaboration with partners with multi-disciplinary competencies makes it possible to pursue the most-varied research goals such as promoting these two crops in the project area, developing innovative methods of qualitative analysis, breeding varieties, and developing efficient processing methods. In the project, the Laimburg Research Centre investigates various different questions with the goal of optimizing cultivation methods and improving the yields and harvest quality of different varieties.

Two-year field trials

In two-year field trials held at the Dietenheim (Bruneck) site, twelve varieties of buckwheat and ten varieties of proso millet were cultivated. Phenological parameters (blossoming, ripening), agronomical parameters (stability, loss of grain, yield) and qualitative parameters (thousand-grain weight, hectolitre weight) were tested.

High variability between tested varieties

In both of the years of the investigation, the twelve buckwheat varieties displayed marked differences in development times; differences of up to 30 days were registered. The stability of the plants in the field and the parameters pertaining to grain formation (thousand-grain weight, hectolitre weight) also showed differences in the variety spectrum. With regards to yield, differences of up to 2 tons per ha were observed between the varieties.

Fig. 2: Buckwheat field

Fig. 3: Proso millet field

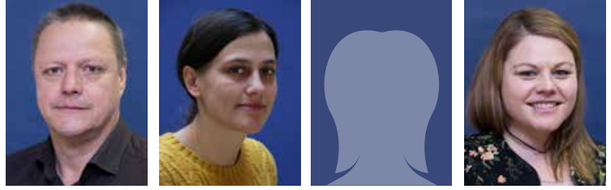
The varieties of proso millet were divided into two groups based on their speed of ripening; differences in speed of development of up to 15 days were registered. With respect to the parameters of stability and yield, no significant difference were observed between the varieties, while significant differences could be seen with regards to thousand-grain weight.

Conclusions

Buckwheat enjoys a long tradition in South Tyrol. The project showed that proso millet was also suitable for cultivation in South Tyrol. Because the available spectrum of varieties displays considerable differences, the proper selection of varieties to suit the given purpose is of great importance.

Webseite of the Re-Cereal project

The Re-Cereal project was funded by 2014–2020 Interreg V-A Italy–Austria.



Markus Hauser, Barbara Waldboth, Rhea Mack, Elisa Zangerle,
"Vegetable Growing" working group

The webGIS-VEGEMONT project – a practical digital prognosis model for the cultivation of special crops

webGIS-VEGEMONT

The goal of the webGIS-VEGEMONT project was to demonstrate the suitability for cultivation of certain areas in South Tyrol for special crops and to make the resultant information freely accessible to farmers, consultants, and political decision-makers. The VEGEMONT forecasting model was developed between 2012 and 2016 and pertains to eight crops: cauliflower, strawberries, carrots, radicchio chioggia, radicchio treviso, beets, lettuce, and onions. In order to create the VEGEMONT forecasting model, field tests were carried out over a period of three years at 21 locations at different elevations and data was collected. Additionally, cultivation data and test findings from the previous ten years collected at the test field of the Laimburg Research Centre in Eyrs were integrated into the forecasting model. On the basis of this data, simulation was used to identify potential cultivation areas for these crops at higher elevations (over 700 meters above sea-level) throughout South Tyrol. The cultivation of vegetables and beets at higher elevations can be of interest insofar as these products differ from those grown at lower altitudes with regards to quality, cultivation times, and harvesting windows. Consequently, it can be possible to fill certain market niches and also attain satisfactory profits.

Validation on the basis of data obtained from actual practice

In order to verify that the values forecast by VEGEMONT are in agreement with the reality of South Tyrolean agricultural undertakings, in 2019, data from actual practice was compiled for the entire province. This was based on a questionnaire with questions pertaining to varieties, planting dates, harvest times, use of aids (fleece, mulch films, etc.), crop failures, etc.

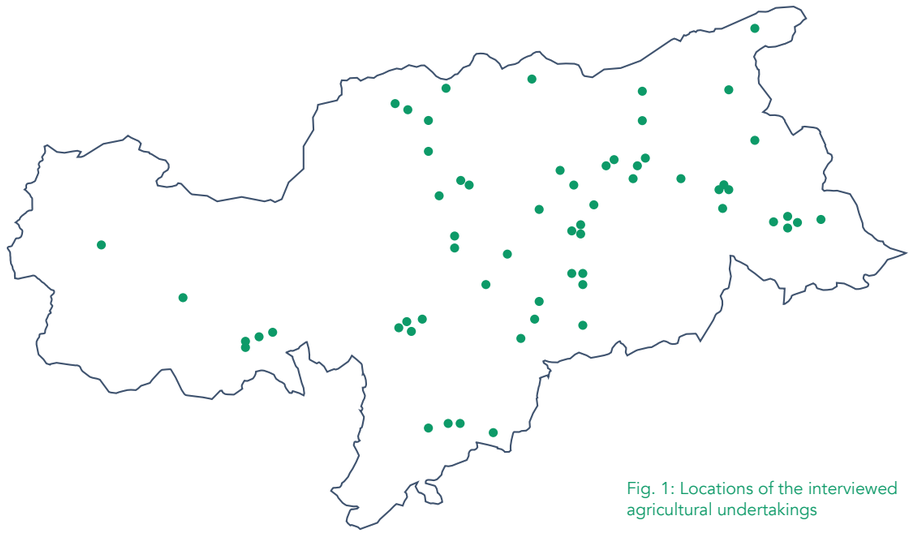


Fig. 1: Locations of the interviewed agricultural undertakings

Fig. 2: Beets

Fig. 3: Different varieties of onion

All in all, 61 agricultural undertakings located throughout South Tyrol were asked about the crops covered in the scope of VEGEMONT. The focus was on those sites which, according to VEGEMONT, are located in border areas (between "suitable for cultivation" and "non suitable for cultivation") for individual crops.

For six of the eight crops in the scope of VEGEMONT, the findings from actual practice correlated largely with the forecasting model. In the case of carrots and onions, however, the classification of zones yielded by the prognosis model did not correspond with the compiled data from actual practice: The cultivation of onions and carrots is carried out at elevations higher than those predicted by VEGEMONT – indeed, with great success.

Conclusion

In cooperation with Südtiroler Informatik AG, during the winter of 2019–20, the VEGEMONT web application will be optimised in order to ensure that the predicted values for both crops (onions and carrots) are in agreement with the values obtained from actual practice.

Fig. 4: Cauliflower at the test field in Eyrs (Vinschgau)

The VEGEMONT project was funded by the European Fund for Regional Development.

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Angelo Zanella, Barbara Stürz, Ilaria Folie,
"Storage and Postharvest Biology" working group

Frudistor – an app for determining storage damages in apples

App Frudistor

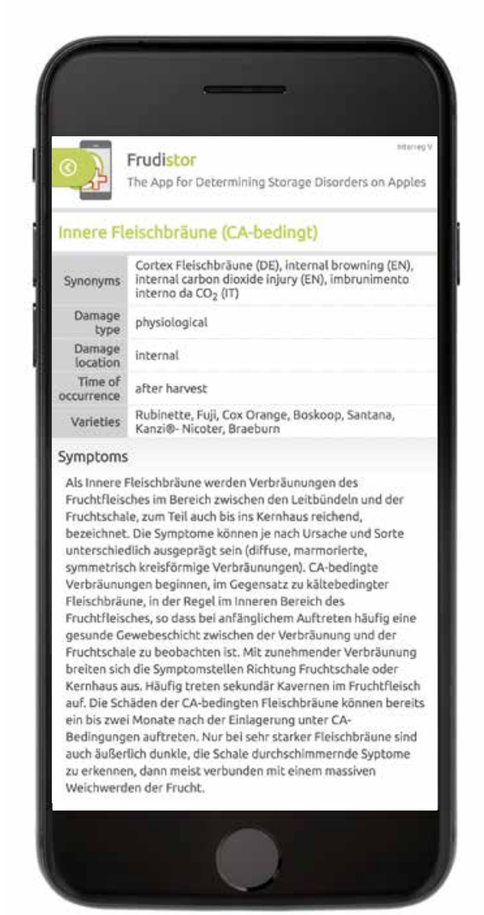

Fig. 1: The Frudistor app provides information on more than 40 different kinds of storage damages.

Despite the constant further development of modern storage technologies, physiological damages still occur quite frequently during the storage of apples, and the fruit is often subject to attack by various different parasites. These storage damages can result in considerable economic losses. The best strategy to combat this problem is to prevent damages in advance. We are applying all of our know-how and innovative strategies to determine the optimal point in time for harvesting and then to ensure optimal storage conditions.

A European research project

Against this backdrop, the three-year Interreg-V StoreWare project was launched in 2015. The project team was composed of researchers from various European institutes (see table) who worked in close cooperation to recognize, identify, and classify the different kinds of damages that can occur prior to and during storage. This collaboration led to the development of a user-friendly and easily-understood software application: **Frudistor** (short for: **Fru**it **di**sorders **stor**age).

How the app works

This application can be accessed from any given digital end device. A filter system makes it possible to select the type of damage, the place, and the time the damage occurs and then to read the corresponding technical data sheet providing detailed information on possible causes, symptoms, and prevention strategies. Furthermore, a series of images depicting the various different diseases and their developmental stages enables the user to make an iconographic comparison. In this manner, the user can compare the different damages occurring in the apple and so find the proper designation of the damage and the possible causes. Frudistor consists of more than 40 technical data sheets in the German language and is now also available in Italian, English, French, and Dutch.

Frudistor
App zur Bestimmung von Lagerschäden bei Äpfeln
INTERREG V

Conclusions

Frudistor is available to everyone free of charge. It is a dynamic application and capable of being expanded. It was developed to support the various users in the sector (producers, storage technicians, and trade organisations) and consumers so that the harvesting and storage process can be made more efficient and sustainable.

PROJECT PARTNERS

- Kompetenzzentrum Obstbau – Bodensee, Ravensburg, Germany (Lead Partner)
- Esteburg – Obstbauzentrum Jork, Germany
- Laimburg Research Centre, Pfatten, Italy
- Agroscope, Wädenswil, Switzerland
- Internetagentur Bodensee, Ravensburg, Germany
- Marktgemeinschaft Bodenseeobst eG, Friedrichshafen, Germany
- Württembergische Obstgenossenschaft Raiffeisen eG, Ravensburg, Germany

Frudistor was carried out in the framework of "StoreWare – Development of a software-based system to identify and reduce storage-damages in fruit cultivation" funded by the Interreg-V-Programme for the Alpine Rhine, Lake Constance, and High Rhine."

interreg
Alpenrhein | Bodensee | Hochrhein


Elena Venir, Giuseppe Romano,
"Fruit and Vegetable Processing" working group

Niche products from South Tyrol: development of a juice from beets and apples

One strategy to enhance the image of regional products is to re-interpret traditional foods. The resultant products can then be placed in niche markets. In many areas of Europe, the production and consumption of beet juice is rising – likely due to the health-giving characteristics of this variety of vegetable. Beets are known to feature several antimicrobial and antiviral properties. It is also believed that they can support the circulatory system, strengthen the immune system, promote good digestion, and even help prevent cancer. Beet juice is rich in betalains – natural pigments with anti-oxidative and anti-inflammatory effects. In Europe, beets are regarded as the most-important food source for betalains.

Production a challenge

The main problems in producing beet juice are to be found in its low acidity (pH > 5). Because of its low acidity, the juice cannot be made non-perishable at room temperature by means of pasteurisation – unless acid is added to the juice. In an experiment at the Laimburg Research Centre, apple juice was used as an additive to increase the acidity of beet extract. No further additives were employed.

In search of a suitable mixing ratio

In an initial exploratory phase, suitable mixing ratios for apple juice and beet juice were defined on the basis of different technical and sensory criteria. To this end, five mixtures of apple juice and beet juice were created in different concentrations (fig. 1). All of the mixtures had pH values below 4.5. The mixtures were taste-tested by the working group in order to obtain a preliminary estimation of the concentrations best-suited for consumption: Mixtures having a 10%, 15%, and 20% proportion of beet juice were classified as interesting and subjected to further study.

Fig. 1: Apple juices and beet juices in different mixing ratios

Fig. 2: Beet extract

Fig. 3: Tasting panel

15% Beet juice ratio preferred

In the second phase of the trial, these mixtures of apple juice and beet juice obtained from fresh beets (juiced using a turbo-extractor) were prepared. The beet extract (fig. 2) (pH = 6.28) was added to the apple juice. The mixtures all reached pH values of under 4, and were then subjected to pasteurisation in the bottle. The different mixtures were then taste-tested by a tasting panel (fig. 3). The mixture containing 15% beet juice achieved the highest score, followed by 10% and 20%.

Conclusion

The juice with the preferred mixing ratio was then produced by a local company. At a public taste-test held at the 2018 Interpoma trade fair, 93% of the taste-testers gave this juice a positive score.


Flavio D'Alessandro, Elena Venir,
"Meat Products" working group

The INNOGeflügel project – innovation in production of poultry meat products in South Tyrol

Website of the INNOGeflügel project

The demand for poultry meat from South Tyrol is growing. Against this backdrop, the goal of the INNOGeflügel project was to identify practicable business models for the production of poultry meat. In this project, the Laimburg Research Centre is concerned with the development of products to enhance the value of drumsticks and wings as cuts of meat. These products are categorised according to their type (fresh, pre-cooked, cooked, aged, and fermented) and the hygienic and health risks associated with them due to the corresponding production process. Moreover, so-called "critical control points (CCP)" were identified, i.e., those steps or procedures in a production process in which measurable process parameters such as the pH value, heat treatment temperature, storage temperature, etc. must be checked in order to obtain a product displaying perfect health-safety.

Improvement of ecological sustainability

Because consumer demand for ecological products is continuing to rise and producers, too, attach great importance to the ecological sustainability of their products, the Laimburg Research Centre focuses on the following factors: Quality of the raw material, energy expenditure for preservation, and environmental compatibility of the packaging. Organic products were proposed that are packaged in glass jars and sterilised. Such products are characterised by higher energy consumption for production, but warehousing, distribution, and shelf-storage yield energy savings insofar as these products require no refrigeration. Additionally, the sterilised products keep longer than pasteurised products.

Sterilised organic turkey sausage

For demonstration purposes, a sterilised organic turkey sausage (fig. 1) was produced in collaboration with two local manufacturers. The plastic packaging was replaced with a glass container with a metal lid which is fully recyclable. The prototype of the sausage was presented for test-tasting at the "EUROPA BIST du – L'EUROPA SEI tu" event (Bozen, Sept. 24–25, 2019). About 10% of the consumers would purchase a product with these characteristics. That is thus the target market: a certain category of consumers who care about sustainable products and short supply chains.

Fig. 1: Sterilised turkey sausage in a glass jar

The INNOGeflügel project was funded by the European Agricultural Fund for Rural Development (ELER) and coordinated by the South Tyrolean Farmers' Association.

This research activity is part of the "Action Plan for Research and Training in the Areas of Mountain Agriculture and Food Sciences."

Europäischer Landwirtschaftsfonds für die Entwicklung des ländlichen Raums Fondo Europeo Agricolo per lo Sviluppo Rurale	Autonome Provinz Bozen - Südtirol Provincia Autonoma di Bolzano – Alto Adige	Republik Italien Repubblica Italiana
EU – Verordnung Nr. 1305/2013 Regolamento (UE) n. 1305/2013		
Hier investiert Europa in die ländlichen Gebiete L'Europa investe nelle zone rurali		


Lorenza Conterno, Luca Debiasi,
"Fermentation and Distillation" working group

Mead 2020: Development of an aperitif based on honey and fruit

Honey wine – also known as mead – is a beverage with an alcoholic content of between 8% and 18% by volume that is obtained by fermenting honey diluted with water. Honey wine can be flavoured by adding further ingredients such as spices or fruits. Despite its long tradition, little is known about the aromatic properties of this fermented beverage, and it is still only a niche product in South Tyrol.

Honey wine made from nectar or honeydew

The goal of the project at the Laimburg Research Centre was to develop a honey and fruit drink suitable for serving as an aperitif. To this end, a honey wine made of nectar honey – blossom honey, obtained chiefly from the "Tree of Heaven" (*Ailanthus altissima*) – was compared with a honey wine made of honeydew honey (forest honey). The honey was diluted with water and acidified and then inoculated with the yeast *Saccharomyces cerevisiae* (Lallemand EC1118). It was then fermented in glass tanks (fig. 1). This was then flavoured (for the first time in South Tyrol) with black currant (*Ribes nigrum*). The two different honey wines were fermented with and without the addition of black current.

Bottle fermentation as an innovative method for the production of honey wine

Another project goal was to modernise the production process for honey wine. To this end, bottle fermentation (commonly employed in making champagne) was carried out to enhance the product's complexity. Bottle fermentation did indeed result in the formation of new compounds, and carbon dioxide was produced, making the final product effervescent and fresher and thus an ideal aperitif.

The total polyphenol content of the honey wine made from honeydew was higher than the mead made from blossom honey. This was true also for the corresponding variants with or without added black currant. Prior to fermentation, a total of 46 volatile organic compounds were identified; fermentation increased this number to 62.

Conclusions and perspectives

A group of 44 untrained tasters carried out a hedonic evaluation of the honey wines prior to bottle fermentation. They found significant differences between the honey wine made from blossom honey and that made from honeydew – independent of the addition of black currant. The honey wine made from blossom honey found greater approval in particular due to its aroma profile.

These findings show that honey has a major influence upon the approval rating of the resultant beverage. Further, the effervescent product generated interest. Additional investigations are needed to determine the relationship between the chemical profile (total content of volatile organic compounds, chemical properties, etc.) and the sensory perception of the honey wine.

Fig. 1: Fermentation in glass containers with air-lock valve

RESEARCH PROGRAMMES AND THIRD-PARTY FUNDED PROJECTS

"Action Plan in Mountain Agriculture"

The **"Action Plan for Mountain Agriculture and Food Sciences"** adopted by the Government of South Tyrol in September 2015 was launched in 2016, and will continue until 2022. The aim of the action plan is to scientifically accompany the wide range of products of South Tyrolean mountain agriculture not only during their production and thus make them more competitive, but also during their processing into typical high-quality South Tyrolean products. In the area of Mountain Agriculture, work focuses on meat, milk, berries and stone fruit, and vegetables, as well as on grains and herbs. In the Foods area, activities concentrate on bacon, sausage, jams, juices, distillates, flour, baked goods, and beer.

The Laimburg Research Centre and the Free University of Bozen-Bolzano have been commissioned to implement the project, and their activities are flanked by other institutions working for South Tyrolean agriculture.

Thanks to the "Action Plan", it was possible to fill an additional 15 scientific positions at the Laimburg Research Centre, which made it possible to both expand existing projects and activities and also initiate new projects.

The **"Arable Crops and Aromatic Plants" working group** can now carry out targeted variety tests of oats in order to provide the "Regiokorn" network with an additional type of grain for the production of regional bread and thus expand the product range accordingly. In addition, variety tests were started in herb cultivation, as the right choice of varieties is an important prerequisite for the production of high-quality herbal products in mountain regions.

For various supplementary crops such as hazelnuts, or mini-kiwis, the **"Berries and Stonefruit" working group** constructed a pilot and demonstration installation in order to provide useful information on the various cultivation issues such as variety selection, training systems, and care. The chestnut – a tree rich in tradition – and problems associated with its cultivation (infestation by the Chestnet Tortrix, Septoria Leaf Spot, and the fungus *Gnomoniopsis*) are now being investigated experimentally. Thanks to the new resources, new niche and/or supplementary crops (the hazelnut, mini-kiwis, the blue honeysuckle, the sea buckthorn, the amelanchier, etc.) can now be tested for their suitability for cultivation in the low mountain ranges of South Tyrol. Together with the Edmund Mach Foundation (TN) and the Fondazione Fojanini (SO), a comparison of new sweet cherry rootstocks for the low mountain ranges was also started.

At "Mair am Hof" (Dietenheim), the Laimburg Research Centre and the Free University of Bozen-Bolzano established testing facilities in the area of livestock husbandry. After structural adjustments of the existing dairy cow stalls were completed and the latest technology installed, experimental work began in 2019. In the **"System Comparison" project**, the advantages and disadvantages of staple feed and pasture-based milk production ("High-Input-System") with a breed of pasture-suited cow ("Low-Input-System") compared with conventional intensive milk production are investigated. The aim of the project is to develop a sound knowledge base for interested farmers. In the future, the "Mair am Hof" testing facilities in Dietenheim will be accessible to all practitioners for viewing and to the pupils of the Dietenheim Professional School for educational purposes.

Thanks to the Action Plan, it was possible, inter alia, to support the production of regional beers. For this purpose, ten different varieties of beer barley are currently being tested for their suitability in making South Tyrolean beer. Furthermore, the **"Fermentation and Distillation" working group** is carrying out a feasibility study on the construction and operation of a malting service tailor-made to the needs of South Tyrol.

Capacity Building I + II

In 2013, the provincial government of South Tyrol passed a resolution for the promotion of technology- and innovation-based research in the area of food sciences, with a view also towards establishing the new Technology Park in South Bozen-Bolzano. To this end, the government signed so-called **"Performance Agreements"** with South Tyrolean research institutions. In the context of this promotion (Capacity Building I: 2013–2018, extended till 2020), the Laimburg Research Centre has established research capacities in the areas of food processing, food safety, food chemistry, and food traceability and is now able to offer companies scientific support along the entire food production chain.

In a second promotion period (Capacity Building II: 2018–2021), the investments acquired and methods developed in Capacity Building I are to be fully exploited, the launched projects to continue operation, while the labs are to be completed. To ensure this, the two programmes – Step-up and SensLab – are running at the Laimburg Research Centre.

The goal of the **"Step-up"** programme is to develop new methods (MALDI-TOF; NMR); to carry out internal and external research projects with research partners on the regional and international level; to conclude research agreements with companies from South Tyrol; to perform service analyses for third parties; and to implement the so-called "Open Lab Concept."

In this programme, various projects – like the development of a **juice made of beetroot and apple**, the elaboration of business models for the productions of high-quality **regional poultry**, the formulation of recipes for the production of **fruit juice honey wine**, and also the establishment of a database for the identification of microorganisms in wine and beer using **MALDI-TOF** have been successfully completed. *p. 44*

The Laimburg Research Centre has expanded its range of services for Small and Mid-sized Enterprises (SMEs) with an innovative concept: Start-ups and other companies can now lease laboratory workplaces and access to lab and analytical equipment at the NOI Technology Park by means of so-called **"Open-Lab Agreements"**. The companies' employees are then trained by Laimburg Research Centre experts and supported in carrying out and evaluating the experiments. As of now, three start-ups have already availed themselves of this opportunity.

In the **SensLab** programme, a competence centre with ISO certification for sensory research is to be established in South Tyrol on the basis of the "Sensory Science" working group already in operation at the Laimburg Research Centre. The "heart" of this centre will be the Laboratory for Sensory Science, which is equipped with a tasting room for carrying out sensory analyses which complies with international standards. Additionally, it is planned to hire specialists to carry out panel sensory tests.

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p. 62
p. 64

LABORATORIES AND SERVICES

TECHPARK SÜDTIROL / ALTO ADIGE

Laboratories and services of the Laimburg Research Centre which are part of the network of the NOI Technology Park.

The Laimburg Research Centre has numerous laboratories in various disciplines. With qualified specialist knowledge and state-of-the-art laboratory equipment, the experts at the research centre guarantee high-quality analytical support for many practical issues. In this way, laboratory results can be translated into practical application notes and companies can be supported in their development. Accredited laboratory methods and continuous further development of laboratory technology guarantee analyses at the highest level.

Laboratory for Virology and Diagnostics

The laboratory is mainly concerned with the diagnosis of known diseases of cultivated and ornamental plants caused by pathogens of various species such as bacteria, fungi, phytoplasms, viruses and viroids. Within the framework of the legally regulated health controls, the experts carry out the corresponding examinations on propagation material in fruit, wine and vegetable growing as well as in ornamental plant cultivation. Furthermore, the laboratory is entrusted by the Phytosanitary Service of the Autonomous Province of Bolzano – South Tyrol to perform phytopathological analyses within the framework of official phytosanitary controls by the Office for the Detection of Quarantine Diseases and Diseases with legally obligatory control. The experts use fast and reliable techniques to identify pathogens: depending on the pathogen, microbiological, serological and/or molecular biological methods are used.

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Laboratory for Molecular Biology

The laboratory investigates the genetic basis for breeding new varieties and undertakes research on apple proliferation. Molecular biological, biochemical and bioinformatic methods are used to identify the factors that influence this disease with the aim of developing innovative control strategies. The breeding of apple and grape varieties is also supported by the use of new technologies in the laboratory. By using molecular markers, those seedlings can be selected whose genetic predispositions come closest to the defined breeding objective. The laboratory also offers varietal authenticity testing for apple and grape varieties.

Opening hours:
Mo – Fr: 8.30 – 12 am, 2 – 4 pm

Thomas Letschka
Laboratory head
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Thomas.Letschka@laimburg.it

Laboratory for Wine and Beverages Analytics

The laboratory tests a wide range of chemical parameters on wine, grape must, distillates, fruit juices and grapes. The laboratory was recently equipped with a so-called FT-IR device ("Fourier Transformation Infrared"), which makes it possible to measure the most important parameters in the shortest time with minimal sample preparation. Free sulphur and total sulphur can also be determined. Every year, the laboratory carries out the grape ripening test, an important tool for farmers and wineries to monitor the ripeness of grapes and determine the optimal time for harvesting.

Accredited according to ISO/IEC 17025 since 2003.

Opening hours:
Mo – Fr: 8:30 – 12 pm, 2 – 4 pm

Eva Überegger
Laboratory head
+39 0471 969 584
Eva.Ueberegger@laimburg.it

Laboratory for Residues and Contaminants

In the laboratory, agricultural foodstuffs are tested for pesticide residues. Using common extraction methods, possible residues of pesticides (fungicides, insecticides, herbicides) are dissolved from the samples and analysed after purification on various laboratory instruments based on mass spectrometry coupled to gas chromatography (GC-MS) or liquid chromatography (LC-MS).

Accredited according to ISO/IEC 17025 since 2011.

Opening hours:
Mo – Fr: 8:30 – 12 am, 2 – 4 pm

Andrea Lentola
Laboratory head
+39 0471 969 572
Andrea.Lentola@laimburg.it

Laboratory for Flavours and Metabolites

This laboratory conducts scientific research in the fields of food quality and plant health. Using modern chemical methods, naturally occurring ingredients in agricultural products (apples, apple juices, grapes, wines, cheese, milk) and plant organs (leaves, roots, wood) are analysed to test their quality, characteristics and purity. The laboratory is equipped with state-of-the-art laboratory instruments such as GC-MS (gas chromatography) and LC-MS (liquid chromatography coupled to mass spectrometers) and the most common analysis techniques. It also has so-called high-resolution mass spectrometers for identifying new, unknown substances and a near-infrared device for non-destructive analysis.

This laboratory is located at NOI Techpark, Via A.-Volta 13/A, 39100 Bozen-Bolzano.

Opening hours:
on appointment only

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Laboratory for Soil and Plant Analysis

In the laboratory, nutrients in agricultural soils, plant material (leaves, buds, branches, roots, etc.), fruits, horticultural soil/substrates, composts, organic fertilisers, farm manures, mineral fertilisers and in irrigation water, are investigated. These analyses form the basis for ensuring an optimal supply of nutrients to the plants. To this end, modern chemical-analytical methods are used.

Accredited according to ISO/IEC 17025 since 2014.

Opening hours:
Mo – Fr: 8.30 – 12 am, 2 – 4 pm

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Laboratory for Fodder Analysis

The laboratory analyses the ingredients in hay, silage and concentrated fodder to ensure a balanced and efficient feeding of farm animals. In addition to the more complex and usually more time-consuming chemical analysis methods, the laboratory also uses near-infrared spectroscopy (NIRS), a non-destructive method for the quantitative determination of ingredients in animal feed.

Opening hours:
Mo – Fr: 8:30 – 12 am, 2 – 4 pm

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Meat products

The "Meat Products" working group of the Laimburg Research Centre was founded in 2019. The goal of this new area is to support the South Tyrolean meat-processing sector with scientific research so that local products can be promoted with innovations, processing processes can be optimised, and new products developed. The experts are concerned with how the quality of traditional South Tyrolean products can be maintained and further enhanced and how more and more stringent food regulations can be complied with.

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Fermentation and Distillation

The "Fermentation and Distillation" working group deals with the fermentation processes for the production and refinement of beverages or food and the investigation of distillates, fruit brandies and liqueurs. The team investigates food technology processes for the fermentation or distillation of agricultural products and develops or optimises processing protocols for the production of fermented fruit-based (cider), cereal-based (beer) and honey-based (honey wine) beverages. In addition, the experts are conducting trials to formulate new fermentation products and distillates.

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Fruit and Vegetable Processing

The "Fruit and Vegetable Processing" working group is concerned with product development and the improvement of food quality and safety, especially for processed fruit and vegetables. The aim is to improve the processing and shelf life of these foods. To this end, pilot plants are used for homogenisation (even under high pressure), drying at low temperature and for the production of juices and purees. The chemical-physical and microbiological stability of the food as well as the thermo-physical and mechanical properties of the individual ingredients and the end products are also examined.

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Sensory Science

The "Sensory Science" working group deals with the sensory and instrumental characterisation of food and the determination of consumer preferences. In order to describe the quality-determining properties of a food as precisely and objectively as possible, results from the sensory perception of trained test persons (appearance, smell, taste, mouth feel), physicochemical analyses and results from consumer tests are combined. The aim of these studies is to find out how production processes in the food sector can be changed and new products developed to meet the needs and requirements of consumers. Sensory science therefore plays an important role in product and process development, e.g. in food quality assurance, recipe development or market research.

Opening hours:
Mo – Fr: 8.30 – 12 am, 2 – 4 pm

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Enology

The task of the Enology research area is to support the wine sector of South Tyrol by means of applied research and basic research. To this end, the experts in this area continue viticultural experiments in the cellar, develop cellar technology processes, and offer advice and further technical training.
Because viticultural measures can influence the quality of the grapes, the experts investigate the relationship between viticultural measures and the wines' flavour profiles. This includes studies on varieties and cultivation sites and the testing of new grape clones with respect to wine quality.
The aim is to fully develop the quality potential of the grapes. That's why the experts in the cellar investigate how the ageing process can be optimised. The goal is to improve in particular the typicality and the mouth-feel, but also to extend the shelf life of the wines. To this end, numerous wines are aged, analysed chemically, and subjected to a sensory evaluation by the tasting commissions.

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Laboratory for Food Microbiology

In this laboratory the microbial status of food is characterised. The laboratory's various analyses are based either on the detection and quantification of a particular microorganism or on the determination of all germs in a food. The laboratory has relevant experience in the characterisation of microorganisms in wine, beer and other fermented beverages. Currently, the analyses are carried out using classical methods; in future, mass spectroscopically (MS) based proteomics will be used for the identification of microorganisms. MALDI-TOF mass spectroscopy (Matrix-Assisted Laser Desorption Ionisation, Time Of Flight) is of central importance for the identification of microorganisms. In the future, the laboratory's analyses will be extended to other typical South Tyrolean products like fruit, meat and dairy products.

Opening hours:
Mo – Fr: 8:30 – 12 am, 2 – 4 pm

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THE LAIMBURG WINERY

The Research Centre also operates the **Laimburg Winery**. Here, findings yielded by the Research Centre's activities in the field of viticulture and enology are pooled, enabling the production of our own high-quality wines. The range of wines includes all of the representative grape varieties of South Tyrol: Pinot blanc, Sauvignon blanc, and Gewürztraminer are the main varieties for white wines, Lagrein, Pinot noir, and Vernatsch for red wines. All of the grapes used come from the vineyards of the Laimburg agricultural estate. These consist of approximately 20 hectares of vineyards in various wine-growing areas and feature different soils and altitudes ranging between 200 and 750 m above sea-level.

Lines of wines

The approximately 90,000 bottles of quality wine bottled annually by Laimburg Winery – and which have repeatedly won important awards at professional tastings – are available in three quality lines:

The **"Estate Wines"** are traditional vintage wines typical of the grape variety and are aged in stainless steel or large oak barrels. In contrast, the wines of the **"Manor Selection"** are individual wines, mainly aged in oak barrels or select wines with names derived from the Ladin mythology of the Dolomites. The **"Special Wines"** include the Pustrissa (produced from the especially fungus-resistant Solaris grape variety), and also the Vernacius solemnis Kalterersee Auslese, whose special nature begins right in the vineyard: In the case of two-thirds of the grapes, the shoots are pruned, i.e., at harvest time, the main shoot is severed and the grapes are allowed to remain hanging on the vine for about another 10 to 14 days. This results in a natural drying of the grapes resulting in a greater concentration of characteristic substances in the must. Following this, the wine is allowed to mature in large wooden barrels.

The winery is a member of the **Tirolensis Ars Vini**, the Association of Quality Wineries of South Tyrol, which are committed to the highest quality as symbolised by the Tatzelwurm, a mythical dragon-like creature.

TIROLENSIS ARS VINI
Südtiroler Qualitätsweinhöfe
Viticultori Sudtirolesi

Laimburg
LANDESWEINGUT
PODERE PROVINCIALE CANTINA
PROVINCE WINERY

"Network wine": 3 wineries – 3 schools – 3 countries – 1 wine

The Laimburg Winery also cooperates with the Professional School for Fruit Growing and Viticulture Silberberg in the Austrian province of Styria and with the State Education and Research Institute for Viticulture and Pomology Weinsberg in the German state of Baden-Württemberg in the project **"Network wine,"** dedicated to product innovation. From the 2016 vintage, each winery created a high-quality Pinot Blanc. In Silberberg, the three Pinot Blanc wines were then blended and bottled in equal parts – the "Network wine" was thus born. With the idea of combining leading varieties from the three regions, further "Network wine" editions have been created from the 2017 and 2018 vintages.

The "Pinot Blanc MUSIS" project

The goal of this cooperation – which is to have a duration of ten years – between the Laimburg Research Centre and the Organization of South Tyrolean Provincial Museums is the dissemination of culture not only in the purely artistic sense, but also aspects of local culture and especially the tradition of wine-growing. To achieve this goal, a wine is to be produced each year in cooperation with the ten South Tyrolean provincial museums. Each vintage will be dedicated to a different South Tyrolean museum. The 2018 vintage was derived from Pinot Blanc grapes from the Schloss Tirol wine estate and is dedicated to the Schloss Tirol Provincial Museum for Culture and Provincial History. The 2019 vintage is dedicated to the South Tyrolean Museum of Mining.

The Stone Cellar

When, in the late 1980s, the Laimburg Winery was confronted with the necessity of obtaining additional space for storing its barrels and wine bottles, the decision was made to expand into the side of the nearby Mitterberg mountain. Thus, in 1989/90, about 4,000 cubic meters of rock were blasted from the mountain's red porphyry using 5,000 kg of dynamite. A barrique barrel and bottle-storage cellar offering a naturally constant ambient temperature was then established here. A vaulted room with 300 square meters of floor space was also built. It represents a unique example of both traditional and contemporary wine architecture and serves as a suitable venue for presenting the wine land of South Tyrol on official occasions.

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AWARD-WINNING WINES OF THE LAIMBURG WINERY IN 2018 AND 2019

	NAME OF THE WINE	AWARD	WINE GUIDE	YEAR OF AWARD
1	Laimburg "Auròna" 2014	The Wine Hunter Award – Meran Wine Festival	Meran Wine Festival	**2018**
2	Laimburg Cuvée "Col De Rév" IGT 2014	The Wine Hunter Award – Meran Wine Festival	Meran Wine Festival	**2018**
3	Laimburg South Tyrolean Pinot Blanc 2017	Best in variety	Unterland Wine-Tasting Festival	**2018**
4	Vernacius solemnis 2017	Golden Star	Vinibuoni d'Italia	**2018**
5	Laimburg South Tyrolean Sauvignon Blanc Riserva "Oyèll" 2015	Best 17 of 20	Vinum Europas Weinmagazin	**2018**
6	Laimburg South Tyrolean Lagrein Riserva "Barbagòl" 2015	Super tre Stelle	I vini di Veronelli	**2018**
7	Laimburg South Tyrolean Sauvignon blanc Passito "Saphir" 2016	3° miglior vino dolce d'Italia	I migliori vini d'Italia 2019 – Luca Marroni	**2018**
	Laimburg South Tyrolean Sauvignon Passito "Saphir" DOC 2016	Dolcissimo "Beste 8"	Vinoculti Meran Wine Festival	**2018**
	Laimburg South Tyrolean Sauvignon Passito "Saphir" DOC 2016	Super Tre Stelle	I Vini Veronelli	**2018**
8	Laimburg South Tyrolean Pinot Blanc "MUSIS" 2018	2 Bicchieri	Gambero Rosso	**2019**
9	Laimburg Cuvée "Col De Rév" IGT 2015	5 Grappoli	Bibenda	**2019**
	Laimburg Cuvée "Col De Rév" IGT 2015	The Wine Hunter Award	Meran Wine Festival	**2019**
10	Laimburg South Tyrolean Lagrein Riserva "Barbagòl" 2016	2 Bicchieri	Gambero Rosso	**2019**
11	Laimburg South Tyrolean Lagrein Riserva "Barbagòl" 2016	Tre Stelle Oro	I vini di Veronelli	**2019**
	Laimburg South Tyrolean Lagrein Riserva "Barbagòl" 2016	Best in variety	Unterland Wine-Tasting Festival	**2019**
	Laimburg South Tyrolean Lagrein Riserva "Barbagòl" 2016	Lagrein Trophy 93 Points	Falstaff	**2019**

The "Open-Access" strategy of the Laimburg Research Centre

In its Basic Principles, the Laimburg Research Centre has committed itself to conveying scientific knowledge to practical implementation, research institutes, educational facilities, and advisory agencies – but also to the general public – quickly and efficiently. To achieve this, the Laimburg Research Centre pursues an "Open-Access" strategy.

Open Access

"Open Access" is the principle of providing access – free of charge and without restriction – to scientific literature and research findings via the Internet. Research findings should be made accessible according to the FAIR principles (Findable, Accessible, Interoperable, Reusable), i.e., the published research data should be easily found, generally accessible, compatible, and reusable. In this way, science is made more democratic, more open, more efficient, and more transparent. By means of improved accessibility, new research findings can be used and put into practical application more quickly and efficiently.

In accordance with these principles, the researchers of the Laimburg Research Centre present their scientific articles whenever possible in publications (e.g., the **"Laimburg Journal"**) in the "open access" mode – i.e., they are freely available to all interested parties.

This not only promotes the exchange of information between research and practice, but also provides the general public with access to the findings yielded by publically financed research.

The "Open-Access" strategy

Laimburg Journal

The "Laimburg Journal" represents the Laimburg Research Centre's scientific publication medium. This open-access online periodical serves to transfer and disseminate information in the areas of agriculture and food sciences and all related fields. The journal publishes sound scientific information in the form of original papers and reports from a broad range of agricultural topics of relevance to South Tyrol. The publication's target audience includes professionals from the areas of research, industry, politics, education, and advisory, as well as interested laypersons.

Laimburg Journal

Publications appearing in 2018–2019

Total survey of publications of the Laimburg Research Centre in 2018 and 2019

The Scientific Library of the Laimburg Research Centre represents a service centre for the publication of research findings in the open-access mode. It is also the publisher of the "Laimburg Journal" open-access periodical.

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HIGHLIGHTS 2018

2018
The new corporate design of the Laimburg Research Centre becomes effective.

11.01.2018
The 65th South Tyrolean Fruit Growing Conference, Meran

22.–24.01.2018
Fruit Growing Seminar, Oberbozen

26.01.2018
The 56th South Tyrolean Wine Growing Conference, Eppan

04.06.2018
Visit by E.U. Commissioner for Health and Food Safety Vytenis Andriukaitis

09.06.2018
Night of the Cellar

02.07.2018
The Laboratory for Flavours and Metabolites moves into its new facilities at the NOI Techpark in South Bozen.

15.07.2018
Open-Door Day at the Laimburg Botanical Facility

18.07.2018
Fruit Growing Technology Day

25.09.2018
Wine harvest of the historic Versoaln grape at the Katzenzungen Castle, Prissian

20.03.2018
The "Food Microbiology" research area begins using a MALDI-TOF mass spectrometer.

23.03.2018
Commencement of a new series of events in the area of food technology: "NOI at the Laimburg Research Centre – The laboratories present themselves"

06.04.2018
Workshop on drift-reduction technology in the area of pesticides

07.05.2018
Presentation of the XVII Network Wine

03.08.2018
Fruit Storage Conference

07.08.2018
Presentation of current wine growing experiments, Piglon

09.08.2018
Presentations in ecological agriculture

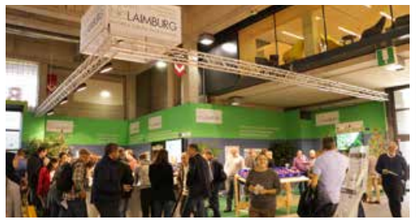
24.08.2018
Wine and Grape Day, Kaltern Winery

27.10.2018
Conference on Aromatic Plants, Meran

15.11.2018
Official presentation and launch of the "Frudistor" application for detecting storage damage

15.–17.11.2018
The INTERPOMA International Apple Trade Fair, Bozen Trade Fair

27.–28.11.2018
Wine Growing Seminar, Oberbozen



HIGHLIGHTS

2019

10.01.2019
The 66th South Tyrolean Fruit Growing Conference, Meran

18.01.2019
Pomologist Walter Guerra elected to be among the top ten most-important persons in the area of Italian fruit growing.

21.–23.01.2019
Fruit Growing Seminar, Oberbozen

01.02.2019
The 57th South Tyrolean Wine Growing Conference, Eppan

14.02.2019
The Laimburg Research Centre launches its own open-access publication, the Laimburg Journal.

06.03.2019
Workshop on the "Effects of Pesticides on Bee Health"

15.03.2019
2019 Expert Forum on Mountain Agriculture, Salern

29.03.2019
2nd edition of the new series of events on research in the area of food technology: "NOI at the Laimburg Research Centre – Report of the laboratories.

09.05.2019
The Laimburg Research Centre provides information on new findings pertaining to the apple proliferation disease.

22.05.2019
Presentation of the "Smart Land South Tyrol" project for optimised irrigation in the area of fruit and wine growing

27.05.2019
National Conference on Mass Spectrometry, NOI Techpark

02.04.2019
Presentation of the new Pinot blanc MUSIS

04.04.2019
Laimburg's apple variety breeding programme: Results handed over to South Tyrolean fruit farmers.

14.07.2019
Open-Door Day at the Laimburg gardens

13.06.2019
Wine Growing Technology Day

02.08.2019
Fruit Storage Conference

07.08.2019
Presentation of current wine growing experiments, Ölleitenhof

08.08.2019
Presentations in ecological agriculture

22.08.2019
Wine and Grape Day, Bozen Winery

07.10.2019
Conference on the "Action Plan for Research and Training in Mountain Agriculture and Food Sciences," Dietenheim

27.09.2019
LUNA Research Late-Night Event, Bozen

22.11.2019
Information event on the "Marmorated Stink Bug"

22.11.2019
Wrap-up event on the REBECKA Interreg project

26.–27.11.2019
Wine Growing Seminar, Oberbozen

04.12.2019
Wrap-up event on the AppleCare Interreg project

Versuchszentrum
Centro di Sperimentazione
Research Centre
LAIMBURG
NATURE & SCIENCE: HAND IN HAND

FACTS & FIGURES

348

projects and **activities** have been carried out by Laimburg Research Centre in 2019.

301

presentations have been given by experts from Laimburg Research Centre in 2019, both in Italy and abroad.

71,424

sensory parameters were measured and analysed by the Enology research area of Laimburg Research Centre during tasting tests in 2019.

56

project collaborators who worked in 2018 and 2019 on third-party funded projects at Laimburg Research Centre.

171

publications by Laimburg researchers were published in 2019.

36

third-party funded projects were supervised in 2018 and 2019.

286

guided tours were held in 2018 and 2019 at Laimburg Research Centre.

15

Number of countries with which Laimburg Research Centre collaborates in EU projects

≈ 95,000

Quantity of wine bottles produced in a year by Laimburg Winery

≈ 60,000

bottles of wine are stored in the **wine archive** of the Stone Cellar at Laimburg Winery.

48,580

wine glasses were poured in 2018 and 2019 during wine tastings in the Stone Cellar.

330

barrels are stored in the Stone Cellar at Laimburg Winery.

3,735

individual insects have been tested for transmitting the Apple proliferation pathogen.

96

intestinal contents of psyllids have been analysed to search for host plants other than apple trees for the transmission of the Apple proliferation pathogen.

166

apple varieties are protected in the physical gene bank at Laimburg Research Centre.

≈ 20

years are needed to complete the genetic improvement of a new marketable apple variety. At least.

Research for Practice LAIMBURG JOURNAL

1,500

web pages were visited on average every month in the Laimburg Journal

395

new apple varieties from all over the world are being tested by the "Pomology" working group.

155

people have been at Laimburg Research Centre in 2018–2019 to complete an internship or work on their thesis.

4

times in 2019 the frost-protection sprinkling system had to be activated at Laimburg.

1,928

prick test lancets have been jabbed into the forearms of allergic volunteers in order to develop an innovative and natural therapy against birch pollen allergy by eating apples.

51,164

samples were analysed by the laboratories of the Institute of Agricultural Chemistry and Food Quality in 2018 and 2019.

15,000

hybrid apple varieties are currently to be found in the orchards of the apple variety breeding programme of the Laimburg Research Centre.

69

cages are used in the laboratories of the "Plant Protection" research area for breeding the Asian bug.

41

locations at which the Brown Marmorated Stink Bug was identified.

≈ 1,000

insects were collected by the public and deposited at the Research Centre. A good example of Citizen Science. Thanks!

Colophon

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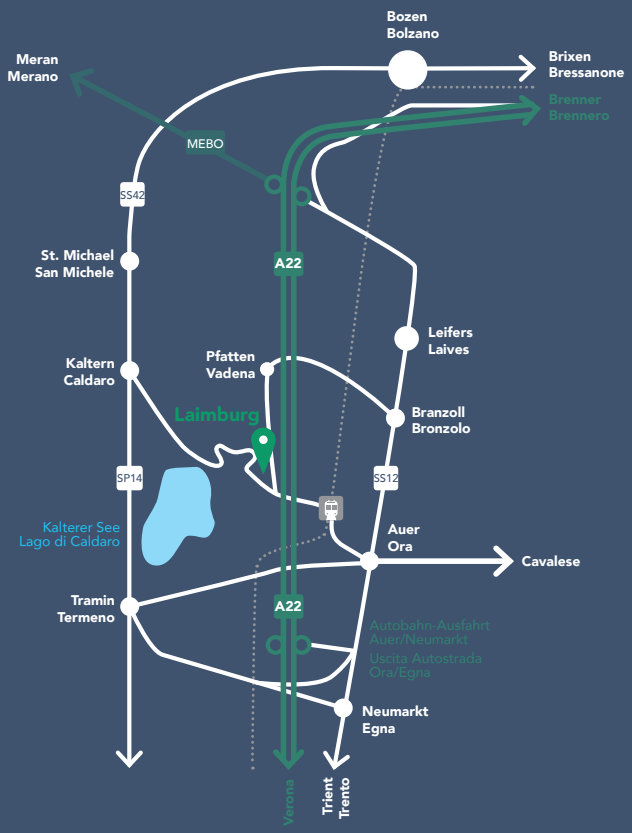
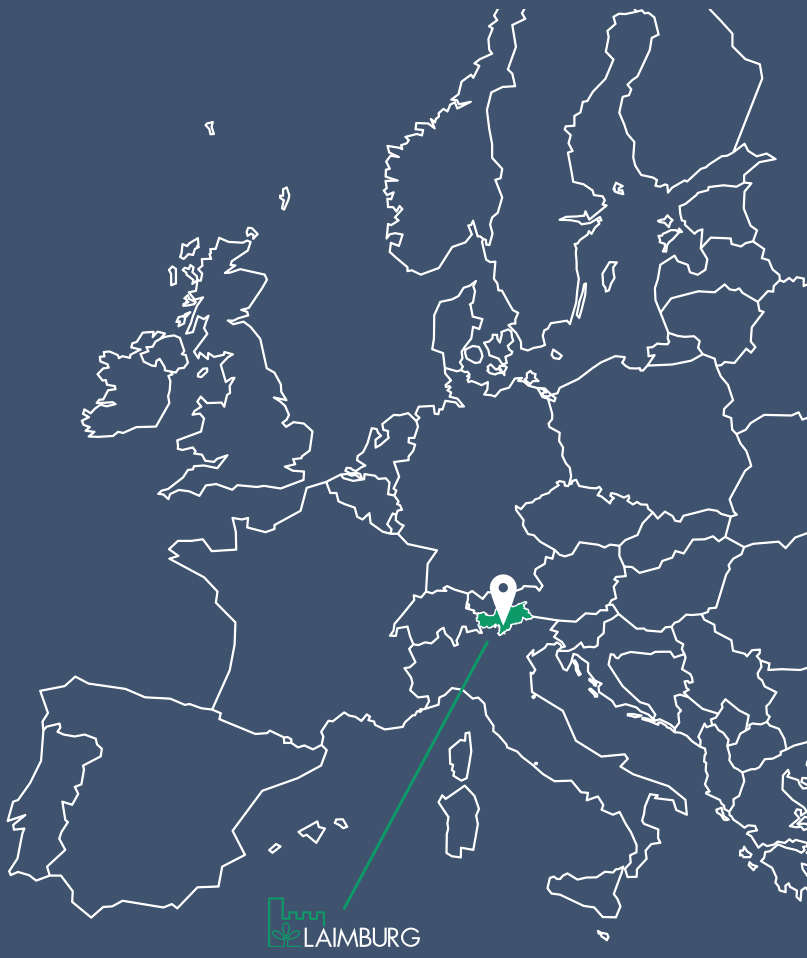
THE LAIMBURG RESEARCH CENTRE IS THE RESEARCH INSTITUTION FOR AGRICULTURE AND FOOD QUALITY IN SOUTH TYROL.

The **Laimburg Report** provides basic information about mission and tasks, history and organisational structure of the research centre and gives an overview of current research projects and new scientific findings.





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