EN

Versuchszentrum
Centro di Sperimentazione
Research Centre

LAIMBURG

NATURE & SCIENCE: HAND IN HAND

LAIMBURG REPORT

2020 -2021

RESEARCH AND INNOVATION

INDEX

1 FOREWORD

Dear Readers,

Laimburg Research Centre is the leading research institute for agriculture and food processing in South Tyrol. Our goal is to support South Tyrolean agricultural businesses, family farms and food processing companies with scientifically sound **experimental and research** activities and so to help secure the quality of agricultural products and boost the competitiveness of commercial enterprises. On our experimental fields, in our laboratories, and in our offices, more than **200 employees work on approximately 350 projects and activities per year**, pertaining to all areas of the South Tyrolean agricultural sector, from fruit growing, viticulture, and mountain agriculture to food processing and product innovation. We thus cover the entire food production chain, from cultivation all the way up to the finished product, and can develop quickly implementable solutions for immediate and future challenges.

To meet the wide variety of challenges we can expect in the coming years, the Department for Agriculture, Forestry, Tourism, and Public Safety developed the „LandWIRtschaft 2030" („2030 Agriculture") strategy paper. This paper established goals and action guidelines for the large agricultural sectors of South Tyrol – fruit-growing, viticulture, and mountain farming – valid until the year 2030. In this strategy paper, the protection of family-run farms and the sustainable development of agriculture in South Tyrol have been assigned the highest priority.

Laimburg Research Centre is an active component of the „LandWIRtschaft 2030" strategy. Thus, its project on „**Biological control of the Brown Marmorated Stink Bug in South Tyrol**" contributes to the action field of "Biodiversity & Landscape" set forth by the strategy paper. In this context, the center's scientists make use of the natural antagonist of the Brown Marmorated Stink Bug – an egg parasitoid called the Samurai Wasp (*Trissolcus japonicus*). The preliminary data and findings indicate that the Samurai Wasp could be a successful component in dealing with this insect pest. *S. 56*

The „**Wood-Up**" EFRE project is a joint project carried out in collaboration with the Free University of Bozen / Bolzano, and is part of the action field of „Climate & CO2-Reduktion" of the „LandWIRtschaft 2030" strategy. In it, scientists of Laimburg Research Centre and the Free University of Bozen / Bolzano examine the effects of biochar on soil fertility in the area of fruit and wine-growing and assess its suitability for the long-term sequestration of carbon dioxide in soil. Biochar is a form of carbonized biomass derived from plant matter and is suitable for agricultural use. It is produced by subjecting biomass to heat under low-oxygen conditions and must not contain any toxic substances. *S. 26*

The scientists conduct trials to determine the effects of biochar in the soil of vineyards on growth and yield.

In accordance with the strategy paper, Laimburg Research Centre has also conducted numerous discussions with representatives of the South Tyrolean agricultural and food processing sector and thus elaborated its own ten-year strategy: The **2021-2030 Research Focus Program** serves as a guide and compass for aligning the experimental and research activities of Laimburg Research Centre with actual needs. Between 2021 and 2030, the activities will concentrate on a total of five key topics. The key topic „**Sustainable and Resilient Cultivation Systems**" concerns the development of sustainable and demand-oriented cultivation techniques to unlock the full potential of nature. The projects and activities of the „**Digital Innovation and Smart Technologies**" key topic utilize digitalization and modern breeding methods to make cultivation and processing fit for the future. The goal of the „**Climate-Neutral Agriculture**" key topic is to adapt cultivation techniques and foods processing methods to the challenges of climate change and to make them more climate-friendly. The use of innovative methods to produce safe and healthy food products in South Tyrol is the goal of the „**Quality and Health**" key topic. The „Local Diversity and Circular Economy" key topic has the task of valorizing regional mountain products and establishing a supra-regional recycling economy.

One example in the „Local Diversity and Circular Economy" key topic is the „**CirBeer**" project. The goal of this project is the development of baked goods on the basis of brewers grain (the malt residues left over from beer production). Until now, brewers grain was usually disposed of as a waste product or used as animal fodder. However, its high content of dietary fiber and proteins makes it very attractive for use as an additive to enhance the nutritional value of foods. At Laimburg Research Centre, food tasters have evaluated cake, cookies, and focaccia made using brewers grain. The resultant findings provided interesting insights into the suitability of brewers grain as an ingredient to enhance the nutritional value of baked goods and the possibility of recycling brewers grain. *S. 38*

The „Digital Innovation and Smart Technologies" key topic also includes the "**Image Analysis of Starch Degradation Patterns for the Objective Determination of the Ripeness of Stone Fruit**" project. Scientists participating in this project are developing a digital method, based on digital image analysis, to measure the starch content of apples. Image analysis has the advantage of being objective, and is intended to replace visual assessment – which, while reliable, is nonetheless subjective. The determination of the degree of ripeness is important in predicting the opening of the harvest window and determining the proper harvest time. After all, it has a major influence on successful storage. *S. 40*

We are proud to present this biannual scientific report to you and believe that it will provide you with an in-depth view of our **2020-2021 experimental and research activities** and their results.

Arnold Schuler
Provincial Councilor for Agriculture, Forestry, Tourism, and Public Safety

Michael Oberhuber
Director of Laimburg Research Centre

We wish you exciting reading!

2 LAIMBURG RESEARCH CENTRE

Our mission

Laimburg Research Centre is the research center for the **South Tyrolean agricultural and food processing sectors**. We are a legal entity, dependent on the Autonomous Province of Bozen / Bolzano.

Through scientifically sound experimentation and research, we develop **know-how, solutions to problems, and future-oriented innovations** for the South Tyrolean agricultural and food processing sectors. With the research and experimental activities and the laboratory analyses we offer, we are able to help secure the continued development of local agricultural holdings.

We transmit our knowledge directly to our **target groups** via extension services. Our target groups are South Tyrolean agricultural and food processing companies; research, training, and consulting organizations; agricultural and food industry associations; and the general public.

Our Programme of activities

We coordinate our program of activities in Advisory Board meetings with representatives from the South Tyrolean agricultural and food processing sectors on an annual basis. This ensures that our research and experimental program directly addresses the real needs of agriculture and food processing in South Tyrol.

Every year, our more than 200 employees work on approximately 350 research and experimental projects pertaining to all areas of South Tyrolean agriculture.

We focus on the following specific **areas of cultivation**: fruit and wine growing, vegetables, berries and stone fruits, herbs, arable crops, and grassland management. We develop sustainable management strategies to make more efficient use of natural resources, such as water, soil, biodiversity, and the climate. Based on our profound understanding of biological mechanisms, the proper use of plant protection products, the use of digital technologies, and by breeding and testing robust varieties and rootstocks, we promote **sustainable and resilient cultivation systems**.

Our goal is to cover the entire food production chain, from cultivation all the way up to the finished product. This enables us to develop innovative methods that companies can use to produce **food products of guaranteed quality and origin**. To make full use of the appeal of regional alpine products, we promote the diversity of high-quality products from South Tyrol's mountain regions and collaborate on the development of regional recycling systems.

In our specialized laboratories, we perform **reliable analyses** for research projects as well as services for private entities.

From research to practical applications:

As an application-oriented research facility, we attach great importance to **quickly and efficiently circulating our research findings to agricultural practices and local companies**.

This is why we disseminate new research and scientific findings to our target groups through consulting organizations, schools, lectures, practical demonstrations, and workshops, as well as through publications and our own Open Access Online Journal **www.laimburgjournal.it** .

We inform our stakeholders and the general public in an application- and target group-oriented manner via print media, radio, online media, at events, and via our website (**www.laimburg.it**)

27.260
laboratory analyses

378
research projects and experimental activities

234
lectures

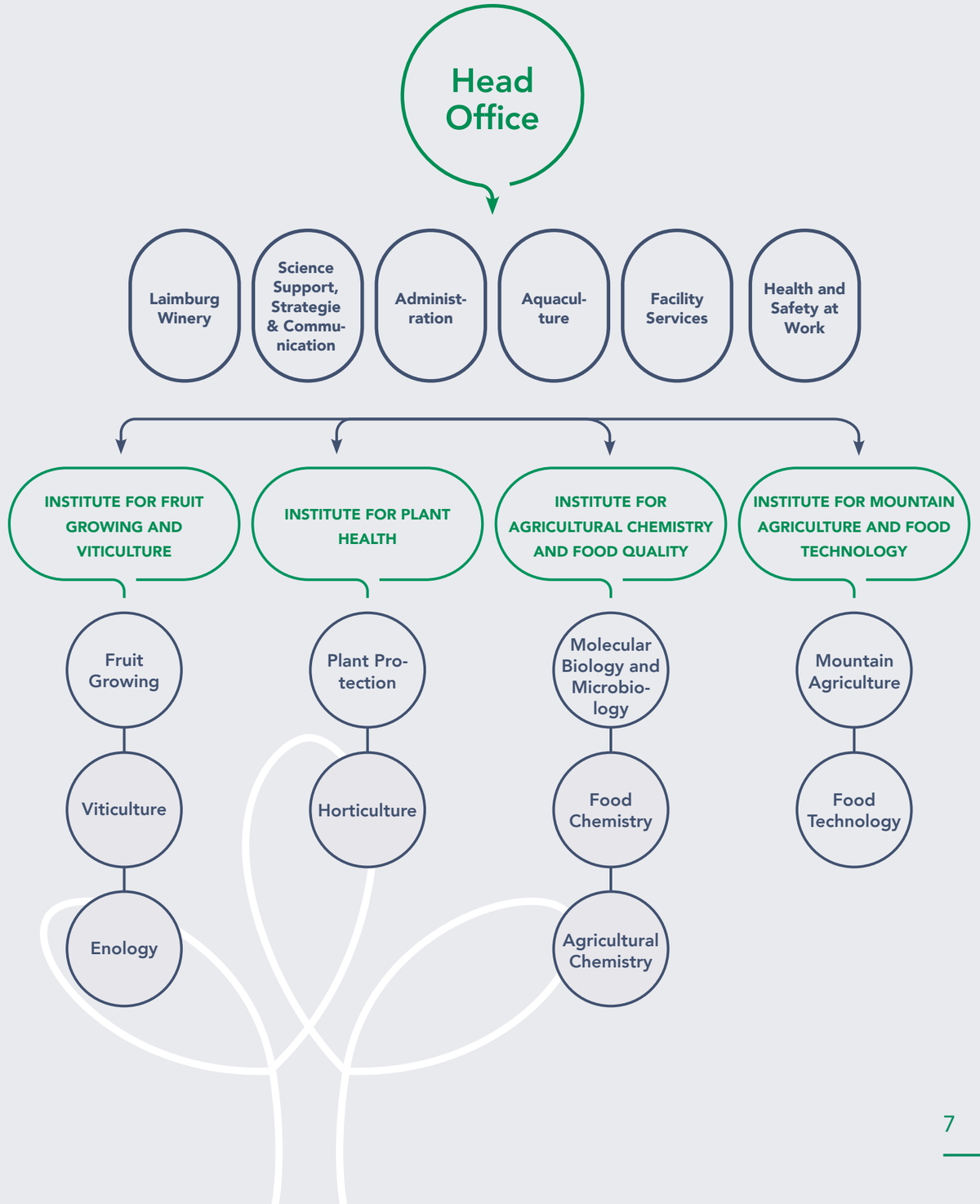
206
publications

199
guided tours through the center

13
articles in the Laimburg Journal

ORGANISATIONAL CHART

as of 01.01.2022



3 ...
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 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 stone cellar

1990
Construction of a field office in Oris (Eyrs) for research into vegetable growing, 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
Opening of the Molecular Biology Laboratory and establishment of the Gene Bank

since 2003
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.

2011
Establishment of the Laboratory for Flavours and Metabolites

2012
Start of construction of a new laboratory building on the site of the former Stadlhof Farm followed by the discovery of an Iron Age settlement with some of the earliest evidence of wine production in South Tyrol: grape seeds dating back 2,400 years.

2014
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.

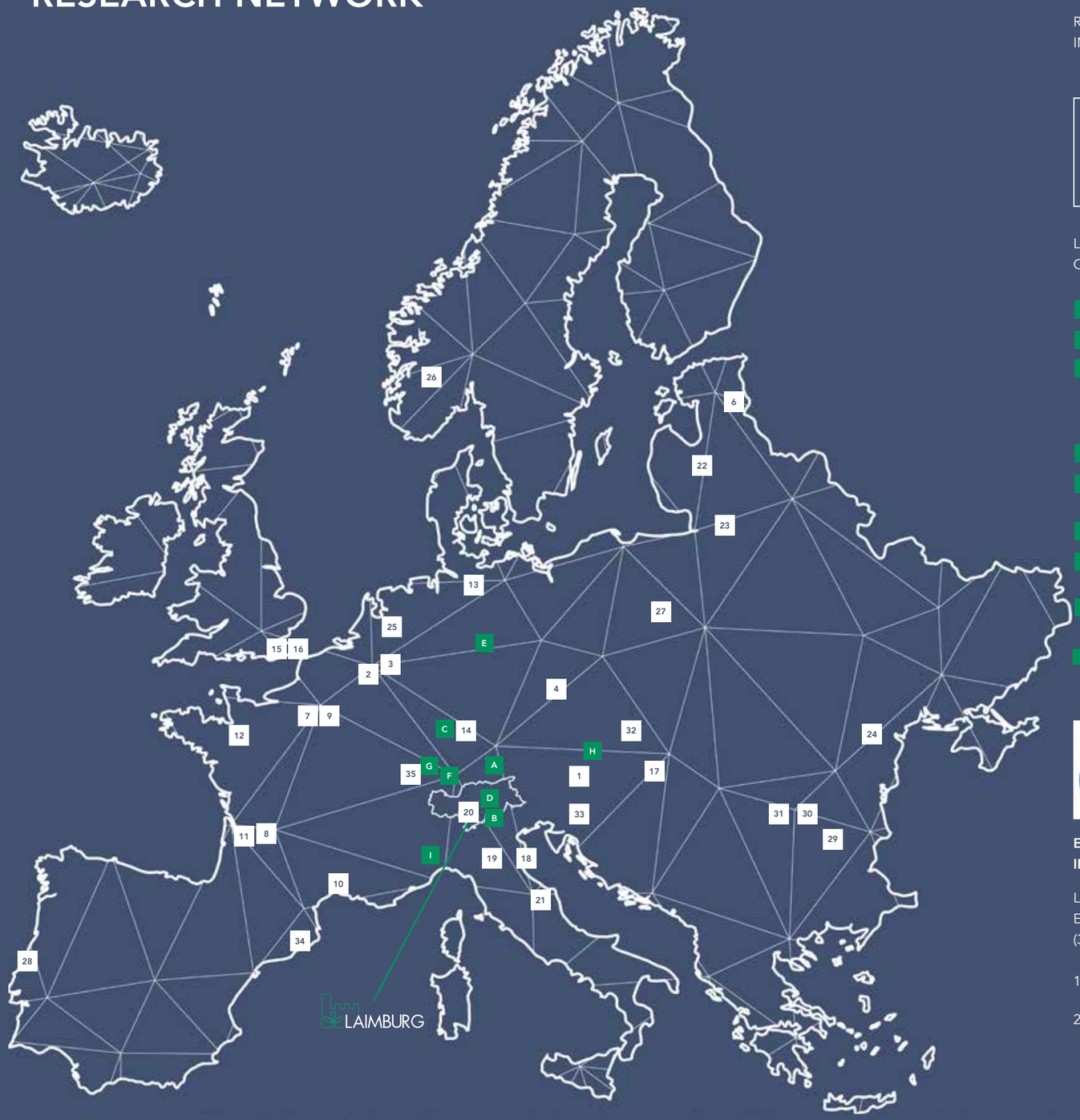
2015
The South Tyrol provincial government adopts the "2016–2022 Action Plan for Research and Training in the areas of Mountain Agriculture and Food Sciences".

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.

4 . . .
RESEARCH NETWORK



LAIMBURG

RESEARCH PARTNERS OF LAIMBURG RESEARCH CENTRE IN SOUTH TYROL

Free University of Bolzano
Eurac Research
Fraunhofer Italia
Eco Research GmbH

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** Kloserneuburg 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).

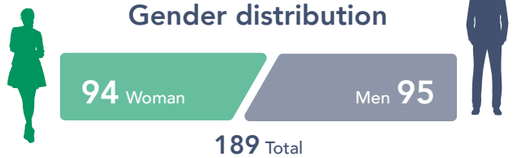
1. Versuchsstation für Obst- und Weinbau Haidegg; Graz, Austria
2. CRA-W, Department of Life sciences, Unit Breeding and Biodiversity, Wallon Agronomical Research Centre; Gembloux, Belgium
3. Research Center for Fruit Growing (pcfruit vzw); Sint-Truiden, Belgium
4. Research and Breeding Institute of 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-Mă¬răcineni, 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. Kompetenzzentrum für landwirtschaftliche Forschung Agroscope; Posieux, Changins, Reckenholz, Switzerland

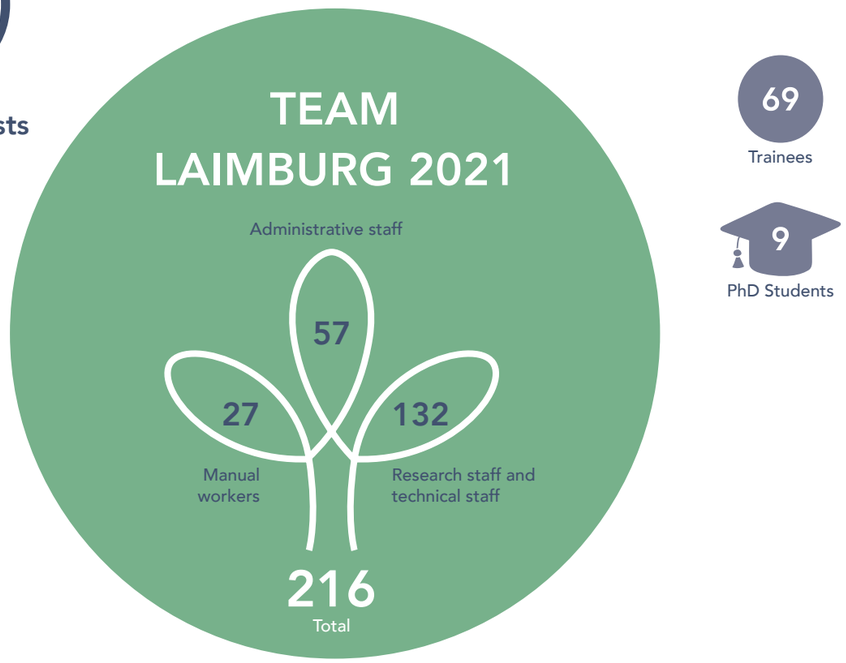
5 ... TEAM & BUDGET

Part-time posts

Research, technical and administrative Staff

Gender distribution

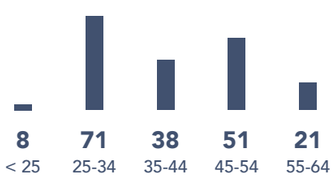




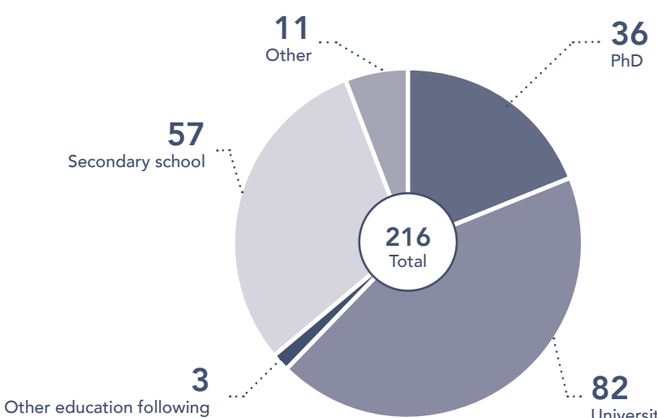
69
Trainees

9
PhD Students

Age distribution



Education

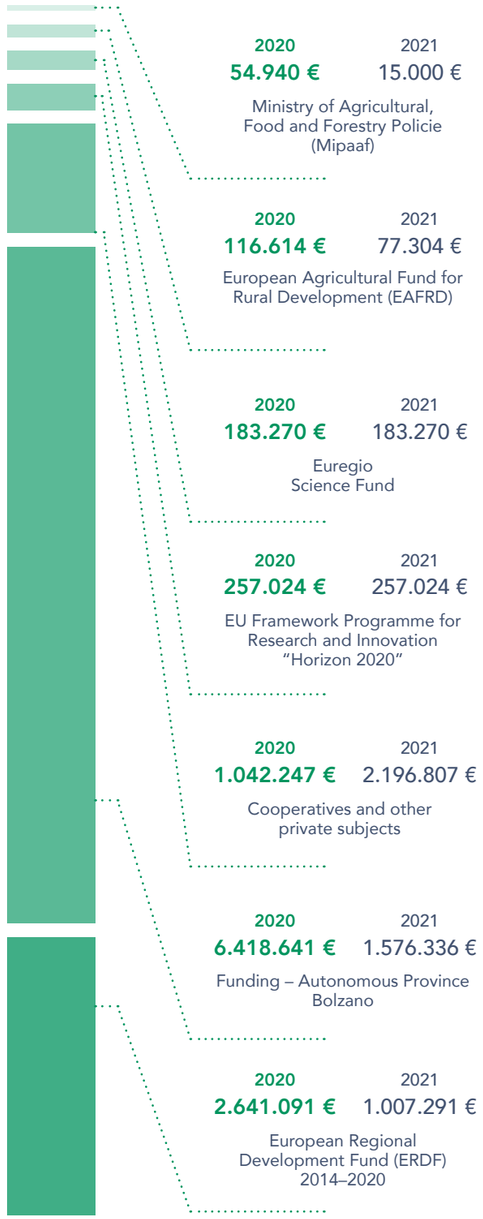


THIRD-PARTY FUNDS

Total budget of all current third-party funded projects*

2020
€ 10.713.826

2021
€ 5.313.031



2020 54.940 € | 2021 15.000 €
Ministry of Agricultural, Food and Forestry Policie (Mipaaf)

2020 116.614 € | 2021 77.304 €
European Agricultural Fund for Rural Development (EAFRD)

2020 183.270 € | 2021 183.270 €
Euregio Science Fund

2020 257.024 € | 2021 257.024 €
EU Framework Programme for Research and Innovation "Horizon 2020"

2020 1.042.247 € | 2021 2.196.807 €
Cooperatives and other private subjects

2020 6.418.641 € | 2021 1.576.336 €
Funding – Autonomous Province Bolzano

2020 2.641.091 € | 2021 1.007.291 €
European Regional Development Fund (ERDF) 2014–2020

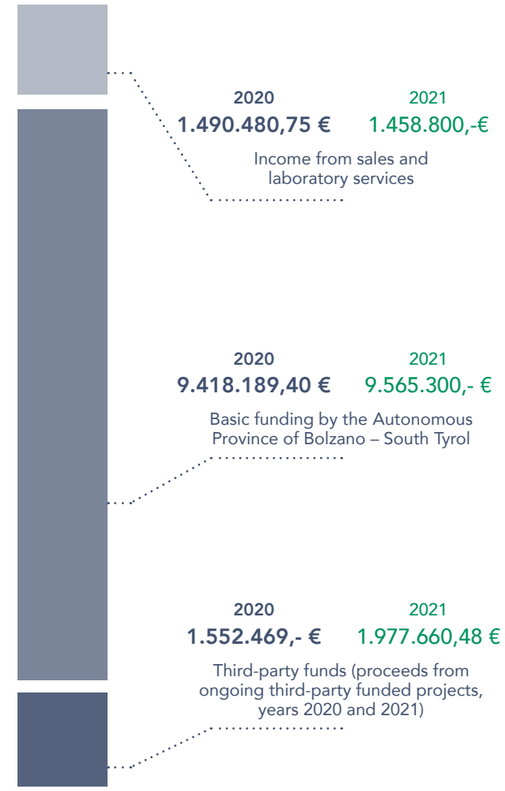
*If several project partners are involved, only the share of Laimburg Research Centre is included.

FUNDING 2020 - 2021

Balance Sheet Laimburg Research Centre

2020
€ 12.461.139,15

2021
€ 13.001.760,48



2020 1.490.480,75 € | 2021 1.458.800,-€
Income from sales and laboratory services

2020 9.418.189,40 € | 2021 9.565.300,- €
Basic funding by the Autonomous Province of Bolzano – South Tyrol

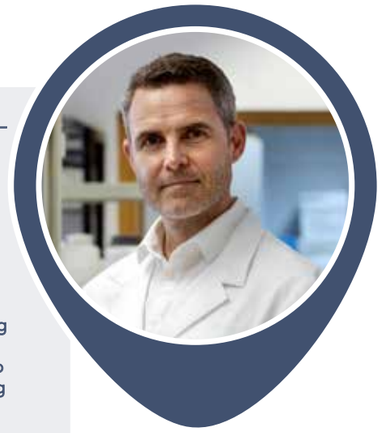
2020 1.552.469,- € | 2021 1.977.660,48 €
Third-party funds (proceeds from ongoing third-party funded projects, years 2020 and 2021)

PROFILES

Gabi Oberhöller

Coworker in the Library working group

- I studied Library, Media, and Information Management in Stuttgart.
- I've been working at Laimburg Research Centre since 2018 and am responsible for the publication of our own online scientific periodical, the Laimburg Journal. My responsibilities encompass the entire range of activities, from proofreading to the layout all the way up to creation and publication of the finished HTML and PDF versions of the submitted articles.
- Special highlights of the 2020/2021 season: In my case, it's always a highlight when I finally get to upload the finished article and can then notify the author that the article is now online.
- I was especially proud of the publication of the first issue of the Laimburg Journal. That was when the results of months of preparation were finally made visible; it was also when my work really started.
- The thing I like most about my work at Laimburg Research Centre is that it's never routine. Each article we process represents a new challenge.



Thomas Letschka

Head of the Institute for Agricultural Chemistry and Food Quality and head of the "Breeding Genomics" working group

- I studied Microbiology at the University of Innsbruck.
- I've been working at Laimburg Research Centre since 2006 and since 2021 I am the head of the Institute for Agricultural Chemistry and Food Quality. At the same time, in the „Breeding Genomics" working group, I am concerned with molecular-biological methods of breeding varieties.
- For me, the special highlights of the 2020/2021 season were the establishment of the new laboratory for NMR Spectroscopy, the expansion of our portfolio of accredited analyses, the award for „Scientific Article of the Year," and – for me personally – my appointment as new head of the institute in 2021.
- I am especially proud of the fact that – despite two difficult years due to the Corona pandemic – we succeeded in maintaining the high standard of our research activities and our range of services.
- The one aspect of my work at Laimburg Research Centre which I most appreciate is that we have the opportunity to deal with practice-oriented issues using cutting-edge technologies in state-of-the-art labs.

Alfredo Mora-Vargas

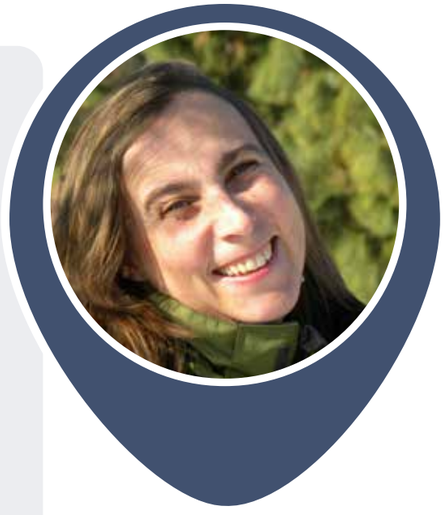
Project coworker in the "Organic farming" working group at the Institute for Fruit Growing and Viticulture

- I studied Agrarian Sciences at the University of Turin.
- I've been working at Laimburg Research Centre since 2019 and am responsible for the "BIOFRUITNET – Boosting innovation in organic fruit production through stronger networks" project. This project focuses on the organic production of pome fruits, stone fruits, and citrus fruits and has the goal of boosting the competitiveness of organically grown fruit production in Europe. The objective is to collect and collate existent scientific and practical knowledge on ecological fruit cultivation to be disseminates throughout the E.U. via more accessible formats like e-learning, podcasts, videos, and short articles. The project is also intended to strengthen already established networks in the field of ecological fruit-growing and forming connections between them to stimulate the exchange of know-how between organic fruit producers and various interest groups.
- For me, one special highlight in 2021 was the conference in Bari where the findings of two years of research were presented. Together with the invited actors, the most innovative results and best practices in the field of ecological fruit-growing were determined.
- I was especially proud of the fact that, thanks to the participation of organic producers and consultants, we were able to reveal the strengths of ecological fruit growing – but also its weaknesses. Thus, we were able to determine where more research was needed to close existent gaps.
- What I like most about my work at Laimburg Research Centre? The investigations and research activities of the different work packages making up this project. Besides that, I really enjoy my work in my working group "Organic farming".

Sabine Öttl

Head of the "Phytopathology" working group and deputy head of the Institute for Plant Health

- I studied Biology with a focus on Molecular Biology at the Leopold-Franzens University in Innsbruck. Afterwards, I earned a PhD at the Technical University Dresden.
- I've been working at Laimburg Research Centre since 2006 (with a 3-year interruption working in the private sector), and I am responsible for the „Phytopathology" working group since 2017. I am chiefly concerned with fungal pathogens in the field of fruit- and winegrowing. Activities include the identification and genetic characterization of pathogens, the determination, and description of symptoms as well as of infection conditions, epidemiological studies in the field, and studying the impact of storage. Using microbiological and biomolecular methods, I study the genetic and biological foundations of fungi and thus, I can contribute to improving our understanding of diseases and the development of preventive strategies.
- For me, one special highlight of the 2020/2021 season was the identification of *Venturia asperata* and a *Colletotrichum* species on apple. Both fungal species were then detected for the first time in South Tyrolean apple orchards. Thanks to the impassioned work of my group, the determination of these fungi was possible within only a few weeks after the appearance of symptoms in the field. In the last two years, my team has made me especially proud because my coworkers showed an exceptional level of enthusiasm both with respect to agricultural practice and research!
- The aspect of my work at Laimburg Research Centre that I most appreciate is that I can pool my long-term practical experience in the field of fruit- and wine-growing, my sound education, and my passion for science – while helping to shape and advance South Tyrol's agriculture.



Lorenza Conterno

Head of the "Food Technology" research area at the Institute for Mountain Agriculture and Food Technology

- I studied Biology at the University of Turin, followed by a PhD in Biology and Fungal Biotechnology, also in Turin.
- I've been working at Laimburg Research Centre since 2017 and am the head of the „Fermentation and Distillation" working group as well as the head of the „Food Technology" research area. This research area is concerned with the application of modern processing techniques in food production with a focus on the region of South Tyrol. The „Fermentation and Distillation" working group investigates how these two processes can be used to introduce new products and processing techniques.
- For me, one special highlight of 2020 was the publication of a study in an international journal on a beverage made from fermented honey. This shows that studies on local niche products, too, can generate international interest. In 2021, the hiring of a researcher from India in the framework of the CIRBEER project was of special importance as it represents a step towards the greater internationalization of Laimburg Research Centre. Furthermore, it marked the beginning of our research activities in the area of circular economy.
- I am particularly proud of the fact that the number of contract research projects and other research projects in cooperation with commercial enterprises in our research area has risen. For me, this is evidence of the trust which local companies place in Laimburg Research Centre's applied research activities in the food sector. I am also proud that many young researchers are interested in our research area and want to gain experience in the area of applied research.
- I am especially pleased that my work at Laimburg Research Centre offers me the chance to work in teams with interdisciplinary research groups and that we receive so much support from the administration, support, and communication teams. In my opinion, this is all the formula for success enabling us to work in a dynamic field and promoting unconventional thinking. That's because this is of fundamental importance for the innovation process and also for the careful of natural resources.

6 PROGRAMME OF ACTIVITIES

Info

More than two out of every three external proposals are implemented

In 2021, approx. 78% of the proposals submitted by various organizations were integrated in some fashion in the Research Centre's program of activities.

Balancing science and actual practice

This is how Laimburg Research Centre's activity program comes about

Laimburg Research Centre carries out more than 350 projects and activities per year. But who actually decides which topics will be addressed in the annual research program?

The Research Centre's program of activities is elaborated and defined in late summer of every year in close coordination with the Centre's stakeholders. Already in the following year, Laimburg Research Centre is thus able to solve concrete problems and concerns of the practice by conducting research and experimentation.

STEP 1 SUGGESTIONS FOR POSSIBLE PROJECTS AND ACTIVITIES

As an institute in the field of applied research, 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 130 representative organizations of the South Tyrolean agricultural and food processing sectors to present their issues to research and to submit proposals for research projects. 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

In late summer 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 Laimburg Research Centre and the local representatives of the South Tyrolean agricultural and food processing sector come 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 prioritized.

A PRIORITIZATION

- Projects and activities already carried out by the Research Centre
- Projects currently "on hold" which are urgently in need of being continued
- Proposals which can be integrated into activities or projects already in progress

B PRIORITIZATION

Proposals for projects and activities which are to be implemented in the following year, e.g., because they should develop solutions to combat current outbreaks of agricultural pests.

C PRIORITIZATION

Proposals which are worthy of being implemented but which, for various reasons (lack of funding, insufficient experimental fields, unavailability of fundamental knowledge, personnel bottlenecks) cannot be implemented at present.

D PRIORITIZATION

Proposals which cannot be implemented in this form or for which no project of its own is considered necessary or meaningful.

Advisory Board

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

→

Scientific Advisory Board

Priority
A
B
D
B
C

→

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

realisable

not realisable

Fig.1: Prioritization of project proposals

STEP 3 SCIENTIFIC ADVISORY BOARD

The prioritizations established in the Advisory Board meetings are then presented in the autumn to the Scientific Advisory Board of Laimburg Research Centre to obtain feedback.

STEP 4 PROGRAM OF ACTIVITIES FINALIZED

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

The agreed-upon research program is then published on the Research Centre's website.

7 . . .

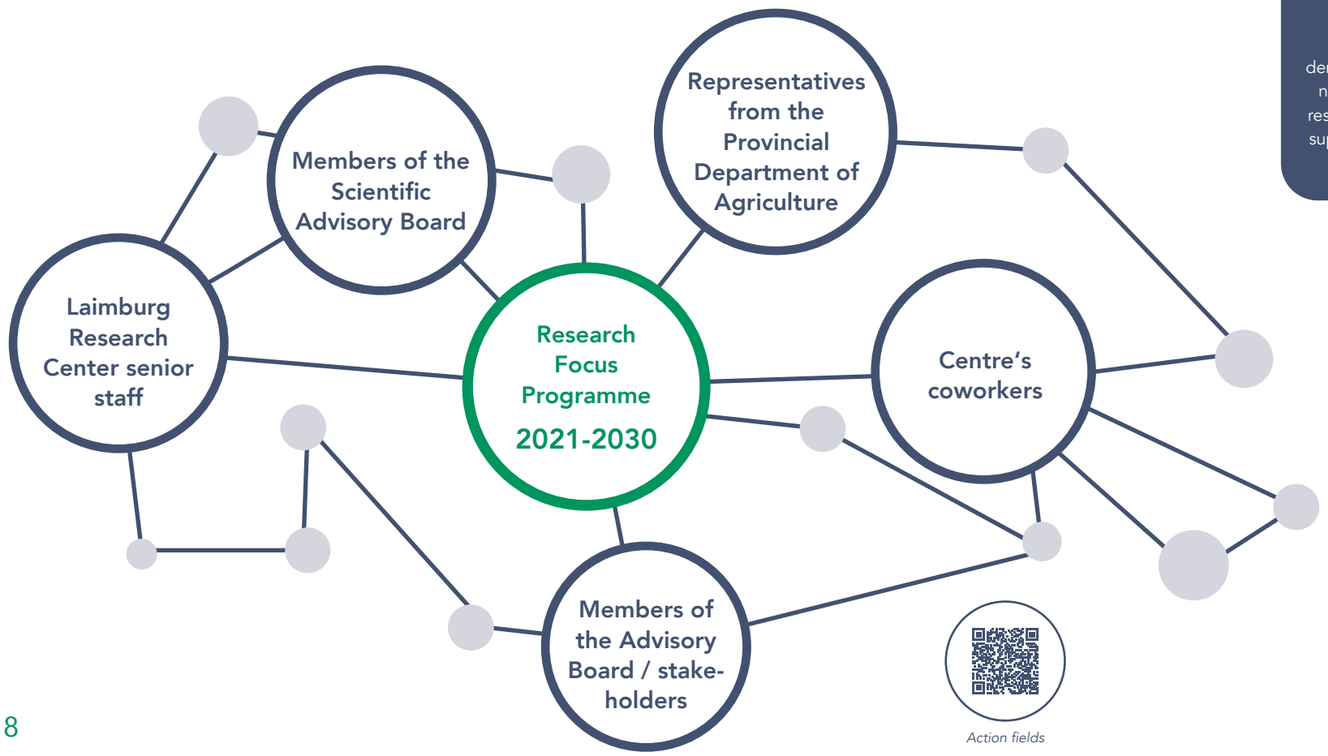
THE 2021-2030 RESEARCH FOCUS PROGRAM

Climate change, drought, diversification and digitalization are some of the challenges that South Tyrol's agriculture and food processing companies will have to face in the coming years. For this reason, Laimburg Research Centre has drawn up a Focus Programme up to 2030, which groups its research activities into five major key topics.

The creation process – a participatory approach

Developing a ten-year program is no easy task. For this reason, Laimburg Research Centre undertook in a two-year-long process to include a wide range of **internal and external stakeholders**. The goal was to collect as much information as possible on the major challenges and topical issues facing South Tyrol's agricultural and food sectors and then to determine which of those issues Laimburg Research Centre is capable of directly addressing.

In several workshops, the Centre's coworkers identified the major challenges for the next ten years in their individual fields. Parallel to that, the Centre's senior staff, representatives from the Provincial Department of Agriculture, and members of the Advisory Board and the Scientific Advisory Board zeroed in on possible topics with a view towards finding an overall strategic approach for the Centre and identifying major international trends.



Action fields

. . . FIVE KEY TOPICS

SUSTAINABILITY
ecological & economic

Sustainable and Resilient Cultivation Systems

Unlocking nature's full potential

We develop sustainable and demand-oriented cultivation techniques to protect and preserve resources and biodiversity, and to support agricultural businesses in the Alpine region.

Digital Innovation and Smart Technologies

Developing future-oriented cultivation and processing techniques

We implement digitalisation and modern breeding technologies into actual practice.

Climate-Neutral Agriculture

Developing cultivation and processing methods that are more climate-friendly

We develop agricultural practices with a smaller climate footprint and higher carbon capture rate, and we adapt cultivation methods to future climate conditions.

Quality and Health

Safe and healthy food products from South Tyrol

We develop innovative methods which companies in South Tyrol can employ to produce food products of certified quality and origin.

Local Diversity and Circular Economy

Valorising regional mountain products

We promote the diversity of high-quality mountain products and ensure that they are utilised in a (supra-)regional circular economy.

8 ...

RESEARCH PROGRAMS AND THIRD-PARTY FUNDED PROJECTS

Action Plan for Mountain Agriculture and Food Science

The "Action Plan for Research and Education in Mountain Agriculture and Food Sciences" adopted by the government of South Tyrol was launched in 2016, and will continue until the end of 2022. Laimburg Research Centre and the Free University of Bozen-Bolzano have been commissioned to implement this project, and their activities are flanked by other institutions working for South Tyrolean agriculture.

The aim of the action plan is to scientifically accompany the primary food products of South Tyrol's mountain agricultural sector not only during their cultivation, but also during their processing into typical high-quality South Tyrolean products, thus making them more competitive.

In the area of mountain agriculture, research focuses on arable crops, the cultivation of herbs and vegetables, on berries and stone fruit, and on the dairy industry and grassland farming. In the area of food processing, activities concentrate on the production of jams, juices, distillates, flour, baked goods, as well as on bacon and sausage products.

Details on the results of the action plan

Info

22
positions in eight different working groups at Laimburg Research Centre were filled thanks to the action plan.

86
projects and activities are currently in progress at Laimburg Research Centre in the framework of the action plan; 13 have already been completed.

30
Research activities encompass more than 30 different crops, including Bread Clover, Flax, Raspberries, Apricots, Sweet Cherries, Chestnuts, Cauliflower, Artichokes, Beer Barley, and Lemon Balm.

Info

20
coworkers in four different working groups were hired at Laimburg Research Centre in the framework of Capacity Building I and II.

54
projects and activities have been conducted as part of the programs Capacity Building I and II at Laimburg Research Centre.

20
Laimburg Research Centre has provided scientific support for more than 20 different products, including fermented vegetables, pureed chestnuts, honey wine, apple champagne, red beet juice, beer, apricot spirits, and bacon.

6
different labs at Laimburg Research Centre were established and expanded in the framework of Capacity Building I and II.

Capacity Building I and 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 (*Capacity Building I 2013–2020*). In this context, Laimburg Research Centre has established research capacities in the areas of food processing, food safety, food chemistry, and food traceability for the NOI Techpark. It is thus able to offer companies support along the entire food production chain.

In a second program (*Capacity Building II 2018–2021*), the established research capacities were further developed and the labs completed. Thus, the new Lab for Sensory Science was set up and new research projects were launched.

Breeding and release of the Samurai Wasp for the biological control of the Brown Marmorated Stink Bug

Since 2016, the Brown Marmorated Stink Bug (*Halyomorpha halys*) has been observed in South Tyrol, too. This invasive species comes from Asia, and is responsible for considerable damage in the South Tyrolean fruit production. The so-called Samurai Wasp (*Trissolcus japonicus*), which is also native to Asia, is a natural antagonist of H. *halys*: This very small species of wasp parasitizes the eggs of the Brown Marmorated Stink Bug. Releasing it could therefore represent a suitable control strategy.

In May of 2020, Laimburg Research Centre was tasked with breeding and releasing the Samurai Wasp. Already in the summer of 2020, the Research Centre's coworkers released this parasitoid in South Tyrol in order to promote its establishment in this region.

Initial findings indicate that this small wasp succeeded in surviving over the winter at different locations. In both release years – 2020 and 2021 – this natural antagonist successfully attacked the egg clutches of the Brown Marmorated Stink Bug.

Info

2021
In 2021, more than 12,700 Samurai Wasp individuals were released at 40 different sites in South Tyrol.

45%
At 45% of these sites, it was possible to observe the Samurai Wasp several months after being released.

74
of the egg clutches of the Brown Marmorated Stink Bug that were parasitized by the Samurai Wasp were found at the release sites.

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REPORTS FROM THE INSTITUTES

Irene Höller
"Pomology" working group

Walter Guerra
"Pomology" working group

SUITABLE POLLINATION COMBINATIONS OF NEW APPLE VARIETIES

One basic prerequisite for the production of high-quality apples is the effective pollination of the blossoms. Apples are dependent chiefly upon cross-pollination. Controlled cross-pollination is carried out in order to determine suitable combinations of varieties. On the basis of data compiled also at the Laimburg Research Centre since 2002 by the "Varieties and Rootstocks" working group for apples and pears in the framework of EUFRIN (European Fruit Research Institutes Network), data on suitable pollen donors for new apple cultivars is being constantly collected (**Table 1**).

Controlled pollination

The blossoming branches of the female varieties are covered with cotton bags in the balloon stage in order to prevent cross-pollination. When full flowering is reached, the dried pollen of the male varieties is applied to the stigmas of the female plants (**Fig. 1**). The fruit set rate represents the ratio of developed fruits to pollinated flowers, and is used to determine the pollination success: A fruit set rate of 0 to 5.9% is classified as "poor," of 6.0 to 9.9% as "moderate," and of more than 10% as "good." At least two test years are necessary in order to define the suitability of a pollen donor for a new variety.

Pollination results

In the case of 75% of the trials, a fruit set rate of almost 30% - which is characterized as "good" – was recorded (**Fig. 1**). Cross-pollinations with "poor" fruit set showed rates averaging less than 3% and produced significantly fewer seeds. In the case of "moderate" and "good" fruit set rates, the mean seed number (number of seeds per apple) was virtually identical (5.8 versus 5.9).

Using the results of the pollination combinations, suitable pollen donors were determined for several different apple varieties (see selected values in **Table 2**). The point in time of flowering was divided into five categories: "early," "medium early," "medium," "medium late," and "late." Pollen donors and recipients should not differ from each other by more than two flowering time categories.

Conclusion

The efficiency of a suitable pollen donor is dependent upon both the genetic disposition and the point in time of flowering of the pollen recipient. It must be taken into consideration that the quality of the flower bud, the activity of the pollinating insects, and the weather conditions during flowering can impact the fruit set rate and the quality of the developing fruits. A low seed number as a consequence of a low pollination rate can increase the June fruit fall or result in asymmetrical fruits. In the case of larger areas planted with varieties unable to optimally pollinate each other, crabapples are often the first choice as pollen donors. Such decorative apples usually feature resistance to diseases, a slim tree structure, and abundant flowering. Crabapples often carry allele S26, which no cultivated apple possesses; this indicates good pollination performance.

Site	Years	No. of pollination combinations
Laimburg Research Centre (I)	2002-2019	391
Agroscope Research Institute (CH)	2002-2015	106
Jork Fruit-Growing Center (D)	2002-2014 and 2016-2018	309
pcfruit Fruit Growers (BE)	2013 and 2018	16

Table 1: Overview of tial data, disaggregated by site and year

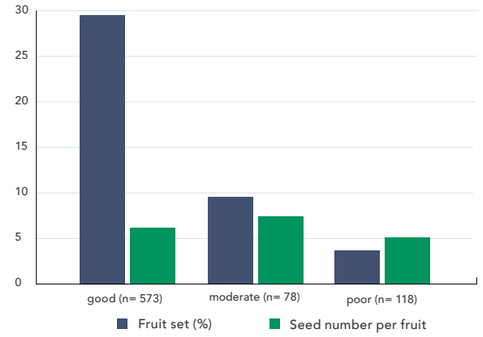

Fig. 1: Mean value of fruit set and number seeds per fruit depending on pollination success based on a total of 769 pollination trials by the Eufrin working group

SUITABLE POLLEN DONOR (GREEN = SCAB-RESISTANT, USUALLY RVI6=VF)

VARIETY	Braeburn (mf)	CIVG198 Modi* (f)	*Evereste (f)	Gala	Golden Del. (m)	*Golden Gem (f)	Granny Smith (mf)	*IF 31 (mf)	*Prof. Sprenger (f)	Red Del. (mf)	Topaz (mf)
Bonita (mf)			■					■			
CIVG198 Modi* (f)	■		■	■			■	■	■		■
Civni Rubens* (m)	■		■	■		■	■		■	■	■
Coop 39 Crimson Crisp* (mf)		■	■								
Cripps Pink / Pink Lady* (f)									■		
Cripps Red Joya* (m)			■	■	■		■		■		
Fengapi Tessa* (m)			■	■	■		■		■		
Galmac (mf)									■		
Lb 4852 (mf)				■	■		■		■		
Lb 17906 (f)		■	■								
MC 38 Crimson Snow* (m)			■	■	■		■		■		
Nicoter Kanzi* (mf)			■	■	■	■	■		■	■	
Scifresh Jazz* (f)			■	■	■	■	■		■	■	
Scilate Envy* (mf)	■		■	■	■	■	■		■	■	
Shinano Gold yello* (msp)	■		■	■	■	■				■	
SQ 159 Natyra* / Magic Star* (mf)		■	■					■			■
Y 101 Kissabel* (msp)			■								

Table 2: Suitable pollen donors for current apple varieties. Flowering time at Laimburg site: f=early, mf=medium early, m=medium, msp=medium late, sp=late

* Crabapples

Barbara Raifer
"Viticulture" research area

FERTILE SOILS AND LONG-TERM DETERMINATION OF CARBON USING BIOCHAR

Vegetable coal was determined to be a main component of the centuries-old, fertile soils of the Amazon. Coal has a very high microporosity and corresponding surface area and thus constitutes an excellent storage medium for minerals and water. It has a carbon content of up to 95% and, depending upon how it is manufactured, is decomposed only slowly. Coal thus binds carbon on a long-term basis.

Biochar

Coal suitable for agricultural purposes is produced under very specific conditions and must not contain any toxic substances. To distinguish it from ordinary coal, we therefore refer to it as „vegetable coal" or „biochar."

Biochar is obtained from vegetable matter subjected to heat under low-oxygen conditions. Char is also a byproduct of wood gasification. The goal of the Wood-Up Project (European Fund for Regional Development, 2014–2020) was to determine the extent to which biochar might be suitable for use in fruit growing and viticulture.

Methods

The following variants were established in two vineyards:

(1) Cont.: the untreated control;
(2) Comp.: 3.9 kg of compost per m^2;
(3) BC1: Biochar 2.5 kg/m^2;
(4) BC2: Biochar 5 kg/m^2;
(5) BC1 Comp.: BC1 with compost;
(6) BC2 Comp.: BC2 with compost.

In the commercial vineyard, the proper amounts of additives were calculated per m^2 of standing room; in the new vineyard, they were calculated per running meter of row of vines; the additives were then applied and worked into the soil. The experimental vineyards were not irrigated and received only minimal fertilizer. In a new apple orchard, besides an untreated control area, one variant with 1.8 kg of pure compost and a further variant with the same quantity of compost and 1 kg of biochar was established. These additives were applied into the tree pit and slightly mixed with the soil there. The apple parcel was cared for, regularly fertilized, and irrigated as customary in the area.

Soil, leaf and fruit analyses, growth and yield measurements, wine production, and wine quality evaluations were carried out.

Findings

In all variants with biochar, a remarkable enhancement of the soils with minerals, a pronounced rise in pH values, an increase in cation exchange capacity (Fig. 1), and a rise in carbon concentration were observed. In all test vineyards, the concentrations of mineralized nitrogen remained at an unchanged low level compared to the control. No changes in vegetative development or yield were observed. The musts and wines likewise showed no differences. On the other hand, in the new apple orchard, in the second and third year, a significantly higher formation of shoots in the biochar variant (Fig. 2) and higher yields (Fig. 3) were determined.

Outlook

Biochar promotes growth and yield when it is applied together with nitrogen. In this case, the effect is usually much greater than when using the same quantity of nitrogen without biochar. To utilize biochar in a sustainable fashion, corresponding production facilities should be developed regionally.

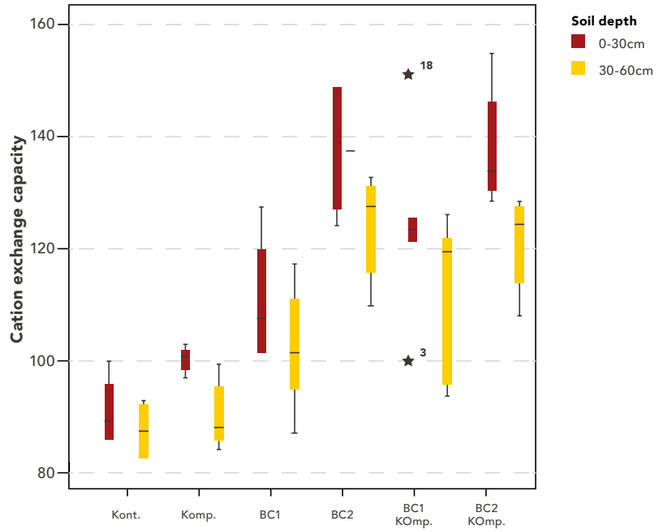

Fig. 1. Cation exchange capacity in the young test vineyards in the year 2020

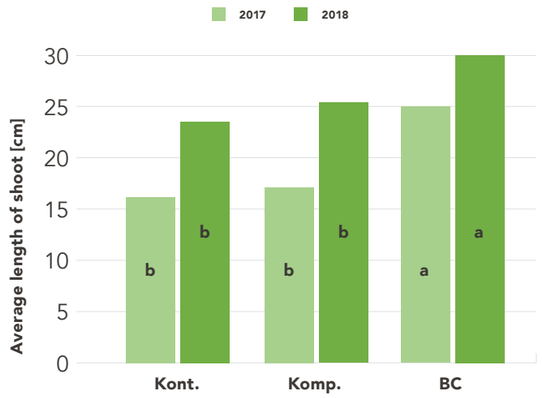

Fig. 2. Average length of shoots of young trees

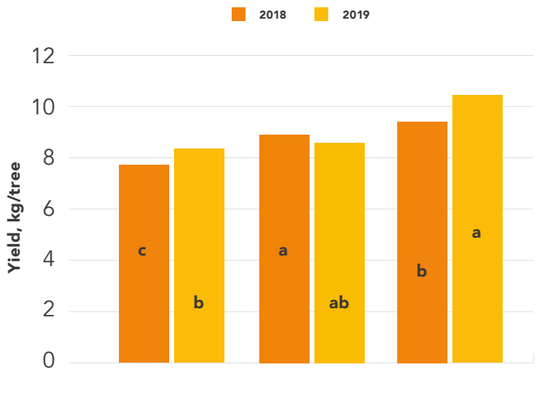

Fig. 3. Yield per tree in 2nd and 3rd year

Info

Additional information on the EFRE Wood-Up Project

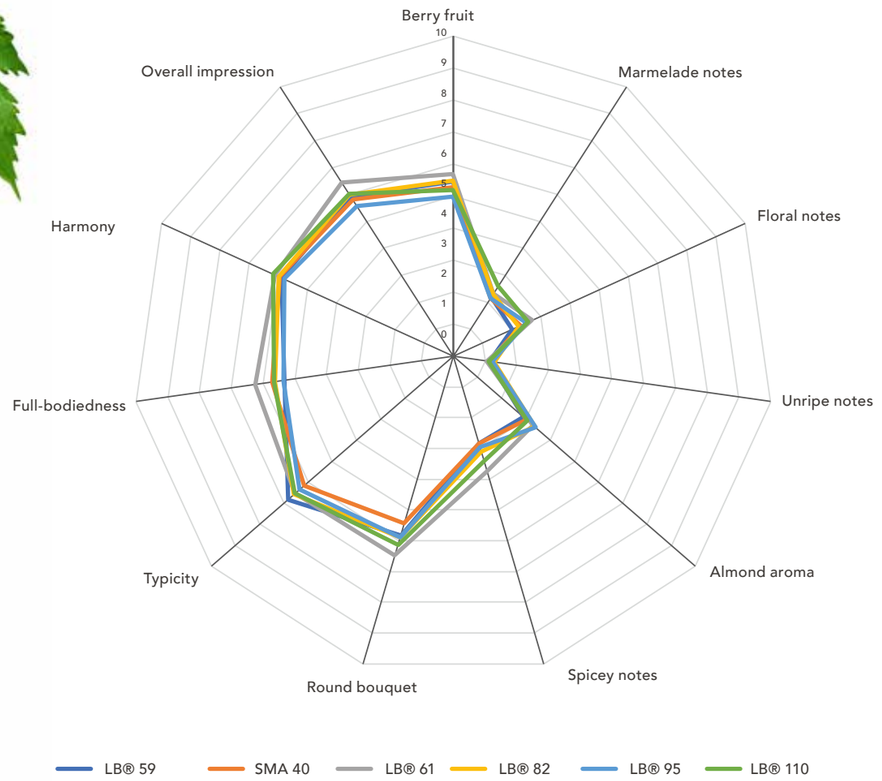

Fig. 1: Comparison of the Vernatsch clones

Christoph Patauner
"Vinification and Viticultural Issues" working group

Josef Terleth
"Grapevine Varieties and Propagation Material" working group

FOUR NEW LAIMBURG EDELVERNATSCH CLONES HOMOLOGIZED

Investigations on the preservation of the South Tyrolean grape variety Vernatsch

Recently, a project which can be traced back to the late-1980s, was successfully concluded. In the context of extensive selection work in old South Tyrolean Vernatsch vineyards, more than 300 individual planting stocks were reproduced. After thorough testing, in the summer of 2020, four new Edelvernatsch clones were homologized and entered into the National Registry of Grape Varieties.

For years, the amount of acreage in South Tyrol under cultivation with the Vernatsch variety has been declining. Laimburg Research Centre thus wished to preserve the biodiversity of this typical South Tyrolean grape variety. The goal was to filter out suitable biotypes from the gene pool which had been selected back then – biotypes which meet the modern quality requirements. Besides its ability to adapt to different terroirs and its affinity for various different grape rootstocks, special attention was paid also to the suitability of its vine clones for wire frame training. Traditionally, Vernatsch is trained on pergolas. Extensive investigations at Laimburg Research Centre have shown that Vernatsch is also suitable for wire frame training. Besides clones and rootstocks, the investigations focused also on vine pruning and different spacing.

Analysis of wine quality

Another important aspect in clone selection is grapevine health. Only healthy vines – i.e., vines which are free of infection with the most important vine viruses and phytoplasmas – come under consideration.

Nevertheless, the decision for or against cloning a particular biotype is ultimately dependent upon the corresponding wine quality. For this reason, the grapes of the clones under investigation are vinified according to a standard procedure, subjected to analytical and sensory testing, and compared with already approved clones in a years-long process.

Result: Four homologized Laimburg clones

In the context of this extensive selection work, the following clones were homologized at Laimburg Research Centre:

Lb® 61

A small-berry clone with a very good sugar production and good acid content. When trained in trellises in a high-quality terroir, this clone has a potential yield of approx. 100 dt/ha. This wine is characterized as somewhat rich in tannins and more intense than wines from the standard clones.

Lb® 82

This clone has noticeably larger berries and smaller clusters – similar to the SMA 40 clone. This clone displays good sugar production. In this study, the potential yield of this clone amounted to about 90 dt/ha. With regards to wine quality, too, clone Lb® 82 is comparable to the standard clones.

Lb® 95

Clone Lb 95 displays small berries and good sugar production. The acid content and the yield are both on the level of Lb® 59. The wine quality of this clone is somewhere between that of the standard clones and clone Lb® 61.

Lb® 110

This clone has a certain similarity to clone SMA 40. It has small clusters and larger berries. The yield is comparable and had a mean value of about 90 dt/ha. The wine quality, too, was described as being similar to that of the reference clone.

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"Berries and Stonefruit"
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Michael Gasser
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Massimo Zago
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INTERCROPPING IN STRAWBERRY CULTIVATION – INITIAL FINDINGS IN THE MARTELL VALLEY

The principle of intercropping (mixed cultivation) is based upon the simultaneous cultivation of different plant species on the same acreage. In doing so, one obtains a main crop and a secondary crop (**Fig. 1**). Ideally, intercropping makes it possible to better exploit limited soil resources; at the same time, the absorption of nutrients can be improved and economically interesting effects achieved.

Materials and methods

This two-year investigation was carried out in Gand in the municipality of Martell (South Tyrol). The strawberry plants (Elsanta, type WB-Waiting Bed) and different complementary plants were transplanted in May of 2020 in a double row on raised beds under tunnel conditions, adopting an intercropping system and a monoculture.

The rows were divided up into parcels, each consisting of 18 strawberry plants (50,000 plants per hectare) and nine plants of each complementary crop (25,000 plants per hectare) (in a ratio of 2:1). In order to be able to compare this system with a crop grown in monoculture, separate parcels were also established exclusively with strawberry plants or with the given complementary crop. All strawberry plants were treated in pre-flowering with sulfur to limit the spread of powdery mildew..

Results

Generally, intercropping combinations did not increase the marketable yield of strawberry plants (**Table 1**). The only exception was a combination of strawberries and peppermint (+10% increase in yield). In all other combinations, the decline in yields can be attributed to the competitive effect between the different crops. This applies also to the usually smaller yield of the secondary crops. Peppermint and chives represented the only exception, insofar as their yields increased by 20 to 40% with practice of intercropping as compared to monoculture.

Using the parameter of "Land Equivalent Ratio" (LER), production results can be examined in greater detail. The LER indicates the relative surface area which would have to be cultivated in monocropping in order to achieve the same yield as in intercropping. As **Table 2** indicates, all plant combinations – except for strawberry and calendula – had an LER of more than 1; this indicates a more efficient utilization of soil in intercropping systems.

Leaf analyses showed that some intercropping variants promoted the absorption of specific nutrients by the strawberry plants. The strawberry leaves grown in combination with peppermint or oregano displayed, e.g., a higher nitrogen content (+10%) and phosphorus content (+20%).

A reduction of harmful mites on strawberry leaves was observed when intercropped with peppermint, lavender, chives, thyme, and oregano (**Table 3**). This finding can be attributed to the release of volatile bio-active compounds which serve to repel harmful mites.

Conclusions

The yield from the intercropped strawberry plants is generally lower in most combinations. However, net commercial proceeds can be increased by the sale of secondary crop products. Furthermore, the role of the farmer as a manager and caretaker of biodiversity must be underscored. Future investigations into intercropping practice will be carried out at Laimburg Research Centre.

These	Marketable yield (g/plant)	Non-marketable quality yield (g/plant)			Total yield (g/plant)	Ø weight (g/fruit)
		too small	deformed	rotten		
Strawberry only	**268,2**	**69,72**	**57,44**	**1,54**	**396,9**	**13,0**
+ Calendula	216.3	64.97	36.13	3.32	320.7	12.4
+ Chives	167.4	41.82	32.37	1.56	243.1	13.1
+ Lavender	252.4	35.33	52.81	1.88	342.4	14.2
+ Lemon balm	270.2	45.20	38.42	0.00	353.8	13.7
+ Mint	293.1	44.21	52.90	8.01	398.2	14.4
+ Oregano	186.0	27.56	37.14	5.29	256.0	13.4
+ Winter savory	191.8	61.43	50.40	4.93	308.6	13.5
+ Thyme	217.6	31.56	45.52	0.33	295.0	13.0

Fig. 1: Effects of intercropping on strawberry plants in comparison with monoculture.

These	LER
Strawberry only	**1.00**
+ Calendula	0.80
+ Chives	1.63
+ Lavender	1.33
+ Lemon balm	1.20
+ Mint	1.75
+ Oregano	1.14
+ Winter savory	1.20
+ Thyme	-

Fig. 2: Land Equivalent Ratio (LER) of intercropping combinations

These	% harmful mites
Strawberry only	**-**
+ Calendula	-27%
+ Chives	-31%
+ Lavender	-8%
+ Mint	-53%
+ Oregano	-70%
+ Winter savory	+26%
+ Thyme	-26%

Fig. 3: Effect of intercropping on incidence of harmful mites on strawberry leaves in comparison with monoculture.

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"Berries and Stone Fruit"
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SWEET CHERRIES IN SOUTH TYROL: THE CHOICE OF VARIETIES AS THE BASIS FOR QUALITY PRODUCTION

In order to raise their profile in comparison with other cherry cultivation areas in Italy, South Tyrolean cherry growers are striving to provide the market with especially high-quality fruits. This can be achieved only by means of modern cultivation systems and very high-quality varieties. The particular topographical and climatic conditions prevailing in South Tyrol allow growers to naturally delay ripening of the fruit. In this way, South Tyrol is able to market its fruits later and thus "evade" competitors from the early-growing Italian cultivation areas in Apulia, Campania, Veneto, and Emilia Romagna. In doing this, a special cultivation and marketing strategy is pursued: The choice of varieties is limited to Kordia and Regina, and cultivation is distributed over tiered levels at different altitudes up to 1,300 meters above sea-level. This results in a six-week harvesting window, and the product can be offered in a consistently excellent quality.

Problems in cultivating the varieties of Kordia and Regina

Despite the high quality standards of both varieties, certain weaknesses must still be reckoned with during cultivation: The pronounced sensitivity to late frost of Kordia and the early fall of the fruit of Regina can lead to considerable decreases in yield and thus impact profitability. The choice of pollinators is also not unproblematic; this is because the recommended pollinators (e.g., Carmen, Schneiders, and Durone 3) display only very modest quality characteristics.

Evaluating varieties at the Fragsburg site

To highlight ways in which these special quality requirements can be met, in 2016, Laimburg Research Centre established a selection of cherry varieties at the Fragsburg site (700 meters above sea-level). Today, this variety collection encompasses almost 70 different accessions and varieties of national and international origin. The varieties are evaluated with respect to parameters such as time-to-harvest (number of years before full harvesting is possible), growth characteristics (habitus), and fruit characteristics (fruit size, shape, length of stem, firmness, taste). Furthermore, for some varieties, the tendency to redden, to age (premature aging of the shoots), and their susceptibility to late frost is evaluated.

Results of the variety evaluation

A few interesting cultivars in the segment of medium-late ripening varieties which have a quick time-to-harvest are described below. Kordia quickly enters the generative phase and displays a good fruit size and a quick time-to-harvest. But with regard to fruit firmness, in 2019-2020, Kordia was topped by Penny, Areko, Henriette, Tamara, and Regina (**Fig. 1**). The numerous late frosts in 2020 made it possible to tentatively classify the varieties with respect to their frost tolerance (**Fig. 2**): In this hierarchy, Kordia was the poorest performer; Penny, Irena, and Henriette displayed significantly more frost resistance. The heterogeneous ripening behavior of Tamara is noteworthy, as are the quick time-to-harvest and considerable fruit size of Henriette: In the fourth year of planting, it already displayed larger fruits than other varieties that were a year older (**Fig. 3**).

Conclusions

Despite the intense breeding work, it is hardly possible to top Kordia with respect to yield and fruit quality. However, due to climate change, the weaknesses of this variety in terms of its sensitivity to late frost are very pronounced. The variety Penny may represent an alternative for self-marketing farmers: It ripens three days after Regina and displays an astoundingly long harvest window. Furthermore, it embodies excellent fruit characteristics such as firmness and taste. Henriette and Areko were shown to be further candidates for supplementing the range of South Tyrolean cherry varieties: They blossom at the same time as the main varieties Kordia and Regina and also display an optimal allele compatibility. Furthermore, their high-quality characteristics, attractive fruits, and late ripening time represent major improvements over the pollinators currently in use.

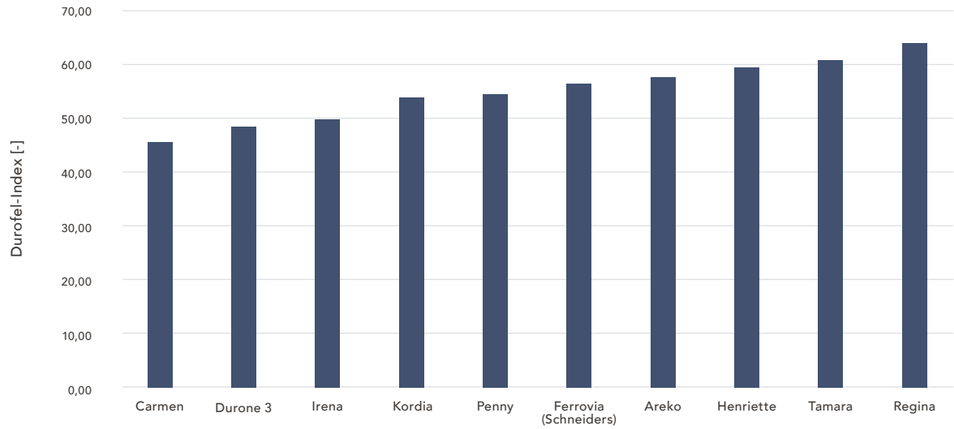

Fig. 1: Firmness of fruit flesh on the day of harvesting. The "Durofel Index" [0–100] indicates firmness. The higher the value, the firmer the fruit.

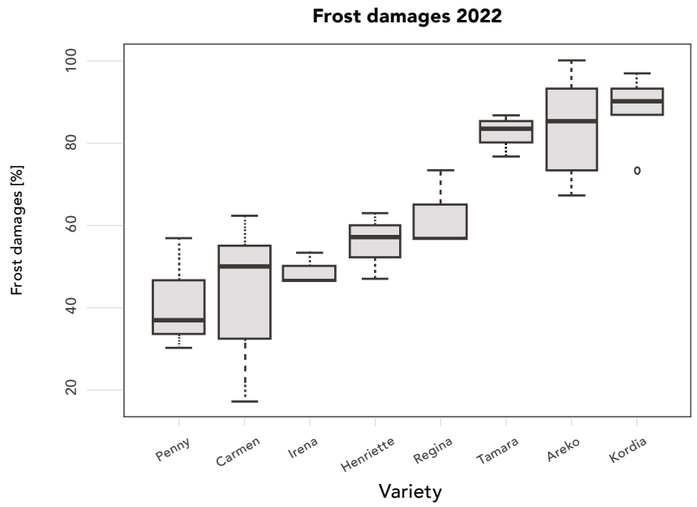

Fig. 2: Proportion of necrotic blossoms at the time of full blossoming in 2020, caused by frost damage. The values pertain to shoots at a height off the ground of approx. 70 cm.

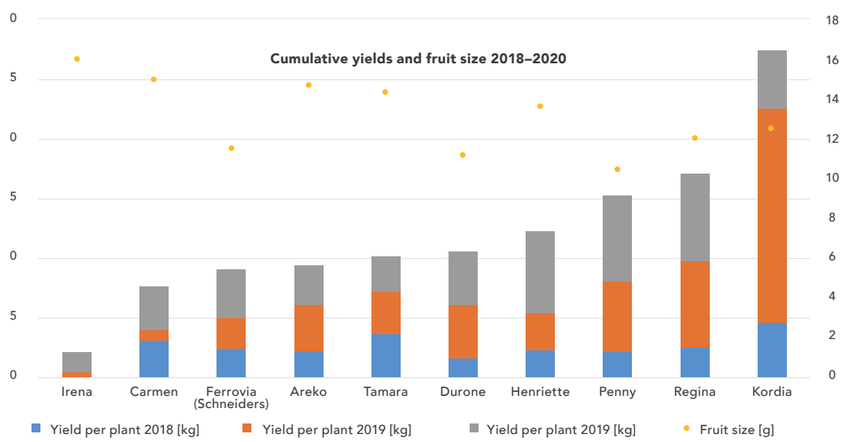

Fig. 3: Cumulative yield and mean fruit size (2018–2020). All varieties were planted in the year 2016, with the exception of "Irena" and "Henriette" (2017).

Martin Thalheimer
"Soil, Fertilization, Irrigation"
working group

HOW MUCH DOES THE BARK OF YOUNG TREES HEAT UP?

Winter temperatures impact fruit trees in different ways. Weather stations generally measure the air temperature. However, the temperatures of plant parts can vary significantly from the ambient air temperature. Major temperature fluctuations in the bark tissue are a possible cause of damage. After all, in the case of apple trees, bark damages frequently occur during the winter and may consequently lead to delayed bud break in the spring, to a general weakening of the trees, or even to their death. Nevertheless, there have been as yet only very few continuous measurements of the temperature at the bark of apple trees.

Measuring bark temperatures

In a few young fruit orchards, temperature sensors were attached to the tree bark; specifically, the sensors were inserted into a slit directly below the surface. To achieve this, very small temperature sensors embedded in a narrow plastic strip were used (**Fig. 1**). The measurement values were recorded by a data logger in one-hour intervals and then also transmitted via a mobile radio network. The influence of white paint on the tree trunk or shade from plastic netting on the heating-up of the bark was investigated.

Bark temperature in the course of the year

Dark objects heat up when exposed to sunlight more than light-colored objects. For this reason, the bark heats up when exposed to sunlight and reaches temperatures which are frequently higher than the ambient air temperature. When looking at the recorded temperature curves, one sees that the bark can reach temperatures of more than 35 °C – not only in mid-summer, but even in winter and spring (**Fig. 2**). How can this be explained? In the winter and spring, the intensity of the sunlight is lower than in the summer; however, in this period of time, the tree trunk is not shaded by the foliage, and the sunlight can reach the tree trunk unhindered. Furthermore, the fact that the sun stands lower in the sky, the rays of sun impinge on the tree trunk in a more-perpendicular angle.

Fig. 1: A temperature sensor prior to (left) and after insertion (right) under the tree bark. The red arrow indicates the sensor's exact measuring point.

Practical consequences

It is assumed that the stronger heating-up of the bark during the winter can lead to a premature degradation of the bark tissue's frost resistance. Subsequent frost events can then result in damages. For this reason, it may be useful to prevent excessive heating-up by painting the tree trunks white or providing for shade with plastic netting. Such measures succeeded in lowering the maximum temperatures of the bark by 6-8 °C.

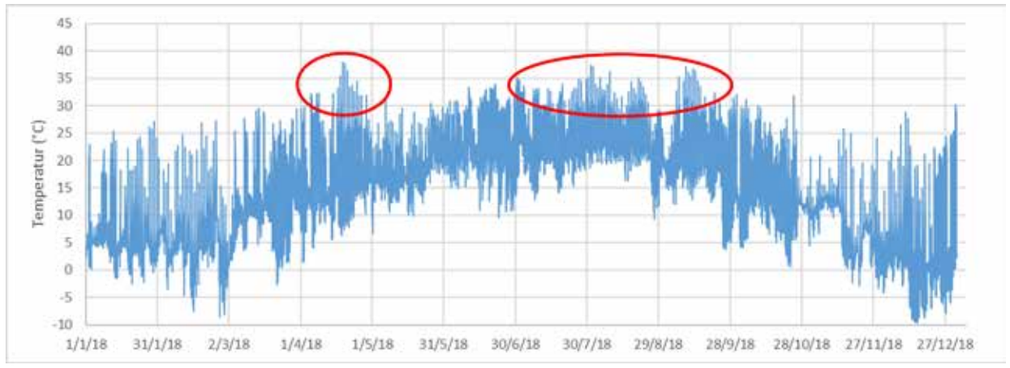

Fig. 2: Temperature curve on the surface of a trunk; the two temperature maximums in spring and summer are indicated.

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NEWS ON WINE STABILIZATION

The science of enology continues to study the topic of wine stabilization. Essentially, the goal is to avoid the precipitation of wine crystals consisting of potassium bitartrate (potassium hydrogen tartrate) or calcium tartrate in the bottle. Wine-drinkers are still averse to the presence of sediments in the wine glass (Fig. 1).

In the years 2018 and 2020, the following vinification variants were tested with respect to their stabilization properties (using 2017 and a 2019 Sauvignon Blanc):

- Control without stabilization measures (C),
- Cold stabilization (CS) at -4 °C for 2 weeks,
- Metatartaric acid (MTA) 10 g/hl (only 2018 for 2017 Sauvignon Blanc),
- Carboxymethylcellulose (CMC) 10 g/hl
- Potassium polyaspartate (PPA) 100 ml/hl and 50 ml/hl.

The study was performed three times, with a size of about 10 L per sample.

The electrical conductivity (µS) of the wine was taken as a measure of the bitartrate stability; this was measured shortly after bottling and after 7, 14, and 21 weeks (Fig. 2) as well as after 52 weeks (Fig. 3). The Checkstab α2000 Life measuring device was used for these measurements. This device measures the change in conductivity (ΔµS) caused by unstable potassium bitartrate crystals, and thus simulates bitartrate stability. Stability is said to be present if the decline in conductivity is less than 40 µS. A drop in conductivity in the range of 40-60 µS is classified as uncertain stability, while a decrease of more than 60 µS indicates that the product is unstable.

The wines also underwent sensory testing. During the tasting, the following parameters were evaluated: Color, turbidity, purity, intensity, fruitiness, bitterness, typicity, developmental stage, and overall impression.

Results

The investigations indicate that cold stabilization is effective and, at the same time, does not impact wine quality. Analytically, a decline in potassium and potassium bitartrate in the wine was determined. This effect can be tasted, but does not result in any reduction in the overall sensory quality. All other stabilization measures resulted in no significant change in the chemical composition of the wine, but some did have an influence upon its organoleptic characteristics (Fig. 4). The addition of metatartaric acid showed the already known shortcomings: Its effect vanishes within 6 months; thus, metatartaric acid provides only short-term protection against the precipitation of potassium bitartrate. Nevertheless, it remains the most used stabilizing agent in combination with prior more or less effective cold stabilization. CMC offers long-term stabilization, but with respect to sensory evaluations, it deviated the most negatively from the control and the cold-stabilized wines. PPA displayed no sensory shortcomings, but it was observed that the stabilization effect vanished after 12 months. The literature does not mention this effect; the cause for it is unknown and requires further investigation. Furthermore, long-term effects lasting for more than 12 months were not investigated in this study, nor was the effect of PPA on red wine.

Summary

One must come to the sobering conclusion that the methods of wine stabilization investigated here are not fully satisfactory. Cold stabilization has the largest CO_2 footprint; the addition of metatartaric acid provides a maximum protection of six months; carboxymethylcellulose can have noticeably negative sensory effects and is not to be used for red wine; Potassium polyaspartate can lose its protective properties after 12 months.

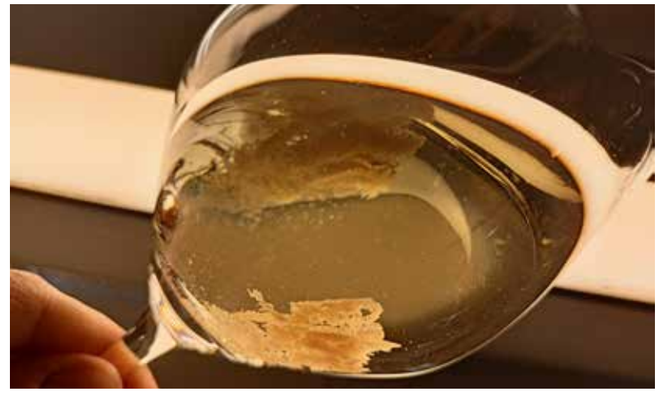

Fig. 1: Potassium bitartrate crystals in a wine glass.

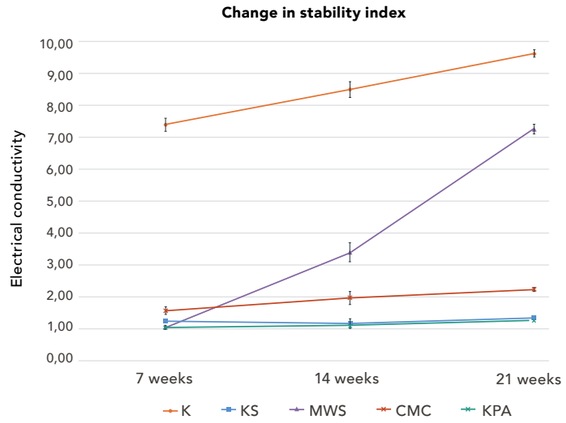

Fig. 2: Change in stability index, expressed as a decline in electrical conductivity (ΔµS %) after the elapse of 21 weeks (from bottling) for a 2017 Sauvignon.

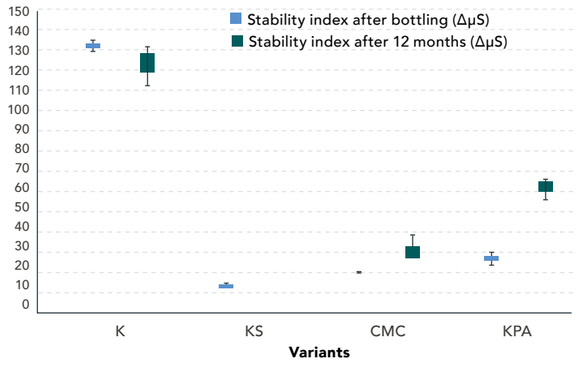

Fig. 3: Change in stability index, expressed as a decline in electrical conductivity (ΔµS %) after bottling and after 12 months for a 2019 Sauvignon.

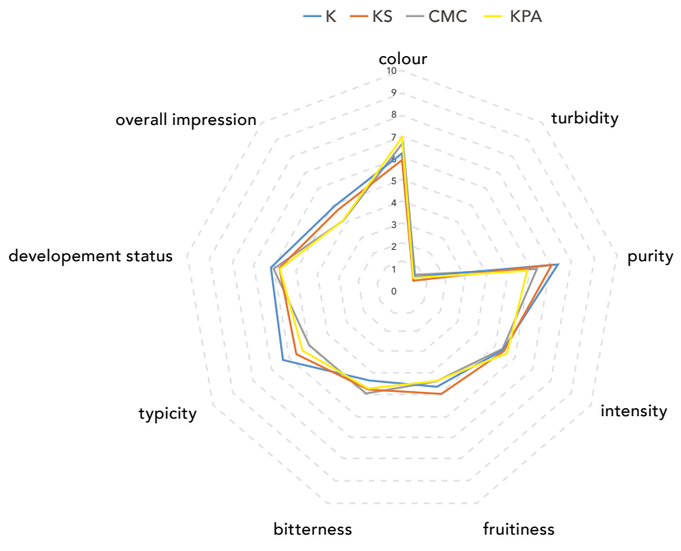

Fig. 4: Influence upon organoleptic characteristics 12 months after bottling

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BAKED GOODS BASED ON BREWERS GRAIN FROM SOUTH TYROLEAN BEER PRODUCTION

Wet brewers grain is the most important byproduct of beer production. Brewers grain is the malt residues remaining after the cooking process, after the majority of the sugar has already been extracted. Brewers grain consists chiefly of dietary fiber (30-50%) and proteins (19-30%), which are also primary nutrients in the context of human nutrition. This aspect makes brewers grain very attractive for use as an additive to enhance the nutritional value of foods. But despite its potential nutritional value, brewers grain is usually disposed of as livestock fodder. However, under the aspect of recycling, brewers grain represents an interesting byproduct with a high nutritional value. The addition of brewers grain in producing baked goods could be interesting for companies of various sizes.

Until now, the color and taste of brewers grain has set limits on its use as a partial replacement for flour. Because of its high moisture content, it is important that the brewers grain be stabilized using a sustainable process in order for it to be employed as a healthy food ingredient. Wet brewers grain obtained from the manufacture of barley malt beer and/or combined rye+barley malt beer was dried using a drum-type drying system (Fig. 1), making it possible to dry it in a short amount of time; this is also more energy-efficient and economically sustainable. The initial moisture content of the brewers grain was 68-70 %. The drying process succeeded in lowering the moisture to 7.2% for barley brewers grain and 5.4% for rye+barley brewers grain. The latter product proved to be more stable. Recipes for cake, cookies, and focaccia were developed using 50% rye brewers grain to replace the white flour the original recipe called for. The temperature, time, and baking method were optimized in a number of tests. In an initial sensory test, the products containing rye+barley brewers grain were assessed by 34 tasters. The cake, cookies, and focaccia were evaluated for flavor, texture, taste, and overall satisfaction; these parameters were measured on the basis of a seven-point hedonic scale (from „very good," to „very bad"). The results of the first trial showed that 66% of the tasters found the cake to taste „very good" to „moderately good" (Fig. 2), while the corresponding values for the cookies was 47% and for the focaccia 52%. None of the tasters reported unpleasant flavors in the products. This study was carried out in the framework of the „Brewing in Circle: Design and Implementation of the Recycling Process of Functional Byproducts of South Tyrolean Craft Beer (CirBeer)" project funded by the Autonomous Province of Bozen / South Tyrol - Dept. for Innovation, Research, and University.

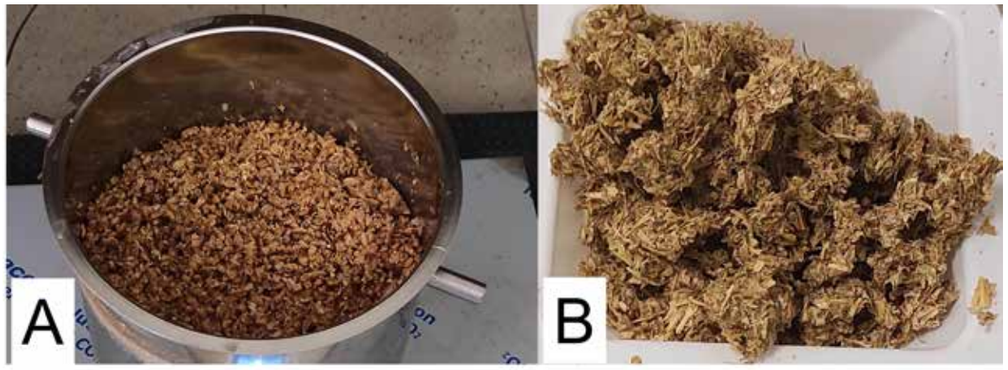

Fig. 1: Wet brewers grain before (A) and after (B) drying

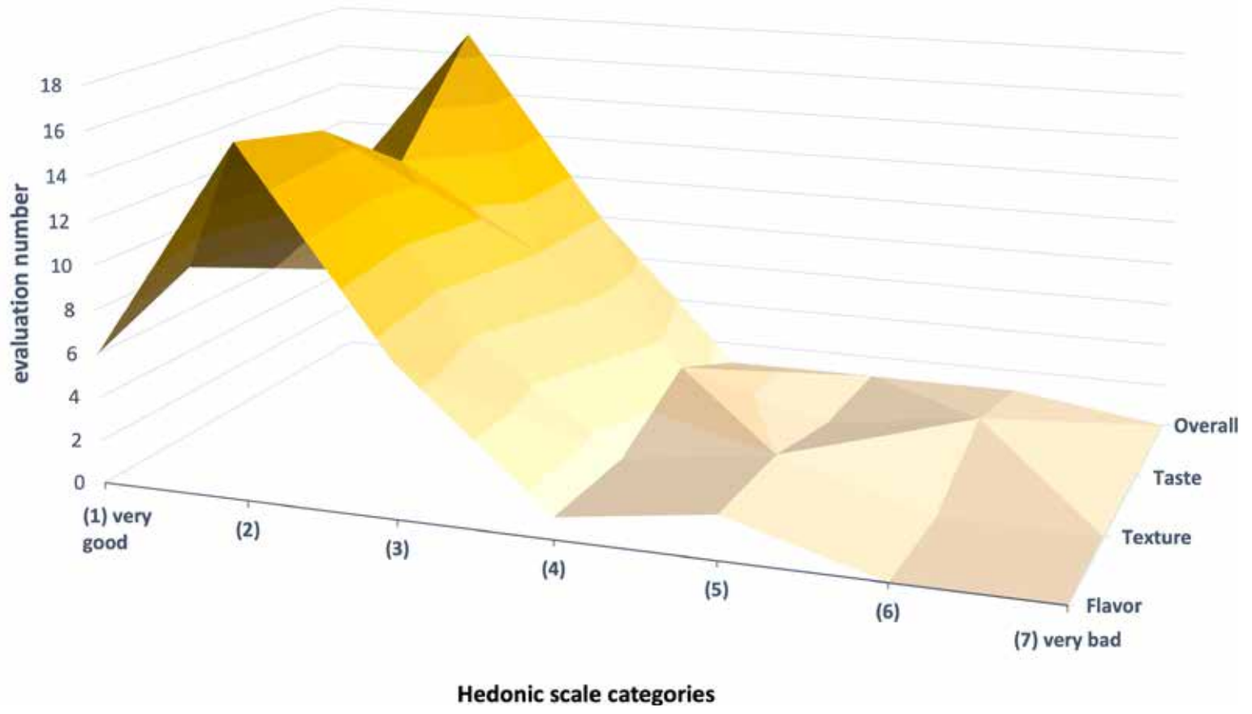

Fig. 2: Satisfaction with the product "cake," made by replacing 50% of the flour with brewers grain

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DIGITAL DETERMINATION OF THE RIPENESS OF APPLES: VISUAL ASSESSMENT OF STARCH DEGRADATION REPLACED BY IMAGE ANALYSIS

The visual assessment of the starch degradation index (SI) serves as a reliable method for determining the degree of ripeness of apples. This assessment is carried out in order to make an early prediction on the opening of the harvest window for different varieties as this is a key strategy for optimal long-term storage.

However, this conventional and simple method has one major drawback: subjectivity. A digital method for determining starch degradation based on image analysis – independent of the individual person carrying out the assessment– would yield objective data and would hence represent a good alternative for use in actual practice.

Why use a starch measuring device?

The starch measuring device calculates the intensity and distribution of the starch contained in the apple on the basis of a digital image analysis. The starch is first dyed dark by immersing an equatorial slice, cut using a two-edged knife, into an iodine solution (Lugol's Solution).

In the course of many years of research, the „Storage and Postharvest Biology" working group has visually analyzed samples of the most important apple varieties having a wide range of starch degradation; this was done using both the 1-5 scale developed at the Laimburg Research Centre and with the international 1-10 scale (Ctifl).

The value calculated by the starch measuring device was compared with the visual assessments of the same samples conducted by the experts; this was to calibrate the device as precisely as possible. The variability – i.e., the subjectivity of the visual assessment of an expert group – was evaluated over the course of several years of development and compared with the values yielded by the device.

Measurement not only of the starch …

Besides having the advantage of precision and reproducibility of the analyses, the starch measuring device also allows the data to be stored in the form of digital image files and in the form of numerical values.

For a holistic interpretation of the ripeness parameters, however, one needs to have a great deal of experience; only then can the proper harvest time be determined. In doing so, one must note that the speed of starch degradation depends not only on ripeness, but also upon many other factors – specifically, it depends also on the amount of fruit hanging on the branch, seasonal climatic influences, or the temperature prevailing during the ripening process. For this reason, it is important that not only the starch value be correctly determined; rather, such other parameters of ripeness and quality as firmness of the fruit, sugar concentration, and acidity as well as base and top color must be taken into account and properly interpreted in combination with the starch value.

Fig. 1: The Laimburg starch scale (LB 1–5)

Assessment of experts still indispensable

The „Amilon" (Isolcell) starch measuring device is already available on the market and represents an important advancement in the objective determination of the starch value. However, in order to obtain a correct interpretation of the measurement values, the expertise and professional knowledge of experts is still needed: The measurement values must be interpreted in the context of other parameters such as the physiological ripeness or the commercial quality (color, size, etc.), in order to predict the ideal harvest time and guarantee a high quality and long-term storability of the fruit.

Fig. 2: Results obtained using the "Amilon" starch measuring device

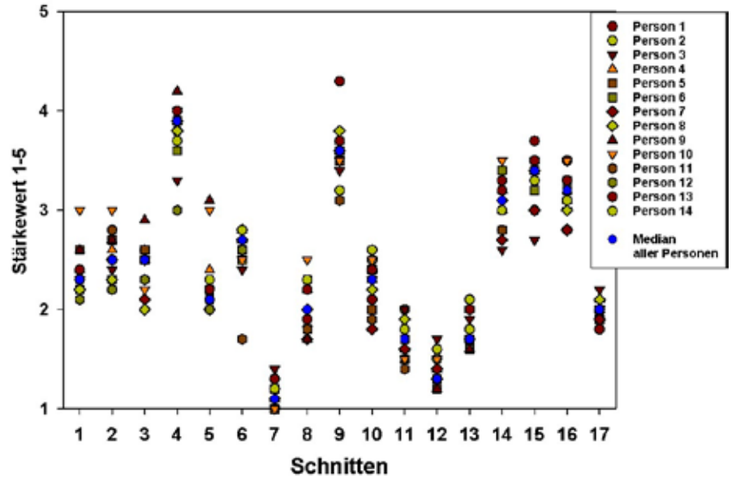

Fig. 3: Visual assessment of starch degradation of 17 equatorial apple slices (14 testers)

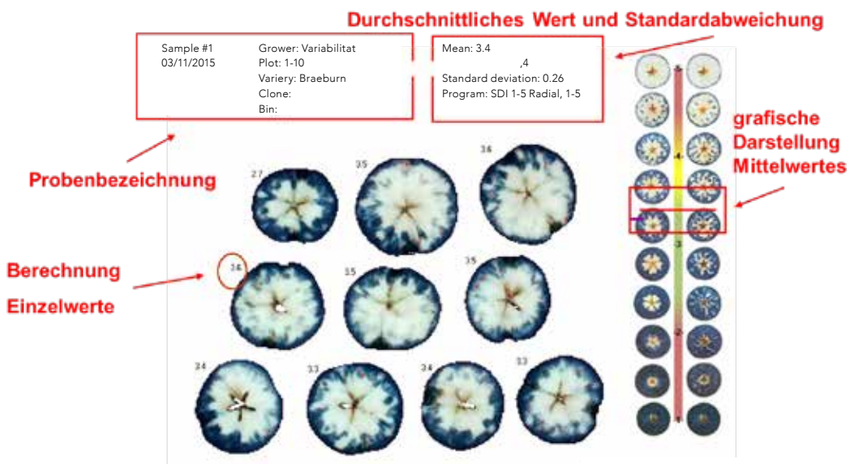

Fig. 4: Example of an image analysis with detailed results

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WHICH VARIETIES OF STRAWBERRY ARE MORE SUITABLE FOR PROCESSING?

Varieties of strawberry suitable for the fresh fruit market are often subjected to different quality criteria from those applied to the varieties intended for processing. Parameters such as color, firmness, and size are of primary importance for fresh produce, while, considering processed products, other characteristics such as susceptibility to browning, discoloration over time and persistence of the strawberry flavor in the finished product must be taken into consideration.

Quality of fruit spreads obtained from different strawberry varieties

It is important for local producers to know which varieties of strawberry are suitable for processing into fruit spreads. For this reason, the „Fruit and Vegetable Processing" working group has carried out a study over two harvest years (2019 and 2020) on four varieties: Elsanta, Senga Sengana, Korona, and LBA (a selection of Laimburg Research Centre). The selected varieties were chosen based on literature data and agronomic criteria and cultivated on experimental fields of Laimburg Research Centre in the Martell Valley. After harvest, a number of quality parameters of the fruits were recorded (pH, Brix) and strawberries harvested over the entire season were pooled and frozen prior further processing. A puree was obtained from the strawberries, which was then used to make fruit spread (**Fig. 1**), containing 1.5% pectin and a final sugar concentration of 30 %. The fruit spreads were tested at Laimburg during a tasting session (**Fig. 2**) and their color change during storage at room temperature in the dark was monitored for a period of 60 days.

Determination of the varieties suitable for processing

It was observed that processing had a greater impact on the color of the fruit spreads obtained from Korona and Elsanta varieties than those obtained from Senga Sengana and LBA. Concerning Senga Sengana, however, low initial browning was followed by a stronger browning during storage time. This can be deduced from the greater slope of the Delta E curve – a parameter that reflects the color variation over time (**Fig. 3**). The fruit spread from the Elsanta variety – which received a good evaluation in the tasting session of 2019 – was not appreciated as much in 2020 because of a pronounced browning. In 2019, fruit spreads from Elsanta and Senga Sengana were the most popular, followed by Korona. In 2020, Senga Sengana obtained the highest evaluations, followed by Korona.

Conclusions

The varieties Korona and Senga Sengana were found to be the most suitable for processing into fruit spread. Senga Sengana was the most appreciated variety. The variety Elsanta did not give reproducible results over a 2-year experimental time; this casts doubt on its validity for use for processing into fruit spreads under the conditions used for this study. During storage, the different varieties started to turn brown at different storage times; nevertheless, for the duration of the investigation (60 days), the color of the fruit spreads obtained from the varieties Senga Sengana and Korona remained stable. This study provides the producers with useful information on selecting varieties of strawberry for processing.

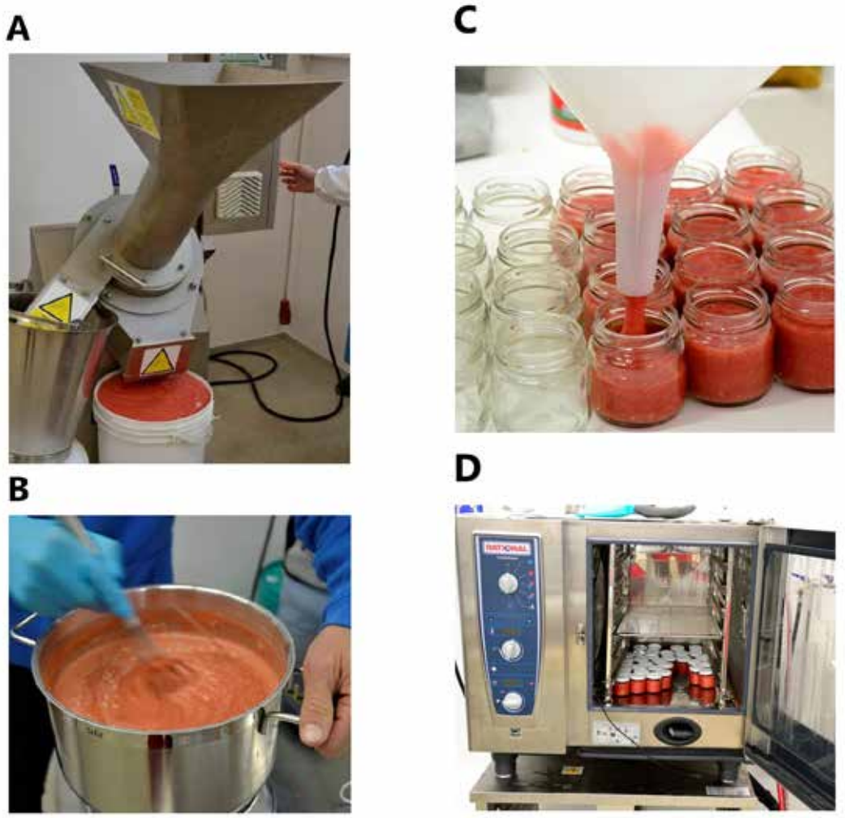

Fig. 1: Processing steps for fruit spread production: (A) Production of puree; (B) Production of fruit spread; (C) Hot canning; (D) Pasteurization at 85 °C.

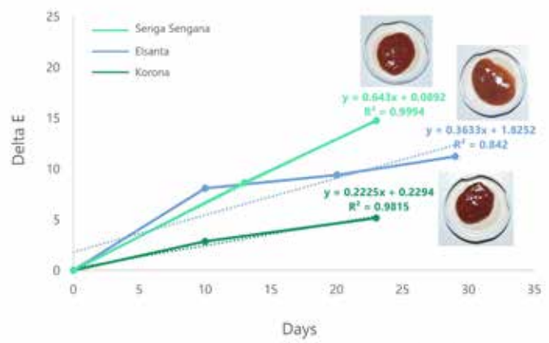

Fig. 2: Browning rate (Delta E) during storage of the fruit spreads.

Fig. 1: Seeds are secured in controlled conditions

Fig. 2: One of the landraces of Rye from the collection

A CENTURY OF THE TYROLEAN GENE BANK: THE COLLECTION OF LANDRACES AT LAIMBURG RESEARCH CENTRE AND THE COOPERATION WITH THE TYROLEAN GENE BANK

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Landraces are traditional varieties which have adapted to the cultivation conditions of their region of origin and which represent a connection to nature and culture. The Tyrolean Gene Bank is among the oldest gene banks worldwide: As early as 1922, efforts began to collect and describe varieties specific to the Alpine region. At present, the Tyrolean Gene Bank has secured more than 1,000 local varieties.

In the early 1990s, the idea arose at Laimburg Research Centre to launch local collection campaigns to collect and properly secure those landraces of the most-important cultivars which were still extant. The increasing abandonment of acreage in the mountainous areas of South Tyrol led to an endangerment of the still existant landraces and to the loss of this local biodiversity. In the initial phase of this collection campaign, the collected seed was transferred to the Tyrolean Gene Bank, which was then responsible for securing the landraces ex situ under the proper conditions. The collected samples were then subjected to further processing for inclusion in the gene bank, and it was ensured that they would be managed by the Tyrolean Gene Bank.

Overview of collection activities in South Tyrol

Since the commencement of collection activities in South Tyrol, a total of 261 different landraces of cereal grain from eight species of cereals (including the pseudo-cereal species buckwheat), 177 landraces of vegetables, and 101 landraces of other species were registered or collected (**Table 1**). With respect to cereals, rye was the species that was reported most frequently. A total of 94 rye landraces were reported, representing 36% of the total number of cereal accessions in the collection. Wheat, oats, and buckwheat are almost equally represented; they account for roughly 15%. At 11%, barley is only slightly less represented. In the case of spelt, maize, and the other cereal species, on the other hand, only a few samples were collected. In the case of vegetables, beans (27%) and turnips (22%) were the most frequently reported species, followed by horse beans (16%) and peas (14%). At 11%, potatoes accounted for a slightly smaller share. This low share was to be expected insofar as, in the case of potatoes, the planting material is no longer usable one year after cultivation has been abandoned. In the category of „miscellaneous," about half of the reported landraces were of poppy.

Local collection and characterization

Despite the fact that collection activities for landraces in South Tyrol had begun quite late, it was possible to acquire a relatively large proportion of the landraces traditionally cultivated in South Tyrol. The collection of landraces at Laimburg Research Centre more or less reflects the historical cultivation situation in South Tyrol. Since 2005, the organizational and technical foundations for the systematic documentation and characterization of the collected landraces were established in South Tyrol and the necessary infrastructure for properly storing them in a gene bank collection was created. The storage of the samples in both South Tyrol (Italy) and the Austrian province of Tyrol is intended to minimize the risk of losing samples. By processing a series of projects, it was possible to describe numerous landraces of different species of the collection and to characterize them agronomically (**Fig. 1**). These characterizations form the basis for determining possible future uses of individual landraces. Individual projects from neighboring countries have shown that these can be used in establishing successful niches for the agricultural and restaurant sectors.

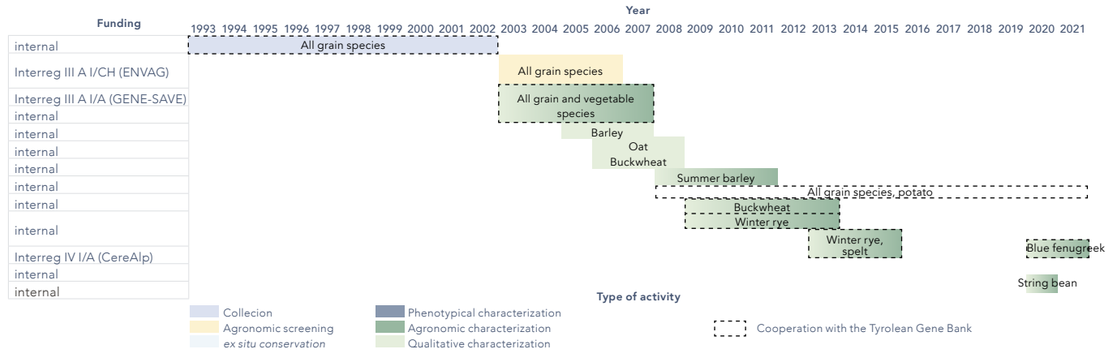

Fig. 1: The projects and activities carried out at Laimburg Research Centre for securing, characterizing, and the ex situ conservation of landraces from 1933 to today. Several projects were carried out in cooperation with the Tyrolean Gene Bank.

VARIETY	SPECIES	COLLECTED LANDRACES (NO.)	SECURED LANDRACES (NO.)	SECURED L ANDRACES (%)
Grains	Rye	94	52	55,3
	Buckwheat	39	29	74,4
	Oat	38	22	57,9
	Barley	29	18	62,1
	Wheat	41	15	36,6
	Maize	14	10	71,4
	Spelt	4	1	25,0
	Other	2	0	0,0
	Total	261	147	56,3
Vegetable	Bean	48	30	62,5
	Turnip	39	27	69,2
	Potato	19	17	89,5
	Horse bean	29	15	51,7
	Pea	24	12	50,0
	White cabbage	4	4	100,0
	Other	14	2	16,7
	Total	177	107	60,5
Miscellaneous	Poppy	52	41	78,8
	Flax	12	4	33,3
	Blue fenugreek	9	7	77,8
	Garden cress	7	5	71,4
	Other	21	5	31,3
	Total	101	62	61,4

Table 1: The number of landraces collected and secured in South Tyrol (most important species of the three partial collections). These secured landraces were those the seed of which was still viable.

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THE DEVELOPMENT OF FERMENTED VEGETABLE PRODUCTS: CASE STUDY ON RED BEETS

In a study carried out in 2020 on the fermentation of vegetable, the "Fermentation and Distillation" working group investigated options for conserving vegetables and developing new and innovative products. Lactic acid fermentation (a metabolic process of lactobacilli) can be employed for this purpose. But lactic acid fermentation also causes other changes to the product: For instance, digestibility is improved and the contents of vitamins and other factors beneficial to human health are increased. The addition of salt impairs the development of microorganisms which might spoil the product; by also lowering the pH value, the product's quality can be preserved.

Development of a fermented canned vegetable product based on red beets

In this study, the "Fermentation and Distillation" working group investigated the development of a fermented canned vegetable based on the red beet (*Beta vulgaris* L. var. Conditiva). The red beet is a vegetable and can be eaten both raw and cooked. Relatively little is to be found in scientific literature on the lactic acid fermentation of this vegetable.

It was first evaluated how lactic acid fermentation can be best initiated: sealable jars limit the oxygen concentration and prevent the proliferation of molds on the surface. The jars were equipped with a valve to vent the carbon dioxide that is produced (**Fig. 1**). Both spontaneous fermentation and the use of various commercially available starter cultures were tested. The lactic acid content, the pH value, the product's texture, and the microflora present at the end of the fermentation process were among the tested parameters. Furthermore, the product's sensory characteristics were analyzed.

Findings

Initial findings confirm the ability of lactobacilli to develop, to produce lactic acid, and to lower the product's pH below 4. The commercially available starter cultures that were tested proved to be effective. The microflora in the spontaneously developed lactobacilli displayed a behavior similar to that of the inoculated cultures. The analysis of the texture of the samples in comparison with the raw or cooked commercially available products showed that lactic acid fermentation resulted in a product with a firmness comparable to that of the raw product (though somewhat lower), but distinctly higher than that of the cooked product. This parameter was positively assessed in an initial sensory evaluation. Acid content and flavor were also positively evaluated. On the other hand, the product's salt content – which was perceived as excessive – was seen as a negative aspect.

Conclusions and prospects

Starting from these observations, lactic acid fermentation appears to be a promising strategy for processing and product innovation. The high betalain content makes the red beet interesting also from a health perspective. For this reason, the fermentation process should be subjected to closer study – also to improve the long-term stability of the finished product.

Fig. 1: Preserving jars for fermenting the Red Beet in a 6% saline solution.

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"Sensory Science"
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PRESENTATION OF THE NEW LABORATORY FOR SENSORY SCIENCE AT THE LAIMBURG RESEARCH CENTRE

How does a product change during storage? How can individual apple varieties be objectively described to the customer? Is a low-sugar product noticeably different from the original product? Laimburg Research Centre addresses these and similar questions using its new Sensory Science research infrastructure. Sensory Science is a scientific discipline in which products are analyzed using the human senses (e.g., senses of smell and taste).

Application areas of Sensory Science

Regular sensory tests are indispensable in the development of new products, the breeding of apple varieties, and quality assurance in food processing. Usually, trained personnel are tasked with describing the visual appearance, smell, taste, mouth feel, and texture of foods and with evaluating individual characteristics (e.g., sweetness or bitterness). Sensory Science also helps clarifying the underlying reasons for food preferences. Depending on the question, Sensory Science employs analytical (objective) tests or consumer tests (so-called hedonic tests).

Who can become a taster?

Sensory tests are always carried out by humans. Anyone can participate in consumer tests who likes the given product; after all, the goal is to investigate the preferences of actual consumers. In contrast, to objectively evaluate a food product, one needs a so-called "panel." A panel consists of a group of selected persons (panelists) who are trained to provide a sensory description of a certain product – e.g., apples, apple juice, or cheese. Sensory-analytical tests (comparable to analytical laboratory equipment) require not only panels of trained tasters, but also a standardized testing lab.

A tour through the new laboratory

Regulated illumination and constant room temperature, walls and furniture in neutral colors, individual and ventilated booths – the lab's interior design is quite minimalistic. There is good reason for this. The tasters mustn't be distracted or their trained senses influenced in any way.

In 16 separated booths, panelists taste food products and record their sensory evaluation digitally on a tablet. A professionally equipped kitchen and a separate preparation room are connected to the tasting booths via reach-throughs and thus guarantee professional sample management. The training and discussion room – equipped with 20 mobile tasting tables – completes the setting of the new research facility.

Networking

The new Laboratory for Sensory Science was funded by the Autonomous Province of Bozen / Bolzano in the context of the promotion of technology and innovation-based research in the field of foods (Capacity Building) and is located in the new Stadlhof Building at Laimburg Research Centre.

The lab belongs to the network of "NOI Labs" and supports South Tyrol's agricultural sector and food sector with research activities, collaborating closely with the NOI Techpark and other working groups in the field of food technology and food quality of Laimburg Research Centre and the Free University of Bozen / Bolzano.

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"Vegetable Growing"
working group

COMPARATIVE CULTIVATION OF STRING BEAN LANDRACES TO DETERMINE VARIOUS AGRONOMICAL PARAMETERS

In South Tyrol, only a small amount of string beans are cultivated in comparison with bush beans (also known as dwarf beans or French beans). In the rest of Italy, in contrast, bush beans are very popular. Depending upon the given variety, string beans can be used in a number of different ways: As a vegetable side dish, salads (in the form of both intact shells/pods – i.e., „vegetable string beans" – and also the beans separately), in stews, and in soups.

Determination of different agronomic parameters

In 2020, the „Vegetable Growing" working group conducted a comparative cultivation of different varieties of string bean at the Eyrs experimental field to study their suitability for cultivation and their yields. In total, six landraces and six varieties obtained from different seed companies were cultivated; all six varieties from the seed companies, three landraces as whole beans, and three landraces as dry beans were harvested (**Table 1**). They were all cultivated on PE mulch films with a spacing between plants of 0.4 meters in rows spaced 1.3 meters apart; support frames were used.
The term „vegetable string beans" refers to those bean varieties which are harvested as shells together with unripe seeds. In contrast, those varieties in which the ripe seeds (suitable for drying) are harvested are referred to as „dry beans." Besides the yield performance, various additional plant characteristics, vegetation properties, and various shell/pod and seed characteristics of the string bean were recorded over a period of several months.

Yield performance of the string bean varieties

The yield performance of all tested string bean varieties was determined to be satisfactory (**Fig. 1**). The highest yield per hectare among the vegetable beans was displayed by the landrace „Großmutterbohne Ulten," with almost 70,000 kg/ha, followed by the variety „Fascine" (Rijk Zwaan) with about 64,000 kg/ha. The yield per hectare (weight of seeds) of the three varieties of dry bean amounted to between 7,000 and 9,000 kg/ha. The average fresh weight of the seeds of the dry beans amounted to 0.8 and 1.5 g.

Conclusions

The attained yields for pods and seeds and the convenient cultivation of string beans make them an interesting alternative for our cultivation area. The tested landraces have potential yields rivalling those of the varieties obtained from professional breeders. However, when choosing varieties for cultivation, one should take into consideration the intended purpose of the string bean as either vegetable bean or as dry bean.

Fig. 2: Landrace "Burgstaller Schoatlen"

Fig. 3: Landrace "Kapuziner Lana"

Fig. 4: Young individual of the landrace "Ziano"

SEED SUPPIERS	VARIETIES	USE
L'Ortolano	Blue Lake	Vegetable bean
	Supermarconi	
Rijk Zwaan	Fascine	
	Faiza	
Seminis	Moraleda	
	SV3212GP	
Sortengarten Südtirol (regional varieties)	Burgstaller Schoatlen	Vegetable bean
	Großmutterbohne Ulten	
	Kapuziner Lana	
	Karnol	Dry bean
	Schlöggbohne	
	Ziano	

Table 1: Varieties of string bean investigated in 2020 study at the Eyrs site

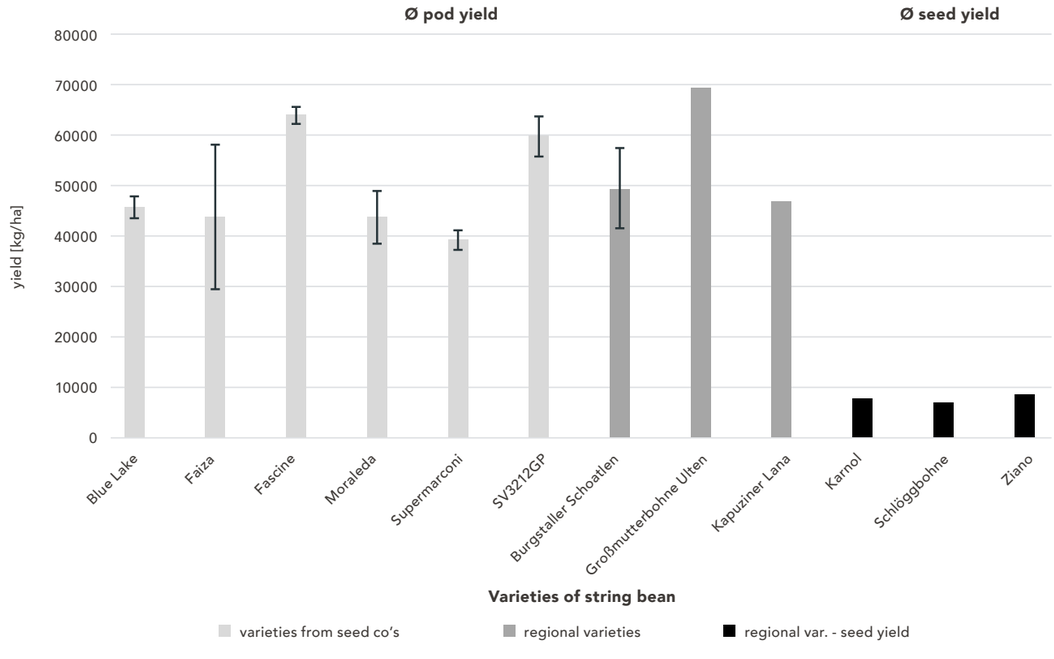

Fig. 1: Average yield of pods and seeds of the different string bean varieties

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BIODIVERSITY ON THE BALCONY AND TERRACE: VEGETABLES, HERBS, AND WINDOW BOX FLOWERS AS SOURCES OF FORAGE FOR BEES AND OTHER INSECTS

Even the smallest areas of foliage can make a buzzing contribution to biodiversity. Whether insect biodiversity on balconies and terraces is not only theoretically, but also practically possible depends upon the size of the given plant container and the choice of plant species. Plants like these can then provide food (nectar, pollen, fruits), building material, or shelter to wild bees and other insects. However, many highly cultivated plant species are no longer capable of doing this. Plants living in window boxes or flower pots have a highly limited root space; for this reason, they must be resistant to overheating and fluctuations in the availability of water and nutrients. This investigation presents a comparison of the attractivity of various plants for people and insects, their resistance to disease, and flowering duration.

Plant species under investigation

A total of 250 different plant species were planted in 45 balcony boxes having a width of 60 cm and in 14 larger containers (**Fig. 1**); two individuals of each species were planted. There were combinations for shadow, for half-shadow, and for full sunlight; all plants were watered automatically. Two peat-free products were used as substrates. Annual plants, but also perennials and woody plants, were used. All combinations were evaluated weekly until the end of September with respect to health and development, the presence of insects, esthetics, and usefulness for people.

In order to ensure that wild bee queens immediately found sufficient food sources when they became active after winter in early spring, the planting of early-flowering geophytes (wild tulips, botanical daffodils, dwarf irises) proved valuable. It was also important that they had a flowering season from late May into autumn since forage then becomes less available in the wild. Some plant species developed well and attracted a noticeably high number of insects (**Fig. 2**); these species included the Greater Knapweed (*Centaurea scabiosa*), species of basil (*Ocimum basilicum ‚African Blue'*), Blueweed (*Echium vulgare*), the Lesser Calamint (*Calamintha nepeta*), Dwarf Catnip (*Nepeta racemosa ‚Snowflake'*), Hyssop (*Hyssopus officinalis*), Wild Carrot (*Daucus carota*), Anise Hyssop (*Agastache foeniculum*), species of thyme (*Thymus sp.*), Garden Heliotrope (*Heliotropium arborescens ‚Laguna®Blue'*), Blue Sage (*Salvia ‚Rockin'®Deep Purple'*), Knautia (*Knautia dipsacifolia*), as well as all spring-blooming geophytes.

Observed insects

Over the course of the investigation, the following kinds of insects were sighted: honey bees, bumblebees (the Garden Bumblebee, the Buff-Tailed or Large Earth Bumblebee, the Red-Tailed Bumblebee, Cuckoo Bumblebee, and the Common Carder Bee), wild bees (the Carpenter Bee, the Pantaloon Bee, the Masked Bee, the Heriades Bee, European Wool Carder Bee, the Nomada Bee, the Leaf-Cutting Bee, the Mason Bee, bees of the genera *Anthophora / Amegilla*), wasps (e.g., *Scolia hirta*), various species of Lady Bugs (*Coccinellidae*), Hover Flies, Green Lace Wings, Heteropterans, spiders, and butterflies (Monarch Butterflies, Hummingbird Hawk Moths, various Gossamer-Winged Butterflies and members of Pieridae, Checkered Spot Butterflies, and Smoky Moths).

It is possible to grow balcony box or terrace plants which attract a wide range of wild bees and other insects. Of the approx. 250 species of plants used in this investigation, only twelve failed to thrive; all the others showed good to very good development. The use of peat-free substrates changed the availability of water and nutrients for the plants but is to be recommended in order to reduce the worldwide exhaustion of peat and thus make an additional contribution to climate protection and the preservation of ecosystems. However, further investigations in this area are needed.

Fig. 1: Among others, Heriades bees, (in the image on *Anthemis tinctoria*; left), Gossamer-Winged Butterflies (in the image of *Achillea millefolium*; middle), and various species of bumblebee (in the image on *Centaurea scabiosa*; right) were sighted.

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FIRST DETECTION OF GLOMERELLA LEAF SPOT (GLS) IN SOUTH TYROL

In early autumn of the year 2020, a rapid increase of necrotic leaf spots was observed in individual South Tyrolean apple orchards. Within a very short time, pronounced yellowing of the leaves known as chlorosis (**Fig. 1**) and a massive, premature shedding of the leaves was also observed in the affected orchards. At almost the same time, reddish-brown spots – frequently surrounded by a purplish halo (**Fig. 2**) – manifested on the fruit. Because similar symptoms had previously been unknown in South Tyrol, comprehensive phytopathological investigations were carried out at the Laimburg Research Centre to identify the causative agent of this symptomatology.

Microbiological and molecular-biological identification of the pathogen

To isolate the pathogen, tissue samples of necrotic leaves and fruit spots were taken and incubated on nutrient media in the laboratory. After just a few days, a majority of the samples showed fungal growth with consistent morphology. Examination of the fungal isolates' conidiospores by light microscopy, an assignment to the genus *Colletotrichum* sp., the asexual form of *Glomerella* sp., was made. By sequencing a specific DNA fragment, the pathogen was preliminarily identified as *Colletotrichum* species. Because of the great genetic similarity of the different *Colletotrichum species*, however, further molecular studies are needed to unambiguously identify the fungus.

Characteristic damages associated with Glomerella Leaf Spot

The identification of the pathogen in combination with the observed symptoms in the field confirmed the first occurrence of Glomerella Leaf Spot (GLS) in South Tyrol. The characteristic pattern of damages have been reported for several decades in some parts of the humid, subtropical apple cultivation areas of South America, in the southwest of the U.S.A., and in eastern Asia. Nevertheless, there have been only a few investigations on the development and occurrence of this disease, and the number of different *Colletotrichum species* with the ability to cause GLS has not yet been definitely determined. Some species are responsible for both Bitter Rot on apples and the symptomatology of GLS. However, the genus *Colletotrichum* is not entirely new to South Tyrol and has already been found to be associated with storage rot. Nonetheless, the preliminary identification of a *Colletotrichum species* as the pathogen responsible for GLS serves as a starting point for further investigations on the highly variable diseases which can be caused by the genus *Colletotrichum*.

Conclusions and prospects

At present, more in-depth molecular analyses of fungal isolates from the affected orchards are being carried out at the Laimburg Research Centre to accurately identify the *Colletotrichum* populations causing these symptoms; this is because they may require specifically adapted preventive strategies matching. To obtain conclusive proof that *Colletotrichum sp.* is the causative agent for the development of this disease in the field, it is also planned to conduct in vivo pathogenicity tests. Finally, a comprehensive field monitoring program will be carried out in order to determine the geographic and temporal distribution of this new GLS disease observed in South Tyrol.

Fig. 1: The first symptoms of Glomerella Leaf Spot are necrotic leaf spots; in the advanced stage, there is an increasingly chlorotic discoloration of the leaves.

Fig. 2: Lesions on fruits of the variety Rosy Glow(cov) caused by an infection with *Colletotrichum* sp.

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BIOLOGICAL CONTROL OF THE BROWN MARMORATED STINK BUG IN SOUTH TYROL

The Brown Marmorated Stink Bug *(Halyomorpha halys)* is an invasive species which in recent years has caused damages to South Tyrolean apple orchards. The usual control strategies – based on the use of synthetic chemical plant protection products as well as on physical methods (e.g., covering the orchards in netting) – have proven inadequate in preventing damages. Against this background, a search was launched in the places of origin of the Brown Marmorated Stink Bug for natural antagonists which could be used for the biological control of this pest. Among these natural antagonists, foremost the Samurai Wasp *(Trissolcus japonicus)* (**Fig. 1 and 2**) revealed itself to be an especially efficient egg parasite to suppress the population of H. *halys*. In 2020, the release of this wasp in certain regions and provinces of northern Italy – including South Tyrol – was approved by the Italian Ministry of the Environment.

Release of the Samurai Wasp (*Trissolcus japonicus*)

The release of the antagonist was carried out starting on June 22 2020, following the guidelines of the technical-scientific committee established by the Italian Ministry of Agriculture. A total of 42 locations in South Tyrol were selected for this task (Fig. 3); most of them were in areas with a high prevalence of the Stink Bug. These release locations included especially green areas, ecological corridors, but also hedges in the vicinity of fruit orchards. During the summer, two to three releases could be conducted at these locations; each time, 100 females and 10 males were released. To be able to determine the parasitization rate of the egg clutches of the Stink Bug, egg clutches were collected at the 42 sites both before and after the release dates. They were then incubated in incubation chambers and the hatching rates of the egg parasitoids determined.

Proof of the role of the Samurai Wasp as a natural antagonist

During the subsequent checks, more than 800 egg clutches were collected. The Samurai Wasp was found at 20 of the 42 release locations. The results show that the wasp apparently was able to successfully reproduce under the different local conditions of the release locations. Approx. 50% of the egg clutches displayed signs of parasitization by one or even several different species of the genus *Trissolcus*. Apart from the released Samurai Wasps, the two most frequent species were T. *mitsukurii* and A. *bifasciatus*.

Generally, the parasitization rate at sites with a low density of Stink Bugs was low. In the case of high Stink Bug densities, in contrast, the parasitization rate for the Samurai Wasp was comparatively higher. Parasitized egg clutches were found in particular in public green zones. Only in exceptional cases was the Samurai Wasp successful in parasitizing other Stink Bug species: This is an indication of a strong preference for the eggs of the Brown Marmorated Stink Bug.

Prospects

The data collected in the year 2020 represent an important foundation for estimating the primary and side effects of the biological regulation of the Brown Marmorated Stink Bug using its natural antagonist, the Samurai Wasp. In the coming years, it will be possible to make a statement on the actual success of the attempted establishment of this species. Nevertheless, the findings of this preliminary investigation for the year 2020 indicated an initial success towards suppressing the Brown Marmorated Stink Bug using this method.

Fig. 1: A Samurai Wasp on a clutch of eggs of the Brown Marmorated Stink Bug

Fig. 2: Female of the Samurai Wasp (*Trissolcus japonicus*)

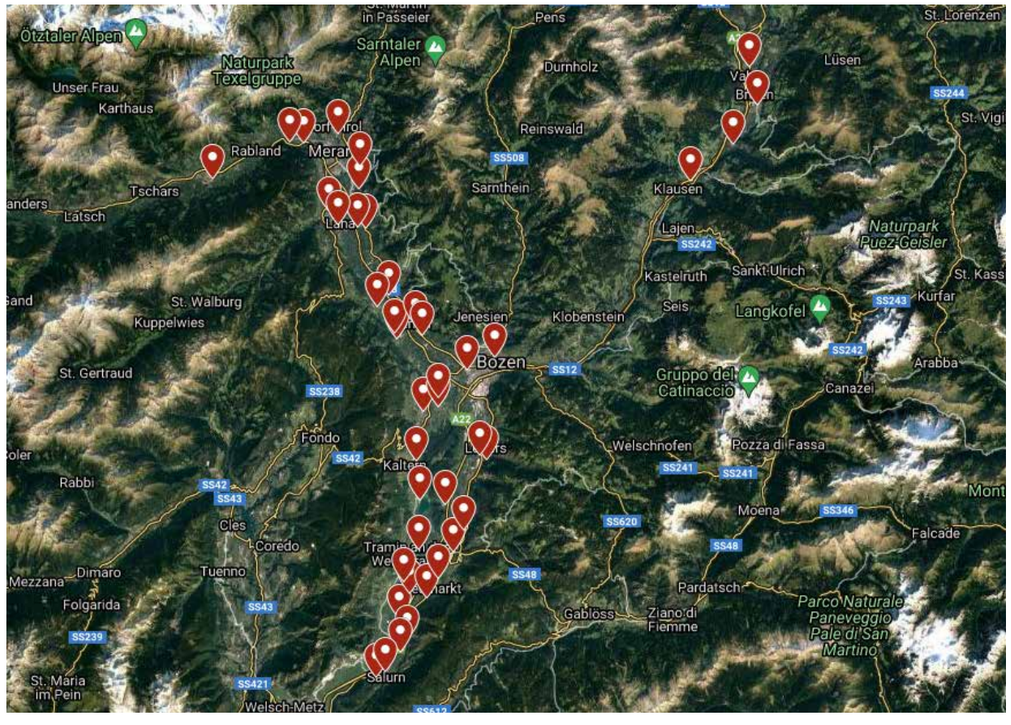

Fig. 3: Release locations of the Samurai Wasp in South Tyrol

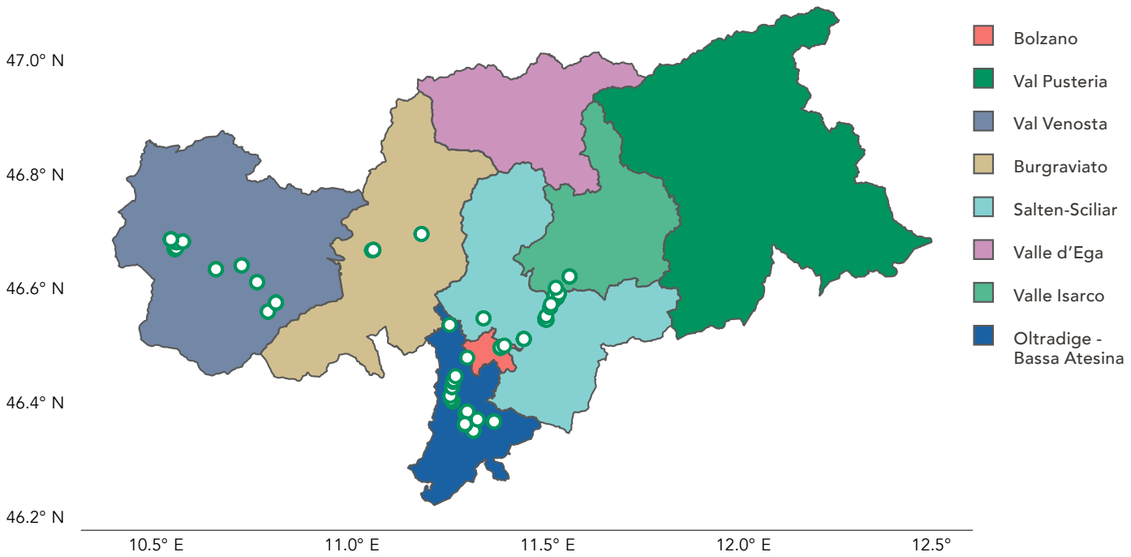

Fig. 1: Overview of monitoring sites in South Tyrol

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ON THE APPEARANCE OF SPECIES OF *MONILINIA* IN SOUTH TYROL STONE FRUIT CULTIVATION

Different species of Monilinia fungi can elicit fruit rot or brown rot and dry tip (also known as Monilia disease) in stone fruit. Among the most important pathogens are the three species *Monilinia laxa*, *Monilinia fructigena*, *Monilinia fructicola*. The first two species are naturally present in Europe. On the other hand, *M. fructicola* is regarded as an invasive species, and was first found in European stone fruit orchards 20 years ago. Because of their similar symptoms, the different species cannot be distinguished on the fruit tree and the various symptoms can not be assigned to individual species. Consequently, laboratory investigations are needed to permit a reliable identification of the individual species.

Large-scale monitoring

In order to determine which species of *Monilinia* are present in South Tyrol, in February of 2020, a total of 155 samples of fruit mummies of cherries, plums, peaches, almonds, and apricots were collected in the Venosta Valley, the district of Burggrafenamt, the Isarco Valley, Bozen/Bolzano, and in the district of Überetsch-Unterland (**Fig. 1**). Fruit mummies are especially well-suited for detecting *Monilinia* because here the pathogen survives the winter (**Fig. 2**). In the lab, the fruit mummies were shredded and studied using biomolecular methods to determine if the *Monilinia* fungus is present in the plant material and to which species it belongs.

Fig. 2: The fungus can survive the winter on fruit mummies (here: on almonds).

Fig. 3: This culture of *Monilinia laxa* was isolated from a fruit mummy.

Identifying Monilinia

The biomolecular analysis yielded the finding that all three species of *Monilinia* are present in South Tyrol. *M. laxa* was the most frequently detected species (in 43% of the samples), followed by *M. fructigena* (16%). The invasive fungus *M. fructicola* was detected in 4% of the samples. This represents the first report of *M. fructicola* in South Tyrol. The sites from which the fruit mummies infected with M. fructicola originated, are located in the communities Mals/Males, Pfatten/Vadena, and Ritten/Renon.

Conclusions

The results show that *Monilinia* is widely distribiuted in South Tyrolean stone fruit orchards. At present, it is not yet possible to reliably state if the invasive species of *M. fructicola* will establish and if this will lead to new challenges for commercial stone fruit production. Currently, it is not yet necessary to adapt and change the plant protection strategy for the prevention of this plant disease,because the same control measures and plant protective agents can be applied against all of these different species. But in the long term, M. fructicola could hinder the prevention of brown rot and dry shoot tip because this species is considered to develop more likely resistances against plant protection products. Further laboratory investigations of the *Monilinia* species which were isolated from the fruit mummies at Laimburg Research Centre (**Fig. 3**) can support the development of strategies for preventing resistance and optimizing plant protection strategies.

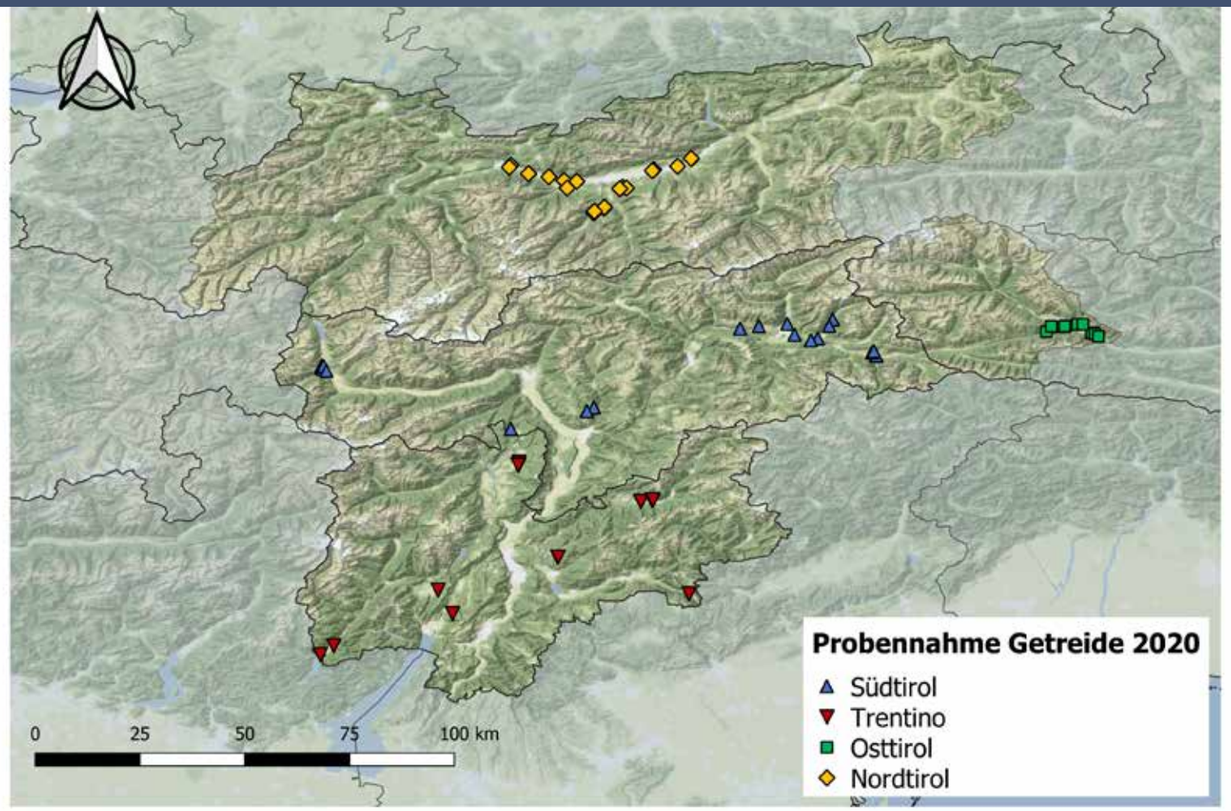

Fig. 1: Map indicating the locations of the sampled cereal fields.

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DETERMINATION OF THE ORIGIN OF CEREALS FROM SOUTH TYROL AND THE NEIGHBORING REGIONS OF TRENTINO, EAST TYROL, AND NORTH TYROL BY MEANS OF STRONTIUM ISOTOPE ANALYSIS

The "Regiokorn" project has led to a revitalization of cereal cultivation in South Tyrol. When certain guidelines are met, prices can be achieved that are significantly higher than the global market price. However, there is a lack of objective and robust analytical methods to protect against counterfeiting and guarantee regional production of cereals. One promising approach to achieve this goal is the Strontium Isotope Analysis.

The strontium isotope ratio

Strontium is comparable to the chemical element calcium and is present in all soils; strontium has several isotopes (isotopes are atoms with the same number of protons and electrons, but a different number of neutrons). Interestingly, there is a strontium isotope resulting from the radioactive decay of rubidium ($^{87}Rb \rightarrow {}^{87}Sr$). The older a rock is and the more rubidium it initially contained when first formed, the higher the amount of ^{87}Sr relative to ^{86}Sr (the latter isotope does not form through radioactive decay and its concentration is therefore constant). Strontium is absorbed by plants just like calcium; for this reason, the $^{87}Sr/^{86}Sr$ ratio of the plants reflects that of the soil. The strontium isotope ratio of the soil depends upon the underlying rock from which the soil arose. Primary rocks like granite and gneiss are usually very old and contain relatively much rubidium; for this reason, they have a high $^{87}Sr/^{86}Sr$ ratio. Carbonate minerals such as dolomite and limestone contain relatively little rubidium and are younger; for this reason, their $^{87}Sr/^{86}Sr$ ratio is lower.

Analysis of the origin of the cereals

In the year 2020, cereal and soil samples from a total of 85 fields (rye and spelt) from South Tyrol, East Tyrol, and North Tyrol and the Italian province of Trentino were collected before harvest (see Fig. 1). The strontium isotope ratio was measured using a special high-resolution mass spectrometer. There is a distinct difference between cereals from South Tyrol and cereals from Trentino (Fig. 2). This is because cereal cultivation in South Tyrol takes place mainly in the Pusteria Valley and the Upper Venosta Valley. The soils in these areas have a pronounced primary rock (gneiss) content; this explains their high $^{87}Sr/^{86}Sr$ ratio. In contrast, in Trentino, limestone and dolomite dominate; for this reason, the isotope ratio is significantly lower here. Between North Tyrol and East Tyrol (Austria), and the other regions, no clear distinction is possible; this is because the soils consist of a mixture of primary rock and calcareous sediments.

Conclusions and prospects

The determination of the origin of foods is of great importance to both consumers and producers. This study shows that the strontium isotope ratio in cereals is dependent upon the geology of the place of growing. For this reason, the analysis of the $^{87}Sr/^{86}Sr$ ratio is a promising method for determining the origin of agricultural products.

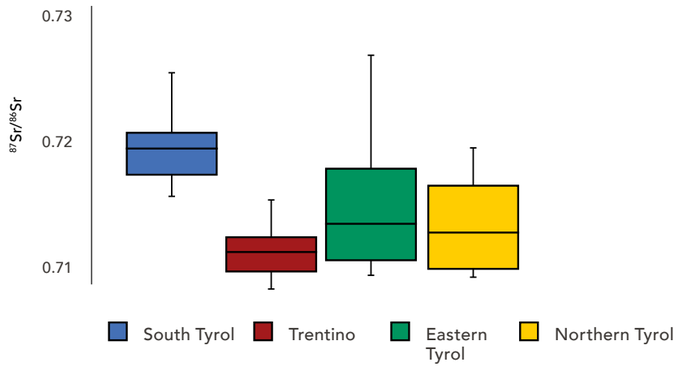

Fig. 2: Box plot of the strontium isotope ratio in cereals from the regions under study.

Fig. 3: Ripe ears of rye.

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CONTRACT RESEARCH

Laimburg Research Center offers companies from the agri-food sector various services to support them in their research and development projects and thus strengthen their competitiveness and innovative power. To this end, the Research Centre has developed standardized service packages for contract research projects that are oriented towards their individual needs.

The following four standardized service packages are suitable for smaller research projects:

Consulting	Small	Medium	Large
Scientific consulting and elaboration of a technical report upon conclusion of the research	Scientific consulting, implementation of a SMALL-scale study, technical report upon conclusion of the study	Scientific consulting, implementation of a MEDIUM-scale study, technical report upon conclusion of the study	Scientific consulting, of a LARGE-scale study, technical report upon conclusion of the study
€ 1,000	€ 5,000	€ 10,000	€ 15,000

All prices include the legally valid V.A.T.

Laimburg Research Centre can conduct larger research projects (**contract projects with a volume greater than €15,000**) in coordination with the companies. Such contract projects are tailored to the specific customer requirements.

Info

Additional information, current price list, and contact data:

OPEN LAB

With the Open Lab concept, Laimburg Research Centre has developed a special offer addressing in particular young, innovative companies and start-ups: After receiving instruction from specialist staff at Laimburg Research Center, the companies' own employees can use the lab devices and equipment at the Research Center to carry out their research work independently.

At present, the equipment and materials of the following labs are available for use

- Lab of Flavors and Metabolites (at the NOI Techpark)
- Lab of Food Microbiology
- Lab of Molecular Biology
- Lab for Wine and Beverage Analysis
- Lab of Residues and Contaminants
- Lab for Soil and Plant Analysis

Use of the labs

The lab devices can be used on a day-to-day basis or – if available – for longer periods of time. The high-end equipment can also be reserved for individual hours (in coordination with the responsible head of the lab). Corresponding skill and experience in the use of these devices is a prerequisite for using them.

Info

Additional information, current price list, and contact data:

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Selected Publications 2020-2021

All Publications of Laimburg Reserach Centre

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LAIMBURG JOURNAL

Since February of 2019, Laimburg Research Centre has been publishing its own Open-Access online periodical: The Laimburg Journal. This portal is freely accessible and available at no cost. Its objective is to promote knowledge transfer and to disseminate professional know-how in the areas of agriculture and food sciences and all related fields. The journal publishes well-founded specialized information in the form of original studies and reports on various agricultural topics relevant for South Tyrol. The journal's target group comprises professionals from the fields of research, industry, politics, teaching, as well as interested laypersons.

Info

In 20202/21, a total of 14 original articles, seven short notifications, and six reports were published in the Laimburg Journal.

35,976 page views were registered in this two-year period.

In 2020, **46%** of the page views came from Italy; in 2021, this had declined to only **42%**.

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LABORATORIES

Laimburg Research Centre has a variety of laboratories focusing on different disciplines and can therefore offer a wide range of lab analyses both for in-house research projects and as a service for private customers. Qualified professional knowledge and state-of-the-art laboratory equipment allow our experts to address various issues derived from actual practice. They translate scientific laboratory results into indications for application in practice and thus support companies in their development. Accredited laboratory methods and constant further development of lab technology guarantee analyses and display consistently high standards.

Laboratory for Virology and Diagnostics

This laboratory works on diagnosing diseases in cultivated and ornamental plants, such as those caused by bacteria, fungi, phytoplasms, viruses, and viroids. In the context of legally required health controls, our experts conduct studies on propagating material in the fruit, wine, and vegetable cultivation sectors, as well in growing ornamental plants. Additionally, the lab is commissioned by the Plant Protection Agency of the Autonomous Province of Bozen / Bolzano to conduct plant disease diagnostics. Our experts employ microbiological, serological, and/or molecular-biological methods to identify pathogens.

Yazmid Reyes Domínguez, *Head of laboratory*
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Laboratory of Molecular Biology

This laboratory investigates the genetic foundations for breeding new varieties and the foundations for the formation and prevention of plant diseases, e.g., apple proliferation. Using molecular-biological, biochemical, and bioinformatic methods, our experts determine the factors having an impact upon this disease, with the goal of developing innovative strategies to combat them. The breeding of apple and grape varieties is supported using new technologies at the lab. Using molecular markers, it is possible to select seedlings with genetic predispositions that are most conducive to attaining breeding aims. Furthermore, the lab offers services to authenticate apple and grape varieties and rootstocks.

Katrin Janik, *Head of laboratory*
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Laboratory of Residues and Contaminants

This laboratory tests agricultural products for plant protection product residues. Using established extraction methods, our experts extract the residues of plant protection agents (fungicides, insecticides, herbicides) from the samples, purify them, and analyze them using suitable laboratory instruments based on Mass Spectrometry coupled with Gas Chromatography (GC-MS) or Liquid Chromatography (LC-MS).

Accredited according to ISO/IEC 17025 since 2011.

Peter Robatscher, *Head of laboratory*
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Laboratory for Wine and Beverages Analysis

This laboratory determines a wide range of chemical parameters relating to wine, grape juice, and grapes. It is equipped with numerous instruments, including an FT-IR device („Fourier-Transformation – Infrared"), which is used to measure the most important parameters in the shortest time with minimal preparation of the sample; even free and total sulfur can be determined. Each year, the lab conducts grape maturation tests – this is a very important tool for wine growers and wineries to monitor the course of maturation of wine grapes and determine the optimal point in time to harvest the grapes. Additionally, the lab also carries out analyses for fruit juice, fruit wine, beer, and distilled spirits. Accredited according to ISO/IEC 17025 since 2003.

Eva Überegger, *Head of laboratory*
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Laboratory for Soil and Plant Analysis

In this laboratory, nutrients present in agricultural soils, plant material (leaves, buds, branches, roots, etc.), fruits, horticultural soils and substrates, composts, organic fertilizers, commercial fertilizers, mineral fertilizers, and in irrigation water are determined. These in-depth analyses serve to ensure the optimal supply of nutrients to the plants. Furthermore, modern chemical-analytical methods are also employed.

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Laboratory of Flavours and Metabolites

Using modern chemical methods, the experts analyze the naturally occurring substances present in agricultural products (apples, apple juices, grapes, wines, cheese, milk) and plant organs (leaves, roots, wood) to determine their quality, characteristics, and purity. The lab is equipped with state-of-the-art laboratory instruments, such as GC-MS (Gas Chromatography coupled with Mass Spectrometry) and LC-MS (Liquid Chromatography coupled with Mass Spectrometry) and uses common analytical techniques. It also has so-called high-resolution mass spectrometers to identify new, unknown substances as well as a Near Infrared device suitable for destruction-free analysis.

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Il laboratorio è situato presso il **NOI Techpark**,
in via A.-Volta 13/A, 39100 Bolzano

Laboratory for Fodder Analysis

This laboratory is concerned with the analysis of substances contained in hay, silage, and concentrated feeds to ensure that livestock receive a balanced diet appropriate to their needs. Besides the classic wet-chemical analytical methods, the experts also employ NIRS (Near Infrared Spectroscopy), a destruction-free, quantitative technique to determine the substances contained in fodders.

Evelyn Soini, *Head of laboratory*
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Fermentation and Distillation

The „Fermentation and Distillation" group investigates the production of beverages and foods by means of fermentation processes and distillation. On one hand, the team deals with traditional products made with fruits (cider), grain cereals (beer), and honey (mead), but it also develops innovative fermented foods and beverages. Furthermore, our experts conduct experiments on the production of distilled spirits, fruit brandies, and liqueurs.

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Meat Products

The „Meat Products" group was inaugurated in 2019. The goal of this new area is to support the meat-processing sector in South Tyrol with scientific research for the purpose of promoting local products with innovations, optimizing processing techniques, and developing new products. Our experts deal with the question of how to maintain and boost the quality of traditional South Tyrolean products and of how to comply with statutory provisions pertaining to the food sector.

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Fruit and Vegetable Processing

This group is concerned with the processing of local varieties of fruits and vegetables. In doing so, it focuses on the development of innovative products and optimizing processing techniques. It supports local producers with its food technology know-how in order to optimize the quality of traditional products and support the development of new ones. In doing so, the experts make use of pilot plants for homogenization (including the use of high pressure), drying at low temperatures, controlled instant decompression, and the production of juices and purees. Furthermore, the physico-chemical and microbiological stability of foods is analyzed and the thermo-physical and mechanical properties of individual ingredients and finished products are studied.

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Sensory Science

The „Sensory Science" group characterizes foods using sensory analyses and instruments and determines consumer preferences. To determine the quality characteristics of a food as precisely as possible and to describe them comprehensively and objectively, the findings of sensory analyses conducted by a trained panel of tasters (appearance, aroma, taste, mouth feel), physico-chemical analyses, and consumer test results are combined. The lab focuses on the characterization of sensory quality and the shelf-life of products; additionally, it investigates the effects of innovative food processing techniques on the resultant sensory characteristics of the products. Sensory Science also has a key role in product development, in the quality control of foods, and in market research.

This lab is located at Laimburg Research Centre, in the new „Stadlhof" Building.

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Laboratory of Food Microbiology

This laboratory characterizes the microbial status of foods. The analytical methods used are based on either the identification and quantification of single microorganisms or on the determination of the total count of microorganisms in a food. The lab is fully experienced in the characterization of microorganisms in wine, beer, and other fermented beverages. Testing is currently performed using classical microbiological methods and is supported using Mass Spectroscopy (MS) based Proteomics. MALDI-TOF Mass Spectroscopy (Matrix-Assisted Laser Desorption Ionization Time of Flight) is of central importance to this. In the future, the range of tests offered will be expanded to include other typical South Tyrolean products (fruits, meat, milk, and cheese).

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Enology

The goal of the „Enology" research area is to support the South Tyrolean wine industry with applied research and consulting services. For this purpose, studies in the vineyard are followed up by enological studies in the wine cellar by carrying out technological experiments and offering enological consulting and professional training programs. Since cultivation methods can affect grape quality, the experts investigate the interrelations between winegrowing measures and the resultant quality and taste of the wine. This includes studies focusing on varieties and terroirs as well as the testing of new grape clones with regard to their wine quality. In this context, the goal is to make the most of the quality potential inherent in the grapes. For this reason, the experts perform studies in the experimental cellar to determine how the wine maturation process can be optimized. The aim is to improve especially the typicity and mouth feel – but also the shelf life of the wines. To achieve this, a large number of different wines are matured and then subjected to chemical analysis and a sensory evaluation by our tasting panels.

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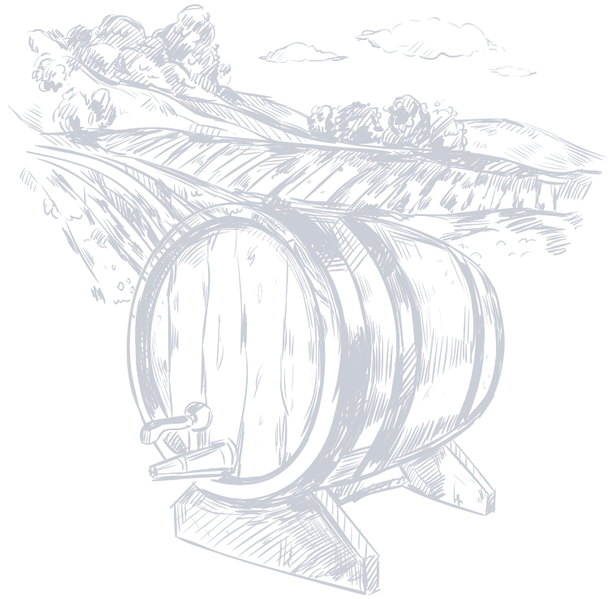
LAIMBURG WINERY



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 winegrowing 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.

Info

The winery is a member of the Association **Tirolensis Ars Vini** which is committed to the highest quality as symbolised by the Tatzelwurm.

TIROLENSIS ARS VINI
Südtiroler Qualitätsweinhöfe
Viticultori Sudtirolesi

Viticulture at high altitudes? The case of *Siralos*

Is viticulture possible in extreme sites? At 1,000 meters above sea level? Is it economically viable?

Local viticultural association Tirolensis Ars Vini set out to answer these questions with its 2013 initiative: to establish a 1,000-square meter vineyard at the Geyrerhof farm (Soprabolzano) located at 1,330 m above sea level. The area was planted with fungus-resistant grapevine variety Solaris, also particularly suited to the location due to its relatively short vegetative cycle. The first vintage of production was 2018, and resulted in an aromatic, full-bodied wine, with a notable, refreshing acidity and long finish. Siralos provides an excellent example of the potential to produce high quality wine in extreme locations, given that prerequisites such as location, soil, exposure, and water availability are met, and that in more climatically challenging years, alternative processing options are available (sparkling, sweet wines, etc.). It will only be over the continuing course of the Siralos vineyard's lifetime that we will better be able to understand the extent to which high-altitude vineyard installation is also economically successful.

Fun fact: The wine's name, Siralos, is the grape variety name, Solaris, read backwards.

Norèy

Gewürztraminer is the second-most widely planted grape variety in South Tyrol, with a surface area of 613 hectares. The 2011 vintage was hot with relatively low rainfall. An autumn with particularly favourable weather conditions yielded excellent grapes. The unique aging potential of the 2011 vintage allowed the Norèy Gewürztraminer Riserva to evolve in the cellar for a decade until its 2021 release, beginning with fermentation in tonneaux, and finishing with eight years of aging on the lees in stainless steel tanks. Norèy is a complex wine, full of character and expression; one that speaks to the potential of this grape variety, which has been cultivated in South Tyrol since Roman times. The name Norèy originates from the Ladin language, and can be translated as „white alpine rose with magical and curative powers."

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.

Info

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Award-winning wines of the Laimburg Winery in 2020 and 2021

	Name of the wine	Award	Wine Guide	Year of Award
1	Laimburg Südtiroler Kerner Riserva „Aurònа“ DOC 2014	The Wine Hunter Award	Meraner Weinfestival	2020
2	Laimburg Weinberg Dolomiten Rot Cuvée „Col de Rèy“ IGT 2015	Hervorragend	Wein-Plus	2020
3	Laimburg Weinberg Dolomiten Rot Cuvée „Col de Rèy“ IGT 2016	5 Grappoli	Bibenda	2020
4	Laimburg Weinberg Dolomiten Rot Cuvée „Col de Rèy“ IGT 2016	The Wine of the Hunter Award	Meraner Winefestival	2020
5	Laimburg Südtiroler Weißburgunder „Musis“ DOC 2018	1 Herz	Merum	2020
6	Laimburg Südtiroler Kalterersee Classico Superiore „Vernacius Solemnis“ DOC 2018	CORONA	Vini Buoni d'Italia	2020
7	Laimburg Südtiroler Sauvignon blanc Passito „Saphir“ DOC 2018	Tre Stelle Oro	I Vini di Veronelli	2020
8	Laimburg Mitterberg Gewürztraminer „Norèy“ IGT 2011	CORONA	Vini Buoni d'Italia	2021
9	Laimburg Südtiroler Gewürztraminer Riserva „Elyònd“ DOC 2017	The Wine Hunter Award	Meraner Winefestival	2021
10	Laimburg Südtiroler Riesling DOC 2019	6. Platz	16. Nationaler Rieslingwettbewerb	2021
11	Laimburg Südtiroler Riesling DOC 2019	90 Points	Falstaff	2021
12	Laimburg Südtiroler Cabernet Sauvignon Riserva „Sass Roà“ DOC 2018	Tre Stelle Oro	I Vini di Veronelli	2021
13	Laimburg Südtiroler Cabernet Sauvignon Riserva „Sass Roà“ DOC 2018	The Wine Hunter Award	Meraner Weinfestival	2021
14	Laimburg Südtiroler Cabernet Sauvignon Riserva „Sass Roà“ DOC 2018	91 Points	Falstaff	2021
15	Laimburg Weinberg Dolomiten Rot Cuvée „Col de Rèy“ IGT 2016	Hervorragend	Wine-Plus	2021
16	Laimburg Weinberg Dolomiten Rot Cuvée „Col de Rèy“ IGT 2017	The Wine Hunter Award	Meraner Weinfestival	2021
17	Laimburg Weinberg Dolomiten Rot Cuvée „Col de Rèy“ IGT 2017	92 Points	Falstaff	2021
18	Laimburg Südtiroler Lagrein Riserva „Barbagòl“ DOC 2018	Tre Stelle Oro	I Vini di Veronelli	2021
19	Laimburg Südtiroler Lagrein Riserva „Barbagòl“ DOC 2018	3° Miglior Vino Rosso d'Italia	Luca Maroni	2021
2o	Laimburg Südtiroler Lagrein Riserva „Barbagòl“ DOC 2018	The Wine Hunter Award	Meraner Weinfestival	2021
21	Laimburg Südtiroler Lagrein Riserva „Barbagòl“ DOC 2018	90 Points	Falstaff	2021
22	Laimburg Südtiroler Kalterersee Classico Superiore „Vernacius Solemnis“ DOC 2019	4 Golden Stars	Vinibuoni d'Italia	2021
23	Laimburg Südtiroler Kalterersee Classico Superiore „Vernacius Solemnis“ DOC 2019	2 Herzen	Merum	2021
24	Laimburg Südtiroler Merlot Riserva DOC 2018	91 Points	Falstaff	2021

14... 2020 HIGHLIGHTS

Feb. 20, 2020

Research Cooperation between Bavaria, Austria, and South Tyrol for the Promotion of Biodiversity

June 25, 2020

Laimburg Research Centre was commissioned to breed the Samurai Wasp, the natural antagonist of the Brown Marmorated Stink Bug, and it was successfully released into the wild

Aug. 21, 2020

Researchers of Laimburg Research Centre were presented with the Award of the American Chemical Society for "Research Article of the Year"

Nov. 18, 2020

Joint conference of Laimburg Research Centre and the Edmund Mach Foundation on "Apple Proliferation" and publication of current research findings in a scientific publication

Nov. 19, 2020

Presentation of the findings of the "PinotBlanc" EFRE research project on adapting the Pinot Noir variety to climate change

Dec. 11, 2020

Completion of the DROMYTAL EFRE project on the development of a sustainable prevention strategy to combat the Spotted Wing Drosophila (*Drosophila suzukii*)

2021 HIGHLIGHTS

March 19, 2021

Presentation of the "Smart Land South Tyrol" project for demand-oriented irrigation in fruit growing, in cooperation with Alperia

April 12, 2021

Virtual 3D tour of Laimburg Research Centre goes online

April 29, 2021

Laimburg Integrated Digital Orchard (LIDO): Start of setting up an open-field digital lab for fruit growing and viticulture

June 13, 2021

"Nibble Balcony" presented during "Open-Doors Day" in the Laimburg plant nursery

June 18, 2021

Laimburg Winery presents the Norèy Gewürztraminer

April 29, 2021

Inauguration of the new DIC pilot plant at NOI Techpark for the innovative production of dried food

COLOPHON

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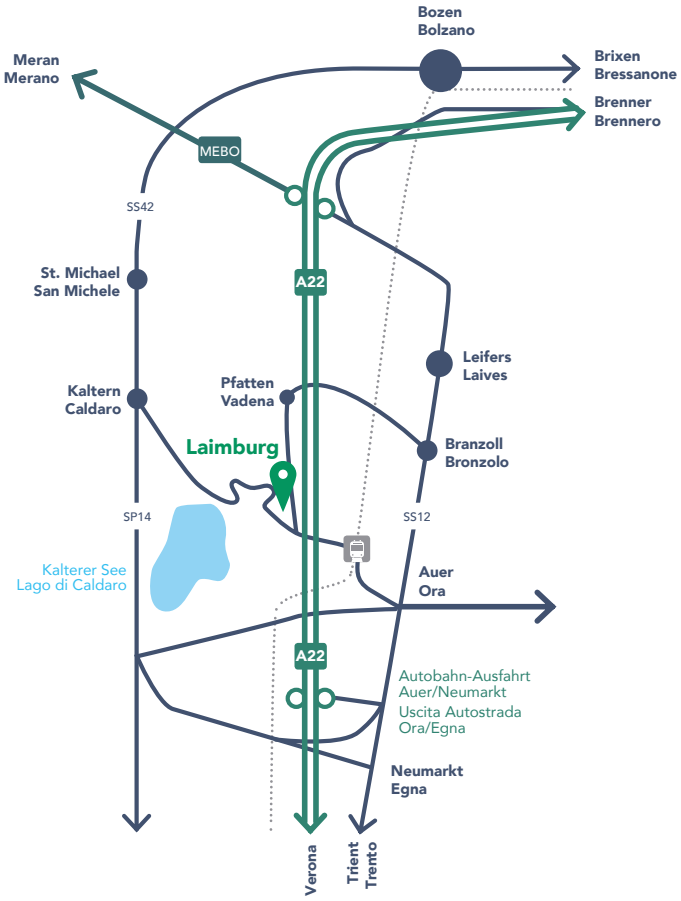
LAIMBURG RESEARCH CENTRE IS THE RESEARCH INSTITUTION FOR AGRICULTURE AND FOOD QUALITY IN SOUTH TYROL.

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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