

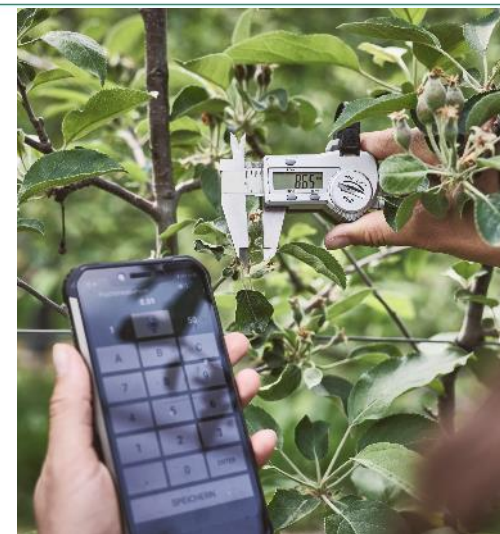
23 luglio 2024

INCONTRO ISPETTORI



Walter Guerra

Relazione tecnica



Progetti di digitalizzazione in Frutti- e Viticoltura presso il Centro di Sperimentazione Laimburg

Walter Guerra



Il Centro di Sperimentazione Laimburg è il centro di ricerca per l'agricoltura e la qualità degli alimenti in Alto Adige.

Con attività di sperimentazione e ricerca condotte su base scientifica **creiamo know-how, elaboriamo soluzioni e realizziamo innovazioni pionieristiche** per il settore agricolo e della trasformazione degli alimenti.

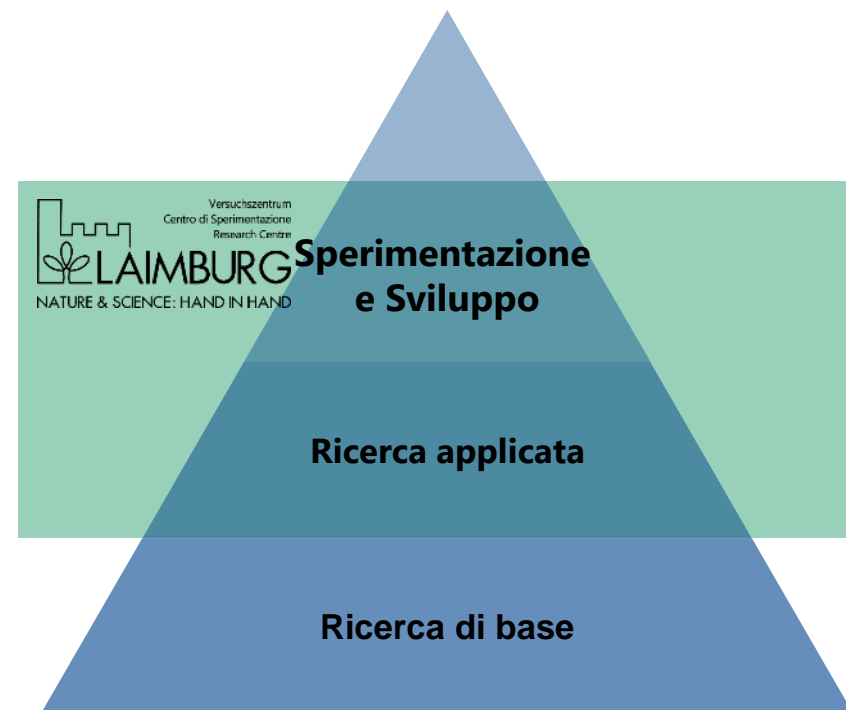
In questo modo forniamo un contributo concreto alla **sopravvivenza** e allo **sviluppo** delle aziende locali.

Obiettivi della nostra ricerca

**Creare
know-how**

**Elaborare
soluzioni**

**Realizzare
innovazioni
pionieristiche**



Programma delle priorità di ricerca 2021–2030



Sistemi di produzione sostenibili e resilienti

Valorizzare il potenziale della natura:
Sviluppiamo sistemi di gestione sostenibili e orientati alla domanda per rafforzare le risorse naturali, la biodiversità e le aziende agricole nella regione alpina.



Agricoltura neutrale per il clima

Metodi di coltivazione e trasformazione più rispettosi del clima:
Sviluppiamo un'agricoltura a ridotta impronta ambientale e maggiore assorbimento di carbonio e adattiamo la gestione alle future condizioni climatiche.



Innovazione digitale e tecnologie smart

Preparare la produzione e la trasformazione alle sfide del futuro:
Trasmettiamo alla prassi agricola digitalizzazione e moderni metodi di miglioramento genetico.



Qualità e salute

Alimenti sani e sicuri dall'Alto Adige:
Sviluppiamo metodi innovativi che consentono alle aziende agricole altoatesine di produrre alimenti di qualità e provenienza sicure.



Diversificazione ed economia circolare

Valorizzare prodotti regionali di montagna:
Promuoviamo la diversificazione dei prodotti di montagna d'alta qualità e ci assicuriamo che vengano utilizzati in un'economia circolare (sovra-)regionale.

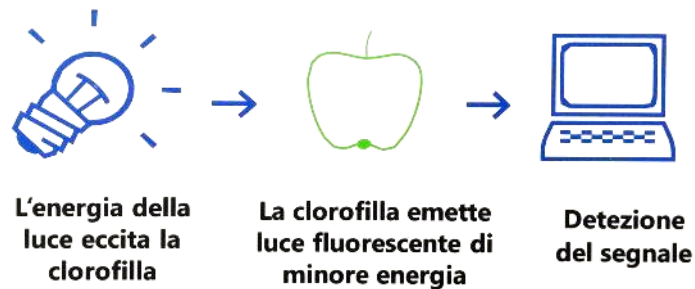
FRUTTICOLTURA



Dynamic controlled atmosphere: DCA measurement using chlorophyll fluorescence

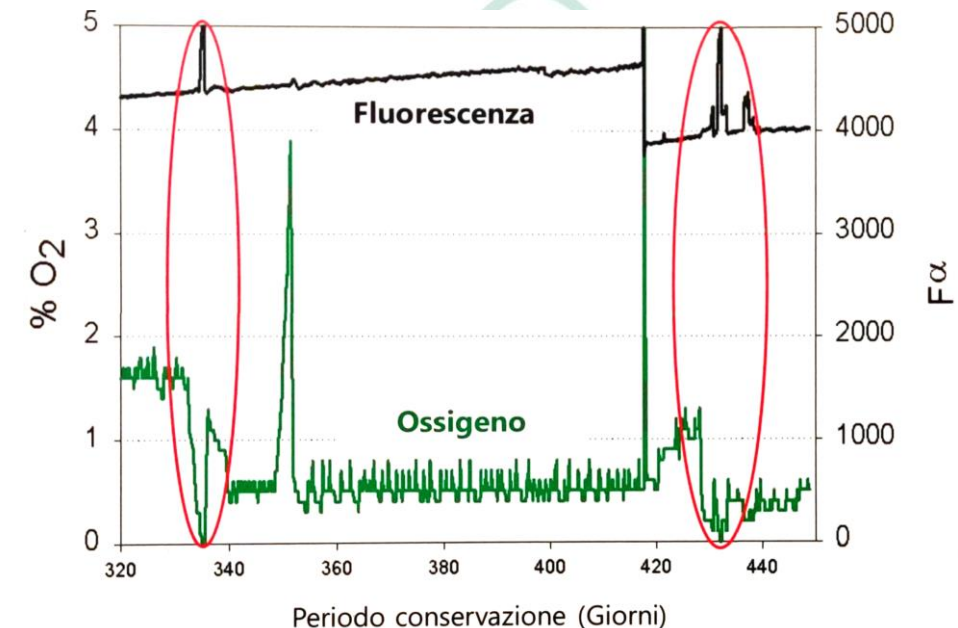
WG Storage and Postharvest Biology

- Precise **adjustment of the O₂ content during storage**
- Chlorophyll fluorescence shows **O₂ demand of the apple**
- Fluorescence sensor: **non-destructive, real time**



→ Reduction of skin browning, no post-harvest treatment with DPA, better quality preservation

- Standard in South Tyrol
- First trial at LRC in 2001, applied worldwide



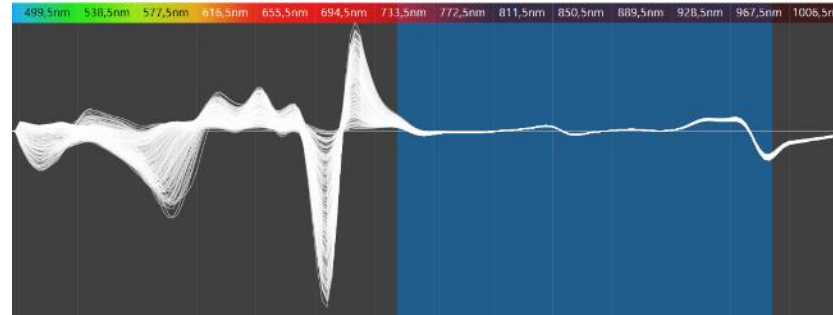
Dry matter (DMC) by NIR spectroscopy

WG Storage and Postharvest Biology

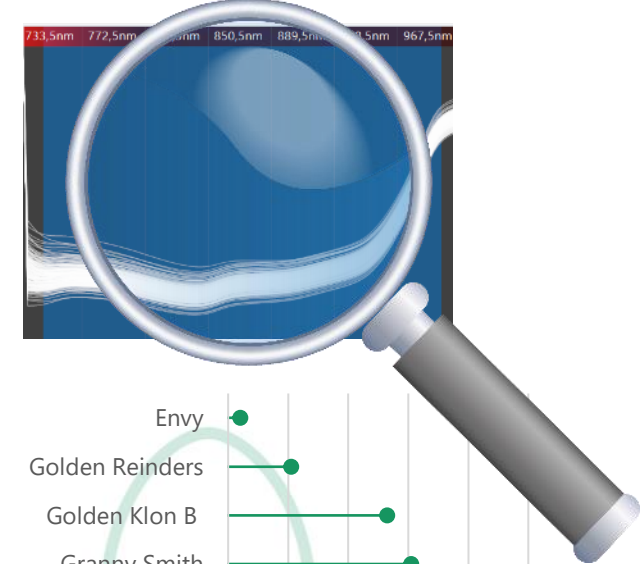
Objectives

- Reliable measurement of dry matter by non-destructive/spectral method using NIRS
- Measurement of dry matter as an alternative quality parameter
- Prediction of the sugar content and/or other quality characteristics after storage already at harvesting

Example of VIS/NIRS spectra of different apple samples in the whole measuring range



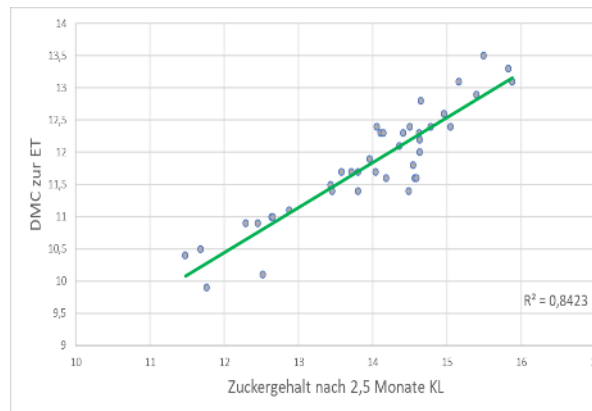
DMC range (729-975nm) of the measured spectra



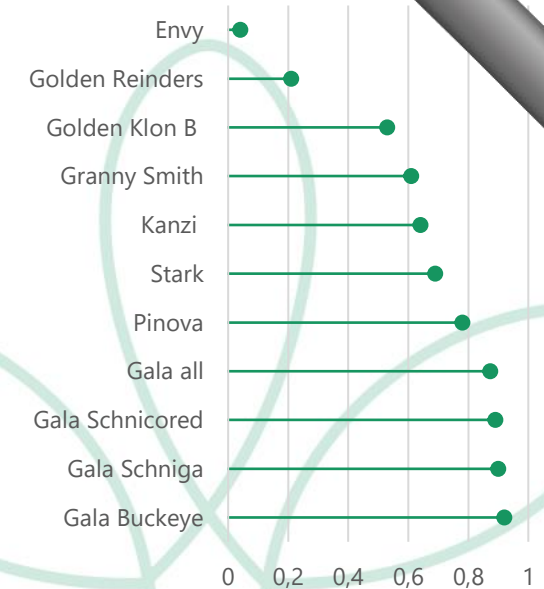
What is dry matter (DMC)?

Ratio between fresh weight and the weight after all the water has been removed.

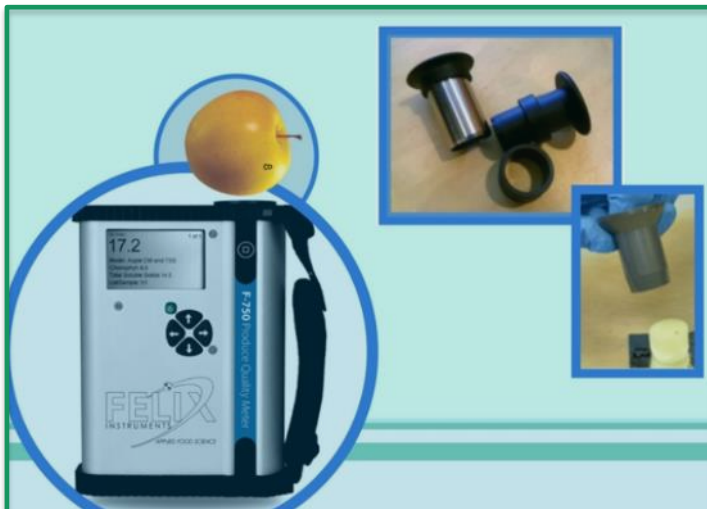
- Carbohydrates • Proteins • Acids • Minerals



Example of correlation between DMC at harvest and sugar content after storage

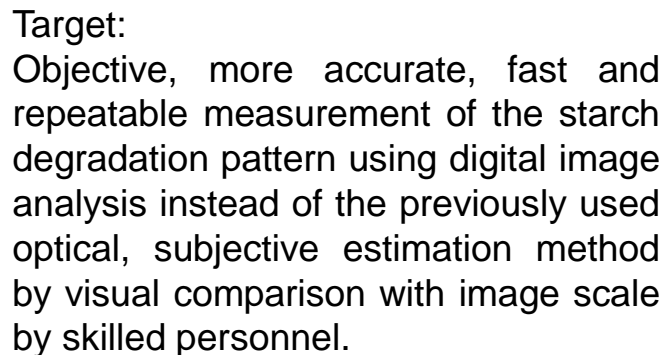


Correlation (R²) between measured and spectral dry substance



WG Storage and Postharvest Biology

AMILON: digital starch meter



Sample #1: 03/11/05
Genus: Malus
Cult: 1-01
Variety: Goldenrum
Color: 376

Mean: 3.4
Error interval: 3.4 - 3.4
Standard deviation: 0.78
Program: 10.1.5
Scale: 1.5

Probenbezeichnung

Berechnung Einzelwerte

grafische Darstellung Mittelwertes

Report produced by: Armin Hage, 8/12

Variation in visual strength estimates between different people

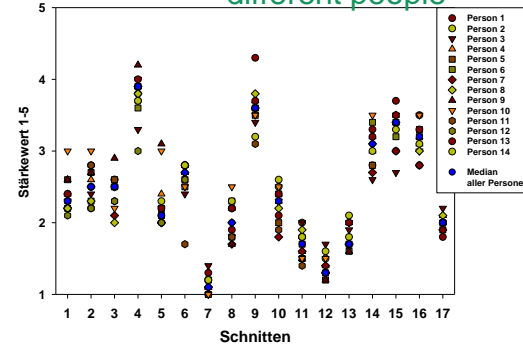
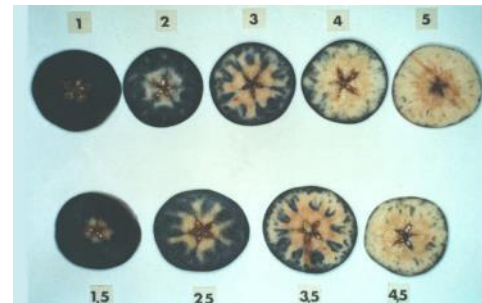


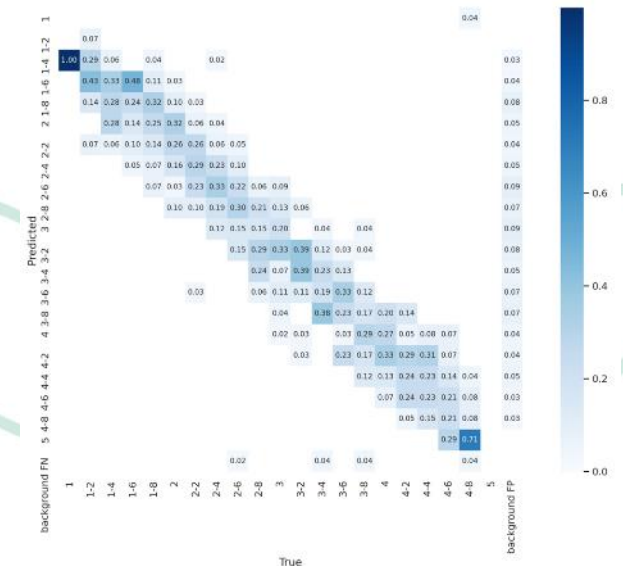
Image scale for visual comparison estimation



AI

Collaboration with UNI- Bologna
Number of images analysed so far:
1,140 photos with approx.10 coloured
apple slices each-> 11,400 accurately
evaluated images analysed with AI.

Correlation (R^2) between visually estimated strength values and values determined using AI



Low-cost and Novel Sensors For Fruit Maturity Assessment Along The Whole Quality Chain

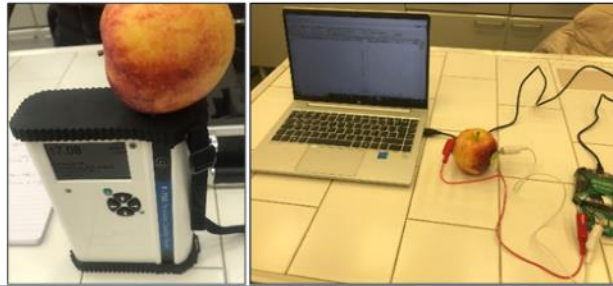
WG Storage and Postharvest Biology

PhD PROGRAM

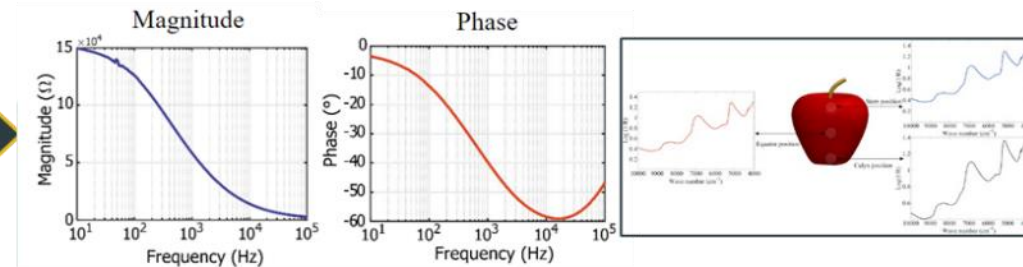
Presenter: **Sundus Riaz**

Food Engineering and Biotechnology

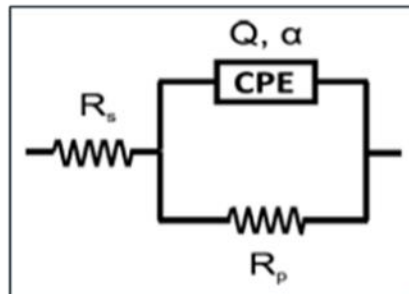
Supervisor (Laimburg): **Dr. Angelo Zanella**



Interaction with an external electrical field and optical measurement



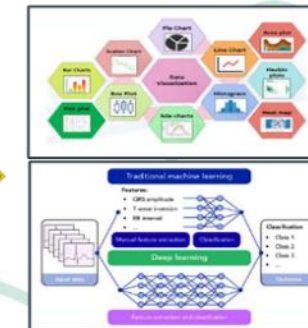
Impedance and NIR spectrum output



Equivalent current model fitting



Correlation with other fruit quality parameters



Statistical Correlation:
Linear method
Machine Learning

Prediction Model Development

Ibba, P., Tronstad, C., Moscetti, R. et al. Supervised binary classification methods for strawberry ripeness discrimination from bioimpedance data. Sci Rep 11, 11202 (2021).

- identify symptoms and to understand disorder development in order
- EU-funded INTERREG V-project "Alpenrhein, Bodensee, Hochrhein", from 2015-2018
- Frudistor: online platform for PCs and smart mobile devices



Frudistor

App zur Bestimmung von
Lagerschäden bei Äpfeln

INTERREG V



www.frudistor.de

Digital outdoor labs for fruit production and viticulture

→ to promote innovation in the area of digitalisation and robotics

- ROBOT READY - Guyot training system
- **Remote control fixed spraying system**
- Demand-based irrigation
- Database
- Working place onsite
- Fibreglass and electricity in the field



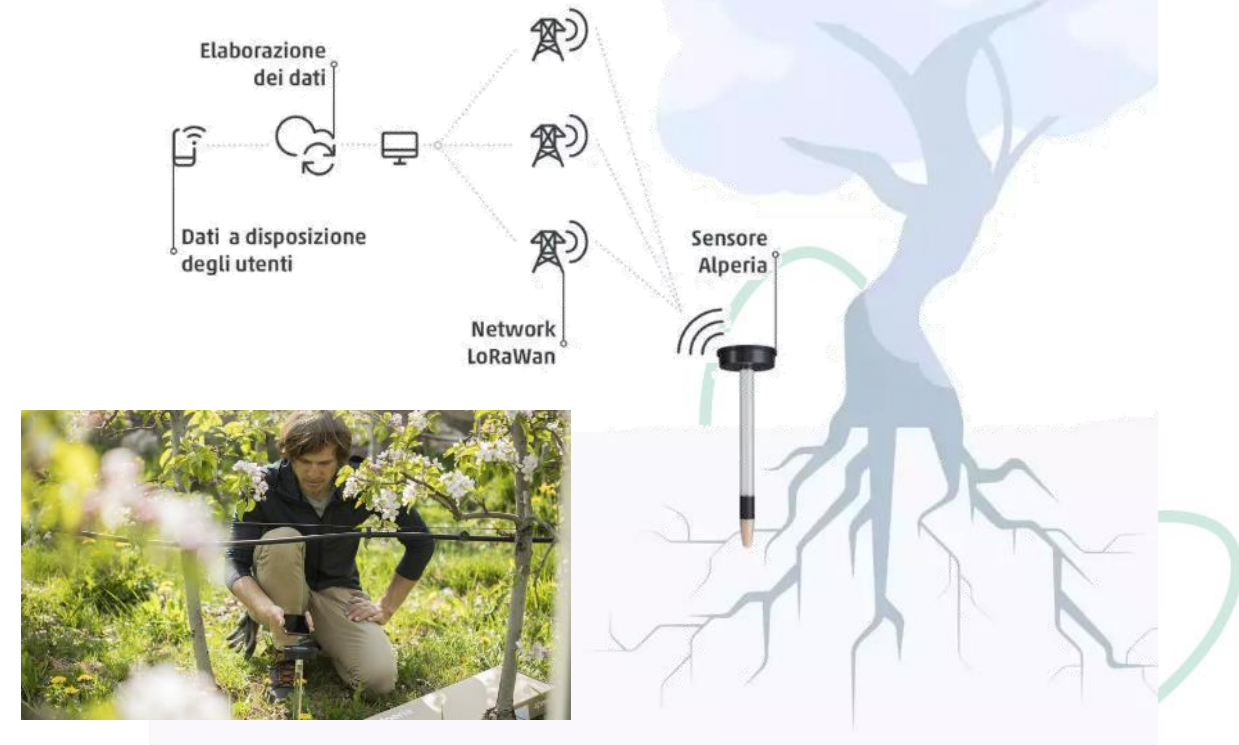
Smart irrigation and stress monitoring in apple cultivation – LIDO-Call 2023



SmartLand – demand-based irrigation

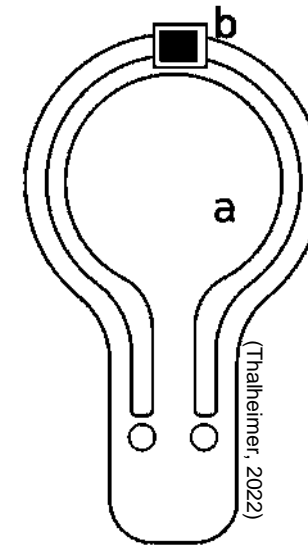
WG Soil, Fertilisation, Irrigation

- Tensiometers with LoRa Wan transmission
- App and web portal with visualisation of soil water potential
- In combination with automatic irrigation control: watersaving up to 60 %



<https://www.alperia.eu/de/energiewende/smartland>

- low-cost leaf-mounted sensor which detects condensing water vapour originating from leaf transpiration
- sensor to monitor solar radiation
- qualitative assessment of plant water status
- close correlation between condensation and irradiance occurs in conditions of unrestricted water supply



DOI:[10.4081/jae.2022.1477](https://doi.org/10.4081/jae.2022.1477)

Bioimpedance-Based Printed Sensors for Environmental Monitoring

Sensing Technologies lab UniBz & WG Pomology

AGRITECH Project

- develop environmentally sustainable printed sensors
- humidity sensors: filter paper as the substrate and conductive ink as the interdigitated electrodes



outdoor



The Sensing Technologies lab, led by Prof. Petti and Prof. Lugli from the Free University of Bolzano, is dedicated to developing sustainable wearable environmental sensors for plants.

Validation of systems for yield and quality forecasting in apple cultivation

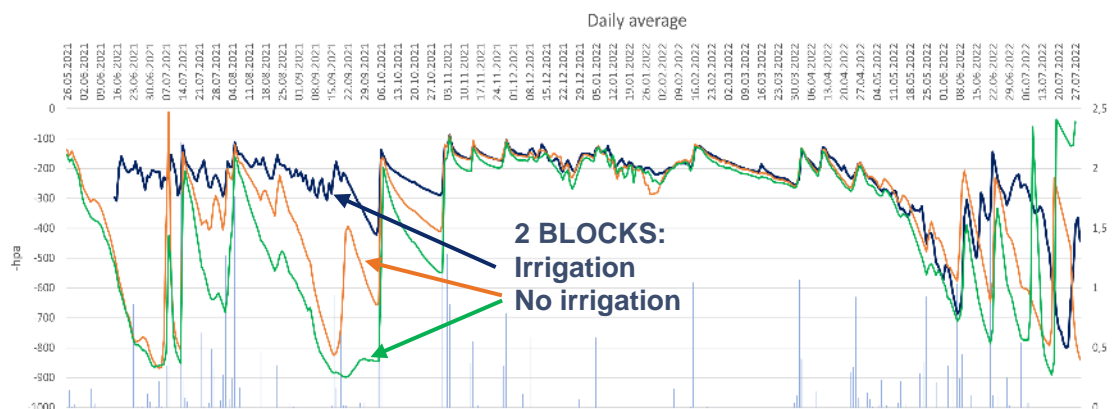
WG Pomology, Physiology



With the help of modern image recognition systems, it is already possible to create yield forecasts to determine **area-related yield capacity and fruit size distribution**. This makes it possible to apply cultivation measures in a more targeted way and to optimize storage and logistics.

- Integration of new methods and tools in advanced variety testing protocols and demonstration in field trials

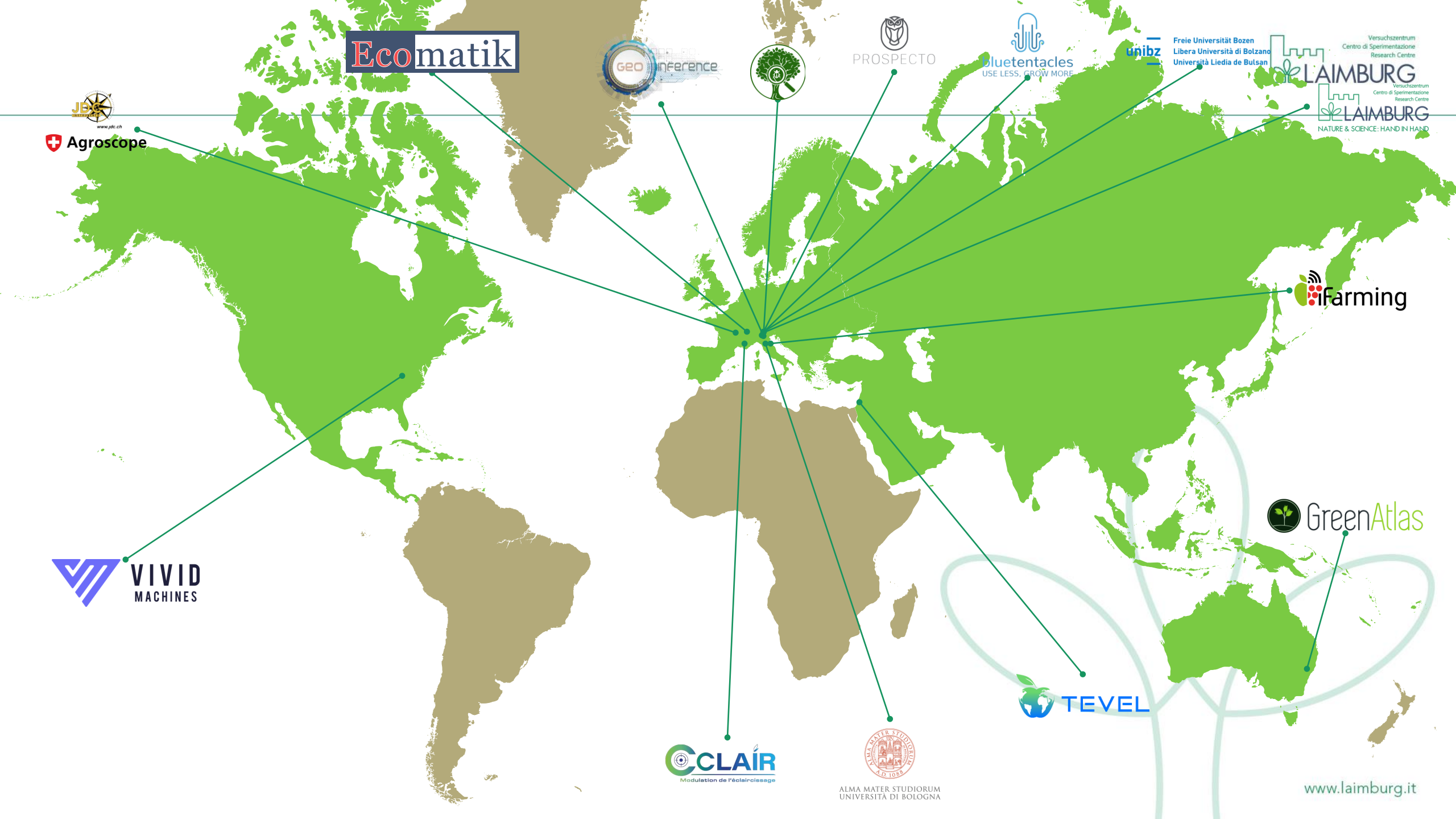
→ improve existing variety testing protocols for variety identification and performance testing: speed, precision and efficiency



LIDO Call: Counting and measurement of fruit in apple and wine growing

Computer Vision Systems
Dendrometer





Ecomatik



PhD: Monitoring Apple Fruit Growth with a Stretchable Strain Sensor

WG Pomology

M. Gullino^{1,2,a}, A.H. Lanthaler¹, A. Altana^{1,5}, S. Vasquez¹, P. Ibba¹, P. Lugli^{1,5}, G. Cantarella⁶, W. Guerra³, L. Petti^{1,5}, L. Manfrini⁴

¹ Faculty of Engineering, Free University of Bolzano-Bozen, Italy;

² Faculty of Agricultural, Environmental and Food Sciences, Free University of Bolzano, Bolzano, Italy;

³ Laimburg Research Centre, Auer/Ora, Bz, Italy;

⁴ Department of Agricultural and Food Sciences (DISTAL) – University of Bologna, Italy;

⁵ Free University of Bolzano, Competence Centre for Plant Health, Bolzano, Italy;

⁶ Department of Physics, Informatics, and Mathematics, University of Modena and Reggio-Emilia, Italy.

Contact: Michele Giullino
michele.gullino@student.unibz.it

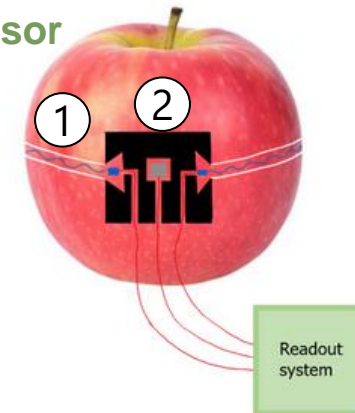


Innovating Fruit Gauges

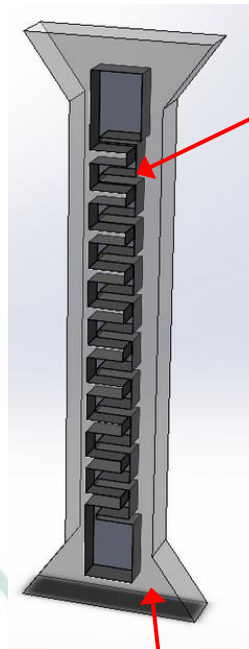
Ecopom « Fruttometro »



New Stretchable Strain Sensor



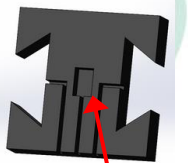
① The sensor:
“Papillon belt”



Stretchable ink sensor:
serpentine design

Silicone rubber encapsulation

② Interconnection
Plate



PT100

Working mechanisms: as the fruit expand, the sensor is stretched, resistance increase. We measure resistance (Ω) correlated with fruit diameter or volume variation.

- set of sensors
- quantitatively monitor apple tree and fruit quality, growth and health status
- In European trial design called "Apple REFPOP"
 - 534 genotypes (2016) at five locations



www.phenet.eu

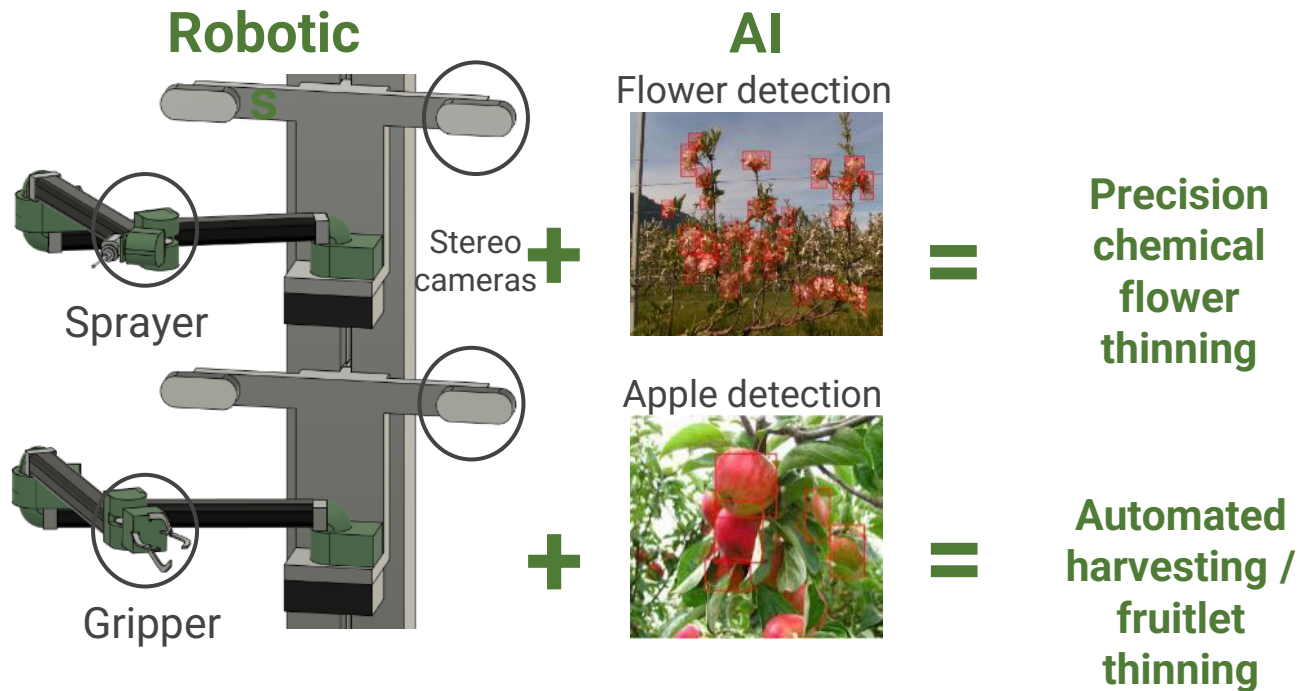


www.laimburg.it

Aigritec - Robot for harvesting and fruit thinning

WG Physiology

aigritec



www.aigritec.com

- Tree pruning contributes significantly to the quality and quantity of the fruit → Yield
- Less qualified workforce is available
- Development of tree pruning goggles with AI, where pruning suggestions are displayed in real time



Monitoring of fruit growth (cherries)

WG Berries and Stonefruit

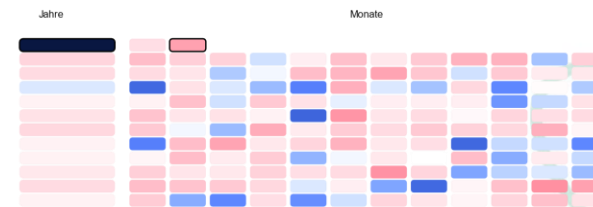
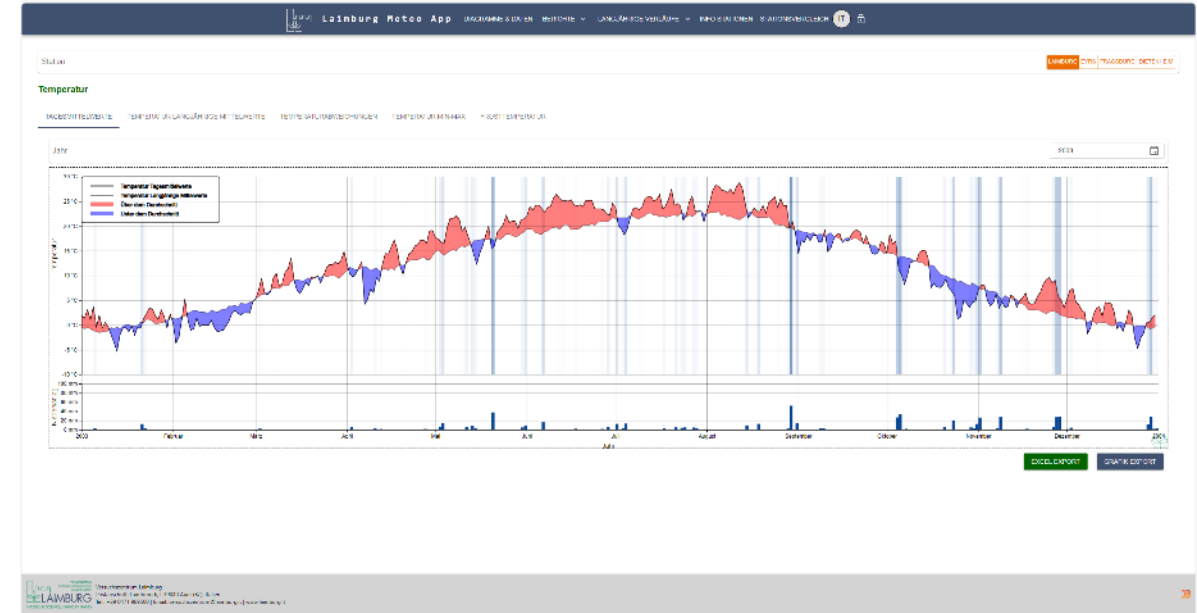


→ estimate the water and nutrients requirement of an orchard in conjunction with environmental data and weather forecasts

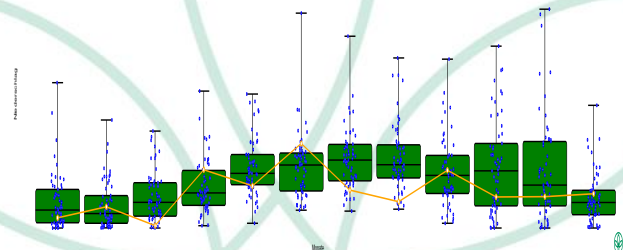
Laimburg Meteo App

WG Soil, Fertilisation, Irrigation & IT Christoph Thaler

- Open source
- Current meteorological data and visualisation of 4 weather stations
 - Laimburg, Eys, Fragsburg, Dietenheim
- Visualisation of current and historical data, reports (monthly, annually)
- Long-term patterns
- Further data integration planned....



www.meteo.laimburg.it



VITICOLTURA



Clevas: Effects of climate extremes on grapevine production in South Tyrol

WG Physiology and Cultivation Techniques

W. Shtai¹, D. Asensio¹, A. Kadison², M. Schwarz³, J. Hoellrigl⁴, M. Steiner³, B. Raifer², C. Andreotti¹, A. Hammerle³, D. Zanotelli¹, F. Haas², G. Niedrist⁴, G. Wohlfahrt³, M. Tagliavini¹

¹ Free University of Bolzano, Bolzano, Italy

² Research Centre Laimburg, Bolzano, Italy

³ University of Innsbruck, Austria

⁴ Eurac Research, Bolzano, Italy

Funded by Autonomous province of Bozen-Südtirol: Research Südtirol/Alto Adige 2019

- Proximal and remote sensing of sun-induced chlorophyll fluorescence as an early stress indicator
- Studying the interactive effects of high temperature and drought on grapevine physiology
- Deficit irrigation experiment in experimental vineyard
- Effects on Wine Quality



Topoclimatic suitability assessment of winegrowing areas in South Tyrol – REBECKA (INTERREG)

WG Physiology and Cultivation Techniques

Simon Tscholl¹, Erich Tasser¹, Barbara Raifer², Arno Schmid², Franz Moser³, Hermann Katz³, Erwin Gartner⁴, Siegfried Quendler⁴, Lukas Vonmetz¹, Lukas Egarter Vigl¹

¹ Eurac Research

² Versuchszentrum Laimburg

³ Joanneum Research

⁴ Obst- und Weinbauzentrum der LK Kärnten

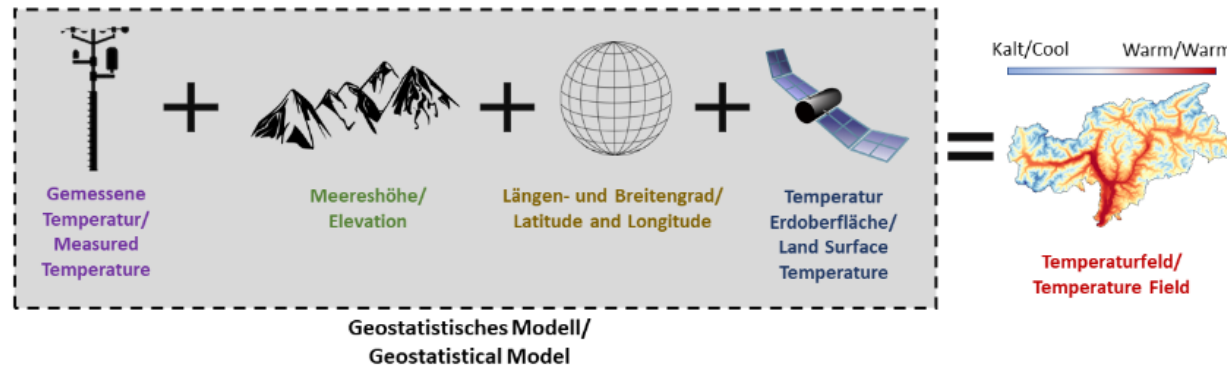


Abb. 5: Schematischer Überblick des Verfahrens zur Ableitung täglicher Temperaturfelder. Für jeden Punkt in Südtirol wird im Bezugszeitraum 2001-2019 ein statistischer Zusammenhang zwischen gemessener Temperatur und Meereshöhe, Breiten- und Längengrad, sowie indirekten Temperaturaufzeichnungen aus Satellitendaten abgeleitet und dadurch ein Schätzwert der Temperatur in einer Auflösung von 100 m bestimmt. // Schematic overview of the method to predict daily temperature fields. A statistical relationship between measured temperature and elevation, latitude, longitude as well as indirect temperature measurements from satellites was calculated and then used to estimate the temperature over whole South Tyrol at a resolution of 100 m.

Die Standortbewertung der Weinbauflächen kommt ab dem Pflanzjahr 2020 zur Anwendung und definiert die Weinbauzone Südtirols. Sie ist zugänglich unter:

<https://landwirtschaft.provinz.bz.it/de/weinbauzonen-browser>

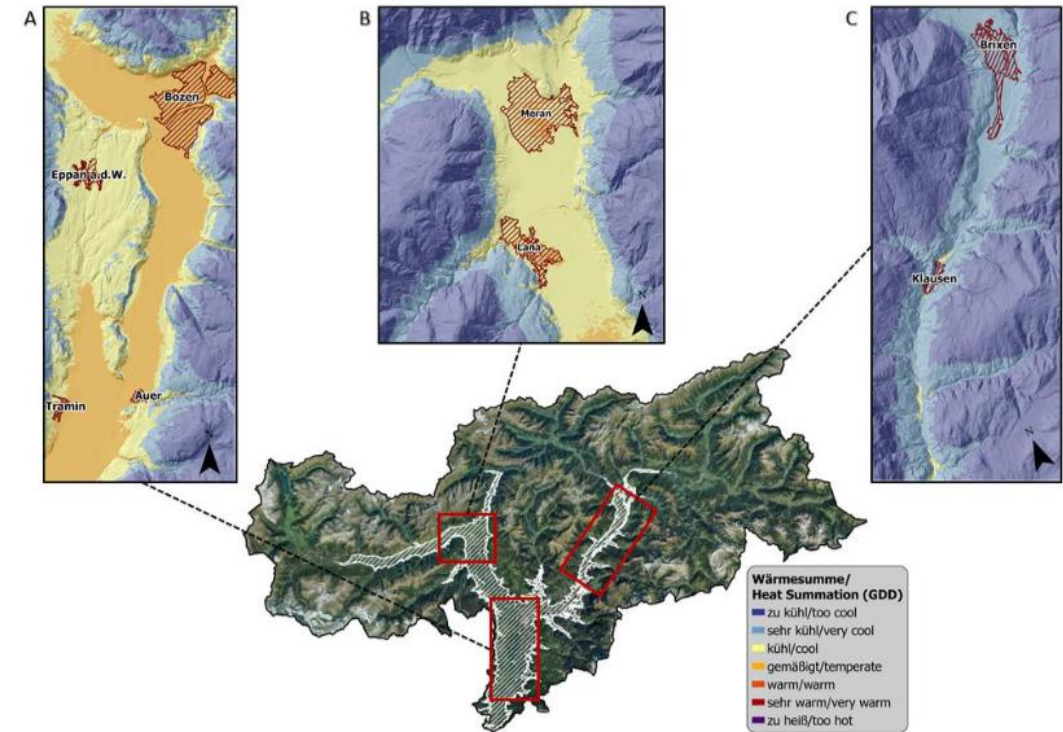


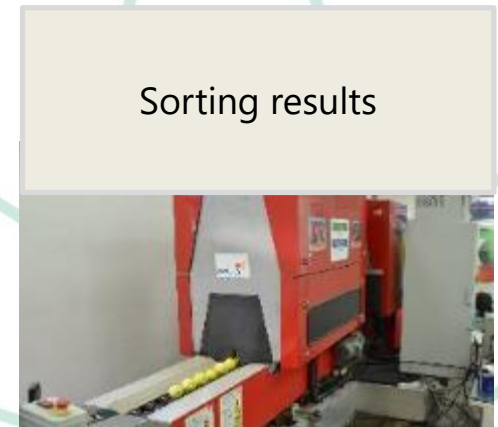
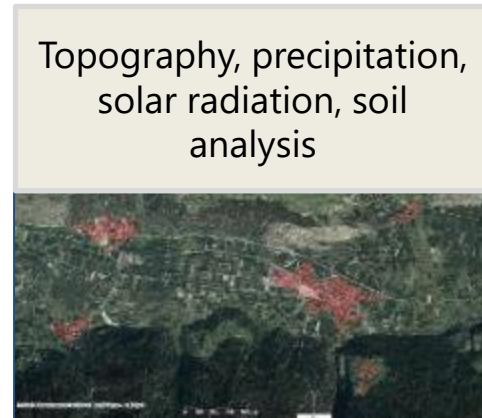
Abb. 4: Das Wärmesummenmodell für Südtirol im Überblick. Die weiß dargestellten Flächen eignen sich für Qualitätsweinbau. Drei Gebiete sind in detaillierter Form dargestellt (A Unterland, B Meran und C Eisacktal), die Farbeinteilung entspricht den Klassen in Tabelle 1. Die für den Weinbau ungeeigneten Flächen sind dunkelblau dargestellt. // The Heat Summation model for South Tyrol. The areas highlighted in white offer suitable conditions for high-quality wine production. Three regions are depicted in more detail (A Unterland, B Meran and C Eisacktal), the different colors correspond to the classification in table 1. Areas in dark blue are classified as not suitable for high-quality wine production.

KULTIVAS - Variety/location pilot project

WG Pomology

KONVERTO

Which apple varieties are suitable for which sites?



Estimation of various crop
parameters, such as apple
size, color and yield

www.kultivas.eu

Comparing soil sensors in viticulture

WG Physiology and Cultivation Techniques



MPS 6 Soil water potential (Decagon Devices, Inc., USA) : Performs similar to a tensiometer but with a much greater range of values.



10HS Soil moisture sensor (Decagon Devices, Inc., USA): Measures the soil moisture in a volume of 1 liter of soil volume.



Drill & Drop Triscan Soil moisture sensor (Sentek Sensor Technologies, AU) : Combines more capacitive water volume sensors. One sensor for each 10cm of length of the sensor.

Grape harvester

WG Physiology and Cultivation Techniques

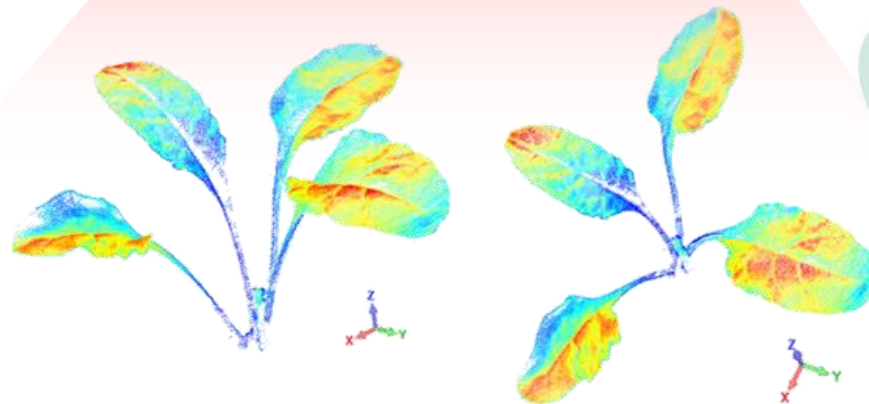


Viticulture: Capacitance sensor of foliar transpiration – FylloClip

WG Physiology and Cultivation Techniques



DIFESA



Flower, fruit and wooly aphid detection with image recognition

WG's Physiology, Pomology, Entomology & Naturamon (Andreas Pichler)

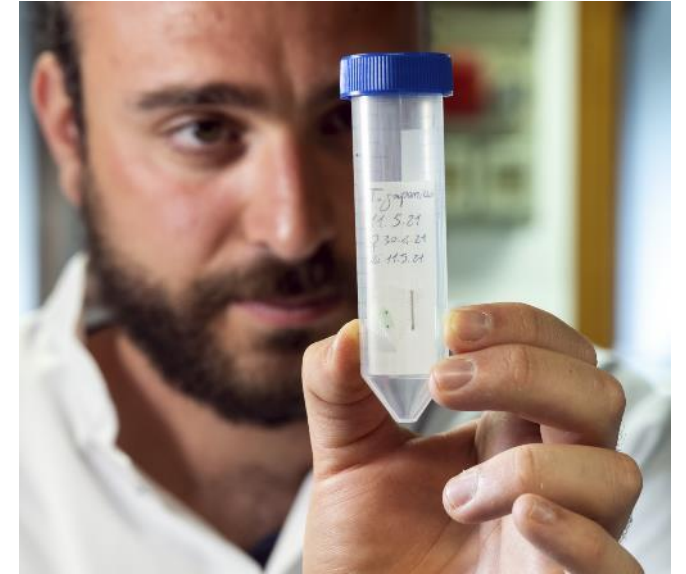


Detection, counting and tree allocation of apples (Golden Delicious)



Leaf and flower detection in young apple trees (Envy®)

- Documentation of observations, traps and collections of insects in the field with the help of a digital medium (smartphone)
- Data collection application and database for data management and storage
- Use in field research and for "Citizen Science" activity
- Spatial and temporal geolocation of the observations
- Automatic recognition of the species with AI



Automatic trap system for the codling moth (Cydia pomonella)

WG Entomology

Co-development and validation



iSCOUT® Pessl

- Comparison of the trap's corpus with already proven codling moth traps
- Adaptation of the corpus of the trap to promote target insect catchability
- Phase 1: Correction of errors in the algorithm for automatic image recognition of codling moth
- Phase 2: Validation of the software
- Comparison of catchability of pheromone capsules vs. kairomone capsules

Target:

Monitoring of codling moth flight at a distance
with automated determination of moth catches

Optimisation of the trap's catch efficiency (corpus + bait)

S. Schmidt, P. Neulichedl

A hyperspectral technique for the detection of 'Ca. Phytoplasma mali' in Apple (Phd thesis)

WG Functional Genomics

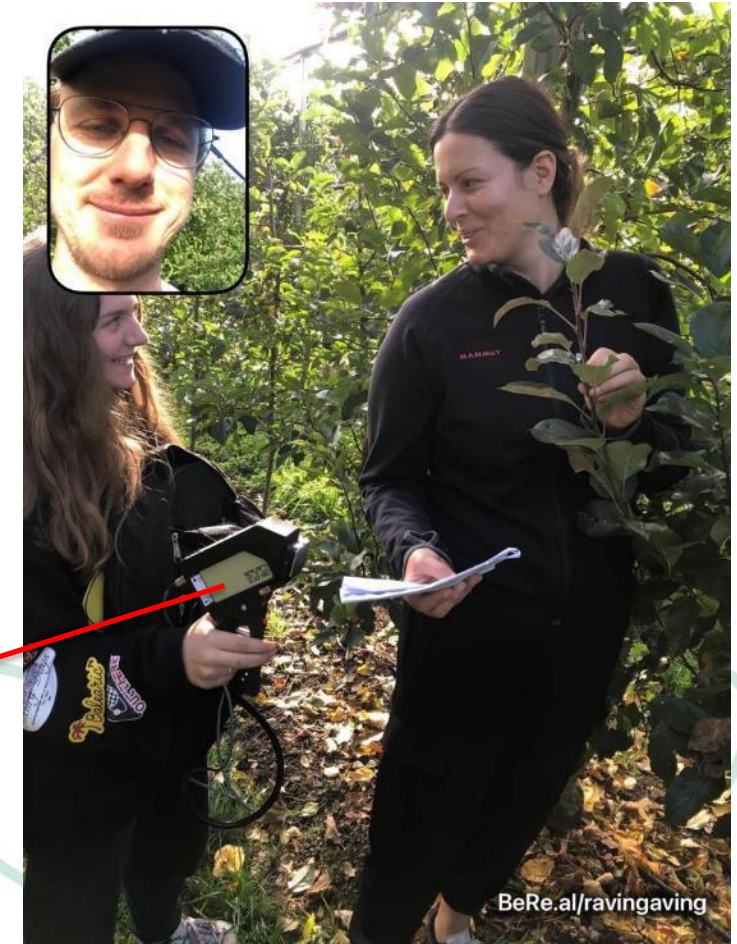
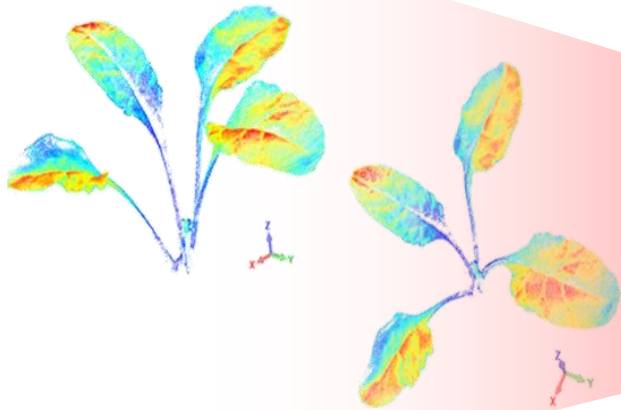
Contact: Cameron Cullinan
ccullinan@unibz.it



Versuchszentrum
Centro di Sperimentazione
Research Centre
LAIMBURG

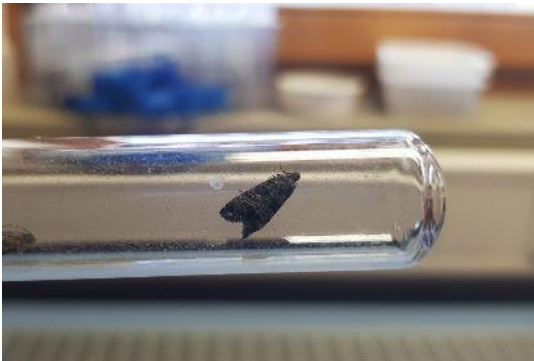
unibz Freie Universität Bozen
Libera Università di Bolzano
Università Lieldia de Bulsan

- Spectral Analysis for detection of biotic and abiotic stress
→ detection of 'Ca. Phytoplasma mali' with a portable spectroradiometer



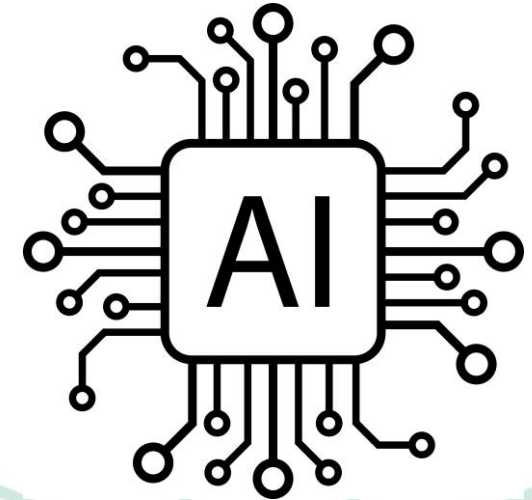
Objective of the project : find new solutions against *Cydia pomonella*, *Drosophila suzukii* in South Tyrolean fruit growing.

- evaluation of traps with new attractants in combination with intelligent sensors and AI
- minimise the use of synthetic insecticides



Artificial intelligence to optimise processes, products and services

- Help companies maintain its digital edge and become more competitive
- expertise, services and access to laboratories, along with financing
- training sessions and workshops



WP 2: SUSTAINABLE AGRI-FOOD SYSTEMS

WP2
SUSTAINABLE
AGRI-FOOD
SYSTEMS

WP3
CONSTRUCTION,
ENERGY AND
WATER

WP4
WORKING AND
LIVING IN SMART
ALPINE AREAS

WP5
SMART
MANUFACTURING



SUSTAINABLE AGRICULTURAL SYSTEMS

Smart technologies for the production of the major agricultural products of South Tyrol's green community



SUSTAINABLE FOOD CONSUMPTION

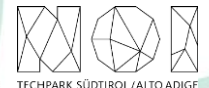
Support the match of supply and demand of food



SUSTAINABLE FOOD SYSTEMS

Challenge to feed people in a healthy and sustainable way

WP2 - PARTNERS



RESEARCH & INNOVATION

ECOSYSTEM GATE
BUSINESS DEVELOPMENT
KPI EVALUATION

Grazie dell'attenzione.



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Steuer-Nr. + MwSt.-Nr. (cod.fisc. + part. IVA) VAT number: IT00136670213
VWV Nummer/numero REA: BZ-201006 vom/del 17/10/2011



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23 luglio 2024

GRAZIE