

## Klima-Widerstandsfähige Rebsorten zur Sicherung des Ertrags

Newsletter #5 (March 2024-October 2025)

### UPCOMING EVENTS

May 14th 2024

KliWiResse Project Meeting III, Institut de Biologie Moleculaire des Plantes (IBMP), CNRS, 12 Rue du Général Zimmer, 67084 Strasbourg

<https://www.ibmp.cnrs.fr/>

### Project meetings:

**14.05.2024:** This time, the partners were guests of the Institute de Biologie Moleculaire des Plantes in Strasbourg. All partners were present. During the one-day meeting, the outcome from the previous year, analysed over the winter, were presented and the plans for the ensuing vegetation period finalised, especially with respect to cooperative activities, such as exchange of materials, synchronisation of time schedules, experimental details and activities for knowledge transfer and publicity. In addition, options for future research were explored, also considering a novel Interreg Upper Rhine project. After the

meeting, the host demonstrated the metabolomics platform established at the IBMP that was already used for this project during the analysis of heat stress responses. The next meeting is foreseen in autumn, after the current experimental campaign, this time at partner ScreenSYS.

### Scientific achievements:

**KIT** at Karlsruhe, Germany has been running a replication of the heat stress experimental campaign comparing the sensitive Riesling and the resistant *sylvestris* genotype Hördt 29. In parallel, an experiment combining heat and drought has been conducted. These experiments are also extended towards the genotypes from the core collection agreed upon with the partners, as well as to relevant rootstock varieties. The experiments are accompanied by non-invasive physiological monitoring using the miniPAM system (Bachelor thesis Vanessa Vrbancic), the samples will be evaluated by measuring expression of stress-marker genes (Bachelor thesis Martina Wagner), but also by metabolomics at partner IBMP. For this purpose, Manasi Nabar will move for two months to IBMP later this fall. The genome database GrapeKIT has been extended by around 20 genomes including PiWi varieties, but also common rootstocks and drought tolerant wild relatives of grapevine (Ruslan Eliseev, Sebastian Eggers). During the period April till July, a continuous flow of fresh leaf material from different genotypes was delivered to partner ScreenSYS for protoplasting. To assess the influence of the rootstock on the stress resilience of the scion, a new study has been launched in September in cooperation with FibL making use of their set-up, where common varieties (Spätburgunder, Riesling x Sylvaner) are grafted on different rootstocks side by side in the same vineyard and measuring the carbon isotope ratios to assess the integrated stress history of the preceding summer (Manasi Nabar in cooperation with Dr. Michael Riemann, who moved from KIT to FibL in July 2024). Associated with KliwiResse, a study on the effect of nitrogen status on climate resilience has been conducted in frame of the Georg-Forster fellowship by Dr. Elnaz Zareei and the PhD of Yijing Wu. As well, beneficial microbes could be identified that can stimulate resilience of the trunk by Dr. Islam Khattab.

**ScreenSYS** develops protocols for the induction of plantlets from pollen precursors, the microspores. This frequently includes application of physical stresses (e.g. temperature) on isolated cells which in some cases is sufficient for cellular reprogramming. However, a high number of plant species are recalcitrant and do not respond to these treatments, which makes protocol developments very challenging. ScreenSYS applies temporary cultivation of microspores with specific chemicals to induce plantlet formation from microspores which was shown to overcome the recalcitrance of several plant species. For this, chemicals with potential reprogramming properties are identified in screening approaches with microspores from model species. Several of such chemicals, identified from a screening of 5000 chemicals from a

chemical library, were now applied on grapevine microspores and tested for their capacity to increase the viability and further promote initial microspore divisions. The results will be analysed and combined with best media conditions for further develop the protocol towards double haploid grapevine plantlets. These experiments were conducted with flower material from this year's growing season from plants in the field provided by the JKI in Siebeldingen, but also from our associated partner WBI in Freiburg who kindly generated flowering plants in the greenhouse during off-season times.

Regarding the identification of basic physiological mechanisms determining heat and drought tolerance at the single-cell level, ScreenSYS has established the experimental conditions required to use a grapevine cell culture system for corresponding investigations. First experiments were performed in which low molecular weight compounds, naturally accumulating in grapevine tissues, were tested for their capability to affect the heat resilience of isolated single cells, the protoplasts. This revealed that the addition of citric acid positively increased the survival rate of protoplasts in a concentration-dependent manner. Additional experiments revealed that citric acid improved the heat resilience by mechanisms acting in heat stress recovery, rather than protecting cells during heat application. Further experiments including also a second genotype are planned to show genotype-specific response differences to citric acid and to further investigate this process.

**IBMP.** The samples from the time-course study comparing Riesling with the wild Hördt 29 collected in 2023 by Paula Venzke were further analysed. The previous targeted hormonal profiling (LC-MS/MS) was now complemented by a non-targeted global metabolomic exploration (high resolution LC-MS/MS), characterising the central metabolism by (GC-ToF-MS), a method developed based on the expertise of Hugues Renault who embarked the project. First results are awaited soon. This newly established technological pipeline can now be applied to other samples as well, including those materials that have been generated during the vegetation period 2024.

**JKI** at Siebeldingen, Germany has made progress in optimisation and establishment of a phenotyping pipeline designed to study the resilience of grapevine varieties to sunburn. The results from screening the *sylvestris* genotypes from the last year were revisited and the differences between the genotypes were confirmed, reinforcing the potential of these accessions in contributing to sunburn resilience strategies in grapevines. A key milestone this year has been the development of AI-based tools for berry sunburn quantification with an accuracy rate of more than 97%. Our advanced AI system can now process and analyze images of up to 1200 berries in just one hour. To further test the deployment and efficiency of our Convolutional Neural Network (CNN), we captured a new set of images from 50 different grapevine varieties post sunburn test and will be used in model validation. The system has proven to be a robust tool for large-scale phenotyping efforts.

**FibL** at Frick had found, during a field study with Pinot noir with FertiRoc, an aluminium silicate fortifier, positive effects during the heat season 2023, such as improved chlorophyll content and higher contents of macro- and microelements in leaves and berries. This led to a better wine quality with favourable acidities and amino acid content. The positive result encouraged us to extend the study on the two PiWi varieties Sorten Sauvignon Soyhières and Divico. However, the season 2024 was cool and humid, meaning a lot of pathogens in the vineyards, but much less drought and heat stress, meaning that the field studies this year will not so informative with respect to abiotic stress. We, therefore, plan a replication in the season 2025. We also conducted a drought-stress experiment with Riesling on two different rootstocks, Selektion Oppenheim 4 (SO4) and Kober (5BB), following different physiological and metabolic parameters. We also continued with our investigation of important local varieties in the Cantons Aargau, Basel, Stadt, Baselland, and Jura with respect to climate change.

## **Interactions**

**1. KIT-ScreenSYS:** Leaf material from the core set of genotypes as well as inflorescences for the double haploidisation been transferred the entire vegetation season.

**2. KIT-FibL:** Manasi Nabar from KIT has collected leaf material in the FiBL vineyard, where the same scions are grafted on different rootstocks side by side to detect systemic effects of the rootstock on climate resilience.

**3. KIT-IBMP:** The analysis of the samples from the current experimental campaign at KIT on heat and combined heat-drought stress in the contrasting pair Riesling versus *sylvestris* Hördt 29, along with different rootstocks, PiWi varieties, and *sylvestris* candidates will start later this autumn at IBMP. For this purpose, a 2 months research visit of Manasi Nabar (KIT) at the IBMP has already been organised.

**4. FiBL-KIT-JKI:** Material from the FiBL PiWi collection has been sent to the partners and is included in the studies on heat stress and sunburn.

**5. WBI-ScreenSYS:** Material provision by WBI for floral buds of the PiWi variety Calardis Blanc in the right stage for somatic embryogenesis has been conducted throughout the season.

**6. JKI-IBMP:** Metabolic profiling at IBMP of controlled greenhouse experiments at JKI has been organised

**7. JKI-KIT:** Sunburn screening for berries of the genotypes from the KIT *sylvestris* collection has been conducted at JKI in the AI-based highthroughput phenotyping platform. Data collected and analysed by by Dr. Nagarjun Malagol show a high tolerance of several *sylvestris* genotypes excelling numerous commercial varieties. There might be a possible link with the density of lenticelles (cork-enocated small apertures in the surface of the berry stalk that are relevant for gas exchange), which will be followed up in more detail in the future.

## Website:

The KliWiResse website has been complemented with a section on the progress achieved by the partners under the section research

## Newsletter:

Newsletter #6 is planned for February 2025.

## Outputs:

### **JKI**

- 04.09.24 KLIWIRE SSE project was presented at PhenomUK (organized by United Kingdom Research Infrastructure) conference held in Coventry, United Kingdom (Nagarjun Malagol).
- 25.08.24 Tag der offenen Tür – Geilweilerhof (Nagarjun Malagol and Oliver Trapp)

### **IBMP**

- 14.05.2024 – Project Meeting at the IBMP in Strasbourg
- 14.06.2024 – Presentation of Kliwiress e at Open Door INRAe in Colmar, exchange with Eric Duchêne, deputy Director of SVQV Unit, and expert in climate change impact on grapevine.
- 01.10.2024 – poster and brochures on Kliwiress e at Alscian cross-border partnership event in Strasbourg and Colmar



### **KIT**

- 18.10.2024 – Public talk in Würzburg with the Gesellschaft der Geschichte des Weines and the Frankonian Weinkönigin, around 120 people attended.

## **FiBL**

- 26.-27.06.2024 presentation of Kliwiresse at the Bio-Ackerbautagung in Aubonne
- 07.-08.09.2024 presentation of Kliwiresse at 1001 Gemüse 2024 in Rheinau (CH)