

A wide-angle photograph of a lush yellow rapeseed field in full bloom. The foreground is filled with numerous bright yellow flowers on green stems. In the middle ground, a line of green trees marks the edge of the field. Behind the trees, a small white building with a dark roof is visible. The sky is a clear, bright blue with a few wispy white clouds.

MAIN EXPERTISE FIELDS

- Environmental monitoring: pests in oilseed rape diseases in cereals, weeds in wheat, maize and oilseed rape, pest and diseases in viticulture, environmental impact of pesticides
- Pesticide reduction in agriculture: viticulture: crop rotation, crop cultural management, disease forecast, use of less harmful or biological products, biological or biotechnological pest control
- Climate change: adaptation strategies in viticulture and horticulture
- Pollinator decline: honeybee colony losses - from monitoring to prevention strategies
- Digital decision support tools for agriculture and viticulture
- Innovative diagnostic tools in plant pathology: genotyping, analytical chemistry and remote sensing
- Soil microbial diversity: the microbiome and microbial processes that moderate nutrient cycling, carbon sequestration, and soil health

Our activities are mainly wired around use-inspired basic research, as well as applied research activities. More specifically, we focus at three complementary domains:

Crop protection

We target a reduction of pesticide application and a more widespread use of techniques - aligned with EU regulations and directives on food quality and sustainable use of pesticides. Our deliverables consist of knowledge generation, knowledge transfer and method development in the domains of

- Pest and disease monitoring services, including resistance management
- Scientific basis for local decisions on the use of plant protection agents which respect non-target organisms, like pollinator insects
- Development and evaluation of sustainable cropping techniques for reducing the use of pesticides as well as adapting to changing environmental factors, especially droughts

PRECISION AGRICULTURE AND VITICULTURE

In cooperation with the [REMOTE group](#) and the [HOST platform](#), we also participate in the development of new approaches for precision agriculture based on drone and fixed-wing, as well as lab based data acquisition (visible, thermal and hyperspectral).

Climate-agro-environmental systems interactions

We aim at predicting the impact of climate change on agricultural systems (including arthropod-plant interactions), as well as achieving a better understanding of its role as one of the major sources of anthropogenic climate forcing. We deliver (non-exhaustive list):

- High-resolution regional climate simulations and projections based on recent emission scenarios
- Local and regional impact studies of climate effects on agro-ecosystems
- Assessment of agricultural management on soil health, soil carbon, and soil nutrient cycling

Development of smart agricultural approaches for transforming agricultural systems to guarantee ecological intensification and ensure food security under a changing climate

APPLICATION AREAS

- Agricultural monitoring: pests in oilseed rape, diseases in cereals, weeds in wheat, maize and oilseed rape, pest and diseases in viticulture, environmental impact of pesticides
- Pesticide reduction: crop rotation, crop cultural management, disease forecast, use of less harmful or biological products, biological or biotechnological pest control
- Precision agriculture: agroecosystem protection and management, digital decision support tools for agriculture and viticulture
- Global change & agriculture: adaptation strategies to climate change in agriculture, viticulture and horticulture, pollinator decline, vegetation response to global change, water cycle-vegetation feedbacks, mitigation strategies to enhance soil carbon sequestration and reduce greenhouse gas emissions from agricultural soils

MAIN ASSETS

- Decision support tools for pesticide and fertiliser management in drinking water protection zones
- Decision support tools for controlling diseases and pest insects in agriculture and viticulture
- High-resolution regional climate simulations
- Collection of well-characterised fungal strains that was established within the framework of the FP7 European Project MycoRed, [Luxembourg Microbial Culture Collection](#). The information on the strains is freely available. Fungal strains are available to academia and industry on request.
- Black rot module of the viticultural disease warning system, [Vigiparas](#).

EQUIPMENT

- We operate well equipped soil microbial, mycology and entomological laboratories, as well as climate chambers to investigate effects of changing environmental factors (e.g., temperature, humidity, radiation and CO₂ levels) on multi-trophic systems
- We use soil chambers and a mobile gas analyser for the assessment of different greenhouse gas emissions (CO₂, NH₃, CH₄, N₂O) from agricultural sites.
- We run and co-develop a suite of established software for terrestrial systems and atmospheric simulations: Weather Research and Forecast Model (WRF), the Terrestrial System Modelling Platform (TerSysMP), and the Community Land Model (CLM).

SELECTED PUBLICATIONS

2021

- **Frequency of Deoxynivalenol Concentrations above the Maximum Limit in Raw Winter Wheat Grain during a 12-Year Multi-Site Survey.** Pallez-Barthel M, Cocco E, Vogelsgang S, Beyer M. *Agronomy*, 11, 960.
- **Advances in Catchment Science through Integrated Hydrological Modelling and Monitoring.** Bertoldi G, Camporese M, Sulis M. *Water* 13.
- **Long-term adaptation of European viticulture to climate change: an overview from the H2020 Clim4Vitis action.** Santos JA, Yano C, Fraqa H, Malheiro AC & al. *IVES Technical Reviews*, vine and wine

2020

1. [Revisiting the incidence of environmental factors on a pre-imaginal population of the red gum, *Psychid, glycaasis hirsuticornis* Moore](#), Junk J, Eickermann M, Milenovic M, Suma P, Rapisarda C. *Insects* 11: 1–12.
2. [The debate on a loss of biodiversity can we derive evidence from the monitoring of major plant pests and diseases in major crops?](#), Dam D, Pallez-Barthel M, El Jarroudi M, Eickermann M, Beyer M. *Journal of Plant Diseases and Protection*. In press.
3. [Quantitative use of passive sampling data to derive a complete seasonal forecast of food event loads: a case study for maize herbicides in Luxembourg](#), Gallé T, Frelat M, Huck V, Bayerle M, Pétis D, Braun C. *Environmental Processes: Processes Impact* 22: 294–304.
4. [Diversity of mobile genetic elements in the mitogenomes of closely related *Fusarium culmorum* and *F. graminearum sensu stricto* strains and its implication for diagnostic purposes](#), Kulik T, Brankovics B, Van Diepeningen AD, Biliska K, Zelechowski M, Myszczyński K, Molcan T, Stakheev AA, Stengelen S, Beyer M, Pasquali M, Sawicki J, Wybręnk J, Baturo-Cieśniewska A. *Frontiers in Microbiology* 11: 1002.
5. [Searching molecular determinants of sensitivity differences towards four demethylethyl inhibitors in *Fusarium culmorum* field strains](#), Pasquali M, Pallez-Barthel M, Beyer M. *Pesticide Biochemistry and Physiology* 164: 209–220.
6. [A review of the potential climate change impacts and adaptation options for European viticulture](#), Santos JA, Fraaije H, Malheiro AC, Moutinho-pereira J, Dinis LT, Correia C, Moriondo M, Leolini L, Dibari C, Costafreda-Aumesda S, Kartschall J, Menz C, Molitor D, Junk J, Beyer M, Schultz HR. *Applied Sciences* 10: 3092.

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5. [Natural compounds for controlling *Drosophila suzukii*: A review](#), Dam D., Gaillet D., Beyer M. *Agronomy for Sustainable Development* 39: 53.
6. [An immersion perspective of emerging microclimatic pressures in Luxembourgish surface waters: A simple evaluation scheme for wastewater impact assessment](#), Gallé T., Pittolo D., Bayerle M., Braun C. *Environmental Pollution* 253: 992-999.
7. [Incorporating a root water uptake model based on the hydraulic architecture approach in terrestrial systems simulations](#), Mauro S., Couvreur V., Keul J., Gal Trebs J., Junk J., Shrestha P., Schmitt C., Vereecken H., Vanderborght J. *Agricultural and Forest Meteorology* 269-270: 28-45.
8. [An eight-year survey of wheat shows distinctive effects of cropping factors on different *Fragaria* species and associated mycorrhizas](#), Vogelgesang S., Beyer M., Pasquale M., Jenny E., Mues T., Blicher T., Wettstein FE., Forrer HR. *European Journal of Agronomy* 105: 62-77.

2018

- [Winter honey bee colony losses, *Varroa destructor* control strategies, and the role of weather conditions: Results from a survey among beekeepers](#), Beyer M, Junk J, Eickermann M, Clermont A, Kraus F, Georges C, Reichart A, Hoffmann L. Research in Veterinary Science 118: 52-60.

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