UNIVERSITY OF HOHENHEIM

The University of Hohenheim

The origins of the University of Hohenheim can be traced back to a devastating natural disaster. In April 1815, the Tambora volcano in Indonesia erupted. 140 billion tons of ash and dust particles were shot into the atmosphere, darkening the sky. 1815 went down in history as the "year without a summer". It was the most disastrous volcanic eruption of the modern era and also led to the worst famine in 19th century Europe. In response to it, King William I of Württemberg and his wife Catherine Pavlovna founded the agricultural teaching, experimental, and model institute of Hohenheim, which would later become the University of Hohenheim. On the occasion of its 150th anniversary, the institute, which had by then evolved into an "Agricultural College", was elevated to university status.

The university consists of three faculties: the Faculty of Agricultural Sciences, the Faculty of Natural Sciences, and the Faculty of Business, Economics and Social Sciences. With its 143 professorships, roughly 2,100 staff, and almost 9,000 students, the University of Hohenheim is the smallest of the nine state universities in Baden-Württemberg.

Distinctive and unique, the University of Hohenheim is highly specialised and the oldest university in the city of Stuttgart. With its unique curriculae, the University of Hohenheim cleaves to the tradition of developing innovative solutions for urgent societal issues, while conducting intensive fundamental research. Today, the University of Hohenheim is second to none in agricultural research and food sciences in Germany and plays a unique and strong role in the natural sciences, economics, the social sciences and communications sciences. The University of Hohenheim has an international network of more than 100 partners from around the globe.

The degrees at the University of Hohenheim are innovative and embrace experimentation. Hohenheim particularly treasures Wilhelm von Humboldt's idea of the unity of teaching and research, and has expanded and modernised this approach. Students are given early opportunities in their Bachelor degrees to gain initial experience in research.

One field which is a core focus in the teaching and research of all three faculties is bioeconomy. The University of Hohenheim is the key player when it comes to bioeconomy in Baden-Württemberg and is recognised in this field at both national and European level. In addition to the striking profile of the University of Hohenheim, the compact green campus surrounding the iconic palace is the perfect foundation for cooperation in teaching and research beyond the boundaries of individual faculties or fields of study. It is considered to be the most beautiful university campus in Germany, offering staff and students an intimate and cooperative atmosphere.

Further information: https://www.uni-hohenheim.de/en/portraet
https://www.uni-hohenheim.de/en/profile
https://www.uni-hohenheim.de/en/geschichte

UNIVERSITY OF HOHENHEIM

Contact: **The President of the University, Professor Dr Stephan Dabbert,** rektor@uni-hohenheim.de

The Faculty of Agricultural Sciences of the University of Hohenheim

For years, the University of Hohenheim has ranked first among Germany's universities in a number of rankings in the field of agricultural research and food sciences, including THE World University Ranking, QS World University Ranking, etc.. It also is among the top universities in Europe in these fields, coming high up in international rankings too. The Faculty of Agricultural Sciences of the University of Hohenheim is the only comprehensive faculty for agricultural science in Germany. It covers the entire range of agricultural science, from soil, plant production and livestock production through to socioeconomic aspects. Hohenheim also conducts in-depth research into ecological and biodiversity issues. And the fact that the University of Hohenheim offers agricultural engineering makes it unique. With 55 professorships, the agricultural science faculty is the largest of the three faculties at Hohenheim. Approximately 2,100 students are enrolled in three Bachelor and twelve Master degree courses at the Faculty of Agricultural Science.

The faculty continues the tradition of the agricultural teaching, experimental, and model institute of Hohenheim that was founded more than 200 years ago. The challenges agriculture has to tackle have fundamentally changed and become significantly broader over the years. While the focus used to be on producing sufficient quantities of food, agriculture now has to address the many societal demands for a multi-functional agricultural sector. These relate to global food security,renewable resources, bioenergy, ecologically sound and sustainable production methods, health-sustaining and socially-oriented food systems, consumer protection, biodiversity conservation and associated ecosystem services, issues of economic viability and ethics, the health, protection and welfare of animals, and social security systems in rural areas. The university considers agricultural science to be a driver of the bioeconomy, with due regard given to resource conservation and climate change mitigation, and of the transformation towards a more sustainable agricultural sector (including organic farming) that uses adaptive and resilient production systems.

Further information: **https://agrar.uni-hohenheim.de/en/**

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The Agricultural Experimental Station

A key factor for the success and excellent reputation of the Faculty for Agricultural Science is the Agricultural Experimental Station. The Agricultural Experimental Station is both a research lab and an educational institution of the University of Hohenheim. Scientists, primarily from agricultural sciences, engineering, and ecology, use the three locations to carry out research projects with plants outdoors and with livestock. The Agricultural Experimental Station provides Hohenheim scientists with unique opportunities to conduct experiments under real-life conditions.

The Station also provides the technical facilities for completing theses at Bachelor and Master level, doctoral dissertations, and other scientific and applied publications. It therefore serves to train students and young researchers. The Experimental Station conducts on-site demonstrations, brings out publications and holds lectures at expert events, ensuring that there is a strong transfer of the findings obtained at the Station into practice.

And the Agricultural Experimental Station is by no means static. The agricultural science faculty is continually developing the Experimental Station in order to be able to continue delivering cutting-edge agricultural research in the future.

Today, the Agricultural Experimental Station has three locations with different climatic conditions, covering a total of roughly 750 hectares of farmed land: Ihinger Hof, Lindenhöfe and Hohenheim with Eckartsweier and Kleinhohenheim.

Further information: **https://agrar.uni-hohenheim.de/en/**

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The Hohenheim Greenhouses Service Unit
The Phytotechnikum

Climate change, biodiversity, world nutrition, bioenergy, renewable resources and plant health: University of Hohenheim researchers investigate questions dealing with the future of these and other topics at the Phytotechnikum (PHT), the new high-tech research greenhouse. Greenhouses are a decisive interim step on the path from agricultural research in the lab to the field. In 2012, the University of Hohenheim decided to bring all greenhouses together into one institution, the Hohenheim Greenhouses Service Unit. The aim was to achieve the greatest possible synergies and resource efficiency. In 2016, the first phase of construction of the new PHT was launched with the support of the Carl Zeiss Foundation, pooling the greenhouse capacities of the University of Hohenheim at one location. Construction was successfully completed in 2020.

The 8.3 million euro building complex, which covers almost 2,000 square metres, gives Hohenheim researchers the opportunity to conduct excellent research in the field of plants using state-of-the-art technology.

Planning for the second phase of construction, covering another 6,500 square metres and projected to cost approximately 83 million euros, is currently underway. With this enlargement, the PHT will be the largest and most modern research greenhouse in Germany. It will create additional space for greenhouses, storage facilities, laboratories and offices, and will enable additional climate chambers and a comprehensive quarantine facility to be installed.

Further information: https://shg.uni-hohenheim.de/en/

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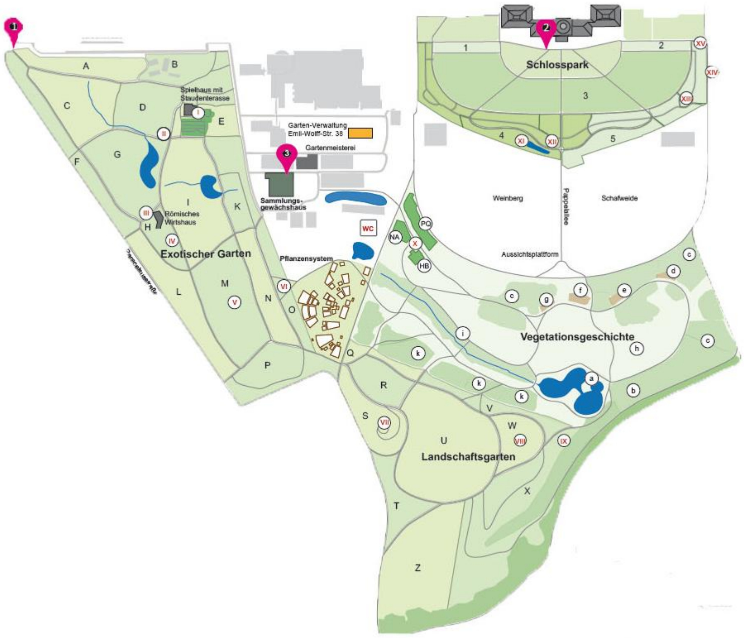
UNIVERSITY OF HOHENHEIM

The Hohenheim Gardens

The Hohenheim Gardens consist of the Exotic Garden, the former English Garden of Duke Carl Eugen and Franziska of Hohenheim, the Palace Park to the south of Hohenheim Palace, as well as the Botanical Garden, the Landscape Garden and the cemetery. The Hohenheim Gardens are a scientific establishment underpinning the teaching and research work of the university and of the State School of Horticulture.



The “Landesarboretum”, consisting of the Exotic Garden and the Landscape Garden, makes up the largest part of the Hohenheim Gardens with an area of 16.5 hectares. It is used to collect and present woody plants of scientific and also horticultural interest, and to provide plant material. The Landesarboretum is home to approximately 2,500 groups of woody plants, with the oldest trees tracing back to the period of the dukes of Württemberg in the late 18th century. The Palace Park is a smaller arboretum, comprising a number of plant species predominantly from the North American and Middle European floral zone.

In addition to the impressive arboreta, the Botanical Garden provides a unique representation of the vegetation history of southern German woody plants, starting from the most recent glacial epoch and based on paleobotanical research findings by the staff of the Institute for Botany. It also incorporates the history of agricultural crops and medicinal plants. The Phylogenetic System of Flowering Plants includes specimens of the most important plant families that have been planted according to how closely they are related, which facilitates recognition of the phylogenetic relationships between higher plants. The collection greenhouse, which is home to a selection of thermophilic plants from subtropical and tropical areas, is a particular gem.

These public grounds are open all year round and access is free of charge.

Further information (in German only): https://gaerten.uni-hohenheim.de/

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UNIVERSITY OF HOHENHEIM

Digital Value Chains for Sustainable Small-scale Agriculture (abbreviated in German to DiWenkLa)

Granting body: Federal Ministry of Food and Agriculture
Support scheme: Trial fields focusing on digital technologies in the agriculture sector
Support volume: EUR 3.3 million
Coordination: University of Hohenheim
Research partners: Nuertingen-Geislingen University (HfWU)

Baden-Württemberg's agriculture consists largely of small farms. The increased use of digital technologies, some of which are capital-intensive, in outdoor and indoor work, means there is a risk that some farms, particularly small and medium-sized farms, might fail to keep pace with the digital transformation. Within the scope of this BMEL funded joint research project, the University of Hohenheim and the Nuertingen-Geislingen University have joined forces with agricultural holdings and the State Institutes of the Ministry of Food, Rural Affairs and Consumer Protection of the State of Baden-Württemberg to address this development.

The DiWenkLa trial field focuses in particular on digitalisation options relating to field vegetables and other arable crops in the metropolitan area of Stuttgart and to the horse-related services sector. In the Southern Black Forest, the project focuses mainly on pasture farming in cattle husbandry.

Here, the project aims to further develop and apply various (digital) technologies in the field of robotics, automation and sensors, also dovetailed with artificial intelligence. However, the project also explores communication systems such as cloud and farm management systems. These (digital) technologies and systems aim to step up the support for environmental protection and nature conservation and allow for more animal welfare, while also easing the workload and increasing economic efficiency. The project also aims to enable farms, independently and at low cost, to add value by gaining access to the processing and retailing sectors and to end consumers. A further objective is to promote the resilience of farms in case of system failures.

Further information (in German only): http://www.diwenkla.de/

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Gefördert durch

Bundesministerium für Ernährung und Landwirtschaft

aufgrund eines Beschlusses des Deutschen Bundestages

Agriculture 4.0 without Chemical and Synthetic Plant Protection (abbreviated in German to NocsPS)

Granting body: Federal Ministry of Education and Research
Support scheme: Agricultural Systems of the Future
Support volume: EUR 5.3 million
Coordination: University of Hohenheim
Research partners: Julius Kühn Institute, Georg August University Göttingen

The use of chemical and synthetic plant protection products has come under increased criticism due to the residues they leave in food and nature and to the threat they pose to biodiversity. However, it currently appears too challenging to shift the entire agricultural sector to organic farming if global food security is to be achieved.

One part of the solution could be to have an agricultural sector that follows biological principles using state-of-the-art, automated and digitally connected technologies and abandoning chemical and synthetic plant protection products. At the same time, along with the (necessary) high biomass yields with high-quality products, it must be ensured that the soil remains fertile. This also includes the ecologically sound use of mineral fertilisers. These cropping systems that use mineral fertilisers but dispense with chemical and synthetic plant protection products (mineral ecological cropping systems or cropping systems without chemical and synthetic plant protection) represent a fundamental realignment of agricultural food production.

The research consortium consists of the Universities of Hohenheim and Göttingen, and the Julius Kühn Institute, which is within the purview of the Federal Ministry of Food and Agriculture. It pursues the development and analysis of cropping systems that dispense with chemical and synthetic plant protection, and compares these with other cropping systems. This comparison is made using system trials, precision trials and on-farm trials on plots, fields and farms, and at regional level as well as from an ecological, economic and social point of view. Many companies along the value chain are providing support to the consortium. The goal is to test the hypothesis that the innovative approach of using cropping systems without chemical and synthetic plant protection can effectively complement conventional and organic farming with good yields and high-quality produce while generating positive environmental effects. Products from this new agricultural system would be expected to have considerable market potential.

The project therefore corresponds to the commitments made by the Federal Government to strive for a new arable farming strategy with an effective reduction of chemical and synthetic plant protection products, underpinning both biodiversity and the protection of insects. The project aims to help make the agricultural sector independent, sustainable and consequently fit for the future.

GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung

Further information: **https://nocsps.uni-hohenheim.de/en/**

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Biodiversity: agriculture's key role

Biodiversity is essential for human existence and for having a good quality of life. It is the foundation of ecosystem services that preserve the quality of air, water and soil, regulate the climate, facilitate pollination and biological pest control, and reduce the impact of natural hazards. Biodiversity is currently deteriorating at a faster pace than ever. Up to one million species could be at risk of extinction in the decades to come if no steps are taken to fight the root causes of biodiversity loss.

Land use changes are the main driver of declining biodiversity. Agricultural land, especially in Europe and North America, is increasingly characterised by monocultures and short crop cycles in order to simplify production methods and concentrate on the best-selling products. These simplified crop rotations degrade the soils and promote pest infestation, the formation of resistance due to the repeated use of pesticides, and the risk of resource shortages for pollinators and natural enemies of pests.

These developments are reversible only if agricultural systems and landscapes are redesigned. Steps to promote biodiversity include species-rich crop rotation, undersowing, green manuring, agroforestry and the combination of arable crops and livestock into integrated agricultural systems. Semi-natural habitats in the proximity of cultivated areas, such as hedges and forb vegetation, are a crucial refuge for plants and animals. The size of the fields is also pivotal: landscapes characterised by small fields provide better connections between different landscapes which allow animals and plants to spread better.

The diversification of agriculture must also involve conventional farming. The lion's share of global arable land continues to be under conventional farming: in Europe, over 90 percent of all farming is accounted for by conventional farming. Crop diversification, small fields, and the promotion of semi-natural habitats are measures suitable for both organic farming and conventional agriculture. As studies have shown, small-scale conventional farming contributes just as much to the conservation of biodiversity as large-scale organic farming.

Halting the decline in biodiversity will also be beneficial for tackling other urgent global challenges such as climate change. Diversified agricultural systems are more resilient to extreme climatic events such as droughts, and boost resilience to economic shocks and the degree to which farmers and consumers depend on global value chains. Whereas current policies generally target the level of plots and holdings, it will in future be necessary to expand incentives and regulations to include the level of landscapes – after all, plants and animals do not make a halt at farm boundaries.

Biodiversity and the conservation of biodiversity in cultivated landscapes is a key research field for the University of Hohenheim. This was clearly underlined once again in 2021 by the establishment of the Centre of Excellence for Biodiversity and Integrative Taxonomy (**KomBioTa**). The Federal State of Baden-Württemberg provides an annual sum of approximately one million euros in funding to KomBioTa. The Centre pools biodiversity research in southern Germany, developing new innovative techniques for biodiversity monitoring. It also trains a new generation of biodiversity experts who are just as well acquainted with up-to-date research methods as they are with domestic animal and plant species.

Further information: https://shg.uni-hohenheim.de/en/
https://agroecology.uni-hohenheim.de/en/

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Applied entomology

With an estimated total of 5.5 million species, insects represent our planet's most diverse group of organisms and play a vital role in almost all ecosystems. Due to the extreme diversity of habitats and ecological niches they occupy, the ways in which insects interact with their biotic and abiotic environments is highly varied. Understanding this interplay is not only absolutely vital for preserving biodiversity; it also offers great potential for applications derived from insects that can serve human society.

A female monarch butterfly laying eggs on scarlet milkweed (Asclepias curassavic).

Unfortunately, the mechanisms by which insects interact with their environment have only been investigated in a very few insect species. Thus, it is likely that a large number will be lost before our society has recognised their unique potential (e. g. for medical or biotechnology applications). In this context, it is crucial to know that the way insects have adapted to their environment is the result of millions of years of evolution and that each of the countless insect species has unique genes, molecules, and biochemical strategies.

The monarch butterfly (*Danaus plexippus*), for instance, is known for its long-distance migration from Mexico all the way to southern Canada. It is one of the most well studied non-model insects in the world. What is more, the monarch has developed fascinating features to adapt to the toxic cardiac compounds of their host plant (milkweed), making them an important model for researching the co-evolution of insects and plants. What is striking about monarchs is that they are not only capable of dealing with these toxic compounds in their feed, but they also use them to defend themselves against birds by storing them in their tissue and hence becoming toxic themselves. Monarch butterflies are a prime example of how profound and finely balanced the interplay between different species is. They also serve to show how much is at stake if we fail to stop the decline in biodiversity.

Further information: **https://phytomedizin.uni-hohenheim.de/entofachgebiet**

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Biorefineries: higher value-added and closed cycles

Zukunftsvision einer On-Farm-Bioraffinerie.

The transformation from production practices based on fossil resources towards a circular bioeconomy will be one of the most urgent challenges in the years to come. Biorefineries are a key component in this transformation. They use biogenic inputs to generate not only conventional products, but also additional new products that can be used in a number of fields. Potential complementary products include foodstuffs, feedstuffs, chemicals, materials and energy; these products could also make a contribution to system services such as nature conservation and environmental protection.

The novel operational processes developed by the University of Hohenheim are being incorporated into existing cycles, expanding the carbon or nutrient cycle, while still ensuring it remains a closed cycle. They are hence creating a truly circular production system.

Plants synthesise carbohydrates and, apart from atmospheric carbon, they are the only regenerative source of carbon in the world. To do this, they also need macro- and micro-nutrients. These nutrients are extracted from the soil when the plants are harvested and must be re-added to the soil in order to make agriculture sustainable and climate neutral. The carbon stored in plants is to be used for producing essential basic materials for industry and for the shift away from fossil resources; the nutrients, however, must remain within the natural cycle. The challenge facing these approaches and technologies is therefore the decoupling of the nutrient and the carbon cycles.

The technologies researched at the University of Hohenheim make this possible. Waste material and by-products, along with agricultural biomass, are turned into products such as biochars, hydroxymethylfurfural, furfural and lignin which can be used as essential chemicals in industry. At the end of the process, a watery by-product remains which is converted into heat and fermentation residues using a biogas plant. This heat can be recycled in the biorefinery as a renewable source of energy. Fermentation residues, in turn, are processed into coal using the hydrothermal carbonisation method (HTC). Carbonisation fixes the previously soluble phosphate within the coal, whereas nitrogen remains as part of a watery by-product. The phosphates can then be leached and precipitated with a part of the process water as magnesium ammonium phosphate (MAP or struvite). The result is a dispersible mineral fertiliser that can be applied in a more targeted and measured manner. In future, the coal that is low in phosphate could be used in activated charcoal material and high-performance carbon or as biochar. This is a way of using and storing carbon in products. The nutrients are then separately returned to the field according to the P and N contents. The natural cycle is therefore not interrupted, but extended.

Various projects, such as **HTC BioGo** and **AMAIZE-P**, aim to scale up these methods, translating them into practice from the lab to a pilot plant. The first small pilot facilities have already been set up for subprocesses at the Lindenhöfe site of the Agricultural Experimental Station.

Further information: **https://shg.uni-hohenheim.de/en/**

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