Horticultural Plant Physiology

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The division is designed to adapt techniques from basic research to the needs of applied research such as horticulture, agriculture and forestry. Accordingly, research and teaching programmes comprise basic and applied research, combining lab techniques with field work.

Research

Stress physiology

We study the various effects of light and temperature on the photosynthetic apparatus. These ecofactors are potential natural stress factors. During winter and springtime they have got a remarkable influence on evergreen coniferous trees. The photochemical capacity of needles can be reduced dramatically by frost, photochilling and strong light. The latter is commonly known as photoinhibition. Natural stress loads will not cause any damage as long as compensation mechanisms cope with the induced stress levels. However, in combination with anthropogenic stress factors, e.g. ozone, natural stress loads might lead to the ecosystem disease "Waldsterben" in spruce forests.

Climatic change

We have a longstanding interest in the reaction of plants to elevated CO_2 tensions. CO_2 basically reduces photorespiration and thus enhances net leaf photosynthesis. This in turn leads to a higher bioproductivity if sufficient water and mineral nutrients are provided. The additional growth under elevated CO_2 depends on the sink capacity of the plant.

Dry matter and energy partitioning

Assimilates produced by the photosynthetic processes are used differently during ontogenesis. In case of a missing sink, substances with high calorific values are stored, e.g. fat, proteins.

During the period of rapid growth or during pod filling processes, however, 'energetically cheap' compounds are formed, e.g. carbohydrates. Using the established storing index (a quotient of energy gain over dry matter gain) we are able to describe these processes much better.

Measurement of photochemical capacity with a non modulated fluorimeter after a period of photochilling.

Chlorophyll fluorescence, P700 absorption changes and gas exchange

In relation to quality and intensity of (actinic) light modifications of fluorescence signals are studied in combination with varying CO_2- and O_2-concentrations. Tracing the time course of recovery after photoinhibition completes these studies. We use

these techniques to examine the sensitivity of the photosynthetic apparatus to natural stress factors and its reaction to higher heavy metal concentrations (e.g.copper) in soils.

Functional and analytical plant anatomy

We are also interested in the relation between photosynthetic characteristics and leaf anatomy. Beside the leaf structure and stomata density the internal free surface area is under investigation. In addition the structure of barks is studied intensively.

Teaching

Basics in Photosynthesis I, II, III (L): These series of lectures, all together 6 hours / week, provide students (second level) with a complete introduction to the photosynthetic processes: From electron transport to bioproductivity, from protein turnover to functional leaf anatomy and from C_3- via C_4- to CAM-plants all fields are covered in this lecture.

Horticultural Plant Physiology (P): This is a practical class for students in the second level (4 hours/week). The aim of this course is to give an intensive training in horticultural techniques together with an explanation of the plant physiological background. Grafting, rooting of cuttings, regeneration, phytohormones, soil analyses, fertilisers, indoor plants and a vegetable garden are subjects of this course.

Techniques in Photosynthesis Research (P): This course (students second level, 10 hours/week) offers training with instruments used in our research programmes to study local- and micro-climate, CO_2- and O_2-gas exchange, chlorophyll fluorescence, P700 absorption changes, energy content of biomass, growth analyses, water relations and functional leaf anatomy.

Ecology of Developing Countries (L,S): This lecture (1 hour / week) is combined with a seminar (2 hours / week). Students are informed about the present situation of ecological research and natural protection in developing countries with respect to natural resources, agriculture and forestry, energy consumption , demography and social structure and the political situation. Colleagues from other institutes and faculties participate in the teaching of this course.

International Cooperations

Biological Research Centre, Szeged and University for Horticulture and Food Industry, Budapest, Hungary; - Academy of Sciences, Prague, Czechia; - University of Essex, Department of Biology, Colchester and University of London, King's College, Division of Life Sciences, UK; - King Mongkut's Institute of Technology (KMITT), Bangkok and Prince of Songkla University (PSU), Hat Yai, Thailand; - Smithsonian Environmental Research Centre (SERC), Edgewater, USA; - Max Planck Institute for Limnology, Manaus, Brazil; - University of Queensland, Department of Biology, Brisbane, Australia.

Selected References

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