Lecture Series Environment & Biodiversity

Tissue formation and adaptation in plants - from basic understanding to biomimetic materials

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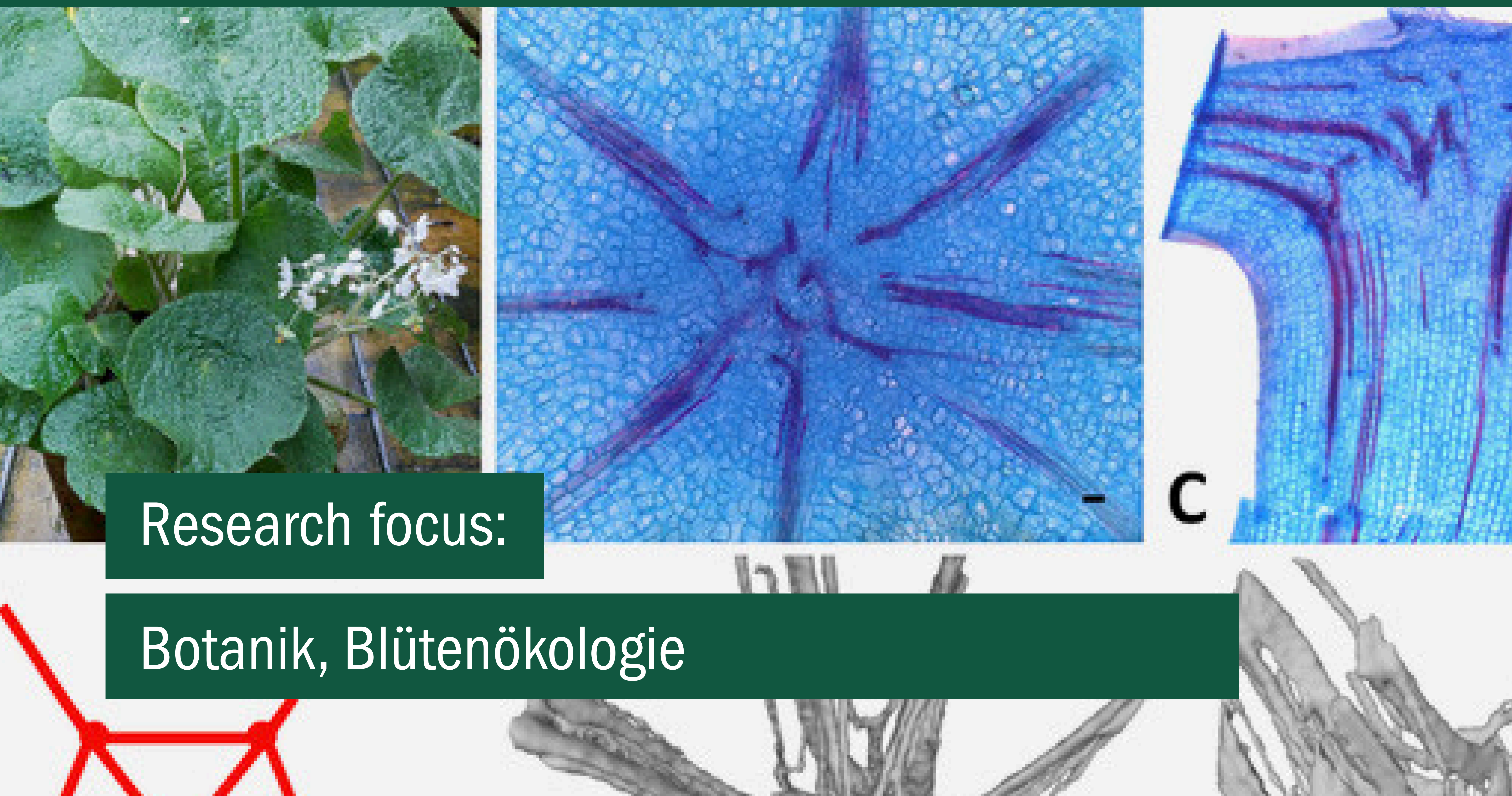
NLW-Faculty, Room 421, 2nd floor



Research focus:

Botanik, Blütenökologie

Abstract

Plant cell walls are the major structural elements that contribute to the stability and functioning of plants. While cellulose is the main fiber forming molecule coping with tension forces exerted by the turgor pressure various types of lignified cells and tissues such as wood are resistant against compressive forces as well. Apart from wood, lignification is often connected to specific functions and can be spatially and temporarily modified, examples of which will be presented.

Flagellaria is a climbing monocot that attaches to the surrounding vegetation via leaf tendrils. Anatomical and biomechanical methods such as three-point bending and torsion tests were used to study tissue development and its modification in the context of a climbing life form. Although F. indica lacks secondary cambial growth, the climbing habit is facilitated by a complex interaction of tissue maturation and attachment.

Apple fruit peduncles are highly modified stems that connect growing fruits securely to the branch while the weight, i.e., static and dynamic loads increase. We studied the tissue formation and modification during fruit development in peduncles, in which fibers contribute mainly to tensile strength and overall axial rigidity of the peduncles while sclereids increase bending stiffness.

Some Martyniaceae produce lignified capsules with hook-shaped extensions that are supposed to attach to feet of large mammals such as buffalos. We studied the development and anatomy of the unique fruit wall tissue and its mechanics under different load conditions. The tissue is characerised by longitudinally oriented fiber bundles that contribute to tensile strength while transversely oriented fibers absorb radial stresses upon bending and stabilize the longitudinal bundles against buckling. While the flexibility and high strain rates allow for proper attachment of fruits during dynamic locomotion, the high strength prevent an abrupt failure due to heavy loads exerted by the animal.

Peltate leaves have a specific morphology, since the petiole is inserted more or less centrally to the leaf lamina. In a broad comparative approach we studied about 500 peltate leaved species in terms of fiber arrangement in the connection between petiole and lamina. In total less than 10 types of fiber arrangement could be detected, that have been abstracted and will serve as models for future carbon fiber arrangements in modular carbon reinforced concrete constructions.