

| | |
|---|--------------------|
| Module Name | Module Code |
| Genetically Modified Plants | AEF-agrig012 |
| Module Coordinator | |
| Prof. Dr. Christian Jung | |
| Organizer | |
| Institute of Crop Science and Plant Breeding - Plant Breeding | |
| Faculty | |
| Faculty of Agricultural and Nutritional Sciences | |
| Examination Office | |
| Faculty of Agricultural and Nutritional Sciences - Examination Office | |

| | |
|---------------------------------|--|
| ECTS Credits | 6 |
| Evaluation | Graded |
| Duration | 1 Semester |
| Frequency | Only takes place during summer semesters |
| Workload per ECTS Credit | 30 hours |
| Total Workload | 180 hours |
| Contact Time | 60 hours |
| Independent Study | 120 hours |
| Teaching Language | English |

| | | | |
|---|-----------------------------|----------------------------------|------------|
| Recommended Requirements | | | |
| Basic understanding of genetics, breeding and molecular biology according to modules "Introduction to molecular biology" and „Introduction to crop and animal breeding“ | | | |
| Module Courses | | | |
| Course Type | Course Name | Compul- sory/Optional | SWS |
| Lecture | Genetically Modified Plants | Compulsory | 2 |
| Internship | Genetically Modified Plants | Compulsory | 2 |
| Prerequisites for Admission to the Examination(s) | | | |
| Students must have passed examinations in modules agrigAEF001-01a and AEF-agrig002. Regular visit of the internship is necessary. | | | |

| Examination(s) | | | | |
|--|----------------------------|-------------------|------------------------------|------------------|
| Examination Name | Type of Examination | Evaluation | Compulsory / Optional | Weighting |
| Oral Examination: Genetically Modified Plants | Oral Examination | Graded | Compulsory | 75 |
| Protocol: Genetically Modified Plants | Protocol | Graded | Compulsory | 25 |
| Further Information on the Examination(s) | | | | |
| 1.+2. period in summer semester 1. period in winter semester examiner: Dr. Melzer, if he is not present: Prof. Dr. Jung QIS: 91400 with number of Examination 91410 and 91420 | | | | |

Course Content

1. Plant transformation methods
 - 1.1. Agrobacterium-mediated Transformation
 - 1.2 Biolistic Transformation
 - 1.3 Protoplast Transformation
 - 1.4 Pollen Tube Transformation
- 2 Selection Markers and Regeneration
- 3 Gene expression in genetically modified plants
 - 3.1 Gene silencing
- 4 Basic research with genetically modified plants
- 5 Traits targeted by genetic modification
 - 5.1 Pest resistance
 - 5.2 Disease resistance
 - 5.3 Herbicide tolerance and resistance
 - 5.4 Abiotic stress tolerance
 - 5.5. Male sterility
 - 5.6 Plant Growth and Development
 - 5.7. Quality improvement
 - 5.8. Novel storage products
- 6.0 The use of genetically modified plants in agriculture
 - 6.1 Benefits from growing genetically modified plants
- 7 Precise genome editing
- 8 Breeding with genetically modified plants
 - 8.1 Transgene genetics
 - 8.2 Yield increase
- 9 Measuring genetic modifications
- 10 Putative risks and risk assessment strategies
 - 10.1 Risks to human health
 - 10.2 Risks concerning antibiotics resistance genes
 - 10.3 Risks to the environment
 - 10.4 Measures to avoid GMP in nature
 - 10.5 Transgene inactivation
 - 10.6 Economic risks
- 11 GMO legislation
 - 11.1. The German genetic engineering act
 - 11.2 EU directives
 - 11.3. The European GMO seed dilemma
 - 11.4 GMO regulations in the US
 - 11.5 The Cartagena protocol on biosafety

Learning Outcome

The students learn about all aspects of plant genetic transformation and usage of transgenic plants in agriculture. They will understand how plants, in the majority crops plants, can be genetically modified to introduce new genes, to modify existing genes or knock out gene function. Emphasis will be given to the classical Agrobacterium system. Students will understand how genetically modified plants are used in plant breeding and plant production. Relevance of genetically modified plants in worldwide agriculture will be highlighted. Students will also learn the new genome editing systems. Here the CRISPR-Cas system will be emphasized. Students will learn how to identify genetically modified plants or products derived thereof and how they are used worldwide in agriculture and food/feed production as well as biomass production. Also, the legal aspects of using genetically modified plants will be taught. The aim is to get a comprehensive understanding of genetically modified crop plants from the initial steps of vector construction to field crop production.

Reading List

- Müller-Röber, B., B. Boysen, et al. (2013). Grüne Gentechnologie. Aktuelle wissenschaftliche, wirtschaftliche und gesellschaftliche Entwicklungen. Dornburg, Forum W – Wissenschaftlicher Verlag Kempken, F. and Kempken, R. (2006): Gentechnik bei Pflanzen. 3rd edition, Springer, Berlin.
- H. C. M. den Nijs, D. Bartsch, and J. Sweet, 2005. Introgression from Genetically Modified Plants into Wild Relatives, Wallingford, Oxfordshire, UK: CABI Publishing
- Gene Flow from GM Plants, Oxford: Blackwell Publishing Ltd, 200
- C. Jung (2007) Ausgewählte Themen der Pflanzenzüchtung. Schriftenreihe des Instituts für Pflanzenbau und Pflanzenzüchtung der Universität Kiel
- P. Christou and H. Klee. Handbook of Plant Biotechnology, Vol. 1 und 2. Chichester: Wiley & Sons Ltd., 2007
- O. Sanvido, M. Stark, J. Romeis, and F. Bigler. Ecological impacts of genetically modified crops, Agroscope Reckenholz-Tänikon Research Station ART, 2007
- F. Kempken und C. Jung. Genetic Modification of Plants - Agriculture, Horticulture and Forestry, Berlin, Heidelberg: Springer, 2010. 676 Seiten.
- Prapat, A. & Kumar, J. Alien Gene Transfer in Crop Plants, Volume 1. Vol. Volume 1 v-319 (Springer, 2014)
- <http://www.nal.usda.gov/plants-and-crops>
- <http://www.aphis.usda.gov/biotechnology>
- Field trials, cultivation
- <http://www.isaaa.org/>
- Risk assessment
- <http://www.lmb.uni-muenchen.de/groups/forbiosich/main.htm>
- <http://www.nbiap.vt.edu/>
- Wissenschaftlerkreis Grüne Gentechnik e.V. (WGG)
- <http://www.wgg-ev.de>

Additional Information

Maximum number of participants: 20

Enrollment by OLAT within workdays Monday through Friday in the 1st week of the 2. audit period of the preceding semester. Following information are necessary:

matriculation number

last name

first name

degree

study program

stu-Email

The allocation of the places takes place in the 2nd week of the 2. audit period of the preceding semester.

Acceptance of the place by students only through participation at the first day of the course.

Students without a place can get a place at the first day of the course by move-up procedure.

| Use | Compulsory / Optional | Semester |
|---|------------------------------|-----------------|
| Master, 1-Subject, Agricultural Sciences, Specialisation Agricultural Economics, (Version 2017) | Optional | - |
| Master, 1-Subject, Agricultural Sciences, Specialisation Agricultural Economics, (Version 2013) | Optional | - |
| Master, 1-Subject, Agricultural Sciences, Specialisation Agribusiness, (Version 2017) | Optional | - |
| Master, 1-Subject, Agricultural Sciences, Specialisation Agribusiness, (Version 2013) | Optional | - |
| Master, 1-Subject, Agricultural Sciences, Specialisation Crop Sciences, (Version 2017) | Optional | - |
| Master, 1-Subject, Agricultural Sciences, Specialisation Crop Sciences, (Version 2013) | Optional | - |
| Master, 1-Subject, Agricultural Sciences, Specialisation Animal Sciences, (Version 2017) | Optional | - |
| Master, 1-Subject, Agricultural Sciences, Specialisation Animal Sciences, (Version 2013) | Optional | - |
| Master, 1-Subject, Agricultural Sciences, Specialisation Environmental Sciences, (Version 2017) | Optional | - |
| Master, 1-Subject, Agricultural Sciences, Specialisation Environmental Sciences, (Version 2013) | Optional | - |
| Master, 1-Subject, AgriGenomics, (Version 2017) | Optional | - |
| Master, 1-Subject, AgriGenomics, (Version 2010) | Optional | - |
| Master, 1-Subject, Biochemistry and Molecular Biology, (Version 2016) | Optional | - |
| Master, 1-Subject, Biochemistry and Molecular Biology, (Version 2007) | Optional | - |
| Master, 1-Subject, Biology, (Version 2015) | Optional | - |
| Master, 1-Subject, Biology, (Version 2011) | Optional | - |
| Master, 1-Subject, Biology, (Version 2007) | Optional | - |
| Master, 1-Subject, Dairy Science, (Version 2017) | Optional | - |
| Master, 1-Subject, Nutritional and Food Science, (Version 2013) | Optional | - |
| Master, 1-Subject, Nutritional and Consumer Economics, (Version 2017) | Optional | - |
| Master, 1-Subject, Nutritional and Consumer Economics, (Version 2013) | Optional | - |