האוניברסיטה העברית בירושלים
THE HEBREW UNIVERSITY OF JERUSALEM

The Hebrew University of Jerusalem

Syllabus

BIOTECHNOLOGY AGRICULTURE - 73534

Last update 30-04-2024

HU Credits: 3

Degree/Cycle: 2nd degree (Master)

Responsible Department: Biotechnology

Academic year: 0

Semester: 2nd Semester

Teaching Languages: English

Campus: Rehovot

Course/Module Coordinator: Dr. Yehiam Salts

Coordinator Email: yehiam.salts@mail.huji.ac.il

Coordinator Office Hours: On appointment by email

Teaching Staff:

Dr. Yehiam Salts,
Dr. Rivka Barg

Course/Module description:
The course will focus on the study of genetic engineering technologies in plants. Understanding the molecular and physiological basis of the technologies, and it's implementation in food and feed crops.

Course/Module aims:
To explain the potential of genetic engineering in crop plants, and to review the achievements accomplishes up-to-date.

Learning outcomes - On successful completion of this module, students should be able to:
To explain the application of genetic engineering in plants.
To comprehend the difficulties of its implementation.
To be able to define the advantages of its application in agriculture.
To be able to define the disadvantages and shortcomings of agricultural biotechnology.
To demonstrate how biotechnology can be applied to improve agricultural properties of various crops.
To be able to analyze and criticize scientific papers dealing with application of biotechnology to agriculture.

Attendance requirements(%):
80 An attendance list will be handed over at the lesson

Teaching arrangement and method of instruction: Frontal lectures and reading of scientific articles

Course/Module Content:
73534 - Biotechnology in Agriculture
Syllabus 2024
Yehiam Salts & Rivka Barg

1) Transforming Plants with foreign DNA, Nuclear genome transformation Technologies for transformation: Agrobacterium, Gene-gun, naked DNA transformation, nanoparticle-mediated gene delivery, transformation of DNA into organelles.

 Tools used for expression of genes in plants: promoters (general, tissue specific, inducible), transcription enhancers and terminators, selectable marker genes, reporter genes.
2) Chloroplast transformation: plastidial oriented plasmids, methods of transformation: bombardment, passive and active intake methods
3) Transgenes containment methods

Methodologies for the identification of valuable genes
 Mutagenesis followed by TILLING
 Gene silencing followed by phenotype examination
 Insertional mutagenesis followed by gene cloning
 Chromosome walking
 Gene expression analysis by microarrays, deep sequencing of cDNA and genomic DNA, proteomics, metabolomics, and system biology
 Site specific mutagenesis, site specific deletions and insertions via ZFN-endonucleases, TALEN- endonucleases and CRISPR/Cas
 Chemical genetics- an alternative approach for identification of new genes of interest

Genome editing
 Utilization of site-specific recombination such as FLP-FRT, Cre-Lox
 Site specific and individual base specific mutagenesis, site specific deletions, insertions, translocations via ZFN-endonucleases, TALEN- endonucleases and CRISPR/Cas

Different applications based on CRISPR/Cas technologies
(i) Site and individual base specific mutagenesis (ii) Deletions. (iii) Insertions. (iv) Knockouts. (v) Transcriptional activation. (vi) Transcriptional repression. (vii) Fusion protein delivery. (viii) Imaging. (x) Epigenetic state alteration. (xi) RNA cleavage. (xii) determination of gene localization within the nucleus.

Transgenic plants harboring valuable traits
 Herbicide resistance
 Resistance to biotic stress by plant transformation
• Resistance to viral pathogens by the following transgenic means:
resistance (R) genes
viral coat protein expression
gene silencing by viral (or viroid) antisense or hairpin RNA
defective viral replicase expression
expression of ribozymes aimed at viral (or viroid) genomes
expression of viral satellite RNA
CRISPR-Mediated viral RNA and DNA cleavage
• Resistance to other pathogens (bacteria, fungi and nematodes) by genes originating from plants, other organisms, or by silencing essential pathogen genes
• Resistance to insects by transformation with Bt endotoxin and other genes

originating from plants or other organisms
If time allows examples will be given of transgenic plants exhibiting resistance to abiotic stress; manipulated flower fruit color and shelf-life; improved nutritional value; improved phytoremediation ability, and the ability to produce biopharmaceuticals and biodegradable plastics

Application of gene-drive methodologies to agriculture and environment
Gene-drive in insects that utilizes Mutagenic Chain Reaction based on CRISPR
Female Specific Lethality based on insect sex determined alternative splicing
Gene-drive in mammals

Required Reading:
Will be given during the course

Additional Reading Material:

Grading Scheme:
Written / Oral / Practical Exam 100 %

Additional information: