The University Of Sheffield.

Department of Molecular Biology & Biotechnology

MBB304 Plant Biotechnology

Module Handbook 2019-20

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MBB304 is a 10-credit module, taught in semester 2A

Module Description

This module considers the application of biotechnology to plants, for both agricultural and research uses. It covers the production of transgenic plants and how this technology has resulted in genetically engineered crop plants that show novel traits or produce novel products. It also covers traditional methods of plant breeding for the development of novel crops without the use of genetic engineering. The release of genetically engineered crops has and is having a major impact on society, raising issues of ethical, economic and ecological importance. An appreciation of these issues will be developed.

Module Aims

A1: provide a treatment of the techniques used in the production of genetically-manipulated plant species, and the impact of different techniques on their classification as genetically modified organisms;
A2: provide an introduction to the range of commercially developed transgenic crops and a balanced view of the impact of these crops on society;
A3: discuss some of the grand challenges for the next generation of crop improvement and the uses of plants for producing novel products and to provide opportunities for students to work in small groups to develop these ideas.

Learning Outcomes

By the end of the module, a student will be able to:

LO1: describe and discuss the techniques employed and the problems encountered in the production of commercially important genetically engineered crops;
LO2: critically analyse the relationship between novel and traditional crop development

methods and be able to select appropriate strategies for a particular desired goal.
LO3: compare and contrast the benefits and limitations of different biotechnological strategies for generating plants with novel traits or that utilise plants to produce novel products whilst considering the impact of these methodologies on society and the environment;
LO4: by working in a small group, design and develop a theoretical next generation plant product.

Detailed Syllabus

By the end of the module you should be able to:

- *demonstrate* a detailed knowledge of the techniques employed and the problems encountered in the production of commercially important genetically engineered crops.
- *assess* the relationship between novel and traditional crop development methods and be able to select appropriate strategies for a particular desired goal.
- *acquire,* use, evaluate and analyse subject-related information contained in primary literature.
- *discuss* the methods used to genetically engineer plants
- *outline* the applications of genetic engineering to the production of transgenic plants *discuss* the products obtained by these techniques and their potential advantages and disadvantages
- *demonstrate* a detailed knowledge of the biotechnological strategies available for the modification of plant species, based on events at the cellular and molecular level. *compare* and *contrast* the benefits and limitations of these strategies.
- *discuss* the general impact on society of these methodologies and the environmental issues arising from the production of genetically engineered crops.
- *understand* model-to-crop translation

Lecture 1, 10-12: Prof Gray (Room C34C; ext 24407)

The course begins by examining the development and controversy surrounding GM technology. Later lectures examine how engineering has modified food properties and quality and allowed the production of novel products (pharming) as well as the impact of model plants.

Lectures 2-9; 13-14: Dr Casson. (Room C34C; ext 24235)

These lecture begin by looking at non-GM breeding strategies continue to develop crop traits. Plant transformation methodologies are then introduced including how they have been adapted for use on agriculturally important species. We discuss new technologies for genome engineering, focusing on CRISPR, illustrating how they can increase allelic variation. Region specific legislation will also be discussed and the implications for commercial application. Progress in achieving and commercialising crop plants with improved agricultural traits will be covered such as herbicide tolerance, insect resistance and viral resistance. We then go on to consider one of the current grand challenges for

plant biotechnology; the engineering of nitrogen fixation into crops. This will consider why nitrogen is so important to crop productivity and the impact of nitrogen fertilisation.

An introduction to the small group assessment will be given in lecture 6.

Lectures 16-17: Dr Johnson. (Room E6a; ext 24418)

These lectures will focus on recent research in the field of photosynthesis and examine how this may be translated to improve yield and crop performance.

Lectures 15 & 18:

These two sessions will be available as preparation time for the assessed group work presentations (see module assessment).

Assessed Group Presentations

The presentations for the assessed group work will take place on Tuesday 24 March 2-5pm (further details will be given during the course). All students are required to attend and attendance will be monitored.

Teaching/Learning Activities

The contents of the course will be delivered by 18 one-hour sessions. Most of these will be lectures. Students will receive a list of recommended reading. This and other links to relevant information will be available on the course webpage (on MOLE).

The University recommends that a student should typically study for a total of 100 hours on a 10-credit module, including all the teaching sessions, the exam and individual study. In addition to revision for the exam, it is expected that each student will spend 8-10 hours per week reading and collating lecture notes, reading, noting and evaluating primary literature, and assessing progress in attaining learning objectives.

The lecturers will be available for consultation by students experiencing difficulties, either by email or in person. If you would like to meet to discuss aspects of the module, please contact the lecturers by email in advance.

It is departmental policy to make lectures available via Encore. However, this is not always possible technically and individual lecturers may have reasons for not recording some sessions.

Five top tips on how to use lecture capture effectively.

1. Attend lectures – students who attend tend to get better grades.
2. Use the captures to supplement your studies. Dip into the parts you need to enhance your knowledge and understanding.
3. Don't wait until a few days before the examination to use the captures. Space your learning throughout the semester to enhance your knowledge and understanding.
4. Don't binge watch! Again, spacing your learning across the semester is a more effective approach.
5. Watch at normal speed (if you speed the recording up you might miss key information).

Nordmann et al 2018 Lecture capture: practical recommendations for students and lecturers, Preprint DOI: 10.31234/osf.io/sd7u4

Self-Assessment

A specimen exam paper will be available on the MOLE page for the module. Individual feedback on specimen exam questions will be provided to students who submit written answers to the relevant lecturer.

Self-assessment questions may be set on the lectures and feedback provided to students who submit answers to the relevant lecturer.

Students will be able to assess their progress through feedback of the assessed coursework.

Module Assessment

80% of the module assessment will be based on a written final examination of 120 minutes duration, held at the end of Semester 2, and covering material introduced in lectures, and prescribed reading. Section A of the exam will contain two essay questions, of which one should be attempted. Section B will be methodology based and encompasses information from across the whole course. Each answer will be weighted at 50% of the final examination assessment to give 80%.
20% of the module assessment will be based on a small group based exercise culminating in short (approx. 10-15 min) presentation outlining the development of a novel plant product. The presentation will be given in **week 29 on Tuesday 24 March 2-5pm**. An accompanying written report is required and further details will be given in lecture 6.

Reading List

The following is a list of further reading that will help you to understand the course, and allow you to follow up the major themes presented to you. One of the criteria for scoring high 2(i) and first class for your answers in the exam is that there should be evidence of further reading.

Scanning Journals

At this stage of your degree course you should be developing your current awareness by regularly scanning the contents pages of recent issues of journals such as Nature Biotechnology, Trends in Biotechnology, New Scientist, Science, or Nature

Internet

Much useful, up to the minute, information can be obtained from the web, by entering the appropriate key words in one of the search engines, and by subscribing to relevant newsgroups. Relevant internet links will be provided in the lectures and available via the course webpage.

Recommended Background Reading:

Most of the material in Slater, Scott & Fowler. *Plant Biotechnology. The genetic manipulation of plants* is directly relevant to the course. Copies of the first and second edition of this book are available in the Information Commons.

More detailed reading lists will be available in the lectures and via the module MOLE page.

Module Timetable

Your timetable can be viewed by clicking on My Timetable from the All Services menu in MUSE. You can also view your timetable via the iSheffield app. Remember to update the app regularly to ensure you are viewing the most up-to-date information.