HR931-10 Plant Breeding and Trial Design for Registration

20/21

Department
Life Sciences
Level
Taught Postgraduate Level
Module leader
Graham Teakle
Credit value
10
Module duration
2 weeks
Assessment
100% coursework
Study location
University of Warwick main campus, Coventry

Description

Introductory description

This module is a core requirement for students on the Sustainable Crop Production: Agronomy for the 21st Century MSc degree. Crop production can be considered as two distinct components. The first is what is grown, i.e. the crop varieties. The second is how it is grown, which includes the use of chemicals to control pests and diseases and to modify plant growth behaviour. It is an exciting time to be learning about these aspects as modern technology is enabling rapid advances on both fronts and they have a central role to play in improving farming sustainability. This module is divided into two complementary, but synergistic sections that address these two aspects and also provide underpinning knowledge for other modules in the degree.

Module web page

Module aims

1. Students will learn about the breeding industry and how genomics, combined with traditional and advanced breeding technologies, are used to generate new varieties. The targets of these breeding activities are genes, or genetic loci, controlling the crop phenotype that have been identified by breeding companies themselves, or often in academic research such as

that undertaken in the School of Life Sciences. To understand how this is done requires a grasp of the principles of genetic inheritance and the methodologies used to combine all the desired properties into the seed of the next generation of varieties.

2. New agrochemicals are subjected to a wide range of safety and efficacy tests in order to satisfy the stringent legislation controlling their use. The later part of this process requires evaluation under field conditions using standards recognised by national plant protection organisations that are responsible for registering new products. Building on the statistical training provided early on in their degree, students will learn how to design and evaluate trials and apply this knowledge using specific case studies. The principles learnt here are also applicable to the design of experiments for genetic analysis.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

1. Introduction to plant breeding
2. Crop evolution and domestication
3. Plant breeding techniques
4. Molecular markers
5. Genetic mapping
6. Quantitative Trait Locus mapping
7. Utilisation of biodiversity
8. GM crops

Seminar 1: Introduction to elementary genetics
Seminar 2: A guide to breeding strategies
Seminar 3: Individual assessed student presentations on ‘The contribution of biotechnology to plant breeding’

Laboratory practical: Marker screening

Computer workshop: Designing experiments for trait analysis, marker scoring, genetic map construction, QTL analysis

Trial design workshop 1: Designing experiments
Trial design workshop 2: Designing practical trials
Trial design workshop 3: Analysis of designed experiments
Trial design workshop 4: Analysis, interpretation and reporting

Learning outcomes

By the end of the module, students should be able to:

- Students should gain from this module a basic understanding of plant genetics, the different sources of genetic variation and the importance of conserving it.
- Students will have experience in generating and analysing genetic data and using it to map

genes controlling traits.
- Students will have an overarching understanding of how modern biotechnological and genomic tools facilitate this process and will know different strategies for using these to incorporate specific genes or mapped traits into breeding programmes.
- By the end of this module students will be able to use this knowledge to investigate and describe how biotechnology is used in a specific example of their choosing.
- Students will also be able to design and analyse a statistically robust trial suitable for registration of new agrochemicals and how to report their findings.

Indicative reading list

Relevant literature
Bevan et al. (2017) Genomic innovation for crop improvement. Nature 543:346-354

Kelliher et al. (2017) MATRILINIEAL, a sperm-specific phospholipase, triggers maize haploid induction. Nature 542:105-109

Jones et al. (2009) Markers and mapping revisited: finding your gene. New Phytol. 183:935-966

Litrico & Violle (2015) Diversity in plant breeding: a new conceptual framework. Trends in Plant Sci. 20(10):604-613

Monteiro et al (2018) Genetic and genomic tools to assist sugar beet improvement: the value of the crop wild relatives. Frontiers Plant Sci. 9:74

Schaart et al. (2016) Opportunities for products of new plant breeding techniques. Trends in Plant Sci. 21(5):438-449

Tester & Langridge (2010) Breeding technologies to increase crop production in a changing world. Science 327:818-822

Wang et al (2018) Expression of the nitrate transporter gene OsNRT1.1A/AsNFP6.3 confers high yield and early maturation in rice. Plant Cell 30(3):638-651

Wu et al. (2018) Genomics of the origin and evolution of Citrus. Nature 554:311-316

Text books
G Acquaah (2012) Principles of genetics and breeding 2nd edn. Willey-Blackwell

AJF Griffiths, SR Wessler, SB Carroll, J Doebley (2015) An introduction to genetic analysis. Pub WH Freeman & Co.

Website
EPPO Guidelines on conducting efficacy trials:
https://www.eppo.int/?utm_source=www.eppo.org&utm_medium=int_redirect

Subject specific skills

Apply appropriate statistical techniques, interpret the results and report the findings for the analysis of data collected in experiments for agrochemical registration studies

Transferable skills

Analysis and communication

Study

Study time

Type	Required
Lectures	8 sessions of 1 hour (8%)
Seminars	2 sessions of 3 hours 30 minutes (7%)
Practical classes	10 sessions of 1 hour (10%)
External visits	1 session of 30 minutes (0%)
Other activity	8 hours 30 minutes (8%)
Private study	66 hours (66%)
Total	100 hours

Private study description

25 hours assessment preparation.
41 hours self-directed study.

Other activity description

3 x 2 hour and 1 x 2.5 hour workshops on trial design and analysis

Costs

No further costs have been identified for this module.

Assessment

You do not need to pass all assessment components to pass the module.

Assessment group A3

	Weighting	Study time	Eligible for self-certification
Assessed Seminar Presentation.	40%		No

	Weighting	Study time	Eligible for self-certification
Written Assignment	60%		No

Written assignment on individual trial design case study.

Feedback on assessment

Constructive feedback will be provided through Moodle: detailing good points, poorer points and how the work could have been improved.

Availability

Courses

This module is Core for:

- Year 1 of THRA-D4A2 Postgraduate Taught Sustainable Crop Production: Agronomy for the 21st Century

This module is Optional for:

- Year 1 of ULFA-C1A1 Undergraduate Biological Sciences (MBio)