Stage 6 Agriculture

# Plant breeding teacher resource 3

This unit is the last of a three-part series about plant breeding in agriculture. Resource 3 looks in depth at plant breeding trials and experimental design. Students will outline the basic components of experimental design and their role through analysis of real-world plant trials.

## Outcomes

* **H2.1** describes the inputs, processes and interactions of plant production systems.
* **H4.1** justifies and applies appropriate experimental techniques, technologies, research by methods and data presentation and analysis in relation to agricultural problems and situations.

[Agriculture](https://educationstandards.nsw.edu.au/wps/portal/nesa/11-12/stage-6-learning-areas/technologies/agriculture-syllabus) Stage 6 Syllabus © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales, 2013.

## Delivery strategies

This resource is adaptable for teachers to use with online platforms such as Google Classroom. Links to the videos and websites could be posted for students to access during learning at home. The activities and questions could be set as classwork documents within Google Classroom, which the students complete and submit for a grade or feedback. Alternatively, students could receive the activities and questions as worksheets to complete and submit later.

## Section one

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| Focus area | Managing plant production and experimental analysis and research. |
| Content | * Explain how plant breeding is used to develop new varieties to improve product quality, yield and environmental adaptation. * Define integrated pest management (IPM). * Outline IPM’s ability to reduce the problems of pesticides and chemical resistance in target organism. * Research using secondary sources an integrated pest management program for a plant production system. * Outline the impact of research on agricultural experiments. * Design and conduct a simple plant or animal trial using appropriate methodology. * Outline the role of a control, randomisation, replication and standardisation of conditions in a simple plant or animal trial. |
| Resources | * [Plant Breeding – wheat breeding for commercial production](https://education.nsw.gov.au/teaching-and-learning/curriculum/tas/tas-curriculum-resources-7-12/tas-11-12-curriculum-resources/plant-breeding-wheat" \l "wheat-breeding-commercial) (duration 3:18). * [Plant breeding – principles of agricultural research](https://education.nsw.gov.au/teaching-and-learning/curriculum/tas/tas-curriculum-resources-7-12/tas-11-12-curriculum-resources/plant-breeding-wheat#principles-agricultural-research) (duration 2:08). * [Plant breeding – researching drought tolerance](https://education.nsw.gov.au/teaching-and-learning/curriculum/tas/tas-curriculum-resources-7-12/tas-11-12-curriculum-resources/plant-breeding-wheat#drought-tolerance) (duration 4:19). * [MEF field map](https://cpb-ap-se2.wpmucdn.com/learning.schools.nsw.edu.au/dist/a/4/files/2015/02/MEF-field-map-images-for-DeptEd-doco-AP-edit-20lf02h.xlsx) – Excel spreadsheet showing layout, randomisation, replication and treatments across the managed environment facility site. * [MEF poster](https://cpb-ap-se2.wpmucdn.com/learning.schools.nsw.edu.au/dist/a/4/files/2015/02/MEF-field-operations-poster-updated-1l883e2.pdf) – PDF summary of field trial management for the managed environment facility. |
| Activities/questions | 1. Outline why an agricultural experiment needs standardisation, replication, randomisation and a control in the design. 2. What is the stated aim of the managed environment facility (MEF) trials being conducted at Narrabri, Yanco and Meredin during the 2014 growing season? 3. Explain how standardisation, replication, randomisation and a control were achieved in the managed environment facility trials at the University of Sydney’s Narrabri plant breeding centre in 2014. 4. Explain why a test of significance is needed before the results of agricultural experiments can be accepted. 5. How do you think the results of the managed environment facility trials will benefit Australian wheat farmers? 6. Outline two challenges that Australian wheat farmers are likely to face in the future years and explain how wheat breeding will help overcome them. 7. 2015 HSC agriculture exam, question 24, a. |
| Resources | * [Plant breeding – breeding disease resistance wheat](https://education.nsw.gov.au/teaching-and-learning/curriculum/tas/tas-curriculum-resources-7-12/tas-11-12-curriculum-resources/plant-breeding-wheat" \l "breeding-disease-resistant-varieties) (duration 1:25). * [Plant breeding – breeding for stem length in wheat](https://education.nsw.gov.au/teaching-and-learning/curriculum/tas/tas-curriculum-resources-7-12/tas-11-12-curriculum-resources/plant-breeding-wheat#stem-length) (duration 1:42). * [Plant breeding – breeding drought and heat tolerant wheat](https://education.nsw.gov.au/teaching-and-learning/curriculum/tas/tas-curriculum-resources-7-12/tas-11-12-curriculum-resources/plant-breeding-wheat#drought-heat-tolerant-wheat) (duration 1:57). * [Plant breeding – breeding for yield in wheat](https://education.nsw.gov.au/teaching-and-learning/curriculum/tas/tas-curriculum-resources-7-12/tas-11-12-curriculum-resources/plant-breeding-wheat#yield-in-wheat) (duration 1:44). |
| Activities/questions | 1. List the major characteristics of the wheat plant that plant breeders concentrate on improving in the new varieties they develop. Outline how these characteristics can improve wheat productivity. 2. Explain why plant breeders need to continuously develop new varieties of wheat. 3. 2017 HSC agriculture exam, question 21, b.(see student workbook) 4. 2018 HSC agriculture exam, question 22, b.(see student workbook) |
| Resources | * [Plant breeding – crown rot and integrated pest management](https://education.nsw.gov.au/teaching-and-learning/curriculum/tas/tas-curriculum-resources-7-12/tas-11-12-curriculum-resources/plant-breeding-wheat" \l "crown-rot) (duration 2:13). * [Root and crown disease of wheat and barley in Northern NSW](https://www.dpi.nsw.gov.au/agriculture/broadacre-crops/winter-crops/general-disorders-of-crops/root-crown-diseases) – website. |
| Activities/questions | 1. Create an information poster about Crown Rot. Include the following:    * Causal agent (pathogen)    * Host range    * Favourable environmental conditions for infection    * Disease symptoms    * Impact on crop yield    * Disease management strategies (for each one, explain how it helps manage crown rot). 2. Explain the role that plant breeders can play in the management of crown rot in cereal crops. |
| Resources | [Plant breeding – breeding wheat for the future](https://education.nsw.gov.au/teaching-and-learning/curriculum/tas/tas-curriculum-resources-7-12/tas-11-12-curriculum-resources/plant-breeding-wheat" \l "breeding-wheat-for-the-future) (duration 1:35) |
| Activities/questions | 1. Discuss (provide points for and/or against) the use of both glasshouse and field trials in plant breeding work. |

## Section two

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| Focus area | Managing plant production and experimental analysis and research. |
| Content | * Outline the role of a control, randomisation, replication and standardisation of conditions in a simple plant or animal trial. * Analyse and interpret agricultural data by calculating a mean and a measure of variability (standard deviation). * Explain the need for a test of significance to be performed before valid comparisons can be made. * Present data in appropriate form. * Propose recommendations based on the interpretation of the results of agricultural experiments. |
| Activities/questions | The biometrical exercise includes a data set of trial results for a plant trial testing the effects of preplant urea on the yield and protein levels of wheat. Students will evaluate the plant trial methodology and analyse results from the trial in this activity before making recommendations based on the results.   1. What plant nutrient(s) are supplied by urea? 2. Why were each of the treatments replicated three times? 3. Explain why all areas of land used for the trial received identical treatment except for the quantities of urea applied? 4. Suggest some reasons for the use of the control? 5. Why do you think the treatments were allocated to the plots shown in figure1? 6. Calculate the mean (average) and sample standard deviation for each treatments yield and protein percentage. 7. Explain why the standard deviation is a useful statistic. What does it tell you about the treatments/data in this trial? 8. Do you think that it would be a reasonable assumption to expect that increasing the quantity of urea would increase the protein percentage of the wheat? Explain your answer. Use data to support your answer. 9. What evidence do you have that indicates that pre-plant application of urea affects the yields of wheat? Use data to support your answer. 10. What other information may be useful to decide whether it is viable economically to apply greater quantities of urea as pre-plant fertiliser? 11. What recommendations would you make for further investigation into the effect of pre-plant application of urea on the yield and protein percentage of wheat? |