The interaction of genotype, environment and management in the forestry industry.

Teacher Overview

Students will:

- gain an understanding of the way plantation forestry trees are bred/propagated
- complete a case study on the Radiata Pine and a plant breeding organisation.
- apply their prior knowledge of plant breeding techniques and agricultural examples and relate this to the forestry industry as a comparative study.
- have the opportunity to analyse a range of source materials to develop their knowledge about the outcomes and the lesson culminates with an extended response question.

Stage

Year 12 Agriculture

Syllabus Links

Outcomes

H1.1   explains the influence of the physical, biological, social, historical and economic factors on sustainable agricultural production

H2.1   describes the inputs, processes and interactions of plant production systems

Students learn about:

- The interaction of genotype, environment and management

Students learn to:

- Outline plant breeding systems and their genetic basis including selective breeding, hybridisation and genetic engineering
- Explain how plant breeding is used to develop new plant varieties to improve product quality, yield and environmental adaptation

Lesson Overview

Introduction (Approx. 5 minutes)

Students will read an introduction on plant breeding and the Radiata pine. This piece touches on the basics of the current method of seed collection by the Forestry Corporation.

Activity One (Approx 15-20 minutes)

1. Teachers:
   a) Organise students into pairs.
   b) Hand out one stimulus material - 1 per student.
      The stimulus material is designed to present up to date information on current plant breeding technologies in the forestry industry.
2. Students:
   a) Proceed to summarise their chosen piece.
   b) Present their summary back to their partner.

Activity Two (Approx. 30 minutes)

Students will:

- View three multimedia sources that pertain to seed processing and seed nurseries in the forestry industry.
- Answer a set of questions relating to each source as included in the student worksheet.

Activity Three (Approx 30 minutes):

Students will:

- visit a URL on the Southern Tree Breeding Association and two other related links to this case study. This organisation and site provides information on the main body that is responsible for genetic improvements in the Radiata Pine industry. Students should:
  - o view these sources,
  - o take relevant notes and
  - o plan a response to the extended question.
- Teachers are advised to give feedback on the plan and then students should complete the extended response answer.

References

1. Forestry Corporation. Accessed 5th June 2017
http://www.forestrycorporation.com.au/our-forests/education/resources-and-publications/wild-forest/woodwork/info/forest-supermodels/radiata-pine/information

2. On Farm: TREEPLAN's goal to make bigger and better trees. The Land: 23rd June 2016. Accessed 29th May 2017
http://stba.com.au/cms/doc?id=81afbde1

3. New pine breeding technique may help trees adapt to climate change. October 12, 2011. Wiley-Blackwell. Accessed 28th May 2017
https://www.sciencedaily.com/releases/2011/10/111012124016.htm

4. Going Bush: Episode 4- Seed Processing. Accessed 28th May 2017
https://www.youtube.com/watch?v=EpgpzuUl8us

5. Going Bush 2016 EP03 Tumut Pine. Accessed 28th May 2017
https://www.youtube.com/watch?v=NEX2fE2IFXA

6. Blowering Nursery, Tumut. Accessed 28th May 2017
https://www.youtube.com/watch?v=7XG853o53Vk

7. Southern Tree Breeding Association: About STBA. Accessed 30th May 2017
http://stba.com.au/page/about%20stba

8. PlantPlan Genetics. Accessed 28th May 2017
http://stba.com.au/cms/doc?id=429969c8

9. seedEnergy: Production and sale of seed orchard seed for plantation and farm forestry. Accessed 5th June 2017
http://www.seedenergy.com/pinus-radiata.html

Resources

a) Student worksheet.
b) Online Sources (links also provided on the student worksheet).
   Activity One
   <u>Stimulus Material One:</u> The Land: 23rd June 2016
   On Farm: TREEPLAN's goal to make bigger and better trees.
   URL: http://stba.com.au/cms/doc?id=81afbde1

   <u>Stimulus Material Two</u>
   October 12, 2011, Source: Wiley-Blackwell
   New pine breeding technique may help trees adapt to climate change
   URL: https://www.sciencedaily.com/releases/2011/10/111012124016.htm

Activity Two:

Multimedia One: Going Bush: Episode 4- Seed Processing (0.00- 5.04)
URL: https://www.youtube.com/watch?v=EpgpzuUl8us

Multimedia Two: Going Bush 2016 EP03 Tumut Pine
URL: https://www.youtube.com/watch?v=NEX2fE2IFXA (0.00-7.15)

Multimedia Three: Blowering Nursery, Tumut
URL: https://www.youtube.com/watch?v=7XG853o53Vk (0.00-3.55)

Activity Three:

Source 1: Southern Tree Breeding Association: About STBA
URL: http://stba.com.au/page/about%20stba

Source 2: PlantPlan Genetics
URL: http://stba.com.au/cms/doc?id=429969c8

Source 2: seedEnergy: Production and sale of seed orchard seed for plantation and farm forestry
URL: http://www.seedenergy.com/pinus-radiata.html

c) Sample answers provided.

Sample Answers

Activity One

Table One:

Summary of Stimulus One	Summary of Stimulus Two
- Tall, straight, quality - Treeplan first developed in 2000 - Performance measurements - Estimated breeding values - Conducted field trials - Identify trees with the best traits - Stud trees used for breeding - Straightness, density, diameter, branch size, growth rates, resistance to pests and disease - Timber doesn't snap and break - Increases productivity.	- Create tree variants in ½ the time of current breeding methods - Increate the security and competitiveness of US industry - Up until now took 13 years, now estimated to take 6 years - Some countries have less regulation and higher photosynthetic capacity - Bypassed uncovering all genetic code but instead used what they knew for a trait prediction model. - Predict which traits will appear in a tree without having to grow it first - If you can modify traits faster you can create more specialized trees.

Activity Two

Answers:

1. Identify what happens to the seeds after they are collected from a logged coupe. Seed collected…transported to seed kilns…heated (16 hours)…cleaned…cold store…tested…
2. Describe what regeneration forestry is? Put back seed which comes precisely from that same region of harvest.
3. When are the seeds replanted? After the coupe is burnt….April, May
4. Identify how the seeds are planted. Large areas by slow moving helicopter…smaller areas are done by hand.

Answers:

> 5. Identify the number of pines that are grown at the Tumut nursery. **8 ½ million.**
> 6. How long are the young pines in the nursery for? **Less than a year.**
> 7. Describe some of the management processes that occur during the growth of the forest. **Planting, thinning (first at 13 years then again at 22 years), harvesting.**
> 8. Identify some of the end uses of the trees. **Posts, houses, cardboard, chipboard, tissues, pulpwood, landscaping, biomass to fuel kilns.**

Answers:

> 9. Define the term "bare rooted". **Seedlings that are grown in the field.**
> 10. Identify the regions that the seedlings are sent to for forest plantation. **Hume region, Macquarie region, the Monaro and northern tablelands.**
> 11. Describe how the process of shortening the tap root is performed. **Mechanical cutter removes the bottom of the tap root and lateral shoots encouraged (at 100mm).**
> 12. Identify how much water is conserved when seedling are growth in containers. **Field = 30 mega litres, containers = 3 mega litres.**

Activity Three:

> Teachers may like to help their students/class to design a marking criteria for this question as a skills task. Consideration should be given to the verbs, making sure that students address "explain" and "evaluate" effectively. Specific examples should be used to address the question.

ForestLearning is an initiative of Forest and Wood Products Limited and these resources have been developed by qualified educators and designed to assist teachers deliver the Australian Curriculum.