

Bt trait vs. European Corn Borer



Introduction

Lesson Introduction

Historically, one of the greatest problems associated with crop production has been the control of insects. This lesson is designed to introduce students to the use and need for insect resistant crops, such as corn.



Grade Level: Grades 9 - 12

Time Needed: 2 class periods; 50-55 minutes in length

Learning Objectives

After completing this lesson, students will be able to:

1. Explain why insect control is so important in corn/crop production
2. Identify the damage of the European Corn Borer (ECB)
3. Describe how *Bacillus thuringiensis* is used to create insect resistance in plants
4. Identify the advantages and concerns of plants that are genetically modified to make them insect resistant
5. Explain how insect resistance is prevented

Next Generation Science Standards (NGSS)

As a result of activities for grades 9-12, all students will learn content in these areas:

Topics

- **ESS5:** Human impacts

Performance Expectation

- **HS-ESS3-4:** Evaluate or refine a technological solution that reduces impacts of human activities on natural systems

Dimension

Practices:

- Planning & carrying out investigations
- Analyzing & interpreting data
- Constructing explanations & designing solutions

Disciplinary Core Ideas:

- **ESS3.C:** Human impacts on Earth systems

Cross-Cutting Concepts:

- Stability & change

Connections to Engineering, Technology, & Applications of Science

- Engineers continuously modify these systems to increase benefits while decreasing costs and risks
- New technologies can have deep impacts on society and the environment, including some that were not anticipated



Materials

Web links

www.extension.umn.edu/distribution/cropsystems/dc7055.html

www.iptv.org/explore/ge/uses/index.cfm

www.ext.colostate.edu/PUBS/CROPS/00707.html

www.wvu.edu/~agexten/ipm/animals/genetic2.htm

www.maizecdna.org/outreach/tpe.html

sites.google.com/a/brvgs.k12.va.us/bt-corn/cons

International Service for the Acquisition of Agri-Biotech Applications - Global Status of Commercialized Biotech/GM Crops: 2007

www.isaaa.org/resources/publications/briefs/37/executivesummary/default.html

USDA - Research Q&A: Bt Corn and Monarch Butterflies

www.ars.usda.gov/is/br/btcorn

U.S. Environmental Protection Agency (EPA)

www.epa.gov

Powerpoint (included)

Student worksheet (included)

Vocabulary

Bacillus thuringiensis (Bt) – A naturally-occurring soil bacterium that occurs worldwide and produces a toxin specific to certain insects (e.g., moths, beetles, blackflies, or mosquitoes).

Cry Proteins – Activated by enzymes in the insect's midgut; these proteins attack the cells lining the gut, cause gut paralysis and subsequently kill the insect.

Refuge – An area planted to non-transgenic plants (e.g. non-Bt corn or alternative hosts for ECB), where susceptible pests can survive and produce a local population capable of inter-mating with any possible resistant survivors from Bt corn.

Resistance – The capacity of an organism to survive exposure to a toxin.



Instructional Process



1. Using the Internet sites or Powerpoint, discuss/address the following questions:
 - Why is there a need for insect control in a crop field?
 - What are ECB and how do they damage corn fields?
 - Why is management necessary for the ECB in the crops grown in the Corn Belt?
 - Identify possible control methods of the ECB.
 - How is corn genetically modified to resist ECB and why or how does it only target certain organisms?
2. Use either instructional approach:
 - a. Using the Powerpoint provided, present the information regarding the development and use of Bt and its effects on ECB.
 - b. Using the listed websites, have the students use scientific inquiry to find the answers for the above questions. Discuss their findings (this would be the recommended option depending on your resources).
3. After the students have a solid understanding of Bt and ECB, have the students complete the worksheet.
4. Use the optional ECB lab

Supplemental Content (optional lab)



1. In a greenhouse, raise both Bt and non Bt corn varieties until they have at least two true leaves.
2. Order ECB eggs from your state's land grant university.
3. Take leaf cuttings from both Bt and non Bt corn varieties and place each variety into two different petri dishes lined with a damp paper towel. Make sure to label each petri dish accordingly.
4. Place egg masses on the leaves and seal them shut with parafilm.
5. Place in an incubator at 83 degrees Fahrenheit for two days.
6. Evaluate the corn leaves for ECB damage.



Follow Up Questions

1. Why is insect control so important to crop production?
2. How is Bt used to create insect resistance in plants?
3. What are the advantages for plants that have been genetically modified to make the insect resistant?
4. What are some common concerns with Bt use?
5. How is ECB resistance to Bt prevented?

Bt Trait vs. ECB – Student Sheet



Name: _____

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Student worksheet

Procedure

A producer has 500 acres of corn to plant that is part of a corn-soybean rotation in the “corn belt.” European Corn Borer (ECB) has been documented to be a major pest in recent years.

Based on the research you found and/or the information presented by your teacher, what is the best recommendation or advice that you could give to the producer (i.e., plant all 500 acres to Bt; plant all conventional corn and use chemicals; plant a certain percentage of genetically modified and conventional; etc.)? Be sure to explain your reasoning.

Make sure you address impacts to the:

1. Producer
2. Public
3. Wildlife
4. Economics
5. Environment