

Name: _____ Group Name: _____

Course Name | University Name

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***Bt* Corn and Monarch Butterflies - Part 2 (Version A)**

The Losey *et al* (1999) generated quite a stir in the scientific community. Soon after, many researchers began investigating similar questions as to the impact of *Bt* corn on monarch survival. Your team has been given the data and results from one such study. Your task is to (1) evaluate the evidence for your study, and (2) create a 1-slide .ppt presentation to showcase the claim and evidence put forth in this paper.

Your Study

Oberhauser, K. *et al*. 2001. Temporal and spatial overlap between monarch larvae and corn pollen. Proceedings of the National Academy of Science 98(21):11913-11918.

Research Question:

Is it likely that monarch larvae will encounter *Bt* pollen in field conditions?

Methods:

Oberhauser *et al* (2001) chose 4 regions in the monarch breeding range. These ranges included cornfields, cornfield edges, agricultural fields, and non-agricultural fields in MN, WI, MD and southern Ontario. All sites had non *Bt* corn planted in/near the location of the study (except MD, where one field did have *Bt* corn present). Weekly from May- August, researchers searched milkweed plants to record the number of monarch egg and larvae. Teams identified weeks in which 20% of the corn plants in the area were releasing pollen (corn anthesis).

Results: Using the paper, look specifically at Figure 1(b) and Table 5. You may wish to look at other figures, but use these as a starting place.

- 1) Revisit the methods section and note strengths and weaknesses for the experimental set up.

- 2) Do monarchs use cornfields as much or more/less than they use non-agricultural fields?

- 3) Is there an overlap between when monarchs use the fields and are susceptible to the toxin (second instar stage) and corn pollination (i.e., corn anthesis)?

- 4) What do you think was the conclusion of the study? Are you convinced?

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Bt Corn and Monarch Butterflies - Part 2 (Version B)

The Losey *et al* (1999) generated quite a stir in the scientific community. Soon after, many researchers began investigating similar questions as to the impact of *Bt* corn on monarch survival. Your team has been given the data and results from one such study. Your task is to (1) evaluate the evidence for your study, and (2) create a 1-slide .ppt presentation to showcase the claim and evidence put forth in this paper.

Your Study

Stanley-Horn. DE., GP Dively, RL Hellmich, HR Mattila, MK Sears, R Rose, LCH Jesse, J Losely, J Obrycki and L Lewis. 2001. Assessing the impact of Cry1Ab-expressing corn pollen on monarch butterfly larvae in field studies. *Proceedings of the National Academy of Science* 98(21):11931-11936.

Research Question:

Stanley-Horn *et al* (2001) asked two questions: (1) Does *Bt* corn pollen negatively impact monarch survival and growth? (2) Does the “dose” or concentration of pollen grains exposed to monarch larvae matter?

Methods:

Researchers have already determined that pollen produced by *Bt* corn variety “Event 176” contains enough insecticide toxin to be harmful to the first instar stage of the monarch larvae, but wonder if other *Bt* corn varieties exhibit similar outcomes (as a side note, Event 176 was discontinued from production in 2001 and is no longer used for planting corn). Researchers Stanley-Horn *et al* (2001) collected data from field studies (IA, Ontario, NY, MD) to assess the impact of *Bt* corn pollen on monarch larvae survival.

At each site, milkweed plants were placed in the study site about 2 days before corn pollen was released. When 50-75% of the plants had shed pollen, leaves were collected from the milkweed plants to determine pollen densities. Then, monarch larvae (less than 24 hours old) were placed onto the milkweed plants in the field; one site was caged to prevent predation. After 5 days, larval survival and weight were recorded. A second leaf was removed from each plant to count the pollen density by *Bt* variety present in the field

Results: Using the paper, look specifically at Table 1 (below) and Figure 4. You may wish to look at other figures, but use these as a starting place.

Table 1. Mean pollen grain counts at each site, representing the spread of pollen density of all *Bt* corn types found on milkweed plants in the field.

Site	Iowa	Ontario	Maryland	New York
Pollen Density (grains/cm ²)	260	309	161	127

*Table created using data from Stanley-Horn paper.

- 1) Revisit the methods section and note strengths and weaknesses for the experimental set up.
- 2) What is the average density of pollen grains across all field types?
- 3) How does monarch larvae survival on *Bt* and non-*Bt* corn fields compare? Is it the same across sites?
- 4) What do you think was the conclusion of the study? Are you convinced?

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***Bt* Corn and Monarch Butterflies - Part 2 (Version C)**

The Losey *et al* (1999) generated quite a stir in the scientific community. Soon after, many researchers began investigating similar questions as to the impact of *Bt* corn on monarch survival. Your team has been given the data and results from one such study. Your task is to (1) evaluate the evidence for your study, and (2) create a 1-slide .ppt presentation to showcase the claim and evidence put forth in this paper.

Your Study

Hellmich, RL, BD Siegfried, MK Sears, DE Stanley-Horn, MJ Daniels, HR Mattila, T Spencer, K Bidne, and LC Lewis. 2001. Monarch larvae sensitivity to *Bacillus thuringiensis*-purified proteins and pollen. Proceedings of the National Academy of Science 98(21):11925-11930.

Research Question:

Hellmich *et al* (2001) ask what is the relative toxicity of 6 *Bt* toxins?

Methods:

Hellmich *et al.* (2001) followed up the Losey study by testing the toxicity of the *Bt* pollen from a variety of *Bt* hybrids. The relative toxicity of these toxins has not yet been evaluated, so they aim to see how toxic these protein-forming crystals really are to monarch larvae. In a laboratory setting, Hellmich and colleagues tested pollen from actual *Bt* plants were applied to 20mm diameter milkweed discs treated with different densities (ranging from 150 grains/cm² to 4000) and types of pollen. Individual larvae were exposed to pollen on two milkweed discs in a small, enclosed area for 48 hours. Following, then an untreated disc was swapped; this was repeated 4 times.

Results: Using the paper, look specifically at Figure 1. You may wish to look at other figures, but use this one as a starting place.

- 1) Revisit the methods section and note strengths and weaknesses for the experimental set up.

- 2) For *Bt*11, what conclusion can you draw about the toxicity of the *Cry* toxin and its impact on mean larvae weight after 96 hours?

- 3) For *Bt*11, does the pattern of results change by pollen grain density?

- 4) Looking at the other *Bt* varieties, are the results similar to *Bt*11?

- 5) What do you think was the conclusion of the study? Are you convinced?

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***Bt* Corn and Monarch Butterflies - Part 2 (Version D)**

The Losey *et al* (1999) generated quite a stir in the scientific community. Soon after, many researchers began investigating similar questions as to the impact of *Bt* corn on monarch survival. Your team has been given the data and results from one such study. Your task is to (1) evaluate the evidence for your study, and (2) create a 1-slide .ppt presentation to showcase the claim and evidence put forth in this paper.

Your Study

Hanson Jesse, LC, JJ Obrycki. 2000. Field deposition of *Bt* transgenic corn pollen: lethal effects on the monarch butterfly. *Oecologia* 125:241-248.

Research Question:

What is the survivorship of monarch larvae under different field-collected pollen densities?

Methods:

Hanson Jesse & Obrycki (2000) followed up the Losey *et al* (1999) study by investigating if *Bt* pollen naturally occurring in fields impacts survival of monarch larvae. To do so, researchers placed potted milkweed plants in a cornfield planted with four different *Bt* corn varieties. They placed these milkweed potted plants 0.2, 1 and 3 meters from the edge of the field, and later added 5 and 10 meter placements. Holes were punched in the leaves (top, middle and base of the plants) of the milkweed plants to create 0.79cm² discs that were used for counting the number of pollen grains. Monarch larvae were placed on the discs for 48 hours (including a control where all the pollen had been washed off the discs). In total, 143 discs were included in the study (35 from the *Bt* corn, 36 from non-*Bt* corn, and 72 control).

Results: Using the paper, look specifically at Figures 1 and 2. You may wish to look at other figures, but use this one as a starting place.

- 1) Revisit the methods section and note strengths and weaknesses for the experimental set up.
- 2) What conclusion can you draw about the impact of field accumulated *Bt* pollen on monarch larvae (less than 12 hours old) survival at 1,300 grains/cm²?
- 3) Does this trend differ for event Bt11 vs. event Bt176? Or, at a density of 135?
- 4) How does the survival pattern from Figure 1 compare with larvae that are 12-36 hours old (Figure 2)? Does it differ by corn variety or pollen density?
- 5) What do you think was the conclusion of the study? Are you convinced?

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***Bt* Corn and Monarch Butterflies - Part 2 (Version E)**

The Losey *et al* (1999) generated quite a stir in the scientific community. Soon after, many researchers began investigating similar questions as to the impact of *Bt* corn on monarch survival. Your team has been given the data and results from one such study. Your task is to (1) evaluate the evidence for your study, and (2) create a 1-slide .ppt presentation to showcase the claim and evidence put forth in this paper.

Your Study

Pleasants, JM, RL Hellmich, GP Dively, MK Sears, DE Stanley-Horn, HR Mattila, JE Foster, P Clark and GC Jones. 2001. Corn deposition on milkweeds in and near cornfields. Proceedings of the National Academy of Science 98(21):11919-11924.

Research Question:

What are the naturally occurring densities of corn pollen on milkweed plants?

Methods:

Pleasants *et al*. (2001) aimed to determine *Bt* corn pollen density in field conditions so that researchers doing lab studies on the impact of *Bt* corn pollen on monarch butterflies could have a realistic vision of what pollen conditions are like in the field. To do so, they measured pollen accumulation on the leaves of naturally occurring milkweed plants, or potted plants inside and outside cornfields. Field edges were defined as 0 and negative numbers refer to milkweed locations within a cornfield whereas positive numbers represent the number of meters away from the field edge. Leaf samples were collected both during anthesis (i.e., pollination) and at the end of anthesis. Five sites were involved: IA, MN, WI, MD and Ontario, Canada. Rain events were noted. Pollen samples were counted with a dissecting microscope.

Results: Using the paper, look specifically at Figure 2 and Table 1. You may wish to look at other figures, but use this one as a starting place

- 1) Revisit the methods section and note strengths and weaknesses for the experimental set up.
- 2) What was the range for average pollen density at 100% anthesis (or 9-11 days into sampling)?
- 3) How does a rain event impact pollen density?
- 4) Which part of the plant contains the most pollen grains?
- 5) Which location in the field appears to have the most pollen?
- 6) What do you think was the conclusion of the study? Are you convinced?