Cases for Teaching Responsible Communication of Science

Monarchs in the corn: Discussion version

Corn farmers have always faced pests that can damage their crop and undermine yields. One important pest is the corn borer, a worm that eats the root of the corn plant underground. Corn borers are especially damaging because they are difficult to reach, difficult to kill, and because they are voracious.

The United States Environmental Protection Agency approved marketing and use of genetically engineered 'Bt corn' plants in 1995. 'Bt' stands for Bacillus Thuringensis, an organism that produces a toxin that is fatal to the corn borer. Bt corn has genes spliced into the corn genome, causing the plant to express this toxin in every cell. Some people initially found it alarming that these plants produce their own pesticide. There was concern that what is toxic to pests might be toxic to people as well. But in the case of Bt toxin, this problem does not arise. Bt toxin responds to the gut chemistry of lepidopteran species like the corn-borer with fatal response. Because mammalian gut chemistry is different, the Bt toxin does not have the same effect on humans or other corn-eating mammals.

Concerned about their findings, Losey, Rayor, and Carter submitted a brief paper to the prestigious journal Nature. Their paper reported the result of an experiment in which monarch butterfly larvae were fed milkweed leaves dusted with corn pollen. Larvae in the control group were given leaves dusted with pollen from an unidentified corn variety that had not been transgenically modified. Larvae in the experimental group were given leaves dusted with pollen from Bt corn. As they reported in the article, Losey and his colleagues found significantly increased mortality and health problems in larvae exposed to transgenic pollen. As the paper shows, monarch larvae will eat milkweed leaves that are covered with pollen, even when the pollen density is toxic or deadly to them. It thus identifies a previously uninvestigated hazard to monarchs.

Put yourself in the position of the reviewers who were asked to evaluate this brief paper for publication. As you read the paper, consider the following issues:

1) Is the research reported good science?

2) Should reviewers consider the fact that this topic is controversial? It is predictable that the research reported in this paper will generate public controversy. GM crops were relatively new at the time this was published, and people were concerned about unintended consequences for human health and for the environment. Is it relevant to you as a reviewer that this paper is likely to generate controversy, and its findings misused and misrepresented? Have the authors taken steps to guard against misuse and misrepresentation?

3) Promoting or undermining new technology product: Some of the reviewers of this paper were researchers responsible for developing Bt corn, or were scientists working in companies that produce and sell this product. These researchers regard it to be a safe product that may allow farmers to use less pesticide. Are there appropriate ways that these interests can enter the review process, or is it always inappropriate for reviewers to include such considerations?

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Before class, read the original article:

> Losey, et al. 1999. "Transgenic Pollen Harms Monarch Larvae." Nature. Vol 399. 20 May 1999. p. 214, available at http://www.nature.com/nature/journal/v399/n6733/pdf/399214a0.pdf

As you read this article, you should take notes to prepare yourself to make a presentation (with your group) that will refer to the main elements. As you read, consider the following questions:

1) Note that this paper was published as "Scientific Correspondence." Is this significant? Is this a more appropriate venue for results that are tentative, as compared with publication in the main body of the journal?

2) The cover of this issue showed an image of a monarch caterpillar eating a milkweed leaf covered in corn pollen. Was the decision to highlight this paper in this way, as a feature publication, a questionable decision?

3) Consider the title of the paper: Is the title accurate? Does the experimental work provide adequate support to show that "Transgenic pollen harms monarch larvae?" Is this title likely to incite an inappropriate public response? Are there other titles that would be more appropriate?

4) When this paper was published, agricultural biotechnology was quite a new thing. Many people had concerns and fears about this technology, but the public was not very informed about its safety. Would it be appropriate for the journal or the authors to take these considerations into account when deciding whether to publish, or when deciding how to describe the work undertaken in the study? For example, should the paper be framed to avoid inciting or increasing the level of public fear about biotechnology? Should it be framed to increase people's reservations about the environmental effects of biotechnology?

Questions for Discussion

1. Is it good science?

Has the control been properly identified? Should researchers have measured more precisely the pollen density on leaves? Should they have considered whether caterpillars, given the choice, would simply avoid leaves dusted with Bt pollen? Is the study reproducible, or is it too vaguely described?

2. Is the research sufficiently complete for publication?

This paper identifies a hazard without analyzing the probability that actual larvae will be harmed by Bt pollen. Should they do more field work before publication, to evaluate the risk? (Risk is quantified as a measure of the badness of the harm multiplied by the probability that the harm will occur.)

3. Does this paper invite public misinterpretation? Is the title inflammatory?

Consider some alternative titles that might have been used, or fill in your own alternative. What kinds of reasons are relevant when considering what title to use? Alternative titles include:

1. "Transgenic Pollen: Effects on a Non-Target Species"
2. "Preliminary Evidence that Transgenic Pollen May be Toxic to Butterfly Larvae"
3. "Does Transgenic Pollen Harm Monarch Larvae?"
4. "Transgenic Pollen Deadly to Butterfly Populations!"
5. _____(Write your own!)

This paper uses the terms 'harm,' 'risk,' and 'toxin.' Do these terms mean the same thing to the general public that they mean to scientists? If not, is it relevant to clarify their use? Nature is a professional scientific journal, but has a wide readership including nonscientists.

4. It is predictable that interest groups may use this research, and may misrepresent the results in an effort to support their own policy agenda.

Is this a consideration that should be taken into account in the decision to publish? Should it be taken into account in the decisions about how this study should be presented in print?

5. Evaluate the (fictional) reviewer comments below. How would you frame your own reasons for or against publication if you were writing a professional review?

- "The study is too incomplete, but if published it should be made clear that the results are preliminary and incomplete. Presentation of the results should not certainly not overstate the significance of this brief experiment."
- "While the results are preliminary, the risk identified is a very serious and imminent environmental risk. The journal should seek to promote additional extensive (and swift!) reëxamination or the problem identified!"
- "This study should not be published. The research does not meet the minimal standards of proper scientific procedure, since it is not described or controlled well enough to allow reproduction."
- "This important research identifies serious environmental harms created by transgenic pollen. We should do everything we can to see that these results are widely disseminated and widely understood."