

## Group 2: Some effects of phosphorus mining, processing and use on land and water

### Part 1: When gypsum stacks fail

Read the articles: *Problems at Piney Point*, and *Hurricane hits Riverview phosphate plant*. Answer the following questions.

1. Were the mining companies responsible for the spills? Explain your answer.
2. What were the consequences of the spills?
3. How were the spills cleaned up, and what changes were made to prevent future spills?
4. The spills seem pretty nasty. Why do you think Florida still allows phosphate mining, given these consequences?

## Part 2: Cadmium in soils: A consequence of phosphate fertilizer use

### Experimental design

Brazilian scientists Alessandra Mendes, Gustavo Duda, Clístenes Araújo do Nascimento and Michelangelo Silva did a simple study in which they grew velvet green beans in soil with different amounts of chemical fertilizer. The soil was a combination of 88% sand, 10% clay and 2% silt. Before any fertilizer was applied, the soil had a pH of 7.7 and contained 2.0 mg/dm<sup>3</sup> of phosphorus (2.0 milligrams per cubic decimeter).

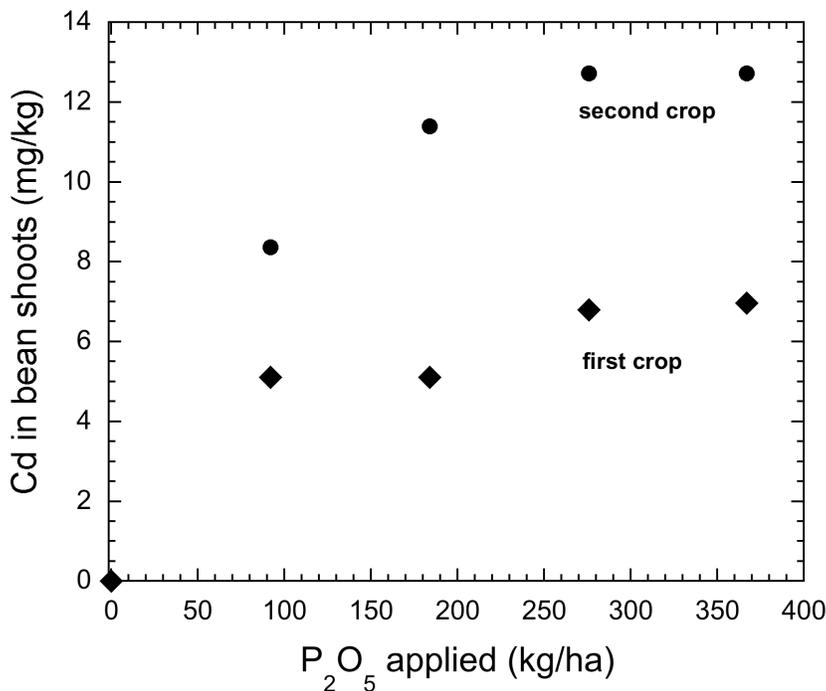
The scientists tested different types of fertilizer, one was a commonly used triple superphosphate. Because phosphate rock contains small amounts of heavy metals, the fertilizer also contains small amounts of heavy metals. The triple superphosphate tested contained 45 mg/kg lead, and 28 mg/kg cadmium.

The scientists harvested one “crop” of beans, then grew a second crop in that same (previously fertilized) soil, fertilizing the new plants as well.

### Results

No detectable lead was found in the bean shoots.

Cadmium was measured in the harvested bean shoots, as shown in this graph:



*Figure 1.* The amount of cadmium (Cd) in bean shoots in the first crop (grown in soil with no previous fertilizer application) and second crop (grown in soil after the second crop) varies with the amount of phosphate fertilizer applied. The y-axis shows the milligrams of cadmium in every kilogram of bean shoots, and the x-axis shows the amount (in kilograms) of fertilizer applied to each hectare (one ha = 10,000 square meters = 2.47 acres) of land. Modified from Figures 1-2 in Mendes et al., 2006.

Questions:

5. What was the scientists' hypothesis? (Given the small amount of information, there are multiple correct answers. Make sure the hypothesis derived matches the experimental design and types of results.)
  
6. Based on the results, should the scientists accept or reject the hypothesis you wrote above?
  
7. What did the scientists learn about cadmium, plants and fertilizer? Summarize (in words) what should be learned from Figure 1.
  
8. Both lead and cadmium are toxic; lead can cause neurological disorders and cadmium can cause cancer. What are the implications of this study with regard to human health? Can you suggest any changes to agricultural methods to limit health effects?

Reference:

Mendes, Alessandra Monteiro Salviano; Duda, Gustavo Pereira; Araújo do Nascimento, Clístenes Williams and Michelangelo Oliveira Silva (2006) Bioavailability of cadmium and lead in a soil amended with phosphorus fertilizers. *Scientia Agricola* 63 (4): 328-332.