

Plant Bioassays

Lesson Title: Toxicology 2: Finding the Toxic Dose

Page 1 of 2

Name: _____

Introduction

A plant bioassay is a simple, inexpensive, accurate, and direct method of determining if it is safe to grow crops on farmland previously treated with known herbicides or on cropland with an unknown history of herbicide use. A bioassay can detect if herbicide or chemical residues are present in the soil at concentrations high enough to adversely affect crop growth, yield, and quality.

The accuracy of bioassays depends on the sampling technique. The following are some of the steps that must be undertaken in a plant bioassay:

- Sample soil from areas suspected of having herbicide residues as well as those areas believed to be free of herbicide. Keep samples separate.
- Collect soil samples from the upper surface (0 to 8 cm/ 0 to 3 inches).
- Using a spade, trowel or soil sampler, take several samples from the suspect area and combine them.
- Store the samples in cool conditions. If the soil is wet, spread it out to dry, keeping different samples separate. When dry, crush clods to pea-sized particles.

Bioassay Procedure

Bioassays are conducted by growing species of plants known to be sensitive to a specific herbicide or class of herbicides (see Table 1) in the sample soil, along with the crop to be planted. If the suspected herbicide contaminant is unknown, a broad range of crop species is grown to help identify the culprit.

Table 1. Selecting plant species for herbicide bioassay		
Herbicide Group	Test Species	Common Injury Symptoms
Group 2: imazethapyr, chlorsulfuron	Sugar Beet, Canola	Stunting, purpling, general yellowing of new growth, terminal bud death
Group 3: trifluralin, ethalfluralin	Green Foxtail, Oat	Stunting, swollen, and shortened roots
Group 4: picloram, clopyralid	Faba Bean, Flax	Malformation; bending and twisting of stem, leaf cupping and curling
Group 5: triazines, bromacil	Oat, Cucumber	Stunting, interveinal yellowing of new leaf
Group 8: triallate	Tame Oat, Wild Oat	Lack of emergence, brittle and dark green coleoptiles, shoots may form loops

To start the bioassay, three or four pots must be made for each sample. The assay pots should contain no drainage holes at the bottom. Ten to fifteen seeds of the bioassay species are placed into the "clean" and "contaminated" soil samples. Usually, plant toxicologists also plant seeds in pots using a sterilized, herbicide-free potting soil.

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Page 2 of 2

Name: _____

Evaluating Results

The amount of herbicide chemical in soil is usually expressed in parts per million (ppm) or parts per billion (ppb). One ppm is equal to 1mg/L and one ppb is equal to 1 μ g/L.

Figure 1 shows the result of a bioassay using faba bean on soil with varying concentrations of picloram.

Figure 1. Faba bean bioassay



Credit: Alberta Agriculture, Food, and Development (<http://www.agric.gov.ab.ca>).