Development and Application of a Bioassay for Detection of Sulfentrazone in Soil

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Introduction

Sulfentrazone is a soil-applied herbicide used for selective control of certain broadleaf and grass weed species. It has been registered in the United States for use in soybean and tobacco. In the near future sulfentrazone will be available in western Canada. Therefore research on behavior of sulfentrazone in western Canadian soils and its impact on rotational crops is needed.

Objectives

The objectives of this study were to develop a lab bioassay for detection sulfentrazone in soil and test its application using soils of varying properties.

Materials and Methods

Development of a lab bioassay:

To identify the most suitable plant species for the detection of sulfentrazone in soil, several crops were tested by measuring root and shoot response to soil-incorporated sulfentrazone. The root bioassay was performed in 2-oz Whirl-Pak TM bags (1) while the shoot bioassay was performed in Styrofoam cups (2). Root and shoot length was measured for plants grown in soil that was spiked at 0.5X of field application rate and for plants grown in the untreated soil, and root and shoot length inhibition (%) was calculated.

Effect of soil properties on sulfentrazone phytotoxicity:

Five soils of varying properties were spiked with sulfentrazone in a range of 0 to 400 ppb (equivalent to 2X of field application rate) and sugar beet bioassay was performed. A log-logistic model was used to fit shoot inhibition data.

Results and Discussion

Development of a lab bioassay:

Sulfentrazone had little effect on the root growth (Table 1). Root length inhibition in the range of 9 to 14% was detected for some plant species. Shoot length inhibition was more sensitive than root length inhibition with shoot length inhibition of sugar beet being significantly greater than that for other crops (Table 1). Sugar beet was selected as the optimal crop for the detection of sulfentrazone. The conditions for the sugar beet bioassay are: six days of growth, light intensity of 16 μmol m^{-2} s^{-1}, 15 seeds planted in 100 g of soil (Fig. 1).

Table 1. Root and shoot length inhibition of different crops grown in soil spiked with sulfentrazone at 0.5X rate.

Crop	Root Length Inhibition %	Shoot Length Inhibition %
Mustard	nd	22
Sugar beet	13	51
Canola	14	25
Red lentil	nd	39
Green lentil	nd	35
Onion	nd	17
Oat	x	3
Lettuce	12	28
Corn	x	5
Cabbage	13	8
Turnip	13	4
Cauliflower	13	15
Broccoli	12	34
Radish	14	15
Beet	9	34
Cucumber	x	nd
Cotton	x	10

Fig 1. Sugar beet bioassay

Effect of soil properties on sulfentrazone phytotoxicity:

The effect of sulfentrazone on % shoot length inhibition of sugar beet varied among the investigated soils (Fig. 2). Organic carbon content appeared to be an important factor affecting the degree of sulfentrazone phytotoxicity. In soils of higher organic carbon content (Soil 5, Melfort association, Black soil zone), phytotoxicity was reduced compared to soils of low organic carbon (Soil 1, Haverhill association, Brown soil zone). The effect of soil properties on phytotoxicity and persistence will be examined in more detail in future work.

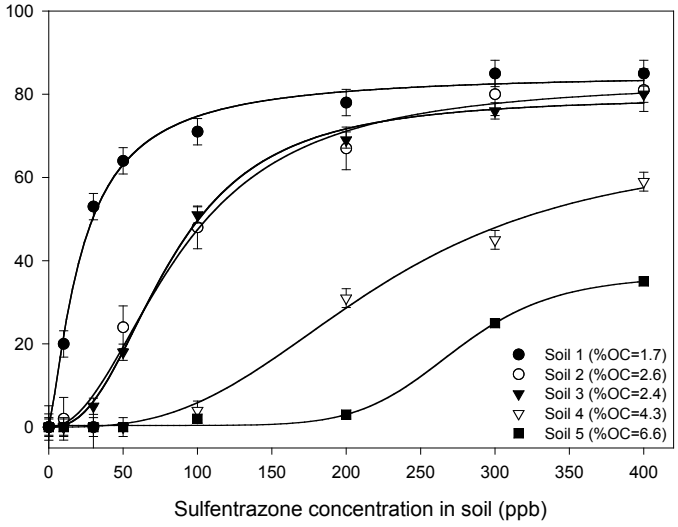

Fig 2. Sulfentrazone phytotoxicity in five soils.

Conclusions

The sugar beet shoot length bioassay is a suitable means of assessment for sulfentrazone in soil. This bioassay is simple and quick and can be easily replicated. The phytotoxicity of sulfentrazone as measured by this bioassay appeared to be soil dependent.

References

(1) Szmigielski A.M., Schoenau J.J., Irvine A. and Schilling B. 2006. Evaluating a mustard root length bioassay for predicting crop injury form soil residual flucarbazone. In press.
(2) Eliason R., Schoenau J.J., Szmigielski A.M. and Laverty W.M. 2004. Phytotoxicity and persistence of flucarbazone-sodium in soil. Weed Sci. 52:857-862.

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