



**SPECIES SENSITIVITY
EVALUATION IN SUPPORT OF
TEBUTHIURON TIER 2
BENCHMARK DERIVATION**

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1.0 Introduction

Stantec Consulting Ltd. was asked to construct species sensitivity distributions (SSDs) using the results of chronic/definitive ecotoxicity tests (Stantec, 2008) for soils contaminated and amended with tebuthiuron. The ultimate goal of this project was to generate SSDs that could be used to derive Tier-2 site specific soil quality criteria (SQC) for tebuthiuron. The SQC derivation process follows the precedent set by the 2006 Canadian Council of Ministers of the Environment (CCME) protocol (CCME, 2006) which utilizes rank species sensitivity analysis. Toxicity data from chronic/definitive toxicity tests with tebuthiuron (Stantec, 2008) were used in the derivation of the soil quality criteria.

This report contains the approach and methodology used in the derivation of the SQC.

2.0 Materials and Methods

The data used in the derivation were obtained from toxicity tests conducted with tebuthiuron (Stantec, 2008) and are summarized in Table 1. Four plant species (blue gramma grass, durum wheat, western wheatgrass, and silver sagebrush), one earthworm species (*Eisenia andrei*), and one arthropod species (*Folsomia candida*) were used in chronic/definitive studies. Non-linear regression analysis or hypothesis-testing procedures were applied to the data from the chronic/definitive tests; statistical models used for each dataset are provided in Stantec (2008).

A rank species sensitivity distribution analysis was conducted using these data, based on the CCME protocol (CCME 2006), as follows:

1. The data, including the species, endpoint of interest, and endpoint value for the toxicant of interest were listed in a spreadsheet.
2. The endpoint values were ranked in increasing order from the lowest value to the highest using the sort function of the spreadsheet.
3. The species rank sensitivity for each endpoint was calculated in the following manner:

$$\text{Rank sensitivity} = (\text{rank number}/(\text{total number of data points} + 1)) * 100$$

4. The toxicant concentration (log transformed or on a log scale) was plotted on the x-axis and the rank sensitivity on a probability scale was plotted on the y-axis.
5. The 25th percentile (the concentration below which 75% of the organisms are not expected to be adversely affected) or the 50th percentile (the concentration below which 50% of the organisms are not expected to be adversely affected) was visually determined from the graph.

Table 1: Toxicity data for tebuthiuron from plant and invertebrate tests conducted in site soil (Stantec, 2008).

Test type	File	Species	Endpoint	IC25 (mg/kg dry wt.)	IC50 (mg/kg dry wt.)
Definitive	DW BGG WW definitive test.xls	blue gramma grass	shoot length	1.14	12.76
Definitive	DW BGG WW definitive test.xls	blue gramma grass	shoot dry mass	0.14	0.54
Definitive	DW BGG WW definitive test.xls	blue gramma grass	root length	1.35	3.8
Definitive	DW BGG WW definitive test.xls	blue gramma grass	root dry mass	0.13	0.52
Definitive	DW BGG WW definitive test.xls	blue gramma grass	emergence	Not calculable	Not calculable
Definitive	DW BGG WW definitive test.xls	durum wheat	shoot length	30.27	1479.11
Definitive	DW BGG WW definitive test.xls	durum wheat	shoot dry mass	0.01	0.75
Definitive	DW BGG WW definitive test.xls	durum wheat	root length	328.1	737.9
Definitive	DW BGG WW definitive test.xls	durum wheat	root dry mass	1.26	31.62
Definitive	DW BGG WW definitive test.xls	durum wheat	emergence	No effect	No effect
Definitive	DW BGG WW definitive test.xls	western wheatgrass	shoot length	0.06	0.22
Definitive	DW BGG WW definitive test.xls	western wheatgrass	shoot dry mass	0.05	0.12
Definitive	DW BGG WW definitive test.xls	western wheatgrass	root length	0.13	12.88
Definitive	DW BGG WW definitive test.xls	western wheatgrass	root dry mass	0.04	0.16
Definitive	DW BGG WW definitive test.xls	western wheatgrass	emergence	Not calculable	0.01
Definitive	SS definitive test.xls	silver sagebrush	shoot length	0.973	120.504
Definitive	SS definitive test.xls	silver sagebrush	shoot dry mass	Not calculable	0.14
Definitive	SS definitive test.xls	silver sagebrush	root length	0	0.018
Definitive	SS definitive test.xls	silver sagebrush	root dry mass	0.044	0.221
Definitive	SS definitive test.xls	silver sagebrush	emergence	Not calculable	0.385
Chronic	Ea Reproduction test.xls	<i>Eisenia andrei</i>	adult survival	Not calculable	758.6
Chronic	Ea Reproduction test.xls	<i>Eisenia andrei</i>	number of progeny	9.8	81.4
Chronic	Ea Reproduction test.xls	<i>Eisenia andrei</i>	progeny wet mass	39.7	148.7
Chronic	Ea Reproduction test.xls	<i>Eisenia andrei</i>	progeny dry mass	35.9	126.4
Chronic	Fc Reproduction test.xls	<i>Folsomia candida</i>	number of progeny	1	253.5
Chronic	Fc Reproduction test.xls	<i>Folsomia candida</i>	adult survival	Not calculable	1235.9

It was assumed that all endpoints determined in a test are ecologically relevant and not redundant (i.e., shoot length and dry mass, and root length and dry mass, measure independent and relevant plant responses to the toxicant). Therefore, all endpoints can be used to determine the rank sensitivity of species. Species rank sensitivity plots were developed using all available chronic/definitive data for tests conducted with tebuthiuron in site soil.

3.0 Results

The species rank sensitivity plots are given in Figures 1-4.

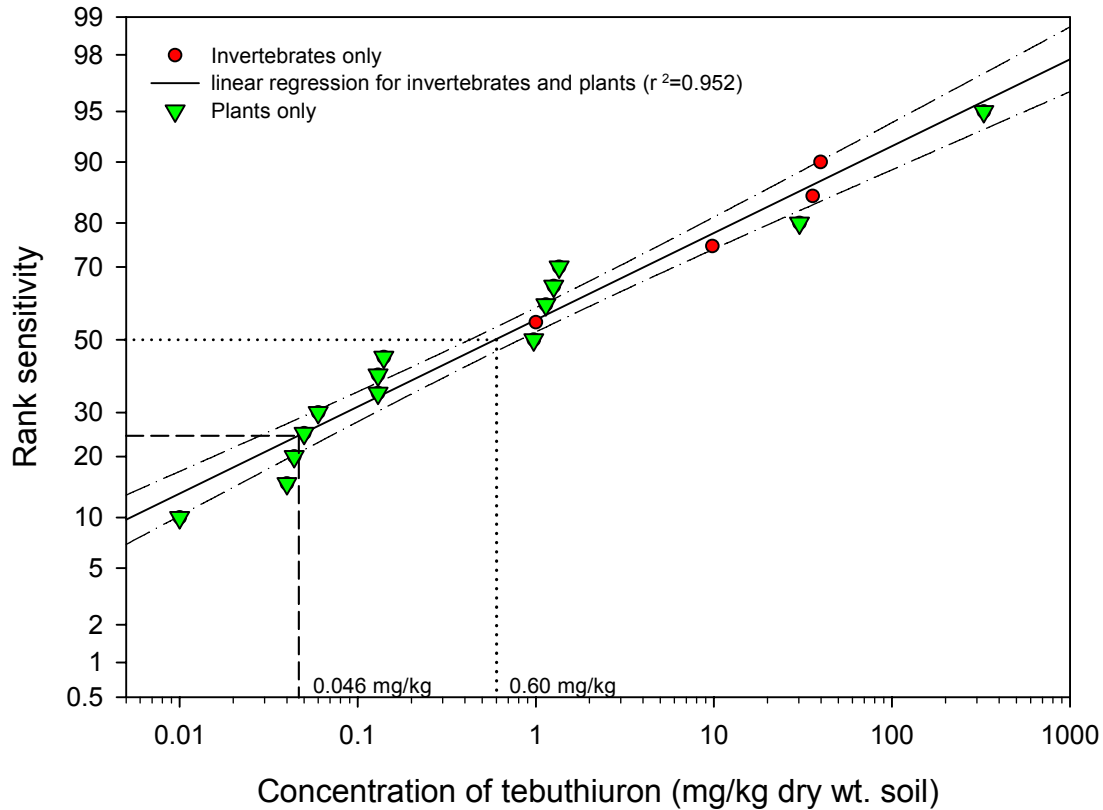


Figure 1: Data distribution of all chronic/definitive IC25s for plant and invertebrate species exposed to tebuthiuron in site soil with 95% confidence intervals indicated. The 25th and 50th percentiles for effects are indicated with straight dashed and dotted lines respectively.

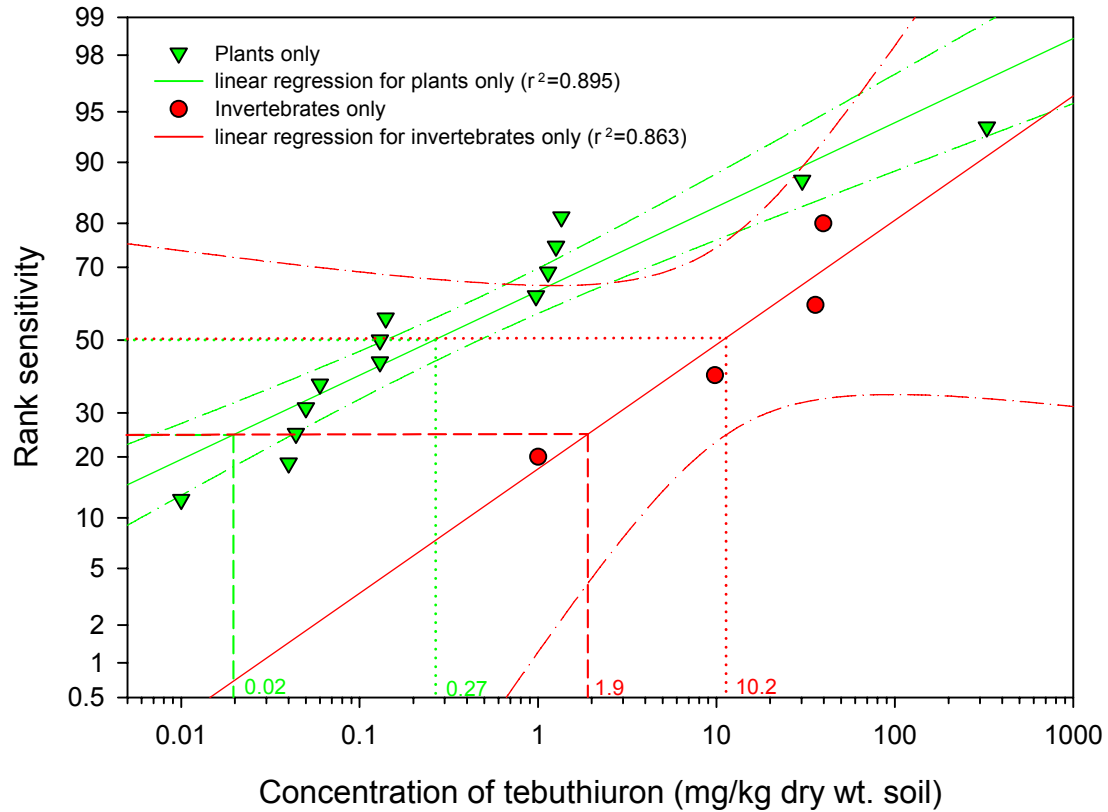


Figure 2: Data distribution of all chronic/definitive IC25s for plant and invertebrate species exposed to tebuthiuron in site soil with 95% confidence intervals indicated. The 25th and 50th percentiles for effects are indicated with straight dashed and dotted lines respectively, for plants only and invertebrates only.

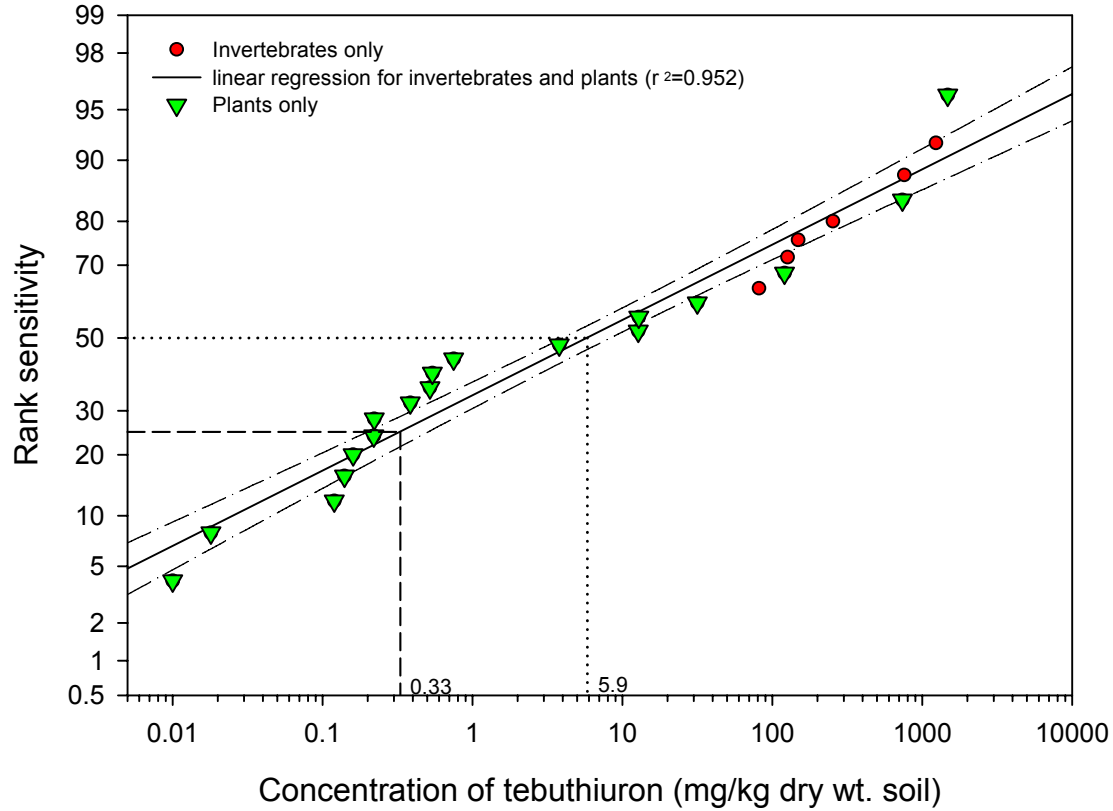


Figure 3: Data distribution of all chronic/definitive IC50/EC50/LC50s for plant and invertebrate species exposed to tebuthiuron in site soil with 95% confidence intervals indicated. The 25th and 50th percentiles for effects are indicated with straight dashed and dotted lines respectively.

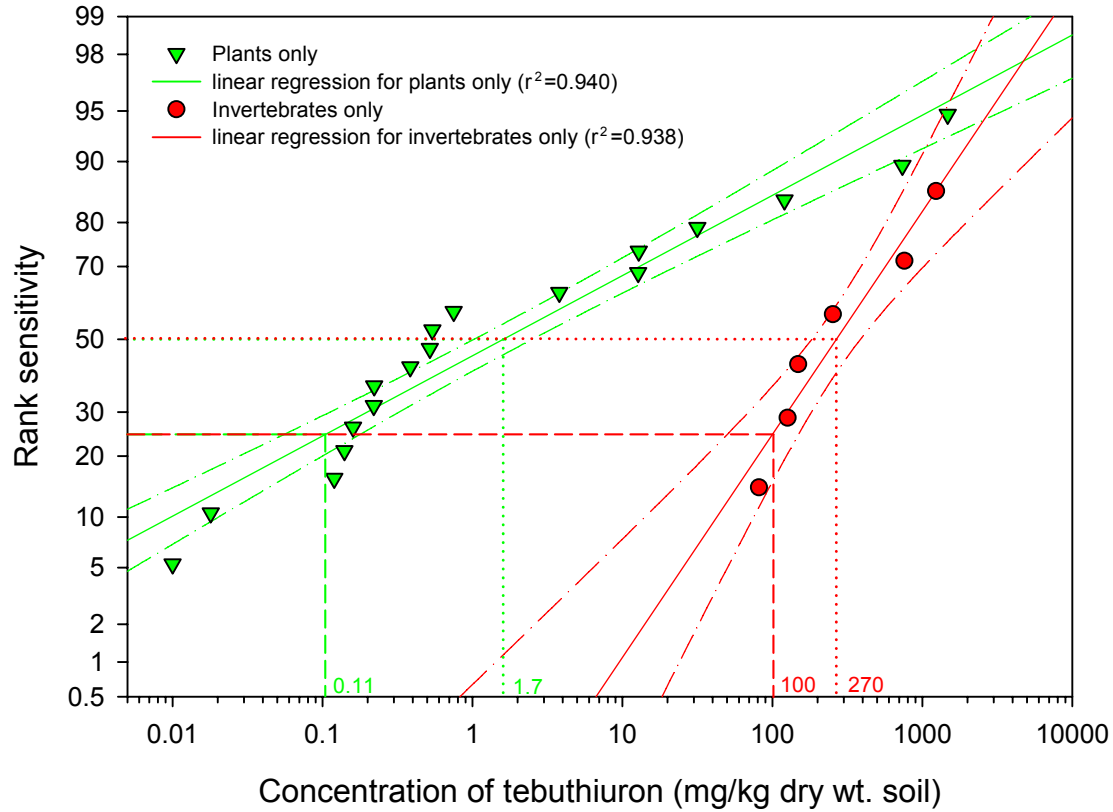
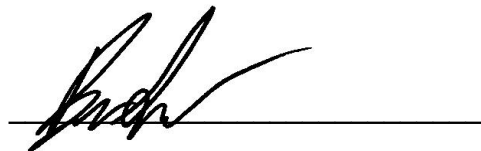


Figure 4: Data distribution of all chronic/definitive IC50/EC50/LC50s for plant and invertebrate species exposed to tebuthiuron in site soil with 95% confidence intervals indicated. The 25th and 50th percentiles for effects are indicated with straight dashed and dotted lines respectively, for plants only and invertebrates only.

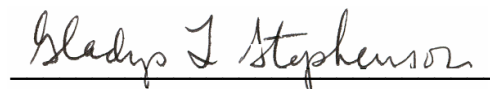
4.0 Discussions and Recommendations

- The IC25 for the root length endpoint for the definitive test with silver sagebrush occurs at concentrations less than the lowest concentration tested; therefore, this extrapolated value cannot be accurately determined and was not included in the SSD derivation. Therefore, 24 IC50/EC50/LC50 and 18 IC25 point estimates of toxicity were used in the generation of SSDs.
- CCME requires a minimum test species battery of two plants, one earthworm and one soil arthropod species. This requirement was met for these analyses.
- The SQC for commercial and industrial soils, obtained as the 50th percentile from the SSDs for plants and invertebrates combined, were 0.60 mg/kg soil dry wt. and 5.9 mg/kg soil dry wt. using IC25 and IC50/EC50/LC50 values, respectively.
- The SQC for agricultural and residential/parkland soils, obtained as the 25th percentile from the SSDs for plants and invertebrates combined, were 0.046 mg/kg soil dry wt. and 0.33 mg/kg soil dry wt. using IC25 and IC50/EC50/LC50 values, respectively.
- CCME (2006) recommends the use of IC25 values, where available, in the derivation of SQC. Data points found below the SQC derived from IC25 values should be identified (i.e., what species and what endpoint parameter) to determine if the risks or effects to that parameter/species are acceptable. Often, these data points represent plant species/endpoints.

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5.0 References

Canadian Council of Ministers of the Environment (CCME). 2006. A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines. PN 1332.

Stantec Consulting Ltd. (Stantec). 2008. Ecotoxicity Evaluation in Support of the Derivation of Tier 2 Values for Tebuthiuron. File No. 160960313. July 2008.