



# Standardized Testing for Diatomaceous Earth

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*This standard protocol for evaluating DEs will make it easier to compare DEs between laboratories.*

## INTRODUCTION

Diatomaceous earth (DE) is obtained from geological deposits of diatomite, which are fossilized sedimentary layers of microscopic algae called diatoms. The fine DE dust, made up mainly of SiO<sub>2</sub>, absorbs wax from the insect cuticle, causing death due to desiccation.

Several factors affect the insecticidal activity of DE: relative humidity, temperature, geological source, grain and insect strain, lifestage, species and density. These factors make it difficult to obtain reproducible results within a laboratory or between laboratories.

## OBJECTIVE

The goal of this project was to develop a protocol that could be used as a standard for studying the efficacy of DE against stored-product insects.

## METHODS



*Sitophilus oryzae* (L.) (CSIRO strain 418), the rice weevil and *Tribolium castaneum* (Herbst), the red flour beetle (CSIRO strain 4), 7 to 21-day old adults, were used in the experiments

Four diatomaceous earths were tested: Dryacide DE (the DE used for Dryacide® before processing to increase activity), INSECTO, Perma-Guard™ and Protect-It® by four different laboratories

## Surface Bioassay

Petri dishes were treated with 4 DE's as a dust at 1 g/m<sup>2</sup> and with a slurry at 6 g/m<sup>2</sup> of DE. The mortality of adult *S. oryzae* and *T. castaneum* was assessed after being held in Petri dishes for 24 h, and after being held for 7 d on clean wheat.



## Grain Bioassay

Wheat (100 g) at 13% moisture content was treated with five different concentrations from 0 to 1000 ppm. Fifty adults were held at 25±1°C and 60±10% r.h. for the remainder of the bioassay. There were 3 replicates.

Mortality was assessed at 7 and 14 days and the offspring production was assessed after 7 weeks for *S. oryzae* and 10 weeks for *T. castaneum* (dated from beginning of the experiment).

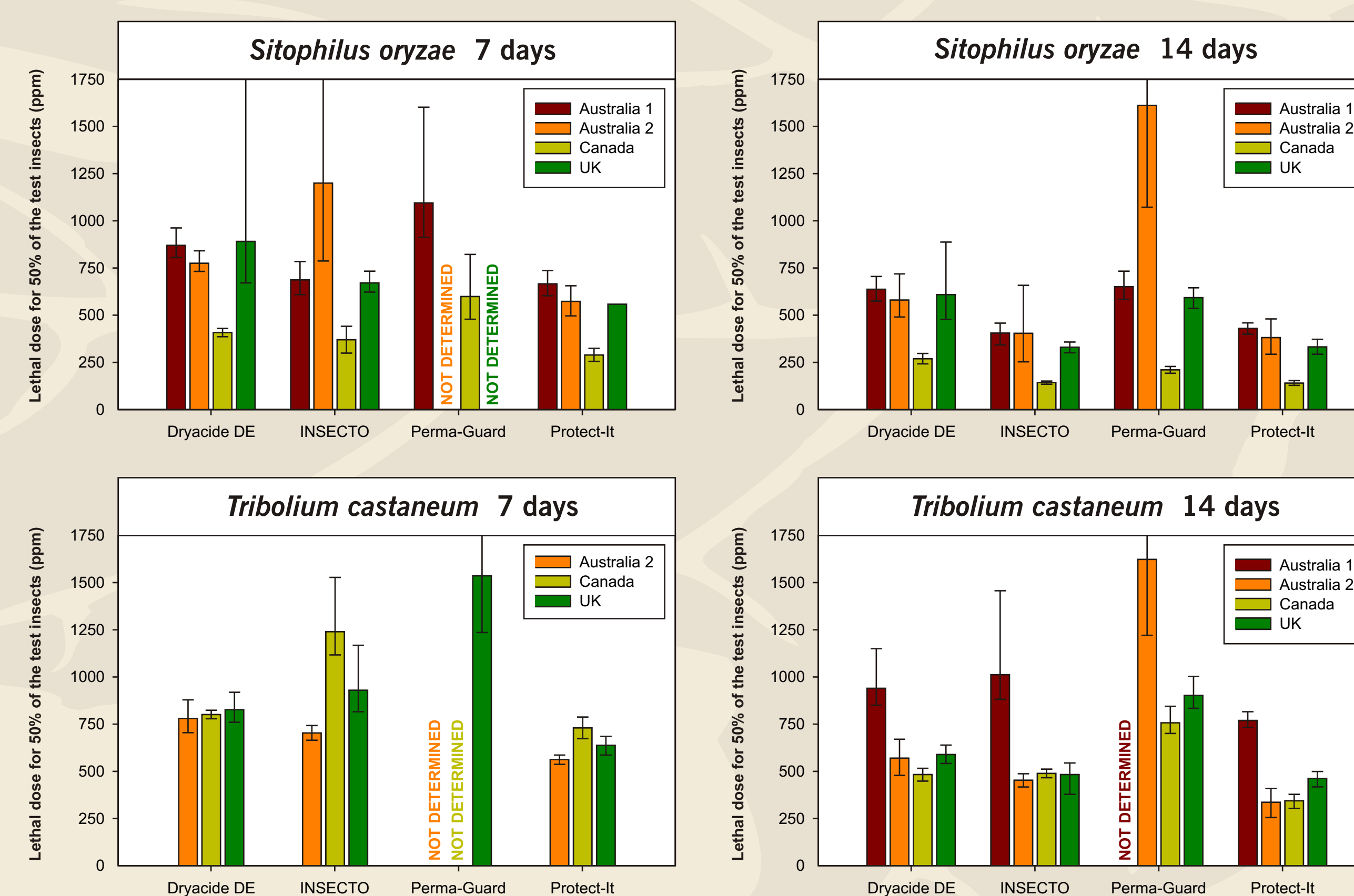


## Rapid assessment

An assessment of the physical attributes of four DEs was conducted according to Korunic (J. Stored Prod. Res. 33: 219-229, 1997).

## RESULTS

Figure 1. The LD<sub>50</sub> (ppm) of the four DE's tested in four different laboratories from grain bioassay<sup>1</sup>



<sup>1</sup> Australia 1 used the following concentrations: *S. oryzae*; 0, 300, 450, 600 and 800 ppm; *T. castaneum*; 0, 450, 550, 700 and 900 ppm. The other labs used: *S. oryzae*; 0, 100, 200, 400, 600, and 800 ppm; *T. castaneum*; 0, 200, 400, 600, 800, and 1000 ppm

Table 1. The rankings<sup>1</sup> of four DE's tested in four different laboratories

Measure	Using grain bioassay data presented in Figure 1				Using rapid assessment data	Using surface bioassay data	
	Australia 1	Australia 2	Canada	U.K			
<i>Sitophilus oryzae</i> 7 days	Protect-It	a	Protect-It	a	Protect-It	Dryacide DE	a
	INSECTO	a	Dryacide DE	b	INSECTO	Dryacide DE	b
	Dryacide DE	b	INSECTO	c	Dryacide DE	INSECTO	b
	Perma-Guard	c	Perma-Guard	d	Perma-Guard	Perma-Guard	c
<i>Tribolium castaneum</i> 7 days	-	-	Protect-It	a	Protect-It	Dryacide DE	a
	-	-	Dryacide DE	b	Dryacide DE	INSECTO	b
	-	-	INSECTO	b	INSECTO	INSECTO	c
	-	-	Perma-Guard	c	Perma-Guard	Perma-Guard	c
<i>Sitophilus oryzae</i> 14 days	INSECTO	a	Protect-It	a	INSECTO	Protect-It	a
	Protect-It	a	INSECTO	a	Protect-It	Protect-It	a
	Dryacide DE	b	Dryacide DE	a	Dryacide DE	Dryacide DE	b
	Perma-Guard	b	Perma-Guard	b	Dryacide DE	Dryacide DE	b
<i>Tribolium castaneum</i> 14 days	Protect-It	a	Protect-It	a	Protect-It	Protect-It	a
	Dryacide DE	b	INSECTO	b	Dryacide DE	INSECTO	ab
	INSECTO	b	Dryacide DE	b	INSECTO	Dryacide DE	b
	Perma-Guard	c	Perma-Guard	c	Perma-Guard	Perma-Guard	c
<i>Sitophilus oryzae</i> Offspring	-	-	INSECTO	a	Protect-It	Protect-It	a
	-	-	Protect-It	a	INSECTO	INSECTO	a
	-	-	Dryacide DE	ab	Perma-Guard	Perma-Guard	b
	-	-	Perma-Guard	b	Dryacide DE	Dryacide DE	b
<i>Tribolium castaneum</i> Offspring	-	-	-	-	Protect-It	Protect-It	a
	-	-	-	-	INSECTO	INSECTO	a
	-	-	-	-	Dryacide DE	Dryacide DE	a
	-	-	-	-	Perma-Guard	Perma-Guard	a

1. In decreasing order of efficacy for a given lab and measure, significant differences between DE's are indicated by different letters.

## CONCLUSIONS

- Adult mortality after 14 days gave a better estimation of the LD<sub>50</sub> than after 7 days for both insects.
- In general there was good agreement between laboratories at 14 days, with the exception of the Canadian laboratory which obtained a higher mortality for *S. oryzae* than the other laboratories.
- Efficacy of the four DEs in the grain bioassay was not correlated to their efficacy in the surface bioassay.
- The rapid assessment method is a good tool for screening large numbers of DE samples, however bioassays are needed to provide a more accurate estimate of efficacy.

### Recommendations for Standardized DE Testing:

We recommend using the following concentrations of DE: 0, 300, 500, 700, 900 and 1100 ppm against *S. oryzae* and *T. castaneum* on wheat (100 g/replicate, 3 replicates, 50 adults that are 7 to 21-days old) at 13% m.c. at 25°C and 60±10 r.h. The mortality assessment should be taken at 7 and 14 days, and the offspring assessment for *S. oryzae* taken 7 weeks and *T. castaneum* taken 10 weeks after the beginning of the experiment.

Full details of the testing protocols are available from [www.geocities.com/de\\_grain/](http://www.geocities.com/de_grain/)