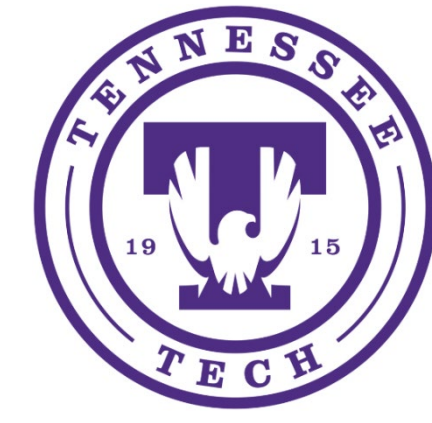




Nymph Exoskeleton



## Evaluation of Diatomaceous Earth and Kaolin Clay as Repellents on Periodical Cicada (*Magicicada* spp.) Adults (Brood X) in Screen Cages

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Cicada Adult

### Abstract

During emergence years, egg-laying by periodical cicada adults (*Magicicada* spp.) (Hemiptera: Cicadidae) poses a serious threat to deciduous trees like *Acer*, *Cercis*, *Malus*, *Quercus*, and others) in open-field nurseries in eastern United States. Garden Safe<sup>®</sup> diatomaceous earth (DE) and Surround<sup>®</sup> WP kaolin clay (KC) were tested for repellence against adult cicada egg-laying in screen cage “choice” experiments using two plant varieties (*Malus* spp. and *Cercis* spp.). This study confirms the potential of these two biorational insecticides to reduce egg-laying damage, and to further aid nursery managers in developing their pest management programs.

### Introduction

- 17-year periodical cicadas are large-to-medium-sized insects with bright body coloration (orange and black) that are distributed in the north and east regions of the USA (Alexander and Moore, 1962).
- Egg-laying by female cicadas causes serious damage to field nursery plants (Hale 2007).
- Periodical cicada emergence densities can range from 8,000–3,500,000 individuals ha<sup>-1</sup> during emergence, thus representing a high biomass of potential plant-damaging insects in the area (Marshall 2008).
- DE was found to be lethal against stored grain pests (Athanasioiu et al. 2005) and hard ticks in laboratory bioassays (Showler et al. 2020).
- Repellency of KC has been tested against insects on plant surfaces (Mmbaga and Oliver 2007).
- Several other authors have reported that KC and DE could potentially deter hemipteran activity.

### Objectives

- To evaluate the repellency and lethality of DE and KC against adult periodical cicadas in a caged choice test using young apple and redbud trees

### Materials and Methods

- DE and KC were diluted in water (average value of three pH readings = 7.5) based on label recommendation (Table 1).
- 181 cicada adults were collected from 5–20 June 2021 at TVA Melton Hill Campground (Loudon Co., TN) (Table 2).
- Insects were transported inside mesh-laundry bags containing apple (*Malus* spp.) and redbud (*Cercis* spp.) branches in plastic vials of water (Figure 1).
- Trees were treated separately with either DE (20.3 g a.i./L H<sub>2</sub>O), KC (17.3 g a.i./L H<sub>2</sub>O) or with nothing (control).
- Cicada adults were released inside cage sections containing treated and control trees (Figure 2).
- Numbers of cicada adults observed under and on each individual tree within sections of the cages were recorded daily for 4 days until the end of the experimental period (Figure 3).
- The experiment was replicated once with new sets of trees and insects.

### Materials and Methods (Cont'd)

Table 1: Chemical treatments evaluated in the experiment. The DE for the experiment was non-food grade. Abbreviations: a.i. = active ingredient.

Class	Trade Name	Active ingredient	Manufacturer	Application rate (a.i. per 1 L of water)
Silicates	Garden Safe <sup>®</sup> Diatomaceous Earth (DE)	Silicon dioxide (85%)	Spectrum Brands Inc., Madison, WI	20.3 g
	Surround <sup>®</sup> WP (KC)	Kaolin (95%)	Engelhard Corporation, Iselin, NJ	17.3 g

Table 2: Total number and proportion of periodical cicada species captured at the TVA Melton Hill Dam Campground and used for Choice Test

Species	N	Proportion
<i>Magicicada septendecim</i>	18	9.94%
<i>Magicicada cassinii</i>	96	53.04%
<i>Magicicada septendecula</i>	67	37.02%
<b>Total</b>	<b>181</b>	<b>100</b>

N: number of individuals tested



Figure 1 (Left to Right): Laundry mesh bags with feeder trees and live adult cicadas



Figure 2: Apple (*Malus* spp.) (A) and redbud (*Cercis* spp.) (B) sprayed with treatments

### Results

Table 3. Mean number of adult periodical cicadas per tree in section cages containing apple or redbud trees treated individually with DE, KC or nothing.

Experiment	Treatment	Adults per plant	Mean Score	Chi-Square	Pr > ChiSq
Section A / n = 46	DE	2.25	3	9.95	0.007
	KC	3.0	6		
	Control	6.0	10.5		
Section B / n = 45	DE	1.25	2.87	9.30	0.009
	KC	2.25	6.25		
	Control	3.75	10.37		
Section C / n = 45	DE	7.75	10.5	10.27	0.006
	KC	2.75	2.5		
	Control	5.25	6.5		
Section D / n = 45	DE	0.75	2.5	10.43	0.005
	KC	6.0	6.5		
	Control	8.5	10.5		

### Discussion

- Number of adult cicadas per treated plants was lower than on controls in the cage sections A, B, and D.
- All treatments used had a statistically significant effect on cicada adult infestation (Table 3).

### Conclusions

- DE and KC, 20.3 and 17.3 g a.i./Liter water, respectively, reduced cicada numbers on trees; and therefore, had the potential to reduce egg-laying damage.

### Future Research

In 2022 & 2023, we will continue testing chemicals for control efficacy and repellency; and review data of crops damaged by emergences of Broods XIV (17-year, 2008) and XIX (13-year, 2011). In 2024 & 2025, we will repeat these efficacy, repellency, and lethality tests on live cicadas.

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