

EFFECT OF DIATOMACEOUS EARTHS ON THE REPRODUCTIVITY OF *CALLOSBRUCHUS MACULATUS* (FABRICIUS) (COLEOPTERA: BRUCHIDAE)

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INTRODUCTION

The pulse beetle (Southern cowpea weevil) *Callosobruchus maculatus* (F.), widely distributed in the tropics and subtropics, causes severe losses of stored pulses. Diatomaceous earths (DEs) kill insects by local absorbing the epicuticular lipid layer and leading to high rate of water loss through this part of the cuticle. The efficacy of DEs depends on their ability to kill the adults before copulation, to affect egg hatchability and progeny production (Subramanyam and Roesli, 2000).

MATERIALS AND METHODS

Newly emerged pre mated pairs of adult females of *C. maculatus* were exposed at 25°C and 75% r.h. to mung-beans (*Vigna radiata* (L.) treated with the DEs Fossil-Shield® and Silico-Sec®, respectively. Fecundity, number of unhatched eggs as well as number of used beans and beans without eggs were evaluated after four days of experiments.

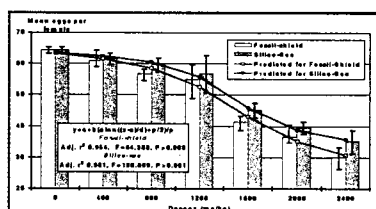


Fig. 1. Relationship between mean number of eggs per female and dosages of the DEs Fossil-Shield® or Silico-Sec®

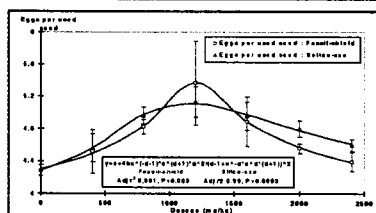


Fig. 2. Relationship between mean number of eggs per used beans and dosages of Fossil-Shield® or Silico-Sec®

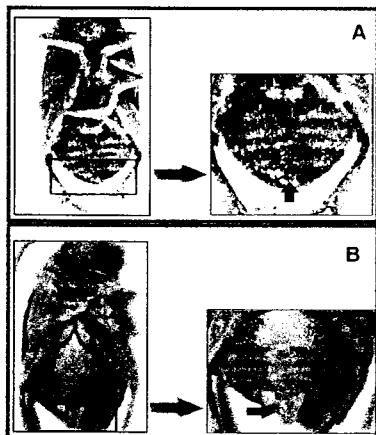


Fig. 3. DE affected external genitals of female *C. maculatus*
 (A) blocked external genitals by Silico-Sec®
 (B) damaged external genitals and obstructed egg laying by Fossil-Shield®

RESULTS & DISCUSSION

Fecundity of female *C. maculatus* significantly decreased sigmoidely with increasing rate of DE content (Fig. 1) of treated beans. The percentages of unhatched eggs as well as beans without eggs (Table) increased with increasing DE dosages. However, the maximum egg densities (eggs per number of used beans) were observed at a content of 1,200 mg DE/kg (Fig. 2) for both DEs tested. The reason for such DE-stimulated behaviour of egg laying - expressed as number of beans with eggs - is not known, but it may be related to the stress caused to the female by the inert dusts or to the reduction of both chemical and physical (tactile) stimuli. Treatment with these DEs altered the surface texture of the beans and caused less cohesion between eggs and the surface. Microscopic observations revealed the damage of the external genitals of males and females (Fig. 3). Therefore, copulation was hindered and number of eggs reduced. A relative high number of eggs was laid on the surface of those beans where the amount of dust had locally been reduced by the adults' movement and their pick up of DE. Also, plenty of larvae tried to penetrate into these treated beans, causing high larval density per partially "cleaned" bean. Some females tended to be disorientated on treated beans and laid their eggs in a wrong, upright orientation to the surface (Fig. 4). All these reasons lead finally to a progeny decline.

Table: Effects of DEs on the egg laying of *C. maculatus* on DE-treated beans and on the hatch of eggs

DE dosages (mg/kg)	Unhatched eggs (% of total)		beans without eggs (% of total)	
	Fossil-Shield® (Mean, 4 reps.)	Silico-Sec® (Mean, 4 reps.)	Fossil-Shield® (Mean, 4 reps.)	Silico-Sec® (Mean, 4 reps.)
0	6.2 Aa [§]	6.2 Aa	0 Aa	0 Aa
400	6.9 ABa	7.3 ABa	10.0 Ba	10.0 Ba
800	8.9 ABa	9.2 ABa	21.7 Ca	20.0 Ca
1200	10.1 Ba	10.6 BCa	31.7 Da	26.7 Ca
1600	14.2 Ca	14.3 CDa	43.3 Ea	39.2 Da
2000	16.4 Ca	17.4 Da	46.7 Ea	45.0 Da
2400	21.6 Da	22.1 Da	54.2 Ea	49.2 Da
ANOVA or *K-W ANOVA	$\chi^2=22.44$ p<0.01	F=8.51 p<0.01	F=66.74 p<0.01	$\chi^2=23.21$ p<0.01

* Kruskal-Wallis ANOVA

§ Means within one column followed by different capital letters are significantly different at p<0.05 and Duncan's multiple rang test.

§ Means within one row for each two column (Fossil-Shield® and Silico-Sec®) followed by different small letters are significantly different at p<0.05 and Mann-Whitney U-test.



Fig. 4. Abnormal egg laying behaviour of *C. maculatus* female, (A) relatively high egg density on the bean, (B) disorientated egg laying

CONCLUSION

Fossil-Shield® and Silico-Sec® showed similar and significant effects on the reproductive biology of *C. maculatus*. Therefore we can conclude that DE leads to progeny reduction not only by direct killing but also hindrance of the egg laying behaviour.

Subramanyam B. and Roesli R. (2000): Inert dusts. In: Alternatives to pesticides in stored-product IPM. Subramanyam B. and Hagstrum D., eds., Kluwer Academic Publisher, 321-380.