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**Toxicity and Residual Efficacy of Lambada -Cyhalothrin Insecticide Applied on Cement and Polyethylene Surfaces against *Rhyzopertha dominica* and *Callosobruchus maculatus*.**

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**ABSTRACT**

Laboratory studies were undertaken to assess the initial and persistence of lambda-cyhalothrin insecticide on some porous and some non-porous surfaces. Formulation of insecticide was applied to polyethylene and cement surfaces which are materials commonly used for grain storage facilities (packages) and in the construction of silos or storage. Lambda-cyhalothrin insecticide was applied at concentrations 15.7, 7.8, 3.93, 1.9, 0.949 to 0.479 g/m<sup>2</sup> to test surfaces to determine Lc<sub>95</sub> to study their persistence against *Rhyzopertha dominica* and *Callosobruchus maculatus* adults. Insects were exposed on treated surfaces. Initial and residual efficacy was determined after 24 hrs. of insects contact with 7, 14, 30, 60, 90, 120, 150, 180 days of exposure deposits on each surface. Results indicated that; mortality rates were positively correlated with the concentration and negatively correlated with the time of application. Results indicated that:

-Polyethylene was the most persistent surface which gave 100% mortality up to 6 months in *Callosobruchus maculatus* and up to 5 months in *Rhyzopertha dominica* at the highest concentration in both tested insects.

- In cement surface lambda-cyhalothrin deteriorated very rapidly starting from the first month on both tested insects.

**INTRODUCTION**

The lesser grain borer, *Rhyzopertha dominica* and broad bean beetle, *Callosobruchus maculatus* were economic pests of stored wheat (*Triticum sativum*) grains and faba bean (*Vicia faba* L.) seeds which found in all facilities used for storage and processing of plant products. Use of contact (residual) insecticides, most liquids and occasionally dusts, is very common in the management of food industry arthropod pests, particularly in storage where, besides regular hygiene measures, treatment of storage area and surfaces is necessary to ensure fast death of existing pests and a long-term protection (Daglish 2006). However, flooring surfaces in food storage facilities are made with

different materials which can significantly interfere with the activity of different formulated contact insecticides (Nayak *et al.*, 2002).

Insecticidal efficacy and persistence will vary depending on the type of surface, type of insecticide, species of insects, or duration of exposure as documented in many studies on stored product insects. (Collin *et al.*, 2000, Jankuv *et al.*, 2013 and Rumbos *et al.*, 2014).

The residual efficacy and persistence of deltamethrin insecticide against *Sitophilus oryzae* (L.) and *Rhyzopertha dominica* (F.) adults on steel, ceramic tile, plywood, and cement (wall or floor surfaces) and plastic, Damour, polypropylene and jute (fabric surfaces) after their application (Nasr and Mahgoub 2017).

Wp-wettable powder and cs-capsule suspension, compound Lambada-cyhalothrin is known as one of the most widely used insecticides for control of cockroaches, flies, important vectors and pests in public health, food industry (Who 2006, Tomlin 2006 and Anonymus2009). There is very little data on the efficacy of contact insecticides applied to different surfaces against *Rhyzopertha dominica* and *Callosobruchus maculatus* and on the effects of Lambada-cyhalothrin on storage pests, for this reason, the aim of the study was to investigate the initial and residual efficacy of Lambada-cyhalothrin applied to cement and polyethelyne surfaces against laboratory population of *Rhyzopertha dominica* and *Callosobruchus maculatus*.

The researchers have made progress in that direction. The reason is the fact that in food products storages grain products are becoming very common, and so are the grain pests.

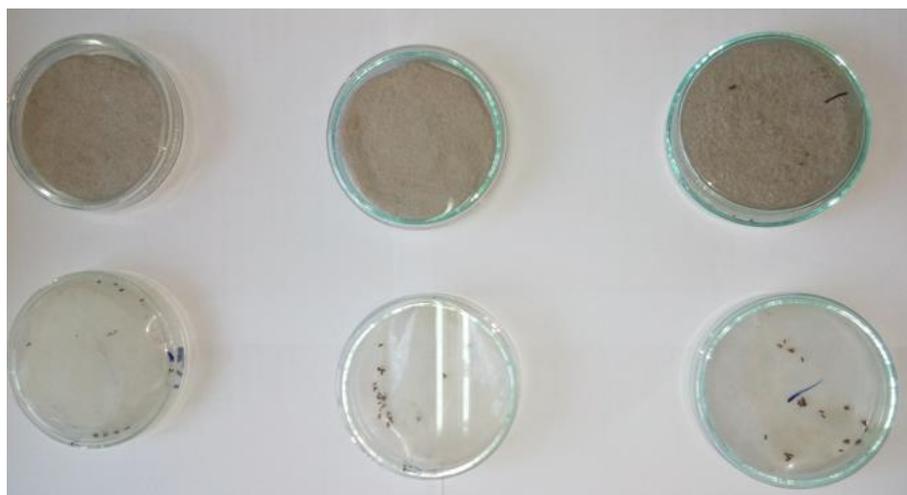
The effectiveness of the treatments was influenced by the type of surface, the insecticide, its concentration and the age of deposits. The treated surfaces were bioassay up to 12 months on each surface after initial treatment.

## MATERIALS AND METHODS

The wheat grains and faba bean seeds used in the present work was been Egyptian wheat (*Triticum sativum*) variety (Sakha 93) and faba bean (*Vicia faba* L.) variety (Giza 2). Kept in the freezer at -20°C for two weeks before use. Moisture content is stabilized at approximately 11.5%. The disinfested grains and seeds were then placed in clean jars and covered tightly.

-Tested insects: The grain borer, *Rhyzopertha dominica* and the cowpea beetle, *Callosobruchus maculatus*.

- Commercial formulation Lambada cyhalothrin insecticide was applied on polyethylene Individual discs were prepared by cutting a circular disc to fit petri dishes (1.5cm high × 9 cm diameter), while, cement discs were prepared by mixing 3.2kg of cement in 1600ml of water, which was subsequently put into individual Petri dishes fig. (1), 1 ml of each concentration was applied on discs to obtain deposits 15.7, 7.8, 3.93, 1.9, 0.949 and 0.479 g/m<sup>2</sup>. To evaluate the persistence efficiency of Lambada-cyhalothrin on different surfaces applied 2x Lc<sub>95</sub> (twice Lc<sub>95</sub>) against the tested insects, 25 adults of each insect species were released on surfaces after 24hrs. from the application (0 times) then introduced periodically at one-week intervals up to 12 months old deposits after initial treatments. In all cases, three replicates were made for each treatment. The percentages mortality was recorded after 24 hrs. from adults exposure and corrected with Abbott's formula (1925).



**Fig. 1:** Types of surface substrates

**RESULTS**

Results in table (1) showed that the toxicity of insecticide was different on the surface substrates. Survival of insects was lower on cement surface than polyethelene. At all tested concentrations, *Rhyzopertha dominica* adults were highly susceptible to Lambada-cyhalothrin insecticide than *Callosobruchus maculates* which showed less susceptibility at two tested surfaces.

Data in table (1) showed clearly the mortality rates of *Rhyzopertha dominica* and *Callosobruchus maculates* after treated with tested insecticide on tested surfaces. Results showed that there was a positive correction with the time of application.

Table (1) revealed that polyethylene had high mortality of 95 % and 98.5 % with *Callosobruchus maculates* and *Rhyzopertha dominica* respectively, meanwhile cement surface gave 80% and 96% with two tested insects *Callosobruchus maculates* and *Rhyzopertha dominica* respectively. At concentration 0.949 g/m<sup>2</sup> polyethylene surface recorded 50.5% and 38.5% mortality with *Callosobruchus maculates* and *Rhyzopertha dominica* respectively, but, in cement, surface gave 17.5% and 28.5% mortality with *Callosobruchus maculates* and *Rhyzopertha dominica* respectively.

**Table1:** percentage mortality of *Callosobruchus maculatus* and *Rhyzopertha dominica* adults on some non-porous surface treated with lambada-cyhalothrin insecticide at different concentrations

Concs. g/m <sup>2</sup>	Percentage mortality%			
	<i>Callosobruchus maculates</i>		<i>Rhyzopertha dominica</i>	
	Tested surfaces		Tested surfaces	
	Polyethylene	Cement	Polyethylene	Cement
15.7	95	80	98.5	96.5
7.8	81.5	50.5	86.5	68.5
3.93	61.5	39.5	71.5	50.5
1.9	58.5	28.5	63.5	36.0
0.949	50.5	17.5	38.5	28.5
0.479	39.5			

In table (2) polyethylene gave 100% mortality to *Callosobruchus maculatus* up to 6 months but up to 5 months against *Rhyzopertha dominica* at 2XLC<sub>95</sub>. At tested concentration 2XLC<sub>95</sub>, polyethylene surfaces were more great persistence than cement surfaces. The concentration of 2XLC<sub>95</sub> lambda-cyhalothrin insecticide applied on polyethylene surface still give 100% mortality for *Callosobruchus maculatus* up to 6 months and gradually decreased to 36.7% mortality at 12 months interval, Meanwhile, in case *Rhyzopertha dominica* polyethylene surface still gives 100% mortality up to 5 months and gradually decreased to 31.7% mortality at 12 months. Cement surface concentrations of lambda-cyhalothrin insecticide were deterioration very rapidly with two tested insects, it gave 100% mortality within one month only and lost half efficiency within second months ( 58.3% and 66.3%) with *Callosobruchus maculatus* and *Rhyzopertha dominica* resp. Then, decreased gradually to 21.3% and 8.7% mortality at the sixth month with *Callosobruchus maculatus* and *Rhyzopertha dominica* respectively.

**Table 2:** persistence of 2 XLC<sub>95</sub> lambda-cyhalothrin insecticide on polyethylene and cement surfaces against *Callosobruchus maculatus* and *Rhyzopertha dominica* adults.

Initial treatment	Tested insects	Months after application													Mean
		Initial treatment	1	2	3	4	5	6	7	8	9	10	11	12	
Polyethylene	<i>Callosobruchus maculatus</i>	100	100	100	100	100	100	100	93.3	81.7	70.3	60.7	48.3	36.7	82.6 <sup>a</sup>
	<i>Rhyzopertha dominica</i>	100	100	100	100	100	100	98.3	94.3	87.5	75.3	63.3	49.3	31.7	83.3 <sup>a</sup>
Cement	<i>Callosobruchus maculatus</i>	100	100	58.3	51.3	43.3	38.7	21.3	0.0	---	---	---	---	---	26.1 <sup>b</sup>
	<i>Rhyzopertha dominica</i>	100	100	66.3	50.6	42.3	24.7	8.7	---	---	---	---	---	---	24.4 <sup>b</sup>
Control		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 <sup>c</sup>

Means with the same letter are not significantly different

F Value 19.85

LSD 14.349

## DISCUSSION

Lambda-cyhalothrin insecticide has shown differences in susceptibility between two species, but susceptibility often varies among two tested insects. *Callosobruchus maculatus* were more susceptible than *Rhyzopertha dominica* to lambda-cyhalothrin. This difference in insecticide susceptibility between tested insects could be dependent on the mode of action, differences, absorption, and/or behavioral characteristics that affect exposure to that insecticide. A number of later studies showed the good potential of various contact insecticides after application on different surfaces in control of stored-product insect pests: e.g. malathion, pirimiphos-methyl and lambda-cyhalothrin against rice weevil *Sitophilus oryzae* (L.) (Jankov *et al.*, 2013). In bioassays with *B. germanica* (L.), *Periplaneta americana* (L.) and *Aedes aegypti* (L.) on glass, unpainted plywood, glazed ceramic tiles, unglazed tiles, cement and vinyl tiles registered high and better knockdown effects, and residual activity of lambda-cyhalothrin CS (applied at 7.5, 15 and 30 mg AI/m<sup>2</sup>) compared to WP and EC formulations Wege *et al.* (1999). On porous surfaces such as mud, the insecticide deposit seems to lose activity much faster than on surfaces such as wooden boards, ceramics and tiles (Penna *et al.*, 1985).

Many studies have shown that treated surfaces with insecticide can greatly affect initial and residual activity of contact insecticides against insects ( Zettler and Arthur

2000). On non-absorbent surfaces (galvanized iron and polypropylene sacking), the activity of insecticides was greater.

In cement surface, lambda cyhalothrin very rapidly starting from the first month in both tested insects at cement surface, the efficacy decreased after one month with *Rhyzopertha dominica* and *Callosobruchus maculatus* resp. These results agree with Dus`an Jankov *et al.*, (2013) concluded that the lambda-cyhalothrin (CS) on concrete and plywood surfaces have the most distinctive residual efficacy against *S. oryzae* during 180 days.

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### ARABIC SUMMARY

تأثير سمية وبقاء اللامبادا سيهالوثرين المطبقة على سطحى الأسمنت والبولى ايتلين ضد حشرتى ثاقبة الحبوب الصغرى وخنفساء اللوبيا

دعاء محمود محمد غريب<sup>2</sup>- نعيمة عبد الروؤف عبد الرازق<sup>1</sup>- محمد عادل حسين توفيق<sup>1</sup> - سناء محمود محجوب<sup>2</sup> - شمس فوقى الشامى<sup>1</sup>  
 1- قسم علم الحشرات جامعة عين شمس  
 2- معهد بحوث وقاية النباتات - مركز البحوث الزراعية

تم اختبار التأثير المتبقى لمبيد اللامبادا سيهالوثرين على سطحى البولى ايتلين والاسمنت وهى مواد معروفة فى التخزين , مبيد اللامبادا سيهالوثرين طبق بتركيزات بتتراوح من 7,15-8,7-9,3-1,9-0,949 الى 0,479مجم مادة فعالة/سم<sup>2</sup> لتعيين LC<sub>95</sub> , تم تعريض الحشرات الكاملة لكل من حشرة ثاقبة الحبوب الصغرى وحشرة خنفساء اللوبيا بعد 24 ساعة من المعاملة بالمبيد لحساب نسب الموت عند بداية التجربة ثم بعد 7, 14, 30, 60, 90, 120, 150, 180 يوم على الاسطح الموضوعه. وأظهرت النتائج ما يلى:  
 - أختلف تأثير المبيد المستخدم على حشرات الأختبار تبعاً لأختلاف تركيز المبيد المستخدم ولأختلاف نوع السطح المعامل.  
 - أعطى سطح البولى ايتلين أعلى بقاء وتأثيراً على حشرات الأختبار حيث أعطى نسبة موت 100% حتى 6 أشهر فى حشرة خنفساء اللوبيا و5 أشهر فى حشرة ثاقبة الحبوب الصغرى من المعاملة.  
 - أعطى سطح الأسمنت أقل كفاءة بقائية حيث حدث تدهورا واضحا من أول شهر فقط بعد المعاملة فى الحشرات المختبرة.