

**ASSESSMENT OF THE INSECTICIDE EFFICACY OF  
AN IMPREGNATED NET**

**Insect Net Solution (I.N.S.)  
+24 months**

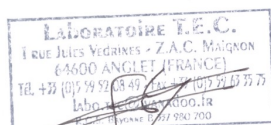
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**Services JLM D  
Rue bois 32 a  
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AUGUST 2015  
Report 1708a/1113R

T.E.C. LABORATORY  
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FRANCE

B.Serrano  
Scientific Director



## **GENERAL**

### **ASSESSMENT OF THE INSECTICIDE EFFICACY OF AN IMPREGNATED NET**

SPONSOR: Services JLM D (Belgium)

Test Facilities: T.E.C. LABORATORY  
1 rue Jules Védrines  
F-64600 Anglet (FRANCE)

## **RESPONSIBILITIES**

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Principal Investigators Martine Falquier, Bruno Serrano

## **SCHEDULE**

Experimental Starting Date 28<sup>th</sup> November 2013  
Experimental Completion Date 27<sup>th</sup> August 2015

## **ARCHIVING**

T.E.C. will retain the study plan and the final report of the present study for 10 years.

## **TEST GUIDELINES**

The study procedures described in this report is a TEC methodology adapted from the following guidelines:

C.E.B. 135

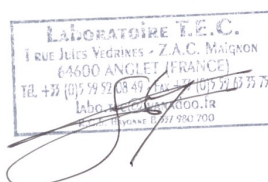
WHO\_CDS\_WHOPEP\_GCDPP\_2005.11-bednets

Manual for the Authorization of Pesticides - EU part – Biocides - Chapter 7 Efficacy - version 1.1; January 2013

The trial is following the Agreement procedures for Officially Recognized Trials according to the European directive 91/414/CE (French ministry of agriculture)

## **SIGNATURES**

Study Director and Management: B.SERRANIO



## **PARTICIPANTS TO THE TRIAL**

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Trial responsible / T.E.C. Director

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Trial engineer

Agronomist engineer ENSAR R74

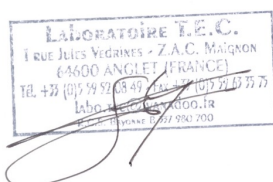
Marie-Paule MONTAUT

Technician

Internal formation

I, hereby Bruno Serrano, T.E.C. Director certify that the trials presented in this issue were done according to the Good Experiment Practices (G.E.P.) – French Agriculture Ministry agreement 94-021.

Anglet, 10<sup>th</sup> September 2015



### **Warning**

The results described in this report are produced by a laboratory test on the samples provided which have not suffered any damage related to the reality of use or of storage.

TEC provides test results only on samples received and may in no event be liable regarding finished products in production or sale.

The trial has been conducted on laboratory strains of "model" insects and the susceptibility of the local insect's strains can be different in other labs or in the real conditions of use.

As such the results should be taken only as an indication of the potential for activity of the formulations or products under test. Then, these results cannot be considered as confirmation that a formulation or product will work in a clinical or field application. Evidence for such activity can only be obtained from properly constructed and executed clinical or local field trials.

Test variability on bioassays implies that the results of test given by TEC shall only be taken as one of the elements that contribute to the development of a product, but cannot be the sole support of product knowledge leading to its production and marketing/sale, and TEC strongly encourages the client to carry out further studies to consolidate the knowledge of the product's effectiveness.

## **CONTENTS**

1. EXPERIMENTAL CONDITIONS
2. TREATMENT
3. EXPERIMENTAL OBSERVATIONS
4. RESULTS
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# ASSESSMENT OF THE INSECTICIDE EFFICACY OF AN IMPREGNATED NET

## **PURPOSE**

To assess efficacy of a net treatment intended to kill various flying and crawling pests.

The trial is following a methodology adapted from the following guidelines:

- C.E.B. 135
- WHO\_CDS\_WHOPES\_GCDPP\_2005.11-bednets
- Manual for the Authorization of Pesticides - EU part – Biocides - Chapter 7 Efficacy version 1.1; January 2013

The principle is to organise a reliable, controlled and reproducible direct contact test between the insects and the net to test.

The methodology is adapted from C.E.B. method No. 135 (1<sup>st</sup> edition: April 1987 Revised: March 2007): “Method for studying the effectiveness of insecticide and/or acaricide preparations intended for surface treatment of premises used for storage, industrial transformation and marketing of animal or plant based products”.

This report uses the plan of the C.E.B. method, indicating any variants.

## **1. EXPERIMENTAL CONDITIONS**

### **1.1. Treatment room**

The treatment was carried out in a closed room measuring 50 m<sup>3</sup> to create the conditions of a confined space as commonly encountered when treating storage premises.

The room represents the average conditions of a house. It was sheltered from draughts and separate from the place where the typical surfaces treated were transferred and stored. It allowed treatments to be performed at constant temperature (+/- 2°C) at between 20 and 25°C.

## **1.2. Surfaces to be treated**

### **1.2.1. "Typical surfaces"**

In the case of this trial, there was only one material in testing, the experimental impregnated net "SIANG MAY CYP Net".

### **1.2.2. Characteristics of the materials to be tested**

The material selected was checked as having no effect on the target species before being treated through a biological test performed prior to the test itself and with the same net but Untreated.

### **1.2.3. Dimensions and preparation of the panels**

The net parts measured 15 cm x 15 cm.  
The tiles were covered by the cover of a PETRI dish of a 14 cm diameter.

### **1.2.4. Storage of the net parts**

The net parts were kept at a temperature of 25°C +/- 2°C and relative humidity of 70 +/- 10%, with no ventilation (passive air exchanges < 1m<sup>3</sup>/h), without any contact between them to avoid any transfer of the preparation up to the date when they were brought into contact with the target species.

The C.E.B method No. 135 recommends to store the fabrics under two conditions: in the dark and exposed to light.

Given the intended use of the test product, it was chosen to store the panels under a photoperiod of 16 hours light and 8 hours darkness.

The net parts were stored flat on the floor of an enclosure to allow even lighting by florescent tubes placed 2.5 m from the ground.

For the tests, tubes were selected that are typical of agri-food premises, covered with a protective plastic film and of which part of the light spectrum emitted is in the ultra-violet range, reference: PHILIPS MASTER TL-D Xtra Secura 58W/840 (colour 840, power 58 W, length 1.50m and diameter 26 mm or equivalent tubes).

### 1.3. Populations of target species

The C.E.B. method No. 135 proposes several arthropods to be tested, depending on the intended use.

But given the categories of approval requested for the test product, the chosen species were:

#### CRAWLING INSECTS

*Sitophilus granarius* (grain weevil)  
*Sitophilus oryzae* (rice weevil)  
*Rhizopertha dominica* (lesser grain borer)  
*Oryzaephilus surinamensis* (saw-tooth beetle)  
*Lasius niger* (common black ant)  
*Cimex lectularius* (bed bug)  
*Lasioderma serricorne* (tobacco beetle)

#### FLYING INSECTS

*Ephestia elutella* (cacao moth)  
*Tineola bisselliella* (clothe moth)  
*Stomoxys calcitrans* (stable fly)  
*Musca domestica* (common house fly)  
*Plodia interpunctella* (Indian meal moth)  
*Ephestia kuehniella* (Mediterranean flour moth)  
*Culicoides imicola* (midge fly)  
*Aedes albopictus* (Tiger mosquito)

The common house flies and the mosquito were from strains bred in TEC.  
Then other species were from a specialized institute (INRA Bordeaux), then they are the French standard strains.

Ants are workers retrieved from a wild nest (Louhossoa – France 64).

Colony breeding conditions:

In a controlled climatic conditions chamber kept at 20+/-1°C, 70+/-10% HR, light 700 lux 16 hours + darkness 8 hours.

Insects are bred into 35 cm x 20 cm x 15 cm plastic boxes containing a shelter, a water source and food (depending on the species)

## AGE AND STAGE OF TARGET SPECIES INTENDED FOR THE STUDY

Latin name	Common name	Stage	Age
<i>Sitophilus granarius</i>	Grain weevil	Adult	2 to 4 weeks
<i>Sitophilus oryzae</i>	Rice weevil	Adult	2 to 4 weeks
<i>Rhizopertha dominica</i>	Lesser grain borer	Adult	2 to 4 weeks
<i>Oryzaephilus surinamensis</i>	Saw-tooth beetle	Adult	2 to 4 weeks
<i>Lasius niger</i>	Common black ant	Adult worker	unknown
<i>Cimex lectularius</i>	Bed bug	Adult	2 to 4 weeks
<i>Lasioderma serricorne</i>	Tobacco beetle	Adult	5 to 15 days
<i>Ephestia elutella</i>	Cacao moth	Nymph	8 mm
<i>Tineola bisselliella</i>	Clothe moth	Nymph	last instar
<i>Stomoxys calcitrans</i>	Stable fly	Adult	4 to 6 days
<i>Musca domestica</i>	House fly	Adult	4 to 6 days
<i>Plodia interpunctella</i>	Indian meal moth	Nymph	last instar
<i>Ephestia kuehniella</i>	Flour moth	Nymph	last instar
<i>Culicoides imicola</i>	Midge fly	Adult	4 to 6 days
<i>Aedes albopictus</i>	Tiger mosquito	Adult	2 to 4 days

For each replicate, batches were used as follows: 25+/-1.

4 replicates were conducted, i.e. a total of 100+/-4 insects were exposed to the product and to the untreated.

### Control batches:

The batches of target species constituting controls were placed on the same material but untreated.

The control batches were intended to check the quality of the batches used for the tests and unintentional effects introduced by handling and experimental conditions. If applicable, mortality observed on the control batches allowed the mortality observed on batches subject to the treatment to be corrected and thus validated the overall test.

4 replicates are conducted



## **2. TREATMENTS**

### **2.1. Experimental product**

The experimental product was supplied by SIANG MAY PTE Ltd (received 25<sup>th</sup> November 2013):

#### **Siang May CYP Net – Production date: 18<sup>th</sup> August 2013**

Experimental design: (Treated + Untreated Control) x 4 replicates

### **2.2. Practical conditions for application of the preparations**

The experimental sample is already treated.

## **3. EXPERIMENTAL OBSERVATIONS**

### **3.1. Principle**

Each experimental unit was constituted of the experimental product and the insects. At Day 0 (opening of the bag containing the sample), an efficacy test was performed. It consisted of installing the pests on the treated surfaces for a period of 1 hour.

The persistence was measured by performing the same efficacy test after X months of storage of the units (cf storage conditions at 1.2.4.).

The actual temperature and hygrometry during the tests (exposure) were from 22.1 °C to 22.5 °C, 63 % to 71% RH, light 1200 lux

The experimenter recorded the mortality of the insects at regular time intervals (1, 2 or 4 hours, depending on the speed of action) in order to know the short-term kinetics of the effect.

After a total exposure time of 1 hour, the insects were removed from the typical surfaces by gentle suction using an adapted vacuum cleaner and transferred to untreated inert surfaces with a nutritious substratum and water available. This was placed under climatic breeding conditions.

### **3.2. Method for checking mortality**

#### **3.2.1. General concepts concerning the processes leading to death**

Insects which had been placed on typical surfaces were checked for two purposes:

- Observation of the knockdown effect (KD),
- Observation of the lethal effect.

Most standard insecticides act on the nervous system and cause a series of successive symptoms: excitation, uncoordinated movements, paralysis (knock down) and lethargy finally resulting in a killing effect.

These different phases are very closely linked to the dose of active substance acting on the organism.

Two important stages may be distinguished in this symptomatology from a practical point of view: the paralysis phase and the lethal phase.

The paralysis phase may appear more or less rapidly (shock action) according to the type of insecticide or acaricide substance and according to the dose. Recovery of normal behaviour may occur after a fairly long knock down period (several days), still in relation to the dose of treatment and the duration of contact between the animal and the preparation deposit.

The lethal effect does not necessarily occur after the knock down period.

### **3.2.2. Observations to be made**

The observations to be made on the arthropods must take into account these two types of effects.

- Observation of the knockdown effect (KD): during the 1-hour period of exposure, the knockdown effect was judged by counting several times the number of individuals moving normally and the others. A compulsory observation was conducted after 4 hours.
- Observation of the lethal effect: 24 hours (and later if necessary) after the beginning of the insects exposure onto the treated surfaces, the dead and living insects were counted several times. Any immobile insect which no longer reacted to mechanical stimulation and any insect which could not move about despite moving its legs were deemed to be dead.

### **3.3. Dates of observation of effectiveness**

#### **3.3.1. Instantaneous effect**

The day of opening of the bag containing the sample = Day 0, the arthropods were put in contact with it to measure the instantaneous effect of the sample.

#### **3.3.2. Persistence of action**

The persistence of action of the sample was judged by putting the target arthropods in contact with them after 6, 9, 12, 18 and 24 months of storage.

## 4. RESULTS

### 4.1. Presentation

Table I and II shows the summary of the results obtained.  
 The raw data are given in the appendices.

Table I: Summary of the data in KT100.

KT 100 = time from the beginning of the experiment - including the 1 hour exposure time of the insects onto the treated surfaces - required to knockdown/kill 100% of the insects

#### KT 100

*	Day0	Day0 + 6 months	Day0 + 9 months	Day0 + 12 months	Day0 + 18 months	Day0 + 24 months
<b>E.e</b>	< 1 hour	< 1 hour	< 1 hour	< 4 hours	< 24 hours	< 48 hours
<b>T.b</b>	< 1 hour	< 1 hour	< 1 hour	< 4 hours	< 24 hours	< 48 hours
<b>S.c</b>	< 1 hour	< 1 hour	< 1 hour	< 4 hours	< 24 hours	< 48 hours
<b>C.i</b>	< 1 hour	< 1 hour	< 1 hour	< 4 hours	< 24 hours	< 48 hours
<b>A.a</b>	< 1 hour	< 1 hour	< 1 hour	< 4 hours	< 24 hours	< 48 hours
<b>M.d</b>	< 1 hour	< 1 hour	< 1 hour	< 4 hours	< 24 hours	< 48 hours
<b>P.i</b>	< 1 hour	< 1 hour	< 1 hour	< 4 hours	< 24 hours	< 48 hours
<b>E.k</b>	< 1 hour	< 1 hour	< 1 hour	< 4 hours	< 24 hours	< 48 hours
<b>L.s</b>	< 1 hour	< 1 hour	< 1 hour	< 8 hours	< 24 hours	< 5 days
<b>L.n</b>	< 1 hour	< 1 hour	< 1 hour	< 4 hours	< 24 hours	< 7 days
<b>S.g</b>	< 2 hours	< 2 hours	< 2 hours	< 24 hours	< 24 hours	< 7 days
<b>S.o</b>	< 2 hours	< 2 hours	< 2 hours	< 24 hours	< 24 hours	< 7 days
<b>R.d</b>	< 2 hours	< 2 hours	< 2 hours	< 24 hours	< 24 hours	< 7 days
<b>O.s</b>	< 2 hours	< 2 hours	< 2 hours	< 24 hours	< 24 hours	< 7 days
<b>C.l</b>	< 2 hours	< 2 hours	< 2 hours	< 24 hours	< 24 hours	< 7 days

- \* *E.e* = *Ephestia elutella* (cacao moth)
- T.b* = *Tineola bisselliella* (clothe moth)
- S.c* = *Stomoxys calcitrans* (stable fly)
- C.i* = *Culicoides imicola* (midge fly)
- A.a* = *Aedes albopictus* (Tiger mosquito)
- M.d* = *Musca domestica* (common house fly)
- P.i* = *Plodia interpunctella* (Indian meal moth)
- E.k* = *Ephestia kuehniella* (Mediterranean flour moth)
- L.s* = *Lasioderma serricorne* (tobacco beetle)
- L.n* = *Lasius niger* (common black ant)
- S.g* = *Sitophilus granarius* (grain weevil)
- S.o* = *Sitophilus oryzae* (rice weevil)
- R.d* = *Rhizopertha dominica* (lesser grain borer)
- O.s* = *Oryzaephilus surinamensis* (saw-tooth beetle)
- C.l* = *Cimex lectularius* (bed bug)

Table II: Actual mortality 24 hours (after the beginning of the experiment - including the 1 hour exposure time of the insects onto the treated surfaces)

**Mortality 24 hours**

*	Day0	Day0 + 6 months	Day0 + 9 months	Day0 + 12 months	Day0 + 18 months	Day0 + 24 months
<b><i>E.e</i></b>	100%	100%	100%	100%	100%	73%
<b><i>T.b</i></b>	100%	100%	100%	100%	100%	86%
<b><i>S.c</i></b>	100%	100%	100%	100%	100%	70%
<b><i>C.i</i></b>	100%	100%	100%	100%	100%	93%
<b><i>A.a</i></b>	100%	100%	100%	100%	100%	76%
<b><i>M.d</i></b>	100%	100%	100%	100%	100%	68%
<b><i>P.i</i></b>	100%	100%	100%	100%	100%	81%
<b><i>E.k</i></b>	100%	100%	100%	100%	100%	75%
<b><i>L.s</i></b>	100%	100%	100%	100%	100%	0%
<b><i>L.n</i></b>	100%	100%	100%	100%	100%	0%
<b><i>S.g</i></b>	100%	100%	100%	100%	100%	0%
<b><i>S.o</i></b>	100%	100%	100%	100%	100%	0%
<b><i>R.d</i></b>	100%	100%	100%	100%	100%	0%
<b><i>O.s</i></b>	100%	100%	100%	100%	100%	0%
<b><i>C.l</i></b>	100%	100%	100%	100%	100%	0%

- \* *E.e* = *Ephestia elutella* (cacao moth)
- T.b* = *Tineola bisselliella* (clothe moth)
- S.c* = *Stomoxys calcitrans* (stable fly)
- C.i* = *Culicoides imicola* (midge fly)
- A.a* = *Aedes albopictus* (Tiger mosquito)
- M.d* = *Musca domestica* (common house fly)
- P.i* = *Plodia interpunctella* (Indian meal moth)
- E.k* = *Ephestia kuehniella* (Mediterranean flour moth)
- L.s* = *Lasioderma serricorne* (tobacco beetle)
- L.n* = *Lasius niger* (common black ant)
- S.g* = *Sitophilus granarius* (grain weevil)
- S.o* = *Sitophilus oryzae* (rice weevil)
- R.d* = *Rhizopertha dominica* (lesser grain borer)
- O.s* = *Oryzaephilus surinamensis* (saw-tooth beetle)
- C.l* = *Cimex lectularius* (bed bug)

## 4.2. COMMENTS

For all the tests, the mortality of the untreated control series was lower than 5%, which validates the tests and allows the results obtained on the treated series to be interpreted as they are (Abbot transformation not required).

At Day 0, the experimental product led to fast knockdown and final mortality (no recovery after 24 hours) against all the pest species in testing.

The results remain the same after 18 months of storage.

After 24 months of storage, the sample required a longer time to kill the pests (from 2 to 7 days).

## 5. CONCLUSION

*Under the conditions of these tests, with the samples of products supplied, the strains of arthropods and the methodology considered, the product:*

### **Siang May CYP Net**

after 18 months of storage, has proved a rapid and definitive insecticide effectiveness on the following insects:

*Ephestia elutella* (cacao moth)  
*Tineola bisselliella* (clothe moth)  
*Stomoxys calcitrans* (stable fly)  
*Culicoides imicola* (midge fly)  
*Aedes albopictus* (Tiger mosquito)  
*Musca domestica* (common house fly)  
*Plodia interpunctella* (Indian meal moth)  
*Ephestia kuehniella* (Mediterranean flour moth)  
*Lasioderma serricorne* (tobacco beetle)  
*Lasius niger* (common black ant)  
*Sitophilus granarius* (grain weevil)  
*Sitophilus oryzae* (rice weevil)  
*Rhizopertha dominica* (lesser grain borer)  
*Oryzaephilus surinamensis* (saw-tooth beetle)  
*Cimex lectularius* (bed bug)

The efficacy remains complete after 24 months of storage but requires a longer time to kill the pests.

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## **APPENDICES**

### RAW DATA

Note: as C.E.B. cannot be copied, they can be ordered on AFPP website:  
<http://www.afpp.net/>

## TRIAL AT DAY0

### EXPERIMENTAL PRODUCT

Insect	Average in % of knockdown / mortality				Mortality After 24 hours
	1 h	2 h	3 h	4 h	
Ee	100	100	100	100	100
Tb	100	100	100	100	100
Sc	100	100	100	100	100
Ci	100	100	100	100	100
Aa	100	100	100	100	100
Md	100	100	100	100	100
Pi	100	100	100	100	100
Ek	100	100	100	100	100
Ls	100	100	100	100	100
Ln	100	100	100	100	100
Sg	37	100	100	100	100
So	35	100	100	100	100
Rd	26	100	100	100	100
Os	41	100	100	100	100
Cl	19	100	100	100	100

*E.e* = *Ephestia elutella* (cacao moth)  
*T.b* = *Tineola bisselliella* (clothe moth)  
*S.c* = *Stomoxys calcitrans* (stable fly)  
*C.i* = *Culicoides imicola* (midge fly)  
*A.a* = *Aedes albopictus* (Tiger mosquito)  
*M.d* = *Musca domestica* (common house fly)  
*P.i* = *Plodia interpunctella* (Indian meal moth)  
*E.k* = *Ephestia kuehniella* (Mediterranean flour moth)  
*L.s* = *Lasioderma serricornis* (tobacco beetle)  
*L.n* = *Lasius niger* (common black ant)  
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*S.o* = *Sitophilus oryzae* (rice weevil)  
*R.d* = *Rhizopertha dominica* (lesser grain borer)  
*O.s* = *Oryzaephilus surinamensis* (saw-tooth beetle)  
*C.l* = *Cimex lectularius* (bed bug)

## TRIAL AT DAY0

### UNTREATED CONTROL

Insect	Average in % of knockdown / mortality				Mortality After 24 hours
	1 h	2 h	3 h	4 h	
Ee	0	0	0	0	2
Tb	0	0	0	0	3
Sc	0	0	0	0	0
Ci	0	0	0	0	4
Aa	0	0	0	0	1
Md	0	0	0	0	1
Pi	0	0	0	0	2
Ek	0	0	0	0	3
Ls	0	0	0	0	0
Ln	0	0	0	0	0
Sg	0	0	0	0	0
So	0	0	0	0	1
Rd	0	0	0	0	0
Os	0	0	0	0	0
Cl	0	0	0	0	0

*E.e* = *Ephestia elutella* (cacao moth)  
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*O.s* = *Oryzaephilus surinamensis* (saw-tooth beetle)  
*C.l* = *Cimex lectularius* (bed bug)



## TRIAL AT DAY0 + 6 MONTHS

### EXPERIMENTAL PRODUCT

Insect	Average in % of knockdown / mortality				Mortality After 24 hours
	1 h	2 h	3 h	4 h	
Ee	100	100	100	100	100
Tb	100	100	100	100	100
Sc	100	100	100	100	100
Ci	100	100	100	100	100
Aa	100	100	100	100	100
Md	100	100	100	100	100
Pi	100	100	100	100	100
Ek	100	100	100	100	100
Ls	100	100	100	100	100
Ln	100	100	100	100	100
Sg	16	100	100	100	100
So	24	100	100	100	100
Rd	18	100	100	100	100
Os	30	100	100	100	100
Cl	14	100	100	100	100

*E.e* = *Ephestia elutella* (cacao moth)  
*T.b* = *Tineola bisselliella* (clothe moth)  
*S.c* = *Stomoxys calcitrans* (stable fly)  
*C.i* = *Culicoides imicola* (midge fly)  
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*P.i* = *Plodia interpunctella* (Indian meal moth)  
*E.k* = *Ephestia kuehniella* (Mediterranean flour moth)  
*L.s* = *Lasioderma serricornis* (tobacco beetle)  
*L.n* = *Lasius niger* (common black ant)  
*S.g* = *Sitophilus granarius* (grain weevil)  
*S.o* = *Sitophilus oryzae* (rice weevil)  
*R.d* = *Rhizopertha dominica* (lesser grain borer)  
*O.s* = *Oryzaephilus surinamensis* (saw-tooth beetle)  
*C.l* = *Cimex lectularius* (bed bug)

## TRIAL AT DAY0 + 6 MONTHS

### UNTREATED CONTROL

Insect	Average in % of knockdown / mortality				Mortality After 24 hours
	1 h	2 h	3 h	4 h	
Ee	0	0	0	0	1
Tb	0	0	0	0	1
Sc	0	0	0	0	0
Ci	0	0	0	0	2
Aa	0	0	0	0	0
Md	0	0	0	0	0
Pi	0	0	0	0	1
Ek	0	0	0	0	2
Ls	0	0	0	0	0
Ln	0	0	0	0	0
Sg	0	0	0	0	0
So	0	0	0	0	0
Rd	0	0	0	0	0
Os	0	0	0	0	0
Cl	0	0	0	0	0

*E.e* = *Ephestia elutella* (cacao moth)  
*T.b* = *Tineola bisselliella* (clothe moth)  
*S.c* = *Stomoxys calcitrans* (stable fly)  
*C.i* = *Culicoides imicola* (midge fly)  
*A.a* = *Aedes albopictus* (Tiger mosquito)  
*M.d* = *Musca domestica* (common house fly)  
*P.i* = *Plodia interpunctella* (Indian meal moth)  
*E.k* = *Ephestia kuehniella* (Mediterranean flour moth)  
*L.s* = *Lasioderma serricornis* (tobacco beetle)  
*L.n* = *Lasius niger* (common black ant)  
*S.g* = *Sitophilus granarius* (grain weevil)  
*S.o* = *Sitophilus oryzae* (rice weevil)  
*R.d* = *Rhizopertha dominica* (lesser grain borer)  
*O.s* = *Oryzaephilus surinamensis* (saw-tooth beetle)  
*C.l* = *Cimex lectularius* (bed bug)

## TRIAL AT DAY0 + 9 MONTHS

### EXPERIMENTAL PRODUCT

Insect	Average in % of knockdown / mortality				Mortality After 24 hours
	1 h	2 h	3 h	4 h	
Ee	100	100	100	100	100
Tb	100	100	100	100	100
Sc	100	100	100	100	100
Ci	100	100	100	100	100
Aa	100	100	100	100	100
Md	100	100	100	100	100
Pi	100	100	100	100	100
Ek	100	100	100	100	100
Ls	100	100	100	100	100
Ln	100	100	100	100	100
Sg	5	100	100	100	100
So	9	100	100	100	100
Rd	11	100	100	100	100
Os	23	100	100	100	100
Cl	6	100	100	100	100

*E.e* = *Ephestia elutella* (cacao moth)  
*T.b* = *Tineola bisselliella* (clothe moth)  
*S.c* = *Stomoxys calcitrans* (stable fly)  
*C.i* = *Culicoides imicola* (midge fly)  
*A.a* = *Aedes albopictus* (Tiger mosquito)  
*M.d* = *Musca domestica* (common house fly)  
*P.i* = *Plodia interpunctella* (Indian meal moth)  
*E.k* = *Ephestia kuehniella* (Mediterranean flour moth)  
*L.s* = *Lasioderma serricorne* (tobacco beetle)  
*L.n* = *Lasius niger* (common black ant)  
*S.g* = *Sitophilus granarius* (grain weevil)  
*S.o* = *Sitophilus oryzae* (rice weevil)  
*R.d* = *Rhizopertha dominica* (lesser grain borer)  
*O.s* = *Oryzaephilus surinamensis* (saw-tooth beetle)  
*C.l* = *Cimex lectularius* (bed bug)

## TRIAL AT DAY0 + 9 MONTHS

### UNTREATED CONTROL

Insect	Average in % of knockdown / mortality				Mortality After 24 hours
	1 h	2 h	3 h	4 h	
Ee	0	0	0	0	2
Tb	0	0	0	0	3
Sc	0	0	0	0	0
Ci	0	0	0	0	2
Aa	0	0	0	0	1
Md	0	0	0	0	0
Pi	0	0	0	0	1
Ek	0	0	0	0	1
Ls	0	0	0	0	0
Ln	0	0	0	0	0
Sg	0	0	0	0	0
So	0	0	0	0	0
Rd	0	0	0	0	0
Os	0	0	0	0	0
Cl	0	0	0	0	0

*E.e* = *Ephestia elutella* (cacao moth)  
*T.b* = *Tineola bisselliella* (clothe moth)  
*S.c* = *Stomoxys calcitrans* (stable fly)  
*C.i* = *Culicoides imicola* (midge fly)  
*A.a* = *Aedes albopictus* (Tiger mosquito)  
*M.d* = *Musca domestica* (common house fly)  
*P.i* = *Plodia interpunctella* (Indian meal moth)  
*E.k* = *Ephestia kuehniella* (Mediterranean flour moth)  
*L.s* = *Lasioderma serricorne* (tobacco beetle)  
*L.n* = *Lasius niger* (common black ant)  
*S.g* = *Sitophilus granarius* (grain weevil)  
*S.o* = *Sitophilus oryzae* (rice weevil)  
*R.d* = *Rhizopertha dominica* (lesser grain borer)  
*O.s* = *Oryzaephilus surinamensis* (saw-tooth beetle)  
*C.l* = *Cimex lectularius* (bed bug)

## TRIAL AT DAY0 + 12 MONTHS

### EXPERIMENTAL PRODUCT

Insect	Average in % of knockdown / mortality				Mortality After 24 hours
	2 h	4 h	6 h	8 h	
Ee	68	100	100	100	100
Tb	67	100	100	100	100
Sc	36	100	100	100	100
Ci	33	100	100	100	100
Aa	27	100	100	100	100
Md	22	100	100	100	100
Pi	71	100	100	100	100
Ek	56	100	100	100	100
Ls	3	19	63	100	100
Ln	53	100	100	100	100
Sg	0	0	2	6	100
So	0	0	5	7	100
Rd	0	0	0	1	100
Os	0	0	0	3	100
Cl	0	0	6	17	100

*E.e* = *Ephestia elutella* (cacao moth)  
*T.b* = *Tineola bisselliella* (clothe moth)  
*S.c* = *Stomoxys calcitrans* (stable fly)  
*C.i* = *Culicoides imicola* (midge fly)  
*A.a* = *Aedes albopictus* (Tiger mosquito)  
*M.d* = *Musca domestica* (common house fly)  
*P.i* = *Plodia interpunctella* (Indian meal moth)  
*E.k* = *Ephestia kuehniella* (Mediterranean flour moth)  
*L.s* = *Lasioderma serricorne* (tobacco beetle)  
*L.n* = *Lasius niger* (common black ant)  
*S.g* = *Sitophilus granarius* (grain weevil)  
*S.o* = *Sitophilus oryzae* (rice weevil)  
*R.d* = *Rhizopertha dominica* (lesser grain borer)  
*O.s* = *Oryzaephilus surinamensis* (saw-tooth beetle)  
*C.l* = *Cimex lectularius* (bed bug)

## TRIAL AT DAY0 + 12 MONTHS

### UNTREATED CONTROL

Insect	Average in % of knockdown / mortality				Mortality After 24 hours
	1 h	2 h	3 h	4 h	
Ee	0	0	0	0	1
Tb	0	0	0	0	2
Sc	0	0	0	0	1
Ci	0	0	0	0	1
Aa	0	0	0	0	0
Md	0	0	0	0	0
Pi	0	0	0	0	2
Ek	0	0	0	0	3
Ls	0	0	0	0	0
Ln	0	0	0	0	0
Sg	0	0	0	0	0
So	0	0	0	0	0
Rd	0	0	0	0	0
Os	0	0	0	0	1
Cl	0	0	0	0	0

*E.e* = *Ephestia elutella* (cacao moth)  
*T.b* = *Tineola bisselliella* (clothe moth)  
*S.c* = *Stomoxys calcitrans* (stable fly)  
*C.i* = *Culicoides imicola* (midge fly)  
*A.a* = *Aedes albopictus* (Tiger mosquito)  
*M.d* = *Musca domestica* (common house fly)  
*P.i* = *Plodia interpunctella* (Indian meal moth)  
*E.k* = *Ephestia kuehniella* (Mediterranean flour moth)  
*L.s* = *Lasioderma serricorne* (tobacco beetle)  
*L.n* = *Lasius niger* (common black ant)  
*S.g* = *Sitophilus granarius* (grain weevil)  
*S.o* = *Sitophilus oryzae* (rice weevil)  
*R.d* = *Rhizopertha dominica* (lesser grain borer)  
*O.s* = *Oryzaephilus surinamensis* (saw-tooth beetle)  
*C.l* = *Cimex lectularius* (bed bug)

## TRIAL AT DAY0 + 18 MONTHS

### EXPERIMENTAL PRODUCT

Insect	Average in % of knockdown / mortality				Mortality After 24 hours
	2 h	4 h	6 h	8 h	
Ee	0	8	30	62	100
Tb	0	4	25	57	100
Sc	0	0	2	19	100
Ci	0	3	22	73	100
Aa	0	5	29	88	100
Md	0	3	17	66	100
Pi	0	7	33	75	100
Ek	0	5	30	81	100
Ls	0	2	27	61	100
Ln	0	0	0	5	100
Sg	0	0	0	9	100
So	0	0	3	12	100
Rd	0	2	12	37	100
Os	0	0	8	16	100
Cl	0	0	0	0	100

*E.e* = *Ephestia elutella* (cacao moth)  
*T.b* = *Tineola bisselliella* (clothe moth)  
*S.c* = *Stomoxys calcitrans* (stable fly)  
*C.i* = *Culicoides imicola* (midge fly)  
*A.a* = *Aedes albopictus* (Tiger mosquito)  
*M.d* = *Musca domestica* (common house fly)  
*P.i* = *Plodia interpunctella* (Indian meal moth)  
*E.k* = *Ephestia kuehniella* (Mediterranean flour moth)  
*L.s* = *Lasioderma serricorne* (tobacco beetle)  
*L.n* = *Lasius niger* (common black ant)  
*S.g* = *Sitophilus granarius* (grain weevil)  
*S.o* = *Sitophilus oryzae* (rice weevil)  
*R.d* = *Rhizopertha dominica* (lesser grain borer)  
*O.s* = *Oryzaephilus surinamensis* (saw-tooth beetle)  
*C.l* = *Cimex lectularius* (bed bug)

## TRIAL AT DAY0 + 18 MONTHS

### UNTREATED CONTROL

Insect	Average in % of knockdown / mortality				Mortality After 24 hours
	1 h	2 h	3 h	4 h	
Ee	0	0	0	0	1
Tb	0	0	0	0	0
Sc	0	0	0	0	1
Ci	0	0	0	0	2
Aa	0	0	0	0	0
Md	0	0	0	0	1
Pi	0	0	0	0	1
Ek	0	0	0	0	2
Ls	0	0	0	0	0
Ln	0	0	0	0	0
Sg	0	0	0	0	0
So	0	0	0	0	0
Rd	0	0	0	0	0
Os	0	0	0	0	2
Cl	0	0	0	0	0

*E.e* = *Ephestia elutella* (cacao moth)  
*T.b* = *Tineola bisselliella* (clothe moth)  
*S.c* = *Stomoxys calcitrans* (stable fly)  
*C.i* = *Culicoides imicola* (midge fly)  
*A.a* = *Aedes albopictus* (Tiger mosquito)  
*M.d* = *Musca domestica* (common house fly)  
*P.i* = *Plodia interpunctella* (Indian meal moth)  
*E.k* = *Ephestia kuehniella* (Mediterranean flour moth)  
*L.s* = *Lasioderma serricorne* (tobacco beetle)  
*L.n* = *Lasius niger* (common black ant)  
*S.g* = *Sitophilus granarius* (grain weevil)  
*S.o* = *Sitophilus oryzae* (rice weevil)  
*R.d* = *Rhizopertha dominica* (lesser grain borer)  
*O.s* = *Oryzaephilus surinamensis* (saw-tooth beetle)  
*C.l* = *Cimex lectularius* (bed bug)



## TRIAL AT DAY0 + 24 MONTHS

### EXPERIMENTAL PRODUCT

Insect	Average in % mortality				
	24 hours	48 hours	72 hours	5 days	7 days
Ee	73	100	100	100	100
Tb	86	100	100	100	100
Sc	70	100	100	100	100
Ci	93	100	100	100	100
Aa	76	100	100	100	100
Md	68	100	100	100	100
Pi	81	100	100	100	100
Ek	75	100	100	100	100
Ls	0	39	91	100	100
Ln	0	9	67	99	100
Sg	0	9	52	91	100
So	0	3	44	93	100
Rd	0	5	53	97	100
Os	0	7	51	93	100
Cl	0	10	46	88	100

*E.e* = *Ephestia elutella* (cacao moth)  
*T.b* = *Tineola bisselliella* (clothe moth)  
*S.c* = *Stomoxys calcitrans* (stable fly)  
*C.i* = *Culicoides imicola* (midge fly)  
*A.a* = *Aedes albopictus* (Tiger mosquito)  
*M.d* = *Musca domestica* (common house fly)  
*P.i* = *Plodia interpunctella* (Indian meal moth)  
*E.k* = *Ephestia kuehniella* (Mediterranean flour moth)  
*L.s* = *Lasioderma serricorne* (tobacco beetle)  
*L.n* = *Lasius niger* (common black ant)  
*S.g* = *Sitophilus granarius* (grain weevil)  
*S.o* = *Sitophilus oryzae* (rice weevil)  
*R.d* = *Rhizopertha dominica* (lesser grain borer)  
*O.s* = *Oryzaephilus surinamensis* (saw-tooth beetle)  
*C.l* = *Cimex lectularius* (bed bug)

## TRIAL AT DAY0 + 24 MONTHS

### UNTREATED CONTROL

Insect	Average in % mortality				
	24 hours	48 hours	72 hours	5 days	7 days
Ee	0	0	0	0	2
Tb	0	0	0	0	0
Sc	0	0	0	0	1
Ci	0	0	0	0	1
Aa	0	0	0	0	1
Md	0	0	0	0	0
Pi	0	0	0	0	2
Ek	0	0	0	0	1
Ls	0	0	0	0	0
Ln	0	0	0	0	0
Sg	0	0	0	0	0
So	0	0	0	0	0
Rd	0	0	0	0	0
Os	0	0	0	0	1
Cl	0	0	0	0	0

- E.e* = *Ephestia elutella* (cacao moth)  
*T.b* = *Tineola bisselliella* (clothe moth)  
*S.c* = *Stomoxys calcitrans* (stable fly)  
*C.i* = *Culicoides imicola* (midge fly)  
*A.a* = *Aedes albopictus* (Tiger mosquito)  
*M.d* = *Musca domestica* (common house fly)  
*P.i* = *Plodia interpunctella* (Indian meal moth)  
*E.k* = *Ephestia kuehniella* (Mediterranean flour moth)  
*L.s* = *Lasioderma serricorne* (tobacco beetle)  
*L.n* = *Lasius niger* (common black ant)  
*S.g* = *Sitophilus granarius* (grain weevil)  
*S.o* = *Sitophilus oryzae* (rice weevil)  
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