

**EFFICIENCY OF THE STORED LOCUST AND GRASSHOPPER  
INSECTICIDES IN EGYPT ON *CATANTOPS AXILLARIS*  
THUNBERG (ORTHOPTERA: ACRIDIDAE) UNDER THE FIELD  
CONDITIONS OF BAHARIA OASIS**

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(Manuscript received 1<sup>st</sup>. December 2008)

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**Abstract**

The chemical insecticides still the most effective controlling agent against the heavy plagues of the desert locust, *Schistocerca gregaria* and the other locust species. The affected countries with these insects used to keep sufficient amounts of the recommended insecticides by food and Agriculture Organization (FAO) for many years in their stores to protect their Agricultural economy from damage by locust plagues. These stocks have to be re-evaluated annually to insure their efficiency against locust.

Therefore, the present study was carried out in Baharia Oasis to re-evaluate the efficiency of some insecticides formulations against the most predominant Acrididae member, the Grasshopper *Catantops axillaris* in August, 2008. The tested insecticides were, ultra low volume (ULV) formulations of the organophosphorous chlorpyrifos 45% (Bestban and Briban), pyrethroid Deltamethrin 1.25% emulsifiable concentrate (EC) formulation of the organophosphate Malathion 57% (Malatox) and, ULV formulation, Green Muscles, of the fungus, *Metarhizium flavoviride*. The recommended doses of FAO 8<sup>th</sup> meeting of pesticide Referee group, 1999 were used. The samples of the tested insecticides were obtained from the insecticides store of the General Directorate for locust and grasshoppers control in Baharia Oasis. Green Muscles oil formulation sample was a gift from FAO project in Locust and Grasshopper Research Department, Plant protection Res. Institute, Agriculture Res. Center, Ministry of Agric., Egypt.

The obtained results indicated that, Deltamethrin and Bestban insecticides were the most effective ones against *C. axillaris*, followed by a moderate effect of Briban. The EC Malatox exhibited high efficiency only during the first 3 days of the application. The microinsecticide Green Muscles lasted 7 days to induce its lethal effect, reaching its maximum effect after 9 days.

Thus, it could be concluded that, the oil ULV insecticides have to be used only against locust in the desert and non-edible crops areas, but EC organophosphorous insecticides are preferred to use against locusts and Grasshoppers on the edible crops and cultivated area. Green Muscles could be used against the low density populations of the immature stages of these insects without treating non-target arthropods other than orthopterans. The ULV

formulation stock of Chlopyrifos 45%, Briban have to be renewed. Moreover, the present field study drew the attention to re-evaluating the ground sprayers periodically as well as the stored Locust and Grasshoppers insecticides.

## INTRODUCTION

Competing Locusts and Grasshoppers in the affected countries still rely on the chemical insecticides, because studies on alternative controlling agents still under controlled conditions in the laboratory, beside some field trials to evaluate the efficiency of some formulations of the fungus *Metarhizium spp.* under field conditions, Peveling *et al.* (1999) carried out medium-scale experimental field trials in Niger using the mycoinsecticide *M. anisopliae* compared with the organophosphate Fenitrothion insecticide against *Qedoleus senegalensis*. Both controlling agents were effective, the efficiency of *M. anisopliae* and Fenitrothion were 86% and 76%, respectively. They concluded that, the microinsecticide can be effective as Fenitrothion without threatening non-target arthropods other than Orthopterous. In another field trials in Niger, Langewald *et al.* (1999) found that, the oil formulation of *M. anisopliae* significantly reduced the population of this Grasshopper by 90% after 7 days, whereas Fenitrothion achieved more than 90% reduction shortly after application, but due to the immigration, the Grasshopper population recovered to the initial level within 16 days. Recently, laboratory and field studies were conducted to evaluate some alternatives from different chemical and biochemical classes against locust and Grasshoppers such as insect growth regulators, anti-moulting, anti-feedants and *Metarhizium spp.* (El-Gammal *et al.*, 2002, 2004 (a, b), El-Gammal and Mohamed, (2008) and El-Gawhary *et al.*, (2006). They observed that, the naturally produced bio-insecticides by plants or by micro-organisms could provide effective alternative controlling agents against Acrididae insects. It suppress producing the mobile swarms from their breeding sites if we have the means to discover these sites in the huge distributed area of desert locust which estimated by approx. 30 million square km. For this difficulty, the affected countries used to keep sufficient amounts of insecticides in their stores for many years to compete the insuppressible Locust plagues effectively in suitable time.

To insure this goal, the present study was conducted to reevaluate some of the stored insecticides as well as the microinsecticides Green Muscles against the available member of Acrididae, *C. axillaris* in Baharia Oasis, Egypt, to draw attention to any intangible deficiency in the toxicity of the stored controlling agents before any sudden plague of the desert locust, to Egypt.

## MATERIALS AND METHODS

### 1. Target insects

It was found that the Grasshopper, *Catantopis axillaris* is the most predominant species on alfalfa, *Medicago sativa* and *Zea mizae* in Baharia Oasis, followed by other species such as, the grasshopper, *Chrotogonus homalodermus* and *Acrida turrita* (Mohamed, 2007). So, *C. axillaris* was chosen to evaluate the toxicity of the stored insecticides stock in Baharia Base under the field conditions of this Oasis during August, 2008.

### 2. The tested insecticides

Samples of the stored insecticides stock for Locust and Grasshopper control in Baharia Oasis for one to three years were evaluated within its validity or re-analyzed for chemical and physical properties at central laboratory of pesticide. These samples were two of ultra low volume (ULV) formulations of the organophosphate Chlorpyrifos 45% (Bestiban and Briban), the pyrethroid ULV formulation, Deltamethrin 1.25% and the emulsifiable concentrate (EC) formulation of the organophosphate Malathion, (Malatox 57%). These samples were obtained from the stored insecticides stock in Baharia Base, General Directorate for Locust and Grasshopper control, Ministry of Agriculture. The sample of the oil formulation of *Metarhizium flavoviride* was a gift from Food and Agriculture Organization (FAO) project in Locust and Grasshopper Research Department, its trade name is Green Muscles. These chemicals and the microinsecticide (Green Muscles) have been included by FAO Desert Locust guide appendix (Gressman and Dobson, 2001).

### 3. Experimental field design

Medium-scale experimental field applications of the tested Locust and Grasshopper insecticides were conducted in Baharia Oasis, August, 2008. These insecticides were ULV formulations of Chlorpyrifos, 45% (Bestiban and Briban), the pyrethroid ULV formulation, Deltamethrin, 1.25%, the E.C. formulation of Malathion, (Malatox 57%), and the microinsecticide, Green Muscles. The applications of these controlling agents were carried out in experimental plots of alfalfa and maize that were heavily infected with the latent nymphal instars of *C. axillaris*. Each application was replicated three times in experimental plots of about 300 square meter (m<sup>2</sup>) with a wide belt of 200 m<sup>2</sup> in between to prevent the transition of the Grasshopper from one plot to another and avoid drift spraying between treatments. In addition untreated plot/treatment was specified as control (check).

#### 4. Field application

The recommended doses rates of Locusts pesticides by the 8<sup>th</sup> meeting of FAO pesticide Refree Group, (1999) were used in the present field study. These doses were, 225 gm.a.i./ha equal to 94.54 gm. a.i./fed for Chlorpyrifos ULV formulation, 12.5 gm.a.i./ha equal to 5.25 gm.a.i./fed. for Deltamethrin ULV formulation, 925 gm.a.i./ha equal to 388.66 gm.a.i./fed. for Malatox EC formulation and 100 gm.a.i./ha equal to 42.02 gm.a.i./fed. for Green Muscles ULV formulation. The ULV formulations were applied by a hand-held spinning disc battery sprayer, provided with a pink restrictor. The doses of the chemical insecticides were diluted with diesel oil, whereas the dose of the oil formulation, Green Muscles was dissolved in Natural oil. the application rate was 1.89 liter/fed. with swath width of 10 m . and a flow rate of 180 ml/min. to cover each plot with 135.0 ml including the application rate of the controlling agent. On the other hand, Malatox 57% EC formulation was applied with application rate of 20 liter /feddan aqueous solution by , using motorized knapsack sprayer Solo with 5.0 meter swath width , and flow rate was 0.950 L/min .

#### 4. Sampling and evaluation

The treated and untreated control plots were sampled daily for 10 days after application of the chemicals and micro-insecticides using sweep-net sampling technique. This technique was conducted in 5 sites in each plot, and repeated twice in each site, so each plot was sampled 10 times daily for 10 days after treatment. The numbers of the treated and untreated nymphs of the grasshopper, *C. axillaris* were related to 10 sweeps. The reduction percentages in the population density of the treated plots were calculated daily by Henderson and Tilton equation (1955).

## RESULTS AND DISCUSSION

### 1. Efficacy of the ULV formulations of Chlorpyrifos 45%

The present study was conducted to reevaluate (Check up) the efficiency of some stored Locust and Grasshoppers control agents against the most predominant member of Acrididae, *C. axillaris* in Baharia Oasis during August 2008.

Table (1) shows that, the application of the ULV formulations of the organophosphate Chlorpyrifos 45% (Bestiban and Briban) against the Grasshopper *C. axillaris* on alfalfa obviously reduced the number of this insect. The reduction percentages after one day of application (initial kill) of Bestiban and Briban insecticides were 81.19 and 53.47, respectively. These percentages were increased after two days of application they were, 86.14 and 73.48 for each insecticide, respectively. The

efficacy of Bestiban still high to day 5<sup>th</sup> of treatment, in which its reduction percent was 74.26 compared to 65.44% of reduction after Briban application in the same day. The efficiency decline slightly of Bestiban application, the reduction percentages achieved the least (66.68 %) at the 10<sup>th</sup> day. But in the same period from the 6<sup>th</sup> day (71.6) of the efficacy of Bribane was sharply reduced, its reduction percentages during this period ranged between , 59.39, and 28.06, respectively.

It's clear that, the two formulations of Chlorpyrifos 45% (Bestiban and Briban) still effective against *C. axillaris*, but the persistence of Bestiban was more than Briban which indicates that Bestiban didn't suffer from storage and its initial and latent kill still convenient to compete locust and grasshoppers for at least one year after which this re-evaluation have to be repeated.

Table 1. The first annual reevaluation of the stored ULV formulations of Chlorpyrifose 45% (Bestiban and Briban) against the Grasshopper *Catantopis axillaris* on alfalfa in Baharia Oasis, August 2008.

Days of treatments	Average No. Control insects/ 10 sweeps		Average No. treated insects/ 10 sweeps		% reduction caused by	
	In Bestiban plots	In Briban Plots.	In Bestiban plots	In Briban Plots.	Bestiban	Briban
0	38.00	70.00	42.00	48.00	0.00	0.00
1	37.67	70.33	8.00	22.33	81.19	53.47
2	38.33	68.33	6.00	12.67	86.14	73.48
3	37.00	68.33	8.67	11.67	78.37	75.52
4	38.67	67.67	10.33	12.33	75.50	73.22
5	38.33	65.00	11.00	15.33	74.26	65.44
6	36.00	65.33	11.33	18.33	71.65	59.39
7	36.67	63.67	12.67	25.33	68.88	42.23
8	36.33	66.33	12.33	34.33	69.55	24.40
9	38.33	68.67	12.67	33.00	70.30	25.48
10	38.67	64.33	14.33	31.67	66.68	28.06

## 2. Effects of the EC formulation of Malathion (Malatox 57%)

The application of the organophosphate Malathion (Malatox 57%) against the field population of *C. axillaris* was conducted on Zea maize in Baharia Oasis in the same period of the previous experiments. This formulation was sprayed by the low volume spraying technique with a rate of application of 20 liter/ feddan using motorized knapsak sprayer Solo .

Table 2. Susceptibility of the Grasshopper, *Catantopsis axillaris* to Malatox 57%.

Days of treatments	Average No. insects (10 sweeps / plot )		% Reduction
	Untreated control	Malatox 57%	
0	70.00	22.67	0.00
1	48.33	27.33	75.45
2	42.00	25.67	88.71
3	51.00	25.67	54.81
4	53.33	23.67	35.72
5	67.67	27.33	25.11
6	61.33	23.67	18.56
7	58.67	21.67	14.24
8	59.33	20.67	7.38
9	59.33	20.67	7.38
10	60.67	20.67	4.99

Table (2) indicates that, the initial kill of emulsifiable concentrate (EC) Malatox 57% was sufficient to reduce the field population of *C. axillaris* by 75.45% and 88.71% in the first and the second days after treatment, respectively. But drastic decline in its efficacy was started early in the third day of applications in which the reduction percent was 54.81, followed by sharp decreasing to the end of evaluation. This decline started by day 4<sup>th</sup> to day 10<sup>th</sup>, the reduction percentages during this period were 35.72, 25.11, 18.56, 14.24, 7.38, 7.28 and 4.99 after 4, 5, 6, 7, 8, 9 and 10 days, of application respectively.

Thus, Malatox by one or two days after application could be convenient for controlling Locust or Grasshoppers on the edible crops in Nile Valley and its Delta, specially it was not preferable to compete the desert locust plagues 2004 in these areas by ULV formulation. Also, this organophosphate compound stored for one year only, therefore its efficiency still in its high level (88.71%), but an annual re-evaluation have to be done next year.

### 3. Efficacy of the pyrethroid ULV formulation, Deltamethrin 1.25%

The ULV formulation, Deltamethrin 1.25% was also, evaluated against *C. axillaris* on alfalfa in Baharia Oasis during August. 2008.

The obtained results of this evaluation were shown in table (3), in which the reduction in the field population of *C. axillaris* started to increase after the 2<sup>nd</sup> day of application and the maximum percent (93.70%) obtained the 5<sup>th</sup> day . The reduction percentages were 78.58, 86.91, 85.06, 86.50, 93.70, 83.66, 81.08, 74.08, 71.44 and 61.46 after 1,2, 3, 4, 5, 6, 7, 8, 9 and 10 days of treatment , respectively. It was observed that, the knock down effect of this compound was enough to compate desert locust plagues in desert areas before its immigration to Nile Vally, because the oil and ULV formulation could be used safely in the desert area, but it unaccebtable for using against Locust and Grasshoppers on edible crops in the Nile Vally.

Table 3. Effects of the pyrithroid ULV formulation, Deltamethrin 1.25% on the field population of the Grasshopper, *Catantopis axillaris* in Baharia Oasis (August., 2008).

Days of treatment	Average No. insects (10 sweeps / plot )		% Reduction
	Untreated control	Deltamethrin	
0	30.00	29.33	0.00
1	29.33	6.30	78.58
2	39.33	5.00	86.91
3	36.00	5.33	85.06
4	33.3	4.33	86.50
5	27.33	2.00	93.70
6	35.00	5.67	83.66
7	35.33	6.33	81.08
8	31.33	8.00	74.08
9	35.67	10.00	71.44
10	32.00	12.00	61.46

#### 4. Efficacy of the micoinsecticide Green Muscles

The oil formulation of Green Muscle (*Metarhizium flavoviride* spores) was sprayed by ULV sprayer in natural oil against *Catantopis axillaris* on alfalfa in Baharia Oasis in August, 2008. Due to the high temperature and the low soil humidity in the treated plots, the application was before sunset with one more irrigation to make the field conditions more suitable for the germination of the Green Muscles spores on the target insects.

Table 4. Efficiency of the oil formulation of *Metarhizum flavoviride* spores, Green Muscles against the field population of the Grasshopper, *Catantopis axillaris* on alfalfa in Baharia Oasis (August, 2008)

Days of treatment	Average No. insects (10 sweeps / plot )		% Reduction
	Untreated control	Green Muscles	
0	30.00	28.67	0.00
1	32.00	27.22	1.10
2	61.33	59.00	9.60
3	55.00	47.00	9.80
4	39.00	42.66	12.42
5	38.33	26.33	28.24
6	34.33	22.00	33.01
7	36.33	14.33	58.58
8	35.33	10.67	68.55
9	38.67	9.33	74.26
10	40.33	11.00	71.88

Table (4) indicated that, the reduction in the population of the treated *C. axillaris* started with low percentages during the first 6 days of treatment, and tended again to increase with the beginning of the 7<sup>th</sup> day of treatment to the last day of experiment . These percentages were 58.58, 68.55, 74.26 and 71.88 in days 7, 8, 9 and 10, respectively. These results reflect the slow acting of the micoinsecticide, Green Muscles against this Grasshopper inspite of its application during sunset and the high humidity in the soil of the treated plots.



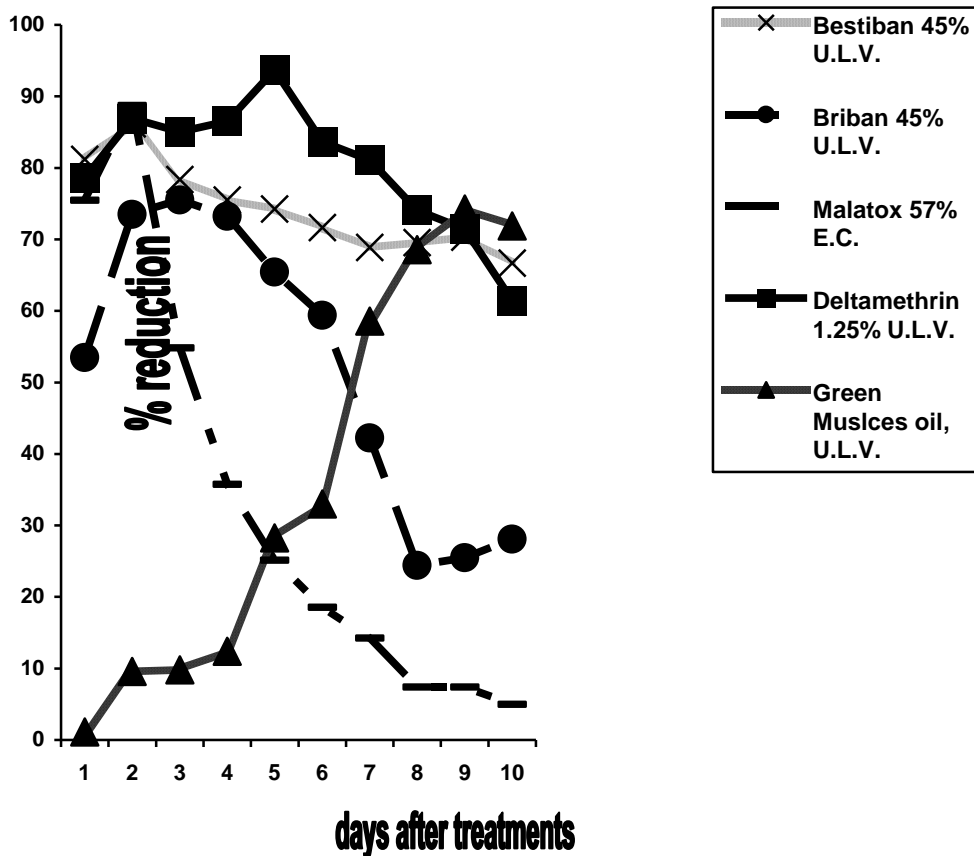


Fig .1. comparison between the reduction capacity of all the applied stored compounds against the field strain of the Grasshopper, *Catantopis axillaris* .

Fig : (1) and tables (1-4) showed that, the ULV formulation, Deltamethrin and Bestiban were the most effective insecticides against the Grasshoppers, *C. axillaris* under field conditions, followed by the moderate effect of Briban. The emulsifiable concentrate formulation of Malathion, Malatox 57% exhibited high efficacy during the first 3 days of the application. The microinsecticide, Green Muscles lasted 7 days to induce its lethal effect against this grasshopper. The rate of initial kill of Bestiban, Briban, Malatox, Deltamethrin and Green Muscles were 81.19, 53.47, 75.45, 78.58 and 1.10 respectively percent after application with one day. The effects of the first 4 compounds were increased in the second day, their reduction percentages ranges, between 73.48, & 88.71 and 86.91. But the maximum efficacy of the microinsecticide, Green Muscles induced after 9 days of its application.

In conclusion, the results of the present re-evaluation refer to the high performance of the stored Deltamethrin, and Bestiban ULV formulations against the target Grasshopper, *C. axillaris*, and the moderate effects of the other ULV formulation, Briban on this pest. On the other hand, the EC. Formulation, Malatox

exhibited good performance only, during the first 3 days after application, whereas the microinsecticide Green Muscles induced convenient reduction as abioinsecticide in the population of the treated Grasshopper after 9 days of treatment. These results go in line with many others field studies such as the medium-scale experimental field trials of Peveling *et al.* (1999) in Niger using the mycoinsecticide *M. anisopliae* and one of the organophosphorous compounds, Fenitrothion against *Oedaleus senegalensis*, the efficiency of Fenitrothion ranged from 75 to 86% over 31 day post treatment whereas *M. anisopliae* had an efficiency of 76% during the last sampling period, days 21-31. They concluded that *M. anisopliae* can be effective as organophosphate Fenitrothion without threatening non-target arthropods other than orthopterans. In another trial in Niger, Langwald *et al.* (1999) stated that the treatment with the oil formulation of *M. anisopliae* reduced the population of the treated Grasshopper significantly after 7 days and by 93% within 16 days. Fenitrothion caused a population reduction of more than 90% shortly after application. These field trials in Niger supported the results of the present study, in which we could conclude and recommend that the fast degradable EC formulation of the organophosphorous insecticides have to be used against the unusual invasions of the desert locust to Nile valley such as in 2004-2005 plague to avoid pollution and contamination. The tested ULV insecticides formulations in the present study could be used against hopper bands or adult swarms in the desert areas, except the microinsecticide, Green Muscles which will be effective against the low density of hopper bands or Grasshopper. Also, the Chlorpyrifos formulation (Briban) have to be renewed due to its low toxicity during this bioassay.

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## فاعلية مبيدات الجراد والنطاط المخزنة بمصر على النطاط "كاتانتوبس أكسلارس" (مستقيمات الأجنحة: جراديات) تحت الظروف الحقلية بالواحات البحرية

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بمعهد بحوث وقاية النباتات - مركز البحوث الزراعية - دقى - جيزه

ما زالت المبيدات الكيماوية هى أكثر عناصر المكافحة ضد غزوات الجراد الصحراوى "شيتوسيركاجرباريا" والأنواع الأخرى من الجراد. لذلك اعتادت الدول المتضررة بهذه الحشرات الاحتفاظ بكميات كافية من المبيدات التى توصى بها منظمة الأغذية والزراعة، (FAO) لسنوات عديدة بمخازنها لحماية اقتصادها الزراعى من أن تدمرها غزوات الجراد. لذا يجب أن يعاد تقييم هذه المبيدات سنويا للتأكد من استمرار فعاليتها ضد الجراد.

لذلك أجريت هذه الدراسة بالواحات البحرية ضد أكثر أنواع الجراديات انتشارا هناك وهو النطاط "كاتانتوبس أكسلارس" فى أغسطس ٢٠٠٨. وكانت الكيماويات المختبرة هى المستحضرات للرش بالحجم المتناهى فى الصغر ULV وهى من المستحضرات الفسفورية لمركب الكلوروبيرفوس وهما البستبان والبريبان ٤٥%، والدلتامثرين ١.٢٥% من مستحضرات مركبات البيروثرويدز والمستحضر الفسفورى المستحلب (EC) مالاتوكس ٥٧% بالإضافة إلى المركب الحيوى "جرين مسلس" المستحضر من جراثيم فطر "الميتاريزيم فلاقوفيريدي".

فى هذه الدراسة تم إعادة تقييم الجرعات الموصى بها من هذه المركبات بمعرفة مجموعة تحكيم المبيدات بمنظمة الأغذية والزراعة عام ١٩٩٩م، وتم الحصول على عينات التجريب من هذه المركبات من مخزن الإدارة العامة لمكافحة الجراد والنطاط بالواحات البحرية، كما تم الحصول على عينة مستحضر الفطر كهديّة من مشروع منظمة الأغذية والزراعة بقسم بحوث الجراد والنطاط بمعهد بحوث وقاية النباتات بمركز البحوث الزراعية، وزارة الزراعة بمصر.

أوضحت النتائج المتحصل عليها أن مبيدات الدلتامثرين والبستبان أكثر المبيدات تأثيرا ضد هذا النطاط يليهما مبيد البريبان الذى أعطى تأثيرا متوسطا ضد هذه الآفة، كما أوضح المبيد الفسفورى المستحلب "مالاتوكس" فعالية عالية خلال الثلاثة أيام الأولى من الرش، واستغرق المبيد الحيوى "جرين مسلس" سبعة أيام كى يعطى تأثيره القاتل ضد هذا النطاط والذى وصل إلى أقصاه بعد تسعة أيام.

وخلاصة القول أن المبيدات المجهزة للرش بالحجم المتناهى فى الصغر ULV يجب أن تستخدم ضد الجراد فى الصحارى فقط ولا تستخدم على الزراعات المأكولة والمناطق المنزرعة، ويفضل استخدام المركبات الفسفورية المستحلبة (EC) ضد الجراد والنطاط فى المناطق المنزرعة. كما يمكن استخدام المركب الحيوى "جرين مسلس" ضد الكثافات المنخفضة من الأطوار غير الكاملة للجراد والنطاط حيث لها تأثير سلبي على الكائنات غير المستهدفة بخلاف مستقيمات الأجنحة، ويجب إعادة تجديد المركب الفسفورى "بريبان". وقد لفتت هذه الدراسة النظر إلى ضرورة إعادة تقييم آلات الرش المتاحة أيضا إسوة بإعادة تقييم المبيدات الخاصة بمكافحة الجراد والنطاط.