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**Table 1.** Efficacy of contact action of water/ethanol and water extracts of the plant materials on migratory locust under laboratory conditions.

Treatments	Water/ethanol				Water			
	No. of tested insects	Knock Down % ± SD	Mortality % ± SD	Time to death in days ± SD	No. of tested insects	Knock Down % ± SD	Mortality % ± SD	Time to death in days ± SD
Control	57	0.00±0.0 a	20.60±11.7 a	4.33±0.7 a	66	0.00±0.0 a	0.00±0.0 a	-
<i>Calotropis</i> 50 g/l	56	22.33±17.2 b	10.17±13.3 a	3.62±0.7 ab	60	0.17±0.4 a	5.00±8.4 a	4.42±0.9 a
<i>Azadirachta</i> 50 g/l	58	21.83±1.7 b	91.67±13.9 b	2.97±0.9 b	59	0.80±1.3 a	96.00±5.5 b	4.74±1.5 a
<i>Adenium</i> 50 g/l	58	31.33±20.8 b	21.00±26.7 a	2.99±0.6 b	59	0.00±0.0 a	3.33±5.2 a	4.23±1.1 a
<i>Mucuna</i> 50 g/l	60	26.83±15.0 b	98.83±2.9 b	1.11±0.3 c	65	48.33±21.7 b	98.33±4.1 b	1.15±0.4 b

NB.: Means (with standard deviation) in the same column followed by the same lower case letters are not significantly different at P= 0.05.

**Table 2.** Efficacy of stomach action of water/ethanol extracts of plant materials on Migratory Locust under laboratory conditions.

Treatments	Water/ethanol				Water			
	No. of tested insects	Knock Down % ± SD	Mortality % ± SD	Time to death in days ± SD	No. of tested insects	Knock Down % ± SD	Mortality % ± SD	Time to death in days ± SD
Control	60	0.00±0.0 a	3.00±0.2 a	5.00±0.3 a	60	0.00±0.0 a	0.00±0.0 a	-
<i>Calotropis</i> 50g/l	60	0.00±0.0 a	66.43±43.3 bc	4.04±1.5 ab	55	0.00±0.0 a	0.00±0.0 a	5.12±1.9 ab
<i>Azadirachta</i> 50g/l	60	0.00±0.0 a	100.00±0.0 c	2.77±0.6 bc	60	0.00±0.0 a	98.57±3.8 c	3.20±0.6 b
<i>Adenium</i> 50g/l	60	0.00±0.0 a	33.50±31.3 ab	5.31±0.8 a	60	0.00±0.0 a	0.00±0.0 a	6.14±0.5 a
<i>Mucuna</i> 50g/l	60	0.00±0.0 a	93.14±14.9 c	2.48±0.6 c	60	0.00±0.0 a	30.00±21.1 b	3.94±2.1 b

NB.: Means (with standard deviation) in the same column followed by the same lower case letters are not significantly different at P= 0.05.

## المخلص

عبد الله، محمد عبد الله، ميهان لوني - اسكوفماند، ميشيل ليكوك والسيد البشير. 2009. تأثير بعض المستخلصات النباتية في الجراد الرحال. مجلة وقاية النبات العربية، 27: 99-102.

نالت الطرائق البديلة لمكافحة الجراد قديراً كبيراً من الإهتمام في السنوات الأخيرة حيث تم تقويم العديد من المركبات الطبيعية بما في ذلك المستخلصات النباتية كبدايل للمبيدات الكيميائية المصنعة ومازالت الدراسات جارية في تقويم هذه البدائل. تستعرض هذه الدراسة نتائج التقويم الحيوي تحت ظروف المختبر لمستخلصات نباتات (*Asclepiadaceae*) على الجراد الأفريقي الرحال (*Orthoptera: Acrididae*) *Locusta migratoria* Linne. وقد تم إعداد المستخلصات النباتية باستخدام الماء أو الماء والكحول الإيثيلي كمذيبات ومن ثم تم اختبار أثر هذه المستخلصات كمبيدات بالملامسة وكسوموم معدية ودونت المعلومات عن الفعل الصارع، نسبة الموت وزمن الموت كمؤشرات للفعالية. أظهرت النتائج أن مستخلصات *Mucuna pruriens* تعمل بالملامسة وكسوموم معدية حيث سجلت نسبة موت بلغت 99% عندما تم رش المستخلص المائي والمائي الكحولي لنبات *Mucuna pruriens* تركيز 50 غ/لتر مباشرة على الجراد. سجلت النسبة نفسها من الموت عندما اطعم الجراد بادرات قمح معاملة بالمستخلص المائي الكحولي لـ *Mucuna pruriens* تركيز 50 غ/لتر. كما أظهرت مستخلصات هذا النبات أنها أسرع في الأثر من مستخلصات *Azadirachta indica*. خلصت الدراسة إلى أن مستخلصات *Mucuna pruriens* ذات فعالية عالية ويمكن استعمالها في عمليات مكافحة المختلفة.

كلمات مفتاحية: نبات *Mucuna pruriens*، الجراد الرحال، *Locusta migratoria*، المستخلصات النباتية، تقويم حيوي.

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chemical surfactant (Alkylphenol Oxyethylene) were added to each extract before application. This procedure is a modification of that adopted by Aruna *et al.* (2) in their phyto-chemical studies on roots of *M. pruriens*.

### Locust rearing

The Migratory Locust, *Locusta migratoria* (Linné 1758) collected from Sumatra, Indonesia in June 2000 was reared and used as test subjects throughout the course of this study. Locusts were reared in clear Plexiglas cages (40 x 40 x 50 cm) with a removable floor that supported four egg laying tubes (6.5 cm in diameter and 10 cm in height), the top and the front sides were of Plexiglas with a flappable slits for locust handling, cleaning and feeding. The three sides of the rearing cage were covered with a mosquito screen to facilitate ventilation and to receive light. A 40-Watts lamp was placed against a screened side of the cage to warm the cage and provide a 12 h-day light period. The room temperature was kept at 25-26°C with 50-60% R.H. Pots of 10-15 days old wheat seedlings with some wheat bran were provided daily for feeding. Some grasses and bamboo leaves were added from time to time to enrich the locust diet. The 2<sup>nd</sup> nymphal instars, which were selected for the bioassay, were from the 3<sup>rd</sup> generation reared under the described laboratory conditions. This method is similar to that described by Quesada-Moraga and Santiago-Álvarez, (20) for rearing the Moroccan locust, *Dociostaurus maroccanus*.

### Bioassay tests

To determine the efficacy of the plant extracts as stomach poisons, second nymphal instars of *L. migratoria*, were deprived of food for 4-5 h before they were transferred to the test cages and fed on wheat seedlings contaminated with extracts of plant material. The wheat seedlings (10-15 cm long) were dipped in the respective solution of the plant extract for one minute, then dried for one hour under room conditions and fed to 10 starved nymphs. Each treatment including the control (treated with the solvent alone) was replicated six times. On the other hand contact toxicity of plant extracts was assayed by direct spraying of groups of caged nymphs (10 nymphs) with the respective solution of the plant extract and fed on untreated wheat seedlings until the end of the test period. Each treatment was replicated six times. Test subjects were kept at 25-26°C and 12h/12h light/dark regime and provided with moist cotton rolls. Knock down effect was determined one hour after treatment and mortality was assessed on 24-hour basis. However, records of dead nymphs and of those which failed to moult were also recorded until the end of the experiment i.e 100% moulting or 100% mortality.

### Statistical analysis

The control mortality was used to correct the final mortality according to the following formula (1):

$$\text{Corrected Mortality} = \frac{\text{Test mortality} - \text{control mortality}}{100 - \text{Control Mortality}} \times 100$$

Data from each experiment were analyzed separately using Mstatc statistical software package. A completely

randomized design was applied to all laboratory experiments. Means comparison was run in each case.

## Results and Discussion

Table 1 shows the toxic contact action of the water/ethanol and water extracts of roots of four plants on nymphs of the migratory locust. It is evident that extracts of *Azadirachta indica* and *Mucuna pruriens* in both types of solvents were significantly more toxic than those of *Calotropis procera* and *Adenium obesum* to nymphs of the migratory locusts. The active material in the extracts of *A. indica* and *M. pruriens* is probably water soluble, since addition of ethanol did not increase activity of the extract. It is worth noting that the water/ethanol extracts of all the tested plants caused low levels of knock down effect (22-31%), while the water extract produced a medium level of knock down effect (48%) in the case of *Mucuna*, but failed to induce such effect with the other three test plants. *Mucuna* extracts appeared also to act approximately 3-4 times faster than the extracts of the other test plants. Note that with water/ethanol solvent (Table 1) control mortality was surprisingly high.

Results in table (2) summarize the toxic effect of ingested ethanol/water and water extracts of plant materials on nymphs of the migratory locust. In general, all ethanol/water extracts were toxic to hoppers when ingested, with the highest toxicity manifested by extracts of *Azadirachta*, followed respectively by those of *Mucuna*, *Calotropis* and *Adenium*. On the other hand, the water extracts of *Calotropis* and *Adenium* were non-toxic when ingested by the hoppers while that of *Mucuna* was only slightly toxic causing low mortality (30%). However, the water extract of *Azadirachta* appeared to be a highly toxic stomach poison. The ethanol/water and the water extracts of the four test plants failed to cause any knock down effect when ingested, indicating that the active toxic molecules were probably not readily absorbed through the gut.

Morris (17) listed some leguminous plants, including *Mucuna pruriens*, as sources of bio-active pesticidal substances such as bufotenine, mucunin and serotonin. Beckstorm-Sternmerg and Duke (6) also indicated that *Mucuna* contained some phyto-chemicals which could be useful. Furthermore, Aruna *et al.* (2) confirmed the presence of bioactive sterols, triterpenes and flavonoids in roots of *M. pruriens*. Lorenzetti *et al.* (15) also observed that seeds of *Mucuna*, unlike those of other legumes, were mainly free of insect infestation, implying that they contain a chemical deterrent. Our findings are inline with those claims and show that *Mucuna* root extracts have a potential as pest control agents. It is worth mentioning that our focus was on the roots rather than the seeds because *Mucuna* seed pods are covered with irritating hairs, which are hazardous and difficult to handle.

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## Effect of Some Plant Extracts on the Migratory Locust *Locusta migratoria* L.

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### Abstract

Abdalla, A.M., M.H. Luong-Shovmand, M. Lecoq and S. El-Bashir. 2009. Effect of Some Plant Extracts on the Migratory Locust, *Locusta migratoria* L. Arab Journal of Plant Protection, 27: 99-102.

In this paper the results of laboratory tests of extracts of four plants, namely *Mucuna pruriens* (Fabaceae), *Adenium obesum* (Apocynaceae), *Azadirachta indica* (Meliaceae) and *Calotropis procera* (Asclepiadaceae) against the migratory locust (*Locusta migratoria*) are presented. The extracts were prepared using water or water/ethanol as solvents and screened for their locusticidal properties, both as contact and stomach poisons. Knockdown, mortality and time to death were considered as indicators for efficacy. The bio-tests have shown that *Mucuna* extracts act both as contact and stomach poisons. Up to 99% mortality was achieved by direct spraying of water or water/ethanol extracts of *Mucuna* at 50 g/l on the migratory locust, and similar percentage kill was also obtained when locusts were fed on wheat seedlings treated with *Mucuna* at 50 g/l (water/ethanol extract). *Mucuna* extracts, also appeared to act faster than neem extracts on locust. The study concluded that *Mucuna* has a potential as an effective natural product which can be used in different plant protection activities.

**Keywords:** *Locusta migratoria*, locust control, *Mucuna pruriens*, plant extracts, bioassay.

### Introduction

Chemical pesticides are currently the only dependable tool for combating locust and grasshoppers during upsurges. Yet these products are reluctantly used because of their negative environmental impact, and because of the risks they pose on human health and the different ecosystems (4, 18, 19, 21). Data on eco-toxicological risks of chemical insecticides have recently been compiled, especially on the effect of locusticides on non-target fauna (5, 25).

The current problems of chemical control of locust, including the high cost and the associated environmental hazards, have substantiated the need to investigate new products which could be incorporated in IPM menus. IPM has been advocated as a viable acridid future management approach, with botanicals and behaviour modifying chemicals (semiochemicals) as major components (9, 13, 14). Globally, there are approximately 500.000 plant species, of which only 10% have been chemically characterized. The fact that plants are a rich source of active pest control agents has been demonstrated by many workers in this field (11, 22). Thus the scope for further investigations on development of pesticides of plant origin is enormous (7).

Most of the research on botanicals focused on products of plants of the Meliaceae family, especially the neem tree *Azadirachta indica* and *Melia volkonski* (16, 22, 24). Schmutterer (23) compiled extensive literatures on the bio-activities of neem products on several pests including some acridids. The studies covered the methods of extraction and preparation as well as the chemistry and mode of action of the neem products. Although the bio-activity of the neem and other Miliaceae products against the desert and the migratory locusts was investigated by a number of researchers (8, 10, 12). However, there is still

much work which needs to be accomplished on this important subject. In this study, the effect of four plant extracts for the control of migratory locust were evaluated.

### Materials and Methods

#### Collection and Preparation of Plant Materials

Different plant parts of *Adenium obesum* (sim tree), *Calotropis procera* (usher shrub), *Azadirachta indica* (neem tree) and *Mucuna pruriens* (a climber locally known as Erig El-Ghamoal) were collected from different regions of the Sudan. These plant materials are traditionally used by the locals as pest and/or disease control agents. Roots of *A. obesum* and *M. pruriens* were chopped in slices and dried under shade and then ground. Leaves of *C. procera* were also collected, dried under the shade, crushed and subsequently ground in the same way as described earlier. Fruits of *A. indica* were soaked in water for 6 hours in order to release the seeds, which were then dried under the shade. The kernels were obtained by decorticating the dried seeds using a wooden mortar and pestle.

#### Extraction of the Plant Materials

50 g of each of the plant materials were separately mixed with one liter of solvent (distilled water or water/ethanol mixture v/v). The mixtures were first blended for 3 min. then stirred by a magnetic agitator at 500 rpm at 40°C for 20 min and finally shaken in an ultra-sonic device for 15 min to enhance extraction. Each plant extract was filtered separately through a fine muslin cloth and used against the test insects, similar to the method of extraction described by Ascher *et al.* (3) who worked with Neem seed kernel against *Spodoptera littoralis* (Lepidoptera: Noctuidae). To reduce the surface tension of the mixture and to insure an even spray film on the treated targets, 3 droplets of a