



THE NEWSLETTER OF THE ORTHOPTERISTS' SOCIETY

# Metaleptea

SPECIAL ISSUE 2007: AFRICAN SYMPOSIUM ON ORTHOPTERA

A symposium on acridology in the 17th Conference  
of the African Association of Insect Scientists

Université Cheikh Anta Diop, Dakar, Senegal,  
11 – 15th June 2007



The African Association of Insect Scientists (AAIS PO Box 59862, 00200 City Square Nairobi, Kenya. President : Prof. Dr. Daniel Obeng-Ofori) organized in Dakar, Senegal, from 11 – 15th June 2007 its 17th Conference entitled “Towards food security, health and protection of the environment in Africa: The role of Insect Sciences”. The conference was hosted by the University Cheikh Anta Diop and the local organizing committee was headed by Prof. Karamoko Diarra from Dakar University (web page: <http://www.biol-env.com/congresAAIS.html>).

In this framework, Mohamed Abdallahi Ould Babah, as Regional Representative of our Society for West, North and Central Africa and member of the scientific committee of the conference, organized a symposium dedicated to acridology in close and exemplary collaboration with the President of the local organisation committee and the editors of AAIS. This symposium, supported by the Orthopterists' Society, was held in two half day sessions moderated respectively M.A. Ould Babah and Prof. Doumandji from Algeria. It gathered 30 communications and was a real big success. Presentations covered various fields and specially many communications dealing with biodiversity as well as on control of pest locusts and grasshoppers, with a focus on alternative methods to chemical pesticides.

Despite the fact that some of the authors were not able materially to travel and attend the conference, Mohamed Abdallahi told me about many fruitful discussions, debates during this symposium, demonstrating the vitality, too often ignored, of acridology in this part of the world where many countries are deeply affected by chronic and episodic invasions/ outbreaks of various pest locusts and grasshoppers. We all keep in memory the last invasion of the Desert Locust during the years 2003-2005, but many other species are a permanent threat for the crops of African farmers.

We should keep in mind that too often, our african orthopterists colleagues are lacking from financial support to undertake their research. They have sometimes security problems to go to the field. More generally they have difficulties to access to the modern means of information and to the most recent scientific publications and, at the end, to covers their fees for travel and sharing theirs results at the regional and international scientific forums. Translation of the papers in english is quite often a problem. All this is sometimes reflected in some works which can have some difficulties to reach the international standards. AAIS is trying its best to stimulate and develop the scientific entomology in Africa. But it is also our role, as an international scientific organization having to foster communication and research on Orthopteroids, to give a full support to our african colleagues.

I think the Orthopterists' Society can be proud to have supported this event. I hope we will have modestly contributed to stimulate communication and exchanges between Orthopterists of the African continent, like – largely thanks to Mohamed Abdallahi - to a better information in this area of the world on our Society and its objectives. It is to be noted that the next conference of AAIS will be held in Nouakchott, Mauritania, in 2009.

Enjoy your reading,

Michel Lecoq  
President, Orthopterists' Society  
CIRAD, Montpellier, France

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## Abstracts

### Contribution to the study of gibberellic acid on the embryogenesis of *Locusta migratoria migratoria* (Orthoptera: Acrididae)

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The effect of the vegetable growth hormone, gibberellic acid (GA3) was assessed on the embryonic and post-embryonic development of *Locusta migratoria migratoria* (Orthoptera: Acrididae) at concentrations of 125, 625 and 3125 ppm in water. The effects of GA3 on the embryonic development of *L. migratoria* were investigated by immersing 3, 6 and 9-day old eggs to these concentrations. The control eggs are immersed in the same quantity of distilled water. We also used a negative control that did not receive any treatment. The following emersion periods were evaluated: 1h, 2h, 4h, 8h, 16 h and 32 h. The results showed that the GA3 provokes in the treated eggs a reduction of the bursting rate that observes itself dice the first time of immersion used (1h), with 3-day old eggs and a delay in embryonic development that was demonstrated by delayed emergence. The effect of GA3 was observed for all three egg ages tested. The treated embryos underwent abnormal morphogenesis and pigmentation. A morphometric study of the eggs (length, weight and volume), seven days after treatment and incubation at 33 °C, showed meaningful differences between the different treatments especially at the highest concentrations used (625 and 3125 ppm). Emersion in gibberellic acid therefore has a significant effect on the embryonic development of eggs. The modes of action of the GA3 needs further study.

**Key words:** *Locusta migratoria*, gibberellic acid, fertility, embryonic development.

## Ecological and faunistic characterization of the communities of Orthoptera of Algeria

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This work constitutes a synthesis of the inventory and an ecological characterization of the communities of *Orthoptera* of Algeria. To this end we took into account three ecological factors: bioclimate, altitude and vegetation. 324 surveys were carried out between 1992 and 2005. During this period 60 species of *Orthoptera* belonging to the *Caelifera* and *Ensifera* were recorded. The community structures were not affected by bioclimates and were similar in wet and sub-wet environments. The latter included the communities of *Orthoptera* that were most diversified compared to the semi-arid and arid climates. On the other hand the communities' diversity of *Orthoptera* was observed to decrease as altitude increases. Generally, the maquis contain few species as well as fallows and cultivated areas. The communities of *Orthoptera* occupy mainly the areas with light cover and low vegetation. Results analyses by the means of ecological indices also allowed us to highlight, to determine and compare the species richness and the diversity of the *Orthoptera* according to ecological factors mentioned above.

**Key words:** Algeria, *Orthoptera*, species richness, diversity

### Biological activity of the teflubenzuron, an insect growth regulator, on the structure of the cuticle and the digestive tract of *Schistocerca gregaria*

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This study was carried out to determine the biological activity of teflubenzuron on the morphological aspects of the cuticula and the midgut level of 5th instar nymphs of *Schistocerca gregaria*. The study was conducted in the laboratory. The treatment was carried out on newly moulted 5th stage nymphs. A topical application of a concentration of 2 µg teflubenzuron was deposited beneath the pronotum. The teflubenzuron wrongly affect on the post ecdysial cuticle (endocuticula) produced an amorphous structure in the treated nymphs. At the mesenteron, severe and rapid injury was observed in epithelial cells.

Keys words: *Schistocerca gregaria*, teflubenzuron, midgut-level, cuticula, histology

### **The Migratory Locust, *Locusta migratoria cinerascens* (Orthoptera. Oedipodinae) in anthropized zones of the algerian Sahara : life cycle and strategy for preventive control**

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During the 1980s the Algerian state introduced cereal crops under pivot irrigation systems. Approximately 400 pivots with a total of more than 200 000 hectares of cereals are in place. At Adrar (Central Sahara), these irrigated agricultural areas increase of more than 60 % between 1984 and 1989 and involved not only an increase in the produced quantities, but also a physical modification of the habitats in favor of the acridian communities. Colonization, followed by establishment of the Migratory Locust whose solitary populations were always regarded as sedentary, followed one another in these anthropized biotopes. Since 1994 damage regularly occurred in the pivot systems and

the gardening perimeters which become favourable to the multiplication of the Migratory Locust. In order to define a strategy of monitoring and preventive control, the objective of this study was to determine the geographical distribution of the *L. m. cinerascens* populations and their life cycle in the irrigated pivots of the Algerian Sahara. Research involved analyzing the complete acridian data files of the National Institute of Plant Protection at El Harrach (272 records in 1995), and to conduct further research from 1995 to 2004, on irrigated wheat and sorghum crops (24 sites) in the Adrar and Ouargla regions. We calculated the frequency of the nymphs and the average density of the adults as well as the variations of cover of the principal crops colonized by *L. migratoria*. In the anthropized cereal perimeters, we suggest that the cycle of this locust would present a succession of three generations: a first spring generation on wheat until the harvest, a second spring and summer generation in the vegetable gardens bordering wheat thatches or in pivots of sorghum at the beginning of development, and a third summer and autumn generation developing only on summer cereals which would be wintering during the off season. It appears of paramount importance to undertake a systematic weeding on winter cereals, in particular on durum wheat to limit the chances of appearance of the spring and summer generation likely to generate damage on summer cereals and vegetable gardens.

Key words: Migratory Locust, *Locusta migratoria cinerascens*, Algerian Sahara, control

### **Towards a new approach to use bacteria in locust control : first results with *Bacillus subtilis* on *Locusta migratoria***

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One of the advantages of *Bacillus subtilis*, a resistant bacterium that occurs in the soil, is that it is not very pathogenic for human and mammals and therefore easy to handle. The goal of this new approach is to explore methods which would lead to the greatest possible specificity of action against the target pest, *Locusta migratoria*. We tested in the laboratory the effectiveness of three strains of *B. subtilis* on the TL50 on the fifth instar, the growth and the resorption of the oocytes of the adults, by using several modes of administration. To study the influence of *B. subtilis* on the mortality of the L5-stage, we evaluated the following treatments: injection of the 3 strains (B213, VIII3 and II4) with the 3 respective doses : D1 =  $5,2 \times 10^9$ , D2 =  $5,2 \times 10^7$  and D3 =  $5,2 \times 10^5$  spores or vegetative cells /ml. The treatments were managed during 7 and 8 days respectively with sporal and vegetative cells solutions. The influence of the *Bacillus* on the ponderal growth of the larvae was studied according to spore injections in the haemolymph (strains VIII3 and II4) with the dose D4 =  $1,7 \times 10^5$  spores. The weight increase of nymphs in each batch was recorded after 12, 48 and 72 h. In immature females and females in the reproductive phase, we carried out only one injection of the 2 bacterial strains in the form of spores (VIII3 and II4) with the D4 dose. Dissections were made 4 days after treatment. The most effective mode of the administration to kill the larvae consists of the injection of spores (strains VIII3 and especially II4) in particular to the highest dose D1. One interesting aspects of our results was that the bacteria disturbed the metabolism of *L. migratoria* since the larvae treated with the low dose showed a loss of weight. Moreover, the vitellogenesis was inhibited at the time of the maturation of the final oocytes in the pre-reproductive phase. An increase in the oocyte resorption during the reproductive phase was observed.

Key words: locust control, *Bacillus subtilis*, *Locusta migratoria*

### Study on the degree of association between different species of Orthoptera in the El-kantara oasis, Algeria

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Because of importance of the locust and grasshopper problem in Algeria, a study of the Orthopteroid fauna was undertaken in the palm plantation of El-Kantara, one of the Algerian Oasis located at 450 km in the south East of Algiers. Three locations were studied: a traditional palm plantation, a modern palm plantation and an uncultivated area. In each of these locations, a study of the flora and of the Orthoptera community was carried out one time a month. The results are exploited using the index of Pearson in order to establish the degree of association between the species of Orthoptera in each location.

Key words: degré d'association, oasis, Elkantara, Orthoptera, palm plantation

### The Locust control Support Project: a tool for the development of concerted initiatives for a sustainable management of locust populations

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The Locust control Support Project, which is being executed by the AGRHYMET Regional Centre, is funded by USAID/West Africa over a three (3)-year period. The overall goal is to reduce the economic impact of damage caused by desert locusts and to minimize/prevent adverse environmental effects of control actions. Activities are carried out in the fields of capacity building, surveillance of outbreak areas, investigation into environmentally-friendly alternative methods in collaboration with national and international institutions.



Key words: *Schistocerca gregaria*, capacity building, Green Muscle®, PAN

## Biological activity of four botanical extracts on the Desert Locust, *Schistocerca gregaria* (Forskål 1775)

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Active ingredients with acridicides properties can be found in several botanical families and various parts of the plants. Their use as biopesticide constitutes a possible alternative to the current large use of chemical pesticides. The biological activity of leave extracts of *Inula viscosa*, *Nerium oleander*, *Salvia officinalis* and *Sapindus utilis* against adults of the Desert Locust, *Schistocerca gregaria*, was studied under laboratory conditions. The results showed a very low, even null, acute toxicity for the Desert Locust. For all these extracts the percentage of the survivors remains higher than 90%. However the differed toxicity results in a significant reduction of the female fecundity and hatchling rate for the eggs. The *Salvia* extracts is particularly harmful regarding Desert Locust vitellogenesis.

Key words: *Schistocerca gregaria*, botanicals, acute toxicity, differed toxicity

## Relation between the food choice of *Schistocerca gregaria* (Forskål 1775) in its solitary phase and the abundance of different plant species in some biotopes of South Algeria

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To evaluate in the field, in the Algerian Sahara, the diet of the Desert Locust (*Schistocerca gregaria*) we compared the range of plant species in the biotopes of this locust and in its faeces. To have a quantitative evaluation we compared the frequencies of the plant species observed in the faeces with their abundances in the field. The frequency a plant species is consumed is estimated by calculating the ratio of the number of adults having consumed the plant species on the number of adults present in the biotope. The Desert Locust in its gregarious phase is known for a long time for its great polyphagia. On the contrary, the solitary Desert Locust expresses a limited polyphagia. The discordance between the consumption of the different plant species and their abundances in the biotope shows that solitary Desert Locusts presents an important food selection. The floristic composition of the biotope influences its diet and limits the possibilities of choice for the locust. The diet differs little according to the sex in the same biotope. It appears that the diet of the Desert Locust depends at the same time on the composition of the plant cover and on the choice it makes in his search for food. The food spectrum of the adults include species of low abundance. The high displacement capabilities of the adults increase the probabilities of a larger choice.

Key words: *Schistocerca gregaria*, Algerian Sahara, diet

## Pattern of distribution of the Desert Locust populations, *Schistocerca gregaria* Forsk. 1775 (Insecta Orthoptera), in Algeria from 1983 to 2000 during recession periods

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A study on the Desert Locust in Algeria was undertaken in a large part of Central and Southern Sahara, regions considered to be high frequencies breeding areas during the winter/spring and summer/autumn reproductions of this locust. We made surveys in spring and autumn, from 1994 to 1998, to characterize Desert Locust populations and their biotopes. These data were supplemented by archives data from the Algerian Plant Protection Institute (INPV, El Harrach). Monthly distribution maps were drawn up. They allowed us to note that adults Desert Locust in the solitary phase, from January to June, are mainly distributed in the Central and Southern Sahara. Just a few records have been made, mainly in March and April, in Northern Sahara. Distribution maps of solitary nymphs follow the same pattern. There is certainly two generations of solitary populations in South Algeria. The first generation take place between March and June in the Central Sahara and the second between September and December in the Southern Sahara. These generations take place in very localised areas; they are not very frequent and depends on the rainfall regime. The presence of new irrigated areas in the North of the Sahara results in new favourable biotopes allowing solitary and transient Desert Locust populations to breed. Some places in Central and Southern Sahara allow more regular reproductions, resulting on some favourable years, in a phase transformation. The situation of the Desert Locust in Algeria depends much on the locust activities in the neighbour countries of West Africa. As a result it is necessary to have a good monitoring and control strategy as well as a good information flow on the locust situation between the countries in order to be able to anticipate the locust events, as far as possible.

**Key words:** *Schistocerca gregaria*, Algerian Sahara, recession period, distribution maps

## History of the Desert Locust problem in Algeria

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The Desert Locust problem in Algeria is very old. Invasions has been reported by Kunckel d'Herculais since year 125 BC. We establish an historical record of the occurrence of this locust in Algeria as well as of the measures undertaken for its control. To deal with the locust problem several organizations were successively created such as the obligatory trade unions for locust control in Algeria, and the National Anti-Locust Office ("Office national antiacridien") hosted in the Agricultural Institute in "Maison carrée" at El Harrach, not far from Alger. Following the creation, in 1951, of the Technical Advisory Committee for locust control by FAO (the Food and Agriculture Organization of the United Nations), several other organizations were established to organize the Desert Locust survey and control in North and West Africa : OCLALAV, Common organization for locusts and birds control, well known locust organization for West Africa; CLCPANO, Commission from FAO to control the Desert Locust in North-West Africa, and recently - established in 2002 - the CLCPRO, Commission for Desert Locust Control in the Western Region. Since the implementation of the preventive control in the sixties, the invasions were definitely less frequent. This is also the result of a better international coordination as well as of a better involvement of the countries concerned by survey operations and preventive control. We stressed the necessity to constitute national collective memories to better control this plague, and to reinforce the international coordination from where the technical and scientific support to the affected countries can be provided.



Key words: *Schistocerca gregaria*, Algeria, history, preventive control, international organisation

## Comparison of the virulence of two strains of *Metarhizium anisopliae* var *acridum* on the Desert Locust, *Schistocerca gregaria*, and effect of temperature on their efficacy

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In Akjoujt, Central Western Mauritania, we compared the virulence, on nymphs and adults of the Desert Locust, of two strains of *Metarhizium anisopliae* var. *acridum* : the IMI 330189 strain and a strain obtain from the Institute for Biological Control (BBA) at Darmstadt (Germany). For the biotests and the test on the effect of the ambient temperatures (variable between 22 and 26,5 °C) on the virulence of the mycopesticide, two doses were used : 1,1 x 10E3 and 5 x 10E4 spores/insect. The IMI 330189 and BBA strains caused, respectively, a mortality of 85 and 95% of the nymphs treated (4th stage). For the adults the mortality, for all doses, is 55%, with the exception of the highest dose of the IMI 330189 strain for which the mortality reach 95%. For the 4th stage nymphs exposed to the ambient temperatures varying between 11,0 and 31,5 °C, mortality was lower than 25%, with the exception of the highest dose of the IMI 330189 strain who kill 73,3% of the nymphs. The exposure of the nymphs treated with the highest dose of the IMI 330189 strain to high temperatures ranging from 32 to 46,5°C during eight hours per day, strongly inhibited the virulence of the mycopesticide and result in a mortality of only 7%. For the test in semi-natural conditions, only the IMI 330189 strain was used at a dose of 5 x 10E12 conidies/ha. For this test, two treatments were undertaken : nymphs and vegetation treated and untreated nymphs placed in a vegetation treated to evaluate the effect of the secondary pick up. In the first case, a mortality of 66% was observed against 41,3% in the second one.

Key words: *Metarhizium anisopliae* var *acridum*, *Schistocerca gregaria*, IMI 330189

## Survival and post embryonnic development of *Zonocerus variegatus* (Orthoptera: Pyrgomorphidae) on the legumes for short fallow in the laboratory

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The introduction of legumes in the *Chromolaena odorata* (Asteraceae) fallow is a strategy to improve the fertility level of short fallows in the humid forest zone of southern Cameroon. This work assesses the effect of these legumes on the survival and post embryonnic development of the grasshopper pest *Zonocerus variegatus* (Orthoptera: Pyrgomorphidae). In this study the effects of 13 monospecifics and eight mixed diets (based on legumes, cassava, Siam weed and *Synedrella nodiflora*) on survival and post-embryonic development of *Zonocerus variegatus* was determined. In each cage (25 x 25 x 30 cm<sup>3</sup>), 20 one-day old larvae were provided with these diets and their survival monitored every two days until all individuals died. The study was undertaken between August 2000 and May 2001 and from August 2001 to September 2002. Results showed that the number of larval stages varied between six and eight according to the diet. Six larval stages were most frequent followed by seven and eight stages. Complete development was obtained on 52 % diets, with a highest frequency for the mixed diets. All the poly-specific diets showed a complete development except *Cajanus cajan* + *Synedrella nodiflora* + *C. odorata*. Development to the adult stage was observed on four mono specific diets: two legumes (*Lablab purpurea* and *C. cajan*), one Euphorbiaceae (*Manihot esculenta*) and one Asteraceae (*S. nodiflora*). Compared to legumes and Asteraceae, *M. esculenta* was the species that resulted in the highest level of survival and development of *Z. variegatus*. The survival rate of *Z. variegatus* was very low at the beginning of the breeding. No difference in survival

was noted between mono and poly specific diets. *C. odorata* and *S. nodiflora* induced late appearance of the different *Z. variegatus* nymphal instars and the appearance times was shorter on legumes. This results indicate that legumes for short fallows affected the survival and post-embryonic development of *Z. variegatus* in the laboratory and may play an important role in the research on control methods against the grasshopper.

Key words: *Zonocerus variegatus*, survival, development, legumes, diets

## Environmental impact of locust control operations in sahelian area : case of the 2004-2005 invasion

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During the agricultural season 2004/2005, some West African countries were concerned about locust outbreaks. Because of the breadth locust control, great quantity of pesticides were used. The side effects of these pesticides were analyzed by taking into account operational phases of treatments, ecotoxicological characteristics of the pesticides and the potential ecological risks. The gap noted compared to the standards of treatment are relative to non respect of the recommended dose of application, a very diversified experiment of workers involved in the operations of treatment and management of pesticides the circulation of none approved pesticides. Chlorpyrifos 240, the main insecticide used against locust caused a mortality of 50 % of *Pimelia senegalensis* which is a natural enemy of insect pests and very common in this zone, in comparison to an untreated zone. This mortality occurred after an overdose of 7 % compared to the standard of treatment. However the Shannon index did not show a significant difference between the treated and untreated zones. A reduction of 46 % of pesticide residues in soil and 51 % in vegetation 72 hours after treatment shows a rather fast degradation of the pesticide which allows a recovery by the

species. In addition, the multiple treatments of sites during locust control did affect the non-target species. *Pimelia senegalensis* population was reduced to 40 % three months after treatment in spite of relatively fast degradation the pesticide in zone Sahelian.

Key words: environmental impact, chlorpyrifos, *Pimelia senegalensis*, locust control, Sahel, pesticides

## Influence of the drought on food selection of the Moroccan locust, *Dociostaurus maroccanus* (Thunberg, 1815) in the Aures region (Algeria)

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A survey was conducted during 1993 and 1994 to determine the food regime of the Moroccan locust, *Dociostaurus maroccanus* (Thunberg, 1815), in the Aures region (Algeria). The plants consumed by the different stages of this locust were identified and quantified. In 1993, the good health of the plant covering the ground resulted in this locust expressing food preferences. While in 1994, the very early drought of the natural plant cover obliged this locust to broaden its host plant range. A plant like *Peganum harmala* L., poisonous to animals, as well as some wing fragments, paws, antennae, buccal pieces and even of whole individuals of aphids *Sitobion fragariae* (Walker, 1848) and *Brachyunguis harmalae* Das, 1918 were consumed extensively by the different locust stages.

Key words: Moroccan locust, *Dociostaurus maroccanus*, food selection, Algeria

## Mechanism of infection and effects of the colonization of eggs of the Senegalese Grasshopper *Oedaleus senegalensis* (Krauss, 1877) by a hyphomycete fungus, *Metarhizium* sp. (Metschikoff, Sorokin)



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In the search for alternative methods to chemical control, the use of the biopesticides against pest locusts is more and more developed. Fungus are the most promising from this new point of view. A local strain of *Metarhizium* sp., virulent against nymphs and adults of the Senegalese grasshopper, *Oedaleus senegalensis*, was experimented against the eggs of this important crop pest of the Sahelian countries of Africa. The mechanisms of adhesion, penetration and germination of *Metarhizium* sp. fungus into the grasshopper eggs was studied. The eggs were infected with a liquid formulation of fungus at a concentration of 340\_105 conidia/ml and observations made in hours and days after infection. The virulence of the fungus strain and its effect on egg hatching was also estimated for various conditions of eggs infection. Results showed a 2,5% of adhesion after 12h and a 90% of penetration and germination after 4 days. At 7 days after infection sporulation is observed for all the eggs. The fungus is more virulent on eggs having a greater moisture content before the infection. *Metarhizium* sp. speed up the egg to hatch out by the germination of hyphae which exert a push on the chorionic envelope and lead to its burst. The micropylar zone of the egg is more sensitive to the action of the fungus.

**Key words:** *Oedaleus senegalensis*, hyphomycetes, *Metarhizium*

## Bio-ecological study of the Orthopteroid fauna of the Tlemcen region (North Algeria)

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A study of the Orthopteroid fauna has been undertaken in the Tlemcen region (North Algeria) in 9

locations of various climatic conditions. 20 species of Caelifera and 2 species of Ensifera were observed. We studied the ecology and diet of the main species. Results have been exploited using various ecological and statistical indices.

**Key words:** Orthoptera, Caelifera, Ensifera, acridids, bio-ecology, Tlemcen

## Importance of *Stipa tenacissima* in the alimentary diet of the grasshoppers of the steppe region of Tlemcen (North Algeria)

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After a bibliographical review of the grass *Stipa tenacissima* (Poaceae) (local name "alfa") and a geographical and climatic presentation of the Sidi Djilali steppe area around Tlemcen (North Algeria), an inventory of the Orthoptera fauna of this region is presented as well as the importance of *Stipa tenacissima* in the alimentary diet of the different grasshopper species.

**Key words:** Orthoptera, steppe, alimentary diet, bio-ecology, pasture

## Space-time dynamics of the Desert Locust in Mauritania 1988-2006 : principal tendencies

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Data on the Desert Locust have been collected and analyzed in Mauritania from 1988 to 1999 and from 2000 and 2006. These data - which represents 50,000 records - have been partially analysed, covering the occurrences and the frequencies of Desert Locust aspect, with regards to the three phases (solitary, transians and gregarious), and the two phenologic stages (nymphs and adults) using a geographical scale of a quarter of square degree and a time of monthly or seasonally basis. Results of these analyses have confirmed tendencies previously shown on the space-time distribution and population dynamics as well as localization of locust high frequency zones. New high frequency zones with different degrees of interest have been identified. These results have a positive impact to improve field survey organisation as well as preventative and curative Desert Locust control in the country.

Key words: Mauritania, Desert Locust data, high frequency areas, population dynamics

### **The African Emergency Locust Project : an example of innovating approach in the financing and the integrated management of the Desert Locust problem in the Sahel**

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The African Emergency Locust Project concerns 7 country in Western and central Africa (of which 4 countries are on the front line- Mauritania, Niger, Mali, Tchad, and 3 countries of invasions- Senegal, Burkina Faso and Gambia) and was prepared in the emergency between September and December 2004. In that time, these countries have faced unpredictable locust invasions destroying within few weeks most of the agricultural and pastoral productions of the region. Facing this situation, the World Bank had responded

positively to the call of governments and international community through FAO. The Bank had allowed to these countries an IDA credit of 60 millions USD as a contribution to this international effort. The project objective was to controlling 2005 infestations and preventing any future invasion threats in the 7 affected-countries. This project contributed- in addition to FAO technical support, and also assistance from the donors - to step-down locust threat in 2004 and 2005 and better prepare the teams to preventing and how to facing new invasions. The setup of this project had integrated, for the first time, the funding a support to develop preventive and curative capacities in locust control in one hand, and in another hand, rehabilitation of populations production capacities affected by the pest. Roughly, a quarter of the fund was granted to this last issue. In the mean time, the implementation of the project since 2005 was an opportunity to establish an efficient coordination with other projects, implemented programs, institutions and partners concerned on national, regional and international level. One particularity of this project was also the integration aspect and regional coordination that permitted to all concerned countries to practicing concretely the useful exercise of scheduling and of concerted assessment. This institutional and financial setup is described in detail in this article.

Key words: Locust, preventive, curative, rehabilitation, World Bank project

### **Contribution to the study of locust and grasshopper species in the Constantine area (Algeria): inventory, bioecology, morphometry and diet**

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An inventory of locusts and grasshoppers in the area of Constantine (Algeria) revealed the presence of 30 different species, which are mainly distributed in four families: Acrididae, Pyrgomorphidae, Pamphagidea and Tetrigidae. Acrididae is the best represented fam-



ily, as well by the number of species as by the number of individuals. Various morphometric measures were made on males and females of the tree locust *Anacridium aegyptium* L. The diet spectrum of *Calliptamus barbarus barbarus* Costa was studied and is mainly composed of *Hordeum* sp. and *Triticum aestivum* (Poaceae). Diet of some other grasshopper species (i.e. *Ochrilidia geniculata* Bolivar) was also studied.

Key words: Algeria, locusts and grasshoppers, ecology, morphometry, diet

### **Efficacy of three strains of *Metarhizium anisopliae* var. *acridum* (DPV5, DPV10 et DPV15) over *Locusta migratoria* and *Zonocerus variegatus* compared to the strain of reference IMI 330189 Green Muscle TM in Sénégal**

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In Senegal, locusts and grasshoppers are responsible for many crop losses. Control operations use only chemical pesticides that most of the times are highly toxic and associated with ecological threats and health risks. In order to contribute to the development of biological control measures, the efficacy of three local strains of *Metarhizium anisopliae* var. *acridum* on *Locusta migratoria* Reiche & Fairmaire and *Zonocerus variegatus* Linné was studied. Strains (called DPV5, DPV10 and DPV15) were isolated by the Entomological Laboratory based in the Crop Protection Department (DPV) of Senegal. The efficacy was compared with the *Metarhizium* IMI330189 strain discovered by the LUBILOSA project in Niger and marketed under the brand name of Green Muscle<sup>TM</sup>. It was assessed by the maximum rate of mortality but also by the lethal time (LT50). The highest mortality was registered

with DPV5 (1,2 107conidia/ml) : 92% on *Locusta* and 75% on *Zonocerus*. On *Locusta*, the strain IMI330189 seems to be more virulent (LT50 6-7 days) than DPV5 (LT50 7-8 days) DPV10, and DPV15. On *Zonocerus*, DPV5 and DPV10 (both LT50 8 days) were more pathogenic followed by IMI strain and DPV15. While DPV5 and IMI330189 remained more pathogenic on *Locusta*, DPV5 and DPV10 are more promising on *Zonocerus*. This study, showing the difference of vulnerability between the locust *Locusta* and the grasshopper *Zonocerus*, proved that DPV5 is a promising strain and could be proposed as an alternative to Green Muscle<sup>TM</sup>. However, further investigations in order to find out more pathogenic strains are recommended.

Key words: *Metarhizium anisopliae* var *acridum*, *Locusta migratoria*, *Zonocerus variegatus*, virulence, efficacy

### **Effect of plant densities on phase shift of the Desert Locust *Schistocerca gregaria* Forsk.**

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Field and semi-field studies on phase shift of the Desert Locust were realized in Sudan and ongoing studies in Mauritania. The first studies conducted in field arenas were carried out in Red Sea Coast from 2003 to 2006. The different densities and configurations tested revealed some large variations in the pace of development of gregarious traits of the Desert Locust *Schistocerca gregaria* and confirmed that, a detailed quantitative understanding of the relation between desert plant configurations and the rate of phase change is possible in manipulated arena experiments. A second study on Desert Locust population dynamics was carried out in Mauritania during the last outbreak in October 2006. Two main parameters were used to characterize

locusts : coloration shift and morphometric measures. The results could form the basis of a more accurate characterization of biotopes prone to gregarisation and development of an area-wide locust outbreak model. This would facilitate the development of an early warning system critical for a preventive intervention strategy.

Key words: gregarisation, host plant, simulation model, solitary locusts, coloration, morphometrics.

## Orthoptera communities of the southern area of Aurès, in southern Algeria

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A study of the Orthopteroid fauna was carried out in the Aurès region of Algeria. Fauna was sampled at six locations: two palm plantations (at Chetma and Droh), two uncultivated areas (at Chetma and M'chouneche), and two rocky areas (at Ain Zaâtout and M'chouneche). Samples were taken every 15 days from July 2002 to June 2005. Thirty five species of Orthoptera were identified. Twelve (12) species were found in the palm plantation at Chetma (with a 85 % plant cover : 40% palm trees, 20% fruit trees, 15% market gardening and 5% weeds). Fifteen (15) species were observed in the palm plantation at Droh (with a 80% plant cover including 60% of palm trees, 10% of fruit trees and 10 % of weeds). The number of Orthoptera species was lower in the uncultivated areas : 10 species at M'chouneche (20% plant cover with a majority of halophilous species) and 5 species at Chetma (10% plant cover, mainly weeds). In the rocky areas we notice a large variation in the total richness of the Orthoptera fauna: 15 species at Ain Zaâtout (40% plant cover including 25 % of olive-trees and 15 % of weeds) but only 5 species in the rocky zone at M'chouneche (20% plant cover, mainly weeds). The specific diversity of the Orthoptera communities in the Aurès area is in close correlation with

the structure and composition of the plant cover in each of the locations studied.

Key words: Algeria, Aurès, specific diversity, Orthoptera communities, plant cover

## Diet of *Aiolopus thalassinus* (Orthoptera: Acridinae) in the Oasis of Biskra, Southern Algeria

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*Aiolopus thalassinus* (Fabricius, 1781) is a grasshopper from humid areas which is distributed, in Algeria, from the Mediterranean coast in the North to the saharian oasis in the South. We studied the diet of this species by analysing the composition of the faeces (containing epidermic fragments of the vegetal species consumed). Four biotopes were studied from mid-February to early April 2005. Despite the richness of the herbaceous layer, few vegetable species were found in the faeces of *Aiolopus thalassinus*. Among the 15 species consumed by nymphs and adults, we find 9 Poaceae, 2 Umbelliferae, 2 Chenopodiaceae, 1 Malvaceae, with a predominance of the Poaceae *Cynodon dactylon*. (L.) Pers.

Key words: *Aiolopus thalassinus*, diet, faeces, Algeria, oasis

## Post-campaign assessment of desert locust pesticide pollution at loading sites in Senegal and Mauritania

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During the Locust control campaign of 2003-2005 in West- and N.W. Africa, c. 13 million litres of pesticides were sprayed against Desert Locust, *Schistocerca gregaria* (Forsk.) nymphs and adults. The main products used were chlorpyrifos and malathion, both organophosphates. In 2006, two years after the height of the campaign an inventory was conducted in five Sahelian countries to assess the extent of soil pollution due to accidental leakage or spillage during the campaign. The inventory and subsequent risk assessment was made by the so-called QUEST teams (QUality and Environment Survey of Treatments) in close collaboration with the Africa Stockpiles Programme (ASP). Target sites were aerodromes on which spray planes were loaded and sites where large quantities of pesticides were stored or transferred. This paper is limited to Senegal and Mauritania, the only countries from which soil residue analysis and subsequent risk analysis have been completed. The sites were assessed through visual inspection and interviews with campaign field officers, recording on specially designed forms. The forms covered all aspects needed to assess environmental risks. It was based on the methodology developed by ASP, but adapted to the specific situation of soil pollution. Soil samples from 17 sites in Senegal and 7 sites in Mauritania were taken and stored frozen until analyzed. If needed two depths were sampled: surface (0-10 cm) and sub-surface (10-25 cm) to assess infiltration rates. Three pesticides (chlorpyrifos, fenitrothion and malathion) were specifically analyzed by gas chromatography (GC) and confirmed by GC-mass spectrometry. All sites examined by residue analysis were contaminated, ranging from slight (0.5-10 mg of pesticide/kg of soil) to very heavy (> 1000 mg of pesticide/kg of soil). The size of polluted areas ranged from one to 3500 m<sup>2</sup>. Some of the sites smelled badly, up to 1500m distance. Although most sites were fenced, no hazard warning signs were present, and many sites were close to habitations and accessible to humans and livestock.

Key words: Desert Locust, pesticide pollution, Senegal, Mauritania

## A study of the acridid fauna of the Sétif area in Algeria

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Many acridid species can become serious crop pests when meteorological conditions are favourable to their development. The aim of this study was to acquire a better knowledge of the grasshoppers in the Sétif area which has been very little studied. We collected in this region 32 acridid species belonging to three families (Pamphagidae, Pyrgomorphidae and Acrididae) and distributed into 16 genus (*Pamphagus*, *Ocneridia*, *Acinipe*, *Euryparyphes*, *Pyrgomorpha*, *Pezotettix*, *Caliptamus*, *Acrida*, *Aiolopus*, *Dociostaurus*, *Omocestus*, *Ochrilidia*, *Acrotylus*, *Oedipoda*, *Sphingonotus* and *Thalpomina*). We show, using Shannon-Weaver and equitability indices, that the studied biotopes contains diversified and well structured acridid communities. A study of the spatial distribution of the species studied reveals four main types of distribution: contagious (which is the most frequent), regular, random and uniform.

Key words: biodiversity, acridid, Algeria, Sétif

## Control of the Desert Locust by an entomopathogenic fungus

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The Desert Locust, *Schistocerca gregaria*, constitutes a permanent threat for the agriculture of many countries of Africa. To prevent their damages an integrated control strategy is generally recommended. To this end we studied the possibility to use a local strain of the entomopathogenic fungus *Beauveria bassiana*, isolated from the Reghaïa marsh, in the east of Alger. In this study, we applied to 5th instar hoppers of *S. gregaria* of the same age, by ingestion, 3 doses of the fungi *B. bassiana* : D1, D2 and D3 with respectively  $1.64 \times 10^7$ ,  $1.64 \times 10^6$  and  $1.64 \times 10^5$  spores/ml. Control was treated only with distilled water. With the highest dose D1, all the treated individuals died in the 6th day. With the low dose D3, 100% mortality was recorded only at the 9th day. The LC50 value was estimated at  $6.91 \times 10^5$  spores/ml. We studied the effect of this fungus on the tegument of the Desert Locust. A first batch of hoppers was treated by ingestion with the LC50 dose and a second batch, for control, only with distilled water. A microscopic observation of the tegument, five days after treatment, reveals notable differences in the cuticle structure for the treated individuals compared to the control.

Key words: *Schistocerca gregaria*, *Beauveria bassiana*, mortality, histology, tegument

## EMPRES Program: Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases. Desert Locust component in Western Region

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EMPRES program is conceived to assist countries in their efforts to combat and to prevent Desert Locust plagues and furthermore to set up a regional collaboration. The implementation of the Phase I of this EMPRES program in western region (Western Africa and North-West Africa), formally decided in 2001 for a period of 4 years, was delayed until 2006, essentially due to the lack of funding. This program must allow

the concerned countries to lead, in a coherent and coordinated way, the preventive control actions against the Desert Locust, at national, regional and international levels. This approach was consolidated after the creation in 2002 of the Western Region Desert Locust Commission, CLCPRO, which includes all the countries members of EMPRES-WR program. This creation is considered as an important institutional step forward in the region. The global objective of the EMPRES-WR program is the reduction of the risks of the Desert Locust invasion which will contribute to the fight against poverty, food security of the populations of this region and the protection of the environment. In this frame, the EMPRES-WR Program aims at strengthening *early warning*, *early reaction* and *operational research*. To reach these results, the program has the role of developing an efficient system of preventive control against Desert locust based on (1) strong national locust units with an autonomy clearly defined (2) efficient regional coordination (3) the progressive installation of the appropriated mechanisms to ensure, at long term, the sustainability of the preventive control strategy. The funding of the program is provided by African Development Bank, French Cooperation, USAID, Libya, FAO, CLCPRO and the support of the World Bank AELP Project and IFAD Project which is intended to reinforce the protection of the environment. The external contributions are basically devoted to strengthening the capacities of the sahelian countries containing Desert locust gregarization areas, these countries are known as front line countries (Mali, Mauritania, Niger and Chad).

## Biological activity on the Desert Locust of extracts from seeds or leaves of *Peganum harmala* at different phenological stages

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Desert locust (*Schistocerca gregaria*) presents a major obstacle for economical development in many countries. Morocco is subject to periodical locust invasions. Control relies on the use of conventional insecticides. These products are efficient but many have detrimental environmental effects. Much research focussed towards exploration of new products to control locusts, efficiently and with less harmful effects on the environment. During the 1994-95 upsurge in south Morocco, we observed various plants - such as *Peganum harmala* - not consumed by the Desert Locust. The present work reports the effects of extracts of *P. harmala* seeds or leaves at the vegetative, floral and fructification stages, on the mortality and reproductive capacities for young females of the Desert Locust under laboratory conditions. The results indicate that a high mortality rate is obtained with seeds extracts and leaves extracts at the floral stage. Furthermore, we have noted, for all the treated females, a decrease in physical activity (immobility, trembling of appendages...), in food intake, weight, and a loss in water in the form of wet faeces. These perturbations were not important in the females treated with leaves extract at the fructification stage. An important delay of sexual maturity was observed in females surviving from the treatment with extracts from seeds or from leaves at the vegetative stage; we notice also a decrease in both fecundity and hatching rate. Differences in the nature of indolic alkaloids in the leaves, at their different phenological stages, and in the seeds may explain the results obtained.

Keys words: *Schistocerca gregaria*, mortality, reproduction, *Peganum harmala*, phenological cycle, leaves, seeds

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