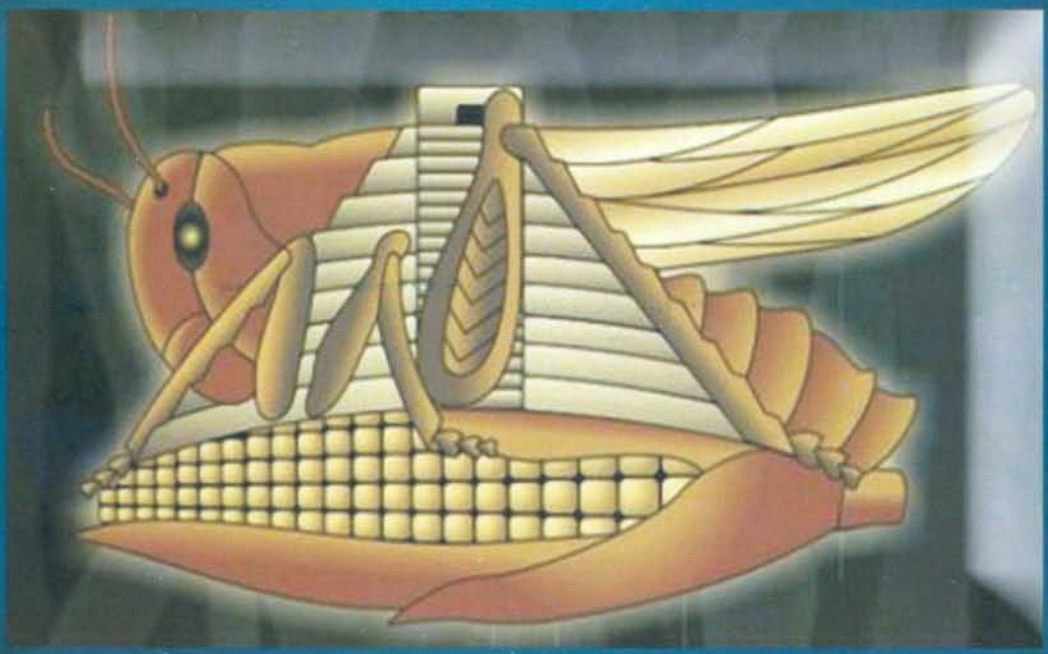
TALLER
CONTROL BIOLÓGICO Y MANEJO
DE LA LANGOSTA CENTROAMERICANA
(*Schistocerca piceifrons piceifrons* WALKER)

Noviembre 11 - 13 de 2007
Mérida, Yucatán



XXX Congreso Nacional
de Control Biológico

C. A Diversidad Biológica

SEP
SECRETARÍA DE EDUCACIÓN PÚBLICA

Sistema Nacional de Educación Superior Tecnológica
Dirección General de Educación Superior Tecnológica

CD. VICTORIA

A BRAZILIAN STRATEGY TO CONTROL THE MATO GROSSO GRASSHOPPER USING A MYCOINSECTICIDE

M. Lecoq[1], B. Magalhães[2], M. Faria[2], W. Guerra[3]

[1]CIRAD, Locust Ecology and Control, TA A-50/D, In ternational Campus of Baillarguet, 34398 Montpellier Cedex 5 – France. E-mail: lecoq@cirad.fr
[2]Embrapa, Parque Estação Biológica – Final W3 Norte, Brasília, DF, CEP 70770-901- Brazil.E-mail:bonifacio.magalhaes@embrapa.br, faria@cenargen.embrapa.br
[3]Ministério da Agricultura, Pecuária e Abastecimento, Superintendência Federal de Agricultura, Pecuária e Abastecimento em Mato Grosso, Alameda Molina S/Nº, Várzea Grande,MT, CEP 78115-901 – Brazil. E-mail: wanderleidias@agricultura.gov.br

1. INTRODUCTION

Two important points to implement a biological control program for grasshopper with a mycoinsecticide are the efficacy tests of the biological product and its safety to non-targets organisms. In addition, it is crucial to define a control strategy to optimize the potential of the product (Lomer et al 2001).

Each species of grasshopper may represent a specific problem and the control strategy should be adapted for each case. As an example, it was taken the case of the grasshopper from Mato Grosso, *Rhammatocerus schistocercoides* Rehn (Orthoptera: Acrididae), a well known graminivorous species in Mato Grosso state, Brazil. In the 1990's, a research project conducted by Embrapa and CIRAD provided a better understanding of the biology, ecology and the causes of its outbreaks (Lecoq 2000; Miranda et al 1996). This pest was adopted as a model system in the development of a mycoinsecticide based on the entomopathogenic fungus *Metarhizium anisopliae* var. *acridum* by Embrapa, the Brazilian Agricultural Research Corporation (Magalhães et al 2000; 2001).

1. INVASIONS: HISTORY AND CONTROL STRATEGIES

Rhammatocerus schistocercoides became a serious pest in Brazil particularly in the 1980's as a result of the agricultural development in different

areas in the states of Mato Grosso and Rondônia. In face of the magnitude and severity of the outbreaks registered in 1984 and 1985, a tentative chemical control effort took place. The rapid populational increment, its significative migrations and the successive accelerated passages of swarms, hampered the producers to protect their crops. To avoid a disaster, they asked for federal government help.

Chemical insecticides were donated to growers to protect their crops against nymphal bands. However, it was necessary several air sprays as an alternative approach since the terrestrial treatments were not preventing their losses. From that time on, the control was coordinated on a national scale. The National Program for Control of Grasshoppers was created in 1986 by the Ministry of Agriculture, Livestock and Food Supply (MAPA). The main partners were Embrapa, Emater, Agriculture Secretary and MAPA Offices in each affected state. This program was devoted to control grasshoppers in the whole country, particularly *R. schistocercoides* in Mato Grosso and Rondônia. These efforts were partially sponsored by the Food and Agriculture Organization of the United Nations (FAO). Several consultants were hired to manage and organize campaigns of control (Lecoq e Pierozzi 1994).

Those consultants recommended that the treatments should be directed to protect crops in localized foci in the plantations and surrounding areas. However, the majority of nymphs were in pastures and savannah areas. They also recommended to establish an information center in Cuiabá, Mato Grosso's capital; to use all available means to localize outbreaks by control teams, growers, and the establishment of a communication network; and to use aircrafts and helicopters to spray chemical insecticides with low toxicity to human, cattle, and crops.

A two-phase control strategy was devised by Curti and Britto (1987). Firstly, the treatment was directed to nymphs by terrestrial spraying during the rainy season and aimed to protect the crops. Another phase involved air spraying against adults during the dry season to control swarms.

The National Program for Control of Grasshoppers allowed developing an emergency strategy more efficacious, although, as we will see below, this strategy

should evolve to consider the recent research results. In the beginning, the Program had a very positive balance, reducing the outbreak areas, protecting the crops in different affected regions, allowing an increase in the information on this pest, entirely unknown by the time of its first outbreaks (Lecoq e Pierozzi 1994). The Program became inactive in 1989. As a consequence, an increase in the grasshopper population in the 1990's was made possible. New control measures were needed until 1994. After that, the problem became less important due to extensive cropping of soybean and other non-gramineous species, but the monitoring system was permanently alert.

In our opinion, control of the Mato Grosso grasshopper could be performed in a systematic way instead of temporary measures in reaction to outbreaks. It would be desirable to adopt a continuous and preventive control supported simultaneously by a regular monitoring of the grasshopper population and sound knowledge of its ecology. The information gathered during the outbreaks in the 1980's widely increased our current understanding of the pest. The knowledge acquired allows now to establish the basis for a long preventive control strategy in which the use of a mycoinsecticide could certainly become a real option in the future.

3. HOW A MYCOINSECTICIDE FITS IN THE STRATEGY TO COMBAT THE GRASSHOPPER

In all the operational measures to control the Mato Grosso grasshopper, insecticides should always be formulated to allow ULV (ultra low volume) applications. One advantage of this technique is that water is not required as compared to the conventional application of EC's (emulsifiable concentrates). The ULV and OF (oil miscible flowable concentrate) formulations make possible to cover one hectare with one liter or less of the product. Besides that, during the rainy season these oily formulations provide higher adherence to leaves and prevent insecticide from being removed by frequent rains.

The use of chemical insecticides against grasshopper in Brazil can cause problems as already registered in the recent past. Since 1984, the massive use of insecticides to control *R. schistocercoides* in Mato Grosso provoked controversy among people responsible for the control operation at that time. On one side there were the growers and on the other the Indian defenders. In fact, there are divergent opinions regarding the use of chemical insecticides. For some, chemical treatments could not be avoided. The application of chemical insecticides was considered as the only control method available, and the products utilized showed low toxicity for human and the environment if applied according to the recommendations. Nevertheless, similarly to the insecticide toxicity, issues such as methods of treatment, magnitude of the treated areas, pollution problems, and eventual sprays in Indian reserves raised many controversies at that time.

For all these reasons, a substitution solution to the chemical insecticides was needed. This solution can now be offered through the use of a mycoinsecticide based on conidia of the entomopathogenic fungus *M. anisopliae* var. *acridum*, prepared as an oil formulation. These products are in development in different regions of the world, particularly in Australia and Africa (Lomer et al 2001, Faria and Wraight 2007). In Africa, the "Green Muscle" was developed by the LUBILOSA project and, after tested in large scale. It is now commercially available. In Australia, another mycoinsecticide - the "Green Guard" – is already included in the strategy to control grasshoppers by the Australian Plague Locust Commission.

In the case of Brazil, the research project conducted by Embrapa/CIRAD from 1992-1996 concluded that the utilization of a mycoinsecticide would be the most promising alternative to control *R. schistocercoides* (Miranda et al 1996). The project recommended the development of a fungus-based product to replace the chemical insecticides used against grasshoppers in Mato Grosso. This is particularly interesting considering the environment, possible preventive control, and the possibility to conciliate the interest of growers and Indian populations. The project also remarked that the grasshopper from Mato Grosso is certainly a very adequate target for such a product. The main reasons include the local ecological

conditions with high humidity, the insect biology with only one generation per year, and a long nymphal cycle of approximately 6 months.

The strategy now suggested relies on the control of nymphs. The main reason is that the nymphal bands are smaller than adult ones, more sensitive to control measures, and occur during the rainy season when environmental conditions favor fungal infections. Therefore, there will be need for fewer product doses and applications, and consequently the treatment would be less expensive.

The nymphal bands are easier to control than the adult swarms since the nymphs will not fly away with the spraying equipment approach. Under this view the most favorable time for application is that immediately after the nymph eclosion, starting on November.

The adult swarms, on the contrary, occupy a surface considerably larger than nymphs do. For example, a 1,000 m^2 young nymphal band will generate a swarm occupying a surface of 20 or 30 hectares when flying during the day. The adults are more resistant to insecticides and need a higher dosage of the active ingredient per hectare. Finally, adults are able to fly away by the approaching of the spraying equipments and escape from the application. Consequently there may be need for nocturnal applications.

A mycoinsecticide may not totally replace the traditional insecticides, but can occupy a conspicuous place among the available options. The inocuity of the product to the environment was demonstrated by Foucart et al (2007). Those results reinforce the idea that the product could be used effectively in zones with natural vegetation owned by private growers and even in the Indian reserves where the use of chemical is forbidden or highly restricted.

The main limitation for the use of mycoinsecticides is related to the current cropping of soybean and other non-preferential species in the natural habitat of the Mato Grosso grasshopper. However, this condition may be changed, if for economic reasons, gramineous crops reach the same status of decades ago. For instance, cultivation of sugarcane in the Brazilian Midwest to boost ethanol production is being discussed by large corporations. Another problem is the

reduced capacity of biocontrol companies to supply all conidia necessary for a control company, particularly considering the long recession periods of the pest. This limitation can be minimized through the development of technical and formulated products with high capacity of storage – at least 2-3 years at room temperature.

4. REFERENCES

Curti, J.B.; Britto, J.S. 1987. National Program of Locust Control. Ministério da Agricultura/SDSV. Brasília. 14 pp. [not published].

Faria, M.; Wraight, S. Mycoinsecticides and mycoacaricides: A comprehensive list with worldwide coverage and international classification of formulation types. Biological Control [in press].

Foucart, A. ; Mancet, F. ; Silva, J. ; Lecoq, M. ; Faria, M. ; Schmidt, F. 2007. Impacto de um micoinseticida contra o gafanhoto do Mato Grosso sobre insetos não-alvo. In: Bioinseticida e Gafanhotos-Praga. Relatório final do projeto "Desenvolvimento de bioinseticidas para controle de gafanhotos-praga no Brasil". Bonifácio, B.P. e Lecoq, M. (eds.). Brasília: Embrapa Recursos Genéticos e Biotecnologia / Montpellier, França: CIRAD [in press].

Lecoq, M. 2000. How can acridid population ecology be used to refine pest management strategies ?, p. 109-129. In: "Grasshoppers and Grassland Health. Managing Grasshopper Outbreaks without Risking Environmental Disaster". Lockwood, J.A., Latchininsky, A.V. e Sergeev, M.G. (eds.), Nato Science Series 2. Environmental Security - Vol. 73, Kluwer Academic Publishers, Dordrecht, The Netherlands. 221 pp.

Lecoq, M.; Pierozzi Jr., I. 1994. *Rhammatocerus schistocercoides* (Rehn, 1906), criquet ravageur des Etats du Mato Grosso et du Rondônia au Brésil. Essai de synthèse bibliographique. CIRAD-PRIFAS, Montpellier, France. 89 pp.

Lomer, C.J.; Bateman, R.P.; Johnson, D.L.; Langewald, J.; Thomas M. 2001. Biological control of locusts and grasshoppers. *Annual Review of Entomology*. 46: 667-702.

Magalhães, B.P.; Lecoq, M.; Faria, M.R.; Schmidt, F.G.V.; Guerra, W.D. 2000. Field trial with the entomopathogenic fungus *Metarhizium anisopliae var. acridum* against bands of the grasshopper *Rhammatocerus schistocercoides* in Brazil. Biocontrol Science and Technology 10: 427-441.

Magalhães, B.P.; Faria, M.R.; Lecoq, M.; Schmidt, F.G.V.; Silva, J.B.T.; Frazao, H.S.; Balança, G.; Foucart, A. 2001. The use of *Metarhizium anisopliae* var. *acridum* against the grasshopper *Rhammatocerus schistocercoides* in Brazil. Journal of Orthoptera Research 10:199-202.

Miranda, E.E. ; Lecoq, M. ; Pierozzi Jr., I. ; Duranton, J.-F. ; Batistella, M. 1996. O gafanhoto do Mato Grosso. Balanço e perspectivas de 4 anos de

pesquisas. 1992-1996. *Relatório final do* projeto "Meio Ambiente e Gafanhotos Pragas no Brasil". Embrapa-NMA, Campinas, Brasil / CIRAD-GERDAT-PRIFAS, Montpellier, France. 146 pp.