FIGHTING THE LOCUSTS... SAFELY

PESTICIDES IN DESERT LOCUST CONTROL: BALANCING RISKS AGAINST BENEFITS

THE BATTLE AGAINST THE DESERT LOCUST IS NOT WITHOUT **RISKS**

This brochure presents the human health and environmental activities of FAO's Emergency Centre for Locust Operations (ECLO).

ECLO managed emergency assistance to countries affected by the major upsurge in Desert Locust numbers that occurred in 2004/2005, mainly in western Africa.

Donors approved US$80.6 million to fight the locust through FAO's technical assistance in 18 countries. Financial contributions were made by the European Commission, FAO's Technical Cooperation Programme, France, the Netherlands, Canada, Italy, USA, Saudi Arabia, Japan, United Kingdom, African Development Bank, IFAD, Islamic Development Bank, Sweden, Spain, Germany, Finland, Belgium, Norway, Austria, Portugal, Agence intergouvernementale de la francophonie, Luxembourg, Australia, Ireland, Greece, UNDP and the Czech Republic.

ECLO assistance to the affected countries included pesticides, spray aircraft, locust control and communication equipment, environmental monitoring and technical advice.

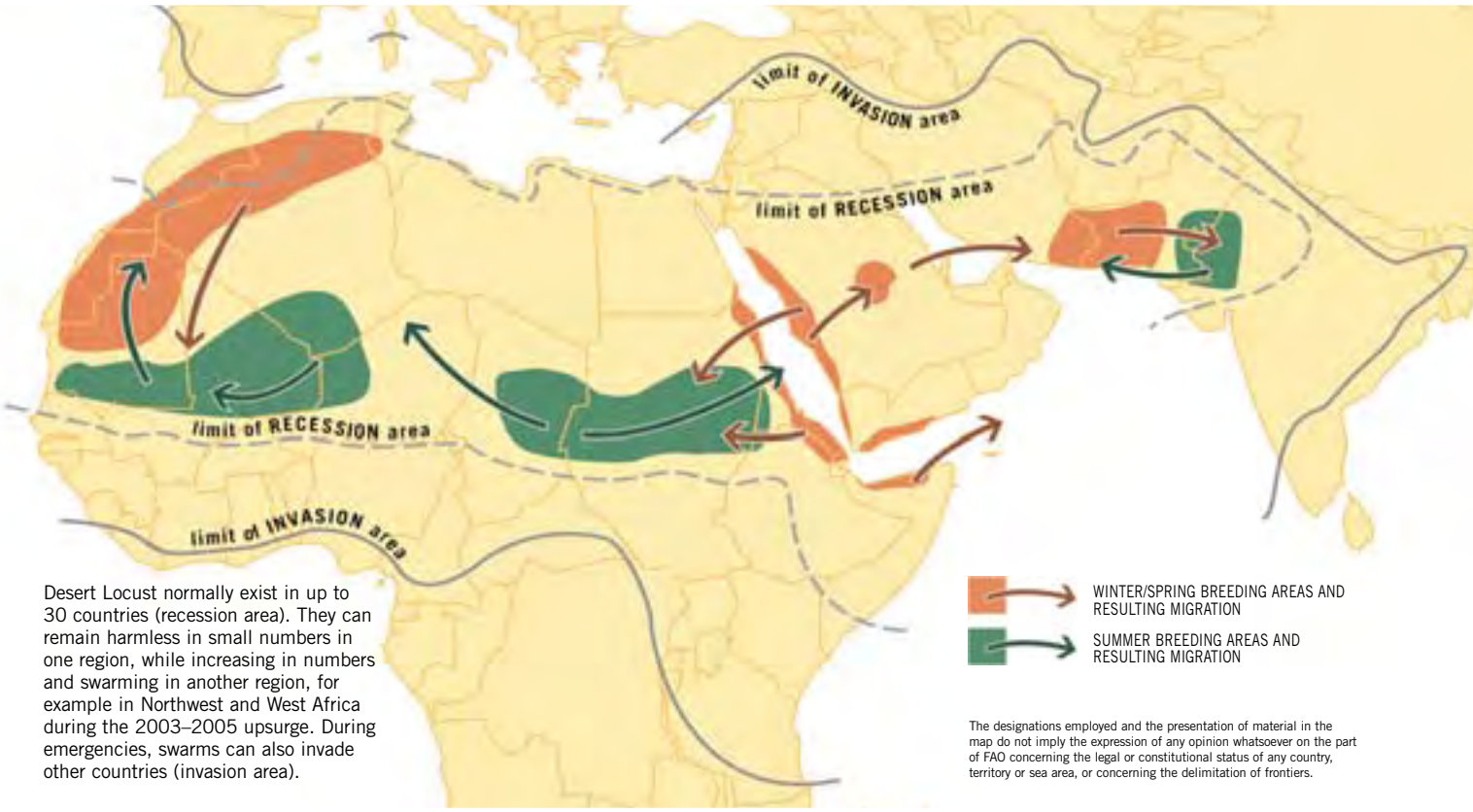
ECLO operations continue until it is certain that each locust emergency is over. Long-term activities promoting preventive control of the Desert Locust under the EMPRES (Desert Locust) Programme are handled by FAO's Locust and Other Migratory Pests Group.

DESERT LOCUST UPSURGES CAN CAUSE SIGNIFICANT AND WIDESPREAD CROP LOSSES. FOOD SECURITY AND EXPORT EARNINGS MAY ALSO BE SERIOUSLY THREATENED IN AFFECTED AREAS.

Consequently, it is not surprising that extensive control efforts are mounted whenever hopper bands or swarms of the Desert Locust develop in or invade a country. Applying chemical pesticides is still the principal approach used in Desert Locust control. However, chemical pesticides may have adverse effects on human health and the environment. The risks of a locust plague therefore need to be continuously balanced against the risks of using pesticides.

A serious Desert Locust upsurge developed in West Africa in late 2003, and by mid-2005 had affected 26 countries in Africa, the Near East and southern Europe.

Nearly 13 million ha of Desert Locust infestations were treated with pesticides from October 2003 to September 2005.



Desert Locust normally exist in up to 30 countries (recession area). They can remain harmless in small numbers in one region, while increasing in numbers and swarming in another region, for example in Northwest and West Africa during the 2003–2005 upsurge. During emergencies, swarms can also invade other countries (invasion area).

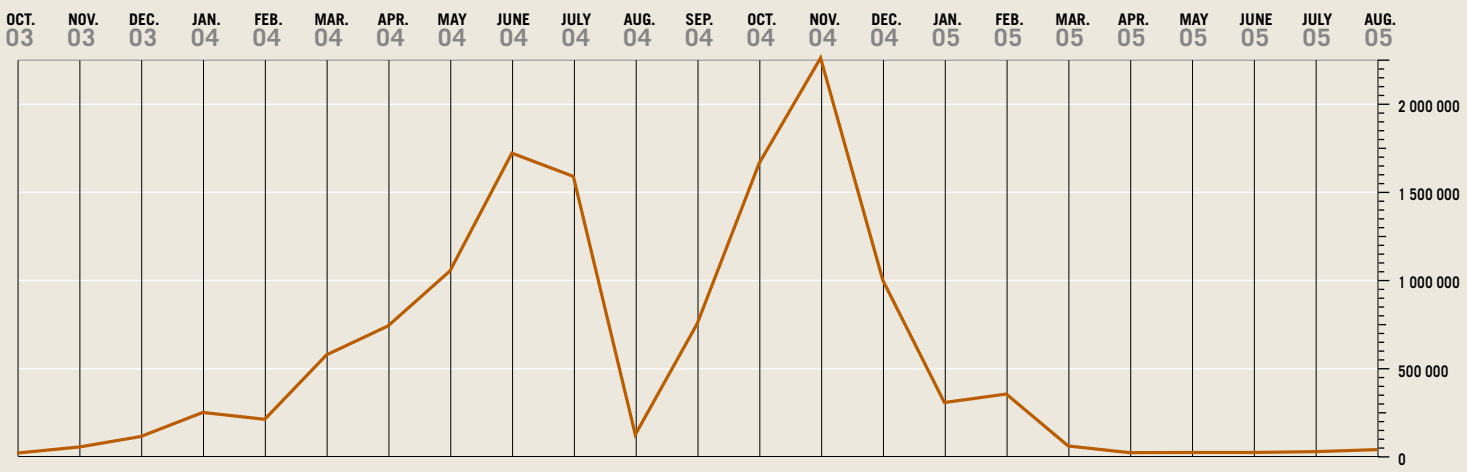
WINTER/SPRING BREEDING AREAS AND RESULTING MIGRATION

SUMMER BREEDING AREAS AND RESULTING MIGRATION

The designations employed and the presentation of material in the map do not imply the expression of any opinion whatsoever on the part of FAO concerning the legal or constitutional status of any country, territory or sea area, or concerning the delimitation of frontiers.

MONTHLY NUMBER OF HECTARES TREATED WITH PESTICIDES DURING THE DESERT LOCUST UPSURGE FROM 2003 TO 2005

AT THE PEAK OF THE UPSURGE, MORE THAN 1 MILLION HA WERE TREATED EVERY MONTH



FAO STRIVES TO MINIMIZE THE USE OF PESTICIDES AGAINST THE DESERT LOCUST AS MUCH AS POSSIBLE. THE ORGANIZATION PROMOTES A PREVENTIVE CONTROL STRATEGY THROUGH A SPECIAL PROGRAMME: THE EMERGENCY PREVENTION SYSTEM FOR TRANSBOUNDARY ANIMAL AND PLANT PESTS AND DISEASES (EMPRES) – DESERT LOCUST COMPONENT.

EMPRES encourages intervention in the early stages of the development of a locust outbreak. This reduces the amount of pesticide to be applied because locusts are only present in relatively small areas. As an outbreak continues to develop first into an upsurge and then into a plague, more and more countries are affected and much larger areas need to be treated in order to control the locusts.

Nevertheless, for various reasons, a preventive strategy may not always be effective. Access to infested areas may be limited because of insecurity; financial and human resources cannot always be mobilized quickly enough to control an outbreak in time; or weather and environmental conditions are unusually favourable for the development of the locusts so that the national control capacity is overwhelmed. Therefore, it is likely that Desert Locust units will occasionally need to cope with particularly large infestations, and use significant quantities of pesticide.

As a result, FAO has initiated applied research into control methods that are less hazardous to the environment, such as biological control and barrier treatments. The Organization has also assisted governments of countries affected by the Desert Locust to set up pesticide management and quality control systems for control operations. Such actions help to increase the quality of pesticide formulations and the efficiency of the control operations and to reduce the risks for control staff, local people and the environment.

The EMPRES Programme is further explained on page 8.

QUALITY CONTROL

FROM THE **FACTORY** TO THE **FIELD**

FAO ATTEMPTS TO ENSURE QUALITY CONTROL THROUGHOUT THE ENTIRE LIFE OF THE PESTICIDES USED IN CONTROL OPERATIONS.

PRECAUTIONARY STEPS IN THE USE OF PESTICIDES AGAINST THE DESERT LOCUST

- SELECTION
- PURCHASE
- STORAGE
- TREATMENT
- MONITORING
- CLEAN-UP AND DISPOSAL
- ALTERNATIVES

This already starts with the selection of the pesticide, its formulation quality control and the control technique. It continues with the purchase of the product and its transport to the affected country and to the spray site. The greatest risks occur during storage, in-country transport and the various stages of field control operations; a great deal of attention is given to monitoring and reducing risks during loading, handling and spraying of pesticides. Pesticide storage, periodic formulation quality control, and eventual disposal of empty pesticide drums need to be carried out with minimum risk to the environment and the human population.

The remaining part of this brochure explains in more detail what can be done to ensure the quality of Desert Locust control and reduce the risks for human health and the environment.

SELECTING THE APPROPRIATE PESTICIDE AND CONTROL TECHNIQUE

PESTICIDES TO BE USED IN CONTROL CAMPAIGNS SHOULD BE EFFECTIVE AGAINST THE DESERT LOCUST AND HAVE MINIMAL IMPACT ON HUMAN HEALTH AND THE LOCAL ENVIRONMENT.

To ensure that this is the case, FAO seeks advice from the Pesticide Referee Group, an advisory body of independent eminent experts that evaluates pesticides for locust control. The Group assesses the quality of efficacy trials that have been carried out against locusts and grasshoppers. On the basis of these evaluations, verified dose rates are defined for Desert Locust control. National Desert Locust control units in affected countries can rely on these dose rates to provide effective control of Desert Locust infestations.

Furthermore, the Pesticide Referee Group evaluates the results of environmental impact studies relevant to locust control. The Group classifies the risks of using these pesticides for Desert Locust control, so that national control units can make an informed choice about the products they wish to use.

Efficiency can also be optimized and adverse impact reduced by selecting the appropriate control technique. The so-called "barrier treatments" have both operational and environmental advantages. FAO actively promotes the wider use of this technique in Desert Locust control. Control operations usually concentrate on treating settled swarms, but logistical difficulties may limit such an approach. Large blanket treatments against diffuse hopper populations are avoided because they waste pesticides and pollute the environment. Depending on the locust target and the local situation, the most appropriate control technique is chosen.

FAO has launched a new initiative to carry out trials designed to optimize barrier treatments. Of particular interest is the question as to how far barriers can be spaced while still ensuring effective locust control.

TESTING PESTICIDES FOR BARRIER TREATMENTS

A particular control technique that can be used against hopper bands of the Desert Locust is that of barrier treatments. In this technique, parallel strips of vegetation are treated with a pesticide while the areas between the strips are left unsprayed. Since hopper bands tend to move downwind in their search for food, they will encounter the treated strips of vegetation and accumulate a lethal dose of the pesticide.

The advantages of barrier treatments are multiple. From an operational point of view, they allow rapid treatment of large areas infested with Desert Locust hopper bands, thus freeing badly needed time for survey and control activities elsewhere. An important environmental advantage is that parts of the infested areas remain untreated, reducing effects on non-target organisms. And finally, barrier treatments are much less costly than blanket sprays.

PURCHASING PESTICIDES: GETTING THE NUMBERS RIGHT

LARGE AMOUNTS OF OBSOLETE PESTICIDES ARE STILL TO BE FOUND ALL OVER AFRICA, WHERE THEY RISK CONTAMINATING THE ENVIRONMENT AND POSE A **HEALTH HAZARD FOR LOCAL PEOPLE**.

A considerable part of these pesticides was originally purchased for migratory locust control. The pesticides became obsolete because of overpurchasing by the affected countries, donations that were more generous than necessary and badly coordinated, or simply because the pesticides were delivered after an outbreak had died down.

Countries face a serious dilemma when planning to purchase pesticides since Desert Locust outbreaks are periodic and are difficult to predict in the long term. If countries buy large stocks and the outbreak does not last long, they may find themselves with significant quantities of unused products that can become obsolete. If countries buy small amounts of pesticides, they risk running out of stock if the outbreak lasts longer than expected.

As a result, FAO and various other donors now purchase pesticides in small amounts and send them at short notice, mostly by cargo aircraft, to the affected regions. This allows a rapid response to local needs but avoids creating large stocks that can become obsolete.

Furthermore, to avoid overstocking of pesticides, FAO carries out detailed needs assessments before purchasing new stocks and attempts to coordinate with other (bilateral) donors and affected countries to avoid simultaneous purchases that may result in overstocking. A central databank of national stocks has been created to improve the Organization's capacity to send pesticides where needed. Strict purchasing criteria ensure that the products bought by FAO are effective, pose the least possible hazard for their users and are of good quality.

In the longer term, FAO assists locust-affected countries in determining realistic strategic stocks of pesticides. These stocks should be large enough to enable a country to intervene in an early locust outbreak before further pesticides are obtained, but not so large as to risk becoming obsolete. In addition, there are ongoing discussions with the pesticide industry to set up pesticide banks of both chemical pesticides and biopesticides. These banks are intended to be pesticide stocks that the pesticide industry can make available at short notice for locust control, but that can be sold for the control of other insect pests when no locusts are present. By turning over the stock at the factory, the pesticide stock should not become obsolete.

All these measures will reduce the risk of the creation of obsolete stocks while ensuring rapid intervention against locust outbreaks. Cleaning up obsolete pesticide stocks is extremely expensive, often now costing more than the value of the products when they were originally bought.

THE FOLLOWING ARE SOME OF THE TECHNICAL CRITERIA THAT FAO APPLIES WHEN PURCHASING PESTICIDES FOR DESERT LOCUST CONTROL

- **The pesticide must have a demonstrated efficacy against the Desert Locust, i.e. have a verified dose rate set by the FAO Pesticide Referee Group**
- **The product has not been classified as extremely hazardous (class Ia) or highly hazardous (class Ib) according to the World Health Organization**
- **The product should be authorized for locust or grasshopper control in the country of intended use**
- **The product formulation must conform to FAO quality specifications**
- **The product should be packed and shipped in UN-certified steel containers**
- **The product should be labelled according to FAO guidelines, in the language(s) of the country, and contain the necessary information on pesticide composition, use recommendations and risks**

RENOVATION AND CONSTRUCTION OF PESTICIDE STORES

PESTICIDES NEED TO BE STORED PROPERLY TO AVOID RISKS FOR LOCAL PEOPLE AND THE ENVIRONMENT.

Correct storage and periodic quality control of existing pesticide formulations are necessary in order to extend the shelf-life of pesticide stocks and are crucial in order to be prepared for a pest such as the Desert Locust that only occurs irregularly. At the same time they will lessen the speed at which stocks become obsolete.

Pesticide stores meeting international standards are being built and/or renovated in Chad, Mali, Mauritania, Niger and Senegal with support from FAO and its donor partners. In the longer term, these stores will be used to keep strategic stocks of pesticides as part of the preventive control system being set up under EMPRES in West Africa.

PREVENTIVE CONTROL

FAO's Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases (EMPRES) attempts to strengthen Desert Locust survey control in countries along the Red Sea. It is being expanded to western Africa. Its principal objective is to minimize the risk of Desert Locust emergencies by strengthening national capacities. The three components of EMPRES are:

- **early warning of increases in locust populations through improved locust survey,**
- **early reaction against locust outbreaks through strengthening control capacity, increasing the efficacy of pesticide treatments, reducing environmental and health hazards of spraying, and**
- **research on improved locust and survey control including trials on alternatives to chemical pesticides.**

PRECISE AND EFFECTIVE TREATMENTS WITH LIMITED RISKS

NEW TECHNOLOGY HAS GREATLY INCREASED THE PRECISION OF DESERT LOCUST CONTROL OPERATIONS. GLOBAL POSITIONING SYSTEMS (GPS) IN SURVEY VEHICLES AND AIRCRAFT ENABLE THE EXACT LOCATION OF THE LOCUST HOPPER BANDS AND SWARMS TO BE DETERMINED.

Control teams then rapidly reach these spray targets. Advanced electronics in spray aircraft now permit precise spray targets to be found back in the middle of the desert and spray swaths to be laid accurately over the target. This greatly facilitates quality control of the treatments and monitoring of potential environmental effects.

However, advanced technology in itself is not enough. A basic prerequisite in order to minimize the risks of Desert Locust control operations is that national survey and control staff be well trained. This will ensure that pesticides are applied when and where they are absolutely necessary, and at the right dose rate. Furthermore, field staff will prepare the spray operations and take care of appropriate aftercare such as cleaning up equipment and assessing the efficacy of the treatment.

Through its technical consultants in the field, FAO is continuously in contact with local survey and control staff and can provide on-the-job training when required. In addition, extensive training programmes on Desert Locust management are routinely carried out.

For example, 21 master trainers from 11 countries (Burkina Faso, Cape Verde, Chad, Gambia, Guinea, Guinea-Bissau, Mali, Mauritania, Niger, Senegal and Djibouti) attended a three-week regional workshop from March to April 2005 in Niamey, Niger, with various FAO experts and consultants, sharing and upgrading their knowledge on the theme: “What to know, what to teach on the Desert Locust”. These master trainers, in turn, trained a total of approximately 600 staff in Desert Locust bioecology, locust survey and control techniques, environmental and health precautions, and Desert Locust campaign management. The benefits gained from these regional and national training sessions are then assessed in order to identify and fill any remaining gaps.

Special care is taken to avoid using chemical pesticides in ecologically or economically sensitive areas. Nature reserves and other protected areas should be off-limits for large-scale locust control. Waterbodies and major beekeeping zones are avoided or, if control is essential, only low risk pesticides are used there.

MONITORING CONTROL OPERATIONS

IN VARIOUS COUNTRIES WHERE DESERT LOCUST CONTROL TAKES PLACE, A QUALITY CONTROL SYSTEM FOR SPRAYING OPERATIONS IS BEING SET UP. SPECIALIZED TEAMS OF CHEMISTS, BIOLOGISTS, AGRONOMISTS AND MEDICAL PERSONNEL CARRY OUT TREATMENT MONITORING, INDEPENDENT OF THE CONTROL TEAMS. **QUALITY CONTROL CONSISTS OF SEVERAL ACTIVITIES THAT TRY TO ANSWER A WIDE RANGE OF QUESTIONS.**

Evaluation of quality and efficacy of the treatments. How effective have the treatments been? Has the dose rate been respected? Are the mortality rates of the locust populations sufficiently high? Have any problems been encountered with the pesticide or the spray equipment?

Assessment of risks to the environment. Has any excessive mortality been observed in organisms not targeted by the spraying? Are populations of important groups of fauna affected by the pesticides? Have adverse effects on fisheries or beekeeping been observed?

Assessment of risks to local people. Have buffer zones around villages and (drinking-) water sources been respected? Were local populations informed about the precautions to be taken? Are withholding periods for cattle or pre-harvest intervals for crops being adhered to?

Health checks for control staff. Are safety precautions followed? Have spray operators been excessively exposed to pesticides? Have any pesticide poisoning incidents occurred? Do certain control practices need to be modified to reduce risks?

Sampling for pesticide residues. What are the initial pesticide levels on vegetation or crops and how quickly do they disappear? Do residue concentrations exceed legal limits or environmentally safe levels?

Locust control reaps a twofold advantage from this type of treatment monitoring: it increases efficiency of operations and it limits adverse effects on control staff, local people and the environment.

Specialized teams, with officers from the Ministries responsible for Environment, Health and Agriculture have been trained in several countries. Their task is to check the health of the workers who handle pesticides and that of the population in affected areas; to monitor any environmental pollution; and to help improve the quality of the treatments. National institutions involved include the CERES-Locustox Foundation in Dakar and the Central Veterinary Laboratory in Bamako.



Above and below right: examples of terrestrial and aquatic animals that are vulnerable to pesticides




CHECKING THE HEALTH OF CONTROL STAFF

Because locust control staff are in daily contact with pesticides, they run the highest risk of exposure. Health monitoring of pesticide applicators and other field staff is therefore a major concern for national locust control organizations and for FAO.

At the start of a control campaign, field staff undergo a thorough medical check-up. The objective is to assess whether a person may be particularly sensitive to pesticide poisoning. If so, the person can be given a task in the campaign that does not expose him/her to pesticides.

During the campaign, a doctor or nurse regularly monitors control staff. Any general health problems are assessed, possible poisoning symptoms evaluated and blood samples taken to ascertain exposure to the pesticides. In the blood, the level of an enzyme called acetylcholinesterase (AChE) is measured. An inhibition of the activity of AChE in the blood indicates that the person has been exposed to organophosphate pesticides. These are a group of pesticides often used in locust control. High AChE inhibition is a symptom of pesticide poisoning. Staff showing increased AChE inhibition will be taken temporarily off the job and transferred to work that does not involve pesticides. This will prevent them from being poisoned through regular exposure.

Blood analysis for AChE inhibition can be undertaken in the field, using sophisticated portable analysers. This will ensure that rapid action can be taken from the moment that overexposure to pesticides is observed. FAO has trained medical staff in health monitoring of campaign staff and has provided the necessary equipment.

CLEANING UP

DESERT LOCUST CONTROL TAKES PLACE IN THE ARID OR SEMI-ARID REGIONS OF AFRICA, THE MIDDLE EAST AND SOUTHWEST ASIA. IN ALMOST ALL THESE AREAS, WATER IS IN SHORT SUPPLY.

Metallic and plastic pesticide containers used for Desert Locust control are consequently in great demand by the local population since they can be used to store and transport water, and sometimes even food. FAO always buys pesticides in UN-certified steel drums and never buys pesticides in plastic containers.

Unfortunately some bilateral donors provided plastic drums, which cannot be sufficiently well cleaned to prevent potentially toxic residues. The reuse of empty containers for drinking-water or food can thus pose a serious health hazard.

Empty containers must be collected and either recycled or destroyed. This has always been a difficult problem in locust control.

The collection of empty containers is time-consuming, especially in the middle of a control campaign. Moreover, appropriate recycling or destruction of these containers is not possible locally because of lack of facilities.

In collaboration with the national locust control organizations, FAO is developing systems of collection and recycling of empty pesticide drums in Mauritania, Mali, Niger and Senegal. State-of-the-art drum rinsing and crushing units have been installed in Mauritania and Mali, and specialized staff trained in their use.

Whenever possible, a limited number of steel containers are reused for pesticide storage. In some cases, empty containers are taken back by the manufacturer for recycling. In all other cases, the steel drums are cleaned and crushed to reduce the volume for storage and transport. They can then be used as scrap metal and recycled in national smelters. Plastic pesticide containers are much more difficult to recycle locally. No environmentally sound solution in locust-affected countries has yet been found for destroying them. Hence FAO's decision not to buy them any longer.

In addition to these more technical solutions, awareness raising campaigns are also mounted. Local people are informed about the risks of reusing pesticide containers. Whenever they come across empty containers, they are asked to take them to the locust control unit or the plant protection service.

LOOKING FOR ALTERNATIVES

MANY OF THE PESTICIDES USED IN DESERT LOCUST CONTROL WILL POSE SOME RISK TO THE ENVIRONMENT AND TO HUMAN HEALTH, EVEN IF THEY ARE USED JUDICIOUSLY.

The search for alternative, more environmentally benign control options therefore continues. One approach being investigated is the further introduction of barrier treatments using persistent, but biologically safe pesticides. In barrier spraying only a small portion of the infested area is treated (the "barriers"), thus saving money and the environment.

The use of biological pesticides is another option. For some time, a mycopesticide based on the fungus *Metarhizium anisopliae* var. *acridum* has been on the market. This is a locust-specific biological insecticide that has very limited side-effects on other groups of organisms. The fungus penetrates the cuticle of the locust, grows inside its body and subsequently kills it.

Its commercial formulation, Green Muscle™, has been tested for several years in Africa on a large range of grasshoppers and locusts and found to be very effective. A similar product, Green Guard™, is being used on a large scale in Australia. However, more field-testing is necessary in Africa to explore the potential and limitations of the product under different climatic conditions. Such tests are carried out whenever possible and coordinated by FAO.

Because of its relatively slow mode of action, Green Muscle™ is likely to be most effective in a preventive control system, where crops are not directly threatened. Furthermore, it can be used in ecologically sensitive ecosystems, where conventional pesticides would not be allowed, such as in national parks and other nature conservation areas.

Locust affected by *Metarhizium*. Photo: IITA

FIELD TRIAL WITH GREEN MUSCLE™ IN ALGERIA

A trial was organized by FAO in May 2005 in close collaboration with the Algerian National Institute of Plant Protection and the International Institute of Tropical Agriculture. Various elements had to be right. Sufficiently large populations of Desert Locust hoppers had to be present. The drums of the biopesticide Green Muscle™ needed to be cleared rapidly through Customs and transported 500 km by truck to the trial site. The spray aircraft and vehicle-mounted sprayers had to be calibrated and ready to go. Field staff needed to be briefed on exactly how to verify the effects of the fungus. It was go-ahead on 1 May 2005. This was one of the first large-scale trials with the fungus *Metarhizium anisopliae* var. *acridum* on Desert Locust.

After four days, locust hopper bands started to slow down their movements. Diseased locusts were hanging off the branches of shrubs, unable to march on. Hopper bands began to lose cohesion and disintegrate. Natural predators of locusts, such as birds, lizards, scorpions, beetles and ants attacked and ate the weakened locusts. After eight days, no live hopper bands were observed on the treated plots; only fragments of dead locusts could be seen. Incubation of treated insects showed that they had succumbed to the effects of the fungus.

A back-up plan had been made to spray the locust population with conventional pesticides were the pathogen not to be effective. The plan was never needed. Desert Locust control organizations were one step closer to incorporating biological methods in their control strategies.

ACKNOWLEDGEMENTS

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Front cover photos
Above: a farmer walks through a Desert Locust swarm near Mourdiah, Mali.
Below: a typical temporary pond near Lake Chad, important for humans, cattle and wildlife.

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SELECTION

PURCHASE

STORAGE

TREATMENT

MONITORING

CLEAN-UP AND DISPOSAL

ALTERNATIVES

For further information, contact:

LOCUST AND OTHER MIGRATORY PESTS GROUP

PLANT PRODUCTION AND PROTECTION DIVISION

Food and Agriculture Organization of the United Nations
Viale delle Terme di Caracalla
00100 Rome, Italy

Fax (+39) 06 57055271
E-mail: eclo@fao.org
www.fao.org/ag/locusts

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