PEST MANAGEMENT NOTES *No. 4*

Desert locust control in Africa

A briefing for the *IPM in Developing Countries Project* funded by the European Commission *Environment in Developing Countries* budget (DGVIII)

This overview aims to introduce Commission officers, delegations, and policy advisers to issues in locust control, and discusses current research and concerns among donors and locust-affected countries.

Locust swarm: drawing courtesy of CIRAD, France.

Why locusts cause concern

Grasshoppers are common in many parts of Africa. But locusts are unique among grasshoppers because they can undergo *phase change*. This means that, under certain conditions of rainfall and population density, they change their appearance and move, feed and behave as a group, with the potential to form huge swarms which can travel great distances and devastate crops. This briefing focuses on one species, the desert locust. Desert locust plagues can affect 20% of the earth's surface across Africa, the Middle East and Southwest Asia.

The problem now

After the 1950s chemical pesticides raised expectations that locust plagues could be controlled by spraying breeding areas, or spraying the swarms in the air. Money was spent on chemicals, equipment, and organisational infrastructure to monitor outbreaks. But increasingly donors and locust-affected countries are questioning whether money may not be better spent in improving crop storage, or crop insurance, local food aid or other more appropriate forms of assistance.

Chemical controls—do they work?

Older organochlorine pesticides used to spray on locusts were hazardous to the environment. Newer pesticides can be hazardous to humans and wildlife. The FAO's Pesticide Referee Panel provides information about recognised locust control chemicals. There is little evidence that chemical controls—as opposed to winds, rain or lack of food—have wiped out plagues. But although locusts may cause local devastation when a swarm settles, do locusts cause damage on a national scale? Attempts are now being made to assess the damage caused by locusts and set this in a national context, to see whether money may be better spent in other ways.

The disposal problem

Donations of inappropriate or excessive amounts of pesticides have meant that a large part of the estimated 20,000 tonnes of surplus or outdated stocks in Africa result from locust control programmes.These stocks are a danger to human health and the environment.

The way forward

The main issues for consideration in locust control, together with the factors needed to evaluate whether control strategies will work, are explained, and Page 4 of this briefing gives contacts and further resources.

Desert locust plagues can affect over 20% of the earth's surface ... over 65 countries can be at risk.

Locusts

Migrating locust swarms have been known since biblical times. Some species have the ability to form swarms covering hundreds of square kilometres. The swarm can migrate for thousands of kilometres, devastating crops en route. There are many different locust species. and this paper will focus on one of the principal migratory species—the desert locust *Schistocerca gregaria*—which can affect huge areas in Africa, the Middle East and South-West Asia. Over 65 countries can be at risk of swarm, invasion and breeding.

Locusts live as solitary grasshoppers in semi-desert areas. After birth the juvenile passes through five instar phases, or moults, before adulthood. The juveniles are known as hoppers. Specific conditions—a combination of rainfall, population density and food—leads to a condition known as *phase change* or *gregarisation*. The solitary individuals become gregarious and move and behave as a group that can increase in size dramatically. These groups are known as hopper bands. Often the bands coalesce to form large groups, leading to swarms and outbreaks.

The problem now

The last major outbreak was in 1988-89, although a smaller outbreak threatened in 1993-94. Breeding areas cover the Sahel, the Arabian peninsula, India and Pakistan. The range of locust-affected countries is much wider. At its height, the 1988-89 plague threatened 43 countries, one fifth of the world's land mass.

During the this outbreak, nearly US$300 million were spent in Africa and the Arabian peninsula for locust control. The report commissioned by the US Congress (see *Publications*) concluded that there was little evidence that the costs expended on chemical controls contributed to the eradication of the plague. In fact instead of turning inland from Morocco to devastate the interior of the country and other countries in Northern Africa, the plague turned out to sea and ran out of food in the Atlantic.

Locust control has been estimated to cost more than US$10 million annually for all of the African locust-affected countries. The legacy has been stocks of surplus or outdated pesticides. Consequently, the strategic aims of locust control need careful analysis, taking into accunt the issues below.

Prevention or cure?

There are two views on locust control strategies—preventing the problem at source or trying to deal with locust swarms when they are in the air. These different approaches arise as a result of the locust's life-cycle and the habitat in which it breeds.

The preventative approach seeks to monitor locust breeding areas and spray as gregarising populations of locusts are identified. This is difficult in practice, as many of the principal breeding zones are difficult to reach.The cost and effort of infrastructure and communications required is very considerable. In many areas—Mali, Niger, Chad, Ethiopia and Sudan—there is or has been until recently civil strife.

The other approach aims to identify and deal with the result of the exponential increase in the gregarised population that eventually leads to a plague or swarm. This involves aerial spraying of the swarm in flight, or trying to prevent crop damage in areas in the path of a swarm. This requires resources that can be extensively deployed at short notice. Swarms often dissipate as a result of wind, rain and lack of food, making the role of chemical controls in ending the swarm unclear.

The most appropriate controls will therefore depend on whether prevention at source, or destruction of swarms, is the objective. An overview of the locust controls follows.

Chemical controls and concerns

Dieldrin was the first insecticide to be used on a large scale for locust control. Dieldrin is toxic on contact with the insects. It could be sprayed on the ground from a backpack or vehicle, and by air onto locust hopper bands or over the swarm in flight. Being persistent in the environment, ground spraying onto hoppers or across their likely path meant that, provided they were located, the hoppers were killed if they marched across the treated 'barrier'. Dieldrin and other organochlorine insecticides were eventually banned because of persistence, environmental effects, and bioconcentration in fatty tissues.

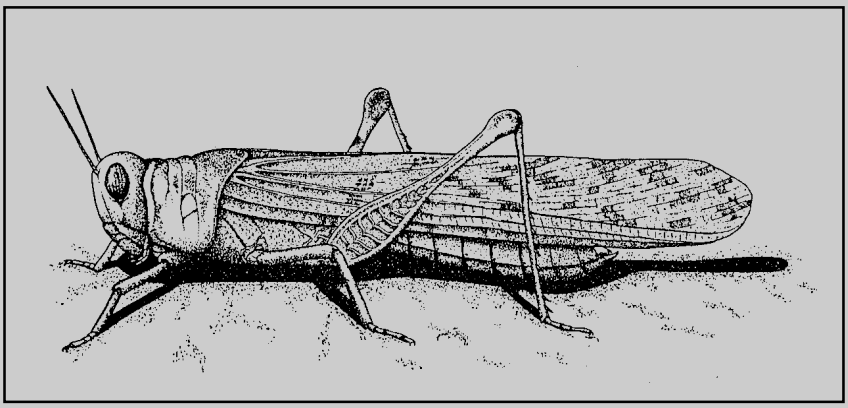
Replacement insecticides included the organophosphate products fenitrothion, malathion and diazinon, and the carbamates carbaryl and propoxur. These were less hazardous to the environment but more hazardous to human and animal health. They were followed by chemicals of the pyrethroid family such as cypermethrin and lambda-cyhalothrin, and the new phenyl pyrazole fipronil. All these broad spectrum 'knock-down' chemicals are hazardous to non-target species, and must only be used on a clearly identified locust swarm target or a breeding site.

Pesticides: costs and benefits

The local devastation caused by a settling swarm of locusts can be very great. However, the damage at regional or national level will be nothing like so large. The German development agency GTZ has concluded that "no large scale famines have been caused by desert locusts during the last 50 years, and in all probability there have not been any during the last 150 years." Estimates of damage are difficult to obtain, but there is now a recognised and authoritative body of work indicating that frequently infestation has little or no effect on the crop price or availability of food other than at a localised level. Senegal was afflicted with locust plagues in 1957, and Mali in 1986-88, but although there were local shortages, national production as a whole was unaffected. This may be because locusts swarm in years of exceptional rainfall, which is one of the factors that produces higher harvests.GTZ has pioneered research to try and estimate the costs and losses caused by locust infestations, examining:

- the area of land afflicted with locusts
- the value of threatened crops
- the potential loss of yield
- the effectiveness of control measures.

The financial costs of locust control are generally borne at the national level. Indirect costs fall on health, and the environment. More work is needed to clarify the effect of locust infestations on the local economy and livelihoods.



Desert locust (Schistocerca gregaria). (Drawing courtesy of PANOS, UK.)

Newer types of chemicals include growth regulators such as diflubenzuron and trifluormuron. These products interfere with the insects' development by interrupting moulting between growth stages. But the locusts have to be treated before they reach adulthood.

Commercial suppliers have an understandable interest in promoting chemical use. It is, however, an increasing concern among donors and regulators that chemical treatment by itself may not be effective in controlling locusts. Swarms cannot always be identified, they move too quickly, the costs of chemicals and infrastructure are great, or breeding sites are inaccessible. New technologies are available, as are resources to assist decision-makers.

Current developments

New biopesticides are about to become available. These include formulations of the pathogenic fungal pesticide *Metarhizium flavoviride*, and others based on plant extracts are in development. Global Information Systems based on satellite technology promise help to locate swarms. There is exciting research on semio-chemicals and pheromones: these natural chemicals are the 'messengers' that may prevent or interfere with the phase-change process. This interference will cause locusts to remain solitary, and they will not gregarise or swarm.

No large scale famines have been caused by locusts during the last 50 years, and probably not during the last 150 years.

FAO's EMPRES scheme (see *Resources*) aims to prevent potential locust upsurges and plagues by an effective monitoring, surveillance, early warning and control programme, together with research on locust ecology and control. The initial focus is on FAO's Central Region of North and East Africa, the main source of upsurges and plagues.

FAO's Migratory Pest Group is the focus for information exchange on locust control strategies and developments. It also operates the Pesticide Referee Panel, a panel of independent experts that evaluates field data on locust chemicals (including biopesticides) and makes information about them available—including environmental information, which had until recently been lacking.

Donors are cooperating to consider the economic impacts of locusts, and the most cost-effective forms of response, including the most appropriate strategic responses. Donors are are also coordinating field research and support programmes. Some of the outputs are listed in *Publications* below, and are available from bodies mentioned in the *Resources* section.

Key points

- ❖ Consider the amount and area of damage threatened by locusts.
- ❖ Clarify the objective of the action—whether it is for prevention or swarm control—and whether chemical treatment is appropriate.
- ❖ Contingency planning and coordination between locust-affected areas and donors is vital.
- ❖ Shared experience and expertise is available from other donors and agencies.

Conclusions

Research and technology in locust control are advancing. There are real prospects of biological controls and better analysis of the economic costs of locusts. If there are yet no ready-made solutions to swarms, there is increasingly sophisticated expertise available. There is no substitute for long-term planning to enable decision makers to deal with emergency problems in a strategic context.

A recent World Bank discussion paper (see Joffe *Publications*) summed up the recommended approach to locust control: "... the need for a targeted, impact-oriented response to the risks created by locusts will shape the strategies adopted. These will need to be cost-effective. A balance will need to be found between the political pressures, which are an inevitable characteristic of locust management, and the realistic capacity of Desert Locusts to cause economic and social hardship."

Contingency planning has been shown to be important, and so has coordination between donors. Because of the mobility of locust swarms, it is difficult for one country alone to take effective action.

Decison-makers should bear in mind a number of factors which may require expert advice. These factors include the estimated damage, and the possibility of coordination with neighbouring affected areas, regional bodies and FAO's EMPRES service. There are increasing alternatives to chemical control of locusts. Advice on strategies, coordination and experience can be sought from the agencies and donors listed opposite.

Resources

Publications

A Plague of Locusts—Special Report. US Congress Office of Technology Assessment OTA-F-450. US Government Printing Office, Washington DC, USA.

Desert Locust Management—A time for change. S.R. Joffe. World Bank Discussion paper 284. World Bank, Washington 1995.

Desert Locust Control Using Existing Techniques—an evaluation of strategies. A.Van Huis. Proceedings of a Seminar held in Wageningen, Netherlands, 6-11 December 1993. Wageningen Agricultural University, Wageningen, Netherlands, 1994.

Economics of Desert Locust Control. C.A. Herok, S. Krall.GTZ, Eschborn 1995.

Organisations

FAO's Emergency Prevention System (EMPRES) project provides early warning of locust upsurges in breeding areas. FAO's Pesticide Referee Panel also publishes data on the effects of particular pesticides and usage recommendations. Contact: Bernard Zelazny, Locust, Migratory Pests and emergency Operations Group, FAO, Via delle Terme di Caracalla, 00100 Rome, Italy. Tel. +39 6 5705 53468; fax +39 6 5705 52271.

Programme of research, information and training on desert locusts (PRIFAS). Publishes a large body of research and locust warning bulletins. Contact: PRIFAS (Département GERDAT, Centre de Recherche CIRAD, 2477 av. Du Val de Montferrand, BP 5035, 34032 Montpellier Cedex 1, France. Tel +33 4 67 61 58 45; fax +33 4 67 41 09 58.

Deutsche Gesellschaft fur Technische Zusammenarbeit (GTZ) runs research programmes including assessment of crop losses, and trials of new control methods. Contact: Dr Stephan Krall, GTZ, OE 4232 Pflanzenschutz, Dag Hammarskjoldweg 1-5, D-65760 Eschborn, Germany. Tel +49 6196 79 1428; fax +49 6196 79 7173.

CABI Bioscience works on the development of biological controls against insect pests including locusts. Contact: Director, Silwood Park, Buckhurst Road, Ascot, Berks, SL5 7TA, UK. Tel. +44 1344 872999; fax +44 1344 875007.

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This briefing is one of a series prepared by Pesticide Action Network *UK* (PAN *UK*), which is responsible for its contents, as consultants to DGVIII of the EC. PAN *UK* is an independent charity working to reduce pesticide problems in developing countries. Its quarterly journal *Pesticides News* reports on pesticides and IPM.

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