Desert Locust Guidelines

5. Campaign organization and execution

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Second edition – 2001

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PREFACE

The Desert Locust plague of 1986-89 and the subsequent upsurges in the 1990s demonstrate the continuing capacity of this historic pest to threaten agriculture and food security over large parts of Africa, the Near East and southwest Asia. They emphasize the need for a permanent system of well-organized surveys of areas that have recently received rains or been flooded, backed up by control capability to treat hoppers and adults efficiently in an environmentally safe and cost-effective manner.

The events of 1986-89 showed that, in many instances, the existing strategy of preventive control did not function well, for reasons including the inexperience of the field survey teams and campaign organizers, lack of understanding of ultra low volume spraying, insufficient or inappropriate resources and the inaccessibility of some important breeding areas. These reasons were compounded by the general tendency to allow survey and control capacity in locust-affected countries to deteriorate during locust recession periods. To address this, FAO has given high priority to a special programme, the Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases (EMPRES), that will strengthen national capacities.

Given the certainty that there will be future Desert Locust upsurges, FAO produced a series of guidelines primarily for use by national and international organisations and institutions involved in Desert Locust survey and control. The guidelines comprise:

1. Biology and behaviour
2. Survey
3. Information and forecasting
4. Control
5. Campaign organization and execution
6. Safety and environmental precautions

Appendixes (including an index) are provided for easy reference by readers.

This second edition has been produced to update sections on technology and techniques that have undergone changes in the seven years since first publication, to modify presentation of the material, to make it easier to understand and to facilitate updates in the future. The revision was carried out by K. Cressman of FAO and H.M. Dobson of the Natural Resources Institute, United Kingdom, with input from many locust and locust-related specialists around the world. This edition will be available in the three key languages of the locust-affected countries, English, French and Arabic.

I would like to extend my gratitude to all those who have been involved in this important contribution to improved Desert Locust management.

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Contents

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FAO is grateful to P.M. Symmons who produced the first edition of the guidelines, to K. Cressman and H.M. Dobson who revised and updated it, and to S. Lauer who produced most of the illustrations. FAO would also like to thank T. Abate, B. Aston, F. Bahakim, L. Barrientos, T. Ben Halima, D. Brown, M. Butrous, M. Cherlet, J. Cooper, C. Dewhurst, J. Duranton, C. Elliott, A. Hafraoui, M. El Hani, T. Galledou, S. Ghaout, G. Hamilton, Z.A. Khan, M. Lecoq, J. Magor, G. Matthews, L. McCulloch, M. A. Ould Baba, J. Pender, (the late) G. Popov, T. Rachadi, J. Roffey, J. Roy, S. Simpson, P.M. Symmons and H. van der Valk for their comments and criticism on this new version. Acknowledgements are also due to R. Mitchell and C. Smith-Redfern for general editorial advice, K. Whitwell for indexing, Medway Design Team, University of Greenwich and Andrew Jones for production of digital artwork and to manufacturers for providing illustrations of their equipment. The Control guideline and parts of the Appendixes are outputs from a project funded by the United Kingdom's Department for International Development (DFID) for the benefit of developing countries and carried out by the Natural Resources Institute. The views expressed in these sections are not necessarily those of DFID.

INTRODUCTION

This guideline is intended for use by those individuals who have the responsibility of organizing a locust control campaign in their country. Field staff, administrators, donors and other international organizations may find some of the information useful in understanding what is involved in the organization and implementation of locust campaigns. The guideline deals almost exclusively with aerial control campaigns because only aerial control can cope with large numbers of locusts in which the aim is not only to protect crops but to reduce the size of the total locust population and bring an end to the upsurge or plague. It concentrates on the resources required for a campaign as well as the organization and deployment of these resources. The guideline does not address ground control campaigns in great detail because these will differ greatly among countries depending on the infrastructure and the resources available within the country.

The campaigns dealt with in this guideline cover major control operations during the latter stages of an upsurge and throughout a plague. These control operations are likely to be required throughout the whole of a small country or a major part of a large country, i.e. typically over areas of at least 100 000 km^2. A major infestation can, in some places, be restricted by topography into a much smaller area. As a rule, the campaign period starts with invasions by swarms, and may include control of the breeding that follows, and even control of a second generation of breeding. Combating the infestation may, for convenience, be broken down into swarm campaigns and hopper campaigns since these two stages require different search tactics and control methods.

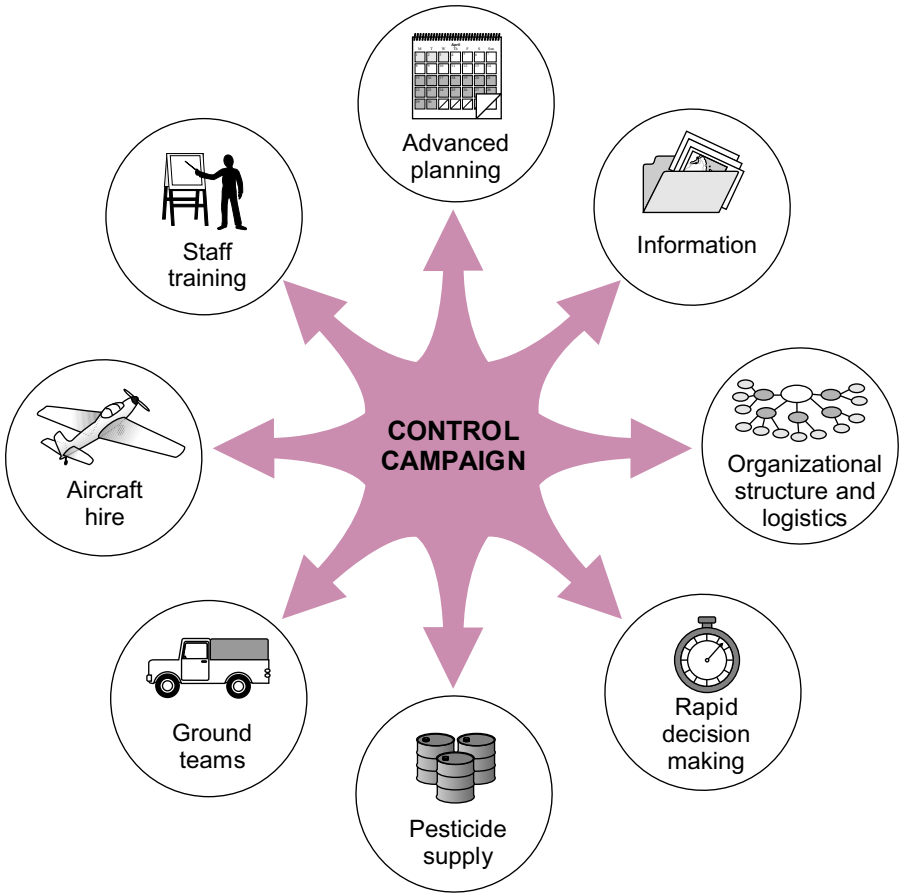
The infested area may be present along both sides of a national frontier. In this case, there will be two campaigns, one organized by each country. There should be cooperation between the countries but, because of different organizational structures and chains of command, a unified campaign would be difficult to organize and is, therefore, unlikely to occur.

Information, advice, procedures and explanations are given on the right-hand pages of the publication; illustrations and summaries are given on the left-hand pages. When appropriate, tips and warnings may appear on either side.

There is also a series of Frequently asked questions (FAQs). These deal with some of the common problems encountered by locust field staff. Answers are given where available, but further research is needed in some areas, and FAO welcomes feedback on new information and solutions.

Much of the information in this guideline is relevant to control campaigns carried out against other types of locust and some grasshoppers, but techniques may have to be adapted to match the particular characteristics and habitat of the target species.

Figure 1. Summary of the control campaign process.



WHAT IS A LOCUST CONTROL CAMPAIGN?

It has been said many times that a locust campaign is like a small war with the same needs for information, intelligence and rapid decisions (see Fig. 1). There will be a need for advanced planning, the supply of pesticide, aircraft hire contracts, the presence or establishment of an organizational structure including the designation of responsibilities, the provision and training of seconded staff, and so on. It is important to realize that a campaign is a matter of improvization and cannot be fully planned in detail in advance. A well-run campaign cannot operate only from headquarters but must rely on field headquarters or field bases. While a campaign is in progress, it is virtually impossible to assess how the battle is going. One can only attack as many targets as possible. Targets may suddenly be in short supply. This could mean the campaign has been successful or that the swarms have emigrated.

All control campaigns are a race against time. A swarm campaign or a hopper campaign rarely lasts more than three or four weeks. A campaign covering a single breeding from parent swarm invasion to the formation of the swarms of the progeny might last about eight to ten weeks (see the table below). Campaigns will last longer if there are two generations in the same area during one season, if successive breeding occurs at different times, or where development is slowed by low temperatures.

Every campaign will be different. Not only will the scale of the infestation vary, but each country will have different resources and different deployment problems. All that this guideline can do is to describe some of the difficulties which must be overcome in any successful campaign.

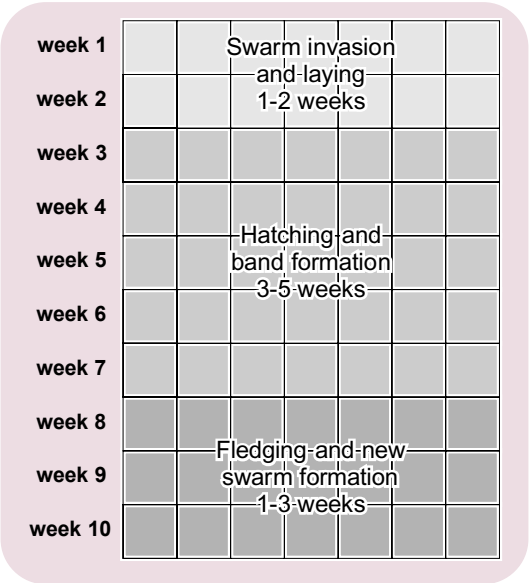
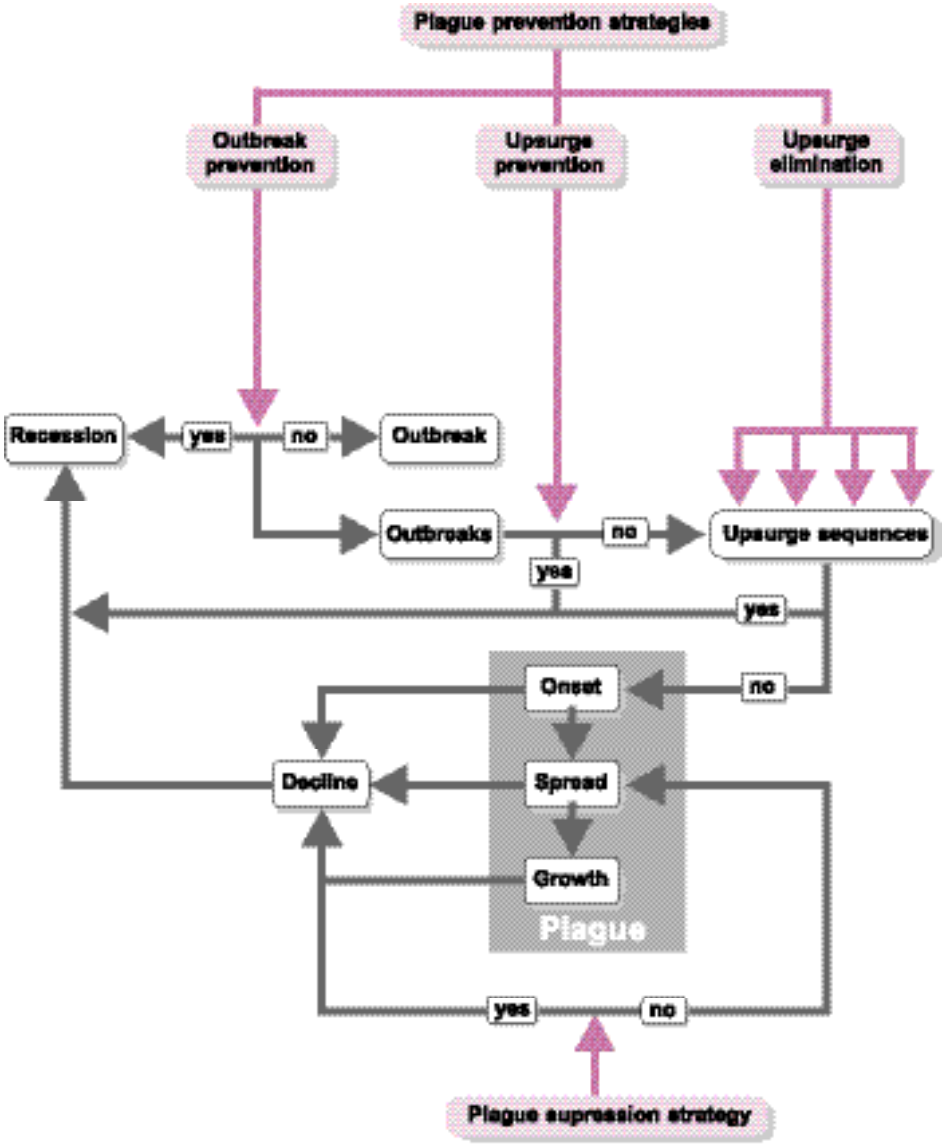


Figure 2. Plague prevention and suppression strategies.



Note: There may be cases in which there is a natural return to a recession without implementation of a strategy. (source: Krall, S. et al)

WHICH CONTROL STRATEGY TO USE

Ideally, upsurges should be prevented by limited control of gregarizing populations that occur during recession periods or outbreaks (see Fig. 2). Failing this, it is hoped that upsurges can be contained by ground control before they develop into plagues. In practice, it is difficult to find and treat enough of the numerous and often small and transient infestations, many of which may consist of large numbers of scattered locusts that are poor control targets, to eliminate the outbreak or upsurge.

For whatever reason, control during outbreaks and early upsurges in the past has not always prevented plagues from developing. This occurred, for example, in 1967-68 and 1985-86. There is no certainty that preventive control will be more successful in the future. It cannot be relied upon, especially if upsurges start in areas where survey and control cannot be carried out because of inaccessibility, or where resources to maintain a Locust Unit are insufficient. Therefore, it is necessary to be prepared to mount major campaigns.

Once faced with a plague or a major upsurge, the aim of control is not merely to protect crops that are infested but to reduce the size of the total population. When swarms are present, crop protection alone is clearly not feasible since they can move many tens of kilometres in a day. Nor would it be practicable with bands since stocks of pesticides would need to be distributed throughout the area where breeding might occur. The patchy nature of locust distributions means that much of this would not be used while in some places stocks would be inadequate. Therefore, it will be necessary to organize a control campaign that reduces the size of locust populations as well as the threat to crops. This will depend on the existence and capacity of Locust Units, training and contingency planning.

Resources needed to control 1 000 km² of swarm or hopper band equivalent

Method	Application vehicles and aircraft	Pesticide	Supply trucks
Aerial swarm control	aircraft (4)	ULV (50 000 l)	3
Aerial block band spraying	aircraft (84)	ULV (1 250 000 l)	75
Individual band control (ULV)	spray vehicles (167)	ULV (50 000 l)	9
Individual band control (bait)	spray vehicles (167)	Mixed bait (10 000 000 kg)	170
Village crop protection (handheld ULV)	---	ULV (38 000 l)	1
Village crop protection (bait)	---	Mixed bait (7 600 000 kg)	127

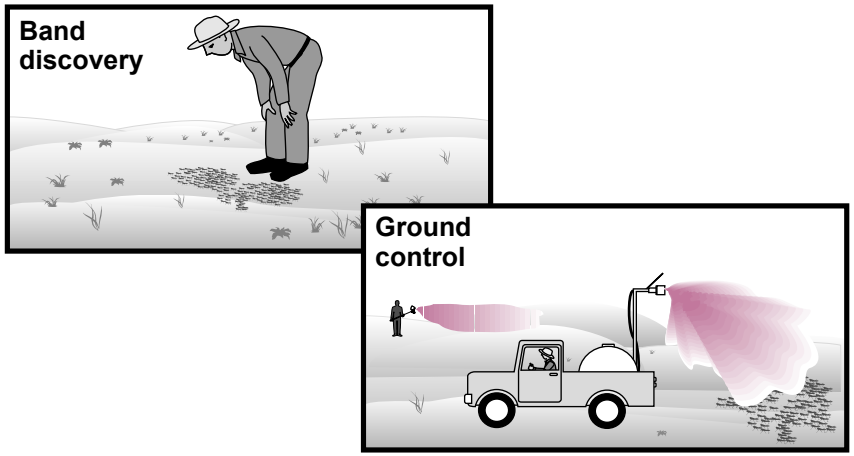
Note: With village crop protection, the resources would treat only 25 percent of the locusts.
(source: Symmons, P. (1992))

In any emergency, all available resources will have to be used. It is useful to realize what can be accomplished by different methods. Although the figures are approximate, they serve to demonstrate the very large resources needed, for example, when treating individual bands. Even if those resources were available, their deployment would present great organizational, logistical and training problems.

Summary of recession strategy:

- ground survey and spraying
- carried out by PPD/Locust Unit
- 10 vehicle sprayers available
- up to 100 handheld sprayers available
- 10 000 litres of pesticide available

Figure 3. Control strategy during a recession.



Control during a recession

Control of the small locust populations found during recessions, outbreaks and the beginnings of an upsurge will usually be carried out by the Plant Protection Department (PPD) and mainly by the Locust Unit where there is one. It is likely to be attempted mainly by ground spraying in immediate response to the discovery of gregariously behaving infestations, usually small bands found during survey (see Fig. 3). Some advance planning could be done earlier than this, once heavy rains fall in breeding areas. Sprayers and a truck to carry pesticides should be constantly available during the locust season, to be sent immediately if infestations requiring control are discovered.

It is not wise to equip survey teams with sprayers and pesticide as a standard procedure. This is because sprayers take up space and, however robust their construction, carrying them over rough ground will inevitably reduce their useful life. Pesticides also take up space and must be handled with care since transporting them for long distances over rough ground may cause the containers to leak. So called armed or search-and-destroy surveys should be carried out only when the Information Section considers there is a good chance of finding something to control (see the Information and forecasting guideline). In this case, two vehicles should be used, one for survey and the second to carry 100-200 litres of ULV pesticide and several handheld portable sprayers.

The number of sprayers and the quantity of pesticide to be held will vary from country to country. Approximately ten vehicle sprayers, about 100 handheld sprayers, and 10 000 litres of ULV pesticide (effective at about 0.5 l/ha) might be held in reserve for recession control in a large country. This amount of pesticide will allow roughly 100 days of vehicle spraying. The requirements for upsurge and plague control will be discussed later.

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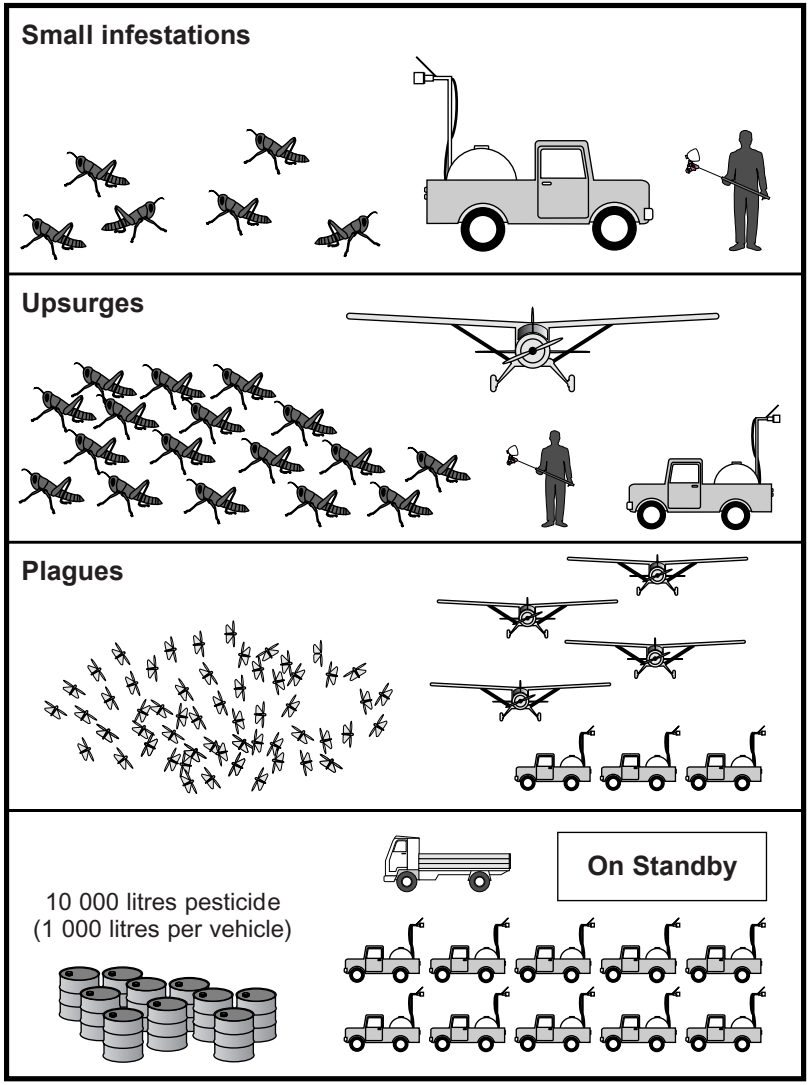
FAQ number 1 (see p. 54 for answers)

Isn't it enough to rely on farmers to undertake control during recession periods?

Summary of upsurge and plague strategy:

- move from ground to aerial spraying
- use all available resources
- additional donor assistance

Figure 4. Control strategies during upsurges and plagues.



Control during upsurges and plagues

There is a continuum of infestation levels between the first stages of an upsurge and a full plague. It will always be extremely difficult to warn of developments during an upsurge and to estimate their likely scale. Locust behaviour is likely to change rapidly during an upsurge, with populations becoming progressively larger, denser and more cohesive. This progressive change will require a transfer of control methods from relying only on ground teams to ones relying primarily on aircraft and supported by ground teams (see Fig. 4). Inevitably, early upsurge campaigns will be less well organized, using whatever resources are already available, or which can be obtained at short notice. When an upsurge has reached an advanced stage, with the population overwhelmingly in bands and swarms, aerial control will be needed.

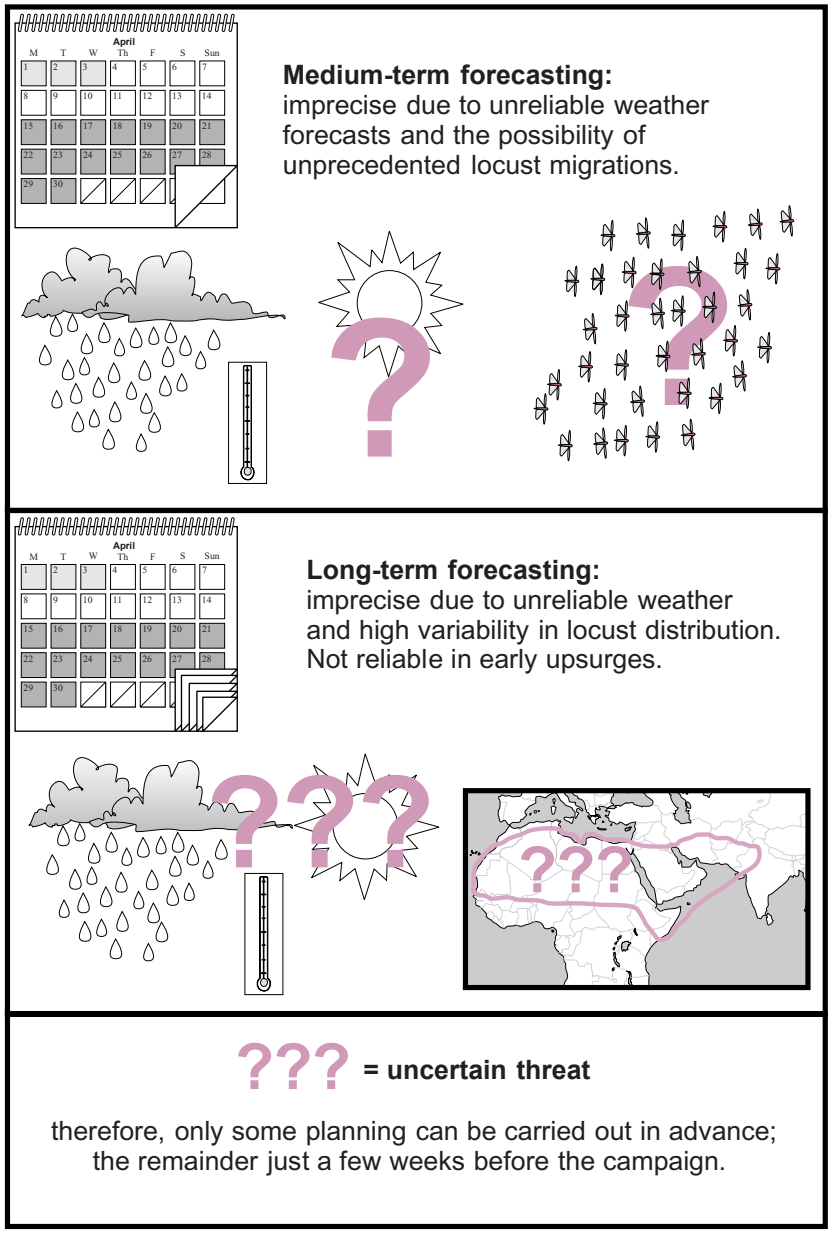
An example of a control campaign during an upsurge

Mauritania 1993-94:	
Campaign duration	7 months
Cost	US$ 7 000 000
Area treated:	
ground	215 934 ha
air	618 466 ha
total	834 400 ha
Pesticide used	560 000 litres
Number of aircraft used (flying hours):	
fixed-wing	12 (1 495 hours)
helicopter	2 (430 hours)
Number of vehicles used:	
4x4	95
10 t trucks	14
Staff	331 people

FAQ number 2 (see p. 54 for answers)

Is it better to control immediately or wait for locusts to concentrate and form dense targets?

Figure 5. Advanced planning will be limited by the reliability of medium-term (4-6 weeks) and long-term forecasts.



WHAT STEPS TO TAKE IN ADVANCE

Advanced warning

Both locust migration and breeding depend on the weather, which cannot be predicted more than a few days ahead (see Fig. 5). The FAO Desert Locust Information Service (DLIS) in Rome is in the best position to forecast locust developments for the medium term (4-6 weeks). For longer-term forecasts the most that can be expected from DLIS is a general warning, up to six months in advance. Such a warning will apply to a region as a whole, not to a specific country, and the scale will be able to be estimated only in very general terms. Advanced warnings are particularly unreliable during the early stages of an upsurge.

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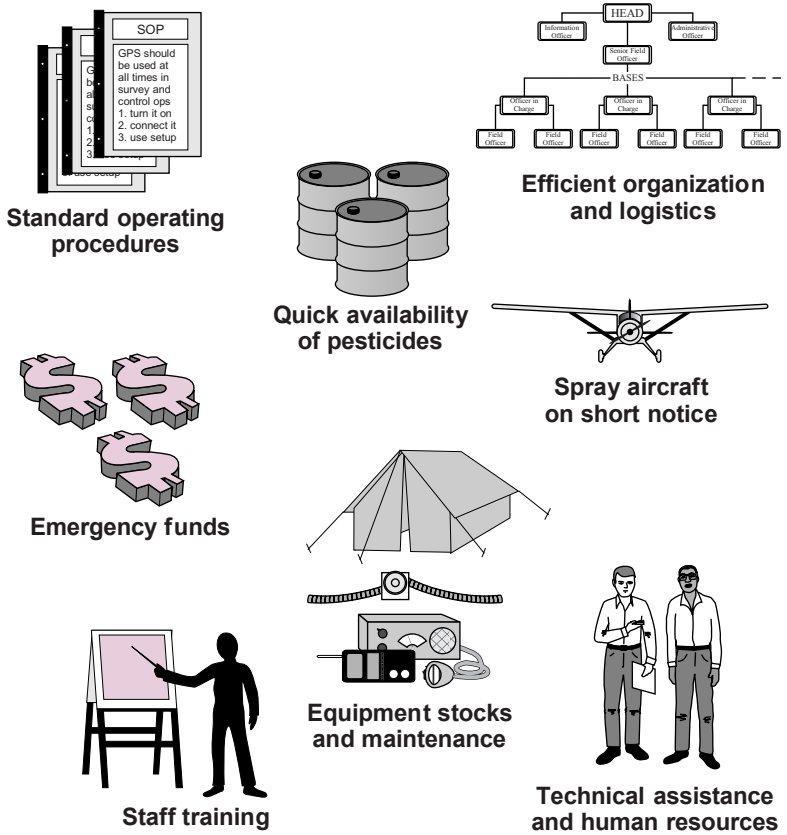
FAQ number 3 (see p. 54 for answers)

How does a country receive advanced warnings of invasions?

Figure 6. An effective contingency plan consists of several different components.



Tip: a good contingency plan will consist of several scenarios involving different levels of locust infestations (e.g. low, medium, high). The resources required for survey and control should be estimated for each scenario. The different infestation levels should be based on the current situation in your country and in neighbouring countries, ecological conditions, rainfall forecasts, the likelihood of breeding, the risk of invasion, historical frequencies and previous experience. In view of the unpredictable nature of the Desert Locust, any contingency plan should be constantly updated as these conditions change over time.

Contingency plans

Dealing with a plague or other major infestations will almost certainly require greater resources than are available in a country during a recession. For countries outside the recession area, there is unlikely to be any permanent locust control capability. Contingency plans should be developed in the former case to build on the limited capability already in place, and in the latter to create a capability quickly (see Fig. 6).

Precise contingency plans will vary greatly from country to country depending on the size of the area potentially at risk, the value of the crop in that area, the governmental organizational structure and the resources that might be tapped. Nevertheless, any contingency plan should take account of the following matters:

- develop a plan of action
- who decides when the plan should be put into operation and in what circumstances
- who should monitor the locust situation in order to advise the officer authorized to initiate the operation of the plan
- who should be in charge of the execution of the plan
- what should be his or her authority and what human and material resources should he/she have the power to requisition and from whom

The plan should include:

- standard operating procedures for survey, control and reporting
- provision of spray aircraft at short notice by preparing model hire contracts and keeping in touch with operators who might accept such contracts
- ways of quickly acquiring pesticide in substantial quantities
- a means of authorizing emergency funds both for aircraft hire and pesticide purchase, and for operations
- an organizational structure both to allow efficient operation and to keep track of expenditure
- training of staff liable for secondment, especially in ULV control
- provision of equipment which would be difficult to procure quickly such as HF and UHF radios, camp equipment, and pesticide pumps
- provision of technical assistance. FAO should be contacted to find out whether technical or material assistance can be provided quickly

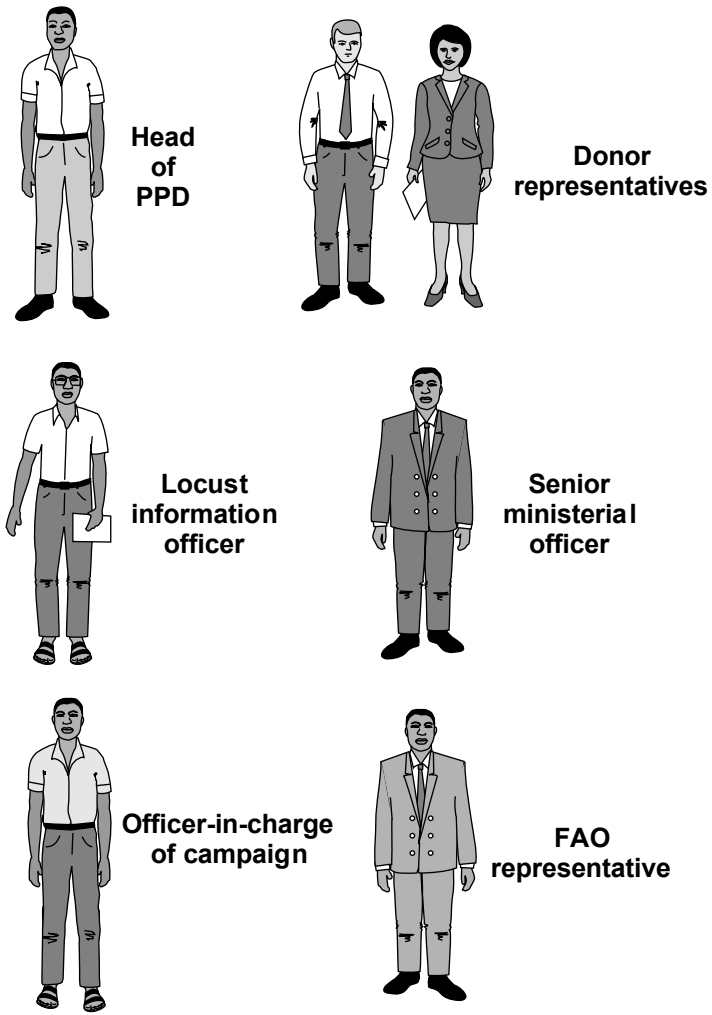
In some countries, the Ministry of Defence may help with locust control. This works best if there has been careful liaison in advance. The army or air force will have its own organizational structure that must operate in parallel with that of the Plant Protection Department. Although this can create potential difficulties, it is important, nevertheless, to involve them during campaigns.

It would be a good idea to test any contingency plan by a simulated exercise in which a substantial number of swarms are assumed to invade the country with little warning. FAO can be asked to devise such an exercise.

Summary of preparations for a campaign:

- establish a Donor Steering Committee
- pesticide provision
- choose aircraft type and make contract
- hire and train extra staff

Figure 7. Potential members of a National Donor Steering Committee.



Preparations

The unspecific nature and lack of reliability of longer range forecasts presents a major problem. Neither countries themselves nor donors are likely to be willing to provide resources to combat an uncertain threat. Donors may well require a reasonably precise forecast before being willing to act and such a forecast may be possible only a few months, and indeed sometimes only a few weeks ahead. Moreover, unprecedented migrations have occurred in the past and will surely occur in the future.

It may be difficult to obtain funds sufficiently far in advance in order to provide the resources necessary to run a campaign. FAO should be contacted at the first signs of an impending invasion or of a large increase in locust numbers.

Donor steering committee

At the first signs of a locust upsurge or invasion, a committee should be established to monitor the locust situation and coordinate donor assistance. Given FAO's role as the globally-recognized coordinator of locust management, such a committee is often initiated by joint-action between the FAO representative and senior officials in the Ministry of Agriculture. If there is no FAO representative in the country concerned, the United Nations Development Programme (UNDP) representative will usually act for FAO. The committee, usually known as a Donor Steering Committee, should consist of donor representatives, the FAO representative, the head of PPD, the Officer-in-charge of the campaign, the Locust Information Officer and concerned parties such as ministries and other national agencies that have an important say and contribution to the locust campaign (see Fig. 7). The exact composition of the committee will vary from country to country. It is the responsibility of each country to determine who best should serve as members of the committee. Information on the campaign and the state of resources is normally supplied by the Locust Information Officer. They are reviewed by the committee during regular meetings, usually weekly or monthly, according to the urgency of the situation.

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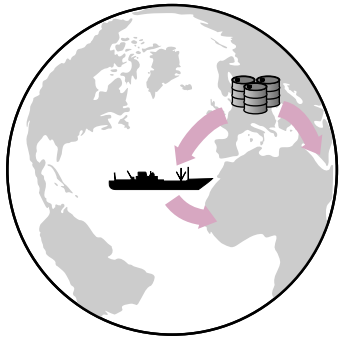
FAQ number 4 (see p. 54 for answers)

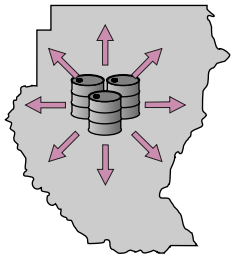
How often should a donor steering committee meet and who should be the chairperson?

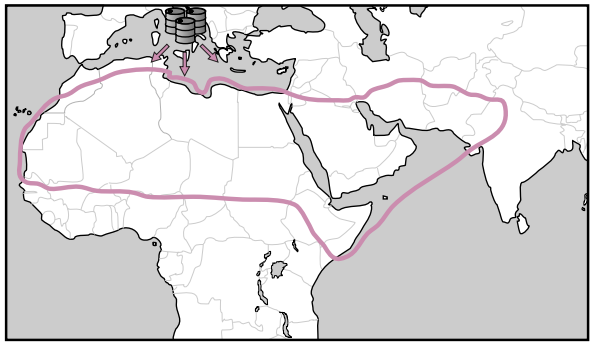
Figure 8. Some possible means of providing pesticides for locust control campaigns.



Normal delivery time: 1-3 months by sea

Permanent country stocks can be expensive and unsafe





A donor-supported pesticide bank to allow quick airfreight of pesticides during emergencies

Pesticide provision

The procurement, delivery, internal transport, storage and disposal of pesticides is probably the most difficult part of managing a locust control campaign. Yet, as they often represent more than 50 percent of the total cost of the campaign, it is important to manage pesticides as effectively and efficiently as possible.

Most countries are unlikely to be able to apply more than about 120 000 litres of ULV pesticide effectively during an eight to ten week campaign. Allowing about 40 000 litres of extra pesticide for positioning difficulties, a total of about 160 000 litres would need to be acquired at a cost of about US$2 million. Few countries will be able to afford this sum. Once the pesticides are ordered, it usually takes from one to three months for delivery by sea (see Fig. 8). Therefore, it is unlikely that donor aid can be organized quickly enough to allow pesticides to be supplied within the period for which reasonably reliable forecasts are possible. An obvious alternative is to hold stocks in the country on a permanent basis. This, however, is very costly since many countries would have to be supplied. Moreover, pesticide must be stored carefully, and even then it deteriorates. In a particular country, decades may pass before there is a major invasion, yet in a hot country the shelf-life of a pesticide will be no more than a few years. This means the pesticide might have to be disposed of and replaced. Proper disposal is difficult and expensive but is essential otherwise the pesticide may become a health hazard. To avoid this, the pesticide might be used on other agricultural pests and replaced. That might require repackaging and possibly reformulation.

Another possibility could be to acquire pesticide from stocks available in neighbouring countries. This is only likely to be feasible if that country is willing to give up stocks when they themselves may be threatened by Desert Locusts or in the midst of a control campaign. The pesticides must not be obsolete or of the wrong formulation. They must be delivered quickly to the requesting country. Transport costs could be covered by FAO or by donors in an arrangement that is sometimes known as triangulation, i.e. three parties, the pesticide supplier, the pesticide recipient and a third party that pays the transport costs.

A partial solution to the overall problem of pesticide supply would be the development of a donor-supported pesticide bank from which pesticides could be airfreighted only where and when they are needed. There would even then be distribution problems within the country, but these will always exist. Distribution problems can be overcome only to a limited degree by placing stocks in the field in advance, and only then if pesticides are available in very large quantities. During a campaign, repositioning of pesticide is almost always necessary. The establishment of a pesticide bank may not occur until FAO has declared a general locust emergency.

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FAQ number 5 (see p. 54 for answers)

Has a pesticide bank been established for locust control?

Desert Locust Guidelines

Figure 9. A comparison between fixed-wing aircraft and helicopters for use in locust campaigns.

	Fixed-wing	Helicopter
Endurance	Long-distance	Short-distance
Pesticide tank size	Large capacity	Small capacity
Observer seats	Varies by aircraft	Varies by aircraft
Target visibility	Good (upper wing configuration) Poor (lower wing configuration)	Good
STOL	Varies by aircraft	Excellent
Fuel availability	Good (AVGAS type) Poor (JET A1 type)	Poor
Suitability	Spraying large, flat areas (e.g. coastal or interior plains)	Spraying in small inaccessible areas (e.g. mountain valleys)
Operating cost	Inexpensive	Expensive
Main advantage	Large-scale control	Airstrip not required

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FAQ number 6 (see p. 54 for answers)

Are there other possibilities of using aircraft for transport purposes?

Choice of aircraft

You should decide which type of aircraft is best suited for your country (see Fig. 9). Fixed-wing aircraft are useful for spraying large, flat areas such as plains along a coast or in the interior of a country. Helicopters may be more useful for spraying in mountainous terrain where infestations are in small inaccessible areas. A suitable aircraft, whether fixed-wing or a helicopter, for locust campaigns should have the following characteristics:

Endurance. Aircraft must often operate at a substantial distance, sometimes at distances of 100-200 km, from the base, which means that they must have good endurance. Small helicopters have limited endurance, poor payload capacity (often they cannot carry more than 200 litres of pesticide) and are relatively slow.

Moderate pesticide tank size. The size of the pesticide tank should be balanced with good endurance. Spray tank capacity of most aircraft is not more than about 2 000 litres. Endurance is not more than four or five hours. A spray aircraft applying ULV pesticide may not need a large capacity pesticide tank if it is unable to spray more than 300 litres of ULV pesticide during one sortie. However, this may differ for barrier treatments for which a larger tank would be desirable.

Observer seat. The ability to carry an observer can be useful in locust operations. If this is not possible, then the observer should be on the ground, equipped with ground-to-air communication for supporting and supervising the spray operations.

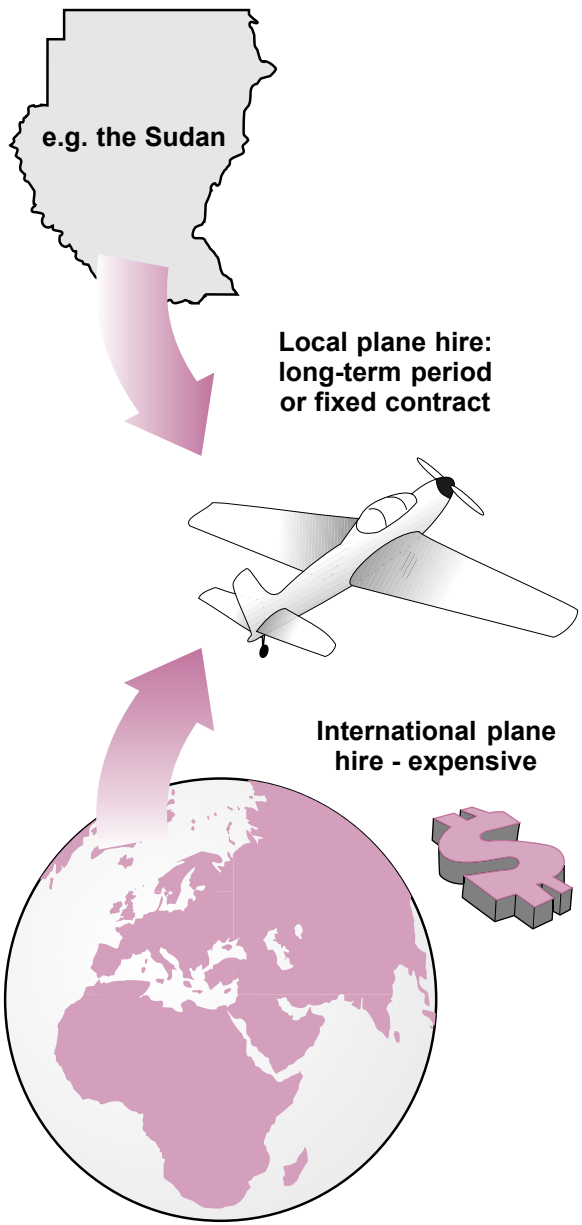
Good target visibility. This is important in order to see the spray targets properly. Aircraft with overhead (upper) wings are preferable because they have better visibility.

STOL. Robust construction with short takeoff and landing (STOL) characteristics are needed so that the aircraft can operate from rough, makeshift airstrips. A tricycle undercarriage is not desirable since such an aircraft may flip over if the front wheel hits a pothole on takeoff or landing. Use of a helicopter avoids these problems.

Fuel availability. Aircraft use either AVGAS or JET A1 (kerosene) fuel. The choice should be made according to what is available in the country. This may limit further the choice of helicopters. For example, if the helicopter must use AVGAS there are perhaps no more than four types of suitable helicopters available, all with similar operating characteristics.

Detailed characteristics of aircraft and helicopters that are in common use for locust survey and control are given in Appendix 1.12.

Figure 10. Aircraft can be hired locally or from abroad.



Aircraft contracts

Suitable aircraft will be available for local hire in only a few countries. This means that in many cases contracts will have to be arranged with overseas companies (see Fig. 10). A requirement to supply fuel and other logistical support can be included within a contract. This may be desirable, even though it will increase the hire rate substantially. Companies supplying aircraft from overseas incur a considerable expense simply through positioning the aircraft, so they demand either a high positioning charge or a guaranteed usage in aircraft hours. Contracted spray aircraft should have the required equipment for ULV locust spraying (see Appendix 2.7).

If aircraft are available locally, it may be possible to arrange a long-term period contract. These contracts are usually for several years, although they can be written to cover seasonal use only. The guaranteed usage is low and the hourly rate also relatively low, but the aircraft are not always available as the company may have a prior booking. However, aircraft can usually be supplied quickly to combat an unexpected emergency if a contract is already in place. A period contract is cheaper than a fixed contract, but it requires trust between the PPD and the aircraft company. It should be possible to write period contracts for the supply of aircraft if and when needed throughout the invasion area, but such a scheme would have to be underwritten by donors. If this is not feasible, one alternative may be to equip other locally available aircraft, such as those used by the military, for locust survey and control.

FAO maintains a list of firms who can supply suitable aircraft for locust campaigns. FAO may also be able to assist with preparation of contracts, whether for local hire or for the employment of firms from outside the country.

Tip: an aerial contract should be as detailed as possible to avoid any misunderstandings or confusion between the contracted company and the Locust Unit.

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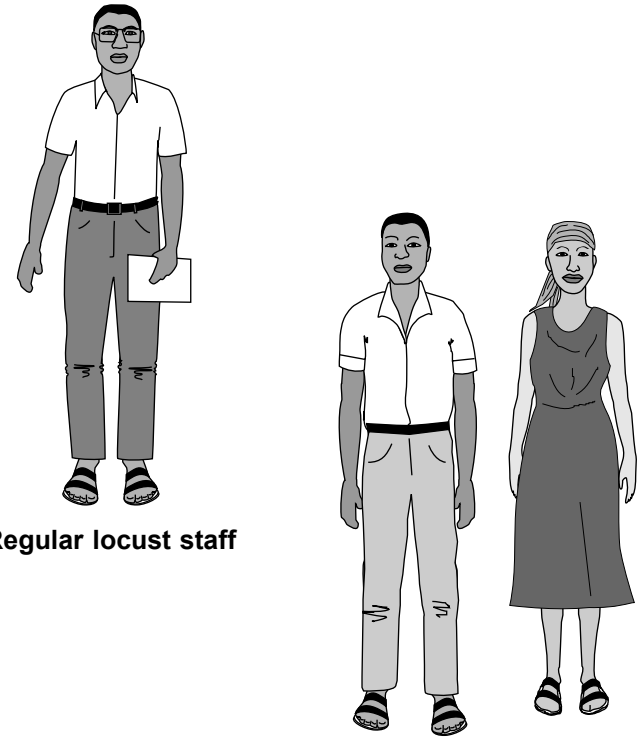
FAQ number 7 (see p. 54 for answers)

Can I use aircraft that may be available from Plant Protection Departments of nearby locust-affected countries?

Figure 11. During locust campaigns, local people can be recruited to supplement regular staff.



Regular locust staff

Seconded locals

Secondment of staff and training

A major campaign is likely to need more people than are regularly deployed on locust work during a recession (see Fig. 11). People who can be seconded for locust control operations during an emergency should be designated in advance. These officers should be given training, both by formal courses and by short-term secondments for locust duties. This would take the form of attachment to the Locust Unit where such a unit exists. The number of extra staff which can be usefully employed is limited, and is certainly no more than two to four seconded officers for every officer employed routinely on locust work. As with aircraft, so with seconded staff – the provision of more resources than can be effectively deployed is not merely wasteful, it is counterproductive.

In most countries outside the recession area, a campaign will have to be run almost wholly by seconded officers.

?

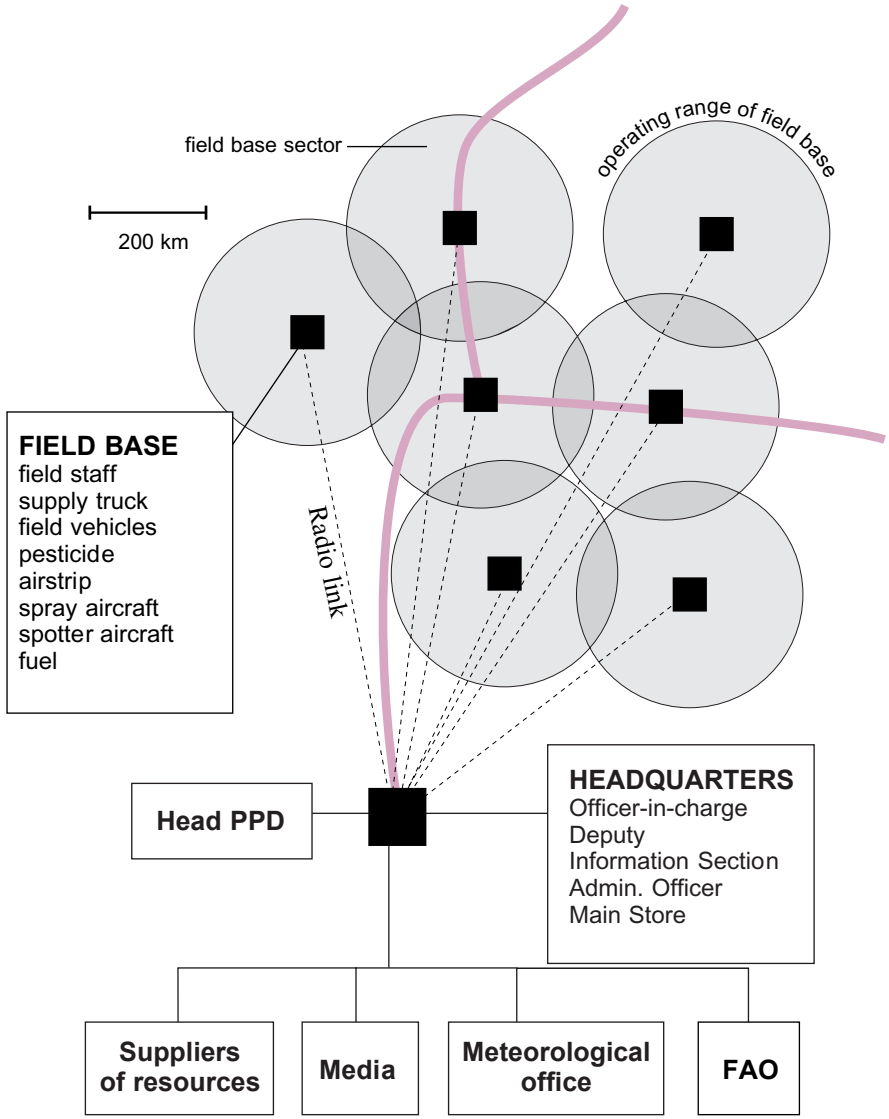
FAQ number 8 (see p. 54 for answers)

Who will pay for seconded officers?

Summary of campaign organizational structure:

- centralized HQ
- field bases for survey and control

Figure 12. One example of an organizational structure of a campaign.



HOW TO ORGANIZE A CAMPAIGN

An aerial control campaign should be based on the structure of the Locust Unit. If a Locust Unit does not exist, a comparable structure will need to be created. There should be one officer in sole charge of the campaign who has full decision power; he/she would normally be the head of the Locust Unit where there is a unit.

The campaign should be organized from a headquarters in radio contact with all the field operations and also in touch with sources of supply of pesticide, fuel and other materials, and with senior officials of the PPD, donor representatives, the National Meteorological Service and FAO (see Fig. 12). In most countries, the headquarters of the campaign will be located at the headquarters of the Locust Unit. If the locust infestations are far from the Locust Unit headquarters, then the headquarters may need to be established in the field near the infestations.

The field operations will usually need to be divided among a number of field bases, each operating from an airstrip within their respective sectors. If the locust infestations are localized and confined to a single area or if the aim is to prevent swarms reaching a relatively small area of high value crop, then the campaign can be run from a single base. Each field base should have an Officer-in-charge who is answerable solely to the Officer-in-charge of the whole campaign. The Officer-in-charge of the field base should have experience or at least training in aerial locust control. A typical setup is illustrated in Fig. 12.

Several specialized teams may need to be established that move throughout the field between field bases and headquarters during a campaign. A team may be required to repair and maintain vehicles, sprayers and other equipment. Another may be needed to conduct health and safety checks of the control staff. A third may be useful to monitor environmental impact and assessing control efficacy. See the Safety and environmental precautions guideline for more details.

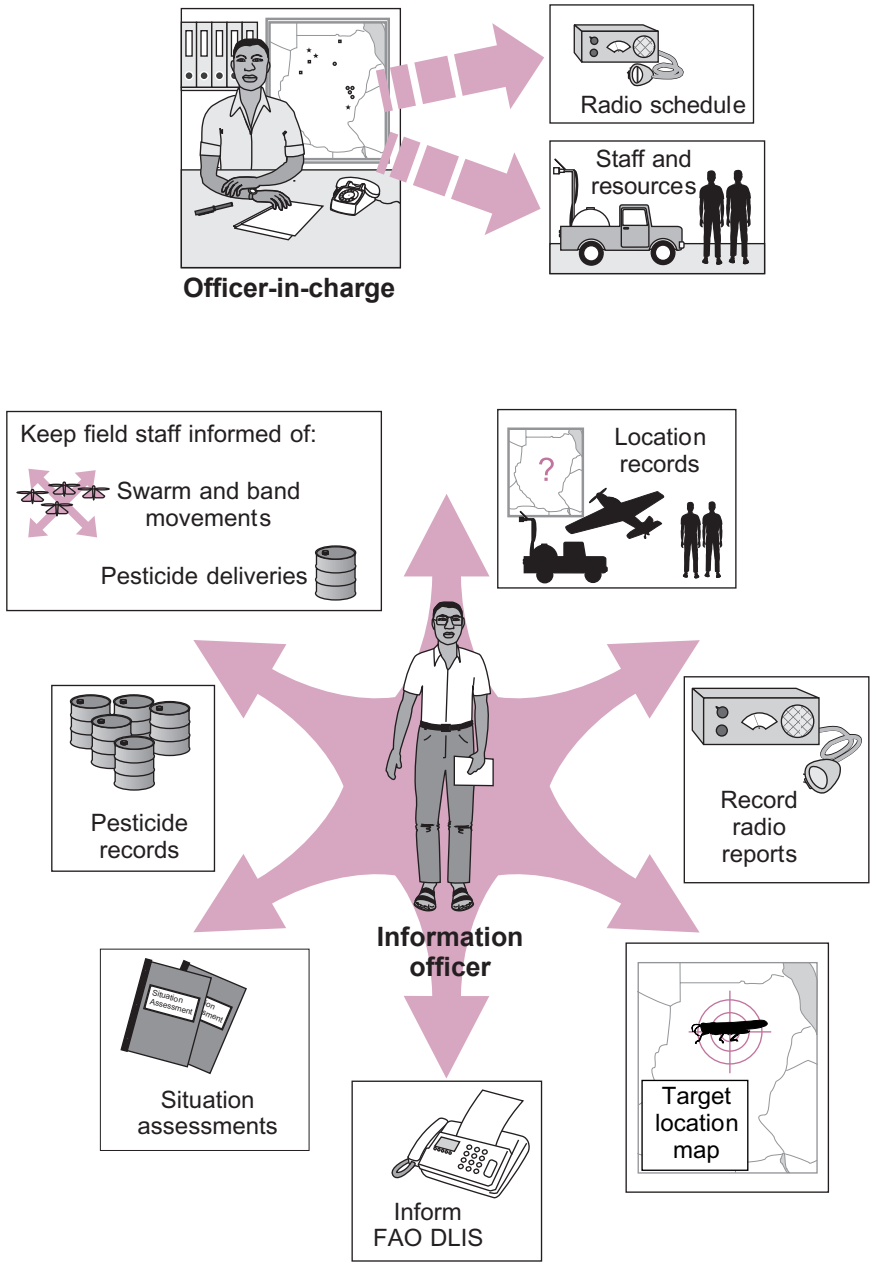
Tip: an effective locust control campaign relies on the active involvement of ground teams that complement and support the aerial teams. Both teams must collaborate closely with each other.

?

FAQ number 9 (see p. 54 for answers)

Can a campaign be decentralized where each province is responsible for survey and control operations?

Figure 13. Headquarters staff and their duties.



Headquarters

At the very minimum, the headquarters staff should consist of an Officer-in-charge of the campaign and a deputy (who would normally be the Senior Field Officer of the Locust Unit), an Information Officer possibly with an assistant, and an Administrative/Logistics Officer. Each of these people have specific duties (see Fig. 13).

The Officer-in-charge of the campaign or, if he/she is in the field, his/her deputy, should:

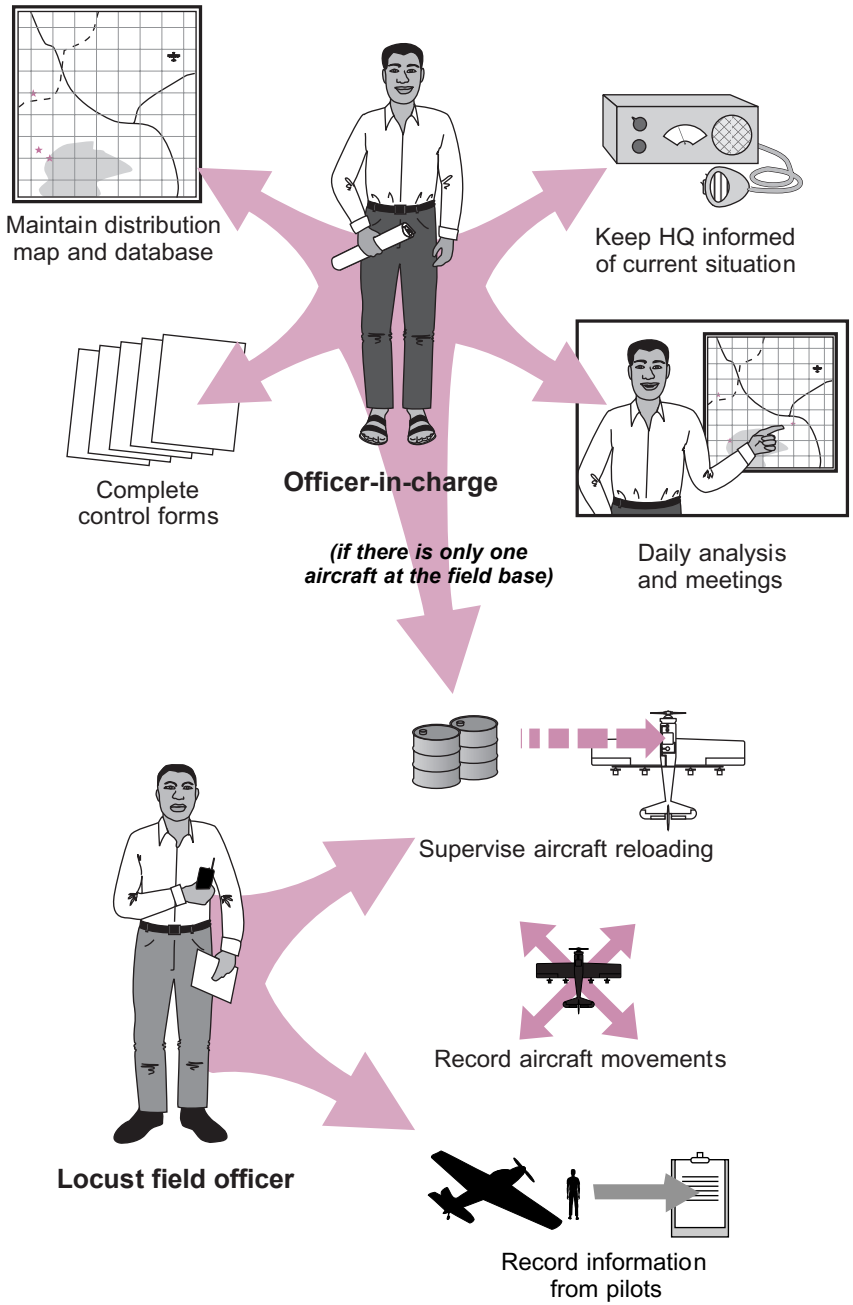
- attend the daily scheduled radio calls
- decide which equipment and staff should be deployed, after discussion with the Information Section. This should be communicated at the next radio schedule, although there may sometimes be a need for immediate decisions without time for discussion

The Officer-in-charge of the campaign must have other resources, such as supply trucks, under his/her sole control so that he/she can order deployment and redeployment. There must be a clear chain of responsibility and no division of authority. To assign resources to officers not under the control of the Officer-in-charge of the campaign is to invite confusion, inefficiency and failure.

The Information Officer and his/her assistant should:

- record all radio reports each day
- maintain a map of all target sightings and all target attacks
- keep a record or a database of all pesticides used by each field base, and the location and amount of pesticide and fuel stocks
- record the position of all locust staff, aircraft and vehicles. *Note*: it is useful to present as much of the information as possible in a map form as well as by a written record
- inform teams in the field of the overall situation including expected swarm movements and pesticide deliveries
- prepare assessments of the situation on a weekly basis
- keep FAO DLIS and neighbouring countries regularly informed in a timely manner about the locust situation and the control operations

Figure 14. Field base staff and their duties.



Field bases

The primary activities of the field base are finding and marking targets for control, supervising and directing spray aircraft for control of these targets, deploying spotter aircraft and ground teams to search for additional targets and planning the daily operations.

Aerial control will normally be carried out by single-engine aircraft with limited endurance and pesticide tank capacity. Covering an area of the size likely to be infested during a plague will require a number of field bases, each established at an airstrip. The area which can be covered from a field base will depend on the type of aircraft located there. An endurance of four hours will give a maximum operating range of about 200 km for a spray aircraft (see Fig. 12).

A field base should have an Officer-in-charge and several other Locust Field Officers to direct the operation of one or more spray aircraft and possibly other spotter aircraft (see Fig. 14). Field bases may also be equipped for limited ground control operations but this may not be ideal since ground teams may not be very motivated to treat when aerial control possibilities exist in the same area. Locust Field Officers could carry out ground surveys if they are not fully occupied in supporting aircraft operations.

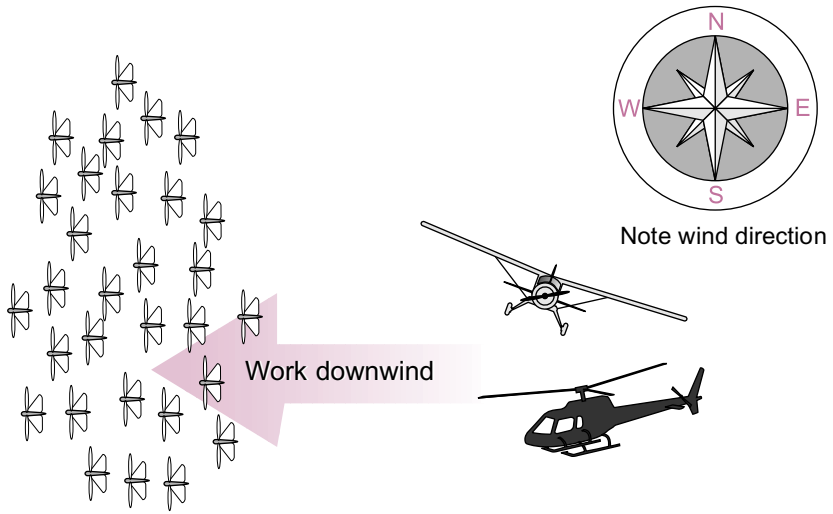
The Officer-in-charge of the field base should:

- maintain a map of the area (sector) within his/her charge on which all target sightings and all target treatments are shown
- make sure control forms are completed for all sorties and file these
- inform headquarters each day by radio of the previous day's sightings and operations and the pesticide and fuel stocks on hand
- hold a daily briefing/debriefing meeting for the officers at the field base and the pilots to obtain the information needed to complete the control forms. Deployment can also be decided. The map of targets and treatments will assist greatly by showing which sectors contain most targets, which sectors need checking and, in the case of swarms, in which direction movement is most likely

A Locust Field Officer should be present before and during the spray operation at the target site. This is especially important in areas where there are no other survey teams present. One officer should always remain at the field base. He/she should:

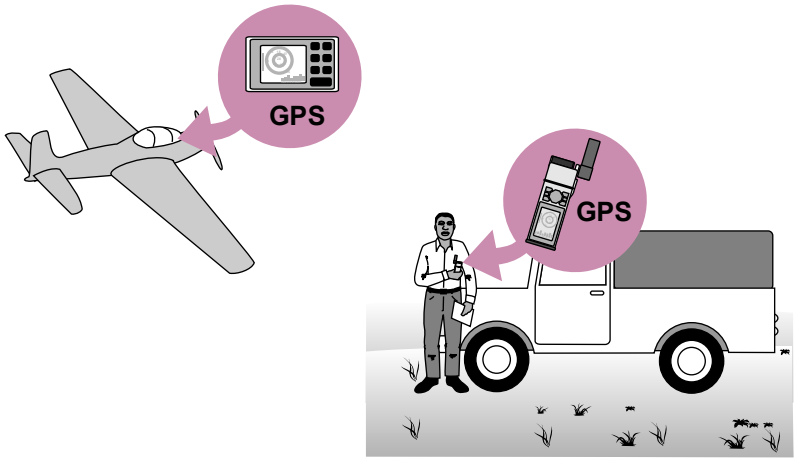
- maintain radio contact with the aircraft and any officers out searching by vehicle
- supervise aircraft reloading operations
- make a record of every aircraft movement
- if there is no Locust Field Officer as observer in the spray plane and no one on the ground at the spray site, information given by the pilot should be recorded

Figure 15. Using aircraft to relocate swarms.



Distance swarm has travelled = **Wind speed** × **Time since last sighting**

Figure 16. Determining the position of the locust target to be sprayed.



Relocating flying swarms

Swarms always move downwind over any large distance. Anyone who locates a swarm should attempt to note the wind direction. If there are no clues visible from the aircraft, throwing out a streamer will show the direction of the wind. When a streamer (such as a paper roll) hits the ground, the tail will point downwind.

To re-establish contact with a swarm, the aircraft should start from the last contact location and look for the swarm in a direction that is downwind (see Fig. 15). The limit of the distance it is worth travelling will depend on the wind speed and the time which has elapsed since the last sighting. Swarms will never move significantly faster than the low-level wind. However, swarms may not fly at all in very strong winds. Ground teams can follow swarms in accessible areas, alert other nearby teams about passing swarms and search for any swarms that may have settled shortly after sunset.

Determining target position

The position of a target found during a search must be determined so that it can be found by the spray aircraft. Even when search and control are combined, it is important to know where the control was carried out. Handheld GPS devices are available at reasonable cost. These give latitude and longitude and certain other information. A GPS should be fitted to all spray and spotter aircraft (see Fig. 16). This should be a requirement in all aircraft hire contracts (see Appendix 2.7). These devices will be an important addition to conventional map reading.

See the Control guideline for more details on how to find and delimit targets.

?

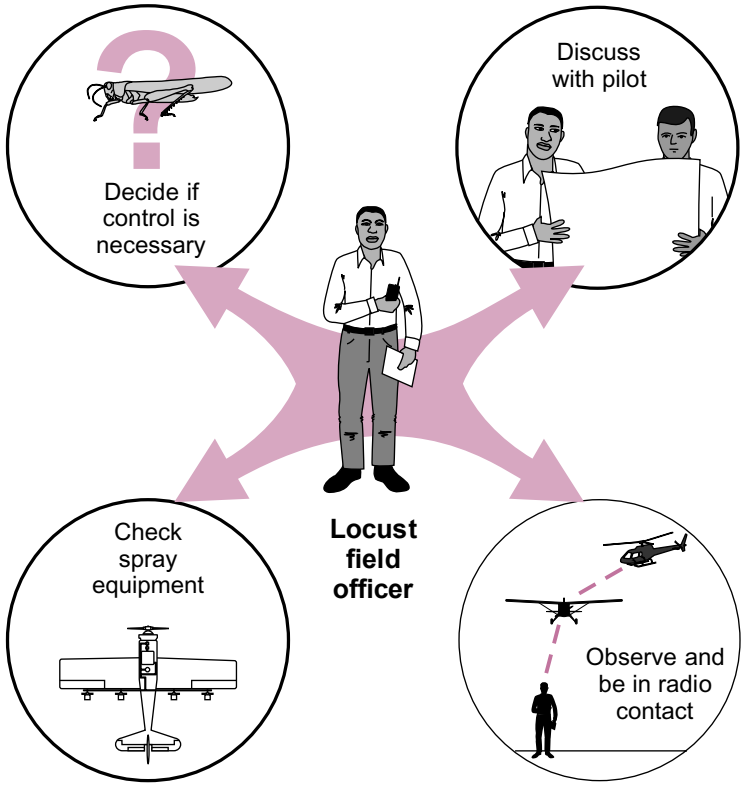
FAQ number 10 (see p. 54 for answers)

What is a differential GPS and when should it be used?

Summary of Locust Field Officer duties when supervising aircraft:

- determine if control is required
- decide upon the application method and calibrate the sprayers
- select the spray targets
- be on the ground (or in the air) at the spray site
- be in radio contact with the pilot
- ensure that there are no people or animals near the spray site

Figure 17. Supervising and directing spray aircraft.



Supervision and direction of spray aircraft

The pilot is in sole charge of the aircraft, and only he/she can decide whether or not it is safe to operate. The selection of the target and the determination of the method of application, however, are not the pilot's responsibility, and he/she should not be expected to make these decisions. These are decisions for the Locust Field Officer either on the ground or in the spotter aircraft (see Fig. 17).

The Locust Field Officer and the pilot should understand fully the requirements of ULV applications (see Control guideline). Only the Locust Field Officer on the spot should decide whether or not control is justified and how it should be carried out. Prior to spraying, the Locust Field Officer should check the spray equipment settings, record the quantity of pesticide that is loaded and help the pilot to check the emission rate. During the operations, the Locust Field Officer should check that the pilot is spraying as recommended, for example, at the recommended height and track spacing and in the right weather conditions.

It cannot be emphasized too strongly that the success or failure of a campaign depends on the decisions taken by the Locust Field Officers. The cost of an aircraft, and the pesticide it applies, will be about US$10 000 a day. Whether or not this money is wasted depends on the judgement of the Locust Field Officer. Aircraft and pesticide, by themselves, will not solve the locust problem. Without well trained Locust Field Officers, backed by a good organization, the materials will simply be wasted.

A Locust Field Officer should always be at the spray site and in radio contact with the pilot of the spray aircraft. He/she should ensure that there are no people or animals nearby. Flagmen should be present on the ground to guide the pilot unless the aircraft is equipped with a differential GPS (DGPS) unit or a spotter aircraft is assisting the spray pilot. If a pilot is only given the coordinates of the target and told to go and spray it, he/she can use the GOTO function on the GPS but, in the absence of ground support, the pilot may have difficulty in identifying the target to spray from the air.

Figure 18. Using separate aircraft for spotting and control.

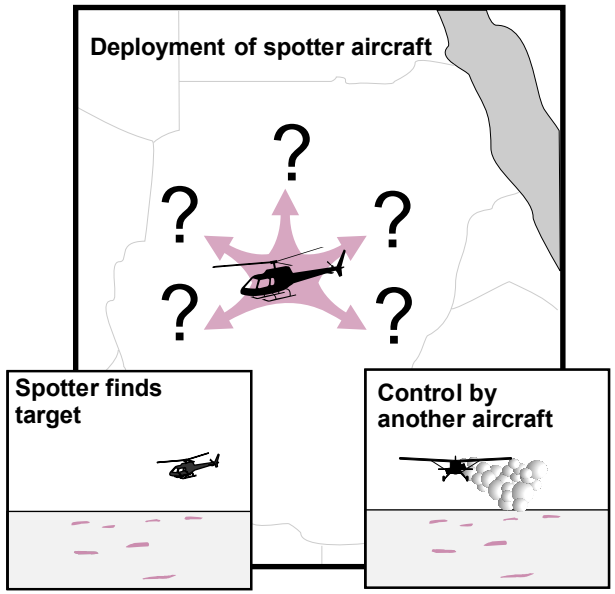
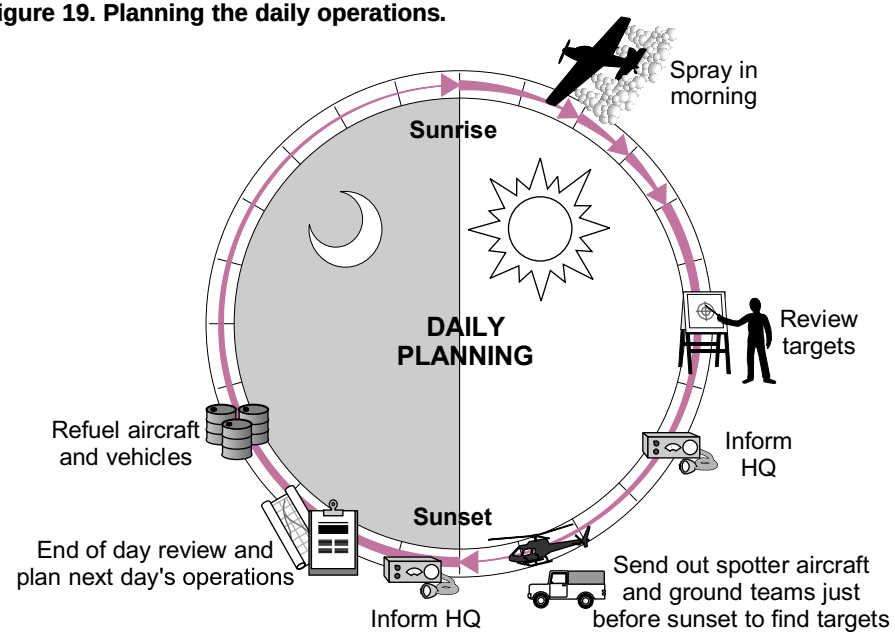


Figure 19. Planning the daily operations.



Deployment of spotter aircraft

The role of a spotter aircraft is to find targets that can be treated by a spray plane (see Fig. 18). The choice of where to deploy spotter aircraft is difficult since there are rarely enough for every field base to have one. Field bases must share aircraft, so deployment must be decided by headquarters on the basis of the daily analysis of the overall situation.

Once the spotter plane finds a target, the GPS coordinates should be radioed to the spray plane or to the field base. In the case of bands, it may be possible in a few days search to line up targets which will occupy the spray planes for some time.

Helicopters can also be used as spotters and have the added advantage of being able to land to confirm a potential control target. In the absence of ground marking, they can also be used to help guide the spray pilot by hovering above the target during control operations.

Microlight aircraft may also be suitable for finding targets and perhaps more cost effective than fixed-wing aircraft and helicopters.

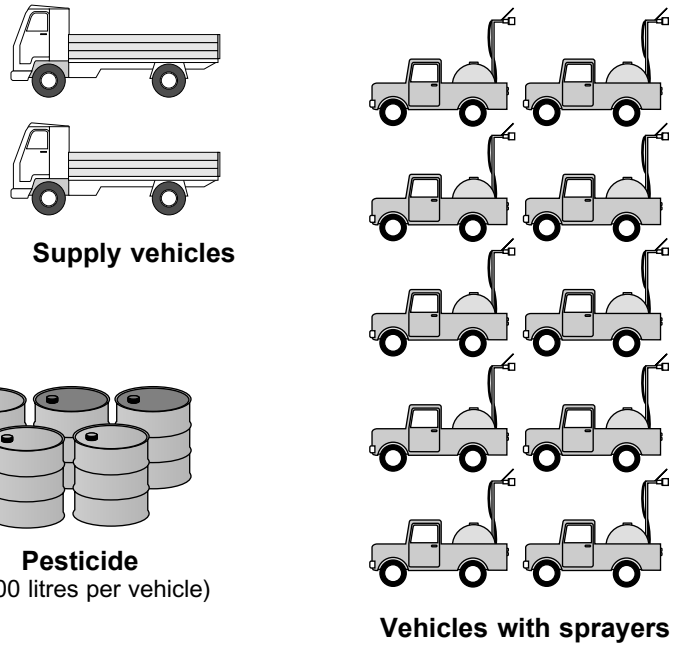
Daily planning

After spraying has finished, the Officer-in-charge of the field base should review with his/her officers and the pilots the work that had been undertaken for that day and inform headquarters (see Fig. 19). Spotter aircraft and ground teams should be sent to the field just before sunset to locate any swarms that may have settled for the day. These can be sprayed early the next morning before they take off. Based on the results, the survey and control operations for the next day should be planned at the end of each day. Moreover, aircraft and vehicles should be refuelled and all equipment should be prepared the night before to avoid losing time the next morning. A map showing which targets have been sprayed and which sectors still require survey and control will greatly assist in the decision-making. Headquarters should be kept informed on a daily basis, perhaps several times per day, and consulted when planning for the next day's operations.

Summary of ground control campaign:

- use all available vehicles and sprayers
- 1 000 litres pesticide per vehicle
- not sufficient during plagues

Figure 20. Resources for ground control campaigns.



GROUND CONTROL CAMPAIGNS

It is very difficult to assess requirements for ground control since a substantial plague infestation will exceed any feasible ground control capacity. Ground control is likely to have to make use of vehicles already in the country, which will have to be diverted from their normal duties. Once the number of vehicles that could be available has been determined, it will be necessary to obtain vehicle-mounted sprayers (see Fig. 20). A pesticide provision of 1 000 litres per spray vehicle should be adequate. Additional trucks will be needed to transport fuel, pesticide and water. One 2-tonne truck should be sufficient for two spray vehicles. A 5-tonne truck should be able to keep at least five, but not more than ten, spray vehicles operating. A 10-tonne truck is likely to be required for a field base to provide logistical support.

The difficulty of organizing ground control on a scale that will have a significant impact on a plague infestation should be appreciated. In practice, teams of spray vehicles will have to be equipped properly in order to operate semi-independently. This means that only well trained and experienced Locust Field Officers should carry out the ground spraying operation, but too few of these are likely to be available.

If the aim of the control campaign is not only to protect crops but to reduce the size of the total population and bring an end to the upsurge or plague, then in all likelihood an aerial control campaign will have to be organized and implemented.

?

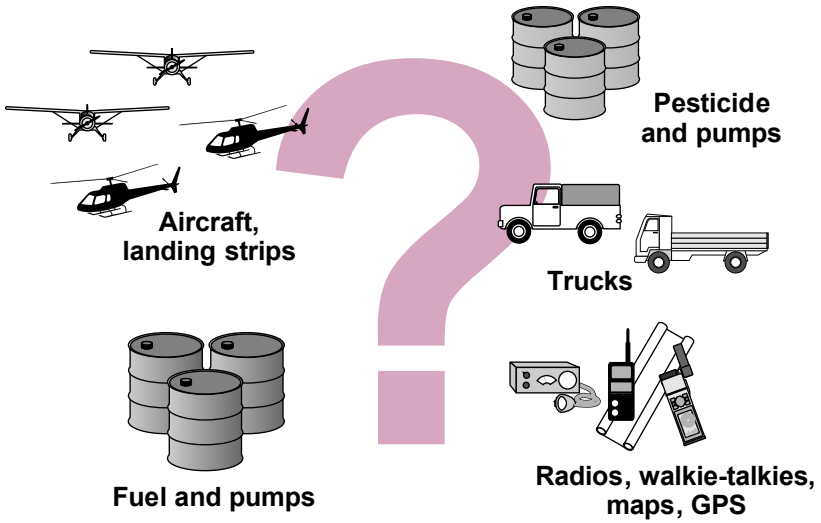
FAQ number 11 (see p. 54 for answers)

Can we rely only on ground control to prevent plagues?

Summary of general requirements

Pesticide	formulation (ULV, EC) application rate brand
Aircraft	type (helicopter, fixed-wing) fuel type (AVGAS, JETA1) use (survey, control, support) landing strips sprayers
Vehicles	type (pickup, stationwagon, truck) fuel (benzine, diesel) use (survey, control, support) size (tonnes)
Radios	type (HF, UHF, VHF) mobile, fixed, walkie-talkie
GPS	type (handheld, aircraft)
Other	pumps (pesticide, fuel) camping equipment maps and compass first-aid kit

Figure 21. Requirements for aerial campaigns.



AERIAL CONTROL CAMPAIGNS

What is required?

It is often very difficult to assess the requirements for pesticide and aircraft to combat locust infestations that are currently present (see Fig. 21). It is even more difficult to estimate the needs of aerial control campaigns in advance with any precision. This is due to the problem of accurately estimating the total area that requires treatment. This could be determined by searching for hopper bands by air but this is too unreliable, or by ground which is simply too time consuming. For swarms, the total area can be assessed only if there is a thorough aerial search so that sightings can be linked. That is rarely feasible. Moreover, an estimate requires careful plotting and analysis of reports. Therefore, planning of pesticide, aircraft, fuel, positioning, supply trucks, radios and GPS, pumps and other equipment must proceed on a different basis. General guidelines for each of these are described on the following pages.

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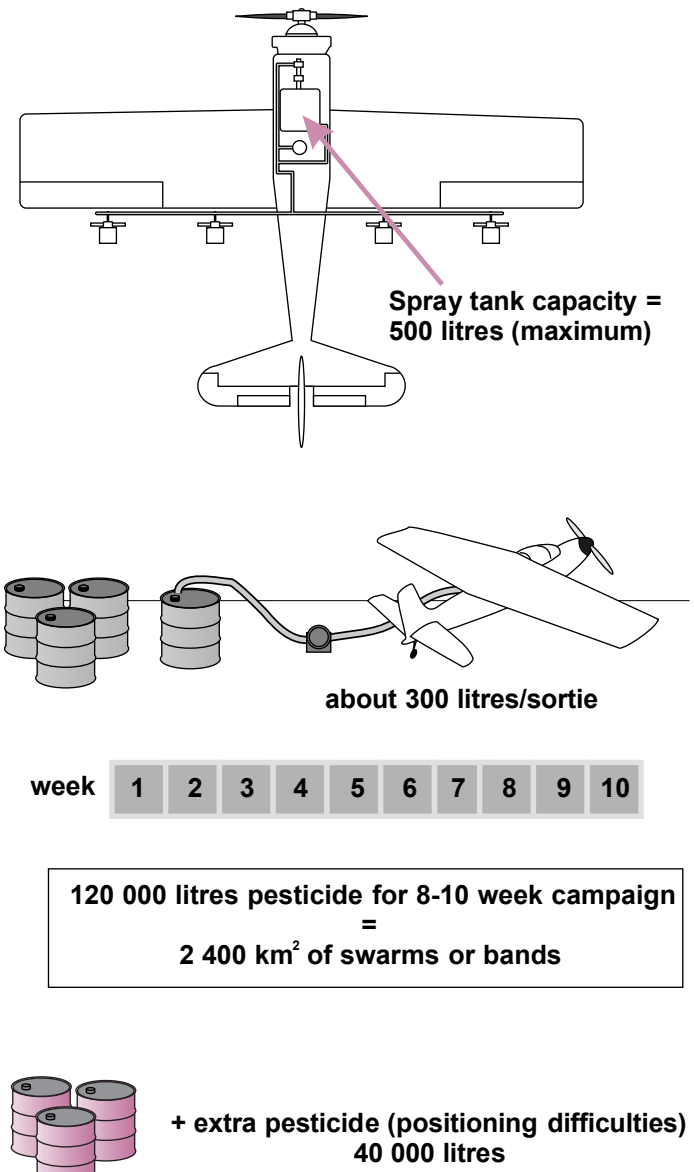
FAQ number 12 (see p. 54 for answers)

Have aerial control campaigns been undertaken recently in any countries?

Figure 22. Pesticide requirements.



Pesticide

Most of the aircraft in common use for locust control are capable of applying a maximum of 500 litres of ULV pesticide per sortie, but about 300 litres is a more realistic average (see Fig. 22). This suggests about 120 000 litres of pesticide for an eight to ten week campaign employing ten spray aircraft. At a rate of 0.5 l/ha, this could treat a total of 2 400 km^2 of swarm or of band-infested blocks. For barrier treatments, much less will be required to treat hopper bands. Positioning difficulties, however, mean that all the available pesticide can never be applied. Therefore, in order to apply 120 000 litres of pesticide, about 160 000 litres would probably need to be available in the country.

Tip: refer to Appendix 3.1 to find out which pesticides are most commonly used in Desert Locust control.

Figure 23. Requirements for control and support aircraft.

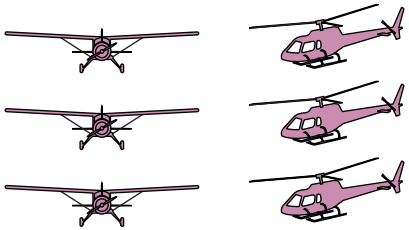
1 600 flying hours =

each plane flying
3-4 hours a day,
2 out of every 3 days,
for an 8-10 week period

Control

1 000 flying hours (aircraft) +
500 flying hours (helicopter) =

each flying
4 hours a day,
2 out of every 3 days,
for an 8-10 week period



Support

Aircraft and helicopters

There is an upper limit to the scale of a control campaign which is set by the capacity of the National Locust Unit to direct and deploy ground and aerial control teams effectively (see Fig. 23). Few countries are likely to be capable of operating more than about 20 light spray aircraft, while in many countries the maximum may be less than half that number. If there are more aircraft than there are trained Locust Field Officers to direct them, the aircraft will either spend much of the time on the ground or they will operate without direction. The latter will lead to ineffective control at a high cost.

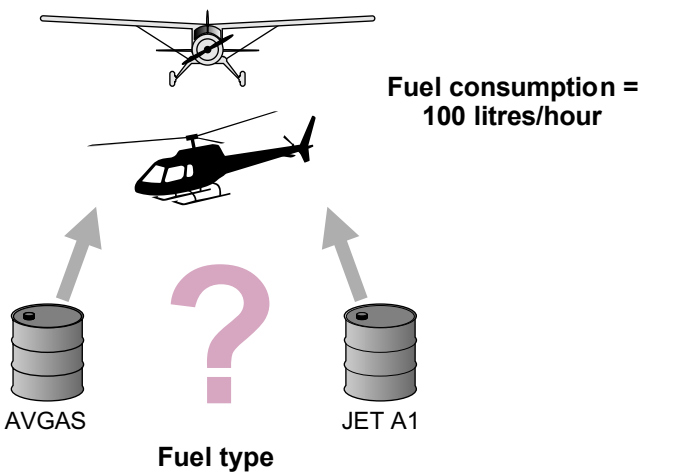
The most that can be done is to use the maximum number of vehicles and aircraft that can be deployed, assuming enough are available, as effectively as possible. This means attacking any good target that is discovered, provided the application conditions are satisfactory. There is rarely enough time to find the targets and then select the best ones for priority treatment. If there are many targets, the Officer-in-charge may decide that poor targets should be left, but in general it is better to attack every reasonable target rather than to waste time in the possibly fruitless search for a better target, especially if this search means leaving a spray plane standing idle.

A realistic spray aircraft use rate is one 3-4 hour sortie two days out of three for hoppers. The work rate with swarms will usually be higher. On the other hand, there will be a greater chance of targets not being available, because swarms move, and more time is lost repositioning aircraft to cope with the changing swarm distribution. Bad weather, shortage of targets, mechanical problems and shortage of fuel or pesticide will inevitably restrict aircraft use. This suggests a total of about 1 600 hours flying for a fleet of ten light spray aircraft during a campaign of eight to ten weeks.

A reasonable deployment to support a unit of ten spray aircraft would be three helicopters and three search aircraft. Use of search (or spotter) aircraft is likely to be greater than use of spray aircraft since spotting is possible under conditions when spraying is not and spray targets may sometimes be difficult to find. An average of four hours per day per spotting aircraft is a reasonable figure. This suggests a requirement for a total of about 1 000 hours of aircraft search and 500 hours of helicopter search to support the ten light spray aircraft. You can search with a spray aircraft but this will be more expensive than using a spotter aircraft. Target searching and marking on the ground using vehicles will be limited during times when swarms are highly mobile or when infestations are present in areas of difficult access. Therefore, aerial search and control supported, whenever possible, by ground control is probably the best method for swarm control.

Tip: include aircraft fuel, oil, positioning time and costs, pilot lodging, and logistical support in the contract with the supplier of the aircraft.

Figure 24. Aircraft fuel requirements.

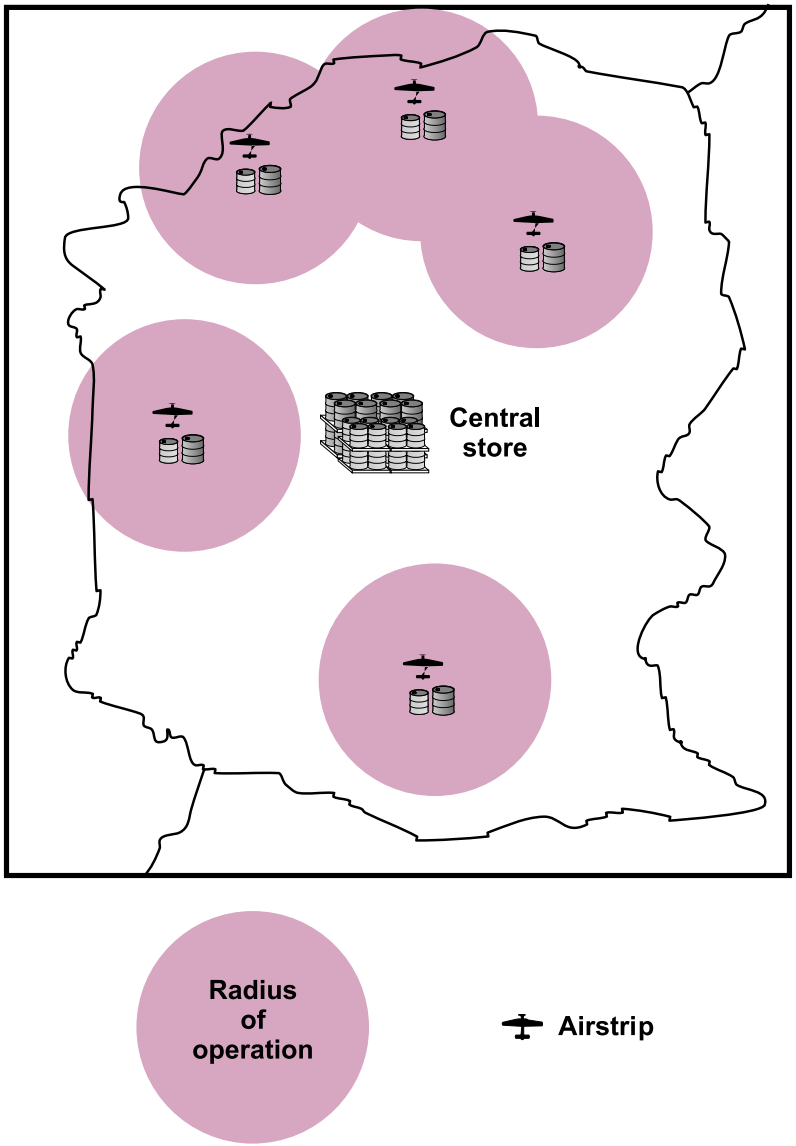


Aircraft fuel

Fuel consumption varies with aircraft type; however, for the purposes of advanced planning, it is sufficient to take a typical figure of 100 l/h for the most commonly used aircraft. This means a total requirement of about 300 000 litres of fuel (see Fig. 24). As with pesticide, positioning problems mean more fuel will be needed than will actually be used, so a more realistic figure would be 350 000 litres. Different types of fuel are needed for piston engine aircraft (AVGAS) and for turbine engines (kerosene or JET A1). The degree to which aircraft fuel is available at designated airports will vary from country to country, but Desert Locust control is often needed far from a commercial source of fuel. In general, major airports have JET fuel, but minor airports with light aircraft more commonly hold AVGAS. If the PPD has to buy and transport fuel, it is important to find out which type is easiest to obtain before a contract is arranged to hire the aircraft. If both types of fuel will be needed, there will be additional supply and distribution problems. Aircraft require significant amounts of lubricants with specific characteristics. Suitable oils must be bought and distributed. Servicing time and the location of service centres should be taken into consideration, which will add to the time that aircraft are not available for operations.

Tip: avoid the need to import aircraft fuel into your country because this can be very expensive. Instead, it is better to use aircraft for which fuel already exists in the country.

Figure 25. Prepositioning of resources within a locust affected country.



Airstrips and positioning of fuel and pesticide

The Information Officer should maintain an up-to-date map of all national airfields and usable airstrips, not merely those officially maintained. If these do not cover the area likely to be infested, additional sites should be inspected and prepared in advance by the PPD. However, there is no point in having an airstrip where there is neither pesticide nor fuel. The nearest service centres where routine aircraft maintenance checks can be carried out should be identified.

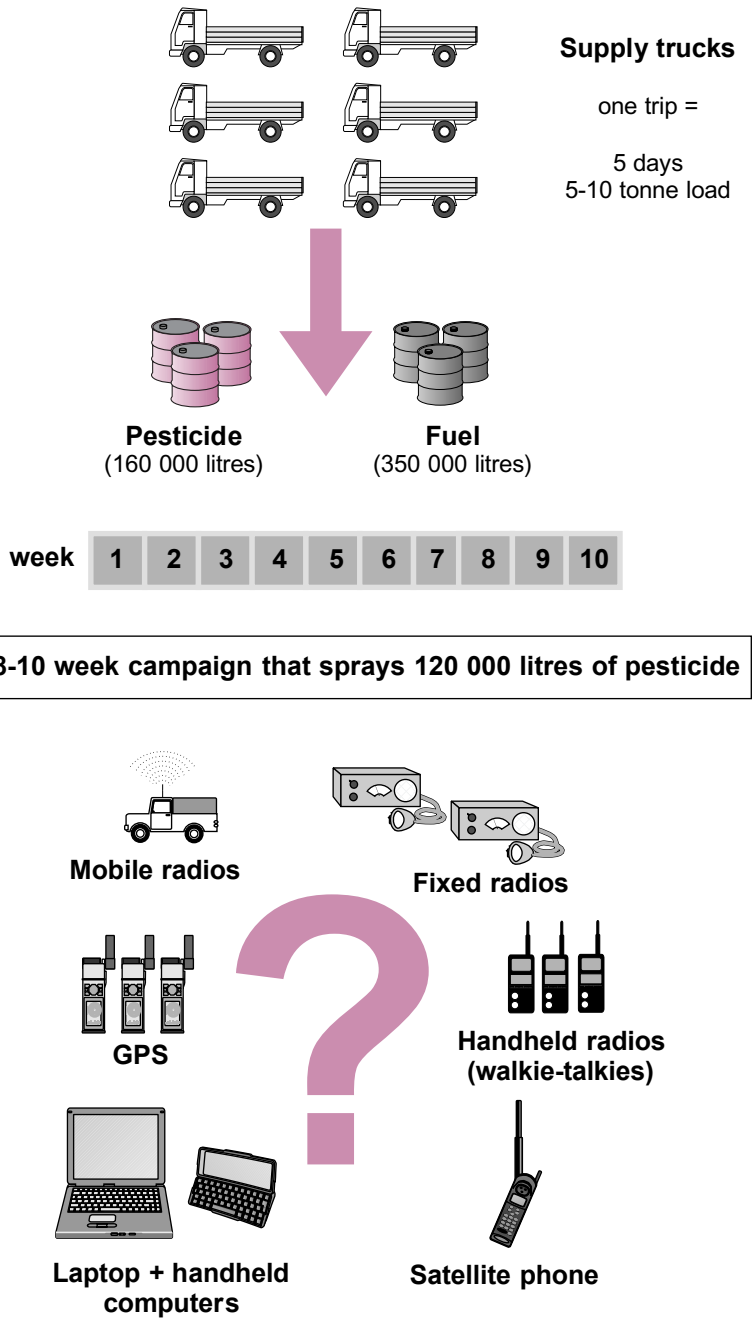
If supplies are distributed in advance, there must be secure buildings to store them. Moreover, if most of the pesticide and fuel is distributed, redistribution will be difficult if, as is likely, only part of the area proves to be heavily infested. The best strategy will vary from country to country. If trucks are in short supply and there are few all-weather roads, more pesticide and fuel will need to be distributed in advance, but then larger total quantities will be needed. It is best to hold as much as possible of the main stocks of pesticide and possibly fuel in a central location and distribute them only where and when they are needed (see Fig. 25).

As far as possible, operations should be mounted from airstrips along all-weather roads, even if this means the aircraft must at times spray when at a considerable distance from the airstrip. The maximum radius of operation for a light spray aircraft with a 4 to 5 hours endurance is about 200 km. In this case, when the distance to the target is more than 100 km, a turbine aircraft with a large payload is essential.

A reasonable advanced supply to a field base would be 5 000 litres of pesticide and 5 000 litres of fuel where there is an all-weather road linking the main base to the field base. This would be enough to allow two light aircraft to operate for about five days.

Tip: try to prepare airstrips in advance of the seasonal rains or use existing all-weather airstrips.

Figure 26. Equipment required for a control campaign.



Supply trucks

Supply truck requirements will depend on the degree to which aircraft fuel is commercially available within the campaign area and also how much fuel and pesticide have been distributed in advance. There will, however, always be a substantial repositioning requirement. A five-day trip time for delivering one load is reasonable. This suggests a requirement for about six trucks of 5-10 tonnes capacity to deliver pesticide and aircraft fuel during a campaign that sprays 120 000 litres (see Fig. 26). Clearly, the truck requirement will depend on how far advanced positioning proves to be correct and the all-weather road network in the country as well as the actual scale of the outbreak.

Radios and communications

All Locust Unit vehicles should be equipped with HF and UHF radios (UHF radios have proved better than VHF over short distances). An additional stock of approximately 20 radios of each type would be needed to equip spray and spotter aircraft and field bases. More radios will be needed if additional officers and vehicles are seconded. Handheld computers linked to a GPS may be useful to Locust Field Officers for entering survey and control data. If these are connected to a modem (either an HF radio or a standard one), they could be used for transmitting data. It may be necessary to equip each field base with a portable laptop computer and perhaps a satellite telephone and modem.

GPS

Each field base should have several handheld GPS units that can be used by survey and control teams to determine the exact position of the locust infestations. Similarly, all spray and spotter aircraft, including hired aircraft, should be equipped with a GPS. In this way, the coordinates of spray targets can be communicated by radio between the air and the ground as well as between field bases. Spray aircraft must be equipped with a GPS-based track guidance and recording system with data transfer capability. This will allow checking of parameters such as volume applied and track spacing. The system must have a demonstrated position accuracy of 10 m or better 95 percent of the time and a velocity accuracy of 95 percent. Differential GPS units can provide this accuracy and conventional GPS units may also be sufficiently accurate, although field validation is still underway.

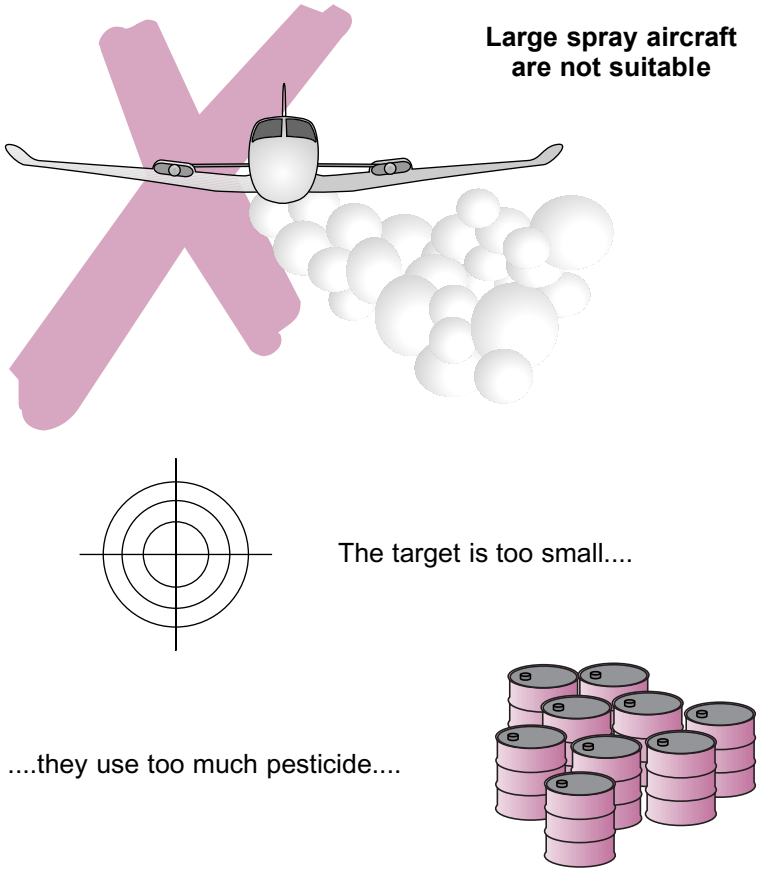
Fuel and pesticide pumps

Hired aircraft may come supplied with hand-operated or motor-driven pumps for loading fuel and pesticide. This requirement should be included in the hire contract. An additional stock of about five motor-driven pesticide pumps and ten fuel pumps is desirable.

Other equipment

There will be a need for camping equipment as well as first-aid kits for the field bases. Additional sets of equipment should be prepared for use in the field away from the field base when directing spray operations at the spray site. This will be in addition to the equipment Locust Field Officers should have with them for survey.

Figure 27. Large aircraft campaigns.



LARGE AIRCRAFT CAMPAIGNS

During the 1986-89 plague, large DC-6 aircraft were occasionally used. In the past, DC-3 and C-141 aircraft have been employed. Large aircraft are **not** recommended for spraying (see Fig. 27). A locust target is rarely large enough to require more than a fraction of the pesticide load of a large aircraft. Finding and marking sufficient targets to keep a large spray aircraft busy is virtually impossible in practice. It is also difficult to maintain large enough pesticide stocks to keep a large spray aircraft in operation. In addition the spraying of such large volumes of pesticide is likely to be harmful to the environment.

On the other hand, large aircraft could be used for transporting pesticide and equipment between countries or, within an affected country, between its headquarters and field bases.

Some items to consider during a post-campaign debriefing

Survey

- how many of the total infestations were located
- were there some areas that were inaccessible
- did surveys start on time; any delays
- were surveys carried out regularly in all areas
- did surveys continue during control operations
- was aerial survey necessary and did it start on time
- what improvements can be made

Reporting

- were survey and control reports received on time at HQ
- was field information complete or were details lacking at times
- were survey and control results used for making decisions
- were the Steering Committee, FAO and other countries kept informed in a timely manner at all times
- what improvements can be made

Control

- did control start on time or were there delays
- were ground and aerial operations properly supervised
- were operations followed up to check efficacy
- were pesticide and equipment deployed on time
- were all targets treated or did some escape
- what improvements can be made

Organization

- were there enough trained staff and were they available when required
- what logistical problems were encountered
- what was the role of the Steering Committee
- were decisions made in a timely manner based on technical considerations
- was external assistance provided on time
- what improvements can be made

These are only a few examples of the many issues that should be examined when reviewing the effectiveness of a control campaign once it has concluded.

POST-CAMPAIGN DEBRIEFING

At the end of the control campaign, the Officer-in-charge of the entire campaign in collaboration with the Head of the Locust Unit or Plant Protection Department should spend some time reviewing the campaign with all the participants. An outside moderator may be useful in leading discussions on logistical and operational difficulties encountered during the campaign. The main purpose of a post-campaign debriefing is to learn from any mistakes that may have occurred and apply these lessons in order to improve future campaigns. A final report of the campaign may be prepared that includes a summary of the campaign results, difficulties encountered and solutions proposed. This can be used as a reference for future campaigns.

Tip: try to determine what resources were used during the campaign, such as:

- ***area surveyed and treated by ground and air***
- ***number and types of vehicles, sprayers, aircraft, staff***
- ***quantities of pesticides and their different formulations***
- ***local assistance provided***
- ***external assistance provided***

FREQUENTLY ASKED QUESTIONS (FAQS)

1. Isn't it enough to rely on farmers to undertake control during recession periods?

Answer: No, because Desert Locust infestations are usually present in the natural vegetation of the desert during recession periods. These places are outside cropping areas so it is unlikely that farmers would be present or have much interest in spraying non-cropping areas. This is one of the primary reasons for establishing a specialized Locust Unit in an affected country.

2. Is it better to control immediately or wait for locusts to concentrate and form dense targets?

Answer: From the standpoint of the environment and cost effectiveness, it is better to wait as long as possible. From the standpoint of possible swarm migration, a further increase in populations from breeding and potential crop damage, this could be a dangerous strategy. Nevertheless, if it is possible to delay control until the locusts concentrate and form dense targets, you will end up using less pesticide to kill a greater number of locusts. This not only saves money and time, but it is safer for the environment. This may only be possible when there are hopper bands, the vegetation is becoming dry and there are not crops nearby.

3. How does a country receive advanced warnings of invasions?

Answer: FAO DLIS in Rome monitors locust, weather and habitat reports from countries and other organizations on a daily basis. They will immediately inform a country when there is a particular threat or a significant development in the situation. This is done by e-mail, fax and telephone. Information on the current situation is also immediately posted on the Internet (www.fao.org/news/global/locusts/locuhome.htm).

4. How often should a donor steering committee meet and who should be the chairperson?

Answer: It is suggested that such committees should meet on a weekly or fortnightly basis during a locust emergency and thereafter on a monthly basis until the situation has returned to normal within the region. Either a donor or a government representative may chose to be the chairperson. It is not necessary that the chairperson is a locust expert but it may help to have some technical or scientific background.

5. Has a pesticide bank been established for locust control?

Answer: So far no, but FAO continues to encourage donors and affected countries to consider the idea.

6. Are there other possibilities of using aircraft for transport purposes?

Answer: In some countries, it may be possible for the air force to provide transport of staff and equipment to infested areas. This may be one component of a national contingency plan.

7. Can I use aircraft that may be available from Plant Protection Departments of nearby locust-affected countries?

Answer: Yes, but often these may be engaged in their own control activities. Nevertheless, if this is desirable, arrangements, perhaps in the form of a protocol, should be made in advance regarding such practical issues as contact people, internal flight authorizations, transport time, pilots and support required.

8. Who will pay for seconded officers?

Answer: It is wise to try to obtain support from your own government. This may be part of a contingency plan or national emergency fund. If additional support is required, then an appeal could be made to the international donor community.

9. Can a campaign be decentralized where each province is responsible for survey and control operations?

Answer: No, because of the migratory nature of the Desert Locust and the difficulty in quickly moving resources (aircraft, vehicles, staff, pesticides, sprayers) to the newly infested areas. Some provinces may prefer to hold on to their resources in case more locusts come rather than transfer them to another province. Good coordination, rapid response and efficient use of resources are extremely difficult to achieve under a decentralized system.

10. What is a differential GPS and when should it be used?

Answer: A differential GPS (DGPS) is a type of GPS that is more accurate than normal units. A correction signal is used to improve the 10 m accuracy of conventional GPS units to give an accuracy of about 1 m. When combined with track guidance and data logging equipment, it can gives an accurate record of exactly where spraying has been done and how much pesticide has been used. Its primary use is for aerial spraying.

11. Can we rely only on ground control to prevent plagues?

Answer: If locusts form good spray targets in the early stages of an outbreak or plague and if all of these targets can be found and treated by ground teams, then it is theoretically possible to prevent plagues. However, in practice, it is impossible to find all targets and treat them in time using only ground resources.

12. Have aerial control campaigns been undertaken recently in any countries?

Answer: Yes, most countries organized aerial control campaigns during the last major plague of 1987-89. Since then, some countries have undertaken aerial operations against bands and swarms during local outbreaks and regional upsurges, for example India (1993), Oman (1993), Pakistan (1993), Yemen (1993), Mauritania (1996), Morocco (1996), Saudi Arabia (1996-98) and the Sudan (1997-99).