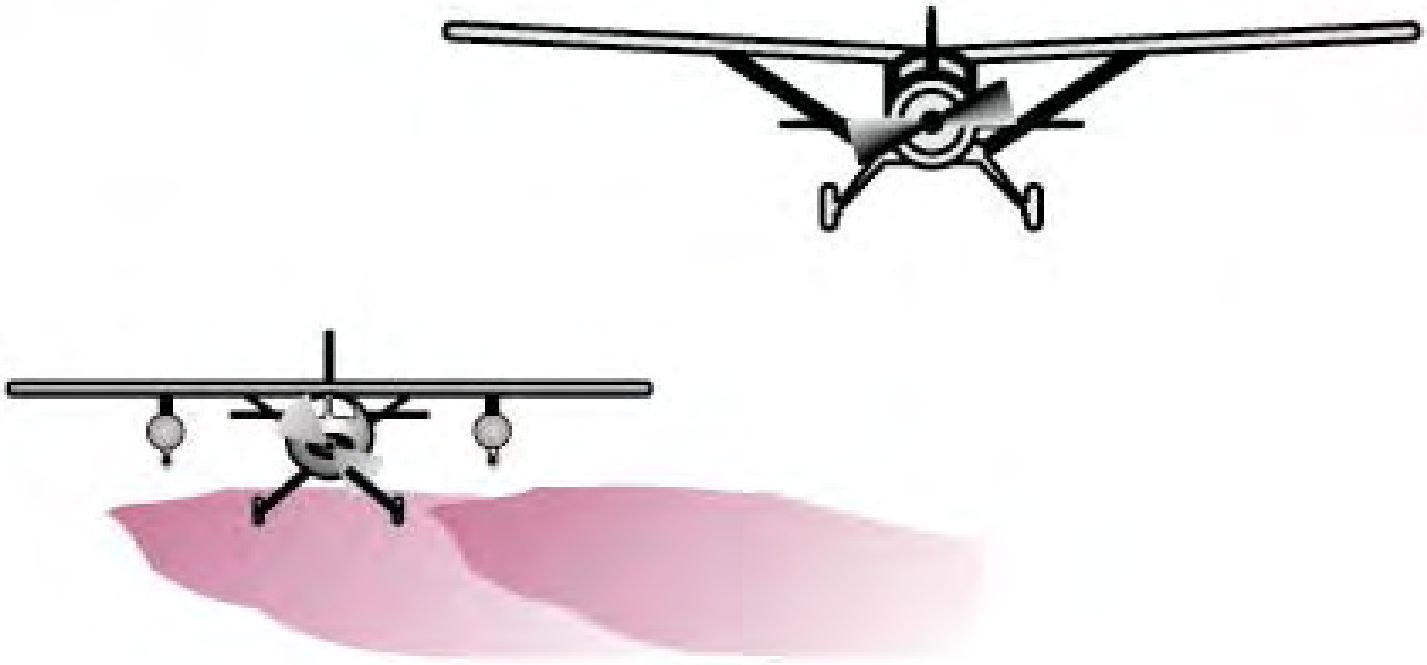
Standard Operating Procedures (SOP) for Desert Locust Aerial Survey and Control



Food and Agriculture Organization Of The United Nations

Standard Operating Procedures (SOP) for Desert Locust Aerial Survey and Control

Objective

The objective of the Standard Operating Procedures (SOP) for Desert Locust Aerial Survey and Control is to give concise instructions for effective and safe survey and control operations against the Desert Locust using aircraft. These instructions are intended for use by the field staff who are involved in Desert Locust aerial operations (including Locust Officers and pilots) to help them avoid dangerous, ineffective or wasteful operations. They are based on the **FAO Desert Locust Guidelines** where more detailed information and references are available.

The instructions focus on:

- Aerial survey operations
- Aerial spraying of ULV insecticides
- ULV aerial spray equipment
- Techniques for safe and efficient operations

1. Survey and control process

A series of steps need to be followed before, during and after aerial survey and control operations.

Aircraft are best for spraying large areas (5000+ ha)

The smallest area an aircraft can spray is 100 ha

PREPARATIONS three months before control operations

- Determine what type and number of aircraft are required for survey and control operations
- Select competent survey and control teams and provide them with training or refresher training
- Check and service the vehicles, trucks and aircraft
- Check and test the spray system on the aircraft, that commonly needed spare parts are available and aircraft are equipped with a GPS-based track guidance system
- Distribute the required quantity and type of insecticides, protective clothing, aviation fuel and pumps to the likely spray sites
- Make sure operational funds are allocated for the control period to cover field allowances, fuel, etc.
- Make sure that aircraft are available in the country and can be contracted by the MoA for control operations. Check that airstrips have been maintained
- Ensure that enough copies of the *FAO Locust Survey & Control Form* and *Spray Monitoring Form* are available

How to make an aerial survey

Step 1. Determine the type and number of aircraft to use. Fixed-wing aircraft and helicopters can be used for finding green vegetation and locating swarms and hopper bands. Helicopters can also be used to visit remote areas, allowing the locust officer to land and make foot transects, and for operations in mountainous areas.

Step 2. Determine in advance where the survey is to be made using all available information and maps.

Step 3. Survey for no more than 3 hours at a time:

Fixed-wing (vegetation survey)

- fly about 300 m above ground
- track spacing = 50 km

Fixed-wing (locust survey)

- fly about 50 m above ground
- track spacing = 10 km (bands), 50 km (swarms)

Helicopter (vegetation and locust survey)

- fly about 300 m above ground
- track spacing = 50 km
- when green vegetation is found, fly towards it and level out at 5 m or less above the ground
- reduce speed to 40-50 km/h and swing tail from side to side
- look towards the helicopter rear for locusts

Step 4. Record GPS coordinates of vegetation and locusts.

BEFORE aerial control operations

Step 1. Determine if aerial control operations are required.

Step 2. If so, choose appropriate aircraft types, insecticide and spray coverage pattern (barrier or full cover).

Step 3. Calibrate the spray system on the aircraft in order to assure the correct amount of insecticide is applied in the right way and in the right place.

Step 4. Ensure that local inhabitants are informed about the date, time and location of control operations, so that they can move their livestock, beehives and families to safety.

Step 5. Find the wind direction in order to establish a spray direction at right angles to it and demarcate the infested area.

Step 6. Make sure that temperature, wind and rainfall conditions are suitable and safe for the aerial control operations.

DURING aerial control operations

Step 1. Make sure that:

- All staff who are handling or applying insecticide use full protective clothing
- All other non-spraying personnel, vehicles and equipment are away from the target area to avoid contamination by the sprayed insecticide
- Start at the downwind edge of the target area and spray cross wind (at right angles to the wind direction), moving upwind after each spray pass, making sure to measure the correct track spacing using DGPS, flagmen or other means
- Make an extra spray pass upwind of the target area to prevent under-dosing at the upwind edge
- Stop spraying if the wind drops (less than 1 m/s) or becomes very strong (more than 10 m/s) and wait for the right conditions
- Stop spraying if it starts to rain or seems likely to rain soon
- Stop spraying if the wind direction changes by more than 45 degrees, adjust your new spray line and spray the remaining area

AFTER aerial control operations

Step 1. Monitor and record all relevant details on the *FAO Spray Monitoring Form*.

Step 2. Empty any insecticide remaining in the aircraft spray tank back into the original insecticide container. Clean and maintain the spray system on the aircraft, and store the insecticide and the empty containers in safe places**.**

Step 3. Wash yourself and the protective clothing as soon as possible.

2. Fixed-wing aircraft vs. helicopters

Advantages of both

- survey and control in remote or difficult to access areas
- for situations requiring a fast work rate
- treating large areas of 5000 ha or more (1)
- spraying large hopper bands, settled or flying swarms (2)

Advantages of fixed-wing aircraft

- cost-effective to operate
- longer range than helicopters
- higher work rate than helicopters

Advantages of helicopters

- can fly slower than fixed-wing aircraft
- more maneuverable in narrow valleys
- no need for an airstrip
- can land to make survey or check mortality

(1) The minimum area which can be accurately and efficiently sprayed by aircraft is 100 ha.

(2) Spraying of settled swarms must be done early in the morning before they take off and late in the afternoon after they have landed. Air-to-air spraying requires experienced pilots with aircraft specially modified to prevent locusts blocking th engine air intakes, clogging the cooling systems and obscuring the windscreen.

3. Ground support team and field equipment

Support Team: one locust officer, two drivers and two vehicles, plus support staff such as assistants and skilled labourers.

Equipment: to be available in each team:

- Hand-held GPS *(1)*
- Maps, compass
- FAO forms *(2)*
- Clipboard, paper and pen
- Anemometer
- Hygrometer
- Flags
- Oil sensitive paper to sample ULV droplets
- Bucket and plastic measuring cylinder or jug
- VHF or UHF walkie-talkies for short range ground-to-air communication
- Vibrating tachometer
- Stop watch
- Hand lens (x10)
- Sweep net
- Plastic bags
- Tool kit, first aid kit
- HF radio
- Cages for mortality assessment
- Water and soap for washing
- Sets of protective clothing for all staff handling insecticides

(1) extra batteries, cigarette lighter adapter, remote antenna

(2) Survey & Control Forms and Spray Monitoring Forms

4. Principles of ULV application

Ultra low volume (ULV) spraying uses small amounts of concentrated insecticide. In locust control, about 0.5-1.0 litre/hectare is applied. The insecticide is not mixed with water or solvent. It is oil-based to prevent evaporation and is usually applied ready to spray.

Droplets of spray are carried by the wind. In full coverage treatments, the insecticide is sprayed as overlapping swaths onto the control target so that a uniform deposit is achieved and the locusts receive enough insecticide. Remember:

- Do **not** spray during the hottest part of the day (1100-1600 hr) when convection may occur and carry the spray up into the sky instead of down onto the locusts
- Do **not** spray at low wind speeds less than 1 m/s
- Do **not** spray at high wind speeds more than 10 m/s

5. ULV aerial spray system

A good ULV sprayer uses rotary atomizers (spinning discs or rotating cages) to produce droplets in a small size range (50-100 *u*m). If droplets are too large or too small, control will be poor and insecticide wasted. For aerial spraying, use the following:

- Volume median diameter (VMD): 75-100 *u*m
- Blade angle: 35° (AU4000), 40° (AU5000) *(1)*
- Emission height: 5-10 meters, depending on wind *(2)*
- Aircraft speed: 140-160 km/h in consultation with pilot

(1) at air speed of 160 km/h, 7000 rpm (AU4000), 8000 rpm (AU5000)

(2) higher for milling and flying swarms and, possibly, barrier control

6. Calibrating ULV spray system

The aerial spray system on the aircraft must be calibrated before the actual spraying takes place.

What is calibration?

The aerial spray equipment needs to be adjusted in order to apply the recommended amount of insecticide, in the right size spray droplets, to the right place.

Before setting flow rates for the first time, consult the manufacturer's manual to get a rough estimate of the required flow rate. On aircraft, flow rate is checked by recording the time spent spraying and the amount of insecticide used. Accordingly, the flow rate should be measured and reset if necessary.

Calibration should always be carried out by using the actual insecticide that will be applied

When do you calibrate spray equipment?

- When the aerial spray equipment is new
- When the insecticide formulation or concentration is changed
- When the volume application rate (VAR), track spacing or forward speed is changed
- Before the beginning of the campaign and at weekly intervals during it

How to calibrate a sprayer

Step 1. Find the recommended dose of the insecticide (g a.i./ha), from the drum label, FAO Guidelines, etc. If it is given as litres/hectare, go to step 3.

Step 2. Calculate the required Volume Application Rate (VAR).

$$\text{VAR (l/ha)} = \frac{\text{Recommended dose (g a.i./ha)}}{\text{Formulation concentration (g/l)}}$$

Example: If the recommended dose for chlorpyrifos is 250 g a.i./ha and its concentration is 450 g/l what is the VAR?

$$\text{VAR (l/ha)} = \frac{250}{450} = 0.55 \text{ l/ha}$$

If the formulation concentration expressed as a percentage of weight to volume (% w/v) convert the concentration to g a.i/l by using the formula:

$$\text{Concentration (g a.i./l)} = \frac{\text{Concentration given x 1000}}{100}$$

Example: If the concentration given for bendiocarb is 10%, then this must be converted by using the formula:

$$\text{Concentration in g a.i./l} = \frac{10 \times 1000}{100} = 100 \text{ g a.i/l}$$

In short, multiply the given percentage concentration by 10.

Step 3. Calculate the Flow Rate (FR).

$$\text{FR (l/min)} = \frac{\text{VAR (l/ha) x speed (km/h) x track spacing (m)}}{600}$$

Example: What flow rate is required from an aircraft flying at 140 km/h using a 100m track spacing in order to apply 100 g a.i./ha of bendiocarb 10% ULV?

$$\text{FR (l/min)} = \frac{1 \text{ (l/ha)} \times 140 \text{ (km/h)} \times 1000 \text{ (m)}}{600} = 23.33 \text{ l/min}$$

It is important to remember that if one of the parameters (flow rate, track spacing or forward speed) is altered, then one or more of the others have to be changed in order to maintain the correct Volume Application Rate and Dose.

- If flow rate increases — VAR increases (and vice versa)
- If track spacing increases — VAR decreases (and vice versa)
- If forward speed increases — VAR decreases (and vice versa)

Example: If the wind becomes stronger, it might be possible to increase the track spacing to allow a faster work rate. In order to maintain the correct VAR and dose, either the spray forward speed must be decreased or the flow rate must be increased. In order to achieve a faster work rate from the wider track spacing, the flow rate must be increased, rather than the forward speed being decreased.

How to measure the flow rate of aerial spray systems

Electronic pesticide pumps (collection technique):

Step 1. Calculate the required flow rate for each atomiser (see page 12).

Step 2. Make sure that the aircraft engine is running so that the correct voltage is being supplied to the pump.

Step 3. Set the approximate flow rate based on tables in the user's handbook.

Step 4. Position a bucket under each atomiser. To prevent insecticide from squirting outside the collecting bucket, fasten plastic bags with a hole in the bottom over the atomizers.

Step 5. Put about 50 litres of insecticide into the spray tank in order to prime the pipework. Ensure that the pipes are full by pumping insecticide through the atomisers until air bubbles disappear (the pipework in an aircraft spray system can contain up to 30 litres of liquid). Return the collected insecticide to the sprayer tank.

Step 6. Put the buckets back under each atomizer, turn on the pump (*but not the atomizers*) and measure the volume of insecticide collected using a measuring cylinder.

Step 7. Adjust the flow rate to bring it closer to the required rate calculated previously. Repeat step 6 until this rate has been achieved to within about 5% error.

Step 8. When the required flow rate has been achieved, recheck it two more times to ensure that it is correct.

Windmill-driven pesticide pumps (loss techique while in flight):

Step 1. Calculate the desired flow rate (see page 12).

Step 2. Set the approximate flow rate based on tables in the user's handbook.

Step 3. Position a bucket under each atomiser. To prevent insecticide squirting outside the collecting bucket, fasten a plastic bag with a hole in the bottom over each atomiser. Put about 50 litres of insecticide into the spray tank in order to prime the pipework. Ensure that the pipes are full by pumping insecticide through the atomisers until air bubbles disappear (the pipework in an aircraft spray system can contain up to 30 litres of liquid). Return collected insecticide to the sprayer tank.

Step 4. Fill the spray tank to a known level with insecticide (either complete full or to a marked level).

Step 5. Take off and spray over the target area using normal spraying techniques for a specific number of minutes **(M)**.

Step 6. After landing, use a measuring cylinder to measure the amount of insecticide required to refill the spray tank to its original level. This is the number of litres emitted **(E)**.

Step 7. Calculate:

$$\text{Flow rate (l/min)} = \frac{\text{E (l)}}{\text{M (mins)}}$$

Step 8. Adjust the flow rate to bring it closer to the required rate calculated previously. Repeat steps 4-7 until this rate has been achieved to within about 5% error.

Step 9. When the required flow rate has been achieved, recheck it two more times to ensure that it is correct.

How to estimate work rate

A rough estimate of the work rate can be calculated from the formula:

$$\text{Work rate (ha/h)} = \frac{\text{Forward speed (km/h) x track spacing (m)}}{10}$$

Note: this formula does not take into account the time required for turning at the end of each spray pass, which can be considerable for aircraft.

Typical track spacings in aerial control

A track spacing of **100 m** is generally used when spraying hopper bands, blocks of bands or settled swarms, milling swarms at roost and stratiform swarms using aircraft.

7. Recording and reporting

Monitoring is very important in order to document the activities and to allow later analysis of the successes and failures of any campaigns. Most of the information concerning the control operations and their efficacy and the efficiency of the campaign are covered in the *FAO Spray Monitoring Form*.

The form should be completed together with the *FAO Locust Survey & Control Form* in order to include details on the location, rainfall, ecology and locusts. Both forms should be returned to the National Locust Unit headquarters as soon as possible for review. Any problems (lack of protective clothing, overdosing, poor efficacy, non-target effects, etc.) can be noted on the form so they can be addressed later.

General flight report and job details produced by the DGPS, track guidance system and any flow control systems on board the aircraft should be submitted to the Locust Control Unit Headquarters.

Field staff recording the details of each control operation should use these forms

8. Cleaning, storing and disposal

Spray equipment should always be clean and ready to use. Properly dispose empty containers.

Always wear protective clothing while handling insecticides

Aerial spray system

- Drain unused insecticide back into the original containers
- To clean the sprayer, put some kerosene or diesel into it and spray it over the target area or waste ground, away from water bodies or supplies used by people or livestock; never dump this liquid in one place such as a pit
- Carry out any repair or required maintenance
- Wash the outside of the spray system with a cloth soaked in diesel or kerosene
- Cover the spray system (atomizer, variable restrictor unit and blades) with suitable protective covering to avoid any contamination (e.g. dust)

Insecticide storage

- Keep insecticide in original containers in a cool locked store to reduce deterioration caused by high temperatures
- Use older insecticides first (first-in-first-out system)

Disposal of empty insecticide containers

- Clean empty insecticide containers three times inside and out with diesel or kerosene
- Collect the small volume of washings and dispose of by adding them to the insecticide in sprayer tanks during the next control operations or, if it is the end of the season, pour them into insecticide containers that are not full
- Never use empty containers for any other purpose than insecticides
- If they are to be recycled, they should be transported back to manufacturer
- Containers for disposal should be punctured, crushed and sent back to national authorities for appropriate disposal

Refer to the *FAO Desert Locust Guidelines* for more details