Standard operating procedures for operating, maintenance and storage of desert locust sprayers

Ultra-low volume handheld sprayer (passive drift)
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Purpose

The desert locust *Schistocerca gregaria* (Forskal) is one of the most serious insect pests that causes heavy losses in agricultural crops and natural pastures, consequently causing economic and social crises for many countries.

Control operations depend on air or ground spraying of conventional chemical pesticides as the main effective technique to contain desert locust threat.

Locust field officers must be familiar with the aspects that relate to the sprayers which are used against desert locusts, e.g. operation, maintenance and common troubleshooting to resolve problems that might otherwise hamper control operations.

This field guide describes a sprayer used in the desert locust control. The sprayer was selected based on technical reports and related references that indicate the importance, effectiveness and efficiency of this sprayer against the desert locust.

This guide presents only the features and characteristics of the sprayer suitable for use against desert locusts in accordance with FAO’s vision and therefore there may be some dissimilarities between this manual and the manufacturer’s manual.

Hopefully, this field guide will contribute to the efficiency and efficacy of desert locust control operations.
Introduction

The ULVA+ is a simple robust hand-held spinning disc, Controlled Droplet Application (CDA) sprayer, powered by torch batteries, with one set of good quality batteries giving up to twenty hours of spraying time.

An electric motor spins the atomiser disc to produce uniform spray droplet size ranges (the actual size of droplets produced depends on the atomiser disc speed, which is determined by the number of batteries fitted). Liquid is fed by gravity through colour-coded feed nozzles.

The sprayer produces relatively small spray droplets, which are distributed and deposited by wind and gravity, allowing several rows/meters to be treated during each spray pass. The sprayer should be held downwind of the operator.

The ULVA+ is a good choice when controlling desert locust hopper bands. The ULVA+ can apply insecticides to control migrant pests with ULV formulations, e.g. locusts and grasshoppers.
Features

1. A lightweight sprayer (could be used to control small-scale infestations detected during surveys);
2. easy to use, robust with few breakdowns;
3. energy source is (four to eight) batteries that could be replaced or recharged;
4. the capacity of the pesticide tank is one litre (enough to treat one to two hectares) which may require additional five litre reservoir backpack tank (enough to treat five to ten hectares);
5. could be used to spray small-scale infestations, as its work rate is 10-15 hectares/day;
6. could be used in rugged areas that are inaccessible by vehicles;
7. requires wind speed at two to ten m/sec to disperse spray droplets;
8. the sprayer produces uniform spray of droplet size ranges;
9. the atomiser disc speed could be controlled by the number of batteries fitted.
1. Components of ULV hand-held sprayer (ULVA+)

- Additional backpack pesticide tank 5 litre
- Spray lance
- Atomise protective cover
- Spray lance extension
- Pesticide tank 1 litre
- On/off switch
- Atomiser
- Nozzle
- Sprayhead in the position of non-spraying or re-filling the pesticide tank
- Sprayhead in the position of spraying
Operating instructions

Be sure that maintenance and calibration accessories are supplied with the machine

1. Use Personal Protective Equipment (PPE).
2. remove the atomiser protective cover and check that the atomiser disc spins freely;
3. extend the spray lance (to insert batteries);
4. remove the ON/OFF switch;
5. insert the required number of batteries (four to eight);
6. place the ON/OFF switch back;
7. screw the one-litre bottle onto the spray head. Do not overtighten;
8. put on the five litres backpack tank to the sprayer (if available), and fill it with pesticide;
9. fill the one-litre bottle with pesticide either directly through the bottle cap or via the five litres refillable tank if available by opening the in-line tap;
10. calibrate the sprayer; see page nine;
11. start the control operation. Spray with the one-litre bottle inverted (atomiser below) to allow liquid to flow and turn over to stop spraying (atomiser above).
Calibration

When should calibration be carried out?
1. When using a new sprayer;
2. when the type or concentration of a pesticide’s formulation is changed;
3. when the volume application rate, track spacing or forward speed is changed;
4. at the beginning of the control campaign and intervals during the campaign.

Calibration equipment
1. Graduated measuring cylinder or jug;
2. stopwatch;
3. a sufficient amount of the same pesticide as the one to be used in the control operation;
4. a sufficient amount of kerosene or diesel;
5. two buckets (Graduated Container);
6. anemometer.

Note: Two persons are required to carry out the calibration.
Calibration steps

For the proper calibration procedure, follow the following steps and record the results in your notes.

1. Before calibration, both sprayer (and tools) should be cleaned using kerosene or diesel;
2. determine the forward speed (for the operator) by measuring the elapsed time (in seconds) for the operator to walk 100 meters then find the speed from the below formula:

\[\text{Speed (km/hr.)} = 3.6 \times \left(\frac{\text{distance travelled (m)}}{\text{time (seconds)}}\right)\]

Note:
• Normally, the operator’s forward speed is around four km/hr;
• the optimal track spacing when using the ULVA+ is ten m at a wind of speed two to five m/sec.

3. according to the previous steps, determine the track spacing as follows:

<table>
<thead>
<tr>
<th>If the Wind speed (m/sec) is</th>
<th>and the Forward speed (km/hr) is</th>
<th>Then Track Spacing (m) is</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 - 5</td>
<td>4</td>
<td>Up to 10</td>
</tr>
<tr>
<td>6 - 10</td>
<td>4</td>
<td>Up to 12</td>
</tr>
</tbody>
</table>
4. calculate the Volume Application Rate (l/ha) from the formula:

\[
\text{\textit{var (l/ha) = \frac{Recommended dose (g.ai./ha)}{Concentration (g.ai./l)}}}
\]

Note:
- The recommended dose could be obtained from recommended doses list (page 19);
- the concentration could be obtained from the pesticide label (% × 10).

5. calculate the flow rate (l/min) from the formula:

\[
\text{Flow Rate} = \frac{\text{VAR (l/ha) × track spacing (m) × speed (km/hr.)}}{600}
\]

6. convert the result (step five) from l/min to ml/min (multiply by 1 000);
7. ensure that the sprayer is ready to spray;

**During calibration, do not switch on the sprayer, only allow the liquid to flow by gravity.**

8. collect the pesticide flowing from the sprayhead in the first bucket;
9. when the pesticide is flowing steadily, collect the pesticide in the second bucket, for one minute.
10. after collecting the liquid for one minute remove the second bucket and run the pesticide into the first bucket again to avoid wasting the pesticide;

11. to stop the flow of liquid, turnover the sprayer head;

12. measure the amount of pesticide collected over one minute (second bucket) using the measuring cylinder (ml/min.);

13. if the collected amount of pesticide in the graduated cylinder (step 12) is equal to the calculated flow rate (step six), then the calibration has been carried out successfully. Steps 7 to 11 should be repeated three times to verify the results.
14. if the collected amount of pesticide in the graduated cylinder (step 12) is greater or less than the calculated flow rate (step six), then the calibration has not been carried out successfully, and it will be necessary to change the nozzle accordingly with the flow rates given in the below table:

<table>
<thead>
<tr>
<th>Nozzle’s color</th>
<th>Flow rate (ml/min) *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow</td>
<td>25</td>
</tr>
<tr>
<td>Orange</td>
<td>34</td>
</tr>
<tr>
<td>Red</td>
<td>90</td>
</tr>
<tr>
<td>Black</td>
<td>150</td>
</tr>
<tr>
<td>Gray</td>
<td>175</td>
</tr>
<tr>
<td>Pink</td>
<td>190</td>
</tr>
</tbody>
</table>

* The flow rates listed in the above table are examples only of typical ULV products, which are used only as a reference for selecting the appropriate nozzle, meaning that it is necessary to measure the flow rate with the actual product.

15. re-check the nozzle three times to verify the results; the new flow rate will be compensated in formula five to obtain the new track spacing.
2. Nozzles and spinning disc (ULVA+)

- Nozzles
- Clean nozzle
- Remove spinning disc
- Clean spinning disc
Maintenance and cleaning instructions

1. Never immerse the spray head in water or under a tap, since this may cause damage to the electric motor;
2. dispose of any surplus spray and use kerosene or diesel for cleaning out the sprayer (do not use water);
3. shake the tank well;
4. run the sprayer to clean the spraying system (with kerosene);
5. remove and clean the atomiser disc with a soft brush, then refit the disc;
6. the sprayer and tank (but not the atomiser disc) should be wiped down externally using a cloth soaked with kerosene;
7. remove the batteries;
8. re-assemble the sprayer in the collapsed position, and put back the disc's cover;
9. always thoroughly wash hands and exposed skin. All protective clothing should be washed and stored separately from other clothing. Contaminated gloves should be washed inside out.
Storage instructions

1. Re-assemble the sprayer in the collapsed position, put back the cover of the disc;
2. remove the batteries, store in a cool dry place away from direct sunlight;
3. nozzles should be cleaned and stored safely;
4. store the sprayer in a cool dry place away from direct sunlight, cover the sprayer with plastic cover if possible;
5. store the sprayer above the ground (wooden pallets);
6. when storing on the shelves, sprayers should be arranged to be easy handled (non-stacked) and leave appropriate spaces between shelves.

Drain any remaining pesticide from the tank. Any unused pesticide must be collected in a suitable container, labeled and should be kept out of reach of children, for future use or safe disposal.
Troubleshooting

1. The sprayer does not work

*Fault Remedy*
- Check that the batteries are fitted and in the correct position;
- check the condition of the electrical wires;
- check that the atomiser spins freely;
- check if the disc turns.

2. Atomiser disc spins but the sprayer does not spray or sprays irregularly

*Fault Remedy*
- Check that the feed nozzle is fitted correctly. Check for possible blockages in the nozzle and clean with soapy water or kerosene. Never blow through the feed nozzle with your mouth, or replace the nozzle with another one with the same colour;
- check the flow valve, hose and refilling system for blockages (if using the five-litre backpack);
- check if the bottle cap is screwed on correctly (if using the one-litre tank) and that the seal inside the cap is in place and undamaged, or replace the tank if possible.

3. Poor spray spectra

*Fault Remedy*
- Check that the spinning disc is not broken or damaged and the flow rate is not too high.
Optimum conditions for spraying

Time
The best time for spraying is usually in the morning between 08.00 and 11.00 hours and in the afternoon after 16.00 hours. Effective spraying may be possible before 08.00 hours if the wind is strong enough. It may also be possible to spray effectively between 11.00 and 16.00 hours if it is either cloudy and relatively cool (less than about 30°C) or if there is a steady wind over four m/s that will tend to prevent convection.

Wind
The best wind speed for spraying is usually between two to ten m/sec. Never spray when there is no wind because the spray will not be appropriately spread over the swath, and the operator is likely to be contaminated by the spray not being carried away from the sprayer.

Sunshine
Never spray when there is strong convection. Convection occurs when the sun rises high in the sky and heats the ground. The hot ground warms up the air near it, which then rises and may carry spray droplets out of the target area. Convection usually occurs on hot afternoons but may also occur in the late morning, especially if there is very little wind.

Rainfall
Never spray when it is raining or expected to rain shortly.
## Verified dosage of different insecticides for desert locust

<table>
<thead>
<tr>
<th>Insecticide</th>
<th>Dose (g a.i./ha)</th>
<th>overall treatment - adults</th>
<th>overall treatment - hoppers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bendiocarb</td>
<td>100</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Chlorpyrifos</td>
<td>225</td>
<td>225</td>
<td></td>
</tr>
<tr>
<td>Deltamethrin*</td>
<td>12.5/17.5</td>
<td>12.5/17.5</td>
<td></td>
</tr>
<tr>
<td>Diflubenzuron</td>
<td>60</td>
<td>n.a.</td>
<td></td>
</tr>
<tr>
<td>Fenitrothion</td>
<td>450</td>
<td>450</td>
<td></td>
</tr>
<tr>
<td>Fipronil</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Lambda-cyhalothrin</td>
<td>20</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Malathion</td>
<td>925</td>
<td>925</td>
<td></td>
</tr>
<tr>
<td>Metarhizium anisopliae</td>
<td>100</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Teflubenzuron</td>
<td>30</td>
<td>n.a.</td>
<td></td>
</tr>
<tr>
<td>Triflumuron</td>
<td>25</td>
<td>n.a.</td>
<td></td>
</tr>
</tbody>
</table>

*The higher dose rate may be required if there is a risk of recovery of late instars or at high temperatures*
## Conversions

<table>
<thead>
<tr>
<th>Area</th>
<th>1 km²</th>
<th>=</th>
<th>1 000 000</th>
<th>m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 km²</td>
<td>=</td>
<td>100</td>
<td>ha</td>
<td></td>
</tr>
</tbody>
</table>

### Speed

<table>
<thead>
<tr>
<th>1 mile/hr</th>
<th>=</th>
<th>1.61</th>
<th>Km/hr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Km/hr</td>
<td>=</td>
<td>0.278</td>
<td>m/sec</td>
</tr>
<tr>
<td>1 m/sec</td>
<td>=</td>
<td>3.6</td>
<td>Km/hr.</td>
</tr>
</tbody>
</table>

### Volume

<table>
<thead>
<tr>
<th>1 litre</th>
<th>=</th>
<th>1 000</th>
<th>ml</th>
</tr>
</thead>
</table>

### Dose (solids)

<table>
<thead>
<tr>
<th>1 kg/ha</th>
<th>=</th>
<th>1 000</th>
<th>g/ha</th>
</tr>
</thead>
</table>

### Dose (liquids)

<table>
<thead>
<tr>
<th>1 l/ha</th>
<th>=</th>
<th>1 000</th>
<th>ml/ha</th>
</tr>
</thead>
</table>
Commission for Controlling the Desert Locust in the Central Region

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