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

Motorised mistblower for ultra-low volume spraying (airblast)
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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 primary 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 for 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 locusts.

This guide presents only the features and characteristics of the sprayer suitable for use against desert locusts in accordance with FAO’s vision. 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 AU8000 Sprayer consists of a Micronair AU8000 sprayhead (Atomiser) mounted on a knapsack mist blower. The sprayhead provides a narrow, easily controlled spectrum of spray droplets to ensure an even distribution of product with a minimum of wastage. Air from the mist blower rotates the atomiser and is then directed into the airstream which carries the spray safely away from the operator and ensures maximum swath width and penetration of foliage.

The AU8000 sprayer is intended for use in agriculture, public health spraying, migratory pest control (locust, African armyworm etc.) and in any other application.

The unit is supplied with easily interchangeable restrictors for quick and easy calibration of output rate for all chemicals and application techniques.

Regardless of the chemical type or application rate, the AU8000 sprayhead ensures optimum coverage of the target with a minimum wastage of chemical due to incorrectly sized droplets or run-off.

The AU8000 sprayhead is also available separately as a conversion kit for use with an existing mist blower. For satisfactory operation, the air output from the mist blower must be as shown in the specification below.
1. The main components of the AU8000 sprayer

2. External Parts of the AU8000 Sprayer’s Motor
Specifications

1. **AU8000 Sprayhead**
   - **Flow rate:** 0.02 – 1.20 litres/min;
   - **spray droplet size:** Adjustable 40 – 200 microns VMD subject to formulation used;
   - **droplets spectrum:** narrow and easily controlled spectrum.

2. **Sprayer**
   - **Weight (empty):** 10.7 kg;
   - **engine:** 77 cc, 5 HP, 2-stroke, gasoline;
   - **pesticide tank capacity:** 17 litres max;
   - **fuel tank capacity:** 2 litres;
   - **fuel consumption:** 2 litres/hour approx;
   - **chemical formulations:** ULV & EC formulations;

**Note**

**AU8000 used to spray:**
- Medium sized areas;
- rugged areas that could not reached by vehicles;
- medium-height-trees, by using optional boost pump.

Be sure that the maintenance accessories and calibration are supplied with the sprayer.
3. Pump (Optional), and operation control modes, pump and engine speed.
Motorised Mistblower for ULV Spraying (Airblast)

4. Pesticide filter

5. Interchangeable flow rate restrictors (Nozzles)

6. Installation Position of pesticide’s filter and nozzle.
7. Control Positions of pesticide flow from the sprayer’s handle (Right = Closed / Left = Open)

8. Sprayer’s head connected to pesticide tube (spraying mode)

9. Sprayer’s head connected to calibration tube (calibration mode)
Operating instructions

Note
• During spraying without using the pump, the level atomiser (emission point) should be lower than the pesticide level (in the tank), because pesticides flow depends on the gravity and pressure of the blower;
• always use the pump when spraying trees;
• never use the pump without a pesticide in the tank.

1. Always use Personal Protective Equipment (PPE);
2. make up a mixture of 25 parts regular petrol (gasoline) and 1 part of two-stroke oil (4% mixture = 1 liter gasoline + 40 ml oil);
3. pour the mixed fuel into the tank, without overfilling.
4. Open the fuel valve.
10. Mixing Scale
(25 units of gasoline + 1 unit of oil)
5. ensure that the chemical control valve on the handle is closed with its lever parallel to the spray-head or downwards;
6. fill the pesticide tank with known amount of pesticide.
7. set the engine ON/OFF switch to the ON position;
8. if the engine is cold, press firmly upwards on the carburetor primer bulb ten times;
9. move the CHoke lever fully downwards to the closed position;
10. move the throttle lever (below the engine stop switch) to the minimum speed position (backwards of the sprayer);
11. put your left foot on the lower part of the sprayer frame and your left hand on the cap of the chemical tank to stabilize the machine. Pull gently on the recoil starter cord until you feel maximum resistance, then pull the cord rapidly and firmly until the engine starts.

Do not pull the cord hard against its end-stop. If the engine fails to start after three to four attempts, then refer to troubleshooting section in this guide page 00.

12. allow the engine to IDLE for 15 – 20 seconds;
   • then slowly move the CHoke lever fully upwards to the open position;
   • move the throttle lever to the mid position (50% of Max. speed) and allow for one minute;
   • set the throttle lever so that the engine IDLEs smoothly.
13. lift the knapsack mist blower onto the operator’s back. Note that the operator must hold the spray-head and NOT let it drag on the ground.
Carrying out control operation

14. turn the flow of chemical **ON** with the valve on the handle.;
15. start the control operation, considering that:
   - the sprayer head must always be directed **DOWNWIND** of the operator;
   - the spraying tracks are vertical to wind direction;
   - operator must move upwind of the previous track;
   - the operator should hold the sprayer at a distance of at least 1 m from the target whenever possible with an angle of about 30 degrees above the horizontal;
   - the atomiser rotating gauze should not be allowed to come into contact with foliage or the operator.

To stop the engine:

1. To stop spraying, turn off the flow of pesticide using the valve on the handle, and close the pump;
2. move the throttle lever to the fully closed position;
3. Set the engine stop switch to the **STOP** position.
Operating instructions with optional boost pump

This section applies only to sprayers fitted with the optional chemical boost pump:

1. Before starting the sprayer, ensure that the boost pump lever is DISENGAGED (downwards);
2. start the sprayer as described on page 11-13;
3. when in the spraying area, move the boost pump lever to the ENGAGED position and proceed;
4. if possible, avoid completely emptying the spray tank;
5. if the tank becomes empty, DISENGAGE the boost pump IMMEDIATELY to avoid the possibility of damage to the pump by running dry.
Safety instructions (operator)

1. Always follow the safety instructions on the pesticide label when handling and using pesticides;
2. always use Personal Protective Equipment (PPE) during filling calibration and control;
3. do not spray near people, domestic animals, waterways, rivers or lakes. Leave a 200-meter buffer zone downwind of the spray area;
4. do not run the engine in an enclosed area. Exhaust gases contain carbon monoxide, an odorless and deadly poison;
5. always wash hands, face and body after filling the spray tank, after spraying and before eating or smoking;
6. always carry soap and towels for washing in the cab of the spray vehicle and a supply of diesel, water and rags for cleaning the vehicle and sprayer.

Diesel is recommended for cleaning residues of ULV products. Petrol is dangerous due to its flammability.
Safety instructions (sprayer)

The following instructions should be followed to avoid burns or injury to the operator:

1. If petrol (gasoline) is spilled, or used for cleaning, move the sprayer away from the area of the spill and avoid creating any source of ignition until the petrol (gasoline) has evaporated;
2. do not fill the petrol (gasoline) tank while the engine is running. Allow the engine to cool for two minutes before refueling. Only fill in a well-ventilated area;
3. avoid contact with the exhaust, cylinder or fins when they are hot as contact may cause burns.

Always, keep the stop switch OFF when the sprayer is not in use.
Calibration

When should calibration be carried out?
1. When using a new sprayer;
2. when the type or concentration of a pesticide 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 during campaign intervals.

Calibration equipment
1. Graduated measuring cylinder or jug;
2. stopwatch;
3. a sufficient amount of the same pesticide as the one that will be used during 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 proper calibration, follow the following steps, and record the results.

1. Before calibration, both sprayer (and tools) should be cleaned by using the kerosene or diesel;
2. determine the forward speed (for operator) by measuring the elapsed time (in seconds) for the operator to walk 100 meters then find the speed from the 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 4 km/hr.

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

<table>
<thead>
<tr>
<th>If the Wind speed (m/sec)</th>
<th>And the Forward speed (km/hr)</th>
<th>Then Track spacing (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 - 3</td>
<td>4</td>
<td>Up to 8</td>
</tr>
<tr>
<td>4 - 7</td>
<td>4</td>
<td>Up to 10</td>
</tr>
<tr>
<td>8 - 10</td>
<td>4</td>
<td>Up to 12</td>
</tr>
</tbody>
</table>
4. calculate the Volume Application Rate (l/ha) from the formula:

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

**Note:**
The recommended dose could be obtained from recommended doses list (page 33), while the concentration could be obtained from the pesticide label (% × 10).

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

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

6. convert the result (of step 5) from l/min to ml/min (multiply by 1 000);

7. ensure that the sprayer is ready to spray;

8. ensure that the chemical ON/OFF valve is closed;

9. fill the chemical tank with known amount of pesticide;

10. disconnect the liquid feed tube to the sprayhead by pulling it off the outlet of the flow restrictor tube on the handle. Fit the short calibration tube supplied with the sprayer to the outlet of the flow restrictor tube. If the calibration tube is not available a 20 cm length of any suitable plastic tube can be used instead;

11. run the engine, open the valve on the handle and collect the pesticide flowing from the calibration tube in the first bucket;

12. when the liquid is flowing steadily, collect the pesticide in the second bucket, for one minute;
13. after collecting the liquid for 1 minute remove the second bucket and run the liquid into the first bucket again to avoid wasting pesticide;
14. stop the engine and ensure that the flow of spray liquid has stopped before removing the bucket;
15. pour the collected liquid (from the second bucket) into a graduated cylinder. The volume measured equals the flow rate per one minute;
16. if the collected amount of pesticide in the graduated cylinder (step 15) is equal to the calculated flow rate (step 6), then the calibration has been carried out successfully. Repeat steps 10 to 14, three times to verify the results.
17. if the collected amount of pesticide in the graduated cylinder (step 15) is greater or less than the calculated flow rate (step 6), then the calibration has not been carried out correctly, and it will be necessary to change the restrictor tubes;
18. referring to the table below, select the correct restrictor tube to give the required flow rate, that is closest to the result in step 6;

<table>
<thead>
<tr>
<th>RESTRICTOR NUMBER</th>
<th>FLOW RATE (litres/minute)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Without boost pump</td>
</tr>
<tr>
<td>1</td>
<td>0.075</td>
</tr>
<tr>
<td>2</td>
<td>0.150</td>
</tr>
<tr>
<td>3</td>
<td>0.300</td>
</tr>
<tr>
<td>4</td>
<td>0.600</td>
</tr>
<tr>
<td>5</td>
<td>1.200</td>
</tr>
</tbody>
</table>
• Repeat steps 10 to 17 three times to verify the results. The new obtained flow rate will be used in formula five to determine the new track spacing;

OR

• If necessary, the track spacing can be adjusted by using formula five to match the exact flow rate obtained (step 15), e.g. if the restrictor valves are not available.

Note
The output (flow rate) of the sprayer with the pump running will be higher than without one.
Daily maintenance after use

1. The atomiser and hose should be flushed through with a cleaning fluid, such as kerosene or diesel;
2. to prevent accidental starting when servicing the engine/sprayer, always remove the wire of spark plug;
3. the sprayer should be washed down at the end of each day to remove any spray residues and dirt. Rags soaked in kerosene/diesel or soapy water can be used to clean all external surfaces;
4. at the end of the spray operation the carburetor must be emptied by closing the fuel valve whilst the engine is running. The engine will stop as soon as the fuel is exhausted.

Maintenance

1. Main Tank cleaning (17 litre):
   • unused pesticide (remaining) in the sprayer must be drained by sprayhead (or calibration tube), then collected in an appropriate container for future use or safe disposal;
   • any remaining pesticide that could not be collected must be disposed of by cleaning the tank with kerosene or Diesel, at the spray site to avoid the risk of contamination of a non-target area by dilute chemical;
2. periodically clean all external surfaces by using rags soaked in kerosene/diesel or soapy water;
3. check that the atomiser spins freely and the gauze cylinder is in good condition;
4. empty the remaining fuel from fuel tank;
5. occasionally check and clean the engine air filter every 50 hours and fuel filters;
6. check the spark plug every 50 hours. If necessary, clean the spark plug and adjust the gap setting or replace it if damaged;
7. remove and clean the carburetor from any oil remaining;
8. the bearings of the atomiser are sealed and lubricated for life, and should, therefore, be replaced if they become worn.

Storage

1. Disconnect the spray head from the sprayer and clean it with diesel. Dry the head before storing it in a sealed bag or box (or inside a separate cover);
2. put 10 ml of oil in the cylinder underneath the spark plug, then pull gently on the recoil starter cord three times.
3. clean restrictor valves and put them in a separate bag or container to preserve them;
4. put the sprayer on a shelf or raised wooden pallet above the ground;
5. store the sprayer in a clean and dry place that is not exposed to the sun and dust;
6. cover the sprayer with plastic cover if possible;
7. when storing on the shelves, sprayers should be arranged to be easy handled (non-stacked) and leave appropriate spaces between shelves.
Troubleshooting

1. The engine will not start

*Fault remedy*
- Check position of **ON/OFF** switch;
- add fuel if necessary;
- open fuel valve if closed;
- clean fuel filter;
- clean and check the carburetor and ensure that the needle slides freely;
- clean the spark plug and adjust the gap to 0.4 – 0.5 mm.

2. Engine fail to start after pulling starter cord

The cord should never be pulled fully out to the end stop as this will strain the cord and the starter mechanism and could lead to premature failure.

*Fault remedy*
- Move **CHOKE** lever to position **ON** (upwards);
- close the throttle (downwards);
- move **ON/OFF** switch to **OFF** position;
- pull the starter cord at least 10 times before repeating the normal starting procedure.
3. Unsteady engine rpm or tendency to stop  
**Fault remedy** 
• Tighten spark plug;  
• fasten or replace lead Ignition contact;  
• clean and check the carburetor.

4. Engine does not develop maximum power  
**Fault remedy** 
• Clean filters fuel and air, or replace it if needed;  
• clean and check spark plug gap setting (0.4 - 0.5 mm);  
• move **CHOKE** lever to position **ON** (upwards);  
• clean carburetor jet.

5. Insufficient flow rate of chemical  
**Fault remedy** 
• Check the pipes and hoses for any leaks or damages;  
• check and clean pesticide filter in sprayer handle;  
• check, clean or replace the restrictor.

6. Droplet spectrum is non-homogenous  
**Fault remedy** 
• Check and clean the spray-head (spinning Cage).

7. The atomiser runs out of balance and vibrates  
**Fault remedy** 
• Check and clean the spray-head (spinning Cage);  
• spraying 1 – 2 litres of kerosene through the atomiser at the end of each spray job.
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 or relatively cool (less than about 30°C) or if there is a steady wind over 4 m/s that will prevent convection.

**Wind**
The best wind speed for spraying is usually between 2-10 m/sec. Never spray when there is no wind because the spray will not be adequately spread over the swath. The operator is likely to be contaminated because the spray is not being carried away from the sprayer.

However, because AU8000 is equipped with a fan blower that produces an air stream that helps to carry and distribute the droplets of the pesticide over a long distance (up to 25 meters), therefore it can be used if the wind speed is less than 2 m/sec.

**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, which 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></td>
<td>100</td>
</tr>
<tr>
<td>Chlorpyrifos</td>
<td>225</td>
<td></td>
<td>225</td>
</tr>
<tr>
<td>Deltamethrin*</td>
<td>12.5 or 17.5</td>
<td></td>
<td>12.5 or 17.5</td>
</tr>
<tr>
<td>Diflubenzuron</td>
<td>60</td>
<td></td>
<td>n.a.</td>
</tr>
<tr>
<td>Fenitrothion</td>
<td>450</td>
<td></td>
<td>450</td>
</tr>
<tr>
<td>Fipronil</td>
<td>4</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Lambda-cyhalothrin</td>
<td>20</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Malathion</td>
<td>925</td>
<td></td>
<td>925</td>
</tr>
<tr>
<td>Metarhizium anisopliae</td>
<td>100</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>Teflubenzuron</td>
<td>30</td>
<td></td>
<td>n.a.</td>
</tr>
<tr>
<td>Triflumuron</td>
<td>25</td>
<td></td>
<td>n.a.</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></th>
<th>1 km²</th>
<th>=</th>
<th>1 000 000</th>
<th>m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area</td>
<td>1 km²</td>
<td>=</td>
<td>100</td>
<td>ha</td>
</tr>
<tr>
<td>Speed</td>
<td>1 mile/hr</td>
<td>=</td>
<td>1.61</td>
<td>Km/hr.</td>
</tr>
<tr>
<td>Volume</td>
<td>1 litre</td>
<td>=</td>
<td>1 000</td>
<td>ml</td>
</tr>
<tr>
<td>Dose (solids)</td>
<td>1 kg/ha</td>
<td>=</td>
<td>1 000</td>
<td>g/ha</td>
</tr>
<tr>
<td>Dose (liquids)</td>
<td>1 l/ha</td>
<td>=</td>
<td>1 000</td>
<td>ml/ha</td>
</tr>
</tbody>
</table>