Technical Workshop on Locust Control

Dushanbe, Tajikistan, 18 - 22 October 2010

Locust spraying: ULV vs EC

-Item 10 of the Provisional Agenda-

In locust control there are two main techniques of insecticide spraying. One applies insecticide diluted with water. In such water-based spraying a high amount of insecticide mixture, usually 200-300 L, is applied to one hectare. It is called full-volume spraying. It involves water-based insecticide formulations, such as Emulsifiable Concentrate (EC) or, less frequently, Wettable Powder (WP) or Suspension Concentrate (SC). The alternative technique is the so-called Ultra-Low Volume (ULV) spraying in which the special, usually oil-based concentrated insecticide formulation is applied without any dilution using small amount of pesticides but spraying in fine droplets at a rate of usually 1 L per hectare.

The ULV spraying technique was developed in the 1950s specifically for Desert Locust (*Schistocerca gregaria*) control in its traditional habitats (less dry areas within arid zones). It is now considered the most efficient, economical and environmentally viable technique of locust spraying, and is strongly advocated as such by FAO. The full-volume EC technique is more commonly used for crop protection worldwide. Until recently, it was the predominant method of anti-locust spraying in CCA countries. However, in the past few years, ULV spraying became increasingly popular in several CCA anti-locust programs. Each of the techniques has its advantages and disadvantages which are discussed below.

Advantages of ULV vs. EC

1. **No need of mixing.** ULV formulations are ready to use and at the volume of 1 L/ha. No mixing means also less exposure to chemicals: the operators just need to fill up the sprayer tank; there is also less risk of spilling and splashing and of related soil contamination. This also further reduces the insecticide evaporation which is already low because of oil-based formulation.

2. **No need for additional water.** This is a very important factor when conducting locust control in arid zones. It simplifies the logistics and eliminates additional operation costs related to the need of water supply, special vehicles (water tanks), fuel and staff.

3. **Optimal droplet size.** Applied by a special ULV sprayer (atomizer), ULV formulations produce droplet size of 50-100 microns in diameter, which is considered to be optimal for locust targets. If an EC formulation is applied by a fogger (aerosol generator), the droplets are very small (usually <<20 microns). This results in an uncontrollable drift of the aerosol cloud which can be carried away from targets by the wind. If an EC formulation is applied by a conventional fan or boom-nozzle sprayer, the droplets are very large (usually >>200 microns). Such big droplets reach the earth surface too quickly resulting in a waste of a substantial proportion of applied chemical and in a very narrow swath. Evidently, both too small and too big EC droplets are less suitable and less optimal for locust control compared to ULV droplets of 50-100 microns in diameter.

4. **Optimal droplet spectrum.** Besides the appropriate droplet size a good ULV sprayer produces homogeneous (narrow) droplet spectrum: usually about 80% of all droplets are of optimal, 50 to 100 micron diameter. EC sprayers produce a very heterogeneous (wide) droplet spectrum with a large proportion of too small or too large droplets, which are inefficient for locusts.
5. Controlled drift spraying. The best ULV sprayers use Controlled Droplet Application (CDA) technology which means producing only the optimum sizes of spray droplet for locust control. This is achieved by specifically designed spinning disc rotary atomizers which break up the spray liquid very evenly, resulting in a narrow range of spray droplet sizes. The sprayer moves cross wind, and droplets are carried to the target by the wind; such application, which lies in the core of ULV technology, is called “controlled drift spraying.”

6. Attraction of locusts by vegetable oil carriers. Many ULV formulations use vegetable (i.e. canola) oil as insecticide carrier. Some of these oils were found to be attractants and feeding stimulants for the locusts. This qualifies them as “liquid baits” which increases the insecticide efficacy by 5 to 10% or even more.

6. Better adhesion to treated vegetation. Since ULV formulations are oil-based, they adhere better to treated vegetation and are more resistant to run-off or wash-off by rain. This increases the period of availability and hence toxic effect of ULV formulations, which is particularly important for insecticides acting by ingestion, such as Insect Growth Regulators (IGRs).

7. Calibration. Whichever ULV sprayer, platform and insecticide have been chosen, adequate calibration is required, i.e. the measurement and adjustment of various parts of the sprayer in order to apply the correct amount of insecticide, in the right size spray droplets, to the right place in order to get the optimal swath width. If calibration is not carried out, spraying may be ineffective or insecticide may be wasted. Three factors need to be calibrated to achieve an efficient result: droplet size, emission height and dose of insecticide. Since ULV spraying does not require mixing, calibration of a ULV sprayer may be easier than EC. Some ULV sprayers have adjustable flow rate capacity which further simplifies their calibration process.

8. Application of biological control products. Most currently available bio-insecticide formulations used in locust control consist in a mixture of fungal spores with oil. As such, ULV sprayers are the only ones suitable for their application.

Advantages of EC vs. ULV

1. Lower quantities of insecticides for transportation and storage. In ULV, one liter of formulation typically treats one hectare, while in the full-volume EC spraying, one liter of formulation would treat 10 or more hectares. EC has a logistical advantage over ULV in this respect.

2. Lower corrosiveness. Usually, water-based formulations are less corrosive for spraying equipment. However, there are now more appropriate ULV formulations.

3. Sprayers are simpler. EC sprayers are easier in operation, maintenance and repair; they do not require additional operator training.

4. Wind-independence. Spraying can be done under windless conditions while the ULV treatments need wind speeds of at least 2 m/s.

5. EC insecticide versatility. Usually EC formulations of insecticides used in locust control are also registered to control other agricultural pests; hence their multi-purpose use. ULV formulations are usually for locust control only.

6. No need for a special sprayer. The biggest advantage of water-based spraying is that it is performed by conventional boom-nozzle or fan (ventilator) sprayers which are available in large quantities in CCA. ULV spraying is usually done with rotating atomizer sprayers which are just making their way into CCA locust control practice. ULV sprayers are more expensive and need a vehicle, usually an all-wheel-drive truck, as a carrier.

7. Cleaning is easier. Since EC sprayers use water-based insecticide formulations, it is easier to clean them than ULV sprayers which use oil-based formulations.

To sum up, each of the spraying techniques has its own pros and cons. From the technical point of view, ULV is better adapted for locust targets, and thus is more efficient; it does not require huge volumes of water – a valuable commodity in arid zones. For these reasons, it is strongly advocated by FAO. EC is simpler, and in practice the choice of the technique is
imposed by the availability of sprayers. In terms of numbers, EC sprayers (mostly tractor-driven) are much more numerous than ULV in CCA countries. Also, the use of ULV may be hampered by low availability of ULV formulations registered for locust control. In some countries they are non-existent.

However, ULV has another very important advantage over EC which consists in the much higher work rate. Tractor-driven sprayer (e.g. OVH model) can treat 40-50 ha daily under ideal conditions although in reality this figure is usually much lower. Vehicle-mounted ULV sprayer (e.g. Micron AU-8115) can treat 100-300 ha per day. Because of this, such sprayers become increasingly used in some CCA countries. For example in 2010 in Uzbekistan, 50% of the total anti-locust treated area of 623,261 ha was done by vehicle-mounted ULV sprayers. One of the objectives of the proposed Five-Year Programme to improve national and regional locust management in CCA is to introduce ULV spraying in those countries where it has not been used yet and to further promote its use in those where it is already practiced.

Certain factors and components of anti-locust spraying are common in either case of ULV or EC spraying. All personnel involved in spraying operations should use Personal Protective Equipment (PPE) which is discussed in more detail in Item 15 of the Provisional Agenda.

**Monitoring of control operations** and their efficacy is very important in order to document the activities and to allow later analysis of the successes and failures of any campaign. Evaluation of locust mortality is an essential part of control program. Typically it is done in the field by comparing locust densities before and after spraying. Depending on the pesticide and its dose rate used, the post-treatment assessment can be done at different time periods. For example, fast-acting pyrethroids will produce signs of locust mortality in the first hours after application while slow-acting IGRs will produce noticeable effect only after several days. For such slower-acting insecticides, including the biological control products, locust mortality could be assessed by collecting treated and untreated locusts, keeping them in cages and recording their mortality.

To record the results of locust control campaign and the impact of treatments on human health and environment, standard forms such as FAO Spray Monitoring Form (discussed and adopted at the Regional Consultation in Almaty in 2009) should be used. It will facilitate information sharing and management among CCA countries. More detail on evaluation of spraying quality will be delivered in the seminar presentation on this subject.

Impact of anti-locust spraying on human health and environment is another essential component of any locust control program. It is discussed in Item 15 of the Provisional Agenda. Finally, cleaning, storing and disposing of spray materials should be done in strict accordance with best practices, advocated by FAO.

**Cleaning.** It is much easier to clean and service a sprayer immediately after control is finished than to do it when the sprayer is required again several weeks or months later – the insecticide will have hardened inside and outside the sprayer and will be very difficult to remove. Engineers, technicians and drivers should wear PPE when handling used sprayers. After draining any unused insecticide back into the original containers, sprayers should be cleaned with diesel fuel, any repairs and maintenance carried out and the sprayer stored in the shade and away from blowing dust or sand. The outside of the sprayer can be cleaned with a cloth soaked in diesel fuel and the inside cleaned by putting some diesel fuel into the tank and spraying it off over the target area or waste ground. Manufacturers’ handbooks have information on routine maintenance and repair procedures.

**Insecticide storage.** Insecticides should be stored in their original containers in cool shade to prevent the chemicals being broken down faster by high temperatures. The insecticide store should be organized on a first in, first out basis, in other words the oldest insecticides of
a particular type should be used first. The storekeeper should be responsible for keeping records of the insecticides in stock and keep the store locked.

**Disposal of pesticide containers.** Many accidents have been caused by empty pesticide containers being used by rural populations. Empty pesticide drums should be cleaned inside and out with diesel (water will not clean out the oily ULV formulations) and the small volume of washings should be disposed of by adding them to the pesticide in sprayer tanks during control operations. These empty containers will still contain significant quantities of pesticide so should be stored securely to ensure they are not taken into use by local communities. If they are to be recycled, they should be transported back to the pesticide manufacturer. If they are for disposal, they should be punctured, crushed and transported back to the national authority for appropriate disposal. An essential reference in this respect is *Pesticide storage and stock control* manual produced by FAO. Units for cleaning and crushing empty metallic containers, the so-called drum-crushers, are also available on the market.