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DESERT LOCUST CONTROL COMMITTEE

Thirty-ninth Session

Rome, 10-13 March 2009

Use of a bio-pesticide: lessons learned from Timor Leste[1]

(Agenda Item 18)

Executive summary

From mid May to end of June 2007, successful aerial and ground spraying operations were undertaken to control a serious outbreak of Migratory Locust, which directly threaten important food crop production in the western districts of Timor-Leste. A total of 56 high density swarms covering an area of 2,318 hectares were treated by air using the biological pesticide Green Guard® ULV. By early July, ground control operations had located and treated less than 100 ha of hopper bands.

The control operations demonstrated that a biopesticide could be used as an efficient alternative to chemical products in ecologically sensitive areas threatened by locusts. The objective, to successfully control a locust outbreak, was achieved and environmental concerns were fully addressed. In the specific habitat where the outbreak occurred, massive and full-cover application of chemical pesticides would have had a potential negative impact on rural communities as well as harming sensitive aquatic habitats throughout the region. Consequently, the use of a biopesticide preserved human health and the environment.

The control operations were organised in the framework of two emergency projects implemented by FAO and funded by the Central Emergency Response Fund (CERF) of the United Nations and the Australian Government (AusAID).

[1] This paper is based on reports prepared by F. Fossi (field visit on 10-12 March 2007), H. McRae (mission on 14 June-2 July), P. Spurgin (22 March-7 April and on 12 May-14 June 2007) and A. Monard (20-28 May 2007).

The control team was composed of local Ministry of Agriculture, Forestry and Fisheries (MAFP) and FAO staff, a spray helicopter team from an Australian company (pilot and engineer) and two officers with the Australian Plague Locust Commission (APLC) as FAO consultants.

Background information

Locust situation in early 2007

In February 2007, significant infestations of a sub-species of the Migratory Locust, Locusta migratoria (Linnaeus 1758), were reported from the Ermera and Bobonaro districts in western Timor-Leste as well as in the neighbouring areas of Nusa Tenggara Timur Province, Indonesia.. Substantial damage to maize crops had already occurred in this important grain producing area from the combined effects of drought and locust activity. As a result, rural communities were facing food shortages. Left uncontrolled, these infestations could have developed further and threatened the rice crops, which were just being planted.

In early and mid-March 2007, high density hopper bands (up to 200 hoppers/m2) and adult swarms were observed during ground surveys carried out in Bobonaro and Ermera districts, in the south-western part of Timor-Leste, especially near the Marobo River. A wide range of locust stages and states was present, such as transiens and gregarious hoppers and adults, from first instar hoppers to egg-laying adults. The situation was considered as an outbreak as a result of at least one month and a half of breeding, which had caused an increase in locust numbers followed by hopper and adult concentration.

In late March, an aerial survey carried out in three districts, Liquiça, Ermera and Bobonaro, confirmed the presence of significant numbers of large and dense bands of gregarious nymphs within an area of approximately 20,000 ha mainly on open riverbanks in the valleys flowing into the sea to the north of Maliana. Due to tall and dense vegetation away from the riverbanks, additional hopper bands may have been hidden and therefore difficult to detect during these surveys. The ecological conditions were to prove particularly suitable for these locust populations: the dry period between the two usual rainfall peaks was relatively short (three weeks) and rains continued through May into early June. The older hopper populations formed a number of small swarms in late April and early May. Other hopper instars survived and fledged. Adults matured, and breeding took place.

In mid-May, just prior to the commencement of the aerial control operations, numerous high density swarms were seen in rice crops along valleys in the Liquica and Ermera districts as well as infestations in Bobonaro and Covalima districts during another helicopter survey undertaken by FAO. Thus, a fourth district, Covalima was affected by locust infestations.

The Maliana area is an important rice production area and damage to the crops would have had severe consequences on the local population already affected by poor maize yields. The locust infestations were located in remote valleys only accessible on foot. In addition, it was suspected that many hopper bands were hidden under tall grass vegetation and shrubs near to the river flats. It was thought that some 20,000 ha could have been infested.

It has to be noted that under optimal conditions, the Migratory Locust can complete five to six generations per year with locust numbers increasing significantly with each generation. Consequently, infestations are likely to escalate in size and density, and to cause damage to a range of food crops and pasture.

Why aerial control with biopesticides?

The local farmers were concerned about the use of pesticides because the infested areas were close to human settlements, streams and major watercourses. Application of a chemical pesticide would have led to significant risks to public health and the environment and therefore was not

considered an acceptable choice. Due to the size of the area infested by locusts, the difficulty of accessing most of these places and the urgent need to carry out control operations, widespread aerial application appeared to be the most suitable option.

Consequently, the decision was taken to organize an aerial control campaign by using the biopesticide Green Guard® sprayed by a helicopter equipped with ULV atomisers, supplemented, if needed, by ground spraying to control small targets. Green Guard® has no mammalian toxicity and only low toxicity to aquatic invertebrates and vertebrates. The active ingredient of the product is spores of the fungus Metarhizium anisopliae var. acridum, strain FI-985. This fungus is specific to orthopteran species (grasshoppers, locusts and crickets) and has been used to control Migratory Locust in environmentally sensitive areas in Australia and China. The biopesticide is not as fast acting as a chemical pesticide and takes usually 8 to 10 days to kill the targets when daily temperatures are between 20°C to 32°C.

It was expected that the aerial control operations would treat the majority of the locust infestations as swarms and they would be supplemented by ground spraying of small locust infestations that directly threatened crops; essentially spot treatments that are too small to be considered as aerial targets.

Aerial survey and control operations

Survey/control aircraft

Aerial application using a fixed-wing agricultural aircraft was ruled out based on a lack of suitable airstrips, the relatively small size of individual targets and the mountainous terrain. Therefore, a helicopter capable of performing both, survey and control offered the best solution.

The Bell 206 JetRanger helicopter contracted for the operations was equipped with two Micronair AU7000 rotary atomizers driven by hydraulics, a smoke generator to monitor wind speed and direction, a tank with a capacity of 250 litres, a high volume pumping system for stirring and mixing Green Guard® with the carrier oil, an accurate flow meter and a Differential GPS system to provide track guidance during application and electronic logging of spray runs.

Previous experience with APLC control operations had demonstrated that the most efficient way to use a spray helicopter was to employ “search and destroy tactics”. This strategy consists of the helicopter flying a systematic search pattern with an experienced observer/navigator on board, who guides the pilot and defines the target boundaries. Both the pilot and observer assess the risks, hazards and environmental considerations associated with each target prior to spraying while the pilot has the final say if spraying is to take place.

Application technique

Once the targets were located and their boundaries defined, they were sprayed using crosswind blanket treatments. After using the aircraft’s smoke generator to determine the wind direction, spray runs at a height of 10 m were made perpendicular to the wind with each successive run made upwind to the last (50 m interval between spray runs). The Micronair AU7000 atomisers were calibrated to deliver the Green Guard® ULV and Caltex spray oil mixture at a rate of 1 l/ha (total flow rate of 8 l/min), for a dose of ca. 65 g of M. anisopliae spores/ha with a spraying speed of 100 km/h. In practice due to variations in flying speed the rate was closer to 0.9 l/ha for a dose of 60 g/ha. The micronairs were spun at 5,500 rpm for a droplet size VMD2 of ca. 100 microns.

A total of 504 litres of Green Guard® ULV concentrate (packed in 36 containers - 20 l bucket each containing 14 l of *M. anisopliae* spores mixed with corn oil @ 300 g spores/l) were supplied along with 2,460 l (12 x 205 l drums) of Caltex Summer Spray oil. Due to the height and density

[2] volume median diameter

of the vegetation encountered at targets, the dose of ca. 50 g spores/ha applied during the spraying of the first 612 ha was increased up to ca. 60 g/ha to treat the following 1,706 ha.

Swarms usually began flying strongly as soon as the helicopter started making passes over them. During spraying, the aim was to stay above the swarm and attempt to remain ahead of the main body of the flying locusts (often by skipping several runs, achievable when using DGPS for track guidance). Doing this meant that the locusts were constantly flying through a drifting cloud of spray droplets, the ideal situation for good coverage of the target insects.

Areas treated

Aerial control was carried out in southern portion of the Liquiça District, western Ermera District, throughout the Bobonaro District and around Suai in the Covalima District. The helicopter treated fifty-six targets constituting a total area of 2,318 ha, in 78.5 hours of survey and spraying sorties from 19 May to 13 June.

Efficacy of Green Guard® ULV

Two methods were selected to assess the efficacy of Green Guard® ULV in the field, to take into account the slow action of the biopesticide and its application on mobile adults:

- *Direct post treatment assessment:* Swarms treated in the Liquiça district were checked eight days later. A substantial proportion of the locust population was infected and could easily be caught by hand. Farmers reported similar observations from other treated areas nearby. In Maliana area, dead immature adults were collected 10 days after treatment. The bodies were incubated under moist conditions and sporulation was observed indicating mortality due to *M. anisopliae.* In addition, aerial surveys conducted in previously sprayed areas of Maliana did not detect any more swarming locusts.
- *Field cages:* Untreated and treated locusts were collected two days after spraying and caged. Unfortunately the caged locusts were attacked and eaten perhaps by rats. There was no time to repeat the test.

In addition, indirect assessment was carried out during a ground survey in the previously infested areas of the Maliana zone on 20-21 June. It was reported that farmers saw huge numbers of locust bodies in their fields and that they were very pleased with the results of the aerial spraying and the ground control by MAFP. They reported a significant decline in the number of swarms and in locust activity. The first rice harvest was successful with only few reports of locust damage. Many farmers who previously told MAFP officers that the locust threat was too great to plant a second rice crop, changed their minds after the successful campaign.

The small size of the post-treatment hopper populations detected in the Maliana area in late June (about 100-200 ha of mid instar hoppers that required control) implies that the large number of high density swarms were effectively treated before they could lay eggs. While not definitive, these observations indicate that Green Guard® achieved a high mortality of the treated locusts.

Results and Lessons learned

- The campaign was very successful and demonstrated the effective use of Green Guard® ULV against swarms;
- The pre-spraying public awareness campaign conducted by FAO and national authorities was highly effective. Understanding that a biopesticide was to be used greatly increased community support for and acceptance of the control helicopter;
- The farming communities were very pleased with results of the control campaign;
- The control campaign demonstrated that Green Guard® ULV, when applied correctly, is effective for locust control, and suitable for use in populated and ecologically sensitive areas.