# LOCUST CONTROL IN CENTRAL ASIA: MiGS VERSUS MICRONAIRS

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**Key words:** locusts, Central Asia, insecticides, spraying technologies.


## Abstract

Locust control in the countries of the former Soviet Union targets three locusts (the Italian, the Moroccan, and the Asian Migratory locusts) and many non-swarming grasshopper species. The areas treated annually against these pests increased after the collapse of the USSR in 1991 and culminated with 10.4 million ha in the year 2000. The bulk of the control was applied to the populations of the Italian locust. The anti-locust treatments use mostly water-based insecticide formulations applied from ANTONOV-2 aircraft or tractor-driven sprayers. In recent years, new spraying platforms like giant aerosol foggers based on MiG jet engines and ultra-light aircraft have been used. Ultra-Low Volume formulations and atomizer sprayers are making their way into practice for locust control in Central Asia.


## Introduction

Locusts and grasshoppers have been problems since ancient times and they remain serious pests at the beginning of this third millennium. In order to curtail the 2003-2005 upsurge of the Desert locust (*Schistocerca gregaria*), over 13 million hectares were treated with insecticides in 26 countries at a cost to the international community of $280 million, and with additional costs of food assistance and agricultural rehabilitation bringing the total costs of the recent Desert locust campaign to $400 million (FAO-DLCC, 2006).

Spectacular outbreaks of the Desert locust always attract attention from donors, media, and international organizations, not to mention the scientists. Its invasion area covers 29 million km$^2$ (one-fourth of the emerged dry land on the planet) in over 60 countries (Symmons & Cressman, 2001). Its swarms are known to fly distances of over 5,000 km, as happened in 1989 when huge numbers of locusts crossed the Atlantic Ocean from West Africa to the Caribbean islands in 10 days (Ritchie & Pedgley, 1989). Other locusts (there are about a dozen locust species on Earth) on occasions cause considerable damage on every continent except Antarctica including temperate Eurasia, and in particular, the huge area of the former Soviet Union (fSU). However, information on the locust situation from this region remains sparse. Nevertheless, locust and grasshopper control in Russia, Kazakhstan and the Central Asian republics developed some unique approaches and technologies, which the present article attempts to share with pest managers worldwide.

## Locust problem in the former Soviet Union: A brief historical overview

Devastating locust and grasshopper outbreaks were recorded in 40 years of the 19$^{th}$ century in the Russian Empire . Only 20 of about 500 species of the acridids family (Orthoptera: Acrididae) inhabiting the fSU can be considered as frequent economic pests. The most important economic species are the Asian Migratory locust (*Locusta migratoria migratoria*), the Moroccan locust (*Dociostaurus maroccanus*), the Italian locust (*Calliptamus italicus*), and non-swarming grasshoppers such as *Aeropus sibiricus*, *Arcyptera microptera, Dociostaurus kraussi* (Latchininsky *et al.*, 2002). During Soviet times, locust and grasshopper control was taken under federal supervision, and special anti-locust units were created in every region where these pests threatened agriculture. Such units implemented locust monitoring and control, which was fully funded by the federal government. They were particularly efficient in Kazakhstan, Uzbekistan and other Central Asian republics. Locust control was done using the most progressive strategies and technologies. Soviet specialists were the first in the world to introduce aerial insecticide treatments into locust control in 1922-1925 (Korotkih, 1926; Figure 1). Treatments involved dusting the locust infestations with arsenate powders. Locust management practices were based on a solid scientific

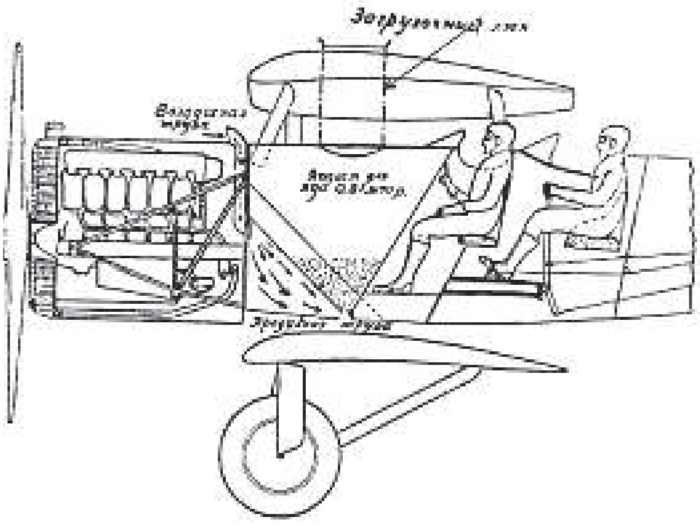

Figure 1. **One of the first setups for aerial anti-locust treatments with insecticide dusts (from Korotkih, 1926).**

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foundation developed by such great names in Russian applied entomology as V. I. Plotnikov, S. A. Predtechensky, G. Ya. Bei-Bienko, and many others. The first theoretical and practical locust works of B. P. Uvarov were also accomplished in the fSU. Later, he became famous as Sir Boris Uvarov, the founder and the first director of the London Anti-Locust Research Centre, and the Father of Acridology.

Efficient and inexpensive stomach poisons organochlorines (e.g. gamma-BHC) became the leading insecticide option in locust control after World War II and into the mid-1980s. Treatments were done aerially using crop duster planes. In 1947, an ANTONOV-2 aircraft, which was specially designed for agricultural uses, was launched into mass production. Today, sixty years later, more 20,000 units have been built, and the construction of new planes still continues in several countries despite its admittedly antiquated design. Over half a century since its inception, this extremely durable, single-engine biplane (Figure 2) still remains the leading agricultural aircraft over the entire fSU, although the number of operational planes is falling. Its low take-off and landing speed and robust construction allow it to be used in a variety of field situations without building special airstrips. Just a 200 m long stretch of dirt road is enough to ensure safe operation. The plane carries a huge 1,200-liter insecticide tank and can be equipped with different types of dusting and spraying equipment, typically, a boom with 80 nozzles producing a 40-m treated swath allowing for a high work rate of up to 1,200 ha/day.

Figure 2. **Anti-grasshopper insecticide spraying from ANTONOV-2 aircraft in Siberia** (photo by A. Latchininsky).

The anti-locust treatments in the fSU were applied to vast areas every year because of the availability of these planes (Figure 3). Annual treatments reached their maximum in the very last years of the fSU (1989 and 1990), with the bulk of the treatments done in Kazakhstan, followed by Uzbekistan and Russia. Dusting by BHC was replaced in the mid-1980s by spraying water-based formulations of organophosphates (malathion) and pyrethroids (deltamethrin and others) which were applied at a full-volume rate of about 100 l/ha.

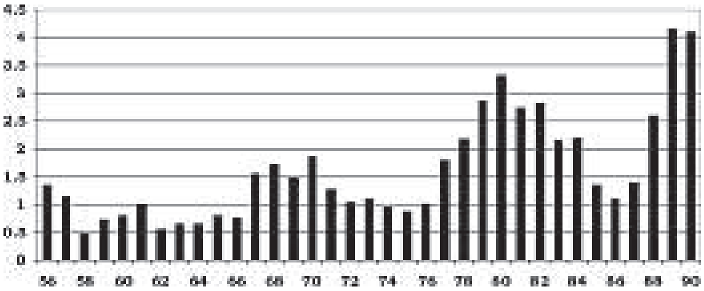

Figure 3. **Areas of anti-acridid treatments in the former USSR from 1956 till 1990 (from Latchininsky *et al.*, 2002).**

Treatments were also applied from the ground using boom or (more often) rotary ventilator-type tractor sprayers (Figure 4). Inexpensive and very numerous, these sprayers were the work horse of anti-locust treatments despite their very low work rate of 40 ha/day.

Figure 4. **Tractor-driven ventilator sprayer at work against grasshoppers in Siberia** (photo by A. Latchininsky).

## New challenges after the collapse of the fSU

The collapse of the fSU in 1991 brought significant changes in the economies of the newly-independent post-Soviet republics. Agricultural production was in a deep recession. In Russia alone, the areas of pesticide and fertilizer treatments dropped from 48 million ha in 1991 to 26 million ha in 1996. In Kazakhstan, the former "bread basket" of the Soviet Union, the area of grain production decreased more than 50% in ten years, from 24 million ha in 1987 to 11 million ha in 1998. The abandoned fields became weedy fallows which created the most favorable habitats for the Italian locust and pest grasshoppers.

The federal system of plant protection service was devastated. Locust surveys and anti-locust treatments were reduced to a bare minimum. Every year, a significant proportion of area infested by locusts remained untreated because of lack of funds. Such discrepancy between the infested and treated areas reached its peak in Kazakhstan with 2 million under-treated hectares in 1999 (Figure 5). There was no international coordination between the adjacent countries, and locust swarms frequently crossed the borders creating political tension between neighbors. Many agricultural pests, but especially locusts, "capitalized" on the deteriorating phytosanitary situation leading to a series of major outbreaks in the last decade of the 20th century.

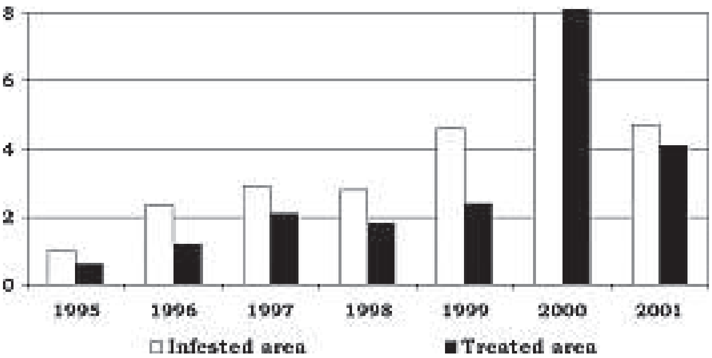


Figure 5. **Areas infested by and treated against the pest Acridids in Kazakhstan from 1995 till 2001 (from Latchininsky *et al.*, 2002).**

## Locust outbreaks at the turn of the century

Populations of pest acridids exhibited dramatic growth in the last years of the 20th century in nearly all of the fSU. In Kazakhstan, the situation was especially serious. In 1999, about 220,000 ha of cereal crops were destroyed by the Italian locust with an estimated damage of US $15 million (Khasenov, 2001). Funding for control operations lagged behind, and the peak of the anti-locust treatments did not happen until the following year. The campaign in 2000 broke the world record for annual area treated against locusts: in Kazakhstan alone, 947,000 liters of chemical insecticides were applied to 8.1 million ha (Khasenov, 2001). The cost of this campaign exceeded US $23 million, with $20.1 million coming from governmental sources. In addition, over 2 million ha were treated in Russia, and about 300,000 ha in Uzbekistan (Latchininsky *et al.*, 2002). The bulk of the treatments (about 80%) were applied to control the Italian locust, followed by the Moroccan locust, the Asian Migratory locust, and non-swarming grasshoppers. The Italian locust is an extremely ecologically plastic and highly polyphagous species. It can infest a wide range of habitats, from weedy fallows to hayfields, and attack a wide variety of crops. It is known to produce very dense concentrations of egg-pods, up to 10,000/m$^2$. Its swarms can produce medium-range (up to 300 km) migratory flights. Mass hatching is spread across a time period of two or more months even in the same habitat. All these factors make control operations extremely difficult.

## Campaign of the year 2000 in Kazakhstan: the world record is set

The 8-million ha treated area was unprecedented in the history of anti-locust battles. As there is only one locust generation per year in Kazakhstan, the entire campaign was accomplished in just 3 months, from early May until early August. For comparison, during the recent upsurge of the Desert locust in Northwest Africa, the areas treated in Morocco and Algeria exceeded 4 million ha each, but the treatments were spread over a period of 17 months (October 2003 – March 2005), and were applied to several locust generations. In the United States, where grasshoppers have only one annual generation, a comparable (8.2 million ha) area was treated with 5 million liters of insecticides over a period of 3 years (1986-88) (Latchininsky *et al.*, 2000).

The Kazakhstan 2000 campaign became a showcase of diverse spraying equipment. Almost half of all treatments (43%) were done from ground machines, the most numerous being the conventional, tractor-driven ventilator sprayers (3,500 units) which treated over 3 million ha. Thirty ANTONOV-2 aircraft treated over 1 million ha, or 15% of all areas. In addition to the conventional aircraft and tractors-driven sprayers, there were several other spraying platforms used in the campaign. Two of them are treated in more detail below.

*Giant aerosol fogger.* This huge machine was developed in one of the formerly secret Soviet defense-oriented scientific enterprises in Novosibirsk (Siberia). The spraying devise is mounted on a heavy truck weighing no less than 5 tons (Figure 6). The core of the sprayer is the enormous air compressor which is based on an engine from the MIG-15 fighter jet refurbished after its primary use. Some recent modifications utilize the TUPOLEV-154 engine. The insecticide tank has a 1,500 liter capacity. The fogger produces extremely fine aerosol droplets, with a median diameter between 10 and 20 µm. The treated width reaches 2,000 m and the insecticide dose rate is 0.15 l/ha and higher, which allows for a work rate of up to 5,000 ha per night. The treatments with this fogger are possible only during the night and under very low wind, otherwise the aerosol cloud may be driven kilometers away from the target. This technology proved very efficient in the control of forest insect pests, when it is necessary to cover vast areas in sparsely populated zones quickly. In locust control, the concerns over environmental safety limited the foggers use to large continuous treatment blocks situated far from villages, water bodies and other sensitive areas. Nevertheless, high productivity and fast coverage resulted in a sizeable proportion of anti-locust treatments (31%, or 2.5 million ha) done by 60 of these machines in 2000.

Figure 6. **Giant aerosol fogger based on jet engine used in locust control in Kazakhstan** (photo by A. Latchininsky).

*Ultra-light aircraft.* The technical conditions of the existing ANTONOV-2 aircraft are generally very poor and continue to worsen. An alternative to these heavy machines emerged in the form of ultra-light aircraft sometimes called “deltaplanes” because of the shape of their wing (Figure 7). Such machines are indeed very light (170 kg), are easily transportable on a light trailer and they need just a 40-m strip of level terrain for take-off. An ultra-light aircraft for agricultural use is equipped with a 100-liter insecticide tank. Its spraying equipment is mounted on two, 6-m long booms with 40 nozzles on each. It works in a regime of low-volume spraying with a dose rate of 5 to 10 liters of formulation per hectare and a spray width of about 35 m. Each load will treat 100 ha, which amounts to 800 ha per day - weather permitting. Fifty ultra-light aircraft treated 730,000 ha or 9% of the entire treatment area in 2000 in Kazakhstan. The main concern in the use of these machines is safety; they are accident-prone if the wind speed is higher than 5 m/s.

Figure 7. **Ultra-light aircraft with ULV spraying equipment for locust control in Uzbekistan** (photo by A. Latchininsky).

## Which insecticides are being used in locust control in the fSU countries?

There are more than 50 formulations of over 20 active ingredients registered in Kazakhstan, Uzbekistan and Russia (Latchininsky, 2000; Dolzhenko, 2003). The list is dominated by pyrethroids and also includes organophosphates, benzoyl-ureas, chloro-nicotinyls and phenyl-pyrazoles. Most products are water-based emulsifiable concentrates (EC) and only a few are oil-based ULV formulations. The ultra-low volume spraying of oil-based insecticides, which became the standard practice for locust control in Africa, was not very common until recently. The primary reason is the lack of locally manufactured, reliable and efficient atomizer sprayers. In recent years, the situation has changed, and more and more atomizer sprayers (mostly, manufactured by Micron Sprayers, although some are assembled locally) are making their way into Kazakhstan, Russia and other fSU countries. Several ULV formulations have been registered. The ULV technology entering this vast market is being promoted by FAO UN and through technical assistance projects from GTZ and other aid agencies. Hand-held (e.g. Ulva+) and back-pack (e.g. AU8000) ULV sprayers are used for targeted treatments of

Figure 8. **Micron Sprayers AU8115 atomizer mounted on Russian UAZ light truck spraying the Moroccan locusts in Uzbekistan** (photo by S. Krull, GTZ).

locust hopper bands and for crop protection treatments. Light pick-up truck mounted ULV sprayers (e.g. Ulvamast V3 and AU8115) are used for larger areas (Figure 8). For aerial ULV spraying, several ANTONOV-2 aircraft in Kazakhstan were equipped with 6 to 12 atomizers AU5000. Ultra-light aircraft also can carry the ULV equipment, for example, four to six atomizers AU7000.

## ULV vs. EC: pro et contra

ULV technology, especially if it is executed with high quality, controlled droplet application atomizers, has several advantages over conventional, full volume spraying. This technology produces droplet sizes (50-100 µm) which are consistent and most appropriate for acridid targets (Dobson, 2001). Furthermore, it does not require dilution of formulation, saves water, minimizes the evaporation of the insecticide, and eliminates additional application costs related to mixing. As such, it is most appropriate for locust and grasshopper treatments which are often executed in arid areas with water shortages. An interesting advantage of the ULV consists of the fact that oil-based formulations frequently use vegetable oils as insecticide carriers. Some of these oils were found to be attractants and feeding stimulants for the acridids. This qualifies them as “liquid baits” which increase the insecticide efficacy (Lockwood *et al.*, 2001).

Application of full-volume, water-based insecticide formulations also has some advantages. First, it requires 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. Usually, water-based formulations are less corrosive for spraying equipment, and sprayers are simpler in operation, maintenance and repair. Spraying can be done under windless conditions while the ULV treatments need wind speeds of at least 2 m/s. The biggest advantage of the full-volume, water-based formulations is that there is still a large quantity of conventional sprayers available in the fSU. However, recent practices showed the tendency of the ULV technology being increasingly accepted by both end-users and regulatory authorities. Currently, the fSU locust control market is still dominated by water-based formulations and conventional spraying equipment, but the pendulum has started to shift towards the ULV. So far, supported by an "army" of tractor-driven sprayers, the MIGs are still holding the battle, but the Micronairs are coming, slowly but surely.

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