Forest Pest Management with Micronair Rotary Atomisers

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Throughout the temperate forests of North America, Europe and Asia, caterpillars of various species of moth pose a serious threat to both natural and commercial forests. Outbreaks of indigenous forest pests are often cyclical in nature, with an interval of many years. When outbreaks do occur, rapid intervention is necessary to prevent long-term damage to trees. Alien moth species invading a new region can be even more destructive as they often have no natural predators and can spread quickly, causing significant defoliation, economic damage and loss of habitat and natural resources. The vast areas involved, together with the need for timely intervention and the inaccessible nature of the terrain often necessitate the selective use of aerial spraying. As a result, Ag aviation has become an essential pest management tool in many state owned and private forests throughout the world.

Some of the first large-scale aerial spraying of forests was undertaken in New Brunswick, Canada by the then newly created Forest Protection Ltd organisation in 1952. They used ex WWII Stearman trainer aircraft to treat over 200,000 acres (about 81,000 ha) to control the spruce budworm, *Choristoneura fumiferana*. This species attacks mainly balsam fir and white spruce, defoliating the growing pine needles. In outbreak years (such as occurred in New Brunswick in 1976), about 9 million acres (3.9 million ha) were sprayed from the air. In remission years some 0.1 – 0.5 million acres (40,000 – 200,000 ha) are routinely sprayed each year.

Spruce Budworm larvae

Almost all aerial forest spray operations in Canada (and in many other countries) now routinely use Ultra Low Volume (ULV) application. This allows spraying to be made typically at 0.1 – 0.53 US gal/acre (1 – 5 l/ha), offering aerial operators the greatly increased productivity; essential for the expansive areas to be treated. To achieve accurate targeting of sprays, particularly with biological products such as *bacillus thuringiensis* (Bt), this requires the use of application equipment capable of precisely controlling spray droplet size. Over

the years, research has highlighted the importance of consistent droplet size to target the growing pine needle shoots where caterpillars feed.

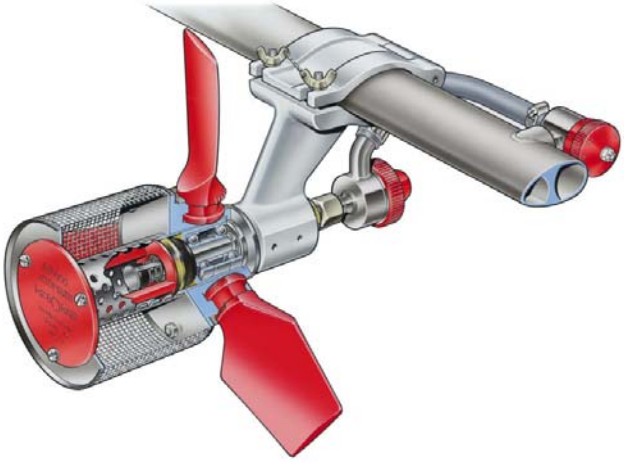
Micronair rotary atomisers are therefore often the equipment of choice as they are one of the few atomisers in the market capable of precise droplet size control at ULV rates of application. Frequently use of Micronair atomisers will be specified in aerial spray contracts in order to ensure consistent spray coverage. The use of Micronair rotary atomiser technology is supported by forest pest management research groups, regulatory authorities and by the chemical suppliers on the product label. Fixed wing aircraft can be equipped with the Micronair AU4000 rotary atomisers with electro-magnetic brakes to prevent atomiser rotation during long ferry trips. Forest Protection Ltd have recently replaced some of their WWII TBM avenger aircraft with the Air Tractor AT802 equipped with AU4000 atomisers. These aircraft are used for both spraying and fire bombing operations. Many fixed wing aircraft also use the smaller Micronair AU5000 atomiser. On both models the atomiser rotational speed is typically set to produce spray droplets of around 100um – 150 µm diameter. For many years, the US Forest Service has used Micronair atomisers to apply Bt formulations such as Valent Biosciences' Foray 48B and 76B and the insect growth regulator, Dimilin (diflubenzuron – ex Crompton) to control infestations of the Gypsy Moth (*Lymantria dispar)*. Bt is a biological insecticide that acts as a stomach poison and inhibits feeding after ingestion by lepidopterous insect larvae (caterpillars). As such it is highly species specific and has extremely low toxicity and limited environmental impact. Diflubenzuron, is similarly highly selective, acting as a chitin synthesis inhibitor. When it is ingested it prevents insect larvae moulting and developing into adult moths. Both insecticides are widely used in forest pest management programs throughout the world

Air Tractor AT502 equipped with Micronair AU5000 (USA)

The gypsy moth is one of North America's most devastating pests. It was first introduced by accident from Europe over 100 years ago and the insect is a voracious feeder. The European gypsy moth is now widely established in Northeast USA and Canada. This species defoliates over 4 million acres (1.7 million ha) each year in the Eastern US, causing millions of dollars of damage. The insects feed on many tree species but mainly prefer oak. Its closely related cousin the Asian Gypsy moth is a more mobile pest and is capable of spreading rapidly over great distances. Because of this, large-scale eradication programs are implemented to control outbreaks in the Eastern US and Canada. The gypsy moth is native to Europe and Asia and is present in forests from Spain, through Eastern Europe and across Asia to China and Japan.

Integrated Pest Management (IPM) programs are used in many countries to monitor insect populations by egg mass counts and control programs, often aerial application of Bt, are started when economically damaging threshold levels are reached.

Aerial spray operations over forest canopies typically use release heights of around 30 – 45 feet (10-15 m). The US Forest Service, together with US and Canadian research and commercial organisations, has been instrumental in the development of aerial spray dispersal models for forestry. These models, together with numerous field trials are a useful tool for forest pest management organisations, regulatory authorities, industry and aerial spray operators. Droplet size data for various nozzle types, including Micronair atomisers, has been analysed in wind tunnels to simulate aerial application at different airspeeds and operating parameters with different spray tank mixes. This data is used to predict spray dispersal, deposition, spray drift etc.



Micronair AU5000 rotary atomiser

Table 2 Recommended application parameters for different aircraft types with hydraulic pressure nozzles and Micronair rotary atomisers

Type	Horse Power	Hopper Capacity US Galls	Aircraft	Lane Seperation (feet) Hydraulic	Rotary
Fixed Wing	Turbine >1100	>750	Air Tractor 802	200	200
	Turbine 750-1100	500-750	Air Tractor 502/602	125	150
			Dromader M18	125	175
			Thrush T-34/T-41/T-45	125	150
			Thrush 660	125	150
			Thrush G-10	125	150
	Turbine 600 - 750	300-500	Air Tractor 400/500	125	150
			AgCat King C/Turbo	100	125
			Thrush R1820	100	125
			Thrush T-15	100	125
	Piston 600-750	300-500	Air Tractor 301/301A/302/401/	100	125
			AgCat Super B	100	125
			Thrush 600	100	125
			Thrush T-11	100	125
Helicopter			Bell 204/205/212/214		150
			BellOH58		125
			Bell 206B		100
			Bell /Soloy 47G-3B		125
			Hughes 500D		75
			Hiller/Soloy 12E		75
			Bell 47G		100
			Hiller 12E		100

(data kindly supplied by John Ghent, USFS, 2004)

An outbreak of Gypsy Moth in the Balkans (Serbia, Romania and Bulgaria) in 1997 – 99 required the spraying over 3 million acres (1.3 million ha) using Kamov KA-26 helicopters and Anotonov AN-2 and Dromader M-18 aircraft, all equipped with Micronair atomisers to apply Foray 48B and Dimilin products.

More recently (2002/3) there has been an outbreak of the pine processionary caterpillar in Southern Europe. This has affected the Mediterranean forests in Italy, Spain and Southern France. Control operations included aerial application with Bt insecticides applied at ULV rates. 'Hot spots' of infestation were targeted using helicopters equipped with the electrically operated Micronair AU6539 atomisers with electronic speed control to regulate drop size.

One of the largest and most successful European forestry pest management programs was carried out in Poland during 1994 – 1997 to control an outbreak of the nun moth *lymantria monacha*. 73 fixed wing aircraft and 15 helicopters were deployed to spray over 6 million acres (2.5 million ha) of forest in May and June 1995. All were equipped with Micronair AU5000 atomisers and applications made with Bt and diflubenzuron products at rates of 2 – 4 l/ha. Productivity for fixed wing aircraft was typically 200 – 250 ha/hr and 80 ha/hr for helicopters. The aircraft used were mainly Antonov AN- 2 with some M-18

Dromaders and Mi-22 helicopters (all of East European manufacture). The nun moth outbreak lasted 5 – 7 years and the cost of control was US $ 10 – 20/ha (1995), achieving a cost :benefit ratio of 20:1 compared to the economic damage to forests. Again, an outbreak of the Siberian Silk Moth *Dendrolimus sibericus* was prevented in Siberia in 1996 after aerial spraying of some 150,000ha using 15 AN2 aircraft equipped with Micronair AU5000 atomisers. More recently, programs (many supported by the Food and Agriculture Organisation of the UN) have been undertaken in Moldova and Mongolia (both using Bt with AN-2 aircraft) and in SE Asia.

Kamov K-126 Helicopter with Micronair AU6539 electric atomisers in Eastern Europe

In the southern hemisphere similar aerial spray programs are also conducted to protect forest resources. Painted Apple Moth has threatened deciduous forests in New Zealand and there have been simultaneous outbreaks in Chile. Micronair AU6539 electric atomisers were used on helicopters, often to spray in and around residential areas. In New Zealand this required highly accurate spray delivery on narrow forest stands using drop sizes nearer 200 µm to minimise spray drift. The AU6539 with its ‘dial a drop’ electronic atomiser speed control was essential for precise application.

Targeting the larval stages of caterpillar pests requires rapid intervention with often only a 2-3 week window for application. The ability to spray large areas rapidly and accurately with spray deposited at the feeding sites for caterpillar larvae is a unique attribute of ULV aerial application and will continue to play an important role in protecting the world’s natural and commercial forests.