ReJeX-iT™ AG-36 AS BIRD AVERSION AGENT FOR TURF AND AGRICULTURE

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ABSTRACT: In limited field studies on turf, winter rye, cherries and blueberries, where the presence of sufficient concentrations of ReJeX-iT™ AG-36 were known to exist, excellent bird repellency was achieved. Variations in the results are attributed to low concentrations of the initial application, rapid biodegradation due to environmental conditions, or limited application (covering less than 100% of the test plot).

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INTRODUCTION

While agricultural losses to birds have always occurred, the problem is increasing as most of the control methods are either prohibited or are withdrawn from the market. Canada geese (*Branta canadensis*) and American coots (*Fulica americana*) cause considerable aesthetic, monetary and health problems in the urban and suburban landscape, such as golf courses, parks, corporate headquarters and private lawns. Other nuisance birds cause losses in all sectors of agriculture (Mason et al. 1992). Losses to blueberries (*Vaccinium* spp.) were reported at $8.5 million in 1989 (Avery et al. 1991) but are estimated now at more than $18 million for 1993 (Brazelton 1994). Losses to vineyards were estimated at more than $7 million per year (Himelrick 1985), damage to cherries at $24.2 million (Crase et al. 1976), and losses from red-winged blackbirds (*Angelaius phoeniceus*) in the rice fields of Louisiana alone were reported at $4 million for 1983. We estimate the overall loss and damage to the U.S. economy, caused by birds, is in excess of $1 billion.

METHODS

The basic reason for the problems on turf and in agriculture is the presence of food for birds, food the birds like, an abundance of food that does not require long foraging, and there are usually not many people around to interfere with their feeding. Many of the effective control methods used in the past have and are disappearing from the market leaving only marginal or unacceptable methods to deal with an increasing problem.

Extermination - such as shooting, only affects the killed birds and is not acceptable to many in our society. In many instances it leads to heavy fines.

Poisons - they kill many non target species and are a general concern of environmentalists and the public in general.

Noise - normally does not work as birds habituate to it and in some cases it attracts birds, signaling availability of food (as observed with gulls on fish farms).

Scare crows - they are good for perching, not much more.

Distress calls - of whom? The farmer?

Netting - while effective, it can be very expensive and can lead to entanglement of birds with resulting fines.

Repellents - are effective if available. They do not kill, but work through behavior modification, making the food source unpalatable, and thus require the birds to look for other food sources.

The effectiveness of methyl anthranilate (MA) as bird repellent has been established in the laboratory and cage environment for many years (Kare 1961). However, the interest to develop a commercial application did not get strong enough until the late 1980s (Askham 1992, Dolbeer 1992, Mason 1989). Several attempts were made by a few companies to formulate a commercial product without much success (Mason et al 1988, Cummings 1991 & 1993).

Many problems are associated with the properties of the active ingredient MA (Table 1). The pure compound is phytotoxic at the concentrations where it is active as a bird repellent, it biodegrades rapidly, it is much heavier than water, it is not very soluble in water, and is generally hard to formulate by known methods. The increased need for an effective bird repellent led to the development of ReJeX-iT™ AG-36, a non-phytotoxic, food grade formulation of special grades of MA. ReJeX-iT™ AG-36 was submitted to EPA for registration in 1993 for use in agriculture and on turf.

ReJeX-iT™ AG-36, along with its active ingredient MA, exhibits no adverse toxicological properties towards birds, mammals, and humans (Table 2), and due to its rapid biodegradation does not accumulate in the environment. It truly can be classified as a low risk control method.

ReJeX-iT™ AG-36 is an aqueous slurry, miscible with water at any ratio. Once it dries, it does not wash off the fruits or leaves. It is best applied with regular agricultural spray equipment, such as an "Air Blast," after dilution with water at a ratio of 1:4. As a guideline for most bird problems, an application rate of 9 kg a.i./ha is suggested to provide good repellency.

RESULTS

Many limited evaluations with ReJeX-iT™ AG-36 and other MA-based formulations have been reported with mixed results. Unfortunately, none followed the concentration of the active ingredient over the test period.

A recent study on plots of Kentucky blue grass (*Poa pratensis*) with ReJeX-iT™ AG-36 at an application rate of 2.9 kg MA/ha showed a 92% reduction of geese feces collected on the second day after the application (Figure 1). On the fourth day after application the reduction was only 66%, further deterioration to 22% was observed at the sixth day (Cummings 1993). While this rate of application is far below the recommended 9 kg/ha it still yielded satisfactory results in the open environment as

was evident when the geese left after exposure the first day. In this controlled study, the Canada geese could not leave the general study site. With the degradation of the repellent the geese eventually returned to the treated areas. In an open environment the geese would have left the area after the first exposure, longer activity would only be required if new flocks of geese would invade the target area.

Table 1. Properties of ReJeX-iT™.

Property	ReJeX-iT™ MA	ReJeX-iT™ AG-36
Melting point	23.8°C min	
Boiling point	208°C, 406°F	100°C
Solubility	0.29 g/100 ml water	slurry - miscible
Octanol/water	42 ± 11.6	
Density	1.161 - 1.169	1.02
Phytotoxic	yes	no

Table 2. Toxicological Data for ReJeX-iT™.

TEST	ReJeX-iT™ MA TGAI	ReJeX-iT™ AG-36 End-use product
Acute oral LD_{50} (rat)	3288 mg/kg	>5000 mg/kg
Eye irritation (rat)	slight to moderate	slight redness
Primary dermal (rat)	none	
Primary dermal (rabbit)		none
Acute dermal (rabbit)	LC_{50} > 2000 mg/kg	LD_{50} > 2000 mg/kg
Acute oral (mallard)	LD_{50} > 290 mg/kg[1] LD_{50} > 5620 ppm[2]	
Bluegill sunfish LC_{50}	9.1 mg/1	
Channel catfish LC_{50}	12.2 mg/1	
Rainbow trout LC_{50}	22.9 mg/1	
Atlantic salmon LC_{50}	32.4 mg/1	

[1] Birds regurgitated at higher levels.
[2] Highest level tested.

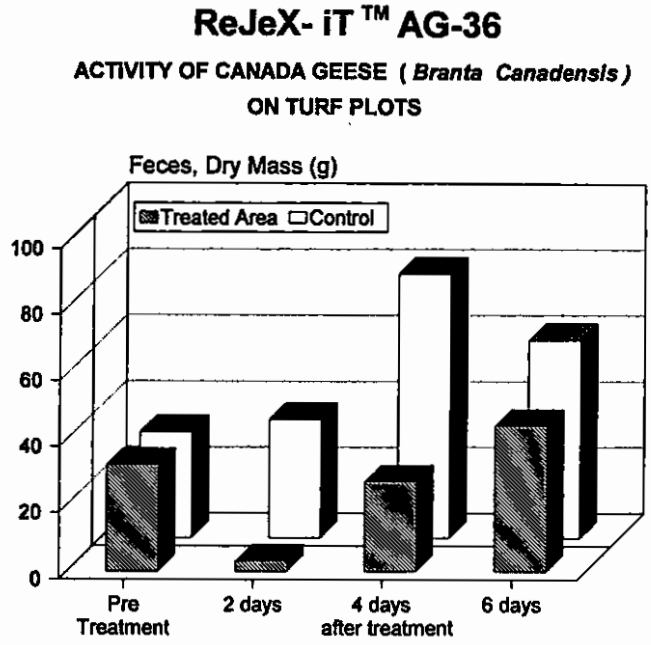

Figure 1. Canada Geese droppings on turf plots, before and after application of ReJeX-iT™ AG-36 at a rate of 13 kg/ha (2.9 kg MA/ha).

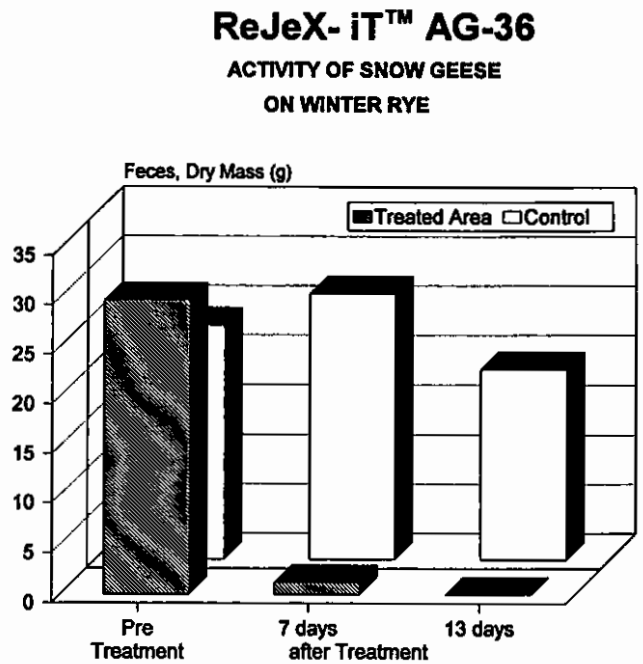

Figure 2. Droppings of Snow geese (*Chen caerulescens*) along two transects of rye (*Secale cereale*) before and after application of ReJeX-iT™ AG-36.

During the growing season, new and untreated blades of grass are produced continually and the turf is generally cut once a week. Thus, repellency beyond one week with a single application is not possible. It is most important to apply the repellent in a strength to force all the birds to leave within the first day.

A preliminary study in March 1993 with ReJeX-iT™ AG-36 on snow geese (*Chen caerulescens*) on a field of winter rye (*Secale cereale*) in New Jersey (Clark 1993) showed a 96% and 100% reduction of droppings collected along a transect after 7 and 13 days, respectively (Figure 2). Here the geese had the freedom to leave the test site and find a feeding area suitable to them. A study completed in the summer of 1993 on sweet cherries (*Prunus avium* - variety "Hartland") treated with ReJeX-iT™ AG-36 at a rate of 26.8, 53.5 and 80.3 kg/ha (3.9, 7.8 and 11.6 kg MA/ha) showed considerably less damage than the control and 18% splitting versus 48% on the non-treated fruits (Curtis 1993). Fourteen days after treatment 99% and 98% of the treated cherries were undamaged versus 89% of the control for the 26.8 and 80.3 kg/ha rates, respectively.

Studies of ReJeX-iT™ AG-36 on blueberries (*Vaccinium* spp.) were not as clear. While generally excellent protection is achieved for the first three to five days, the birds start to come back and the damage increases as the birds try to pick and find untreated berries. However, no field was ever treated completely and no part was ever treated repeatedly to assure an adequate concentration of the active ingredient. Also, blueberries ripen over a much longer period of time, allowing for greater damage by birds if not done properly.

DISCUSSION

While the study on cherries was conducted during dry and warm summer weather with low humidity, the blueberry study was done at extremely high temperatures and very high humidity, interrupted by frequent rain. The adverse weather led to fast degradation of the formulation and the MA. The birds generally started to come back after four days when no MA could be detected.

Recent studies revealed rapid degradation of MA and loss of activity. Biodegradation studies in aqueous solution, performed by Toxicon under controlled conditions at 23°C showed a half life time of .866 days in aqueous solution (Kabler 1993). While UV degradation studies showed rapid initial loss of material, it slows down considerably after about 25% degradation (Ashkam 1992, Clark 1992), which will only cause problems on application of marginal concentrations. Biodegradation is by far the dominating factor in the degradation of ReJeX-iT™ AG-36.

These findings impact little on other formulations and applications such as landfills, where daily applications have to be made. Others formulations that are not aqueous in nature, such as ReJeX-iT™ TP-40 are much more resistant to degradation until eventual dissolution in water takes place. Thus in tests on woodpeckers (*Picidae*) ReJeX-iT™ TP-40 was active for several weeks, repelling woodpecker from suet and wood sidings (Dolbeer 1994). Longer lasting specific modifications of ReJeX-iT™ AG-36 for use in agriculture, where this is needed, are in development.

There are still many variables, that have not been identified. However, there is no case known where birds preferred food with a verified minimum active concentration of MA above the threshold limit.

WHY ReJeX-iT™ AG-36

The product is formulated from FDA-GRAS listed (1965) raw materials, that have been widely used in food and feed products for over 100 years (grape bubble gum contains 2200 ppm of the active ingredient). It has extremely low toxicity (Table 2). It does not persist in the environment and biodegrades to CO_2 without the formation of any intermediate. The product functions by aversion rather than toxicity eliminating danger to any animal whether target or not.

OUTLOOK

All birds tested are effected by ReJeX-iT™ AG-36 or its active ingredient. While there might be different threshold limits for various species, no details are known. Slight modifications to optimize the effects for the various applications will still be done, as large scale field data become available. Judging from recent test results of other MA based formulations in landfills, it can be assumed, that widespread use will increase its efficiency.

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