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New Starling Toxicant: DRC-1347

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ABSTRACT: DRC-1347 (3-chloro-**p**-toluidine) has proved to be an effective contact toxicant for starlings *(Sturnus vulgaris)*. Its low mammalian toxicity and apparent absence of secondary hazards to mammalian and avian predators indicate that it may be an excellent replacement for avian contact toxicants now in use that are more hazardous. Several field trials have been conducted with good results.

RECENTLY, the Denver Wildlife Research Center developed an effective and safe toxicant for baiting starlings *(Sturnus vulgaris)* (Besser 1967, DeCino 1966, Royall 1967, West 1968). This compound, DRC-1339 (3-chloro-**p**-toluidine hydrochloride), is now registered for use in many states for control of problem flocks in cattle and poultry feedlots. But starlings also cause problems in urban areas by defacing such structures as buildings, neon signs, and bridges, and at these sites they usually cannot be baited effectively. For this reason there is a need for a safe and effective starling perch toxicant for use on urban structures.

Two common insecticides, endrin and fenthion, have been used as starling perch toxicants, but both are potentially hazardous to man, domestic animals, and nontarget birds. We are currently investigating a new compound that offers promise as an effective and much safer substitute. This compound is 3-chloro-p-toluidine (DRC-1347), the free base of DRC-1339.

TABLE 1. Acute oral and dermal toxicity of DRC-1347 to four species of birds

Species		LD_{50} (mg/kg) DRC-1347	DRC-1339	Endrin	Fenthion
Starling	Oral	4.2	3.8	2.4	6.0
	Dermal (Breast)	8.0	14	5.6	9.5
	Dermal (Foot)	25	80	56	41
Pigeon	Oral	13	18	5.6	1.8
House sparrow	Oral	320	>365	1.8	5.6
Sparrow hawk	Oral	420	320	1.5	1.0

Toxicity

Table 1 shows the acute oral

and dermal toxicity to starlings of DRC-1347, endrin, and fenthion, in milligrams of toxicant per kilogram of body weight (mg/kg). Oral toxicity was determined by stomach-tubing birds with varying concentrations of the toxicant in propylene glycol. Dermal toxicity was determined by applying acetone solutions of the toxicant to the breast beneath the feathers or to the pad area of the foot. LD_{50}'s (median lethal doses) were calculated by the method of Thompson (1947), Thompson and Weil (1952), and Weil (1952).

Table 1 shows that DRC-1347 applied to the foot is toxic to starlings at lower levels than either endrin or fenthion. Although we did not test dermal application on pigeons *(Columba livia)* or house sparrows *(Passer domesticus)*, the higher oral toxicity of DRC-1347 to them (considerably higher in the case of the sparrow) suggests that a perch treatment with this toxicant could selectively kill starlings.

Secondary Hazard

One of the most favorable things about DRC-1347 is the probability that it will have low toxicity to bird and mammal predators. Many urban starlings feed in surrounding rural areas, and since they are not killed by perch treatments of endrin, fenthion, or DRC-1347 until 6 to 120 hours after contact, secondary toxicity—poisoning of predators who eat the affected or dead starlings—is a matter of concern.

Table 1 shows that it takes only a small dose of endrin or fenthion to kill sparrow hawks *(Flaco sparverius)*, but that it takes a very high dose of DRC-1347. In additional tests, there were no apparent toxic effects when 59 starlings killed with a 20% DRC-1347 perch formulation were fed to two 120-gram female sparrow hawks in 39 days. In contrast, two sparrow hawks died within 3 days after eating two to four house sparrows killed with an experimental 12% fenthion paste, and a 650-gram Swainson's hawk *(Buteo swainsoni)* died in 11 days from eating 15 starlings killed with a commercial endrin perch formulation (9.75% in diesel fuel).

Preliminary information on the toxicity of DRC-1347 to mammals is equally promising. Again, this is an important consideration for a perch toxicant because not only wild predators, but dogs, cats, and even children may come in contact with the perch-killed birds. The acute oral toxicity of endrin is 7-43 mg/kg for rats and 16-36 mg/kg for guinea pigs (Negherbon, 1959). That of fenthion is 190-310 mg/kg for rats, 260 mg/kg for guinea pigs (Anon., 1959), and 150-190 mg/kg for mice (Francis and Baines, 1963). We found the acute oral toxicity of DRC-1347 was 1500 mg/kg for rats and 1000 mg/kg for mice—making it 5 to 200 times safer than endrin or fenthion.

Studies in which low levels of the toxicants were incorporated in the feed of mammals have given similar results. For example, 10 parts per million (ppm) of fenthion in the feed over a 60-day period proved fatal to rats (DuBois, 1964). Dogs and rats receiving more than 5 ppm of endrin in feed lost weight, and some died; animals receiving 10 ppm all died in less than 30 days (Negherbon, 1959). On the other hand, it appears that mice receiving 500 to 1000 ppm of DRC-1339 (the hydrochloride salt of DRC-1347) for similar periods of time experience only minor weight loss and no other symptoms.

There are many indications that DRC-1339 is rapidly eliminated by starlings, and that the lethal effect occurs after most, if not all, of the chemical and its metabolites (breakdown products) are excreted by the bird. The supposed final metabolite, 4-acetamino-2-chloro benzoic acid, is safe for mice or starlings at doses greater than 1000 mg/kg. Since DRC-1347 is simply the free base of DRC-1339, it is very probable that DRC-1347 acts in the same way. This would be further evidence that starlings affected or killed by a DRC-1347 perch formulation should not poison the predators that eat them.

Stability

Endrin and fenthion are very stable compounds when exposed to the elements. For example, a 6% fenthion paste will kill starlings contacting it for 10 seconds or less for up to 26 days, while a 12% paste remains toxic for 2 months. DRC-1347 is not so stable. In a weathering test, DRC-1347 and endrin, both mixed at 9.75% in diesel fuel, were placed in slit steel tubes with wicks and exposed to sunlight for various periods. Starlings were allowed to perch on the tubes for 1-minute periods before and after the different periods of exposure. The endrin perches remained effective throughout the 6-day test. The DRC-1347 perches lost most of their toxicity after 2 days and were not effective for the 1-minute period although they retained enough of it even after 6 days of weathering to kill starlings that roosted on them overnight.

Further tests with DRC-1347 paste and liquid formulations applied in films 3 millimeters (mm) thick indicated that much of the chemical's instability

came from volitilization and decomposition caused by ultraviolet light. Addition of ultraviolet-absorbing chemicals in different concentrations to paste formulations extended their toxic life from one-and-one-half to three times. For example, the expected life of a 20% formulation was extended from about 24 hours of sunlight to 44 hours by adding 4% of an ultraviolet absorber. Higher concentrations of the absorber gave somewhat greater protection.

Relative instability, particularly when it can be partially overcome when necessary by adding another chemical, can actually be an advantage in a perch toxicant. In many situations it is undesirable to have a stable toxicant linger on a perch after the target population has been removed. This is a real danger with endrin and fenthion.

Field Results

Five field trials with DRC-1347 have provided information on the chemical's utility under actual conditions of use.

In the first test, a 20% paste formulation of DRC-1347 applied in 3-mm-thick beads inside a barn cupola proved extremely effective, with only 2 of 100 roosting starlings returning after 3 days. This treatment was not exposed to sunlight, and retained its effectiveness throughout the test. Thirty pigeons were using the same roost, but only three were killed, even though heavy use of the roost had left their feet covered with the paste.

In a second trial, the same 20% paste in 3-mm-thick beads was applied on an outdoor advertising sign used by 1200 starlings; the population was reduced 70%. In a third trial, a 10% paste in 3-mm-thick beads was 50% effective in reducing a starling population of 300 at another outdoor advertising sign.

A fourth trial conducted on approximately 600 starlings roosting in a hay barn in Idaho was apparently almost completely successful in eliminating that problem population. Only a single starling returned to the barn 2 nights after treatment, and many dead starlings were found within the barn and throughout the surrounding countryside.

In a final trial, a 10% spray, 1 mm thick, was ineffective because it lost activity in the 6 hours it was exposed to sunlight before the starlings came to roost. Evidently DRC-1347 cannot be used effectively in a thinly deposited spray if the treatment is exposed to sunlight before the birds arrive.

Conclusions

DRC-1347 has unique properties that enhance its appeal as a contact toxicant for starlings. It will probably prove safe to mammals and birds of prey that eat affected or dead starlings, and perches treated with it are less apt to kill other birds than those treated with endrin or fenthion. In addition, its decomposition rate can be modified to a considerable extent by changing the physical and chemical properties of the carrier. For a short-lived treatment, low concentrations or thin applications may be suitable. When longer effective life is needed, higher concentrations, thicker films, or an ultraviolet absorber can be used.

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