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Paul P. Woronecki
U.S. Department of Agriculture/APHIS

Richard A. Dolbeer
U.S. Department of Agriculture/APHIS

Thomas W. Seamans
U.S. Department of Agriculture/APHIS

William R. Lance
Wildlife Pharmaceuticals, Inc.

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PAUL P. WORONECKI, RICHARD A. DOLBEER, and THOMAS W. SEAMANS, U.S. Department of Agriculture/APHIS, 6100 Columbus Avenue, Sandusky, Ohio 44870

WILLIAM R. LANCE, Wildlife Pharmaceuticals, Inc., 1401 Duff Drive, Fort Collins, Colorado 80524

ABSTRACT: During 1990 and 1991 we conducted safety, efficacy and clinical trials required to register alpha-chloralose (A-C) for capturing nuisance waterfowl and pigeons with the U.S. Food and Drug Administration (FDA). We determined the Most Effective Dose (MED) to be 30 and 60 mg of A-C/kg of body weight for capturing waterfowl and pigeons, respectively. We conducted 11 field trials in 4 states, capturing 587 waterfowl and 1,370 pigeons with 8% mortality for ducks, 0% for geese, and 6% for pigeons. We submitted a New Animal Drug Application to FDA in October 1991 and anticipate registration in 1992.

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INTRODUCTION

Domestic pigeons or rock doves (*Columba livid*), waterfowl, [primarily Canada geese (*Branta canadensis*), wild mallards (*Anas platyrhynchos*), feral ducks and hybrids of wild and feral ducks], and coots (*Fulica americana*) are nuisance birds in many situations in the United States (Woronecki et al. 1990). The use of strychnine-treated baits, historically the most common method of reducing pigeon populations, was suspended by the U.S. Environmental Protection Agency in October 1988 for all "above ground" situations. Presently, there are no nationally registered toxic baits available for use on pigeons in the United States. Fenthion is still registered in toxic perch formulations for pigeons but there is concern over nontarget hazards of this chemical (Krysik 1987). Current management of nuisance waterfowl has consisted largely of reducing populations by trapping for translocation or euthanasia, nest and egg destruction, and hunting within the framework of current federal regulations (Woronecki et al. 1990). Presently there are no chemical products registered for alleviating waterfowl problems nor are there any drugs registered for capturing nuisance birds for relocation (Eschen and Schafer 1986).

Alpha-chloralose ($C_8H_{11}Cl_3O_6$; A-C) was successfully used in the United States to capture Canada geese, mallards, feral and hybrid ducks, and coots from commercial and residential sites (Woronecki et al. 1990). In addition, over 600 pigeons were captured with A-C at a dairy farm in Nevada with only 8% mortality (Woronecki, unpubl. date). However, additional research was necessary for federal registration of A-C through the U.S. Food and Drug Administration (FDA) for use on waterfowl and pigeons. Our objective was to conduct quality-assured safety, efficacy and clinical trials required to register A-C for capturing nuisance waterfowl and pigeons under an Investigational New Animal Drug Application (INADA) with the FDA.

This report summarizes our laboratory studies and clinical field trials. All but one field trial were audited to insure compliance with good laboratory and clinical practices. The status of FDA registration of A-C is also discussed.

METHODS

Laboratory Studies

The objective of these studies was to determine the Most Effective Dose (MED), the Therapeutic Index (TI = LD_{50}/ED_{50}) and Certain Safety Factor (CSF=LD_{01}/ED_{99}) (Loibl et al. 1988) for Canada geese (as a representative waterfowl species) and pigeons. The ED_{50} and LD_{50} are the dose levels (mg/kg) which capture and kill, respectively, 50% of the treated birds. We define MED as the minimum dosage necessary to capture at least 95% of the treated animals. Once an MED (X) was selected, dosing of captive birds was done at the 1/2X, 1X and 3X dosage levels for a sample of birds of each species to examine behavioral response, blood profiles and tissue changes.

Birds were captured in traps and held >2 days before being tested. Only adult waterfowl and pigeons were used. Following each test, all birds not exposed to A-C and birds that fully recovered from A-C treatment were released when suitable sites were available. Otherwise, birds were euthanized and buried.

Birds were provided with food and water ad libitum. Ten geese were tested at each of 8 dosage levels and 4 to 10 pigeons at each of 13 levels. Doses were administered at 1/4-log intervals or successive dosage levels whose logarithms differ by a constant. Dosages were calculated according to bird weight and toxicant concentrations (mg/kg). Inoculated bread baits and liquid gavage material were made from a suspension of A-C and corn oil. Geese and pigeons were dosed using orally administered bread baits and liquid gavage respectively. Concentrations ranged from 218.6 to 218.9 mg of A-C per ml of com oil for geese and 52.1 to 53.7 mg of A-C per ml of corn oil for pigeons. After dosing, birds were placed in outdoor shaded holding pens for observation. The effective dose parameters were the inability to avoid capture by hand or hand-held net, and the time after dosing required to render the bird capturable (Crider and McDaniel 1967, Martin 1967).

Necropsy of 5 geese and 5 pigeons treated at 1X (MED) and 3X and of controls was conducted at day 0, 1 and 7

posttreatment by a pathologist from Wildlife Pharmaceuticals, Inc., Fort Collins, Colorado to determine any morphological changes. Blood samples were collected at 0, 1 and 7 days posttreatment and shipped to California Avian Laboratory, Citrus Heights, California to determine hematology and blood chemistry profiles of birds treated at 0, 1X (MED) and 3X levels. Samples of baits and suspensions were sent to Affiliated Environmental Services, Sandusky, Ohio, for analyses of A-C levels.

To demonstrate whether the MED determined for Canada geese was appropriate for other waterfowl, a laboratory evaluation of A-C with mallards was conducted. Wild mallards were captured in northern Ohio 3 weeks before testing. Twelve mallards of each sex were dosed with A-C at 30 mg/kg using orally administered bread baits. Birds were kept in shaded holding pens for observation for at least 1 week after dosing.

All birds were maintained, dosed, sacrificed, bled, necropsied, and disposed of at the Denver Wildlife Research Center, Ohio Field Station, Sandusky, Ohio. Methodology for laboratory studies are described in more detail in Woronecki et al. (1991b) and Woronecki and Dolbcer (1991). A-C (99.5% a.i.) and documentation regarding purity was obtained from BioSynth Ag in Switzerland.

Field Trials

From May 1990 through December 1991, 10 field trials were conducted at 4 sites in Ohio, 3 sites in Nevada, 2 sites in North Carolina and 1 site in Arizona. Test sites included a business district, residential area, resort, park, golf course, hotel casino, airport, school, and agricultural experiment station. Tests were arranged by and cooperatively conducted with U.S. Department of Agriculture, Animal Damage Control (ADC) biologists who had found other methods of alleviating the specific problem situation to be unsuccessful.

A-C-treated bread baits for capturing waterfowl were made from slices of fresh white sandwich bread cut into 2-3 cm square pieces. Each 13-ml of suspension was prepared by mixing 1.63 g of A-C with 12 ml of corn oil. Each bread piece was inoculated with a calculated volume of suspension that would provide a MED of 28 to 31 mg A-C/kg body weight. The plan was to capture individual geese and ducks with single baits. Baits were made in small batches to maintain bread freshness and reduce crumbling and breaking. A 13-ml suspension would treat 14 to 17 baits for geese and 41 to 50 baits for ducks.

Corn baits treated with A-C were prepared by adding A-C powder (1.0 mg of A-C per kernel) to corn that had been sized, screened and cleaned of dust and chaff. Typically, 2,000 kernels of corn (weighing 600 to 650 g) and 2.0 g A-C were placed in a plastic container with a lid and shaken for at least 30 sec to distribute the A-C evenly. Corn oil was added (10 ml per 2,000 kernels of whole corn) and the contents mixed again.

Birds were prebaited at least 1 week before any treatment by spreading bait on the ground where the birds normally fed or by hand tossing bait to individual birds. Prebait was similar to bait used in the test. In two tests powdered sugar was used on the prebait to simulate A-C. During prcbaiting, we counted the number of target and nontarget animals present and estimated feeding rates. Prebaiting and baiting were usually conducted in the morning. Initial doses were calculated using the mean weight of targeted species as reported by Dunning (1984). Subsequent bait doses were based on the mean weight of initial birds captured at the bait site.

Bait selection, either bread or corn, depended upon the number, species, and wariness of target birds. In situations where single baits could be selectively fed to individual waterfowl, bread baits were preferred because each bird could be given a known amount of A-C (e.g., 1 or 2 baits to achieve a dose of 30 mg A-C/kg). Where large flocks of birds could not be individually fed (i.e., pigeons, wild waterfowl), corn baits containing 1 mg of A-C/kernel were spread over the bait site. For example, a site with 100 wild mallards (mean weight 1.0 kg) or 150 pigeons (mean weight 0.33 kg) would receive 3,000 kernels of corn treated with 1 mg of A-C/kernel. Theoretically, each duck would eat 30 kernels and obtain a dose of 30 mg of A-C/kg and each pigeon would eat 20 kernels and obtain a dose of 60 mg of A-C/kg. In some situations, after birds consumed treated baits we attempted to keep them on the bait site by feeding them token amounts of untreated bread or corn. Untreated baits were also used to segregate or lure nontarget birds from target birds and treated birds from nontreated birds.

At the time of baiting, we estimated the target bird population present and the number of birds treated. Observations were made to determine the time of initial bait consumption, initial reaction to A-C, and immobilization. Treated birds were monitored for signs of sedation, the reaction of unaffected birds to affected birds, and to prevent accidental drowning. Birds were captured by hand or with a long-handled net as soon as they were sufficiently sedated. Sedated birds were transported in cloth bags to holding cages or an enclosed truck. Sedated birds were kept in cages lined with straw for at least 24 hours or until they recovered. All birds were weighed and dead birds buried. Mallards and geese were relocated to wildlife management areas. Domestic ducks were relocated or euthanized. Hybrid ducks and pigeons were euthanized.

Methodologies for each field trial are described in more detail in Dolbeer and Cleary (1991), Dolbeer et al. (1991), Seamans and Cleary (1991), Woronecki et al. 1992, Woronecki et al. (1991a), Woronecki and Fairaizl (1991a), Woronecki and Fairaizl (1991b), Woronecki et al. (1991c), and Woronecki et al. (1991d).

RESULTS

Laboratory Studies

Canada geese as a representative species of waterfowl Doses and responses used to calculate the ED and LD values for orally administered bread baits treated with A-C on Canada geese are listed in Table 1. The ED_{50} for Canada geese was 15.5 mg/kg (95% fiducial limits were 9.0 to 19.0 mg/kg). The MED was determined to be 30.0 mg/kg. The LD_{50} was 53.9 mg/kg (95% fiducial limits were 47.5 to 62.0 mg/kg). The TI was 3.5 mg/kg and ranged from 2.5 to 6.9 mg/kg. The CSF of A-C for capture of geese in this situation was 0.7, and the extreme case analysis of CSF based on 95% fiducial limits indicated the CSF ranged from 0.2 to 1.2.

Only control geese and geese dosed at 1X (MED) and 3X were used for hematology and serum chemistry profiles. Blood values were similar to those reported by Leonard (1982) and Shave (1986) for normal geese. Samples from 3X

Table 1. Doses and responses used to calculate effective dose (ED) and lethal dose (LD) values for orally administered bread baits (Canada geese) or oil suspension (pigeons) treated with alpha-chloralose (A-C), June-October 1990.

Species	Dose (mg/kg)	Dose level (X=MED)[a]	Number of birds		
			dosed	capturable	died
Canada geese	15	1/2X	10	5	0
	24		10	8	0
	30	1X	10	10	0
	37		10	10	3
	47		10	10	2
	58	2X	10	10	4
	72		10	10	9
	90	3X	10	10	10
Pigeons	15		4	0	0
	21.2		7	0	0
	30	1/2X	15	10	0
	35.7		7	2	0
	42.4		7	7	0
	46		5	5	0
	58		5	5	0
	60	1X	10	10	0
	72		4	4	0
	90		5	5	0
	120	2X	10	10	0
	180	3X	10	10	3
	240	4X	5	5	3

[a]The MED is the dose required to capture at 95% of the treated animals.

birds were not obtained since all geese died at this level. Gross and histologic examination of treated geese compared with control geese did not reveal any identifiable, consistent pattern of morphological changes related to toxicity.

Pigeons Doses and responses used to calculate ED and LD values for orally administered suspensions of A-C on pigeons are listed in Table 1. The ED_{50} for pigeons was 30.5 mg/kg (95% fiducial limits were 26.1 to 34.0). The MED was determined to be 60 mg/kg. The LD_{50} was 215.0 (95% fiducial limits of were 180.6 to 493.6 mg/kg). The TI was determined to be 7.1 and ranged from 5.3 to 18.9. The CSF of A-C for capture of pigeons in this study was 2.2 and the extreme case analysis of CSF based on 95% fiducial limits indicated that the CSF ranged from 0.1 to 3.5 (Woronecki et al. 1991b).

Only control pigeons and pigeons dosed at 1X (MED) and 3X were used for hematology and serum chemistry profiles. Blood values were similar to those reported by Woerpel and Rosskopf (1984) and Allen (1988) for normal pigeons. Samples from 1X and 3X pigeons were obtained on Days 1 and 7 post-treatment. Gross and histological examination did not reveal a consistent morphological toxicity pattern in the dosed groups when compared with controls.

Canada geese and pigeons The following clinical effects of A-C noted in this study were typical for both pigeons and waterfowl and were considered important indicators of the stage of sedation, depth of sedation or anesthesia, and dose received. Early stages of light sedation were characterized by the loss of equilibrium, blinking of eyes and torticollis. Midstage and deepening sedation leading to the point when the animal could be captured was typified by the closing of eyes, limited movement, and the bird becoming prostrate or supine. Deep anesthesia sometimes followed by death was exemplified by torticollis, fluid in the oral cavity and respiratory irregularity. Recovery was marked by reversal of the previously described effects. As the dose rate increased, onset of clinical effects generally occurred sooner and recovery time was longer (Table 2). Male Canada geese appeared to be affected more rapidly (t-test, $P<0.02$) than females, but in pigeons there was no difference (t-test, $P<0.50$) between the sexes (Table 3). Results of these laboratory studies are described in more detail in Woronecki et al. (1991b).

Mallards Twenty-three of 24 mallards dosed at the Canada goose MED level of 30 mg/kg were capturable within 69 minutes of dosing. There were no differences (t-test, $P>0.20$) between males and females in time to first symptoms or time to capturability. All mallards fully recovered

Table 2. Relationship between alpha-chloralose dose level and its effect on Canada geese and pigeons.

Species	Dose level (X=MED)[a]	Dose mg/kg	Elapsed time (hours) from dosing to: First symptoms N	$\bar{x}$	(range)	Capture N	$\bar{x}$	(range)	Recovery N	$\bar{x}$	(range)	Death N	$\bar{x}$	(range)
Canada geese	1/2X	15	10	0.6	(0.3-1.1)	5	2.4	(1.4-3.4)	10	<9	(3.5<20)	0	——	——
	1X	30	10	0.5	(0.3-0.8)	10	1.5	(0.6-2.6)	10	<23	(<21-28)	0	——	——
	2X	58	10	0.6	(0.4-0.9)	10	1.5	(0.7-3.9)	8	<26	(<21-31)	2	5.3	(5.1-5.5)
	3X	90	10	0.3	(0.2-0.6)	10	0.9	(0.5-1.3)	0	——	——	10	8.0	(4-10)
Pigeons	1/2X	30	10	0.7	(0.3-1.8)	6	1.2	(0.9-1.5)	10	6.5	(4.9-6.9)	0	——	——
	1X	60	10	0.4	(0.2-0.6)	10	0.8	(0.5-1.4)	10	<17	(7-<22)	0	——	——
	2X	120	10	0.4	(0.2-0.6)	10	0.7	(0.5-1.1)	10	<21	(<20-<21)	0	——	——
	3X	180	10	0.3	(<0.1-0.3)	10	0.5	(0.3-0.8)	7	28	(24-30)	3	<6.2	(1.6-<14)
	4X	240	5	0.3	(0.2-0.3)	5	0.5	(0.3-0.7)	2	24	(22-27)	3	1.2	(0.9-1.5)

[a]The MED is the dose required to capture at least 95% of the treated animals.

within 24 hours (Table 3). Results of this laboratory study are described in more detail in Woronecki and Dolbeer (1991).

Field Trials

Waterfowl Thirty-one Canada geese and 556 nuisance ducks were removed from 8 situations in 4 states with 100 and 92% survival, respectively (Table 4). Nuisance waterfowl were generally accustomed to being fed, making prebaiting easy. Generally, bait formulations were based on 1-kg wild mallards and 4-kg Canada geese. Bait formulation for feral ducks and geese and hybrid ducks were determined in the field by visually estimating weights relative to wild mallards and Canada geese. However, between and within sites there was considerable variation in duck and goose weights which contributed to some individuals receiving under- or overdoses. Consumption of more than one treated bread bait also contributed to mortality. All baits were consumed within 15 minutes after application and symptoms produced by A-C were usually noted within 30 minutes after ingestion. Most waterfowl were capturable 60 minutes after ingestion. Affected waterfowl were typically ignored by other waterfowl, which continued to feed or rest until affected. Birds not captured the first baiting readily accepted A-C baits in subsequent baitings without apparent bait shyness or chemical repellency.

Trials in Ohio and Arizona using bread baits on nuisance ducks resulted in the exposure of baits to nontarget animals. In Ohio a ring-billed gull (*Larus delawarensis*) consumed a single treated bait and died shortly after being captured. In Arizona 4 nontarget animals [2 Koi goldfish, 1 black swan (*Cygnus stratus*) and 1 great-tailed grackle (*Quiscalus mexicanus*)] ingested A-C-treated bread baits but none were observed affected. However, we suspect that the grackle may have died from an overdose of A-C.

Trials were favorably received by the general public as an effective and humane tool for capturing, removing or relocating nuisance waterfowl. Most trials were in locations where the public could observe the operations.

Pigeons In a preliminary, unaudited trial conducted in 1989 at the University of Nevada Agricultural Experiment Station (UNAES) in Reno, using whole kernel com treated with 90% a.i. A-C (1 to 4 mg/kernel), 697 pigeons were removed from a dairy with 90% survival (Table 4). In audited trials, 673 pigeons were removed from locations in 2 states with 98% survival (Table 4). In 1990, at the UNAES, pigeons were baited with whole kernel corn treated with A-C on 6

Table 3. Time to capturability (hours) for male and female Canada geese, mallards and pigeons dosed at the Most Effective Dose (MED) level (30 mg/kg - geese and mallards, 60 mg/kg - pigeons).

Sex	Elapsed time (hours) from dosing to capture[a] Canada geese N	$\bar{x}$	SD	Mallards N	$\bar{x}$	SD	Pigeons N	$\bar{x}$	SD
Male	4	0.9[b]	0.2	12	0.8[c]	0.1	6	0.9[d]	0.3
Female	6	1.7[b]	0.5	12	0.9[c]	0.3	4	0.7[d]	0.3

[a]All birds fully recovered within 24 hours.
[b]Means are different ($P = 0.02$; $t = 3.11$, 8 df).
[c]Means are not different ($P > 0.50$; $t = 0.56$, 22 df).
[d]Means are not different ($P > 0.50$; $t = 0.24$, 8 df)

Table 4. Nuisance ducks, Canada geese and pigeons captured with alpha-chloralose (A-C) during field trials in 1990 and 1991.

Species	Year	State	Situation	Bait	Population treated	Population removed	% survival	Attempted A-C dose rate: No. of baits/ bird	Attempted A-C dose rate: mg/ bait	Attempted A-C dose rate: mg/kg body weight	Reference[a]
Ducks	1990	NV	Hotel	Bread	74	56	86	1	37.6	28.1	A
	1990	OH	Park	Bread	29[b]	29	98	1-3	37.7	28.1	B
	1990	NV	Golf course	Bread	144[c]	102	83	1-2	37.6	28.1	C
	1991	NC	Residential	Corn	11[d]	5	40	38	1.0	28.1	D
	1991	NC	School	Bread	6[e]	4	100	1	37.6	28.1	D
	1991	AZ	Resort	Bread	73[f]	68	88	1	25-40	30	E
	1991	OH	Park	Corn	318[c]	292	97	45	1.0	30.0	F
			Total ducks		655	556	92				
Geese	1990	OH	Airport	Bread	15	15	100	1	120.0	30.0	G
	1991	NC	Residential	Corn	16	7	100	112	1.0	28.1	D
	1991	NC	School	Bread	9	9	100	1	112.8	28.1	D
			Total geese		40	31	100				
Pigeons	1989[g]	NV	Agriculture	Corn	1,828	697	90	20	1-4	60	H
	1990	NV	Agriculture	Corn	1,800	650	98	20	1.0	60	I
	1991	OH	Business	Corn	103	23	96	20	1.0	60	J
			Total pigeons		3,731	1,370	94				
			Grand Total		4,426	1,957	94				

[a]A = Woronecki and Fairaizl 1991a; B = Woronecki et al. 1991a; C = Woronecki and Fairaizl 1991b; D = Woronecki et al. 1991d; E = Woronecki et al. 1991c; F = Woronecki et al. 1992; G = Seamans and Cleary 1991; H = Woronecki, Unpubl. data.; I = Dolbeer et al. 1991; J = Dolbeer and Cleary 1991.
[b]Feral and hybrid ducks and geese. [c]Wild, feral and hybrid ducks. [d]Nontarget wild mallards consuming baits placed out for nuisance geese.
[e]Tame mallards. [f]Mallards and hybrids. [g]Not an audited trial (A-C 90% a.i. used).

occasions over 4 days. A total of 64,000 treated kernels (1 mg A-C/kernel) were offered and 650 pigeons were captured with 2% mortality. All bait was consumed within 30 minutes of placement. Captured pigeons ingested an average of 39 kernels, resulting in a mean dose of 115 mg A-C/kg of body weight. We suspect that many other pigeons obtained sub-immobilizing doses. No hazards to nontarget wildlife were noted and no evidence of bait shyness developed after 4 consecutive days of baiting. This study demonstrated that A-C is an effective, safe means of capturing pigeons.

In 1991, pigeons were baited on 2 days with whole kernel corn treated with A-C (1 mg A-C/kernel) on 3 rooftops in downtown Mansfield, Ohio (Table 4). About 300 pigeons loafed in the downtown area daily. Bait acceptance was moderate; 61% of the 18,000 treated kernels were consumed by pigeons within 5 hours of placement. But, only 23 pigeons were captured and all recovered from the effects of A-C. No nontarget birds fed at bait sites. We believe more pigeons would have been captured if a traditional feeding site had been used for baiting instead of traditional loafing sites. No negative public reaction was noted in any pigeon test.

DISCUSSION

Laboratory Studies

Canada geese appear to be more susceptible to the effects of orally administered A-C (ED_{50} = 15.5 mg/kg, LD_{50} = 53.9 mg/kg, TI = 3.5) than chickens in which the ED_{50} = 45 mg/kg, LD_{50} = 300 mg/kg and TI = 6.7 (Loibl et al. 1988), but similar to mallards in which the ED_{50} = 14.8 mg/kg, LD_{50} = 54.6 mg/kg, and TI = 3.3 (Woronecki, Unpubl. data). Pigeons, however, appear to be more resistant to the effects of A-C (ED_{50} = 30.53 mg/kg, LD_{50} = 215 mg/kg, TI = 7.04) than Canada geese.

The CSF is useful in evaluating the safety of capture drugs, particularly when groups of animals must be caught without mortality. A drug with a CSF <1 is contra-indicated under such a requirement because the LD_{01} is less than the ED_{99}. In the case of Canada geese where the LD_{01} is 0.7 of the ED_{99} (CSF = 0.7), this problem can be minimized because the number of bread baits ingested by individual geese can be controlled by selective baiting of individual birds. For pigeons (CSF = 2.23) the drug is safe, particularly in field applications of whole kernel corn baits in which the number of baits ingested by an individual bird cannot be controlled. With respect to minimum mortality being tolerated (e.g., 10%

= LD_{10}/ED_{99}), the CSF for geese is 1.02 and the CSF for pigeons is 2.93, indicating that the drug can be used safely on both geese and pigeons where minimal mortality is tolerable.

Similar to the findings of Loibl et al. (1988) only torticollis, fluid in the oral cavity, respiratory irregularities and shivering were observed in A-C affected birds in this study. Tonic convulsions such as induced by strychnine poisoning (Lees 1972, Winters 1976), were not observed. The only convulsion-like behavior observed seemed to occur when animals in mid to deep sedation were disturbed or startled by other affected birds staggering within the holding cage. Overall, A-C-induced sedation did not appear to cause stress. Furthermore, untreated birds showed no negative response to birds in the same cage undergoing A-C-induced sedation.

The MED derived for Canada geese (30 mg/kg) appears suitable for mallards and probably other waterfowl because 100% of the mallards dosed at 30 mg/kg reached capturable stage with no mortality. The mean time to first effects was almost identical for mallards (33 minutes) and Canada geese (36 minutes). The mean time to capturability was less for mallards (52 minutes) than for Canada geese (90 minutes).

Field Trials

Trials involving waterfowl demonstrated the safety and efficacy of A-C at a dose rate of 30 mg/kg body weight. Waterfowl were successfully captured in 8 situations in 4 states using bread or whole kernel corn baits with minimal (8% for ducks, 0% for geese) mortality and hazards to nontarget animals. Audited field trials with pigeons demonstrated the effectiveness and safety of whole kernel com baits treated with 1 mg A-C/kernel of corn for capturing pigeons with negligible mortality and no hazards to nontarget animals. In addition, the general public and wildlife personnel accepted A-C as an effective and humane tool for capturing and removing waterfowl and pigeons.

During laboratory trials we found that more control of dose levels is needed when baiting Canada geese and mallards than pigeons. However, the hazard caused by this susceptibility can be minimized by selective baiting of individual birds with treated bread baits or providing an optimum number of treated corn baits per waterfowl present. Field trials reflect this susceptibility of waterfowl to A-C and support our laboratory data because some mortality occurred in most field trials. However, pigeons experienced minimum mortality during field studies when non-selective baiting was conducted using treated whole kernel corn baits. In some cases pigeons ingested 3 times the MED without dying.

The trials also demonstrated that A-C can be safely used in high-traffic public areas where capture of waterfowl and pigeons is not possible by the traditional means of explosive or other propelled net devices or where trapping creates public relations problems. In addition to the safety issues of using explosive net devices in public areas, netting or trapping of wild birds can produce significant physical trauma, e.g. broken wings and legs, cervical column damage to long neck birds, as well as stress-induced capture myopathy (Spraker et al. 1987). Although some mortality was experienced due to birds consuming excessive amounts of A-C, the overall mortality was within acceptable limits when compared with more stressful procedures such as trapping, poisoning or shooting of birds.

CONCLUSIONS AND STATUS OF FDA REGISTRATION

The data from controlled laboratory and field studies substantiate that A-C is a safe capture agent for waterfowl when the amount of drug ingested by an individual bird is controlled and is a safe capture agent for pigeons even when the amount of drug or treated bait ingested by individual birds cannot be controlled. On 18 October 1991, copies of the New Animal Drug Application (INAD 6602) were submitted under Expedited Review Status to the FDA Center for Veterinary Medicine (CVM), Division of Drugs for Non-Food Animals. Included in the submission were: 1) identification data including the trade name "BIRDNAP", 2) a summary of chemistry, scientific rationale, and purpose of the new animal drug, and highlights of laboratory and field studies, 3) draft of the labelling, and 4) evidence of established safety and efficacy (11 laboratory and field trial reports). Presently we are awaiting the outcome of the review but we expect registration in 1992 for use in applying baits for sedation and capture of waterfowl and feral pigeons by Federal and state wildlife biologists.

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