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PHIL. AGR. U.P. LOS BAÑOS
VOL. 65, No. 1
Jan.-Mar. 1982

PHIL. AGR. 65: 53-58
JAN.-MAR. 1982

ISSN 0031-7454

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Research partially funded by the U.S. Fish and Wildlife Service and the U.S. Agency for International Development under the Participating Agency Service Agreement "Control of Vertebrate Pests," ID/TAB 473.1.67.

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Reference to trade names does not imply Government endorsement.

CESC No. 3507. Received for publication 16 September 1981.

Acute LD_{50} values and distress behavior responses of 4-aminopyridine (Avitrol[R])[2], a chemical frightening agent, were determined for three species of mannikins, *Lonchura punctulata*, *Lonchura leucogastra*, *Lonchura malacca*, and one species of sparrow, *Passer montanus*. LD_{50} values of 7.94, 3.11, 4.45, and 3.54 mg/kg were found for the four species, respectively. *P. montanus* exhibited the most pronounced distress behavior.

INTRODUCTION

Three species of weaver birds are recognized by farmers as destructive to maturing rice and other cereal grains in the Philippines. No assessments, however, have yet determined the economic losses to these birds on standing or harvested grains. Almoja et al. (1973) and Benigno et al. (1975) studied the damage potential of the nutmeg mannikin (*Lonchura punctulata*), white-breasted mannikin (*Lonchura leucogastra*), and the chestnut mannikin (*Lonchura malacca*). The European tree sparrow (*Passer montanus*) has been identified as a pest in warehouses (National Post Harvest Institute for Research and Extension, pers. comm.).

One control method against red-winged blackbird (*Agelaius phoeniceus*) damage in North America is the use of a neurological chemical frightening agent, 4-aminopyridine (4-AP) (De Grazio et al., 1971, 1972; Besser, 1976). Affected blackbirds emit distress calls and perform erratic flight that frighten away other birds in the flock. This study evaluated the effects of 4-AP on Philippine bird pests.

MATERIALS AND METHODS

We determined the LD_{50} of 4-AP and evaluated the distress behavior of affected birds. All birds were obtained from professional trappers in Laguna Province, Philippines, and maintained in the aviary at the National Crop Protection Center, College of Agriculture, University of the Philippines at Los Baños.

We prepared various concentrations of 4-AP using propylene glycol, and dosed all birds by gavage using a 50-ul syringe with 4-cm polyethylene tubing attached to the needle. The birds received a dose volume of 10 ul/10g body weight. After dosing, six birds per treatment for *Lonchura* species and four for *Passer* species were placed in individual 15 x 22 x 15-cm wire mesh cages and held for 24 hr. Food and water were provided *ad libitum*. Surviving birds were banded and transferred to small holding cages for at least 7 days. LD_{50} values for each species were determined by methods outlined by Thompson and Weil (1952).

To evaluate behavioral response to 4-AP treatment, we observed birds dosed at the LD_{50} levels 2 hr after dosing. The amount of chemical received, the nature of affectation, the time from dosing to first distress call, the number of calls, the length of each call, and the mortality rate were recorded for all birds.

The effects of 4-AP formulated on screened whole-grain rice were also evaluated on *P. montanus*. These particles were treated with 4-AP in a methanol-acetone latex solution at the previously determined concentrations. Six birds at treatment levels of 0.5% and 1.0% were force-fed with one kernel of treated rice. The same distress data mentioned above were recorded for each bird during a 2-hr period. Data were analyzed by analysis of variance and Duncan's new multiple range test.

RESULTS AND DISCUSSION

Results of the oral LD_{50} determinations are summarized in Table 1. *L. punctulata*, the smallest and lightest of the three weaver bird species, showed the least sensitivity to 4-AP (7.94 mg/kg). The LD_{50} value for *L. leucogaster* (3.11 mg/kg), the second heaviest species, indicated sensitivity more than twice that of *L. punctulata* (7.94 mg/kg), but only slightly more than *L. malacca* (4.45 mg/kg), the heaviest species. Schafer et al. (1973) determined an acute oral LD_{50} of 5.6 mg/kg for 4-AP on the African red-billed weaver *(Quelea quelea)*. This value falls between the values of *L. punctulata* and *L. malacca*. Our LD_{50} of 3.54 mg/kg for *P. montanus* indicates twice the sensitivity of 7.5 mg/kg for the house sparrow *(P. domesticus)* found by Schafer et al. (1973).

Lonchura leucogaster dosed with 2.5 mg/kg of 4-AP became affected 56 min after dosing (Table 2). The typical affectation sequence began with

Table 1. Acute toxicity of 4-aminopyridine to four species of Philippine birds

Species	Birds (no.)	Mean Body Weight (g)	LD_{50}, mg/kg (95% CL)
L. punctulata	24	10.5	7.94 (5.47–11.52)
L. leucogastra	24	11.5	3.11 (2.62–3.69)
L. malacca	18	12.4	4.45 (3.33–5.97)
P. montanus	12	19.3	3.54 (1.94–6.50)

the bird sitting motionless in cage, its loss of equilibrium, and fluttering about in the cage. Only two of the six affected birds emitted cries. When 4-AP was increased to 5 mg/kg and 10 mg/kg, 11 of the 12 birds emitted distress cries within the first 30 min after dosing. The responses were variable with *L. malacca*. All birds dosed with 5 mg/kg and 10 mg/kg became affected, only one bird on the 2.5 mg/kg level was unaffected. Only two birds emitted vocal distress cries within the first 30 min. *L. punctulata* was the least sensitive and least affected species. Only two of six birds dosed with 2.5 mg/kg became affected but neither emitted a distress cry. As the dose level increased, birds began to be distressed; at a level of 20 mg/kg all birds emitted cries.

Of the four species tested, *P. montanus* gave the most audible and greatest number of distress calls. 5 mg/kg and 10 mg/kg appeared to be the most effective levels for producing the desired responses. At these levels, all birds became affected within 22 min. Only two birds which were dosed with 2.5 mg/kg and 10 mg/kg failed to produce cries.

All sparrows receiving the 0.5%-treated bait became affected within 28 min after dosing and those on the 1%-treated bait were affected within 21 min (Table 3). Only four of six birds emitted cries on the 0.5% level whereas all birds on the 1% level emitted cries within the first 30 min. The average time to mortality was 90 min at the lower dose and 26 min with the higher dose.

In actual baiting programs to control bird predation, the use of one concentration of 4-AP bait is desirable. Feeding observations, however, indicate that in the Philippines only occasionally do all three *Lonchura* species feed together. Because of interspecific variation in the sensitivity and responses of these species, 4-AP may not be an appropriate chemical to control damage by mannikins. Additional studies are required to better evaluate its potential.

The use of 4-AP to control *P. montanus* in both field and grain storage warehouses shows promise. In one field test at the Institute of Plant Breeding (IPB), University of the Philippines at Los Baños, rice and corn grits treated with 1% 4-AP resulted in several affected sparrows and the classical

Table 2. Response of caged Lonchura *and* Passer *to dosing with 4-aminopyridine solutions. Values with a common letter are not significant at P < 0.5. Birds dosed with 2.5 mg/kg did not emit distress calls*

Species	Treatment Level (mg/kg)	Birds (no.)	Avg Body Wt (g)	Avg Time From Dosing to 1st Distress Call (Min)			No. of Birds Emitting Vocal Distress Calls per Time Unit (min)			Distress Calls			
				min	max	$\bar{x} \pm SD$	0-30	31-60	61-120	Avg No.	Length (sec)	Range (sec)	Deaths (no.)
L. punctulata	5.0	6	10.8	16	19	11.8 ± 1.16 a	1	1	0	7 a	1	1-9	1
	10.0	6	10.6	21	27	29.0 ± 3.0 ab	1	0	0	1 a	1	1-5	1
	20.0	6	10.3	10	21	14.5 ± 4.1 b	6	0	0	2 a	1	1-17	6
L. leucogaster	2.5	6	12.2	41	56	48.5 ± 10.6 a	0	2	0	10 a	1	1-8	0
	5.0	6	11.6	12	31	21.1 ± 6.1 b	5	1	0	5 b	5	1-11	6
	10.0	6	11.8	9	18	13.7 ± 3.7 b	6	0	0	3 b	3	1-15	6
L. malacca	2.5	6	11.5	37	62	49.0 ± 12.5 a	0	2	1	1 a	2	1-3	0
	5.0	6	12.7	41	73	52.8 ± 17.9 a	0	4	2	1 a	1	1-11	6
	10.0	6	12.9	21	41	32.5 ± 9.6 a	2	2	0	2 a	2	1-10	6
P. montanus	2.5	4	20.1	32	49	39.7 ± 8.6 a	0	3	0	2 b	2	1-8	1
	5.0	4	19.6	13	35	23.0 ± 8.3 b	3	1	0	10 a	10	1-61	3
	10.0	4	18.2	10	12	11.3 ± 1.2 c	3	0	0	12 b	7	1-10	1
	20.0	4	18.9	5	10	7.5 ± 2.1c	4	0	0	2 b	4	1-20	0

Table 3 Response of P. montanus to dosing with 4-AP-treated rice Values with a common letter are not significant at P < 0.05 n = 6

	Level of 4-AP (mg/kg)	
	4.4	9.2
% equivalent	0.5	1.0
Avg body wt of birds (g)	20.3	15.3
Avg time from dosing to 1st distress call (min)		
Minimum	11	
Maximum	49	
$\bar{x} \pm SD$	23.2 ± 12.1 a	17.5 ± 4.5 a
No. of birds emitting vocal distress calls per time unit (min)		
0-30	4	6
31-60	2	0
61-120	0	0
Distress calls		
Avg no	19.2 a	9.2 a
Avg length (sec)	13.9	19.3
Range (sec)	1 - 300	1 - 240
Deaths (no)	6	6

behavioral pattern of the other birds in the flock. The majority of the birds left the area within 10 to 15 min. Goodhue and Baumgartner (1965) reported that house sparrows affected by 4-AP showed marked population reductions in grain fields and were eliminated from buildings. With additional evaluation, 4-AP could be an effective control measure against *P. montanus* in the Philippines and other Southeast Asian countries.

ACKNOWLEDGMENT

We acknowledge the assistance of M. Hoque and E. A. Benigno in conducting this study and J. L. Guarino and R. L. Bruggers (DWRC) for their comments on the manuscript.

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