WEATHERABILITY OF ZINC PHOSPHIDE TREATED RICE BAITS[1]

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Four rice baits containing 2% zinc phosphide—polished rice or bimild (broken rice), with or without 1% coconut oil—were exposed outdoors 24, 48, or 72 hours with about 1 inch of simulated rain per day, or for 72 hours without rain. Gas chromatographic analysis showed that all exposed baits lost considerable amounts of zinc phosphide in comparison with unexposed baits. After exposure without rain, baits without oil lost more (5[illegible]-[illegible]%) than those with oil (15-23%). Polished rice without oil lost about 65% regardless of exposure. After 1 and 2 days of rain, rice with oil and bimild with or without oil lost [illegible]%. However, limited bioassays suggested that, even after losses of [illegible]%, 2% baits should retain enough zinc phosphide to kill most ricefield rats (*Rattus rattus mindanensis*).

The stability of zinc phosphide on baits exposed to weathering has been investigated by several workers, but the results have not been consistent. Doty (1964) reported that wet zinc phosphide baits deteriorate rapidly in Hawaiian sugar plantations. Crabtree (1962) stated that when grain baits coated with zinc phosphide were exposed to rain, they lost 50% of their toxicity in 12-24 hours and most of it in 2-3 days. Elmore and Roth (1943) found that grain baits coated with 0.6% zinc phosphide by weight lost 23% of the toxicant when exposed to heavy rain for 2 days. However, Hayne (1951) found that cracked corn baits coated with 2% zinc phosphide by weight lost only 50% when exposed to rain and snow for 27 days.

This study used gas chromatographic analysis to determine the amount of zinc phosphide lost from rice baits exposed to rain in the Philippines.

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MATERIALS AND METHODS

Four rice baits were treated to contain 2% active zinc phosphide by weight: (1) polished rice (C-4 variety) mixed dry with zinc phosphide; (2) binlid (broken pieces of rice kernels) mixed dry with zinc phosphide; (3) polished rice coated with 1% coconut oil by weight, then mixed with zinc phosphide; and (4) binlid coated with 1% coconut oil, then mixed with zinc phosphide.

Fifteen 25-g samples of each formulation were placed at random in a circle 8 feet from a rotating lawn sprinkler. To facilitate recovery, the rice was placed on screen wire over bare ground and the binlid on three layers of cheesecloth over bare ground. The sprinkler, operating daily for 1-½ to 2 hours, soaked the baits with water of pH 7.0 to simulate about 1 inch of rain every 24 hours. The amount of water delivered was recorded by six rain gages set around the sprinkler. Five samples of each formulation were collected after 24, 48, and 72 hours of exposure. Five other samples of each formulation were exposed in similar manner for 72 hours with no rain, and five were frozen immediately after treatment.

The 60 samples exposed to rain were air-dried in a vented hood for 6-8 hours, then all 100 samples were frozen and air-freighted to the Denver Wildlife Research Center. The five samples for each formulation and exposure period were pooled, and a 1-g aliquot of each pool was analyzed by gas chromatography for zinc phosphide content by the method of Robison and Hilton (1971).

RESULTS AND DISCUSSION

The analysis showed that all formulations initially lost considerable amounts of zinc phosphide when exposed to rain (Fig. 1). Polished rice without coconut oil lost the most; even when it was exposed without rain, it had lost two-thirds of its toxicant by 72 hours. Losses from polished rice with oil and from both formulations of binlid were about the same after 24 hours of rain, but the rice with oil had lost considerably more than the binlid by 72 hours. Oil did not appear to improve the resistance of treated binlid to rain. Apparently, the exposed endosperm of the

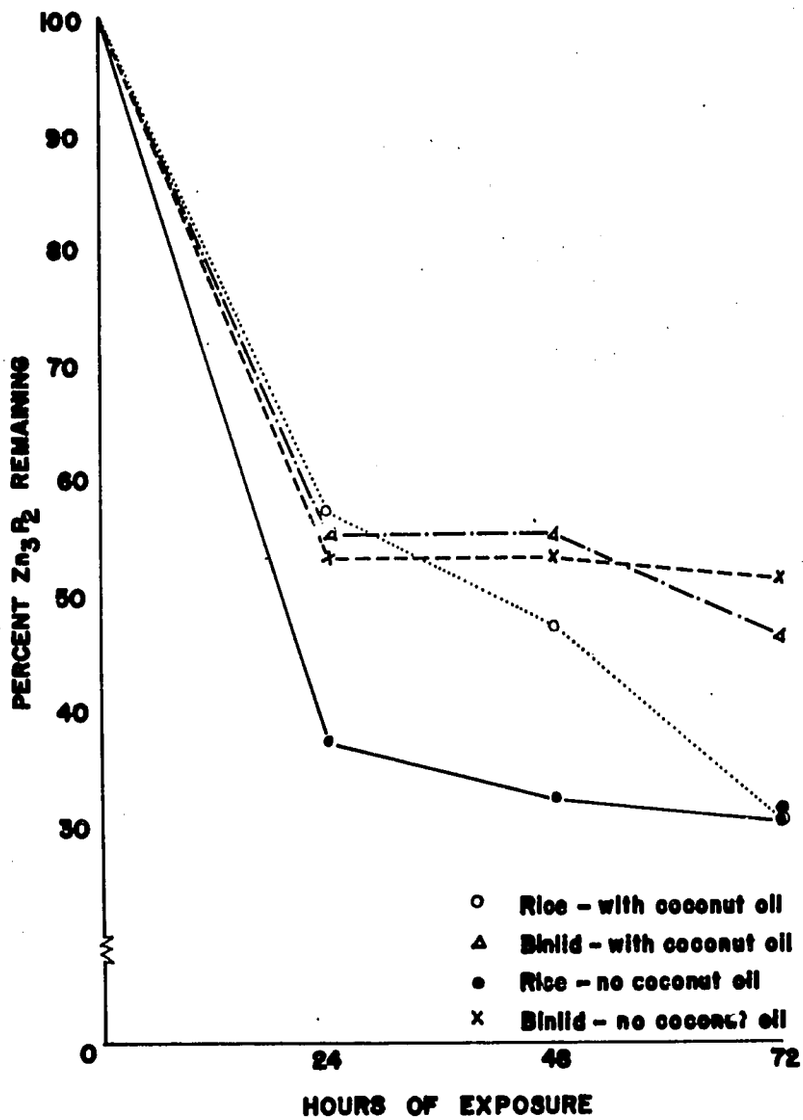

Figure 1. Change in Zinc phosphide content of rice baits after weathering. Connected points represent samples that were exposed to about 1 inch of rain during each 24-hour period. Disconnected points shown at 72 hours represent samples that were not exposed to rain.

broken kernels in binlid absorbed a certain amount of zinc phosphide whether oil was added first or not, but the oil acted as glue for the toxicant on the less absorbent polished rice. When rice was not coated with oil, it lost most of its toxicant, possibly from handling, regardless of rain.

Although the gas chromotographic analysis showed a considerable loss of toxicant, limited bioassay tests suggest that bait weathered for 48 hours would contain ample zinc phosphide to kill rats (*Rattus rattus mindanensis*) that ate moderate amounts. In these tests, polished rice was coated with 0.5% corn oil by weight, then mixed with 0.75% zinc phosphide by weight; half the bait was exposed to 1.4 inches of rain during a 48-hour period and half was left unexposed. Of 10 rats allowed to feed on the exposed bait, all died after consuming an average of 2.4 g; 10 rats given the unexposed bait died after consuming an average of 2.1 g. Studies at this laboratory have shown an LD_{50} for zinc phosphide to *R. r. mindanensis* of 28 mg/ kg and an LD_{90} of 41 mg/kg. This LD_{90} indicates that, if 60% of the zinc phosphide were lost from bait originally containing 2% active ingredient, most 150-g rats would die after eating 43 treated 18-mg kernels (6.2 mg of zinc phosphide or 0.8 g of bait).

The 55-70% losses of zinc phosphide from rice baits exposed to rain suggest that baiting should be delayed if rain is expected within 24 hours. (Rain on subsequent days should be less important because most kills with acute toxicants usually result from the first night's feeding.) However, the chemical and bioassay results indicate that exposed 2% baits should retain enough zinc phosphide to kill most rats even after 2 or 3 moderately rainy days. The extra expense of protective bait stations would therefore appear unnecessary.

Grain baits for rats are commonly placed along or on dikes in Philippine ricefields. Under these conditions, deterioration from rain, dew, spoilage, or insects may make the grain so unpalatable that toxicant loss is irrelevant. Whole grain baits usually remain intact for a few days under wet conditions, but we have observed that ground or fragmented grain absorbs moisture rapidly when placed on wet soil or grass. We have also observed that baits treated with coconut oil are highly attractive to ants. How such factors affect bait acceptance by rats is still unknown. Field nests showing how placement, particle size, and pre-baiting affect bait acceptance may prove more important than studies evaluating weathering characteristics and acceptability of various bait formulations.

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