PROJECT REPORT

Project Title:

Tetracycline as a synergist in diphacinone baits to increase efficacy, reduce residues and/or lower potential secondary hazards

Research Agency:

National Wildlife Research Center

Principal Investigators:

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Budget:

$74,300

Background:

Broadcast application of 0.005% diphacinone steam-rolled oat bait for ground squirrel control is essential to control damage to crops and rangeland forage in California. One of the main concerns is the potential for secondary hazards to non-target species that may scavenge on the carcasses of target species.

The synergistic (additive) affect of antibiotics such as tetracycline and erythromycin with anticoagulant drugs is well documented. For example, during a study to assess the use of tetracycline as a biomarker in rodent baits in Hawaii, several of the test animals unexpectedly died. The control bait, containing 1.0% tetracycline and extremely low traces of diphacinone (0.0001%), resulted in the mortality of 3 out of 12 rats. Without the addition of tetracycline, no mortality would have been expected from bait with such a low concentration of diphacinone. It appears that tetracycline greatly increased the potency of the diphacinone. However, since ingested tetracycline does not concentrate in tissues and is rapidly excreted in feces, it is unlikely that addition of tetracycline to baits would increase the secondary hazards associated with consumption of carcasses by non-target wildlife.

Potential applications for tetracycline baits include:

1) Adding tetracycline to 0.005% diphacinone baits to increase the toxicity of baits for hard to control species such as Belding's ground squirrels.
2) For rodent control in ecologically sensitive areas, tetracycline could be added to baits containing reduced levels (<0.05%) of diphacinone. Secondary hazards could be reduced without sacrificing efficacy towards the target species.

Objectives:

1) To assess the efficacy of tetracycline-fortified diphacinone rodenticide baits.
2) To evaluate the potential for reduced residue levels in carcasses and therefore decreased potential secondary hazards.

Summary:

The study monitored diphacinone/tetracycline bait uptake for 10 days. Each of the 10 test animals (5 female and 5 male Norway rats) in each of the 5 treatment groups was given test substance ad lib for 10 days along with water ad lib. The consumption of the bait was monitored daily to determine the dose of diphacinone and tetracycline each test animal consumed. Each of the 5 test baits was analyzed for diphacinone and tetracycline before and after the 10 day treatment trials. This portion of the study was completed in Dec 2004. The mortality was 10 out of 10 for each treatment group with diphacinone (concentrations of 0.005%diphacinone and no tetracycline, 0.0025% diphacinone and 1% tetracycline, and 0.001% diphacinone and 1% tetracycline) and 0 of 10 for the first control group (no tetracycline or diphacinone) and 1 of 10 for the second control group (1% tetracycline but no diphacinone).

The residues of diphacinone in the rodent whole body and liver tissues were determined and completed in March 2005 with a modified version of Analytical Chemistry Project Method #114B. Mean residues in the animals treated with the registered bait (0.005% diphacinone) were approximately 4 times greater than in the 0.001% diphacinone experimental bait containing the tetracycline synergist.

Tetracycline residues in the rat whole body and liver tissues were determined with a recently developed method. The tetracycline residue analyses were completed in May 2005. The residues ranged from 35 to 360 ppm in the combined tissue samples for the treatment groups. This represents 3 to 8% of the total amount of tetracycline that the rats consumed. The total amount of tetracycline consumed was determined by multiplying the mass of consumed bait by the concentration of the tetracycline in the baits. This quantity of tetracycline was then divided by the final weight of the rat at the end of the study to yield the total tetracycline residue expected if there was no excretion or metabolism of tetracycline.

The results suggest that using the antibiotic tetracycline with the anticoagulant rodenticide diphacinone is an effective means of reducing rodenticide residues in carcasses (observed up to 75% reduction) while still achieving 100% mortality.

Final Update: 04/03/06