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An investigation of the effects locust-control pesticides, fenitrothion and fipronil, on avian development using an in ovo model

Melissa Russ
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**An investigation of the effects locust-control pesticides,
Fenitrothion and Fipronil, on avian development
using an *in ovo* model**

Melissa Russ, B.Sc.

**A dissertation submitted in partial fulfillment of the requirements for the degree of
Masters of Science at the University of Wollongong**

March 31, 2005

DECLARATION

I certify that this thesis does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person where due reference is not made in the text.

ACKNOWLEDGEMENTS

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Abstract

Locust control operations, carried out by the Australian Plague Locust Commission (APLC), typically coincide with times of insect abundance as well as the breeding periods of many oviparous Australian vertebrates. Maternal exposure and storage of pesticides can result in the subsequent deposition of these lipophilic chemicals within the yolk lipids. Thus, these chemicals can be sequestered within an egg, exposing the embryo throughout its *in ovo* development. Fenitrothion and fipronil are pesticides currently in use by the APLC. A few teratogenic studies have been conducted regarding *in ovo* exposure to fenitrothion, though exposure occur during the later stages of development and was not modeled as maternal deposition in yolk. To date no *in ovo* study has investigated the effects of fipronil on development.

The lethal effect of fipronil varies widely between species, making toxicity to a given species difficult to predict. Limited research on rats has suggested that fipronil may adversely affect normal thyroid function, causing an increase in thyroid hormone clearance and related changes in thyroid hormone levels and regulation. Using these findings as a starting point, further investigation was warranted into the full extent of fipronil's interaction with the thyroid system.

Eggs of the domestic chicken were treated *in ovo* at day 3 of development with either fenitrothion or fipronil over a range of doses. Controls included groups that received the oil vehicle only or that received no injection. Measurements oxygen consumption of embryos were made on days 12, 14, 16, 17 and 18 of incubation. Upon

hatch, body mass and skeletal lengths of the skull and tarsus were measured. Blood was collected and analyzed for either cholinesterase inhibition (a biomarker for fenitrothion exposure) or plasma thyroxine levels (for fipronil treated eggs).

Embryos treated with fenitrothion did not differ significantly between treatments in hatchability, body mass or skeletal measurements. Plasma total, acetylcholinesterase and butyrylcholinesterase activities followed a weak linear pattern, increasing as the dose increased, but were not significantly different from controls. Oxygen consumption for the control group was significantly higher than the fenitrothion 0.1 and 5.0 mg/kg treatment groups, however none of the treatment groups differed significantly from the oil-injected group.

Embryos treated with fipronil in general exhibited lower hatchability at the highest doses, although there were no statistically significant differences between fipronil treated groups and the controls. There were also no statistically significant differences between treatments in body mass or skeletal measurements. While plasma thyroxine levels in general increased with increased dose, there were no statistically significant differences between the fipronil and the oil-treated groups. Oxygen consumption of the embryos in the control group was higher than fipronil-treated groups over time, but there were no statistically significant differences between dose treatments.

In a separate pilot study, I gave breeding female Zebra Finches oral doses of fipronil (100, 200 and 500 mg/kg and control oil) to determine the extent of maternal

transfer of the pesticide to the egg yolk. All eggs laid by these females were collected within a day of laying for 3 weeks after treatment and analysed for fipronil residues. Although the total number of eggs laid by treated females was small, there was a weak dose dependency in fipronil deposition in yolk. The degree to which this may affect embryo development was not examined as part of this thesis.

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