

APPENDIX F. Summary of Ecological Effects Data for Terrestrial Invertebrates and Plants

a. Terrestrial Insects, Honeybee Acute

A honey bee acute contact study using the TGAI is required for permethrin because its use on cotton will result in honey bee exposure. The acute contact LD50, using the honey bee, *Apis mellifera*, is an acute contact, single-dose laboratory study designed to estimate the quantity of toxicant required to cause 50% mortality in a test population of bees. The TGAI is administered by one of two methods in an acute test: whole body exposure to technical pesticide in a non-toxic dust diluent; or, topical exposure to technical pesticide via micro-applicator. The median lethal dose (LD50) is expressed in micrograms of active ingredient per bee ($\mu\text{g a.i./bee}$). Results of this test are tabulated below (**Table F.1**). Toxicity category descriptions for honey bee acute contact toxicity are the following (Atkins, 1981):

If the LD50 is less than 2 $\mu\text{g a.i./bee}$, then the test substance is *highly toxic*.

If the LD50 is 2 to less than 11 $\mu\text{g a.i./bee}$, then the test substance is *moderately toxic*.

If the LD50 is 11 $\mu\text{g a.i./bee}$ or greater, then the test substance is *practically non-toxic*.

The acute oral LD50, using the honey bee, *Apis mellifera*, is an acute oral, single-dose laboratory study designed to estimate the quantity of toxicant required to cause 50% mortality in a test population of bees. The TGAI is administered by feeding bees the technical pesticide in a sugar and water (and possibly solvent) solution using a feeding tube inserted into a cage. The LD50 is expressed in micrograms of active ingredient per bee ($\mu\text{g a.i./bee}$). Results of this test are tabulated in **Table F.1**. The Office of Pesticide Programs (OPP) does not have a categorization scheme for acute oral toxicity to honey bees. However the following acute oral toxicity categorization scheme based on ICBB (1985) categorization is provided for informational purposes:

If the LD50 is greater than 100 $\mu\text{g a.i./bee}$, then the test substance is *virtually non-toxic*.

If the LD50 10–100 $\mu\text{g a.i./bee}$, then the test substance is *slightly toxic*.

If the LD50 1–10 $\mu\text{g a.i./bee}$, then the test substance is *moderately toxic*.

If the LD50 less than 1.0 $\mu\text{g a.i./bee}$, then the test substance is *highly toxic*.

A honey bee foliar residue toxicity study is required on an end-use product for any pesticide intended for outdoor application when the proposed use pattern indicates that honey bees may be exposed to the pesticide and when the formulation contains one or more active ingredients having an acute contact honey bee LD50 which falls in the moderately toxic or highly toxic range. Usually, pesticides toxic to honey bees require precautionary labeling specific to bees on all end-use formulations and registrants are required to submit data in accordance with 10

Guideline 141-2 (Honey Bee Toxicity of Residues on Foliage). The purpose of this guideline study is to develop data on the residual toxicity to honey bees. Bee mortality determinations are made from bees exposed to treated foliage harvested at various time periods after treatment. The available study on foliar residue toxicity for permethrin is listed in **Table F.1**.

Table F.1. Honey bee acute toxicity.

Species	Type of study	% a.i.	48-hour LD50 (µg a.i./bee)	Category	Identification number, date	Study classification ^a
Honey bee (<i>Apis mellifera</i>)	Acute Contact	Tech	0.05	Highly toxic	MRID 00045044 1975	Supplemental
Honey bee (<i>Apis mellifera</i>)	Acute Contact	NR	0.16	Highly toxic	MRID 00045046 1975	Supplemental
Honey bee (<i>Apis mellifera</i>)	Acute Contact	93.1	0.024	Highly toxic	MRID 42674501 1993	Acceptable
Honey bee (<i>Apis mellifera</i>)	Acute Oral	Tech	0.19	Highly toxic	MRID 00045044 1975	Supplemental
Honey bee (<i>Apis mellifera</i>)	Acute Oral	93.1	0.13	Highly toxic	MRID 42674501 1993	Acceptable
Honey bee (<i>Apis mellifera</i>)	Foliar Residue	25WP	<0.2 lb a.i./acre (97-100% mortality at this application rate)	Highly toxic	MRID 42009301 1991	Acceptable

^aAcceptable: study satisfies guideline; Supplemental: study is scientifically sound, but does not satisfy guideline.

b. Terrestrial Invertebrates, Toxicity to Beneficial and other Non-Target Insects

In addition to the guideline studies with honey bees, a number of other older studies with terrestrial invertebrates and formulated permethrin are available to the Agency; however, many of the studies have little information reported and the results presented below are presented as they are in the studies. Several studies were submitted to show the effects of permethrin on non-target insects, primarily wasps and mites that are natural predators or parasites of the target insects for the pesticide. These studies include acute contact and foliar residue exposures and are summarized in **Table F.2**. The results of these studies indicate that permethrin is highly toxic to beneficial and other non-target insects.

One acute contact 5-day study with various species of parasitic wasps (MRID 05009995) demonstrates a range in sensitivity of the five tested species (*Apanteles sp.*, *Opius bruneipus*, *Telenomus remus*, *Copidosoma truncatellum*, and *Diglyphus intermedius*), with mortality ranging from 0% to 85% at 0.1 lb a.i./A, and 40% to 100% at 0.2 lb a.i./A. A study with alkali bees (*Nomia melanderi*) exposed to foliage treated with formulated permethrin reported mortality ranging from 25% to 78% at rates ranging from 0.5 oz. a.i./A to 2 o.z. a.i./A, respectively (NR 1975). Another study with alfalfa leafcutter bees (*Megachile rotundata pacifica*), exposed to foliage treated with formulated permethrin reported mortality ranging from 24% to 88% at rates ranging from 0.5 oz. a.i./A to 2 o.z. a.i./A, respectively (ICI US1975). In other studies with mites (*Amblyseium fallacis*), convergent ladybeetles (*Hippodamia*

convergens), and predatory mites (*Metaseiulus occidentalis*) acutely exposed to formulated permethrin, LD50 values ranging from <0.5 to 15.5 ppm a.i. were reported (MRID 00045048, 05009995, 00045048, ICI US 1975, ICI US 1976, ICI US NR). These laboratory studies indicate that permethrin is highly toxic to terrestrial invertebrates at rates equal to or below the maximum allowed on current labels, or concentrations well below what can be expected to be found in the environment following use of permethrin according to current labels.

Species	% a.i.	Test type	Test result	Identification number, date	Study classification^a
Parasitic wasp (<i>Apanteles sp.</i>)	3.2EC	Acute, 5 day contact	100% mortality at 0.2 lb a.i./A 17% mortality at 0.1 lb a.i./A	MRID 05009995 1975	Supplemental
Parasitic wasp (<i>Opius bruneipus</i>)	3.2EC	Acute, 5 day contact	43% mortality at 0.2 lb a.i./A 0% mortality at 0.1 lb a.i./A	MRID 05009995 1975	Supplemental
Parasitic wasp (<i>Telenomus remus</i>)	3.2EC	Acute, 5 day contact	90% mortality at 0.2 lb a.i./A 13% mortality at 0.1 lb a.i./A	MRID 05009995 1975	Supplemental
Parasitic wasp (<i>Copidosoma truncatellum</i>)	3.2EC	Acute, 2 day contact	100% mortality at 0.2 lb a.i./A 85% mortality at 0.1 lb a.i./A	MRID 05009995 1975	Supplemental
Parasitic wasp (<i>Diglyphus intermedius</i>)	3.2EC	Acute, 5 day contact	40% mortality at 0.2 lb a.i./A 55% mortality at 0.1 lb a.i./A	MRID 05009995 1975	Supplemental
Mite (<i>Amblyseium fallacis</i>)	25EC	Acute	100% mortality at 0.5 ppm	MRID 00045048 1975	Supplemental
Mite (<i>Amblyseium fallacis</i>)	Ambush	Acute	LC50 <1 ppm	ICI US 1976	Supplemental
Mite (<i>Amblyseium fallacis</i>)	Form.	Acute, dip test	LC50 <0.5 ppm	ICI US NR	Supplemental
Convergent ladybeetle (<i>Hippodamia convergens</i>)	Form.	Contact	LD50 <3.9 ppm	MRID 05009995 1975	Supplemental
Convergent ladybeetle (<i>Hippodamia convergens</i>)	Form.	Treated foliage	LD50 = 15.5 ppm	MRID 05009995 1975	Supplemental

Table F.2. Non-target insect toxicity.					
Species	% a.i.	Test type	Test result	Identification number, date	Study classification ^a
Alfalfa leafcutter bee (<i>Megachile rotundata pacifica</i>)	NR	Caged with treated foliage	48-hour LD50 = 0.16 µg a.i./bee	ICI US 1975	Supplemental
Predatory mite (<i>Metaseiulus occidentalis</i>)	Ambush	Acute	LD50 <2.0 ppm	ICI US Aug/Sep 1976	Supplemental
Predatory mite (<i>Metaseiulus occidentalis</i>)	25 EC	Acute, contact	LD90 = 1–5 ppm	MRID 00045048 1975	Supplemental
Predatory mite (<i>Metaseiulus occidentalis</i>)	Form.	Acute, dip test	LD50 = <1 ppm	ICI US NR	Supplemental
Alkali bee (<i>Nomia melanderi</i>)	NR	Caged with treated foliage	48-hour LD50 = 0.16 µg a.i./bee	NR 1975	Supplemental

^aAcceptable: study satisfies guideline; Supplemental: study is scientifically sound, but does not satisfy guideline.

In addition to the above laboratory studies, a number of field studies examining the toxicity of permethrin to ladybird beetles (*C. undecimpunctata* and *Coccinella septempunctata*) (ICI US NR), hover flies (Syrphidae) (ICI US NR), six-spotted thrips (*Scolothrips sexmaculatus*) (ICI US 1976), hemipteran predators (*Geocoris pallens*, *Orius tristicolor*, and *Nabis americoferris*) (NR 1976), and earthworms (*Lumbricus* and *Allolobophora spp.*) and unnamed spiders, mites and collembola were available to the Agency. Again, however, the utility of these studies for risk assessment purposes is limited because very little information was reported in the available files. Spray application of permethrin to oil rape seed resulted in significant reductions in ladybird beetles were observed at rates as low as 15 ppm. Spray application of permethrin at rates as low as 31.2 ppm caused a reduction in the numbers of hover fly larvae, and at 125 ppm no larvae survived. A field 8-spray program on a 10 day interval with an 25% EC of permethrin applied to cotton caused a significant reduction in the numbers at all rates tested (0.8, 1.6 and 3.2 oz) in all hemipteran predators, with populations temporarily eliminated. Lastly, earthworm populations were slightly reduced (non-statistically significant) when exposed to permethrin at levels of 11 lb a.i./A, but not at 1.1 lb a.i./A. Overall, these studies show that applications of formulated permethrin are likely to reduce the numbers and possibly eliminate populations of invertebrates. The results of these studies are shown in **Table F.3**.

Species	% a.i.	Test type	Test result	Identification number, date	Study classification^a
Seven spot ladybird (<i>Coccinella septempunctata</i>) and Eleven spot ladybird (<i>C. undecimpunctata</i>)	NR	Field application to oil seed rape	Significant reduction in numbers at rates of 15 ppm and higher, 24 h post-treatment.	ICI US NR	Supplemental
Hover flies (Syrphidae)	NR	Field, spray application	All rates of 31.2 ppm and above ceased a reduction in the numbers of larvae and no larvae observed at 125 ppm.	ICI US NR	Supplemental
Six-spotted thrips (<i>Scolothrips sexmaculatus</i>)	25	Field, 8-spray program on a 10-day interval with PP557 25% EC and PP383 25% EC applied to cotton.	No significant reduction in numbers at 8 days post-treatment at 3.2 oz a.i./A.	ICI US 1976	Supplemental
Hemipteran predators (<i>Geocoris pallens</i>) (<i>Orius tristicolor</i>) (<i>Nabis americanus</i>)	25	Field, 8-spray program on a 10-day interval with PP557 25% EC and PP383 25% EC applied to cotton.	Significant reduction in numbers at all rates tested (0.8/1.6 and 3.2 oz); populations temporarily eliminated.	NR 1976	Supplemental
Earthworms (<i>Lumbricus</i> and <i>Allolobophora</i> spp.) and unnamed spiders, mites and collembola	NR	Spray application	Slight decrease (non-statistically significant) in earthworm populations at 5 kg a.i./A, no effect at 0.5 kg a.i./A.	ICI US 1975	Supplemental

^aAcceptable: study satisfies guideline; Supplemental: study is scientifically sound, but does not satisfy guideline.

c. Terrestrial Plants

No data have been submitted to the Agency to evaluate the effects of permethrin on terrestrial plants because historically, terrestrial plant toxicity studies and associated risk analysis of plants were not required for registration of a pesticide unless it met specific use and pesticide classification criteria which would trigger potential concerns. In addition to the lack of registrant-submitted data, no studies demonstrating significant adverse effects of permethrin to any

terrestrial plant have been identified in the open literature. Although a number of studies involving terrestrial plants and permethrin were identified in the open literature, none of these studies provide reliable estimates of toxicity that may be used in this risk assessment. These studies were deemed unacceptable for use for reasons that include, but are not limited to: there were no observed effects at any test level but did not test up to the maximum allowable rate, there were no controls, they were efficacy studies in which observed effects were confounded by the presence of an insect pest complex, there were severe methodology limitations inhibiting the achievement of definitive conclusions.