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OFFICE OF PREVENTION, PESTICIDES AND TOXIC SUBSTANCES

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MEMORANDUM

SUBJECT: EFED Registration Chapter for **Clothianidin** for use on Tobacco, Turf, Apples, Pears and Ornamentals.

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This memo summarizes the Environmental Fate and Effects Division's (EFED) screening-level Environmental Risk Assessment for Clothianidin. The registrant, Arvesta Corporation, is submitting clothianidin to be used on turfgrass, tobacco, apples, pears, and ornamentals as a proposed Reduced Risk chemical.

Risk to Terrestrial and Aquatic Organisms

EFED concludes the following concerning the potential environmental risk from the use of Clothianidin on the proposed crops:

Clothianidin's major risk concern is to nontarget insects (that is, honey bees). EFED expects adverse effects to bees if clothianidin is allowed to be sprayed on blooming, pollen-shedding, or nectar producing parts of plants. Because of this, EFED is recommending bee precautionary labeling prohibiting such clothianidin applications.



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Clothianidin is a neonicotinoid insecticide that is both persistent and systemic. Acute toxicity studies to honey bees show that clothianidin is highly toxic on both contact and oral basis. Although EFED does not conduct RQ based risk assessments on non target insects, information from standard tests and field studies, as well as incident reports involving other neonicotinoids insecticides (e.g., imidacloprid) suggest the potential for long term toxic risk to honey bees and other beneficial insects. Other neonicotinoid compounds like imidacloprid (e.g., sunflower seed treatment) have resulted in incidents to honey bees.

Based on proposed application rates and uses, acute risks to small birds and mammals are possible. Both endangered and non-endangered small birds (20g, $RQ = 0.49 LD_{50}/sq.ft.$) and small mammals (15g and 35g mammal, $RQ = 0.7$ and $0.3 LD_{50}s/sq.ft.$, respectively) may be at risk from ingestion of granular clothianidin under the turf use only. Also, mammalian acute RQs exceeded (RQs from 0.11 to 0.23) the endangered species LOCs, should exposure actually occur. However, it would seem unlikely that small birds or mammals would or could ingest the amount of granules needed to reach an LD50 dose.

A Tier II assessment for the aquatic species (using the PRZM/EXAMS model) indicate that only acute endangered species level of concern were exceeded for estuarine/marine (RQs 0.08 to 0.10) and freshwater invertebrates (RQs 0.10 to 0.23), should exposure actually occur.

Clothianidin does not appear to present risk to terrestrial plants (there were no significant effects in the studies submitted). In addition, it does not appear to present risk to aquatic vascular or nonvascular plants.

The available environmental fate data for clothianidin indicates that the chemical is persistent, mobile, and systemic. It is stable to hydrolysis at all pHs at environmental temperatures, has the potential to leach to groundwater, be transported via runoff to surface water bodies, and could accumulate in soils from year to year with repeated uses. The major route of dissipation for clothianidin would appear to be photolysis if exposure to sunlight occurs (e.g., the measured aqueous photolysis half-life was <1 day and aerobic half-lives were 148 to 1155 days). Major degradates include TMG, MNG, and TZNG.

Risk to Endangered Species

Based on available information, clothianidin may be of concern to endangered aquatic invertebrates and some small bird and mammal species, should exposure actually occur. Also, endangered beneficial insects may be at risk due to the toxicity profile for honeybees (clothianidin is toxic to honeybees, thus risk is assumed).

EPA's Interim Policy for Potential Endocrine Disruptors

EPA is required under the Federal Food, Drug and Cosmetic Act (FFDCA), as amended by FQPA, to develop a screening program to determine whether certain substances (including all pesticide active and other ingredients) "may have an effect in humans that is similar to an effect produced by a naturally-occurring estrogen, or other such endocrine effects as the Administrator

may designate.” Following the recommendations of its Endocrine Disruptor Screening and Testing Advisory Committee (EDSTAC), EPA determined that there was scientific basis for including, as part of the program, the androgen- and thyroid hormone systems, in addition to the estrogen hormone system. EPA also adopted EDSTAC’s recommendation that the Program include evaluations of potential effects in wildlife. For pesticide chemicals, EPA will use FIFRA and, to the extent that effects in wildlife may help determine whether a substance may have an effect in humans, FFDCA authority to require the wildlife evaluations. As the science develops and resources allow, screening of additional hormone systems may be added to the Endocrine Disruptor Screening Program (EDSP). When the appropriate screening and or testing protocols being considered under the Agency’s Endocrine Disruptor Screening Program have been developed, clothianidin may be subjected to additional screening and or testing to better characterize effects related to endocrine disruption.

Data suggests that clothianidin could be a candidate for additional screening and/or testing to better characterize effects related to endocrine disruption. Effects in avian species included significant decreases in eggshell thickness. Effects in mammalian reproduction studies included decreased body weight gains and delayed sexual maturation (males only), decreased absolute thymus weight in F1 pups (both sexes), increased stillbirths (F1 and F2 litters), decreased sperm mobility and increased number of sperm with detached heads (F1 and F2 litters).

Outstanding Data Requirements

Environmental Fate:

162-4 Aerobic Aquatic metabolism Study. Based on the additional information submitted by the registrant, EFED agreed to change the previously-reviewed aerobic aquatic metabolism study (MRID 45422324) from “unacceptable” to “supplemental”. However, the aerobic aquatic metabolism data requirements are still not fulfilled, the registrant must submit a new aerobic aquatic metabolism study. Reasons are presented below:

1. The potential for clothianidin to move from the treated area to the nearby surface water body has been increased significantly since 2003 because the registrant has recently added new uses on the labels. According to the review completed on 2/20/2003 (Title - “EFED Risk Assessment for the Seed Treatment of Clothianidin 600FS on Corn and Canola”, the Agency required the registrant to conduct a new aerobic aquatic metabolism study (162-4). This risk assessment was based on the maximum application rate for the seed treatment at 0.1 lb ai/A. However, according to the new uses reviewed by EFED (Turfgrass, Tobacco, Apples, Pears, and Ornamentals), this chemical can be directly applied to the soil surface/foliage at much higher application rate (0.4 lbs ai/A). As a result, the potential for clothianidin to move from the treated area to the nearby surface water body under the new uses is much greater than the use as a seed treatment. Therefore, there is a need for a better understanding of the fate of clothianidin in the aerobic aquatic environment.
2. The fate of the thiazolyl ring was not monitored in the previously-reviewed aerobic aquatic metabolism study (MRID 45422324) because the test substance was labeled on the nitroimino

side chain. Therefore, the fate of the thiazolyl ring remains unknown. The fate guidelines recommend to use the ring-labeled test substance.

3. A well-designed new aerobic aquatic metabolism study is deemed critical for EPA to fully assess the risk of clothianidin in the aquatic environment.

166-1 Small-Scale Prospective Groundwater Monitoring Study. Due to direct soil and foliar applications of clothianidin and concerns about the chemical leaching into ground water (see below), the Agency will request the registrant to submit a small-scale prospective groundwater monitoring study.

Source: EPA review "EFED Risk Assessment for the Seed Treatment of Clothianidin 600FS on Corn and Canola" dated February 20, 2003 (page 3):

"Clothianidin has the properties of a chemical which could lead to widespread ground-water contamination, but no ground-water monitoring studies have been conducted to date. Should the registrant request field uses involving direct application of clothianidin to the land surface, Prospective Ground-Water Monitoring Studies may be needed to evaluate fully the potential impact of such uses." Due to the extreme mobility and persistence of clothianidin in the environment, a small-scale prospective groundwater monitoring study will provide additional fate information on the better understanding of this chemical in the environment and improve the certainty of the risk assessment.

Ecological Effects:

The database available for clothianidin to support the assessment was largely complete. EFED received and reviewed a honey bee residue on foliage (141-2). EFED also received a honey bee field testing for pollinators (141-5) protocol from Bayer CropScience's (BCS's) [Clothianidin (044309), D295318]. The protocol title is: An Investigation of the Potential Long-Term Impact of Clothianidin Seed Treated Canola on Honey Bees, *Apis mellifera* L. EFED is providing the status of this requested study in the following table:

Proposed Date	Action	Actual Date
Start (April/May 2003)	Conditional Registration of Clothianidin 600 FS	5/30/03
60 days (June/July 2003)	Registrant submission of draft protocol	11/28/03 (received by EFED)
120 days (August/September 2003)	EPA response with proposed changes to draft protocol	2/17/04 - 1 st reviewer completed review 3/5/04 - 2 nd reviewer completed review 3/8/04 - EFED's response completed

Proposed Date	Action	Actual Date
180 days (October/November 2003)	Registrant submission of final protocol for approval	
210 days (December 2003/January 2004)	EPA and registrant concur on study	
540 days (1.5 yrs.) (December 2004)	Final completed study submitted to EPA for review	May, 2005 (Bayer requested extension)

EFED and Canada's Pest Management Regulatory Agency (PMRA) completed a joint review of BCS's proposed field study at the end of March, 2004. EFED has not received any response from BCS since the completion of this joint review. The following ecological studies for clothianidin are still outstanding and need to be submitted.

OPPTS 850.1735: Whole Sediment Acute Toxicity Invertebrates, Freshwater. This is a 28 day test that measures survival, growth and emergence of *Chironomus riparius* that have been exposed to pesticide spiked sediment. EFED is requesting this acute sediment toxicity test because clothianidin is toxic to aquatic invertebrates, persistent in the environment, and binds to sediment over time.

OPPTS 850.1740: Whole Sediment Acute Toxicity Invertebrates, Estuarine and Marine - Testing with estuarine/marine invertebrates using the TGAI is required for clothianidin because clothianidin is toxic to aquatic invertebrates, persistent in the environment, binds to sediment over time. and the end-use product is expected to reach the marine/estuarine environment because of its use in coastal counties.

Field Test for Pollinators (141-5): The possibility of toxic exposure to nontarget pollinators through the translocation of clothianidin residues that result from seed treatment (corn and canola) has prompted EFED to require field testing (141-5) that can evaluate the possible chronic exposure to honey bee larvae and queen. In order to fully evaluate the possibility of this toxic effect, a complete worker bee life cycle study (about 63 days) must be conducted, as well as an evaluation of exposure and effects to the queen.

Based on the new proposed uses of clothianidin, EFED is requesting the following study be submitted:

Field Test for Pollinators (141-5): The possibility of toxic exposure to nontarget pollinators through the translocation of clothianidin residues that result from prebloom foliar spray and granular clothianidin applications has prompted EFED to recommend field testing (141-5). This testing should evaluate the possible acute and chronic toxic exposure to honey bees. In order to fully evaluate the possibility of this toxic effect, EFED is proposing that prebloom foliar spray and granular clothianidin applications be made at maximum proposed label rates to a crop attractive to bees (that is, pears or apples). This study is expected to evaluate the amount of clothianidin translocated to the nectar and pollen in the target crop and potential adverse effects

to honeybees. EFED recommends the registrant submit a draft protocol to be reviewed by EFED prior to implementing the study and a time frame for study completion.

Uncertainties

The uncertainties associated with clothianidin exposure in the environment are mainly focused in these areas; 1) accumulation of clothianidin in soils after repeated uses and the potential for transport/migration to surface water bodies and potential risk to sensitive aquatic invertebrates (e.g., sediment-dwelling benthic organisms); 2) repeated or continuous exposure of small mammals and birds to the pesticide presenting a potential reproduction and developmental risk; 3) the possibility of toxic exposure to nontarget pollinators through the translocation of clothianidin residues to blooming, pollen-shedding or nectar-producing parts of plants that result from clothianidin's uses; and 4) repeated or continuous exposure to soil invertebrates and small mammals to clothianidin accumulated in soils after repeated uses.

For terrestrial screening risk assessments, a generic bird or mammal is assumed to occupy either the treated field or adjacent areas receiving pesticide at a rate commensurate with the treatment rate on the field. The actual habitat requirements of any particular terrestrial species are not considered, and it is assumed that species exclusively and permanently occupy the treated area being modeled. This assumption leads to a maximum level of exposure in the risk assessment. In the absence of specific data, EFED assumes the most conservative scenario. Screening-level risk assessments for spray applications of pesticides usually consider dietary exposure alone.

EFED Label Recommendations

Manufacturing Use:

Do not discharge effluent containing this product into lakes, streams, ponds, estuaries oceans or other waters unless in accordance with the requirements of a National Pollutant Discharge Elimination System (NPDES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously notifying the local sewage treatment plant authority. For guidance contact your State Water Board or Regional Office of the EPA.

End Use Products:

This product is toxic to aquatic invertebrates. Do not apply directly to water or to areas where surface water is present or to intertidal areas below the mean high-water mark. Do not contaminate water when cleaning equipment or disposing of equipment washwaters. Do not apply where runoff is likely to occur. Do not apply when weather conditions favor drift from treated areas. Drift and runoff from treated areas may be hazardous to aquatic organisms in neighboring areas. Apply this product only as specified on the label.

For products applied as a foliar spray, EFED recommends the following labeling statement:

"This product is toxic to bees exposed to treatment and for more than 5 days following treatment. Do not apply this product to blooming, pollen-shedding or nectar-producing parts of plants if

bees may forage on the plants during this time period, unless the application is made in response to a public health emergency declared by appropriate state or federal authorities.”

Label statements for spray drift management:

Do not allow this product to drift onto neighboring crops or non crop areas or use in a manner or at a time other than in accordance with label directions because animal, plant or crop injury, illegal residues or other undesirable results may occur.

AVOIDING SPRAY DRIFT AT THE APPLICATION SITE IS THE RESPONSIBILITY OF THE APPLICATOR. The interaction of many equipment-and-weather-related factors determine the potential for spray drift. The applicator is responsible for considering all these factors when making decisions. Where states have more stringent regulations, they should be observed.

Data Requirement Tables

Table of Environmental Fate Data Requirements				
Guide-line #	Data Requirement	MRID #	Study Classification	Is more data needed?
161-1	Hydrolysis	45422317	Core	no
161-2	Photodegradation in Water	45422318	Core	no
		45422319	Supplemental	
		45422320	Core	
		45422321	Supplemental	
		45422322	Core	
161-3	Photodegradation on Soil	45422323	Core	no
161-4	Photodegradation in Air		Waived	no
162-1	Aerobic Soil Metabolism	45422325	Core	no
		45422326	Core	
		45422327	Supplemental	
		45422328	Supplemental	
162-2	Anaerobic Soil Metabolism	N/A	N/A	no
162-3	Anaerobic Aquatic Metabolism	45422330	Core	no
162-4	Aerobic Aquatic Metabolism	45422324	Supplemental	yes
		45422329	Supplemental	

Table of Environmental Fate Data Requirements

Guide-line #	Data Requirement	MRID #	Study Classification	Is more data needed?
163-1	Leaching-Adsorption/Desorption	45422311	Core	no
		45422312	Ancillary	
		45422313	Supplemental	
		45422314	Supplemental	
		45422315	Supplemental	
		45422316	Supplemental	
163-2	Laboratory Volatility	N/A	N/A	Waived
163-3	Field Volatility	N/A	N/A	Waived
164-1	Terrestrial Field Dissipation	45490703	Core	no
		45490704	Core	
		45490705	Core	
		45422331	Supplemental	
		45422332	Core	
		45422333	Core	
		45422334	Core	
		45422335	Core	
		45422336	Core	
		45422508	Supplemental	
		45422604	Ancillary	
		45422612	Ancillary	
164-2	Aquatic Field Dissipation	N/A	N/A	Reserved
165-4	Accumulation in Fish	N/A	N/A	Waived
165-5	Accumulation- aquatic non-target	N/A	N/A	Reserved
166-1	Ground Water- small prospective	N/A	N/A	Yes
201-1	Droplet Size Spectrum	45490701	Supplemental (upgradable)	Reserved
202-1	Drift Field Evaluation	N/A		Reserved

Table of Ecological Toxicity Data Requirements

Guideline #	Data Requirement	MRID #	Classification	Is more data needed?
71-1	Avian acute oral LD ₅₀ (mallard duck) (japanese quail)			No
		45422417	Core	
		45422418	Supplemental	

Table of Ecological Toxicity Data Requirements

Guideline #	Data Requirement	MRID #	Classification	Is more data needed?
71-2	Avian subacute dietary LC ₅₀ (bobwhite quail) (mallard duck)	45422419 45422420	Core Core	No
71-4	Avian reproduction (bobwhite quail) (mallard duck)	45422421 45422422	Core Supplemental	No
72-1	Freshwater fish acute LC ₅₀₀ (rainbow trout) TGAI DEG DEG DEG (bluegill sunfish) TGAI	45422406 45422408 45422409 45422410 45422407	Supplemental Supplemental Supplemental Supplemental Core	No
72-2	Freshwater invertebrate acute EC ₅₀ (daphnia) TGAI DEG DEG DEG (chironomid) TGAI	45422338 45422401 45422340 45422339 45422414	Core Core Core Supplemental Supplemental	No
OPPTS 850.1735	Acute Freshwater Invertebrate Sediment Toxicity TGAI	not applicable	not applicable	Yes
72-3a	Estuarine/marine fish acute LC ₅₀ (sheepshead minnow)	45422411	Supplemental	No
72-3b	Estuarine/marine invertebrate acute EC ₅₀ (eastern oyster) (mysid)	45422404 45422403	Core Core	No
72-4a	Freshwater fish early life stage (fathead minnow)	45422413	Supplemental	No
72-4b	Freshwater invertebrate life cycle (daphnia)	45422412	Supplemental	No
72-4d	Estuarine/marine life cycle (mysid)	45422405	Core	No
OPPTS 850.1740	Acute Freshwater Invertebrate Sediment Toxicity TGAI	not applicable	not applicable	Yes
72-7	Aquatic Field Study		NA	No
81-1	Acute mammalian oral LD ₅₀ (rat) (mouse)	45422621 45422622	Core Core	No

Table of Ecological Toxicity Data Requirements

Guideline #	Data Requirement	MRID #	Classification	Is more data needed?
83-1	Mammalian Chronic (rat) (rat) (rabbit)	45422714-16 45422825 -26 45422712-13	Core Core Core	No
122-1(a)	Seedling Emergence - Tier I	45422501	Core	No
122-1(b)	Vegetative Vigor - Tier I	45422502	Core	No
122-2	Aquatic plant algae TGAI DEG DEG DEG	45422504 45422505 45422506 45422507	Core Core Core Core	Yes ¹
123-2	Aquatic plant acute EC ₅₀	45422503	Core	No
141-1	Acute honey bee contact LD ₅₀	45422426	Core	No
Non-guideline	Acute honey bee oral LD ₅₀ TGAI DEG DEG DEG DEG	45422426 45422427 45422428 45422429 45422430	Supplemental Supplemental Supplemental Supplemental Supplemental	No
141-2	Honey Bee Residue on Foliage	45490702	Supplemental	Yes
141-5	Honey Bee Field Testing for Pollinators	45422431 45422432 45422433 45422435 45422436 45422437 45422440	Supplemental Supplemental Supplemental Supplemental Supplemental Supplemental Supplemental	Yes
OPPTS 850.6200	Earthworm Subchronic TGAI DEG DEG	45422511 45422512 45422513	Core Core Core	No
Non-guideline	Earthworm Chronic	45422525 45422526	Supplemental Supplemental	No

¹ EFED needs 3 more Tier I or Tier II Core clothianidin studies for the nonvascular surrogate species, marine diatom (*Skeletonema costatum*), blue-green algae (*Anabaena flos-aquae*), and a freshwater diatom.

Environmental Fate and Ecological Risk Assessment
for the Registration of
CLOTHIANIDIN for Use on Turfgrass, Tobacco, Apples, Pears, and
Ornamentals



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I. Executive Summary

The registrant, Arvesta Corporation, is submitting clothianidin to be used on turfgrass, tobacco, apples, pears, and ornamentals as a proposed Reduced Risk chemical. This risk assessment primarily focuses on risk to honey bees from foliar application of clothianidin to blooming crops. It also identifies possible risk to small birds and mammals which may be exposed to residual clothianidin from granular application to turf. Endangered species LOCs for mammalian acute, freshwater and estuarine/marine invertebrates are exceeded, should exposure actually occur.

Clothianidin's major risk concern is to nontarget insects (that is, honey bees). EFED expects adverse effects to bees if clothianidin is allowed to be sprayed on blooming, pollen-shedding, or nectar producing parts of plants. Clothianidin is a neonicotinoid insecticide that is both persistent and systemic. Acute toxicity studies to honey bees show that clothianidin is highly toxic on both contact and oral basis (contact $LD_{50} = 0.044 \mu\text{g}/\text{bee}$; oral $LD_{50} = 0.0037 \mu\text{g}/\text{bee}$). A registrant submitted residue foliage study (guideline 141-2) showed that clothianidin residues on foliage can be expected to remain toxic to bees for 5 days at an application rate of 0.07 lb ai/A from foliar sprays. The maximum foliar application rate proposed for the new use to apples, pears and tobacco is 0.2 lb ai/A while clothianidin's proposed maximum single spray application rate to turf is 0.4 lb ai/A. Bees are attracted to blooming, pollen-shedding, and nectar producing parts of plants. Pesticides with residue toxicity greater than 12 hours will kill bees in substantial numbers if these pesticides are applied to the plant parts that attract bees. Because of this, EFED is recommending bee precautionary labeling prohibiting such clothianidin applications.

EFED's May 2003 environmental risk assessment for seed treatment showed that use of clothianidin to rape (canola) results in detectable levels (ranging from 1.0-8.6 ppb) of clothianidin in the nectar sampled from honeybees' stomach, nectar from rape flowers, pollen from forage bees, pollen from bee hives, and nectar from bee hives. The detectable levels were found in the commodities sampled, more than 60 days after the clothianidin treated seeds were planted. Although EFED was not able to make an adverse effect determination to honey bees, there was uncertainty about the sublethal or chronic risk to bees. At the time it was not clear what will be the effect of exposure on the forage force. Will the exposed foragers become disoriented and fail to return the colony?¹ Will the clothianidin residues being carried back to the hives result in accumulations in the hive adversely affecting the colonies health? As a result, EFED recommended a honey bee field study to answer these questions.

EFED still has uncertainties associated with the seed treatment uses of clothianidin. These uncertainties are compounded with the new proposed uses of clothianidin. The earlier bee field studies for clothianidin demonstrated that clothianidin could be translocated to nectar and

¹ Other neonicotinoid compounds like imidacloprid (e.g., sunflower seed treatment) have resulted in incidents to honey bees. The National Union of French Beekeepers had concerns regarding imidacloprid (GAUCHO) seed treatment to sunflowers after beekeepers noted that honey bees were showing modifications of behavior that were reflected in foraging and orientation that eventually resulted in a drastic change in hive conditions and bee survival. Further research by the Le Centre Technique Interprofessionnel des Oleagineux (CETIOM) confirmed imidacloprid toxic residue levels in the sunflower nectar. This action has prompted France to ban the use of imidacloprid for sunflower seed treatment.

pollen in rape from seed treatment use. EFED feels the proposed bee precautionary labeling would prevent clothianidin's direct foliar application to nectar or pollen producing parts of plants. However, EFED is uncertain about what would happen when foliar spray or granular applications of clothianidin are made prior to bloom. Would the systemic clothianidin be translocated to the nectar or pollen producing parts of plants when applied as spray or as a granular? From the seed treatment field study results, it seems likely such a translocation would occur. If this happens, how much clothianidin can be expected in the nectar and pollen and would these amounts adversely affect bees? Because of this risk uncertainty EFED is requesting another field study for clothianidin's new proposed use.

Based on the proposed application rates, acute risk to avian and mammalian species is possible. Both endangered and non-endangered small birds (20 g, $RQ = 0.49 \text{ LD}_{50}/\text{sq.ft.}$) and mammals (15-35 g, $RQ = 0.7$ and $0.3 \text{ LD}_{50}/\text{sq.ft.}$, respectively) may be at risk from ingestion of granular clothianidin under the turf use only. However, it would seem unlikely that small birds or mammals would or could ingest the amount of granules needed to reach an LD50 dose.

EFED identified residues on grasses and foliage (in nectar and pollen), residues in fruit, and depositions in soil as the most likely sources resulting in clothianidin exposure to nontarget terrestrial organisms. The terrestrial effects database for these species is incomplete and thus recommendations are made for additional studies or assessments to fill data gaps needed for a suitable screening level risk assessment. As part of the Tier 1 terrestrial assessment, EFED modeled exposure concentrations of clothianidin to nontarget terrestrial plants and animals following the proposed turfgrass application rates provided by the registrant. For terrestrial birds and mammals, estimates of initial levels of clothianidin residues on various food items, which may be contacted or consumed by wildlife, were determined using the Fletcher nomogram followed by a first order decline model. Avian acute and chronic RQs were below LOCs (0.5 to 0.1 and 1, respectively). Mammalian chronic RQs do not exceed LOCs (highest $RQ = 0.64$ for clothianidin's use on turf).

The risk concerns for non-endangered aquatic species were minimized in a Tier II assessment using the PRZM/EXAMS model to predict surface water clothianidin concentrations. EFED identified spray drift and runoff to adjacent bodies of water as the most likely sources resulting in clothianidin exposure to nontarget aquatic organisms. The freshwater fish LC_{50} s (ranging from >105 to $>117 \text{ ppm}$) showed clothianidin and its degradates (TMG, MNG, and TZNG) were, practically nontoxic to freshwater fish. Since there were no mortalities or effects at these imprecise LC_{50} levels, which exceed predicted clothianidin EECs, EFED does not expect an acute risk to freshwater fish. Chronic exposure from the proposed clothianidin usage patterns should not pose direct risk to freshwater fish either. The chronic NOAEC for freshwater fish is 9.7 ppm . Maximum peak, 21-day, and 60-day PRZM/EXAMS modeled EECs are all 0.005 ppm . These predicted exposure levels are below levels triggering a chronic risk to freshwater fish. EFED's risk assessment suggests that toxic risk to estuarine/marine fish appears low, although there were no toxicity data to assess chronic risk.

Clothianidin does not appear to present risk to terrestrial plants (there were no significant effects in the studies submitted). In addition, it does not appear to present risk to aquatic vascular or nonvascular plants.

For acute endangered aquatic species, levels of concern for estuarine/marine (RQs ranged from 0.08 to 0.10) and freshwater invertebrates (RQs ranged from 0.10 to 0.23) were exceeded, should exposure actually occur. A probit slope response relationship was evaluated to calculate the chance of an individual event corresponding to the listed species acute LOCs. Analysis of raw data from the aquatic acute toxicity studies for clothianidin estimate slopes of 4.24 (95% C.I. 0.276 and 8.22) for freshwater invertebrates and 4.70 (95% C.I. 2.70 and 6.70) for estuarine/marine invertebrates. Based on these slopes, the corresponding estimate chance of individual mortality following clothianidin exposure is 1 in 294 ($RQ = 0.23$) for freshwater invertebrates and 1 in 7.68×10^5 ($RQ = 0.1$) for estuarine/marine invertebrates.

Also, mammalian acute RQs exceeded (RQs from 0.11 to 0.23) the endangered species LOCs, should exposure actually occur. Analysis of raw data from mammalian terrestrial acute toxicity studies for clothianidin provided an estimate of slope (7.61) for females only ($LD_{50} = 465$ mg/kg). Based on this slope, the corresponding estimate chance of individual mortality following clothianidin exposure is 1 in 7.21×10^{13} for small mammals.

There is uncertainty surrounding clothianidin's possible role as an endocrine disruptor as noted from mammalian developmental and reproductive effects. Data suggests that clothianidin could be a candidate for additional screening and/or testing to better characterize effects related to endocrine disruption. Effects in avian species included significant decreases in eggshell thickness. Effects in mammalian reproduction studies included decreased body weight gains and delayed sexual maturation (males only), decreased absolute thymus weight in F1 pups (both sexes), increased stillbirths (F1 and F2 litters), decreased sperm mobility and increased number of sperm with detached heads (F1 and F2 litters).

The available environmental fate data for clothianidin indicates that the chemical is highly persistent, mobile and systemic. It is stable to hydrolysis at all pHs at environmental temperatures, has the potential to leach to groundwater, be transported via runoff to surface water bodies, and could accumulate in soils from year to year with repeated uses. The major route of dissipation for clothianidin would appear to be photolysis if exposure to sunlight occurs (e.g. the measured aqueous photolysis half-life was <1 day and aerobic half-lives were 148 to 1155 days). Major degradates include TMG, MNG, and TZNG.

The uncertainties associated with clothianidin exposure in the environment are mainly focused in these areas; 1) accumulation of clothianidin in soils after repeated uses and the potential for transport/migration to surface water bodies and potential risk to sensitive aquatic invertebrates (e.g., sediment-dwelling benthic organisms); 2) repeated or continuous exposure of small mammals and birds to the pesticide presenting a potential reproduction and developmental risk; 3) the possibility of toxic exposure to nontarget pollinators through the translocation of clothianidin residues to blooming, pollen-shedding or nectar-producing parts of plants that result from clothianidin's uses; and 4) repeated or continuous exposure to soil invertebrates and small mammals to clothianidin accumulated in soils after repeated uses.

Proposed risk refinement measures include source control measures such as reduction in the application rate, reduction in the number of applications (especially in the presence of pollinators or nesting birds), and increasing the interval between applications may be

implemented for clothianidin as possible risk reduction measures. Sediment toxicity testing of sensitive species (i.e. burrowing mayflies, 28-day chironomid study) would provide data to address the uncertainty of possible risk to invertebrates because clothianidin persists in the environment representing a continual source as an environmental sink. Aquatic field studies (simulated or actual) could be performed to determine system-wide effects to the assemblages of organisms in aquatic communities. In order to fully evaluate the possibility of chronic exposure to honey bees with subsequent impacts to pollination, a complete worker bee life cycle continues to be required as well as an evaluation of exposure and effects to the queen. Additional modeling should be done to simulate the potential affects of repeated uses in order to determine if reproduction and development are affected in birds, mammals, and soil invertebrates.

II. Physical/Chemical Properties Characterization

A summary of selected physical and chemical parameters for clothianidin is presented in Table II.a.

Table II.a. Some Physical-Chemical and Other Properties of Clothianidin	
CAS Name	[C(E)]-N-[(2-chloro-5-thiazolyl)methyl]-N'-methyl-N''-nitroguanidine
IUPAC Name	(E)-1-(2-Chloro-1,3-thiazol-5-ylmethyl)-3-methyl-2-nitroguanidine
CAS No	210880-92-5 (previously 205510-53-8)
Empirical Formula	C ₆ H ₈ ClN ₅ O ₂ S
Molecular Weight	249.7
Common Name	Clothianidin
Pesticide Type	Insecticide
Chemical Family	Neonicotinoid
Color/Form	Clear and colorless/solid, powder
Odor	odorless
Melting Point	176.8°C
Flash Point	N/A
Relative Density	1.61 g/ml (at 20°C), 1.59 g/cm ³
Water Solubility	0.327g/L (at 20°C)

Table II.a. Some Physical-Chemical and Other Properties of Clothianidin	
Solubility in other solvents	heptane <0.00104 g/L (at 25°C) xylene 0.0128 dichloromethane 1.32 methanol 6.26 octanol 0.938 acetone 15.2 ethyl acetate 2.03
Vapor Pressure	3.8×10^{-11} Pa (at 20°C)
Henry's Law Constant	2.9×10^{-11} Pa x m ³ /mol
K _{ow}	1.12 (at pH 7)

Pesticide Type, Class, Mode of Action

Although nicotine has been used as a pesticide for over 200 years it degraded too rapidly in the environment and lacked the selectivity to be very useful in large scale agricultural situations. However, in order to address this problem, the neonicotinoids (chloronicotinyl insecticides) were developed as a substitute of nicotine, targeting the same receptor site (AChR) and activating post-synaptic acetylcholine receptors but not inhibiting AChE. Clothianidin, like other neonicotinoids, is an agonist of acetylcholine, the neurotransmitter that stimulates the nAChR. In insects, neonicotinoids cause symptoms similar to that of nicotine. The symptoms appear rapidly as increased restlessness followed by violent convulsions and death. The advantage of clothianidin and other neonicotinoids over nicotine is that they are less likely to break down in the environment.

III. Use Characterization

Currently Approved Crops

The following crops appear in the currently approved labels of clothianidin which are conditionally registered:

Table III.a. Currently Approved Crops for Clothianidin			
Crop	Application Rate	Maximum Rate lbs ai/A	Number of applications
Corn	5.64 fl.oz/80,000 seeds	0.1	1
Canola	3.84 - 15.36 fl.oz/100 lbs seed	0.05	1

Tolerance Petitions

The registrant has proposed petition for tolerance for the use of clothianidin on the apples and pears with application rates listed in Table III.b.

Table III.b. Crops for which Tolerances Are Being Petitioned for Clothianidin

Crop	Application Rate ¹ (lb a.i./A)	Maximum Application/ Minimum Application Interval
Apples	0.0625 - 0.09375	0.2 lb ai/A per season/ 10 days
Pears	0.125 - 0.2	0.2 lb ai/A per season/ 10 days

¹Time of application: Post-bloom only.

Application Rates

Table III.c. is a summary of the rates from the various product labels for all proposed applications.

Table III.c. Use of Clothianidin on Turfgrass, Tobacco, Apples, Pears, and Ornamentals.

Crop	Product	Appl. Rate (lb ai/A)	Max # Appl	Max Yr. Rate (lbs ai/A)	Min. Interval (days)	Application Methods
Turfgrass	Arena 0.5 G	0.2 - 0.4	N/A	0.4	N/A	Drop-type and rotary-type spreaders for granular use
Tobacco	Belay™ 16 WSG	0.05 - 0.1	N/A	0.2	N/A	Spray
Apples and pears	Clutch™ 50 WDG	0.0625 - 0.2	N/A	0.2	10	Ground spray (air blast)
Tobacco	Clutch™ 50 WDG	0.046875 - 0.0625	N/A	0.2	7	Spray
Turfgrass and Ornamentals	Clutch™ 50 WDG	0.2 - 0.4	N/A	0.4	N/A	Foliar application or Soil applications (including soil injection, drenches and broadcast sprays)

No published data from USDA or other reliable sources are available for Turfgrass usage. However, a rough estimate of turf acreages, obtained by EFED from the Biological and Economic Analysis Division (BEAD) of the OPP, are listed below.

US home lawn acreage - 18-20 million acres

Recreational turf acreage

Golf courses - 1.5 - 2 million acres

Schools and colleges - 1-2 million acres

Parks - 4-5 million acres

Commercial, industrial and other - 10-12 million acres.

According to the proposed label, there are no apparent geographic limitations for the use of this pesticide within the United States.

IV. Problem Formulation

The planning stage for an ecological risk assessment entails initial discussions between risk assessor and risk manager in order to define time lines, management goals, and the problem formulation. The management goals for the registration of the new uses of clothianidin is the protection of terrestrial and aquatic environments from unreasonable adverse effects (death or injury).

Problem formulation is the critical first step in establishing the direction and scope of an ecological risk assessment. Part A of the Guidelines for Ecological Risk assessment states that "in problem formulation, the purpose for the assessment is articulated, the problem defined, and a plan for analyzing and characterizing risk is determined." The analysis plan and rationale for developing a risk assessment for clothianidin is an iterative procedure for determining if the proposed new uses of this compound could result in residue exposure that has the potential for unreasonable adverse effects (risk) to nontarget organisms, as well as endangered/threatened organisms. The portion of the problem formulation which is an explicit statement of the characteristic of the environment to be protected is encompassed in a delineation of endpoints. These endpoints can include a particular species, a functional group of species, a community, or an ecosystem.

Relative to the proposed use of clothianidin on turfgrass, tobacco, apples, pears, and ornamentals, EFED initially had concerns for risk to aquatic organisms due to high persistence and potential mobility of clothianidin to surface waters. In the case of this assessment, EFED relied on the clothianidin hazard assessment which considers standard single chemical toxicity testing (acute and chronic endpoints) submitted by the registrant and reviewed by the Agency. EFED used this information for selection of the most sensitive species tested in order to generate RQ values. Effects data are included under the section "Characterization of Ecological Effects," and represent registrant submitted data. The effects database is mostly complete for freshwater and estuarine/marine aquatic organisms and thus is suitable for a screening level risk assessment. The major endpoints related to aquatic environments at issue are:

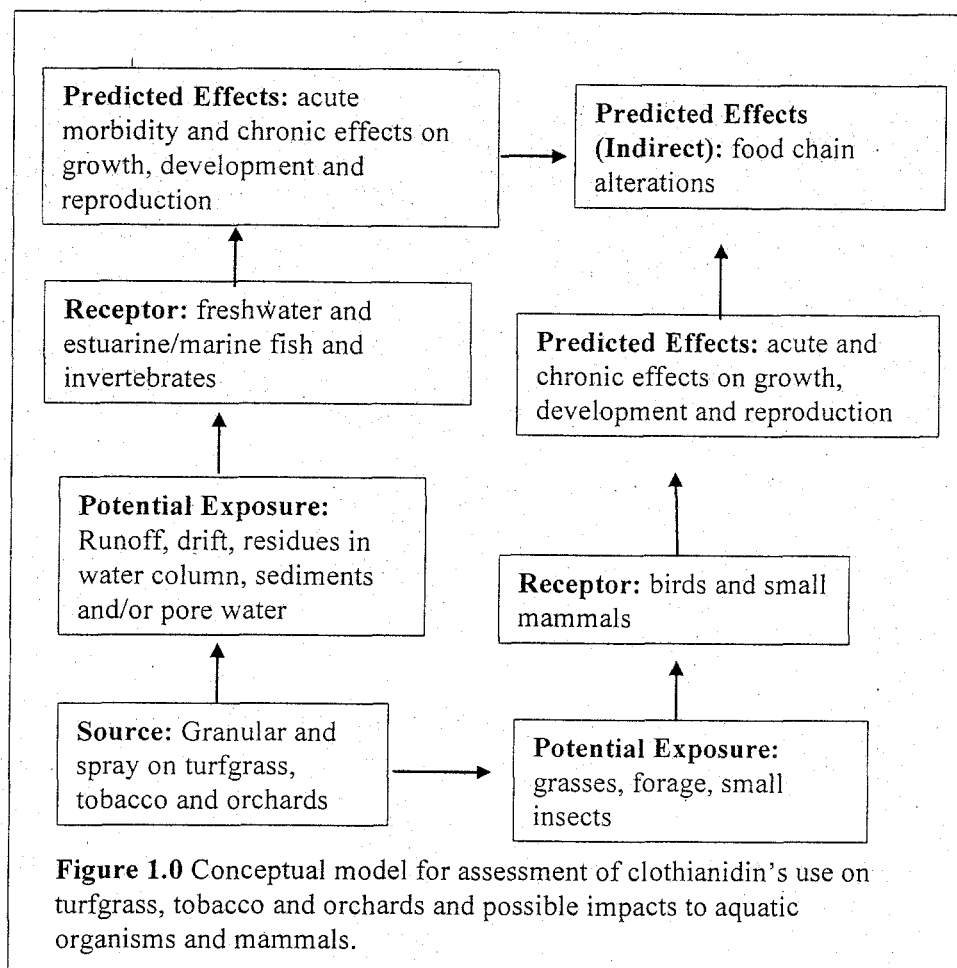
- (a). Direct effects to aquatic invertebrates in the water column via acute toxicity.
- (b). Direct effects to benthic aquatic organisms dwelling in the sediment and/or pore water via acute and/or chronic toxicity.
- (c). Indirect effects to benthic community assemblages (i.e. reductions in diversity and abundance) dwelling in the sediment and/or pore-water.
- (d). Indirect effects to aquatic ecosystems from benthic community disturbances.

In addition to the concern for aquatic ecosystems, EFED is also concerned with potential impacts to terrestrial species and functional groups, including pollinators; nectar and fruit eating birds, mammals, and insects; and soil-inhabiting invertebrates and mammals (i.e. earthworms, burrowing mammals). Available effects data are included under the section "Characterization of Ecological Effects," and represent registrant submitted data. Although EFED does not conduct RQ based risk assessments on beneficial insects, there is potential for direct toxic effects to honey bees as suggested by the toxicity data. The terrestrial effects database for these species and

functional groups is incomplete and thus recommendations are made for additional studies or assessments to fill data gaps needed for a suitable screening level risk assessment. The major endpoints related to terrestrial environments at issue are:

- (a). Direct effects to mammals, insects, and soil invertebrates via acute toxicity.
- (b). Direct effects on reproduction to birds (eggshell thinning), mammals (endocrine disruption), and insects via chronic toxicity.
- (c). Direct effects to insects via toxicity of residues on foliage.
- (d). Direct effects to foraging activity of pollinators
- (e). Indirect effects from soil ecosystem alterations
- (f). Indirect effects from reduced crop yield from impact to pollinators.

During problem formulation, a conceptual model was developed which represented the possible relationships between the stressor, ecological endpoints, and the measurement endpoints (Figure 1.0). Problem formulation focused on laboratory and field studies which indicate that clothianidin is persistent and mobile, stable to hydrolysis, has the potential to leach to groundwater, be transported via runoff to surface water bodies, and could accumulate in soils with repeated uses. Thus, the initial emphasis of the screening risk assessment was primarily about possible risk to freshwater and estuarine/marine fish and invertebrates as well as to terrestrial birds, mammals, and invertebrates which may be exposed to residual clothianidin after granular or foliar spray application.



Tier I Aquatic Assessment

Since clothianidin is not applied directly to water, EFED identified spray drift and runoff to adjacent bodies of water as the most likely sources resulting in clothianidin exposure to nontarget aquatic organisms. Relative to these uses, EFED examined the physical/chemical properties of clothianidin, its fate and disposition in the environment, and mode of application (e.g., granular and foliar spray application) in order to develop a conceptual model (Figure 1.0). This scenario depicts ground (e.g., granular and foliar spray application) or spray application to turfgrass, tobacco, apples, pears and ornamentals, which causes spray drift and runoff subsequent to a rainfall event resulting in potential contamination of adjacent bodies of water. These events involve exposure of the stressor (clothianidin) to aquatic organisms (receptor). The direct predicted effects include acute morbidity, effects on growth, development, and reproduction. Indirect effects may include alterations in the diversity and abundance of benthic organisms, which in turn could affect fish populations resulting in possible adverse effects to fish population diversity, recreational fisheries and commercial aquaculture, should exposure occur. These indirect effects could result in ecosystem instability of water bodies receiving the spray drift and surface runoff.

The Tier II assessment using the PRZM/EXAMS model to predict surface water clothianidin concentrations was sufficient for aquatic assessment. The environmental fate

database is complete for the parent compound clothianidin and suitable for risk assessment. No transformation products were considered in the aquatic ecological assessment as the degradates database was incomplete with regard to environmental fate data. Degradates, such as MNG, TZMU, TZNG, TMG and NTG might potentially contaminate drinking water; however, because of the very long persistence of parent clothianidin (and relatively high soil mobility and low adsorption to soil and sediment) including the degradates in exposure modeling would not likely significantly increase the total exposure level estimates. Available toxicity data for the degradates indicates that with the exception of TZNG, the other degradation products (MNG, TMG, TZMU, and MU) either exhibited the same toxic responses as clothianidin or were less toxic to aquatic organisms. *Daphnia magna* were more sensitive to TZNG than clothianidin with an acute 48-hr EC_{50} of 64 mg/L (NOEC of 11.2 mg/L) [MRID 45422401]. All of the degradates were less toxic than clothianidin to *Chironomus riparius* (48-hr EC_{50} 's ranging from >83.6 - >102 ppm). TZNG was also less toxic than clothianidin but more toxic than the other degradates with an EC_{50} of 0.386 ppm [MRID 45422414]. Aquatic fate studies indicated that TMG was the primary degradate to accumulate significantly in the aerobic aquatic studies (which were not strictly aerobic in the sediment where the TMG was found) and that no degradate was found to accumulate significantly in the anaerobic aquatic studies.

The Tier II level surface water assessment for clothianidin took into consideration registered and proposed label use patterns, application rates and methods of application. This information was used in combination with both registrant-submitted data (e.g., environmental fate and effects) and information gleaned from peer reviewed open literature, in order to characterize possible risk.

In order to emphasize the relationships between the stressor (clothianidin) and the assessment endpoints, and to evaluate the potential risk to aquatic organisms from the use of clothianidin, risk quotients (RQs) were calculated. Risk quotients are calculated from the ratio of estimated environmental concentrations (EECs) to eco-toxicity values. EECs are developed using several models which are based on the maximum application rate of clothianidin for the proposed uses and the physical and chemical characteristics of clothianidin. These RQs were then compared to the LOC's used by EFED for determining potential risk to non-target organisms and the subsequent need for possible regulatory action.

Tier I Terrestrial Assessment

Through this evaluation, EFED identified residues on grasses and foliage (in nectar and pollen), residues in fruit, and depositions in soil as the most likely sources resulting in clothianidin exposure to nontarget terrestrial organisms. Relative to these uses, EFED examined the physical/chemical properties of clothianidin, its fate and disposition in the environment, and mode of application (e.g., granular and foliar spray application) in order to develop a conceptual model (Figure 1.0). This scenario depicts ground (granular and foliar spray application) or spray application to turfgrass, tobacco, apples, pears and ornamentals, which causes the formation of residues on sprayed plants and the deposition of residues in soils. Laboratory and field studies indicate that clothianidin is highly persistent (aerobic soil metabolism and terrestrial field dissipation half-lives ranging from half a year to several years) and could accumulate in soils with repeated uses. Studies also indicate that residues of clothianidin are present in nectar and

pollen of summer rape plants 60 days after application (MRID 45422431, 45422432, 45422433, 45422435, 45422436, 45422437]. These events involve exposure of the stressor (clothianidin) to terrestrial birds, mammals, and invertebrates (receptors). The direct predicted effects include acute morbidity, effects on growth, development, and reproduction, and effects on behavior (foraging activity of pollinators). Indirect effects may include toxic effects to soil communities due to the persistence/accumulation of clothianidin in soils from repeated uses and the potential for reduced crop yield from the impact to pollinators.

As part of the Tier 1 terrestrial assessment, EFED modeled exposure concentrations of clothianidin to nontarget terrestrial plants and animals following the proposed turfgrass application rates provided by the registrant. For terrestrial birds and mammals, estimates of initial levels of clothianidin residues on various food items, which may be contacted or consumed by wildlife, were determined using the Fletcher nomogram followed by a first order decline model FATE.

In order to emphasize the relationships between the stressor (clothianidin) and the assessment endpoints, and to evaluate the potential risk to terrestrial organisms from the use of clothianidin, risk quotients (RQs) were calculated. Risk quotients are calculated from the ratio of estimated environmental concentrations (EECs) to eco-toxicity values. EECs are developed using several models which are based on the maximum application rate of clothianidin for the proposed uses and the physical and chemical characteristics of clothianidin. These RQs were then compared to the LOC's used by EFED for determining potential risk to non-target organisms and the subsequent need for possible regulatory action.

V. Analysis

Analysis is a process that examines the two primary components of risk, exposure and effects, and their relationships between each other and site characteristics. The objective is to provide the ingredients necessary for determining or predicting ecological responses to pesticide uses under exposure conditions of interest. The products of analysis provide the basis for estimating and describing risks in risk characterization.

Environmental Fate Characterization

Summary

Clothianidin appears to be a persistent compound under most field conditions. Based on analysis of the laboratory studies alone, the major route of dissipation for clothianidin would appear to be photolysis if exposure to sunlight occurs (e.g., the measured aqueous photolysis half-life was <1 day and aerobic half-lives were 148 to 1155 days). Although photolysis appears to be much more rapid than other avenues of degradation/dissipation of clothianidin in the laboratory studies, the very slow rate of dissipation that was observed in field studies suggests that photolysis probably is not significant under most actual-use conditions. Photolysis may be quite important in surface waters if residues have reached clear bodies of water and are in solution rather than bound to sediment. Clothianidin is stable to hydrolysis at environmental pHs and temperatures. Degradation is also relatively rapid under anaerobic aquatic conditions (overall half-life of 27 days); however, metabolic degradation occurs very slowly in aerobic soil. Clothianidin is mobile to highly mobile in the laboratory [soil organic carbon partition coefficients (Koc) values were 84

to 129 for all test soils except for a sandy loam soil which had a Koc value of 345], although only a modest amount of leaching was observed in the submitted field studies. Previous studies have confirmed that compounds with a similar combination of mobility and persistence characteristics have a potential to leach to ground water at some use sites. Volatilization is not expected to be a significant dissipation process.

Degradation and Metabolism

Metabolism in aerobic soil occurred very slowly. At 20°C, clothianidin degraded in two soils with a first-order half-life of 148 and 239 days (Hofchen and Laacher soil series), in seven soils ranging in texture from sand to silt loam with half-lives of 495 to 1,155 days (BBA 2.2, Quincy, Sparta, Crosby, Susan, Elder, and Howe soil series), and in a tenth soil with a half-life that was nominally calculated to be 6,931 days (Fugay soil series). Degradation was too little in the Fugay soil study to accurately calculate the degradation rate over the 1-year study period ($r^2 = 0.05$).

Under anaerobic aquatic conditions, metabolic degradation occurred relatively quickly (half-life of 14 days in water; 37 days in sediment; 27 days overall). Clothianidin was <1% of the applied in the water at and after 120 days and was <2.0% in the silt loam sediment at and after 183 days. No major degradates were isolated; clothianidin was converted primarily to soil-bound residues.

Clothianidin photodegraded with half-lives of <1 day in sterile buffer solution in the laboratory and in natural water outdoors, and approximately 34 days in soil in the laboratory. The range of values (1 - 34 days) given for surface water-source drinking water represents uncertainty with regard to the importance of photodegradation in the long-term fate of clothianidin in natural waters. In the laboratory, clothianidin photodegraded in sterile aqueous pH 7 buffer solutions with a half-life of 6.2-6.8 hours, based on a 12-hour light/12-hour dark cycle. Major degradates were *N*-(2-chlorothiazol-5-ylmethyl)-*N'*-methylurea (TMZU), methylurea (MU), methylguanidine (MG), 4-hydroxy-2-methylamino-2-imidazolin-5-one (HMIO), 7-methylamino-4H-imidazo[5,1-b][1,2,5]thiadiazin-4-one (MIT), formamide (FA), and CO₂. Outdoors, clothianidin degraded in nonsterile river water with a half-life of 25.1-27.7 hours under a cycle of approximately 9 hours sunlight/15 hours darkness. Major transformation products were MG, HMIO, MU, Urea, TMG, 3-methylamino-1*H*-imidazo [1,5-*c*]imidazole (MAI), 2-chlorothiazol-5-ylmethanol (CTCA), and CO₂. There was no degradation in the control samples held in the dark, which is consistent with clothianidin's observed stability to hydrolysis.

On moist soil, clothianidin photodegraded with a half-life of 8.2 days based on continuous irradiation (estimated to be equivalent to 34.2 solar summer days in Phoenix, AZ); degradation was not significant in the dark. At study termination (equivalent to 71 days solar summer days in Phoenix, AZ), 22.3% of the clothianidin remained undegraded. No degradates accumulated to significant levels during the study.

Soil sorption and mobility

In laboratory batch equilibrium studies, clothianidin had medium mobility in a US sandy loam soil and high mobility in US loamy sand and clay loam and German sand and sandy loam

soils. In batch equilibrium studies using the same soils and similar conditions, MNG was very highly mobile, TZMU was highly to very highly mobile, TZNG was moderately mobile, and TMG was immobile or had low mobility. The mobility of clothianidin appeared to decrease as the length of time clothianidin was in contact with the soil increased; the longer clothianidin was aged in treated soil, the less likely it was to desorb from that soil.

Field dissipation

Clothianidin is expected to dissipate very slowly under terrestrial field conditions, based on the results of five bare ground field experiments conducted in the US and Canada. Half-lives of clothianidin, based on residues in the 0-15 cm soil depth, were 277 days (Wisconsin sand soil, incorporated), 315 days (Ohio silt loam soil, not incorporated), 365 days (Ontario silt loam soil, incorporated), and 1,386 days (North Dakota clay loam soil, not incorporated), and could not be determined at a fifth site due to limited dissipation during the 25-month study (Saskatchewan silty clay loam soil, incorporated). Incorporation did not appear to be a significant factor in determining the rate of dissipation. Clothianidin was generally not detected below the 45 cm soil depth except at one site, where it moved into the 45-60 cm depth. No degradates were detected at >10% of the applied, and degradates were generally only detected in the 0-15 cm soil layer. However, in many cases most of the parent remained untransformed at the close of the study; further accumulation of degradates could have occurred. Degradates that were increasing in concentration or at least continuing to persist towards the close of one or more field dissipation studies were: MNG (MRID 45422336) TZNG (MRID 45422335, 45422333), and TZMU (MRID 45422335).

Two studies were conducted to investigate leaching of clothianidin under field conditions (MRIDS 45422331 and 45422508). These studies were conducted in the Federal Republic of Germany and were apparently designed to fulfill certain European regulatory requirements. In these monolith lysimeter studies, 42-59% of the applied remained in the soil approximately 3 to 4 years following the first of two applications, and residues were primarily undegraded clothianidin. The loss of radioactivity was attributed by the authors to mineralization of clothianidin, since $\leq 1\%$ of the total residues were detected in the leachate. Clothianidin was not detected in the leachate. There was also a significant amount of TZNG and/ or MNG that remained in monolith lysimeters at the close of multi-year studies. In one study (MRID 45422331), analysis of the soil in the lysimeter three years after the original application of clothianidin revealed TZNG was present as about 5% of the applied clothianidin. When the soil was analyzed more than 4 years after application in another lysimeter study (MRID 45422508) about 3% of the applied was present as MNG and 2% was present as TZNG. The substantial amount of clothianidin parent remaining in the soil profile at the close of these studies indicates that further leaching of clothianidin may occur in following years if sufficient precipitation occurs.

Aquatic Exposure Characterization

Based on laboratory and field studies, the available data on clothianidin show that the compound is persistent and mobile, stable to hydrolysis and has potential to leach to groundwater as well as to runoff to surface waters. Assessments in this analysis have been based on the contamination potential of the parent compound clothianidin, which appears to be the most significant contaminant of surface and ground waters. However, we note that limited

environmental fate data for the degradates indicate that some of these compounds may be mobile and persistent.

Surface Water Modeling

Tier II EECs for clothianidin were calculated using PRZM/EXAMS. PRZM/EXAMS is a screening model designed to estimate the pesticide concentration found in water for use in ecological assessments.

While no groundwater monitoring studies have been conducted, the registrant did submit monolith lysimeter study results. In these studies, (MRIDS 45422508 and 45422331) there was no parent clothianidin detected in the leachate. The degradates were detected in small quantities in the leachate. In one study, MNG and NTG were detected in leachate samples; in the other study none of the degradates in the leachate were identified. Clothianidin was extremely persistent and still potentially available for leaching at the close of the lysimeter studies (3 or 4 years after initial application), in both studies 42-59% of the applied radioactivity remained in the soil approximately 3 to 4 years following the first two applications and residues were primarily undegraded clothianidin. These results highlight the potential for very high persistence of clothianidin and some degradates and the possibility of leaching to groundwater occurring even in soils of fairly low permeability several years after application of clothianidin.

The current exposure assessment is based solely upon the parent compound. Our understanding of the potential exposure to degradates of clothianidin is constrained by the high persistence of clothianidin parent and the concomitant lack of significant accumulation of any specific product in most laboratory and field studies. Major degradates detected in one or more of the aqueous photolysis studies which might or might not be important under some actual use conditions are TZMU, TMG, MU and MG (however, these studies were of very short duration and these degradates did not accumulate in the longer 17-day soil photolysis studies). TZMU was shown to be an important hydrolysis product in pH 9 solution at elevated temperature (no significant hydrolysis was observed at any pH at 25° C). Little degradation of parent occurred in each of the 10 soils used for aerobic metabolism investigation (54 to 95% of the parent compound remaining in the soil at the close of these studies) but there was still some evidence of accumulation of TZNG, MNG and NTG in some of the test soils. TMG accumulated significantly in the aerobic aquatic studies (which were not strictly aerobic in the sediment where the TMG was found). In the anaerobic aquatic study, no degradate was found to accumulate significantly. In soil adsorption - desorption studies, MNG and TZMU were shown to be extremely mobile in soil and could, if they form and persist in the soil, be significant ground water contaminants. All four of the degradates for which soil sorption was investigated (MNG, TZMU, TZNG and TMG) could occur in runoff water if they form in significant amounts. No soil sorption studies were conducted for NTG. We conclude that degradates such as MNG, TZMU, TZNG, TMG and NTG might potentially contaminate water; however, because of the very long persistence of parent clothianidin (and relatively high soil mobility and low adsorption to soil and sediment) including the degradates in exposure modeling would not likely significantly increase the total exposure level estimates.

Estimated Environmental Concentrations (EECs) for Aquatic Ecological Effects

Table Va summarizes the input values used in the PRZM/EXAMS model. Fate parameters were obtained from studies submitted by the registrant and modified, if necessary, according to the *Guidance for Selecting Input Parameters in Modeling the Environmental Fate and Transport of Pesticides, Version II* (February 28, 2002). The modeling results associated with the maximum allowable rate per year for representative crops are presented in Table Vb.

Table V.a Environmental fate input parameters for clothianidin used in PRZM/EXAMS for calculating surface water EECs.			
Parameter	Value	Source	Comments
Molecular weight (gMole ⁻¹)	249.7	MRID 45422317	
Vapor Pressure (Torr)	4.27×10 ⁻¹⁰	MRID 45422317	
Solubility (mg/L)	300	MRID 45422317	
Hydrolysis (days)	Stable	MRID 45422317	
Aquatic photolysis half-life (days)	1.1 to 34	MRID 45422323 (soil); 45422318, 45422322, 45422319, 45422321 (water)	Longest half-life of 34 days used instead of aqueous photolysis half-life because of demonstrated persistence in water and on soil surface exposed to sunlight. Lower value of 1.1 days used from natural water photolysis study.
Organic carbon partition coefficient (KOC)	188	MRID 45422311	Mean Value
Soil aerobic metabolic half-life (days)	744*	MRIDs 45422325; 45422326	90% upper confidence bound on 9 values.
Aquatic metabolic half-life (days)	1,488	MRID 45422324	2X aerobic soil half-life used since there was no acceptable aerobic aquatic study
Anaerobic Aquatic metabolic half-life (days)	27x3	MRID 45422320	Selected input parameters were multiplied by 3 according to Guidance for selecting input parameters in modeling for environmental fate and transport of pesticides. Version II. February, 2002.
Crop name	Apple, pears, turfgrass, and Tobacco	Proposed label	
Maximum application rate (lb/acre)	0.4 0.2	Proposed label	Tarf applied to apple, pears, and tobacco
Number of applications	1	Proposed label	applied to all proposed crops
Method of application	Granular foliar spray	Proposed label	Tarf applied to all proposed crops
Incorporation depth (inches)	0	EFED	According to Guidance for selecting input parameters in modeling for environmental fate and transport of pesticides. Version II. February, 2002.
* Calculated per guidance for n=9. Fugay soil not included in calculation because too little degradation occurred to accurately calculate half-life.			

Table V.b. below summarizes results from PRZM/EXAMS.

Table V.b. Surface water EECs (ppb) for ecological risk assessment.

Crop	Application rate (lbs ai/A)	Number of applications	Peak (ppb)	21 day (ppb)	60 day (ppb)
Turf (granular)	0.4	1	3.91	3.82	3.70
Turf (Florida)	0.4	1	5.58	5.43	5.19
Pears (California)	0.2	1	0.85	0.83	0.79
Apple (Pennsylvania)	0.2	1	2.26	2.21	2.14
Apple (Oregon)	0.2	1	1.06	1.03	1.00
Tobacco (N. Carolina)	0.2	1	1.93	1.87	1.78

Terrestrial Exposure Characterization

Avian and Mammalian Species

An extensive assessment of the potential exposure and risk to avian guideline species exposed to clothianidin by oral intubation or in the diet concluded that clothianidin was moderately toxic to bobwhite quail on an acute basis ($LD_{50} > 200$ mg/kg) and non-toxic to the mallard duck and bobwhite quail on a sub-acute basis (5 day $LC_{50} > 5040$ ppm and 5230 ppm), respectively. A Tier I screening assessment based on the exposure of bobwhite quail to residual clothianidin after turfgrass application (0.4 lb ai/A, maximum application rate) was performed using the FATE model (see Appendix V). Based on the proposed uses and application rates of clothianidin in this assessment of foliar spray application to turfgrass, tobacco, apples, pears and ornamentals, it is assumed acute exposure to avian species as the result of residual product on grass, fruits and berries as the result of field application would not present a risk to avian species. However, there is a possibility of risk to endangered small (20g) birds ($RQ = 0.49$) and small (15-35g) mammals (RQ s ranged from 0.31 to 0.71) from ingestion of granular clothianidin under the turf use only. However, it would seem unlikely that neither small birds or mammals would or could ingest the amount of granules needed to reach an LD_{50} dose.

The submitted chronic toxicity data show that exposure of 525 ppm of clothianidin in the diet adversely affected eggshell thickness (MRID #45422421). Because birds may be subject to repeated or continuous exposure to the pesticide, especially preceding or during the breeding season, additional modeling should be done to determine if birds are at risk from repeated uses of clothianidin.

Likewise, an assessment of potential exposure and risk to small mammals exposed to clothianidin by the oral route suggests that clothianidin is moderately toxic to small mammals on an acute oral basis (mouse $LD_{50} = 389$ to 465 mg/kg/day). A Tier I screening assessment based on the exposure

of a mouse to residual clothianidin after turfgrass application (0.4 lb ai/A, maximum application rate) was performed using the FATE model (see Appendix V). Based on the proposed uses and application rates of clothianidin in this assessment to turfgrass, tobacco, apples, pears and ornamentals, it is assumed acute exposure to mammalian species as the result of residual product on grass, fruits and berries as the result of field application may present a risk mainly to endangered mammalian species. In addition, there is a possibility of risk (RQs ranged from 0.31 to 0.71) to endangered and non-endangered small mammals (20-35g) from ingestion of granular clothianidin under the turf use only.

Reproduction studies in rats indicate that concentrations of 500 ppm clothianidin resulted in increased stillbirths and delayed sexual maturation in males. Developmental studies in rabbits indicate that concentrations of 75 mg/kg/day resulted in premature deliveries, decreased gravid uterine weights, and increased litter incidence of missing lung lobes/fetus. Because small mammals may feed on fruit or burrow in the soils and; thus, be subject to repeated or continuous exposure to the pesticide, additional modeling should be done to determine if mammals are at risk from repeated uses of clothianidin.

Nontarget Insects and Terrestrial Invertebrates

Currently, EFED does not assess risk to nontarget insects or terrestrial invertebrates using the risk quotient method. However, it appears that clothianidin exposure to honeybees has the potential for high toxicity on both an acute contact and oral basis. Acute toxicity studies to honey bees show that clothianidin has the potential to be highly toxic on both a contact and an oral basis (contact $LD_{50} = 0.044 \mu\text{g}/\text{bee}$; oral $LD_{50} = 0.0037 \mu\text{g}/\text{bee}$), while its degradates (e.g., TMG, MNG, TZMU, and TZNG) are moderately to practically non-toxic on an oral basis ($LD_{50} = 3.9 - >153 \mu\text{g}/\text{bee}$). One honey bee field study (MRID # 45422435) showed that mortality, pollen foraging activity, and honey yield were negatively affected by residues of clothianidin; however, residues were not quantified in this study. Another honey bee field study (MRID 45422440) showed that pollen treated with clothianidin at a measured concentration level up to $19.7 \mu\text{g a.i.}/\text{kg}$ produced no significant adverse effects to mortality, foraging activity (including pollen and honey collection), comb production, honey storage behavior, population growth (including egg, larvae, pupae, and adult growth stages), and behavioral anomalies. However, only one replicate hive per treatment level was tested, therefore, statistical analysis of the data could not be performed.

Pesticides toxic to honey bees require bee precautionary labeling on all end-use formulations and registrants are required to submit data in accordance with Guideline 141-2 - Honey Bee Toxicity of Residues on Foliage. A scientifically sound study was performed. Alfalfa foliage was sprayed with Clothianidin, as V-10066, at application rates of 30, 60, and 90 g a.i./acre. Honey bees, three replicates/rate, were exposed in the lab to the weathered foliage at varying times until the mortality of bees exposed to residues was lower than 25%. Sublethal

observations were also made. The RT_{25}^2 for clothianidin (V-10066) at 30 (0.07 lb ai/A), 60 (0.13 lb ai/A), and 90 (0.21 lb ai/A) g a.i./acre were 111.68 (4.7days), 179.51 (7.5days), and 512.39 (21.3days) hours, respectively. The rates of application were determined to be highly hazardous to honey bees. Results indicate that clothianidin, as V-10066, should not be applied to blooming, pollinating, or nectar producing parts of plants.

Subchronic invertebrate toxicity studies showed that clothianidin adversely affected earthworm mortality and body weight ($LC_{50} = 15.5$ ppm) and its degradates reduced body weight ($LC_{50} = 982.6$ ppm). There were no apparent effects of clothianidin on earthworm reproduction or population dynamics.

VI. Risk Characterization

Aquatic Risk Quotients and Comparison to LOCs

Risk Estimation

A means of integrating the results of exposure and ecotoxicity data is called the deterministic method. For this method, risk quotients (RQs) are calculated by dividing exposure estimates by ecotoxicity values, both acute and chronic.

$$RQ = \text{EXPOSURE} / \text{TOXICITY}$$

RQs are then compared to OPP's levels of concern (LOCs). These LOCs are criteria used by OPP to indicate potential risk to non-target organisms and the need to consider regulatory action. The criteria indicate that a pesticide used as directed has the potential to cause adverse effects on non-target organisms. LOCs currently address the following risk presumption categories: (1) **acute high** - potential for acute risk is high, regulatory action may be warranted in addition to restricted use classification (2) **acute restricted use** - the potential for acute risk is high, but this may be mitigated through restricted use classification (3) **acute endangered species** - the potential for acute risk to endangered species is high, regulatory action may be warranted, and (4) **chronic risk** - the potential for chronic risk is high, regulatory action may be warranted. Currently, EFED does not perform assessments for chronic risk to plants, acute or chronic risks to non-target insects, or chronic risk from granular/bait formulations to mammalian or avian species.

The ecotoxicity test values (i.e., measurement endpoints) used in the acute and chronic risk quotients are derived from the results of required studies. Examples of ecotoxicity values derived from the results of short-term laboratory studies that assess acute effects are: (1) LC_{50} (fish and birds) (2) LD_{50} (birds and mammals) (3) EC_{50} (aquatic plants and aquatic invertebrates) and (4) EC_{25} (terrestrial plants). An example of a toxicity test effect level derived from the results of

²

RT_{25} is the residual time required to reduce the activity of the test material and bring bee mortality down to 25% in cage test exposures to field-weathered spray deposits (Mayer and Johansen, 1990). The time period determined by this toxicity value is considered to be time that the test material is expected to remain toxic to bees in the field from the residual exposure of the test material on vegetation at an expressed rate of application (lb ai/A).

long-term laboratory studies that assess chronic effects is: (1) NOAEC (birds, fish and aquatic invertebrates).

Risk presumptions, along with the corresponding RQs and LOCs are tabulated below:

Table VI.a. Risk Presumptions for Terrestrial Animals

<i>Risk Presumption</i>	<i>RQ</i>	<i>LOC</i>
Birds:		
Acute High Risk	EEC ¹ /LC50 or LD50/sqft ² or LD50/day ³	0.5
Acute Restricted Use	EEC/LC50 or LD50/sqft or LD50/day (or LD50 < 50 mg/kg)	0.2
Acute Endangered Species	EEC/LC50 or LD50/sqft or LD50/day	0.1
Chronic Risk	EEC/NOAEC	1
Wild Mammals:		
Acute High Risk	EEC/LC50 or LD50/sqft or LD50/day	0.5
Acute Restricted Use	EEC/LC50 or LD50/sqft or LD50/day (or LD50 < 50 mg/kg)	0.2
Acute Endangered Species	EEC/LC50 or LD50/sqft or LD50/day	0.1
Chronic Risk	EEC/NOAEC	1

EEC=abbreviation for Estimated Environmental Concentration (ppm) on avian/mammalian food items

$\frac{\text{mg}}{\text{ft}^2}$

$\frac{\text{mg of toxicant consumed}}{\text{day}}$

LD50 * wt. of bird

LD50 * wt. of bird

Table VI.b. Risk Presumptions for Aquatic Animals

<i>Risk Presumption</i>	<i>RQ</i>	<i>LOC</i>
Acute High Risk	EEC ¹ /LC50 or EC50	0.5
Acute Restricted Use	EEC/LC50 or EC50	0.1
Acute Endangered Species	EEC/LC50 or EC50	0.05
Chronic Risk	EEC/MATC or NOAEC	1

¹ EEC = (ppm or ppb) in water

Table VI.c. Risk Presumptions for Plants

<i>Risk Presumption</i>	<i>RQ</i>	<i>LOC</i>
Terrestrial and Semi-Aquatic Plants:		
Acute High Risk	EEC ¹ /EC25	1
Acute Endangered Species	EEC/EC05 or NOAEC	1
Aquatic Plants:		
Acute High Risk	EEC ² /EC50	1
Acute Endangered Species	EEC/EC05 or NOAEC	1

¹ EEC = lbs ai/A² EEC = (ppb/ppm) in water**Exposure and Risk to Nontarget Freshwater Aquatic Animals**

Non-target aquatic organisms (freshwater and estuarine/marine fishes and invertebrates) can be exposed to clothianidin by spray drift and runoff into surface water.

Freshwater Fish

Acute and chronic risk quotients are tabulated in Table VI.d. An analysis of the acute test results show there were no mortalities or effects at the indefinite LC₅₀s shown and, though indecisive, these acute toxicity values are well above predicted EECs. Because of this, EFED did not calculate acute RQ values for the proposed uses. EFED does not expect risk to freshwater fish. Chronic exposure from the proposed clothianidin usage patterns should not pose direct risk to freshwater fish either. The chronic NOAEC for freshwater fish is 9.7 ppm. The maximum peak, 21-day, and 60-day PRZM/EXAMS modeled EECs are all 0.005 ppm. These predicted exposure levels are below levels triggering a chronic risk to freshwater fish.

Table VI.d. Risk Quotients for Freshwater Fish Based On Acute Exposure (LC50 >105 ppm) to Rainbow Trout (*Oncorhynchus mykiss*) and Chronic Exposure (NOAEC = 9.7 ppm) to Fathead Minnow (*Pimephales promelas*)

Crop	Organism	LC50 (ppm)	NOAEC (ppm)	EEC Acute (ppm)	EEC Chronic (ppm)	Acute RQ (EEC/LC50)	Chronic RQ (EEC/NOAEC)
Turf (WDG)	Rainbow trout	>105	N/A	0.005	N/A	0.00	N/A
Turf (Granular)	Rainbow trout	>105	N/A	0.004	N/A	0.00	N/A
Apples/Pears (WDG)	Rainbow trout	>105	N/A	0.002	N/A	0.00	N/A
Tobacco (WDG)	Rainbow trout	>105	N/A	0.002	N/A	0.00	N/A
Turf (WDG)	Fathead Minnow	N/A	9.7	N/A	0.005	N/A	0.00
Turf (Granular)	Fathead Minnow	N/A	9.7	N/A	0.004	N/A	0.00
Apples/Pears (WDG)	Fathead Minnow	N/A	9.7	N/A	0.002	N/A	0.00
Tobacco (WDG)	Fathead Minnow	N/A	9.7	N/A	0.002	N/A	0.00

Freshwater Invertebrates

The acute and chronic risk quotients are tabulated in Table VI.e. EFED's evaluation of the calculated RQ values show that the proposed use of clothianidin on turf, tobacco and apples/pears may result in acute risk to endangered aquatic freshwater invertebrates (RQs ranged from 0.1 to 0.23). Chronic RQ values (RQs ranged from 0.05 to 0.12) for freshwater invertebrates appear to be below EFED's LOC, suggesting low chronic risk.

Table VI.e Risk Quotients for Freshwater Invertebrates Based On Acute Exposure (EC50 = 0.022 ppm) to *Chironomus riparius* and Chronic Exposure (NOAEC = 0.042 ppm) to *Daphnia magna*

Crop	Organism	EC50 (ppm)	NOAEC (ppm)	EEC Acute (ppm)	EEC Chronic (ppm)	Acute RQ (EEC/LC50)	Chronic RQ (EEC/NOAEC)
Turf (WDG)	<i>Chironomus riparius</i>	0.022 ¹	N/A	0.005	N/A	0.23	N/A
Turf (Granular)	<i>Chironomus riparius</i>	0.022	N/A	0.004	N/A	0.18	N/A
Apples/Pears (WDG)	<i>Chironomus riparius</i>	0.022	N/A	0.002	N/A	0.10	N/A
Tobacco (WDG)	<i>Chironomus riparius</i>	0.022	N/A	0.002	N/A	0.10	N/A
Turf (WDG)	<i>Daphnia magna</i>	N/A	0.042 ²	N/A	0.005	N/A	0.12
Turf (Granular)	<i>Daphnia magna</i>	N/A	0.042	N/A	0.004	N/A	0.10
Apples/Pears (WDG)	<i>Daphnia magna</i>	N/A	0.042	N/A	0.002	N/A	0.05
Tobacco (WDG)	<i>Daphnia magna</i>	N/A	0.042	N/A	0.002	N/A	0.05

¹ *Chironomus riparius* 48hr EC50 = 0.022 ppm

² *Daphnia magna* NOAEC/LOAEC = 0.042/0.12 ppm reproductive effects

Estuarine and Marine Fish

The acute and chronic risk quotients are tabulated in Table VI.f. An analysis of the acute test results show that since there were no mortality or effects (limited studies) RQ values would not be calculated for the proposed usage and that acute risk to estuarine/marine fish is not expected.

Table VI.f. Risk Quotients for Estuarine/Marine Fish Based on Acute Exposure (LC50 >93.6 ppm) to Sheepshead Minnow (*Cyprinodon variegatus*)

Crop	Organism	LC50 (ppm)	NOAEC (ppm)	EEC Acute (ppm)	Acute RQ (EEC/LC50)	Chronic RQ (EEC/NOAEC)
Turf (WDG)	Sheepshead	>93.6	N/A	0.005	0.00	N/A
Turf (Granular)	Sheepshead	>93.6	N/A	0.004	0.00	N/A
Apples/Pears (WDG)	Sheepshead	>93.6	N/A	0.002	0.00	N/A
Tobacco (WDG)	Sheepshead	>93.6	N/A	0.002	0.00	N/A

Estuarine and Marine Invertebrates

The acute and chronic risk quotients are tabulated in Table VI.g. EFED's evaluation of the calculated RQ values show that the proposed use of clothianidin on turf, tobacco and apples/pears may result in acute risk to endangered aquatic estuarine/marine invertebrates (RQs ranged from 0.04 to 0.10). Chronic RQ values (RQs ranged from 0.4 to 0.98) do not exceed the LOC and suggest low chronic risk to estuarine/marine invertebrates.

Table VI.g Risk Quotients for Estuarine/Marine Invertebrates Based on Acute (LC50 = 0.051 ppm) and Chronic Toxicity Values (NOAEC = 0.0051 ppm) for Mysid Shrimp (*Mysidopsis bahia*)

Crop	Organism	LC50 (ppm)	NOAEC (ppm)	EEC Acute (ppm)	EEC Chronic (ppm)	Acute RQ (EEC/LC50)	Chronic RQ (EEC/NOAEC)
Turf (WDG)	Mysid	0.051	0.0051	0.005	0.005	0.10	0.98
Turf (Granular)	Mysid	0.051	0.0051	0.004	0.004	0.08	0.80
Apples/Pears (WDG)	Mysid	0.051	0.0051	0.002	0.002	0.04	0.40
Tobacco (WDG)	Mysid	0.051	0.0051	0.002	0.002	0.04	0.40

Terrestrial Risk Quotients and Comparison to LOCs

Avian and Terrestrial Mammals

Predicted residual concentrations (EECs) of clothianidin were compared to toxicity values for northern bobwhite quail and mouse to estimate acute and chronic risk quotients (Table VI h). The quail and mouse were chosen as representative terrestrial bird and mammal. Avian acute and chronic RQs were less than the LOCs (0.5 to 0.1 and 1, respectively). However, mammalian acute RQs exceeded the endangered species LOCs (RQs ranged from 0.11 to 0.23). Mammalian chronic RQs did not exceed chronic LOCs for both endangered and non-endangered species (highest RQ was 0.64). Both endangered and non-endangered small bird (20g) and mammal (15-35g) species may be at risk from ingestion of granular clothianidin under the turf use only (Table VI i). However, it would seem unlikely small birds or mammals would or could ingest the amount of granules needed to reach an LD50 dose.

Table VI.h Risk Quotients for Avian (LC50 = 5040 ppm; NOAEC = 205 ppm) and Mammalian (LD50 = 389 mg/kg; NOAEC = 150 mg/kg) Exposure to Clothianidin Residues¹

Crop	Organism	Short Grass	Broadleaf Grass/ Small Insects	Large Insects	Seeds and Fruit
Turf (WDG)	Avian				
	Acute	0.02	0.01	0.01	0.00
	Chronic	0.47	0.21	0.26	0.03
Apples/Pears (WDG)	Avian				
	Acute	0.01	0.00	0.01	0.00
	Chronic	0.23	0.11	0.13	0.01
Turf (WDG)	Mammal				
	Acute (15 gram)	0.23	0.11	0.13	0.0
	Acute (35 gram)	0.16	0.07	0.09	0.0
	Acute (1 kg)	0.04	0.02	0.02	0.0
	Chronic	0.64	0.29	0.36	0.04
Apples/Pears (WDG)	Mammal				
	Acute (15 gram)	0.12	0.05	0.07	0.00
	Acute (35 gram)	0.08	0.04	0.05	0.00
	Acute (1 kg)	0.02	0.01	0.01	0.0
	Chronic	0.32	0.15	0.18	0.02

¹ RQs determined by ELL-FATE model. Avian RQs based on bobwhite quail acute and chronic toxicity values. Mammalian RQs based on acute mouse toxicity values.

Table VI.i Risk Quotients for Birds and Mammals Based on a Single Granular Weight of 0.087 mg., Acute Avian (LD50 = 423 mg/kg) and Mammalian (LD50 = 389 mg/kg) Toxicity Values for a Broadcast Application¹

Crop	Organism	Acute RQ (LD50/sqft ²)	Number of granules needed to be consumed to reach LD50
Turf (0.5% Granular) 0.4 lbs ai/A	Bird 20g	0.49	97
	Bird 180g	0.05	875
	Bird 1000g	0.01	4,862
	Mammal 15g	0.71	67
	Mammal 35g	0.31	156
	Mammal 1000g	0.01	4,471

¹ Exposed mg ai/sqft = 4.2

App. Rate (lb ai/A) = [Prod. Rate (oz/1,000 linear ft)/16 (oz/lb) * Percent ai] * [43,560 (linear ft/A)/Crop Row Spacing (ft)/1,000 (linear ft)]

App. Rate (mg ai/sq ft within the band) = [App. Rate (lb ai/A) * 453,590 mg/lb]/[43,560 (linear ft/A)/Crop Row Spacing (ft) * Band Width (ft)]

App. Rate for Broadcast (mg ai/sq ft) = [App. Rate (lbs.ai/A) * 453,590 mg/lbs]/43,560 (linear ft/A)

Incorporation efficiency: Broadcast (all unincorporated) = 0%

Exposed (mg ai/sq ft within the band) = [App. Rate (lbs.ai/A) * 453,590 mg/lbs * Percent on Surface]/[43,560 (linear ft/A)/Crop Row Spacing (ft) * Band Width (ft)]

Exposed for Broadcast (mg ai/sq ft) = [App. Rate (lbs.ai/A) * 453,590 mg/lbs * Percent on Surface]/43,560 (linear ft/A)

RQ = Exposed (mg ai/sq ft)/[LD50(mg ai/kg) * Weight of the Animal (g)/1000 (g/kg)]

RQ greater or equal to 0.5 exceeds acute high, acute restricted use and acute endangered species LOCs.

RQ greater or equal to 0.2 exceeds acute restricted use and acute endangered species LOCs.

RQ greater or equal to 0.1 exceeds acute endangered species LOCs.

Number of Granules Exposed = Exposed (mg ai/sq ft)/[Percent ai * Weight of One Granule (mg/granule)]

Number of Granules to Reach LD50 = {LD50 (mg ai/kg) * [Weight of the Animal (g)/1000 (g/kg)]}/Weight of One Granule (mg/granule)

Nontarget Insects and Plants

Insects

Currently, EFED does not assess risk to non-target insects using an RQ method. Results of acceptable studies are used for recommending appropriate label precautions. Direct contact and dietary exposure studies of honeybees indicate that clothianidin is highly toxic to honeybees (acute contact $LD_{50} = 0.0439 \mu\text{g}/\text{bee}$ and acute oral $LD_{50} = 0.0037 \mu\text{g}/\text{bee}$). There is the potential for toxic exposure to honeybees, as well as other nontarget pollinators, through the translocation of clothianidin residues in nectar and pollen. In addition, studies indicate that clothianidin residues may affect foraging behavior. Data from studies determining the toxicity of residues on foliage indicate that clothianidin should not be applied to blooming, pollinating or nectar producing parts of plants because clothianidin will remain toxic to bees for days after a spray application. In honey bees, the effects of this toxic exposure may include lethal and/or sub-lethal effects in the larvae and reproductive effects to the queen. The field study EFED is requesting should resolve uncertainties dealing with clothianidin's affects on bees.

Plants

Clothianidin does not appear to present risk to terrestrial plants (seedling emergence $EC_{25} > 0.2 \text{ lbs ai/A}$; vegetative vigor $EC_{25} > 0.2 \text{ lbs ai/A}$). In addition, it does not appear to present risk to aquatic vascular plants (*Lemna gibba* $EC_{50} > 121 \text{ ppm}$) or aquatic nonvascular plants (*Selenastrum capricornutum* EC_{50} averages 70 ppm) although EFED is still requesting aquatic nonvascular plant testing on four more surrogate species. The maximum peak, 21-day, and 60-day of modeled EECs is 0.005 ppm. This predicted exposure level is below levels triggering an acute risk to aquatic plants.

Risk Description Characterization

Clothianidin's major risk concern is to nontarget insects (that is, honey bees). EFED expects adverse effects to bees if clothianidin is allowed to be sprayed on blooming, pollen-shedding, or nectar producing parts of plants. Based on the proposed application rates, acute risk to avian and mammalian species is possible. Both endangered and non-endangered small birds (20 g, $RQ = 0.49 LD_{50}/\text{sq. ft.}$) and mammals (15-35 g, $RQ = 0.7$ and $0.3 LD_{50}/\text{sq. ft.}$, respectively) may be at risk from ingestion of granular clothianidin under the turf use only. However, it would seem unlikely that small birds or mammals would or could ingest the amount of granules needed to reach an LD_{50} dose. Clothianidin does not appear to present risk to terrestrial (there were no significant effects in the studies submitted) or aquatic vascular or nonvascular plants. Lastly, acute endangered species LOCs for mammals and, freshwater and estuarine/marine invertebrates are exceeded, should exposure actually occur. However, the estimated chance of individual mortality following clothianidin exposure is 1 in 7.21×10^{13} for small mammals, 1 in 294 for freshwater invertebrates and 1 in 7.68×10^5 for estuarine/marine invertebrates.

The available data on clothianidin shows that the compound is relatively persistent to very persistent under most circumstances. Clothianidin is stable to hydrolysis at all pH's at

environmental temperatures, moderately to highly stable under aerobic soil metabolism conditions (half-lives range from 148-6,900 days), and shows moderate stability under anaerobic aquatic metabolism (half-life of 27 days for the overall system). Laboratory data suggests that photolysis appears to play a role in the dissipation of the chemical (half-life of 14.4 hours in sterile water, 25.4 hours in natural water, and 34 days on soil). Clothianidin has medium to very high mobility in soils. The fact that the K_{oc} 's of four of the five soils were of similar order of magnitude (range 84-129) indicates that there may be a correlation of the mobility with the organic carbon content of the soil. Certain degradates appeared to accumulate in some soils under some conditions [e.g., TZNG MNG, NTG, (aerobic) and TMG (anaerobic)]; over the very long term significant contamination of soil and water with these products might occur. The terrestrial field dissipation studies confirm the findings in the laboratory studies. Clothianidin was found to be persistent in the field (half-lives of 277 days, 1,400 days, and too high to calculate). Based on the overall picture that the laboratory and field studies provided, EFED concluded that there is a very high likelihood that clothianidin would persist and accumulate from year to year after repeated uses.

The potential impact to water quality from the use of clothianidin appears to be most likely due to the parent compound. The laboratory studies indicate that clothianidin is initially labile and then relatively persistent under most environmental conditions. This makes the chemical available for lengthy periods of time for runoff and exposure to aquatic environments. The impact of clothianidin to aquatic environments will also be affected by its mobility. The available studies indicated that clothianidin is persistent and mobile, stable to hydrolysis and has potential to leach to ground water and be transported via runoff to surface water, and will accumulate and persist in soils.

Non-target aquatic organisms (freshwater and estuarine/marine fish and invertebrates) can be exposed to clothianidin by runoff or spray drift into surface water. EFED's risk assessment suggests that toxic risk to freshwater and estuarine/marine fish appears low. Acute, restricted use, and endangered species levels of concern for fish and invertebrates were not exceeded for application rates and uses evaluated. However, there is the possibility of acute toxic risk ($RQ = 0.1$) to freshwater benthic invertebrates, via runoff especially if repeated uses occur. Because the clothianidin toxicity threshold is low for freshwater benthic invertebrates on an acute basis, their vulnerability represents acute potential risk from accumulations of clothianidin in sediments. As a dynamic trophic level, invertebrates add to the diversity of an aquatic system. Since clothianidin is persistent in the sediment, sediment toxicity testing will be needed to address the uncertainty of possible risk to the assemblages of benthic communities in order to determine potential impacts to aquatic systems.

EFED's risk characterization of terrestrial animals was focused on the potential for acute and chronic toxic risk from exposure to residual clothianidin after application. Based on proposed application rates and uses, acute risks to terrestrial small birds and mammals is possible. Results from exposure modeling of representative species indicates that acute (small birds and mammals) RQ s exceed LOC s. Mammalian chronic RQ s did not exceed LOC s for both endangered and non-endangered species (maximum RQ was 0.64). In addition, both endangered and non-endangered

small bird (20g) and mammal (15-35g) species may be at risk from ingestion of granular clothianidin under the turf use only. However, it would seem unlikely small birds or mammals would or could ingest the amount of granules needed to reach an LD50 dose.

There is uncertainty surrounding clothianidin's possible role as an endocrine disruptor as noted from mammalian developmental and reproductive effects. This issue is compounded by the fact that clothianidin is an analog of nicotine and that studies in the published literature suggest that nicotine, when administered, causes developmental toxicity, including functional deficits, in animals and/or humans that are exposed *in utero*. Mammalian data shows that exposure to clothianidin can result in developmental effects (rabbit) that include premature deliveries, decreased gravid uterine weights, and increase incidence of missing lung lobe in fetus. The mammalian data also suggests that chronic toxicity in mammals can be manifested as systemic effects that can include decreased body weight gains and delayed sexual maturation (males only); decreased absolute thymus weight in F1 pups (both sexes), and increased stillbirths (F1 and F2 litters). Reproductive effects were also noted for adult rats that included decreased sperm motility and increased number of sperm with detached heads. Although these effects did not reduce rat fecundity, they do raise an uncertainty as to possible reproductive effects to other species that may have a more limited (less frequent) reproductive capability. Because small mammals may feed on fruit and thus, be subject to repeated or continuous exposure to the pesticide, additional modeling should be done to determine if mammals are at risk from repeated uses of clothianidin.

Accumulation of clothianidin in soils as the result of multiple applications and repeated or continuous exposure may adversely affect soil invertebrates. Subchronic invertebrate toxicity studies showed that clothianidin adversely affected earthworm mortality and body weight ($LC_{50} = 15.5$ ppm) and its degradates reduced body weight ($LC_{50} = 982.6$ ppm). Additional testing (chronic study) or modeling is needed to determine if soil invertebrates are at risk from repeated uses of clothianidin. Because small mammals may burrow in the soils, additional modeling should be done to determine if mammals are at risk from repeated uses of clothianidin.

Although EFED does not conduct a risk quotient based risk assessment on non target insects, information from standard tests and field studies, as well as incident reports involving other neonicotinoids insecticides (e.g., imidacloprid) also suggest the potential for long term toxic risk to honey bees and other beneficial insects. Other neonicotinoid compounds like imidacloprid (e.g., sunflower seed treatment) have resulted in incidents to honey bees. The National Union of French Beekeepers had concerns regarding imidacloprid (GAUCHO) seed treatment to sunflowers after beekeepers noted that honey bees were showing modifications of behavior that were reflected in foraging and orientation that eventually resulted in a drastic change in hive conditions and bee survival. Further research by the Le Centre Technique Interprofessionnel des Oleagineux (CETIOM) confirmed imidacloprid toxic residue levels in the sunflower nectar. This action has prompted France to ban the use of imidacloprid for sunflower seed treatment. Since clothianidin has a similar toxicity profile as imidacloprid and is a member of the same family of compounds, there is uncertainty regarding the toxic risk to honey bee development and foraging behavior, as well as the welfare of the queen from long term exposure to clothianidin residues that can be

stored in the hive in honey and/or pollen. Further studies may be needed to determine toxicity to honeybees from granular or foliar spray applications in orchards.

The uncertainties associated with clothianidin exposure in the environment are mainly focused in four areas; 1) accumulation of clothianidin in soils after repeated uses and the potential for transport/migration to surface water bodies and potential risk to sensitive aquatic invertebrates (e.g., sediment-dwelling benthic organisms), 2) repeated or continuous exposure of small mammals and birds to the pesticide presenting a potential reproduction and developmental risk, 3) potential toxic risk to pollinators (e.g. honeybees) as the result of accumulation of foliar spray on plants/blooms from repeated uses in orchards, and 4) repeated or continuous exposure to soil invertebrates and small mammals to clothianidin accumulated in soils after repeated uses.

Incident Characterization

The EPA/OPP 6(a)(2) incident reporting data base currently does not contain incident reports for clothianidin. However, other neonicotinoid compounds like imidacloprid have resulted in incidents to honey bees. The National Union of French Beekeepers had concerns regarding imidacloprid (GAUCHO) seed treatment to sunflowers. Beekeepers noted that bees were showing modifications of behavior that was reflected in foraging and orientation that eventually resulted in a drastic change in hive conditions and bee survival. Further research by the CETIOM confirmed imidacloprid toxic residue levels in the sunflower nectar. France has banned the use of imidacloprid for sunflower seed treatment.

Endocrine Disruption

Data suggests that clothianidin could be a candidate for additional screening and/or testing to better characterize effects related to endocrine disruption. Effects in avian species included significant decreases in eggshell thickness. Effects in mammalian reproduction studies included decreased body weight gains and delayed sexual maturation (males only), decreased absolute thymus weight in F1 pups (both sexes), increased stillbirths (F1 and F2 litters), decreased sperm mobility and increased number of sperm with detached heads (F1 and F2 litters).

EPA is required under the Federal Food, Drug and Cosmetic Act (FFDCA), as amended by FQPA, to develop a screening program to determine whether certain substances (including all pesticide active and other ingredients) "may have an effect in humans that is similar to an effect produced by a naturally-occurring estrogen, or other such endocrine effects as the Administrator may designate." Following the recommendations of its Endocrine Disruptor Screening and Testing Advisory Committee (EDSTAC), EPA determined that there was scientific basis for including, as part of the program, the androgen- and thyroid hormone systems, in addition to the estrogen hormone system. EPA also adopted EDSTAC's recommendation that the Program include evaluations of potential effects in wildlife. For pesticide chemicals, EPA will use FIFRA and, to the extent that effects in wildlife may help determine whether a substance may have an effect in humans, FFDCA authority to require the wildlife evaluations. As the science develops and resources allow, screening of additional hormone systems may be added to the Endocrine Disruptor Screening Program (EDSP). When the appropriate screening and or testing protocols

being considered under the Agency's Endocrine Disruptor Screening Program have been developed, clothianidin may be subjected to additional screening and or testing to better characterize effects related to endocrine disruption.

Threatened and Endangered Species Concerns

The following section discusses the screening level assessment for Federally listed threatened and endangered species (listed species).

Applications

For each of the crop scenarios used to evaluate risk to aquatic organisms, the LOC (0.05) for acute effects to listed species of freshwater invertebrates (RQs ranged from 0.10 to 0.23) and estuarine/marine invertebrates (RQs for turf ranged from 0.08 to 0.10) were exceeded.

For each of the crop scenarios used to evaluate risk to listed species of small mammals, clothianidin may pose acute (RQs ranged from 0.11 to 0.23) risk of adverse effects should exposure actually occur. Both endangered small bird (20g) and mammal (15-35g) species may be at risk from ingestion of granular clothianidin under the turf use only. However, it would seem unlikely that small birds or mammals would or could ingest the amount of granules needed to reach an LD50 dose.

Endangered insects may also be at risk due to the toxicity profile for honeybees (clothianidin is toxic to honeybees thus risk is assumed) should exposure actually occur.

Listed Species

The following table lists the number of listed species within taxonomic groups for which RQs exceed the listed species LOCs. Some of these listed species may not be at risk through exposure to clothianidin based on size, food items and habitat. Turf and Ornamentals do not appear due to no available listings in the Endangered Program.. The entire list of listed endangered/threatened species is given in Appendix VI.

Crop	STATE	Mammal	Crustacean	Arachnids	Insects	Snails	Clams
Apples							
	AL	2				4	10
	AZ	6					
	AR	2	1				
	CA	21	8		17	1	
	CO	1					
	CT	2			1		1
	FL	1					

GA	2					3
ID						
IL	2	1		1		2
IN	2			2		7
IA	1					2
KS				1		
KY	2					13
ME	1					
MD	3			1		
MA	1			1		
MI	2			2		2
MN						1
MO	2					1
MT	2					
NE						
NV						
NH	1			1		1
NJ	2					
NM	2					
NY	2			1		1
NC	4		1			1
OH	1			1		4
OK	1			1		1
OR	1	1		2		
PA	2					2
RI	2					
SC	1					
TN	4		1			7
TX						
UT	1					
VT	1					1

	VA	4	1				5
	WA	4					
	WV	1					
	WI	1			2		1
Pears							
	AL						
	CA	14	7		15		
	CO	1					
	CT	1					1
	FL	1					
	MD	1					
	MA	1					
	MI				2		
	NJ	1					
	NY	2					1
	NC	1					
	OR	1	1		2		
	PA	1					
	UT						
	VA	1					1
	WA	4					
	WI				1		
Tobacco							
	AL						
	CT	1					1
	FL	3	1				
	GA	2					5
	IN	2					3
	KY	3	1				20
	MD	2			2		1

	MA	1			1		
	MO	2			1		
	NC	6		1	1		3
	OH	1					2
	PA	2					
	SC	1					1
	TN	4	1	1		1	26
	VA	5	1				17
	WV	1					2
	WI						1

Taxonomic Groups Potentially at Risk

For the mammalian and aquatic invertebrate species evaluated in this risk assessment, RQs exceeded the LOCs for endangered species for the exposure scenarios considered. The registrant must provide information on the proximity of Federally listed endangered species to the use sites. This requirement may be satisfied in one of three ways: 1) having membership in the FIFRA Endangered Species Task Force (Pesticide Registration Notice 2000-2); 2) citing FIFRA Endangered Species Task Force data; or 3) independently producing these data, provided the information is of sufficient quality to meet FIFRA requirements. The information will be used by the OPP Endangered Species Protection Program to develop recommendations to avoid adverse effects to listed species.

Action Area

The Endangered Species Act defines the action area for a Federal action as being the footprint of possible effects stemming from the action, not necessarily limited to where the immediate action occurs. For screening-level purposes, the risk assessment conservatively assumes that listed species are co-located with the pesticide treatment area. This means that terrestrial plants and wildlife are assumed to be located on or adjacent to the treated field and aquatic organisms are assumed to be located in a surface water body adjacent to the treated field. This assumption places the listed species within an assumed area of high potential exposure to the pesticide. If these assumptions result in RQs that are below the listed species LOCs, a no effect conclusion is made. However, in situations where the screening assumptions lead to RQs in excess of the listed species LOCs there a potential for may affect conclusion exists. In such cases, additional information on the biology of listed species, the locations of these species, and the locations of use sites would be considered to determine the extent to which screening assumptions apply to a particular listed organism. These subsequent refinement steps would consider how this information would impact the action area for a particular listed organism and may include exposures that are downwind and downstream of the pesticide use site.

Indirect Effects Analysis

The Agency acknowledges that pesticides have the potential to exert indirect effects upon the listed organisms by, for example, perturbing forage or prey availability, altering the extent of nesting habitat, and creating gaps in the food chain. In conducting a screen for indirect effects, direct effect LOCs for each taxonomic group are used to make inferences concerning the potential for indirect effects upon listed species that rely upon non-endangered organisms in these taxonomic groups as resources critical to their life cycle.

Because screening-level acute RQs exceed the endangered species acute LOCs, the Agency uses the dose response relationship from the toxicity study used for calculating the RQ to estimate the probability of acute effects associated with an exposure equivalent to the EEC (see Probit Analysis below). This information serves as a guide to establish the need for and extent of additional analysis that may be performed using Services-provided "species profiles" as well as evaluations of the geographical and temporal nature of the exposure to ascertain if a "not likely to adversely affect" determination can be made. The degree to which additional analyses are performed is commensurate with the predicted probability of adverse effects from the comparison of the dose response information with the EECs. The greater the probability that exposures will produce effects on a taxa, the greater the concern for potential indirect effects for listed species dependent upon that taxa, and therefore, the more intensive the analysis on the potential listed species of concern, their locations relative to the use site, and information regarding the use scenario (e.g., timing, frequency, and geographical extent of pesticide application).

Birds and Mammals

Screening-level chronic RQs for birds and mammals that feed on short grass, tall grass, broadleaf plants and small insects, and fruits, pods, and large insects (multiple applications only for fruit foliar type) that exceed the LOC may indicate a potential concern for indirect effects. The Agency considers this to be indicative of a potential for adverse effects to those listed species that rely either on a specific plant species (plant species obligate) or multiple plant species (plant dependent) for some important aspect of their life cycle. The Agency may determine if listed organisms for which plants are a critical component of their resource needs are within the pesticide use area. This is accomplished through a comparison of Service-provided "species profiles" and listed species location data. If no listed organisms that are either plant species obligates or plant dependent reside within the pesticide use area, a no effect determination on listed species is made. If plant species obligate or dependent organism may reside within the pesticide use area, the Agency may consider temporal and geographical nature of exposure, and the scope of the effects data, to determine if any potential effects can be determined to not likely adversely affect a plant species obligate or dependent listed organism.

Indirect effects to terrestrial animals may result from reduced food items to animals, behavior modifications from reduced or a modified habitat, and from alterations of habitats. Alterations of habitats can affect the reproductive capacity of some terrestrial animals.

Probit Slope Analysis

The probit slope response relationship is evaluated to calculate the chance of an individual event corresponding to the listed species acute LOCs. If information is unavailable to estimate a slope for a particular study, a default slope assumption of 4.5 is used as per original Agency assumptions of typical slope cited in Urban and Cook (1986).

a. Terrestrial Species

Analysis of raw data from mammalian terrestrial acute toxicity studies for clothianidin provided an estimate of slope (7.61) for females only ($LD_{50} = 465$ mg/kg). Based on this slope, the corresponding estimate chance of individual mortality following clothianidin exposure is 1 in 7.21×10^{13} for small mammals.

b. Aquatic Species

Analysis of raw data from the aquatic acute toxicity studies for clothianidin estimate slopes of 4.24 (95% C.I. 0.276 and 8.22) for freshwater invertebrates and 4.70 (95% C.I. 2.70 and 6.70) for estuarine/marine invertebrates. Based on these slopes, the corresponding estimate chance of individual mortality following clothianidin exposure is 1 in 294 ($RQ = 0.23$) for freshwater invertebrates and 1 in 7.68×10^5 ($RQ = 0.1$) for estuarine/marine invertebrates.

Critical Habitat

In the evaluation of pesticide effects on designated critical habitat, consideration is given to the physical and biological features (constituent elements) of a critical habitat identified by the U.S. Fish and Wildlife and National Marine Fisheries Services as essential to the conservation of a listed species and which may require special management considerations or protection. The evaluation of impacts for a screening level pesticide risk assessment focuses on the biological features that are constituent elements and is accomplished using the screening-level taxonomic analysis (risk quotients, RQs) and listed species levels of concern (LOCs) that are used to evaluate direct and indirect effects to listed organisms.

The screening-level risk assessment has identified potential concerns for indirect effects on listed species. In light of the potential for indirect effects, the next step for EPA and the Service(s) is to identify which listed species and critical habitat are potentially implicated. Analytically, the identification of such species and critical habitat can occur in either of two ways. First, the agencies could determine whether the action area overlaps critical habitat or the occupied range of any listed species. If so, EPA would examine whether the pesticide's potential impacts on non-endangered species would affect the listed species indirectly or directly affect a constituent element of the critical habitat. Alternatively, the agencies could determine which listed species depend on biological resources, or have constituent elements that fall into, the taxa that may be directly or indirectly impacted by the pesticide. Then EPA would determine whether use of the pesticide overlaps the critical habitat or the occupied range of those listed species. At present, the information reviewed by EPA does not permit use of either analytical approach to make a definitive identification of species that are potentially impacted indirectly or critical habitats that is potentially impacted directly by the use of the pesticide. EPA and the Service(s)

are working together to conduct the necessary analysis.

This screening-level risk assessment for critical habitat provides a listing of potential biological features that, if they are constituent elements of one or more critical habitats, would be of potential concern. These correspond to the taxa identified above as being of potential concern for indirect effects and include small and medium sized mammals. This list should serve as an initial step in problem formulation for further assessment of critical habitat impacts outlined above, should additional work be necessary.

Possible Risk Refinement Measures

Source control measures such as reduction in the application rate, reduction in the number of applications (especially in the presence of pollinators or nesting birds), and increasing the interval between applications may be implemented for clothianidin as possible risk reduction measures.

In order to fully evaluate the possibility of chronic exposure to honey bees with subsequent impacts to pollination, a complete worker bee life cycle study has been required as well as an evaluation of exposure and effects to the queen.

Additional modeling should be done to simulate the potential affects of repeated uses in order to determine if reproduction and development are affected in birds and mammals by chronic exposure.

Additional modeling or toxicity testing should be done to determine if repeated uses may present a risk to soil invertebrates and burrowing mammals.

Sediment toxicity testing of sensitive species (i.e. burrowing mayflies) would provide data to address the uncertainty of possible risk to invertebrates that inhabit or come into contact with sediment receiving surface water runoff or drift from treated fields. An OPPTS 850.1735 (Whole Sediment Acute Toxicity Invertebrates, Freshwater) toxicity test would also provide data concerning the potential chronic effects to benthic organisms because clothianidin persists in the environment representing a continual source as an environ/mental sink. This is a 28 day test that measures survival, growth and emergence of *Chironomus riparius* that have been exposed to pesticide spiked sediment.

Since clothianidin may serve as an environmental sink in aquatic sediments, additional information is needed to address potential effects of repeated uses. Aquatic field studies should be performed to determine system-wide effects to the assemblages of organisms in aquatic communities.

Appendix I. Summary of Individual Environmental Fate Studies

161-1 Hydrolysis (MRID 45422317)

[Thiazolyl-¹⁴C]clothianidin did not significantly hydrolyze in sterile pH 5, 7 and 9 buffer solutions at 25°C; ≥94% of the applied was undegraded at 33 days (study termination; MRID 45422317). Clothianidin did degrade quickly in pH 9 buffer solutions at 62°C and 74°C, with half-lives of 3.7 and 0.7 days, respectively. At pH 9 and the elevated temperatures, two significant degradates were formed. At 62°C, 2-chlorothiazol-5-ylmethylamine (ACT) and N-(2-chlorothiazol-5-ylmethyl)-N'-methylurea (TZMU) reached a maximum concentration of 53.6% and 14.7% of applied, respectively, at 7 days posttreatment. At 74°C, ACT and TZMU reached maximum concentrations of 59.2% and 22.6% of applied, respectively, at 1.9 days posttreatment.

161-2 Photolysis in Water (MRIDs: 45422318, 45422319, 45422320, 45422321, 45422322)

Nitroimino- and thiazolyl- [¹⁴C]clothianidin photodegraded rapidly in sterile pH 7 buffer solution at 25°C under continuous irradiation; half-lives were 3.4 and 3.1 hours, respectively (MRIDs 454223-18, 20, 22). Less than 1% of the clothianidin remained undegraded after 24 hours of irradiation. No significant degradation occurred in the dark controls. The predicted environmental half-life was 14.4 hours (extrapolating from the actual study conditions assuming mid-summer sunny conditions in Phoenix, Arizona; based on continuous irradiation; 5.76 hours of irradiation were equivalent to 1 day of clear midday midsummer sunlight).

[Nitroimino-¹⁴C]clothianidin degraded mainly to methylguanidine (MG), TZMU, 4-hydroxy-2-methylamino-2-imidazolin-5-one (HMIO) and methylurea (MU), with maximum concentrations of 34.7% (432 hours), 29.3% (24 hours), 26.6% (24 hours), and 11.0% (432 hours) of the applied, respectively. [Thiazolyl-¹⁴C]clothianidin degraded mainly to TZMU, formamide (FA), 7-methylamino-4H-imidazol[5,1-b][1,2,5]thiadiazin-4-one (MIT), and CO₂, with maximum concentrations of 39.7% (24 hours), 16.1% (120 hours), 11.8% (24 hours), and 34.1% (432 hours) of the applied, respectively. In nonsterile river water (pH 7.0-9.6) under sunlight, nitroimino- and thiazolyl- [¹⁴C]clothianidin degraded with half-lives of 25.1 and 27.7 hours, respectively (MRIDs 454223-19, -21). Temperatures averaged approximately 25°C (range 21.5 to 31.3°C) and average daylight was 8.7 hours (range 0.7 to 14.4 hours). Clothianidin was <5% of the applied at and after 4 days posttreatment. No significant degradation occurred in the dark controls. This study suggests a longer transformation period than the sterile buffer study; however, variable conditions (temperature, pH, sunlight) make precise comparisons difficult.

In the river water, [nitroimino-¹⁴C]clothianidin degraded mainly to MG, HMIO, and MU with maximum concentrations of 46.5% (696 hours), 28.0% (120 hours), and 12.0% (432 hours) of the applied, respectively. [Thiazolyl-¹⁴C]clothianidin degraded mainly to CO₂, with a maximum concentrations of 28.5% (696 hours) of the applied; other major degradates were Urea, N-(2-chlorothiazol-5-ylmethyl)-N'-methyguanidine (TMG), 3-methylamino-1H-imidazo [1,5-c]imidazole (MAI), and 2-chlorothiazol-5-ylmethanol (CTCA) with maximum concentrations of 18.1% (264 hours), 17.2% (120 hours), 13.6% (120 hours), and 13.3% (432 hours) of the applied, respectively.

161-3 Photodegradation on Soil (MRID: 45422323)

Clothianidin degraded with a half-life of 8.2 days in a sandy loam soil at 20°C, based on continuous irradiation; 5.76 hours of irradiation were equivalent to 1 day of clear midday midsummer sunlight at 40°N latitude (MRID 45422323). The equivalent environmental half-life calculated assuming 5.76 hours under study conditions equals one day under natural summer sunlight is 34 days. At study termination (17 days), 22.3% of the clothianidin remained undegraded. No significant degradation occurred in the dark controls. No degradates accumulated to significant levels during the study.

161-4 Photodegradation in Air (Waived)

162-1 Aerobic Soil Metabolism (MRIDs 45422325, 45422326)

Clothianidin degraded in two soils with a half-life of 148 and 239 days, in seven soils ranging in texture from sand to silt loam with half-lives of 495 to 1,155 days, and in a tenth soil (loamy sand, 0.35% OC) with a half-life of 6,932 days (MRIDs 45422325 and 45422326). In all cases, the data were extrapolated beyond the duration of the study and assumed that decay would continue at a first order rate.

All of the soils were studied at 20°C with a moisture content of 75% of 1/3 bar except for the Laacher Hof silt loam and Hofchen silt soils from Germany, which were studied at a moisture content of 40% of maximum water holding capacity. Since all studies were conducted at 20°C, clothianidin might have been less persistent than if the studies had been conducted at 25°C, the temperature of most laboratory soil metabolism studies. The Hofchen, Laacher Hof, and BBA 2.2 soils were treated with [nitroimido-¹⁴C]clothianidin. The remaining soils were treated with [thiazolyl-¹⁴C]clothianidin.

Summary of aerobic soil metabolism study for clothianidin, presented in order of ascending half-lives.

Soil	% OC	pH in water /0.01 M CaCl ₂	% Remaining at end of study	Extrapolated half- life, days
Hofchen silt from Germany (MRID 45422325)	2.66	7.8/7.2	54.3% at 120 days	148
Laacher Hof (AII) silt loam from Germany (MRID 45422325)	0.86	8.1/7.3	68.6% at 120 days	239
Loamy sand (BBA 2.2) from Germany (MRID 45422325)	2.5	6.0/6.3	57.8% at 365 days	495
Quincy loamy sand (MRID 45422326)	0.4	6.8/---	80.8% at 181 days	533

Soil	% OC	pH in water /0.01 M CaCl ₂	% Remaining at end of study	Extrapolated half- life, days
Sparta sand (MRID 45422326)	0.73	6.22/5.31	79.5% at 181 days	533
Crosby silt loam (MRID 45422326)	1.37	6.74/6.01	60.3% at 379 days	578
Susan silt loam (MRID 45422326)	3.27	6.66/5.91	78.3% at 181 days	693
Howe sandy loam (MRID 45422325)	1.12	6.7/6.7	75.8% at 365 days	990
Elder loam (MRID 45422326)	1.41	6.67/5.84	87.5% at 181 days	1155
Fuguay loamy sand (MRID 45422326)	0.35	6.67/5.84	95.3% at 181 days	6932

Residue analysis. Residues were analyzed using thin-layer chromatography (TLC) in multiple solvent systems and radiographic imaging. In MRID 45422325, clothianidin and four nonvolatile degradates [N-methyl-N'-nitroguanidine (MNG); nitroguanidine (NTG); N-(2-chlorothiazol-5-ylmethyl)-N'-nitroguanidine (TZNG); and N-(2-chlorothiazol-5-ylmethyl)-N'-methylurea (TZMU)] were identified by comparison to reference standards. In MRID 45422326, clothianidin, TZNG, and TZMU were identified by comparison to reference standards and LC/MS. There were no unidentified extractable degradation products.

MNG, a degradate originating from the nitroimino moiety, was a maximum 0.7 and 9.5% of the applied in the Laacher Hof and Hofchen soils and 5.9% in the BBA 2.2 soils (MRID 45422325). The maximum concentrations were measured either at the final sampling interval or, if measured prior to the final interval, showed no pattern of decline through study termination. In sandy loam and silt loam Laacher Hof soils and the Hofchen silt soil at 20°C and 50% of maximum water holding capacity, MNG degraded with half-lives of 65-116 days (MRID 45422327).

NTG, a degradate originating from the nitroimino moiety, was a maximum 3.7-6.7% of the applied; in all three soils the maximum was measured at the final sampling interval (MRID 45422325).

TZNG was a maximum 5.1-9.1% of the applied in the Laacher Hof, Hofchen, and BBA 2.2 soils and 2.5% in the Howe sandy loam soil at the final sampling interval (MRID 45422325). In all other soils, the maximum was ≤0.5% of the applied (MRID 45422326). In sandy loam and silt loam Laacher Hof soils and the Hofchen silt soil at 20°C and 50% of maximum water holding capacity, TZNG degraded with half-lives of 53-122 days (MRID 45422328).

TZMU was ≤2.4% of the applied in all soils (MRIDs 45422325 and 45422326).

The maximum concentrations of MNG and TZNG in the soils are probably limited by the relatively

rapid rate of degradation of these compounds compared to the slower rate of degradation of clothianidin. No additional information was submitted on the rate of degradation of NTG, so it is not certain if significant additional accumulation would occur. TZMU is most likely a minor degradate under all conditions.

CO₂ was a major transformation product in soils in several soils in which significant degradation occurred prior to study termination (MRIDs 45422325 and 45422326).

162-2 Anaerobic Soil Metabolism

No anaerobic soil metabolism study has been conducted; however, an anaerobic aquatic soil metabolism study was conducted in lieu of this study.

162-3 Anaerobic Aquatic Metabolism (MRID: 45422330)

Clothianidin degraded in with half-lives of 14 days in the water phase, 37 days in the sediment phase, and 27 days overall in an anaerobic water:silt loam sediment (3:1, v:w) system at 20°C (MRID 45422330). Clothianidin was <1% of the applied in the water phase at and after 120 days and was <2.0% in the sediment at and after 183 days. No major degradates were isolated and no minor degradates were identified, in large part because the majority of the residues were not extracted from the sediment at later sampling intervals despite the use of more harsh extraction procedures.

162-4 Aerobic Aquatic Metabolism (MRIDs: 45422324 and 45422329)

No acceptable aerobic aquatic metabolism studies have been conducted. Although two studies were submitted by the registrant under this guideline, the experimental designs of both were inadequate to define the pattern of decline of clothianidin under aerobic aquatic conditions (MRIDs 45422324 and 45422329). The experimental design was not in compliance with guidelines (soil and water were pre-incubated before applying the test substance) and aerobic conditions were not fully maintained during the course of the study as indicated by the low redox potential that developed in the sediment

163-1 Mobility, Adsorption/Desorption Batch Equilibrium (MRIDs: 45422311 and 45422312)

Clothianidin has medium to very high mobility in soils ranging from sand to clay loam, with Freundlich adsorption coefficients ranging between 0.52 and 4.14 (MRID 45422311). Soil organic carbon partition coefficients (K_{oc}) values were 84 to 129 for all test soils except the US sandy loam soil, which had a K_{oc} value of 345. For all five test soils, Freundlich desorption coefficients and soil desorption carbon coefficients were slightly higher than those obtained for adsorption.

Freundlich adsorption and desorption constants of clothianidin in the soils.

Soil	Adsorption				Desorption			
	K_d	1/n	r^2	K_{oc}	K_d	1/n	r^2	K_{oc}
Quincy loamy sand	0.52	0.8351	0.9952	129	0.62	0.8068	0.9982	154
BBA 2.1 sand	0.59	0.8648	0.9974	119	0.85	0.8843	0.9966	170
Crosby clay loam	1.48	0.8216	0.9992	123	1.67	0.8240	0.9987	139

Soil	Adsorption				Desorption			
	K_d	$1/n$	r^2	K_{oc}	K_d	$1/n$	r^2	K_{oc}
Laacher Hof sandy loam	1.77	0.8146	0.9998	84	1.99	0.8136	0.9981	95
Elder sandy loam	4.14	0.8088	0.9997	345	4.58	0.8115	0.9987	382

In addition, the desorption of aged clothianidin was studied using Laacher Hof AXXa sandy loam and Laacher Hof AIII silt loam soils from Germany, adjusted to 40% of the maximum water holding capacity, dosed at 0.13 or 1.35 mg a.i./kg, and incubated at $20 \pm 1^\circ\text{C}$ for up to 99 days (MRID 45422312). After aging, the soils were equilibrated for 24 hours. Clothianidin comprised approximately 57% of the applied in the soil at 99 days. Clothianidin has low to moderate mobility in the soils after aging. Freundlich desorption coefficients and soil organic carbon partition coefficients (K_{oc}) increased over time in the low-dose soils.

Freundlich desorption constants of clothianidin in the low-dose soils.

Soil	Days of Aging Prior to Desorption						
	0	2	7	14	27	55	99
Sandy loam							
K_d	2.09	2.51	3.99	3.26	3.65	4.86	5.94
K_{oc}	205	246	391	319	357	477	582
Silt loam							
K_d	1.17	1.40	2.37	2.01	2.23	3.34	4.05
K_{oc}	120	143	242	205	228	341	413

Similar results were observed in the high-dose soils aged for 99 days. Freundlich adsorption coefficients increased from 1.56 to 3.30 for the sandy loam soil and from 0.96 to 3.05 for the silt loam soil after 99 days; corresponding increases in soil organic partition coefficients were 153 to 323 and 98 to 311. The study author attributed the increasing K_{oc} values to changes in the sorption process, leading to stronger adsorption to soil and diffusion processes into less accessible sorption sites.

163-1 Mobility of the transformation products of clothianidin (MRIDs: 45422313, 45422314, 45422315, 45422316)

The mobility of four clothianidin degradates (MNG, TZMU, TZNG, and TMG) was also studied in three US and two German soils using batch equilibrium experiments. The mobilities of the degradates varied from very highly mobile to immobile. MNG had very high mobility in the five test soils, with Freundlich adsorption coefficients between 0.0199 and 0.3736, and soil organic carbon partition coefficients ranging from 5.2 to 34.3 (MRID 45422313). TZMU had high to very high mobility, with Freundlich adsorption coefficients ranging between 0.1764 and 1.0445, and

corresponding soil organic carbon partition coefficients between 46.4 and 95.8 (MRID 45422315). TZNG was moderately mobile in the test soils, with Freundlich adsorption coefficients ranging between 0.6274 and 4.7137 and corresponding soil organic carbon partition coefficients between 204.5 to 432.5 (MRID 45422314). TMG was immobile or had low mobility in the test soils; Freundlich adsorption coefficients were between 2.4381 and 39.4584 and corresponding soil organic carbon partition coefficients were 525.0 to 6159.4 (MRID 45422316). Freundlich desorption coefficients and soil organic carbon partition coefficients (when calculated) for the four degradates were higher than those obtained for adsorption, except were lower for MNG in the US silt loam soil.

Freundlich adsorption and desorption constants of clothianidin degradates MNG, TZMU, TZNG, and TMG in three US and two German soils.

Soil	Adsorption				Desorption			
	K_d	$1/n$	r^2	K_{oc}	K_d	$1/n$	r^2	K_{oc}
MNG								
Quincy sand	0.0514	1.1012	0.9726	21.4	Not calculated			
BBA 2.1 sand	0.0199	0.7017	0.8920	5.2	Not calculated due to low adsorption			
Crosby silt loam	0.1928	0.9249	0.9983	16.5	0.1520	0.8764	0.9812	13.0
Laacher Hof AIIa sandy loam	0.2584	0.9005	0.9999	25.3	0.3561	0.8907	0.9998	34.9
Elder sandy loam	0.3736	0.9083	0.9988	34.3	0.4795	0.9697	0.9993	44.0
TZMU								
Quincy sand	0.1280	0.9276	0.9999	53.3	0.1511	0.8463	0.9995	63.0
BBA 2.1 sand	0.1764	0.8695	0.9999	46.4	0.2604	0.8659	0.9999	68.5
Crosby silt loam	0.6547	0.8645	0.9999	56.0	0.8329	0.8716	1.0000	71.2
Laacher Hof AIIa sandy loam	0.5867	0.8804	0.9996	57.5	0.7832	0.8781	0.9996	76.8
Elder sandy loam	1.0445	0.8430	0.9996	95.8	1.3390	0.8554	0.9998	122.8
TZNG								
Quincy sand	0.6274	0.9010	0.9963	261.4	0.8309	0.8975	0.9958	346.2
BBA 2.1 sand	0.7772	0.8059	0.9994	204.5	1.0290	0.7923	0.9988	270.8
Crosby silt loam	2.8387	0.8070	0.9999	242.6	3.2321	0.8059	0.9999	276.2
Laacher Hof AXXa sandy loam	2.4072	0.8003	0.9999	236.0	2.8622	0.7924	0.9999	280.6
Elder sandy loam	4.7137	0.7832	0.9997	432.5	5.7460	0.7924	0.9997	527.2
TMG								

Soil	Adsorption				Desorption			
	K_d	1/n	r^2	K_{oc}	K_d	1/n	r^2	K_{oc}
Quincy sand	14.7825	0.7798	0.9984	6159.4	21.6317	0.7858	0.9982	9013.2
BBA 2.1 sand	2.4381	0.8256	1.0000	641.6	2.9727	0.8214	1.0000	782.3
Crosby silt loam	15.7889	0.7803	0.9997	1349.5	18.5460	0.7859	0.9994	1585.1
Laacher Hof AIIa sandy loam	5.3550	0.8493	0.9990	525.0	6.1451	0.8094	0.9998	602.5
Elder sandy loam	39.4584	0.7297	0.9977	3620.0	54.4096	0.7348	0.9976	4991.7

163-2 Laboratory Volatility

Data waived due to low vapor pressure.

163-3 Field Volatility

Data waived due to low vapor pressure.

164-1 Terrestrial Field Dissipation (MRIDs: 45422332, 45422333, 45422334, 45422335, 45422336, 45490703, 45490704, 45490705)

TI-435 FS 600 Terrestrial field dissipation. Terrestrial field dissipation studies of clothianidin applied to bare soil have been submitted from Wisconsin (MRID 45422332), Ohio (MRID 45422333), North Dakota (MRID 45422334), Ontario (MRID 45422335) and Saskatchewan (MRID 45422336). Clothianidin was applied as a broadcast spray using the test formulation (a seed treatment for corn and canola seeds) in all five studies. The application rate in the field studies was 243 or 660 g a.i./ha, approximately two and six times the maximum proposed label rate (corn; 1.5 mg/seed, equivalent to 122 g a.i./ha).

Half-lives of clothianidin, based on residues in the 0-15 cm soil depth, ranged from 277 days (Wisconsin test site, sand soil) to 1,386 days (North Dakota test site, clay loam soil); a half-life could not be determined for the Saskatchewan (clay loam soil) test site due to limited dissipation during the study. DT90 values ranged from 980 days to 2,780 days and could not be determined for the Saskatchewan test site. No degradates were detected at >10% of the applied, with the exception of a single detection of TZMU at 10.1% of the applied the Ohio test site. Clothianidin was generally not detected below the 45 cm soil depth, except in the Wisconsin sand soil at a maximum depth of 45-60 cm. Degradates were generally only detected in the 0-15 cm soil layer.

Dissipation of clothianidin in five field studies following a single application of TI-435 FS 600 to bare soil.

Geographic location	Soil texture (0-15 cm)	Application rate (target)	Incorporated	Time to maximum conc. ¹	Conc. at study termination ¹	Half-life ²	DT90 ³
Wisconsin, USA	Sand	660 g a.i./ha	Yes, depth not reported	0.319 mg/kg (7 days)	0.030 mg/kg (823 days)	277 days (r ² = 0.80)	1,330 days
Ohio, USA	Silt loam	660 g a.i./ha	No	0.235 mg/kg (7 days)	0.0305 mg/kg (735 days)	315 days (r ² = 0.85)	980 days
North Dakota, USA	Clay loam	243 g a.i./ha	No	0.124 mg/kg (15 days) ⁴	0.0353 mg/kg (864 days)	1,386 (r ² = 0.10)	2,780 days
Ontario, Canada	Silt loam	660 g a.i./ha	Yes, 5 cm	0.278 mg/kg (7 days)	0.0576 mg/kg (798 days)	365 days (r ² = 0.51)	1,160 days
Saskatchewan, Canada ⁵	Silty clay loam	243 g a.i./ha	Yes, 5 cm	0.0811-0.0985 mg/kg (day 0) ⁶	0.0638-0.0796 mg/kg (775 days)	Could not be determined ⁷	Could not be determined ⁷

¹ Concentration in the 0-15 cm soil layer.

² Reviewer-calculated, based on residues in the 0-15 cm soil layer.

³ Registrant-calculated, based on residues in all soil layers.

⁴ Excludes outlier at 842 days posttreatment (TI-435 detected at 0.146 mg/kg, mean of three replicates).

⁵ Two trials were conducted at the Saskatchewan test site.

⁶ Day 0 (post-incorporated values). The maximum concentration of TI-435 observed in trials 1 and 2 occurred at 61 days (0.122 mg/kg) and 678 days (0.0916 mg/kg), respectively.

⁷ A half-life could not be determined at the Saskatchewan test site due to limited dissipation during the study.

TI-435 50WDG Terrestrial field dissipation. Terrestrial field dissipation studies of clothianidin (TI-435 50WDG) applied to bare soil have been submitted from California (MRID 45490703), Washington (MRID 45490704) and Georgia (MRID 45490705). Clothianidin was applied as a broadcast spray using the test formulation TI-435 50WDG in all three studies. The application rate in the field studies was 229 g a.i./ha. The label application rate was not provided.

Clothianidin concentrations in the California study varied widely with no pattern of decline; consequently, it was not possible to calculate half-lives or DT90. In the other studies half-lives of clothianidin, based on residues in the 0-15 cm soil depth, ranged from 257 days for the Washington study to 990 days for the Georgia test site. However, due to the extreme variability of the data for the Georgia study the calculated half-life is deemed to have limited value by the reviewer. DT90 values ranged from 686 days (Washington) to 3070 days (Georgia). No degradates were detected at >10% of the applied.

Dissipation of clothianidin in three field studies following a single application of TI-435 50 WDG to bare soil.

Geographic location	Soil texture (0-15 cm)	Application rate (target)	Incorporated	Time to maximum conc. ¹	Conc. at study termination ¹	Half-life ²	DT90 ³
California, USA	Loam/sandy loam	225 g a.i./ha	No	96.8 µg/kg (day 0)	78.1 µg/kg (982 days)	Not calculable	Not calculable
Washington, USA	Loam/sandy loam	225 g a.i./ha	No	129 µg/kg (day 0)	12.6 µg/kg (623 days)	257 days (r ² = 0.43)	686 days
Georgia, USA	Sandy loam/sandy clay loam	225 g a.i./ha	No	82.6 µg/kg (365 days)	23.9 µg/kg (739 days)	990 ⁴ days (r ² = 0.15)	3070 ⁴ days

¹ Concentration in the 0-15 cm soil layer.

² Reviewer-calculated, based on residues in the 0-15 cm soil layer.

³ Registrant-calculated, based on residues in all soil layers.

⁴ Excludes outlier at 365 days posttreatment, reviewer considers half-life calculation of limited value due to variability of data.

In lysimeter studies conducted in the Federal Republic of Germany (FRG), clothianidin was applied to the same sandy loam soil (0-10 cm depth: 70.8% sand, 20.7% silt, 8.6% clay, pH 7.2, 1.8% organic carbon; Appendix 5, p. 45) in Monheim, FRG. In the first study, [nitroimino- ^{14}C]clothianidin, formulated as TI-435 200 SC, was applied twice (10 months apart) at approximately 160 g a.i./ha/application to an enclosed plot (1 m² x 1.3 m depth) of sandy loam soil planted with turf (MRID 45422508). In the second study, [Thiazolyl- ^{14}C]clothianidin, formulated as TI-435 70 WS, was applied twice (400 days apart) as a seed treatment at approximately 100 g a.i./ha and 138 g a.i./ha, respectively, to an enclosed plot (1 m² x 1.3 m depth) of sandy loam soil (MRID 45422331).

In the MRID 45422508 study, approximately three years following the first application, 42-45% of the applied was detected in the soil and approximately 1% was detected in the leachate; the loss of radioactivity, approximately 54-56%, was attributed to mineralization of clothianidin. Grass clippings were not analyzed separately. Approximately 39.5-40.4% of the applied was detected within the top 0-30 cm of soil, with clothianidin accounting for the majority of the extracted radioactivity (maximum of 18.02 $\mu\text{g/kg}$ soil in the 0-10 cm soil layer). The degradates MNG, TZNG and NTG were detected at maximum concentrations of 1.57 $\mu\text{g/kg}$ soil, 3.05 $\mu\text{g/kg}$ soil and 0.77 $\mu\text{g/kg}$ soil, respectively, in the 10 cm soil layer. MNG and NTG were also detected in the leachate samples; clothianidin was not detected in any leachate samples.

In the MRID 45422331 study, winter barley seeds were treated and sown for the first application and winter wheat seeds were treated and sown for the second application; the lysimeter was cropped with untreated winter wheat during the third year of the study. Approximately three years following the first application, 59% of the applied was detected in the soil, 3% was detected in the harvested crops and 0.3% was detected in the leachate; the loss of radioactivity, approximately 37%, was attributed to mineralization of clothianidin. Approximately 57% of the applied was detected within the top 0-30 cm of soil, with clothianidin accounting for the majority of the extracted radioactivity (maximum of 25.4 $\mu\text{g/kg}$ soil in the 0-10 cm soil layer). The only degradate detected was TZNG, at a maximum concentration of 5.21 $\mu\text{g/kg}$ soil in the 10 cm soil layer. Clothianidin and TZNG were detected in the harvested crops, with the majority of the radioactivity being detected in the hulls/straw and chaff. Four unknown degradates were detected in the leachate samples; clothianidin was not detected in any leachate samples.

Ancillary studies - The extraction efficiency of two analytical methods to determine clothianidin and its degradates TZNG, MNG, TZMU and TNG was compared in two aged German soils (MRID 45422604). Radiolabeled test substances were applied to the two soils (a sandy loam and a silt loam) at a concentration equivalent to 300 g a.i./ha and maintained in the dark at $20 \pm 1^\circ\text{C}$ and at 75% of 1/3 bar moisture under static aerobic conditions for 92 days. For the "lab method", 100 g soil samples were extracted four times with acetonitrile and once with water by shaking; following centrifugation, extracts were filtered and analyzed by TLC. For the "field method", 20 g soil samples were mixed with 4 g hydromatrix and extracted using an Accelerated Solvent Extractor with acetonitrile:water:acetic acid:guanidine hydrochloride (200:800:0.8:8, v:v:v:w) at a temperature of 140°C and a pressure of 140 bar; extracts were analyzed by TLC. Both total

radioactive residues extracted and extraction efficiencies for each individual test substance were generally greater with the field method as compared to the lab method. The study author speculated that the lower recoveries for the lab method may have been a result of the higher metabolism/mineralization capacity of the 100 g soil samples used in the lab method as compared to the 20 g soil samples used in the field method; however, neither bound residues nor CO₂ were measured.

Soil	Lab method		Field method	
	Total extracted ¹⁴ C	Total identified ¹⁴ C	Total extracted ¹⁴ C	Total identified ¹⁴ C
Sandy loam				
TI-435	105.3	76.5	102.9	82.2
TZNG	89.3	52.4	90.1	69.9
MNG	89.4	56.0	90.4	66.8
TZMU	35.8	20.2	61.0	41.6
TMG	73.3	62.1	83.5	78.9
Silt loam				
TI-435	100.2	70.3	109.4	81.9
TZNG	85.1	50.1	89.5	61.4
MNG	86.6	44.4	79.5	49.0
TZMU	20.9	13.4	34.6	20.8
TMG	64.3	58.2	84.6	80.7

In a storage stability study, no significant degradation of clothianidin and the degradates TZNG, TZMU, TMG, and MNG was observed in frozen samples of Howe soil fortified with parent and degradates at approximately 50 µg/kg and stored frozen for 12 months at temperatures between -18 and -25°C (MRID 45422612). Following storage, clothianidin and the degradates were extracted from soil with acetonitrile:water:acetic acid:guanidine hydrochloride (200:800:0.8:8, v:v:v:w) using an Accelerated Solvent Extractor (ASE). After extraction, an internal standard solution was added and the volume adjusted with acetonitrile:water (1:4, v:v). Extracts were analyzed by LC-MS/MS. Isotopically labeled internal standards (d₃-TI-435; ¹³C, ¹⁵N-TZNG; d₃-TZMU; d₃-MNG and d₃-TMG) were used to compensate for possible matrix effects in the MS/MS detector. Mean recoveries of TI-435 were 106% at day 0, 98.4% at 118 days, 96.1% at 180 days, and 91.2% following 356 days of storage. Mean recoveries of TZNG were 94.6% at day 0, 101% at 118 days, 98.6% at 180 days, and 92.4% following 356 days of storage. Mean recoveries of TZMU were 104% at day 0 and 118 days, 95.6% at 180 days, and 93.7% following 356 days of storage. Mean recoveries of TMG were 95.6% at day 0, 82.3% at 118 days, 94.4% at 180 days, and 83.4% following 356 days of storage. Mean recoveries of MNG were 95.7% at day 0, 96.1% at 118 days, 110% at 180 days, and 101% following 356 days of storage. The study "is still running for at least one more year."

164-2 Aquatic Field Dissipation
Reserved.

165-4 Bioaccumulation in Fish (waived)

This data requirement has been waived. Octanol/water partitioning (K_{ow}) data provided in an aerobic aquatic metabolism study indicates a low potential for clothianidin to accumulate (K_{ow} for clothianidin = 1.12 at pH 7; MRID 45422329).

165-5 Accumulation – Aquatic Non-target Organisms Reserved.

166-1 Groundwater – Small Prospective

The study was requested and is required.

201-1 Droplet Size Spectrum (MRIDs: 45490701)

A single droplet size spectrum study has been complete which has been classified as supplemental (upgradedable). It was considered to be scientifically valid, but cannot be used to fulfill the requirement for an atomization droplet size spectra because the test substance/solution was not adequately characterized. The atomization droplet size spectra of (E)-N-[(2-Chloro-5-thiazolyl)methyl]-N'-methyl-N''-nitroguanidine (clothianidin; TI-435 50 WDG) was studied by spraying the test substance mixed with water and oil (0.25% v:v) under controlled conditions at a rate of 90 g a.i./acre in spray mixture volumes of 150 and 300 gallons/acre. Spray conditions were simulated through four disk-core nozzle types, D14-25, D10-25, D6-25 and D3-46 (0° nozzle orientation, straight back from the wind tunnel airstream), in combination with wind tunnel airstream velocities of 74 and 136 mph. Liquid pressure at the nozzle tips was either 150 psi (treatments 1-16) or 100 psi (treatments 17-24).

For application methods at a liquid pressure of 150 psi (airstream velocities of 74 and 136 mph, rate 150 and 300 gallons/acre), the mean $D_{v0.5}$ ranged from 161-274 μm . At a liquid pressure of 100 psi, $D_{v0.5}$ ranged from 185-343 μm .

Although no statistical analysis was reported, there was good agreement in atomization data between replicates of each treatment. The sprays became finer in the following nozzle order: D3-46 (coarsest) > D14-25 > D10-25 > D6-25 (finest). Sprays were also slightly coarser at the greater dilution rate (300 gallons/acre). The study author proposed that likely resulted from the higher dynamic surface tension expected with the more dilute tank mix.

Sprays were much finer with at the higher airstream velocity due to greater air shear, with the exception of the D3-46 nozzle, which was only slightly finer at the higher velocity. Higher pressure (150 psi) at the nozzle tips also produced a finer spray. The effect of the application volume rate dilution on atomization was much lower than effects of nozzle size, airstream velocity and spray pressure.

The sprays were classified as fine to medium ($V < 141 \mu\text{m}$) according to the British Crop Protection Council (BCPC) and American Society of Agricultural Engineers (ASAE) spray-quality classification scheme for droplet size categories.

202-1 Drift Field Evaluation

Reserved.

Appendix II. Ecological Toxicity Data Summaries

Toxicity to Terrestrial Animals

Birds, Acute and Subacute

An oral toxicity study using the technical grade of the active ingredient (TGAI) is required to establish the acute toxicity of clothianidin to birds. The preferred guideline test species is either mallard duck (a waterfowl) or bobwhite quail (an upland gamebird). The data that were submitted show that the 14-day oral LD₅₀ is >2,000 mg/kg for bobwhite quail. The NOAEL is 500 mg/kg with observed effects including reduced mean body weights, mortality and clinical effects (subdued birds) in the 1,000 and 2,000 mg/kg test groups. A study conducted on a non-guideline species, Japanese quail, showed that the 14-day oral LD₅₀ is 423 mg/kg. The NOAEL is 12.5 mg/kg bw based on clinical signs of toxicity (lethargy and ruffled appearance) at the 25 mg/kg treatment level. Based on these results, clothianidin is categorized as ranging from practically non-toxic to moderately toxic to avian species on an acute oral basis; the guideline (71-1) is fulfilled (MRID #45422417).

Avian Acute Oral Toxicity

Species	% ai	LD50 (mg/kg)	Toxicity Category	MRID No. Author, Year	Study Classification
Northern bobwhite quail (Colinus virginianus)	96.0	>2,000	Practically non-toxic	45422417 Johnson, 1998	Core
Japanese Quail (Coturnix coturnix japonica)	97.6	423	Moderately toxic	45422418 Gallagher et al., 2000	Supplemental

Two dietary studies using the TGAI are required to establish the subacute toxicity of clothianidin to birds. The preferred test species are mallard duck and bobwhite quail. The data that were submitted show that the 8-day acute dietary LC₅₀ is >5,000 ppm; therefore, clothianidin is categorized as practically non-toxic to avian species on a subacute dietary basis. The 8-day NOAEC's for each species based on sublethal effects (reduced body weight gain) were 309 ppm for the quail and 646 ppm for the mallard. The guideline (71-2) is fulfilled (MRID #45422419; MRID #45422420).

Avian Subacute Dietary Studies

Species	% ai	5-Day LC50 (ppm) ¹	Toxicity Category	MRID No. Author, Year	Study Classification
Northern bobwhite quail (Colinus virginianus)	96	>5,230	Practically non-toxic	45422419 Johnson, 1998	Core

Species	% ai	5-Day LC50 (ppm) ¹	Toxicity Category	MRID No. Author, Year	Study Classification
Mallard duck (<i>Anas platyrhynchos</i>)	96	>5,040	Practically non- toxic	45422420 Johnson, 1998	Core

Birds, Chronic

Avian reproduction studies using the TGAI are required for clothianidin because birds may be subject to repeated or continuous exposure to the pesticide, especially preceding or during the breeding season. The preferred test species are mallard duck and bobwhite quail. The submitted data show that clothianidin exposure of 525 ppm adversely affected eggshell thickness for bobwhite quail, but did not result in chronic effects during reproduction for mallard duck; the guideline (71-4) is fulfilled (MRID #45422421; MRID #45422422).

Avian Reproduction

Species	% ai	NOAEC/LOAEC (ppm)	LOAEC Endpoints	MRID. No. Author, Year	Study Classification
Northern bobwhite quail (<i>Colinus virginianus</i>)	97.6	205/525	Eggshell thickness	45422421 Gallagher et al., 2000	Core
Mallard duck (<i>Anas platyrhynchos</i>)	97.6	525/>525	No effect on reproduction	45422422 Gallagher et al., 2000	Supplemental

Mammals, Acute and Chronic

Wild mammal testing is required on a case-by-case basis, depending on the results of lower tier laboratory mammalian studies, intended use pattern and pertinent environmental fate characteristics. In most cases, rat or mouse toxicity values obtained from the Agency's Health Effects Division (HED) substitute for wild mammal testing. These toxicity values are reported below.

Mammalian Acute and Chronic Toxicity

Species	% a.i.	Test Type	Toxicity	Affected Endpoints	MRID No. Author, Year
Rat (<i>Rattus norvegicus</i>)	96	Acute	LD ₅₀ = 5,000 mg/kg/day	Mortality	45422621 Gardner, 1997
Mouse (<i>Mus musculus</i>)	96	Acute	LD ₅₀ = 389-465 mg/kg/day	Mortality	45422622 Gardner, 1997

Species	% a.i.	Test Type	Toxicity	Affected Endpoints	MRID No. Author, Year
Rat (Rattus norvegicus)	96	2-Generation Reproduction	NOAEL (M/F) = 9.8/11.5 mg/kg/day (150/500 ppm) ⁵ LOAEL (M/F) = 31.2/36.8 mg/kg/day (500/500 ppm) ⁵ NOAEL (M) = 31.2 mg/kg/day (500 ppm) ⁵ LOAEL (M) = 163.4 mg/kg/day (2500 ppm) ⁵	Offspring systemic ¹ Reproduction ²	4522714-16 and 45422825-26, 2000 and 2001
Rabbit (Sylvilagus sp.)	96	Developmental	NOAEL/LOAEL = 25/75 mg/kg/day (825/2,475 ppm) ⁴	Development ³	45422712 and -13, 1998

¹ Decreased body weight gains and delayed sexual maturation (males only); decreased absolute thymus weight in F1 pups (both sexes), and increased stillbirths (F1 and F2 litters).

² Decreased sperm mobility and increased number of sperm with detached heads (F1 and F2 litters).

³ Premature deliveries, decreased gravid uterine weights, and increased litter incidence of missing lobe of the lung per fetus.

⁴ ppm conversion based on:

1 mg/kg/day = 20 ppm in adult rats, 10 ppm in younger rats, 7 ppm in mice and 33 ppm in rabbits. (Nelson, 1975)

⁵ ppm value determined from study.

The results indicate that clothianidin is categorized as practically non-toxic to small mammals on an acute oral basis (LD_{50} = 389->5,000 mg/kg/day).

In the 2-generation rat reproduction study, offspring systemic toxicity was detected for males and females at 500 ppm and reproductive toxicity was detected in males at 2500 ppm. The NOAEL for offspring systemic toxicity was 150 and 500 ppm for males and females, respectively, and the NOAEL for reproduction was 500 ppm. In the rabbit developmental study, toxicity was observed at 75 mg/kg/day; the NOAEL was 25 mg/kg/day.

Insects, Acute Contact and Oral

A honey bee acute contact study using the TGAI is required for clothianidin because its foliar application treatment use will result in honey bee exposure. The acute contact LD_{50} , 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 acute contact LD_{50} for clothianidin is 0.0439 μ g a.i./bee and it is, therefore, classified as highly toxic to bees on a contact exposure basis [LD_{50} < 2 μ g a.i./bee, based on toxicity categories in Atkins (1981)]. The guideline (141-1) is fulfilled (MRID No. 45422426).

Five acute oral toxicity studies are available for clothianidin and its metabolites; however, they are categorized as supplemental because the submission of honey bee acute oral toxicity studies is not a guideline requirement. The Office of Pesticide Programs (OPP) does not have a categorization scheme for acute oral toxicity to honey bees. However, based on the ICBB (1985)

acute oral toxicity categorization scheme, clothianidin would be considered highly toxic to the honey bee by the oral route. With the exception of TZNG, the clothianidin metabolites TMG, MNG, and TZMU would be virtually non-toxic to honey bees. TZNG would be moderately toxic.

Nontarget Insect Acute Contact and Oral Toxicity

Species/Study Duration	% ai	LD50 (µg ai/bee)	Toxicity Category	MRID No. Author, Year	Study Classification
Honey bee Acute Contact Toxicity - Clothianidin					
Honey bee (Apis mellifera) 48 hour	96	0.0439	highly toxic	45422426 Weyman, 1998	Core
Honey bee Acute Oral Toxicity - Clothianidin					
Honey bee (Apis mellifera) 48 hour	96	0.0037	not applicable	45422426 Weyman, 1998	Supplemental
Honey bee Acute Oral Toxicity - Clothianidin Metabolite -TMG					
Honey bee (Apis mellifera) 48 hour	96	≥152	not applicable	45422427 Wilkins, 2000	Supplemental
Honey bee Acute Oral Toxicity - Clothianidin Metabolite - MNG					
Honey bee (Apis mellifera) 48 hour	99.2	>153	not applicable	45422428 Wilkins, 2000	Supplemental
Honey bee Acute Oral Toxicity - Clothianidin Metabolite - TZMU					
Honey bee (Apis mellifera) 48 hour	98.8	>113	not applicable	45422429 Wilkins, 2000	Supplemental
Honey bee Acute Oral Toxicity - Clothianidin Metabolite - TZNG					
Honey bee (Apis mellifera) 48 hour	98.6	3.95	not applicable	45422430 Wilkins, 2000	Supplemental

Insects, Mortality, Reproduction, and Feeding Capacity

Two studies were submitted to show acute effects of corn (MRID 45422520) and summer rape (MRID 45422521) seeds treated with TI 435 FS600 (formulated product) on carabid beetles (*Poecilus cupreus*) under extended laboratory test conditions. The goal of these studies was to evaluate whether or not exposing carabid beetles to clothianidin treated corn or rape seeds increased mortality or decreased feeding rate compared to the controls. About one third of the adult carabid beetles exposed to the treated corn seeds at a seed treatment rate of 0.45 lb ai/A showed abnormalities (undescribed signs of intoxication). Rape seed treated with clothianidin at an application rate of 0.095 lb ai/A caused behavioral impacts (intoxication) to 63 % of adult carabid beetles in the treatment group. The feeding rate of beetles in the treatment group was significantly reduced. There was also a significant difference in mortality (13.3 %) of the treatment group compared to the control. These studies were scientifically sound and classified as Supplemental.

Three studies (MRID Nos. 45422524, 45422522, & 45422523) were submitted to show effects of clothianidin on the life cycle of rove beetles (*Aleochara bilineata*) under extended laboratory conditions. The first study (MRID No. 45422524) was designed to evaluate the effects clothianidin would have on the beneficial ground beetles exposed to the pesticide in treated soil. Study endpoints were adult mortality and reproduction (total number of progeny produced). In this study, there were no significant differences observed between the control and clothianidin treatment groups for adult mortality. Reproductive performance (as indicated by decreased number of progeny) was affected in the two highest clothianidin treatment groups (200 and 250 $\mu\text{g a.i./kg}$ soil). The goal of final two (2) rove beetle studies was to evaluate whether or not exposure of rove beetles to corn seeds (MRID No. 45422522) treated at a rate of 0.55 lb ai/A and to rape seeds (MRID No. 45422523) treated at a rate of 0.095 lb ai/A (10 g a.i./kg TI 435 FS 600) would result in significantly increased mortality of parent beetles and whether or not the offspring production rate would be adversely affected. The beetles exposed to the treated corn seed experienced a significant increase in mortality (55%) but no significant reproductive difference when compared to the controls. The reproductive performance of the rove beetles was determined by counting the number of rove beetles which emerged from the host pupae between days 39 and 77 after treatment. Rove beetles exposed to the treated rape seed experienced an increase in mortality and a reduced parasitization capacity. The number of offspring that emerged (reproductive performance) in the rape seed treated test groups was not significantly lower than the control group. These studies were scientifically sound and classified as Supplemental.

Insects, Residual Contact

A honey bee toxicity of residues on foliage 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 LD_{50} which falls in the moderately toxic or highly toxic range. 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. Clothianidin, as indicated in the acute toxicity test (MRID 45422426), is highly toxic to honey bees on a contact basis. Pesticides toxic to honey bees require bee precautionary labeling on all end-use formulations and registrants are required to submit data in accordance with Guideline 141-2 - Honey Bee Toxicity of Residues on Foliage. A scientifically-sound study was performed.

Alfalfa foliage was sprayed with Clothianidin, as V-10066, at application rates of 30, 60, and 90 g a.i./acre. Honey bees, three replicates/rate, were exposed in the lab to the weathered foliage at varying times until the mortality of bees exposed to residues was lower than 25%. Sublethal observations were also made. The RT_{25} for V-10066 at 30, 60, and 90 g a.i./acre were 111.68, 179.51, and 512.39 hours, respectively. EFED expects clothianidin's residue on treated foliage to remain toxic to bees for days after clothianidin is applied. Results indicate that clothianidin, as V-10066, should not be applied to blooming pollen-shedding or nectar-producing parts of plants.

Non-target Insects - Toxicity of Residues on Foliage

Species	g a.i./acre	RT ₂₅ (hours) ¹	MRID No. Author/Year	Study Classification
Honey Bee (Apis mellifera)	30 (0.07 lb ai/A)	111.68 (4.7 days)	45490702 Mayer, 2000	Supplemental
Honey Bee (Apis mellifera)	60 (0.13 lb ai/A)	179.51 (7.5 days)	45490702 Mayer, 2000	Supplemental
Honey Bee (Apis mellifera)	90 (0.21 lb ai/A)	512.39 (21.3 days)	45490702 Mayer, 2000	Supplemental

¹ RT₂₅ is the residual time required to reduce the activity of the test material and bring bee mortality down to 25% in cage test exposures to field-weathered spray deposits (Mayer and Johansen, 1990). The time period determined by this toxicity value is considered to be time that the test material is expected to remain toxic to bees in the field from the residual exposure of the test material on vegetation at an expressed rate of application (lb ai/A).

Insects, Field Testing for Pollinators

Six honey bee field studies were undertaken in various locations (Sweden, United Kingdom, France, Canada, United States, and Germany) to determine the residue levels of clothianidin in various parts of summer rape plants grown from seeds treated at various application rates (8.62 lb ai/1000 lb seed or 0.038 lb ai/acre; 10.4 lb ai/1000 lb seed or 0.046 lb ai/acre; 6 lb ai/1000 lb seed or 0.04 lb ai/acre; and 1 lb ai/100 lb seed or 0.025 lb ai/acre). Residue levels in the honey bees that foraged on the plants grown from the treated seeds were also determined. These studies were considered scientifically sound; however, they do not fulfill the requirements for a pollinator field test (OPPs Guideline 141-5) because the protocol was not approved by EPA. They are classified as Supplemental. An approved protocol would have required that the studies be conducted in the United States, longer duration of honey bee activity observations, and the use of replications in the treatments and controls for statistical analyses. Field exposure to the test substance and the bee observation period were too brief (< 30 days) to fully evaluate the impact the exposure levels of clothianidin would have had on the bee colonies tested. The complete life cycle for an individual worker bee during the time period tested would be approximately 63 days.

These field studies evaluated the effects to small honey bee colonies hived on clothianidin rape seed treated and untreated (control) plots. Colonies were placed on the treated and untreated plots during the rape bloom stage approximately two months after the rape crops were planted. Bees were monitored for short periods of time to determine if they were being adversely affected by the clothianidin exposure as a result of the systemic activity demonstrated by clothianidin. Residues of clothianidin in the nectar from rape flowers ranged from 1.0 to 7.2 µg ai/kg. Nectar sampled from beehives ranged from 0.9 to 3.7 µg ai/kg and nectar sampled from forage bees honey stomachs contained 8.6 µg ai/kg clothianidin. Residues of clothianidin were also found in forage bees (1.4 µg ai/kg), rape flowers (3.3 - 4.1 µg ai/kg), pollen taken from foraging bees (1.7 - 2.5 µg ai/kg), and pollen from beehives (1.6 - 3.0 µg ai/kg). These residues were a result of the clothianidin seed treatments performed approximately 60 days prior to sampling the commodities. Two (2) studies (MRID 45422436 & 45422437) also tested for the clothianidin metabolites, TZMU and TZNG, but residues of these metabolites were not found in the nectar and pollen samples analyzed. With the exception of one study (MRID 45422435), none of the studies reported mortality or adverse effects to the foraging activity of the bees. However, the residue levels in the nectar taken from the bees, 8.6 µg ai/kg, exceeds the honey bee acute oral LD₅₀ of 3.7 µg ai/kg (MRID 45422426). One honey bee field study (MRID # 45422435) showed that mortality, pollen foraging activity, and

honey yield were negatively affected by residues of clothianidin; however, residues were not quantified in this study.

Non-target Insect Field Studies

MRID #	Study Classification	Study Location & Plant Date of Treated Seed	Chemical Application Rate	Sample Date(s)	Commodity Sampled	Clothianidin Residues Found (µg ai/kg)
45422431	Supplemental	Borlunda-Skelinge, Sweden 4/28/98	<u>Clothianidin</u> 8.6 g a.i./kg seed or 8.62 lb ai/1000 lb seed or 0.038 lb ai/acre	1 st week of July '98	forage bees	1.4
				1 st week of July '98	nectar in bees	8.6
				7/3/98 and 7/2/98	nectar from rape flowers	1.2 and 7.2
				1 st week of July '98	rape flowers	4.1
45422432	Supplemental	Elm Farm., United Kingdom 3/28/98	<u>Clothianidin</u> 10.4 lb ai/1000 lb seed or 0.046 lb ai/acre	6/22-6/24/98	rape flowers	3.3
				6/22-6/24/98	forage bees	none detected
45422433	Supplemental	Conches in Northern France 3/19/98	<u>Clothianidin</u> 10.4 lb ai/1000 lb seed or 0.046 lb ai/acre	6/15-6/18/98	pollen taken from forage bees	1.7
45422435	Supplemental	Ontario, Canada 5/3/00	<u>Clothianidin</u> 6 lb ai/1,000 lb seed or 0.04 lb ai /A	6/26-7/20/00	pollen from bee hives	3.0 (61 days after application)
					"	1.6 (68 days after application)
					nectar from bee hives	3.7 (61 days after application)
		Minnesota, US 5/16/00		6/28-7/28/00	pollen from bee hives	0.9 * (68 days after application)
						2.3 (50 days after application)

Non-target Insect Field Studies

MRID #	Study Classification	Study Location & Plant Date of Treated Seed	Chemical Application Rate	Sample Date(s)	Commodity Sampled	Clothianidin Residues Found ($\mu\text{g ai/kg}$)
						2.8 (57 days after application)
					nectar from bee hives	1.1 (50 days after application)
						1.0 (57 days after application)
45422436	Supplemental	Monheim, Germany 5/2/00	<u>Clothianidin</u> 1056 g a.i./100 kg seed or 1 lb ai/100 lb seed or 0.025 lb ai/A	7/6/00 and 7/7/00	nectar from rape flowers	2.8 and 3.0
45422437	Supplemental	Burscheid, Germany 4/28/00	<u>Clothianidin</u> 1056 g a.i./100 kg seed or 1 lb ai/100 lb seed or 0.025 lb ai/A	6/30/00 and 7/6/00	nectar from rape flowers	5.4 and 1.0
				combs sampled 7/12/00; forage bees sampled on 7/2 and 7/18/00	pollen from combs/forage bees	1.9 to 2.5

* <Level of Quantification (LOQ) = 1.0 $\mu\text{g/kg}$ and Level of Detection (LOD) = 0.3 $\mu\text{g/kg}$

A seventh honey bee field study (MRID No. 45422440), reviewed under guideline 141-5, evaluated the effects of clothianidin treated pollen on the development of small honey bee colonies and on the behavior and mortality of honey bees. Three treatment levels and two controls were tested. One small beehive (about 500 bees) per treatment and control was tented on oat plots in cages and fed treated maize pollen. Pollen treated with clothianidin at a measured concentration level up to 19.7 $\mu\text{g ai/kg}$ produced no significant adverse effects to the parameters measured in this study based upon the visual inspection of the data. The parameters measured included mortality, foraging activity (including honey and pollen collection), comb production, honey storage behavior, population growth (including egg, larvae, pupae, and adult growth stages) and behavioral anomalies. Since there was only one replicate hive per treatment level, a statistical

analysis could not be made of the data provided. MRID No. 45422440 was determined to be scientifically sound and classified as Supplemental.

Spider, Mortality and Feeding Capacity

Two extended laboratory studies (MRID Nos. 45422518 & 45422519) evaluated the effects of clothianidin treated seed on the wolf spider, *Pardosa* spp. (Araneae, Lycosidae). The goal of these studies was to evaluate whether or not exposing wolf spiders to treated corn and rape seeds increased mortality or decreased feeding rate compared to the controls. The seed treatment rate for the corn seeds was 48.8 g a.i./Unit (1 Unit = 50,000 seed) with 2 corn seeds per 1170 cm² test box equivalent to 0.15 lb ai/A. The seed treatment rate for the rape seeds was 10 g a.i./kg TI 435 FS 600 with 4 rape seeds per 178 cm² test box equivalent to 0.06 lb ai/A. The studies' results indicated that the wolf spider mortality and feeding capacity in the clothianidin treatments were not significantly different from the controls. These studies were scientifically sound and classified as Supplemental.

Earthworm, Acute and Chronic

Five acute/chronic earthworm studies were reviewed for clothianidin and its metabolite/transformation products. These studies were conducted in compliance with the Organization for Economic Cooperation and Development (OECD) guidelines for testing of chemicals and were reviewed, by EFED, under EPA Ecological Effects Test Guidelines (U.S. EPA Ecological Effects Test Guidelines, April, 1996). EFED does not have a toxicity categorization for earthworms. The clothianidin earthworm LC₅₀ (conc. in soil) was determined to be 15.5 mg/kg (MRID No. 45422511) with the metabolite, MNG, and transformation product, TZNG, being less toxic to earthworms than the parent compound. EPA does not presently require reproductive or population toxicity testing with earthworms for pesticide registration; however, two studies indicate that clothianidin exhibits no apparent effect to earthworm reproduction at application rates equal to or greater than 0.054 lb ai/A (MRID 45422525) or population density/biomass at application rates equal to or greater than 0.08 lb ai/A (MRID 45422526).

Earthworm Acute and Chronic Toxicity

Species/Study Duration	% ai	LC50/ EC50 (mg/kg in dry soil or lb ai/A)	NOAEC/ LOAEC (mg/kg in dry soil or lb ai/A)	Endpoints	MRID# Author/Year	Study Classification
<i>Eisenia foetida</i> 14 days	96	15.5 mg/kg (nominal)	< 10.0 mg/kg (nominal)	mortality	45422511 Weyman, 1998	Acceptable
<i>Eisenia fetida</i> 56 days	48	> 0.054 lb ai/A ¹ (nominal)	≥ 0.054 lb ai/A ¹ (nominal)	no significant treatment-related effects on mortality, body weight, or # offspring/surviving adult	45422525 Meisner, 2000	Supplemental

Earthworm Acute and Chronic Toxicity

Species/Study Duration	% ai	LC50/EC50 (mg/kg in dry soil or lb ai/A)	NOAEC/LOAEC (mg/kg in dry soil or lb ai/A)	Endpoints	MRID# Author/Year	Study Classification
Lumbricus terrestris, L. rubellus, L. castaneus, Apporrectodea caliginosa, A. terrestris longa Allolobophora chlorotica 1 year	47.8	> 0.08 lb ai/A ² (measured)	≥ 0.08 lb ai/A ² (measured)	no significant treatment-related effect on number and biomass of earthworms	45422526 Heimbach, 2000	Supplemental

Clothianidin Metabolite - MNG

Eisenia fetida 14 days	99.2	> 1,000 mg/kg (nominal)	320 mg/kg (nominal)	reduction in body weights	45422512 Noack, 2000	Acceptable
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Clothianidin Transformation Product - TZNG

Eisenia fetida 14 days	99	982 mg/kg (nominal)	125 mg/kg (nominal) 63 mg/kg (nominal)	mortality reduction in body weight	45422513 Noack, 2000	Acceptable
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1 Equivalent to >500,000 clothianidin dressed corn seeds/ha

MRID No. 45422525 - Earthworm (continued)

$$\frac{2.7 \times 10^{-6} \text{ lb ai}}{\text{corn seed}} * \frac{500,000 \text{ seed}}{\text{HA}} = \frac{1.33 \text{ lb ai}}{\text{HA}} = \frac{0.054 \text{ lb ai}}{\text{Acre}}$$

2 Equivalent to > 91.4 g a.i./ha

MRID No. 45422526 - Earthworm

$$\frac{91.4 \text{ g ai}}{\text{ha}} = \frac{0.2015 \text{ lb ai}}{2.47 \text{ Acre}} = \frac{0.08 \text{ lb ai}}{\text{Acre}}$$

Toxicity to Aquatic Organisms

Freshwater Fish, Acute

Two freshwater fish toxicity studies using the TGAI are required to establish the acute toxicity of clothianidin to fish. The preferred test species are rainbow trout (a coldwater fish) and bluegill sunfish (a warmwater fish). The acute studies that were submitted that tested the parent compound showed that clothianidin is practically non-toxic to freshwater fish (LC₅₀ >105.8 -117 ppm). Studies on degradates (TMG, MNG, and TZNG) indicated a similar practically non-toxic profile (LC₅₀ >105 ppm). EFED will use the worst case value (LC₅₀ >105.8 ppm) for evaluating acute

toxic exposure to freshwater fish. The guideline (72-1) is fulfilled (MRID #45422407; MRID# 45422406).

Freshwater Fish Acute Toxicity

Species	% ai	96-hour LC50 (ppm) (nominal)	Toxicity Category	MRID No. Author/Year	Study Classification
Bluegill sunfish (<i>Lepomis macrochirus</i>)	97.6	>117	Practically non-toxic	45422407 Palmer et al., 2000	Core
Rainbow trout (<i>Oncorhynchus mykiss</i>)	96	>105.8	Practically non-toxic	45422406 Wilhelmy et al., 1998	Supplemental
Rainbow trout (<i>Oncorhynchus mykiss</i>)	95.1 TMG	>110	Practically non-toxic	45422408 Dorgerloh, 2000	Supplemental
Rainbow trout (<i>Oncorhynchus mykiss</i>)	99.0 MNG	>105	Practically non-toxic	45422409 Dorgerloh, 2000	Supplemental
Rainbow trout (<i>Oncorhynchus mykiss</i>)	99.0 TZNG	>116	Practically non-toxic	45422410 Dorgerloh, 2000	Supplemental

Freshwater Fish, Chronic

A freshwater fish early life-stage test using the TGAi is required for clothianidin because the end-use product may be transported to water from the intended use site, and the following conditions are met: (1) clothianidin is intended for use such that its presence in water is likely to be continuous or recurrent regardless of toxicity; (2) studies on aquatic invertebrates showed reproductive effects (daphnid 21-day LOAEC = 0.12 ppm) and (3) clothianidin is persistent in water (e.g., half-life of 744 days aerobic soil metabolism).

A chronic early life stage study conducted on the fathead minnow showed that exposure of 20 ppm has the potential to affect length and dry weight of freshwater fish. The NOAEC of 9.7 ppm will be used for risk assessment purposes. The guideline (72-4) is fulfilled (MRID #45422413).

Freshwater Fish Early Life-Stage Toxicity Under Flow-Through Conditions

Species	% ai	NOAEC/LOAEC (ppm)	Endpoints Affected	MRID No. Author/Year	Study Classification
Fathead Minnow (<i>Pimephales promelas</i>)	97.6	9.7/20	Length and dry weight	45422413 Drott et al., 2000	Supplemental

Freshwater Invertebrates, Acute

A freshwater aquatic invertebrate toxicity test using the TGAi is required to establish the toxicity of clothianidin to aquatic invertebrates. The preferred test species is *Daphnia magna*. The data that was submitted that tested the parent compound showed that clothianidin is practically non-toxic to *Daphnia magna* with an acute 48-hour EC_{50} value of >119 ppm, but that it is very highly toxic to *Chironomus riparius* with an acute 48-hour EC_{50} value of 0.022 ppm. EFED will use the worst case value (EC_{50} = 0.022 ppm) for evaluating acute toxic exposure to freshwater

invertebrates. Additional data (48-hour EC_{50}) on degradates (TZNG, MNG, and TMG) indicated a practically non-toxic to slightly toxic profile (EC_{50} = 64.0 to >115.2 ppm). The guideline requirements (72-2) for acute invertebrate toxicity are fulfilled (MRID #45422338; MRID #45422414).

Freshwater Invertebrate Acute Toxicity for Clothianidin

Species	% ai	48-hour EC_{50} (ppm)	Toxicity category	MRID No. Author/Year	Study Classification
Waterflea (Daphnia magna)	99	>119	Practically non-toxic	45422338 Palmer, 2000	Core
Midge (Chironomus riparius)	97.6	0.022*	Very highly toxic	45422414 Mattock, 2001	Supplemental
Waterflea (Daphnia magna)	99.0 TZNG	64	Slightly toxic	45422401 Hendel, 2000	Core
Waterflea (Daphnia magna)	99.0 MNG	>100.8	Practically non-toxic	45422340 Hendel, 2000	Core
Waterflea (Daphnia magna)	95.1 TMG	>115.2	Practically non-toxic	45422339 Hendel, 2000	Supplemental

* The EC_{50} value for exposure to Clothianidin TI-435 was the most sensitive; EC_{50} values for TZMU, MU, and TZNG were >102 ppm, >83.6 ppm, and 0.386 ppm, respectively.

Freshwater Invertebrate, Chronic

A freshwater aquatic invertebrate life-cycle test using the TGAI is required for clothianidin because the end-use product may be transported to water from the intended use site, and the following conditions are met: (1) the presence of clothianidin in water is likely to be continuous or recurrent and (2) aquatic acute LC_{50} or EC_{50} values are less than 1 ppm (i.e., 0.022 ppm), and (3) physicochemical properties indicate that clothianidin is persistent in the aquatic environment (e.g., half-life of 744 days aerobic soil metabolism).

The preferred test is a 21-day life cycle on *Daphnia magna*. The data that were submitted show that clothianidin has the potential for chronic toxicity to daphnids and possibly other freshwater invertebrates. Exposure to 0.12 ppm can result in reproductive effects, including the reduced number of juveniles produced per adult. The NOAEC of 0.042 ppm will be used in assessing risk. The guideline (72-4) is fulfilled (MRID #45422412).

Freshwater Aquatic Invertebrate Chronic Toxicity

Species/ Static Renewal	% ai	21-day NOAEC/LOAEC (ppm)	MATC ¹ (ppm)	Endpoints Affected	MRID No. Author/Year	Study Classification
Waterflea (Daphnia magna) Static Renewal	96	0.042/0.12	ND	Reproduction	45422412 Noack et al., 1998	Supplemental

Freshwater Field Studies

No data submitted.

Estuarine and Marine Fish, Acute

The preferred test species is sheepshead minnow. The data submitted showed that the $LC_{50} = 93.6$ ppm; therefore, clothianidin is categorized as slightly toxic to estuarine/marine fish on an acute basis. The guideline (72-3) is fulfilled (MRID #45422411).

Estuarine/Marine Fish Acute Toxicity

Species/Static	% ai	96-hour LC50 (ppm) (nominal)	Toxicity Category	MRID No. Author/Year	Study Classification
Sheepshead minnow (Cyprinodon variegatus)	97.6	>93.6	Slightly toxic	45422411 Scheerbaum, 1999	Supplemental

Estuarine and Marine Fish, Chronic

No data submitted.

Estuarine and Marine Invertebrates, Acute

Acute toxicity testing with estuarine/marine invertebrates using the TGAI is required for clothianidin because the end-use product is expected to reach this environment due to its potential use on crops with significant acreage in coastal counties. The preferred test species are mysid shrimp and eastern oyster. The data showed that clothianidin significantly reduced survival of mysid shrimp at 0.051 ppm, categorizing the compound as very highly toxic. Clothianidin was categorized as practically non-toxic to Eastern oyster because adverse effects did not occur for this species up to concentrations of 129.1 ppm. EFED will use the worst case value, $LC_{50} = 0.051$ ppm, for evaluating acute toxic exposure to estuarine/marine invertebrates. The data requirements (72-3b) are fulfilled (MRID # 45422404; MRID #45422403).

Estuarine/Marine Invertebrate Acute Toxicity

Species/Static or Flow-through	% ai	96-hour LC50 (ppm)	Toxicity Category	MRID No. Author/Year	Study Classification
Eastern oyster (Crassostrea virginica)	97.6	$EC_{50} > 129.1$	Practically non- toxic	45422404 Scheerbaum, 1999	Core
Mysid (Americamysis bahia)	97.6	$LC_{50} = 0.051$	Very highly toxic	45422403 Drott et al., 2000	Core

Estuarine and Marine Invertebrate, Chronic

An estuarine/marine invertebrate life-cycle toxicity test using the TGAI is required for clothianidin because the end-use product is expected to transport to an estuarine/marine environment from the intended use site, and the following conditions are met: (1) the pesticide is intended for use such that its presence in water is likely to be continuous or recurrent regardless of toxicity, (2) an aquatic acute LC_{50} or EC_{50} is less than 1 ppm (e.g., mysid $LC_{50} = 0.051$ ppm), and (3) studies of other organisms indicate that the reproductive physiology of fish and/or invertebrates may be affected, physicochemical properties indicate cumulative effects, or the pesticide is persistent in water (e.g.,

half-life of 744 days aerobic soil metabolism).

The preferred test species is mysid shrimp. The data submitted indicate that clothianidin reduced the number of young per reproductive day at 9.7 ppb. The NOAEC of 5.1 ppb will be used in assessing risk. The guidelines (72-4c) have been fulfilled (MRID #45422405).

Estuarine/Marine Invertebrate Life-Cycle Toxicity

Species	% ai	39-day NOAEC/LOAEC (ppb)	Endpoints Affected	MRID No. Author/Year	Study Classification
Mysid (<i>Mysidopsis bahia</i>)	97.6	5.1/9.7	Reproduction	45422405 Drott et al., 2000	Core

Estuarine and Marine Field Studies

No data submitted.

Aquatic Plants

Several aquatic plant toxicity studies using the TGAI are required to establish the toxicity of clothianidin to non-target aquatic plants. The recommendation is for testing on five species: freshwater green alga (*Selenastrum capricornutum*), duckweed (*Lemna gibba*), marine diatom (*Skeletonema costatum*), blue-green algae (*Anabaena flos-aquae*), and a freshwater diatom. Studies submitted for two of the five recommended species showed that exposure to clothianidin at levels greater than or equal to 3.5 ppm reduced biomass of aquatic non-vascular plants and increased the incidence of necrotic fronds in aquatic vascular plants. Studies on degradates (TMG, MNG and TZNG) showed reductions in green algal cell density when exposed to levels >1.46 ppm. The EC₅₀ of 64 ppm will be used for evaluating acute toxic exposure to non-target aquatic plants. The guideline requirements (122-2 and 123-2) are fulfilled (MRID #45422503; MRID #45422504) for two of the five required species. EFED needs 3 more Core clothianidin studies for the nonvascular surrogate species, marine diatom (*Skeletonema costatum*), blue-green algae (*Anabaena flosaquae*), and a freshwater diatom.

Table B-16: Non-target Aquatic Plant Toxicity

Species [Study Type]	% a.i.	EC ₅₀ /NOAEC (ppm)	Endpoints Affected	MRID No. Author, Year	Study Classification
Duckweed (<i>Lemna gibba</i>) [Tier 2]	97.6	>121/59	Necrotic fronds	45422503 Palmer et al., 2000	Core
Green Algae (<i>Selenastrum capricornutum</i>) [Tier 2]	97.6	64/3.5	Biomass	45422504 Sutherland et al., 2000	Core
Green Algae (<i>Selenastrum capricornutum</i>) [Tier 2]	95.1 TMG	10/1.46	Cell density	45422505 Dorgerloh, 2000	Core

Green Algae (Selenastrum capricornutum) [Tier I]	99.0 MNG	>100.6/100.6	None	45422506 Dorgerloh, 2000	Core
Green Algae (Selenastrum capricornutum) [Tier I]	99.0 TZNG	>103/<103	Cell density	45422507 Dorgerloh, 2000	Core

Terrestrial Plants

Terrestrial Tier II studies are required for all low dose pesticides (those with the maximum use rate of 0.5 lbs a.i./A or less) and for any pesticide showing a negative response equal to or greater than 25% in Tier I studies. Two Tier I terrestrial plant toxicity studies were conducted to establish the toxicity of clothianidin to non-target terrestrial plants. The recommendations for seedling emergence and vegetative vigor studies are for testing of (1) six species of at least four dicotyledonous families, one species of which is soybean (*Glycine max*) and the second of which is a root crop, and (2) four species of at least two monocotyledonous families, one of which is corn (*Zea mays*). The studies that were submitted tested formulated products of clothianidin (49.3% TI-435 50% WDG). The results of these studies showed that exposure elicited no effect (that is, $\geq 25\%$) on non-target terrestrial plants, so Tier II tests were not necessary. The guidelines (122-1a and 122-1b) are fulfilled (MRID #45422501; MRID #45422502).

Non-target Terrestrial Plant Toxicity

Species [Study Type]	% a.i.	Application Rate (lb ai/A)	Endpoints Affected	MRID No. Author, Year	Study Classification
<u>Dicots</u> : Soybean (<i>Glycine max</i>), Pinto bean (<i>Phaseolus vulgaris</i>), Radish (<i>Raphanus sativus</i>), Cabbage (<i>Brassica oleracea</i>), Lettuce (<i>Lactuca sativa</i>), Tomato (<i>Lycopersicon esculentum</i>) <u>Monocots</u> : Corn (<i>Zea mays</i>), Wheat (<i>Triticum aestivum</i>), Ryegrass (<i>Lolium perenne</i>), Onion (<i>Allium cepa</i>) [Tier I Seedling Emergence]	49.3 TI-435 50% WDG	0.2	No significant effect on seedling emergence	45422501 Brignole et al., 2000	Core
<u>Dicots</u> : Soybean (<i>Glycine max</i>), Pinto bean (<i>Phaseolus vulgaris</i>), Radish (<i>Raphanus sativus</i>), Cabbage (<i>Brassica oleracea</i>), Lettuce (<i>Lactuca sativa</i>), Tomato (<i>Lycopersicon esculentum</i>) <u>Monocots</u> : Corn (<i>Zea mays</i>), Wheat (<i>Triticum aestivum</i>), Ryegrass (<i>Lolium perenne</i>), Onion (<i>Allium cepa</i>) [Tier I Vegetative Vigor]	49.3	0.2	No significant reduction in height or shoot weight	45422502 Brignole et al., 2000	Core

Appendix III. Bibliography

The following studies have been submitted to the Agency and provide either core or some supplemental information about clothianidin.

MRID 45490703 Cassidy, P.S. 2001. TI-435 - Terrestrial field dissipation study, California 1998. Unpublished study performed by Plant Sciences, Inc., Watsonville, CA and Ricerca, LLC, Concord, OH; sponsored and submitted by Tomen Agro, Inc., San Francisco, CA. Plant Sciences Project No. 98.322, Ricerca Project No. 7572-98-0092; Tomen Report No. TMN-0153 and Ricerca Report No.: 7572-98-0092-CR-001. Experiment initiation July 8, 1998 (p. 13) and completion March 16, 2001 (field phase; p. 32). Final report issued July 19, 2001.

MRID 45490704 Cassidy, P.S. 2001. TI-435 - Terrestrial field dissipation study, Washington 1998. Unpublished study performed by Qualls Agricultural Laboratory, Ephrata, WA and Ricerca, LLC, Concord, OH; sponsored and submitted by Tomen Agro, Inc., San Francisco, CA. Qualls Project No. 98-54, and Ricerca Project No. 7570-98-0093; Tomen Report No. TMN-0155, and Ricerca Report No.: 7570-98-0093-CR-001. Experiment initiation July 7, 1998 and completion March 7, 2001 (field phase; p. 30). Final report issued July 19, 2001.

MRID 45490705 Cassidy, P.S. 2001. TI-435 - Terrestrial field dissipation study, Georgia 1998. Unpublished study performed by Research Options, Inc., Montezuma, GA, Ricerca, LLC, Concord, OH, and A&L Great Lakes Laboratory, Inc., Fort Wayne, IN; sponsored and submitted by Tomen Agro, Inc., San Francisco, CA. Research Options Project No. 98-051, Ricerca Project No. 7574-98-0091-CR, A&L Great Lakes Laboratories, Inc. Project No.: F98845-001, Tomen Report No. TMN-0154 and Ricerca Report No. 7574-98-0091-CR-001. Experiment initiation July 22, 1998 and completion January 15, 2001 (field phase; p. 31). Final report issued July 19, 2001.

MRID 45490701 Hewitt, A.J. Orchard airblast atomization droplet size spectra for V-10066/TI-435 50 WDG. Unpublished study performed by Stewart Agricultural Research Services, Inc., Macon, MO; sponsored by Valent USA Corp., Walnut Creek CA (p. 26); and submitted by Tomen Agro, Inc., San Francisco, CA; Laboratory project no.: V00-22832. Final report issued August 29, 2001.

Mayer, D. and C. Johansen. Pollinator Protection: A Bee & Pesticide Handbook. Wicwas Press. Cheshire, CT (1990).

Nelson, A.N. 1975. Appraisal of the Safety of Chemicals: Approximate Relation of Parts Per Million in Diet to Mg/Kg/Day. Quarterly Report to the Editor on Topics of Current Interest. Association of Food and Drug Officials of the United States.

Appendix IV. Structures of Clothianidin and Degradation Products

Clothianidin (TI 435)

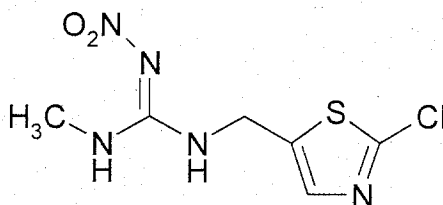
IUPAC name: (E)-1-(2-Chloro-1,3-thiazol-5-ylmethyl)-3-methyl-2-nitroguanidine.

CAS name: [C(E)]-N-[(2-Chloro-5-thiazolyl)methyl]-N'-methyl-N''-nitroguanidine.

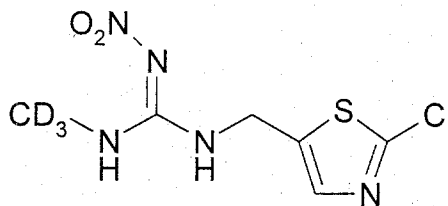
CAS No: 210880-92-5 (formerly 205510-53-8)

SMILES string: CNC(=NN(=O)=O)NCc1enc(s1)Cl

Unlabeled



clothianidin-d₃



D = deuterium, ²H.

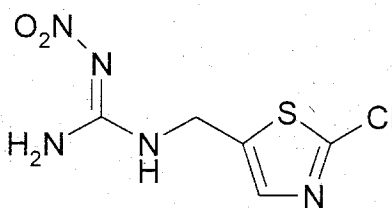
TZNG (thiazolyl-nitroguanidine)

IUPAC name: Not reported.

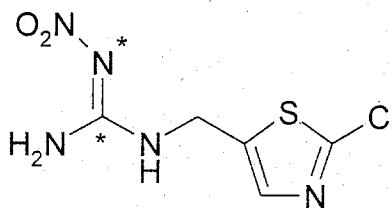
CAS name: N-(2-Chlorothiazol-5-ylmethyl)-N'-nitroguanidine.

CAS No: Not reported.

Unlabeled



[¹³C, ¹⁵N]TZNG



* Position of the radiolabel.

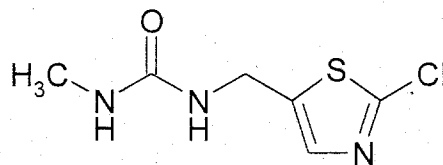
TZMU (thiazolyl-methylurea)

IUPAC name: Not reported.

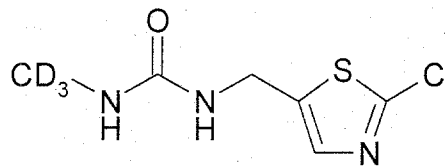
CAS name: N-(2-Chlorothiazol-5-ylmethyl)-N'-methylurea.

CAS No: Not reported.

Unlabeled



TZMU-d₃



D = deuterium, ²H.

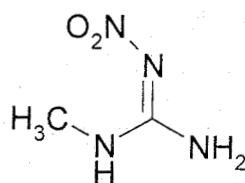
MNG (methyl-nitroguanidine)

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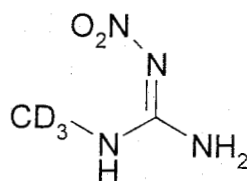
CAS name: N-Methyl-N'-nitroguanidine.

CAS No: Not reported.

Unlabeled



MNG-d₃



D = deuterium, ²H.

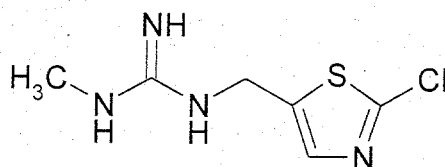
TMG (thiazolyl-methylguanidine)

IUPAC name: Not reported.

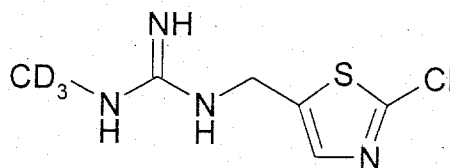
CAS name: N-(2-Chlorothiazol-5-ylmethyl)-N'-methylguanidine.

CAS No: Not reported.

Unlabeled



TMG-d₃



D = deuterium, ²H.

Appendix V. Results of FATE Model

As part of the Tier I screening risk assessment, EPA uses models to estimate exposure of nontarget plants and animals to clothianidin. For terrestrial birds and mammals, estimates of initial levels of clothianidin residues on various food items consumed by wildlife using the Fletcher nomogram followed by a first order decline model such as FATE. The following table shows predicted residues immediately after a single turfgrass application (proposed label) on terrestrial food items following a single application of clothianidin calculated from Hoerger and Kenaga (1972) as modified by Fletcher et al. (1994).

Table VIa. Estimated Environmental Concentrations on Avian and Mammalian Food Items (ppm) Following a Single Application of Clothianidin at 0.4 lb ai/A.

Food Items	EEC (ppm)	EEC (ppm)
	Predicted Maximum Residue	Predicted Mean Residue
Short Grass	96	58
Tall Grass	44	27
Forage and small insects	54	32
Fruits, pods, seeds and large insects	6	3

EECs determined by FATE5 model

Predicted residual concentrations (EECs) of clothianidin were compared to toxicity values for northern bobwhite quail and mouse to estimate acute and chronic risk quotients. The quail and mouse were chosen as representative terrestrial bird and mammal.

Chemical Name:
Use
Formulation

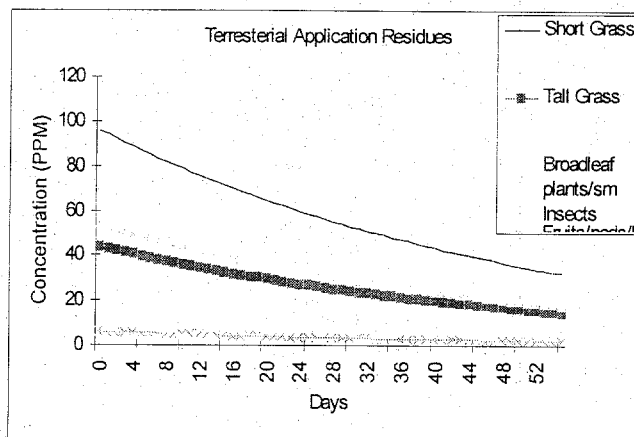
clothianidin
turf
WDG

Inputs

Application Rate 0.4 lbs a.i./acre
Half-life 35 days
Frequency of Application days
Maximum # Apps./Year 1

Outputs

	Maximum Concentration (PPM)	56 day Average Concentration (PPM)	
Short Grass	96.00	58.58	
Tall Grass	44.00	26.85	# days
Broadleaf plants/sm Insects	54.00	32.95	Exceeded
Fruits/pods/1g insects	6.00	3.66	on short grass
			(in first 56)



Avian

Acute LC50 (ppm) 5040 0
Chronic NOAEC (ppm) 205 0

Max Single Application
which does NOT exceed

Avian Acute 21.000
Avian Chronic 0.854 (lb a.i.)

Short Grass

Acute RQ 0.02 Chronic RQ 0.47
(Max. res. mult. apps.)

Tall Grass

Acute RQ 0.01 Chronic RQ 0.21 # days

Broadleaf plants/sm Insects

Acute RQ 0.01 Chronic RQ 0.26 Exceeded
Fruits/pods/1g insects 0.00 0.03 on short grass
(in first 56)

Mammalian

Acute 10.81

Mammalian

Chronic

0.63

Mammalian

Acute LD50 (mg/kg bw) 389 0
Chronic NOAEL (mg/kg) 150 0
Mouse Calculated LC50 (ppm) 2723

15 g mammal

35 g mammal

1000 g mammal

Acute RQ
(mult. apps)

Acute RQ
(mult. apps)

Acute RQ
(mult. apps)

Rat Acute
Dietary
RQ

Rat Chronic
Dietary
RQ

Short Grass	0.23	0.16	0.04
Tall Grass	0.11	0.07	0.02
Broadleaf plants/sm Insects	0.13	0.09	0.02
Fruits/pods/1g insects	0.01	0.01	0.00
Seeds (granivore)	0.00	0.00	0.00

0.04	0.64
0.02	0.29
0.02	0.36
0.00	0.04
0.00	

Figure Appendix V-1: Clothianidin's Use on Turf
ELL-Fate Version 1.4

Chemical Name:
Use
Formulation

clothianidin
apple
WDG

Inputs

Application Rate 0.2 lbs a.i./acre
Half-life 35 days
Frequency of Application 1 days
Maximum # Apps/Year 1

Outputs

	Maximum Concentration (PPM)	56 day Average Concentration (PPM)	
Short Grass	48.00	29.29	
Tall Grass	22.00	13.43	# days
Broadleaf plants/sm Insects	27.00	16.48	Exceeded on short grass
Fruits/pods/lg Insects	3.00	1.83	(in first 56)

Avian

Acute LC50 (ppm)	5040	0
Chronic NOAEC (ppm)	205	0

Acute RQ Chronic RQ
(Max. res. mult. apps.)

Short Grass	0.01	0.23	
Tall Grass	0.00	0.11	# days
Broadleaf plants/sm Insects	0.01	0.13	Exceeded on short grass
Fruits/pods/lg Insects	0.00	0.01	(in first 56)

Mammalian

Acute LD50 (mg/kg bw)	389	0	Mouse Calculated LC50 (ppm)	2723
Chronic NOAEL (mg/kg)	150	0		

15 g mammal

35 g mammal

1000 g mammal

Acute RQ
(mult. apps)

Acute RQ
(mult. apps)

Acute RQ
(mult. apps)

Short Grass	0.12	0.08	0.02
Tall Grass	0.05	0.04	0.01
Broadleaf plants/sm insects	0.07	0.05	0.01
Fruits/pods/lg insects	0.01	0.01	0.00
Seeds (granivore)	0.00	0.00	0.00

Rat Acute
Dietary
RQ

Rat Chronic
Dietary
RQ

0.02	0.32
0.01	0.15
0.01	0.18
0.00	0.02
0.00	

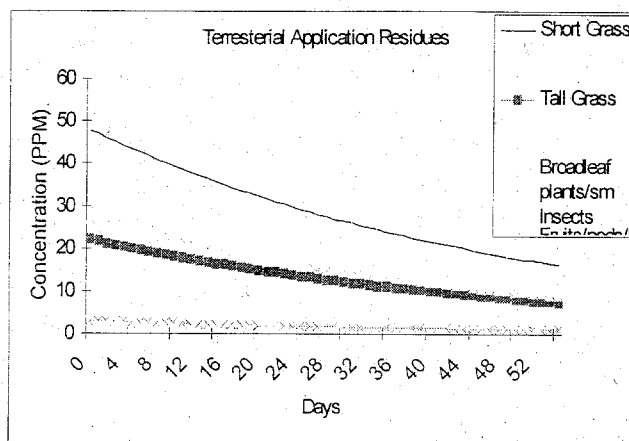


Figure Appendix V-2: Clothianidin's Use on Apples
ELL-Fate Version 1.4

Appendix VI: List of Listed Endangered/Threatened Species

Species Detail by State for Preliminary Assessment

Apples (5), Pears (144), Tobacco (200)

Minimum of 50 Acres.

* Species indicated are likely NOT at risk due to size, habitat, eating habits or other mitigating factors.

Alabama

(16 affected species)

BAT, GRAY	Endangered	Mammal	Critical Habitat
BAT, INDIANA	Endangered	Mammal	Critical Habitat
CAMPELOMA, SLENDER	Endangered	Snail	Critical Habitat
CLUSHELL, OVATE	Endangered	Clam	Critical Habitat
KIDNEYSHELL, TRIANGULAR	Endangered	Clam	Critical Habitat
PEARLYMUSSEL, ALABAMA LAMP	Endangered	Clam	Critical Habitat
PEARLYMUSSEL, CUMBERLAND MONKEYFACE	Endangered	Clam	Critical Habitat
PEARLYMUSSEL, PALE LILLIPUT	Endangered	Clam	Critical Habitat
PEARLYMUSSEL, PINK MUCKET	Endangered	Clam	Critical Habitat
PIGTOE, FINE-RAYED	Endangered	Clam	Critical Habitat
PIGTOE, ROUGH	Endangered	Clam	Critical Habitat
PIGTOE, SHINY	Endangered	Clam	Critical Habitat
POCKETBOOK, FINE-LINED	Threatened	Clam	Critical Habitat
RIVERSNAIL, ANTHONY'S	Endangered	Snail	Critical Habitat
ROCKSNAIL, PLICATE	Endangered	Snail	Critical Habitat
SNAIL, ARMORED	Endangered	Snail	Critical Habitat

Arizona

(6 affected species)

BAT, LESSER (=SANBORN'S) LONG-NOSED	Endangered	Mammal	Critical Habitat
*JAGUAR	Endangered	Mammal	Critical Habitat
*Jaguarundi, Sinaloa	Endangered	Mammal	Critical Habitat
*OCELOT	Endangered	Mammal	Critical Habitat
SQUIRREL, MOUNT GRAHAM RED	Endangered	Mammal	Critical Habitat
*WOLF, GRAY	Threatened	Mammal	Critical Habitat

Species Detail by State for Preliminary Assessment

Apples (5), Pears (144), Tobacco (200)

Minimum of 50 Acres.

Arkansas

(5 affected species)

BAT, GRAY	Endangered	Mammal	Critical Habitat
BAT, OZARK BIG-EARED	Endangered	Mammal	Critical Habitat
CRAYFISH, CAVE (CAMBARUS ACULABRUM)	Endangered	Crustacean	Critical Habitat
MUSSEL, SCALESHELL	Endangered	Clam	Critical Habitat
POCKETBOOK, FAT	Endangered	Clam	Critical Habitat

California

(47 affected species)

BEETLE, DELTA GREEN GROUND	Threatened	Insect	Critical Habitat
BEETLE, MOUNT HERMON JUNE	Endangered	Insect	Critical Habitat
BEETLE, OHLONE TIGER	Endangered	Insect	Critical Habitat
BEETLE, VALLEY ELDERBERRY LONGHORN	Threatened	Insect	Critical Habitat
BUTTERFLY, BAY CHECKERSPOT	Threatened	Insect	Critical Habitat
BUTTERFLY, BEHREN'S SILVERSPOT	Endangered	Insect	Critical Habitat
BUTTERFLY, EL SEGUNDO BLUE	Endangered	Insect	Critical Habitat
BUTTERFLY, LANGE'S METALMARK	Endangered	Insect	Critical Habitat
BUTTERFLY, LOTIS BLUE	Endangered	Insect	Critical Habitat
BUTTERFLY, MYRTLE'S SILVERSPOT	Endangered	Insect	Critical Habitat
BUTTERFLY, PALOS VERDES BLUE	Endangered	Insect	Critical Habitat
BUTTERFLY, QUINO CHECKERSPOT	Endangered	Insect	Critical Habitat
BUTTERFLY, SMITH'S BLUE	Endangered	Insect	Critical Habitat
CRAYFISH, SHASTA	Endangered	Crustacean	Critical Habitat
FLY, DELHI SANDS FLOWER-LOVING	Endangered	Insect	Critical Habitat
*FOX, SAN JOAQUIN KIT	Endangered	Mammal	Critical Habitat
*FOX, SAN MIGUEL ISLAND	Endangered	Mammal	Critical Habitat
*FOX, SANTA CATALINA ISLAND	Endangered	Mammal	Critical Habitat

Species Detail by State for Preliminary Assessment

Apples (5), Pears (144), Tobacco (200)

Minimum of 50 Acres.

*FOX, SANTA CRUZ ISLAND	Endangered	Mammal	Critical Habitat
*FOX, SANTA ROSA ISLAND	Endangered	Mammal	Critical Habitat
GRASSHOPPER, ZAYANTE BAND-WINGED	Endangered	Insect	Critical Habitat
KANGAROO RAT, FRESNO	Endangered	Mammal	Critical Habitat
KANGAROO RAT, GIANT	Endangered	Mammal	Critical Habitat
KANGAROO RAT, MORRO BAY	Endangered	Mammal	Critical Habitat
KANGAROO RAT, SAN BERNARDINO	Endangered	Mammal	Critical Habitat
KANGAROO RAT, STEPHENS'	Threatened	Mammal	Critical Habitat
KANGAROO RAT, TIPTON	Endangered	Mammal	Critical Habitat
MOTH, KERN PRIMROSE SPHINX	Threatened	Insect	Critical Habitat
*MOUNTAIN BEAVER, POINT ARENA	Endangered	Mammal	Critical Habitat
MOUSE, PACIFIC POCKET	Endangered	Mammal	Critical Habitat
MOUSE, SALT MARSH HARVEST	Endangered	Mammal	Critical Habitat
*OTTER, SOUTHERN SEA	Threatened	Mammal	Critical Habitat
RABBIT, RIPARIAN BRUSH	Endangered	Mammal	Critical Habitat
*SEAL, GUADALUPE FUR	Threatened	Mammal	Critical Habitat
*SHEEP, PENINSULAR BIGHORN	Threatened	Mammal	Critical Habitat
SHREW, BUENA VISTA	Endangered	Mammal	Critical Habitat
SHRIMP, CALIFORNIA FRESHWATER	Endangered	Crustacean	Critical Habitat
SHRIMP, CONSERVANCY FAIRY	Endangered	Crustacean	Critical Habitat
SHRIMP, LONGHORN FAIRY	Endangered	Crustacean	Critical Habitat
SHRIMP, RIVERSIDE FAIRY	Endangered	Crustacean	Critical Habitat
SHRIMP, SAN DIEGO FAIRY	Endangered	Crustacean	Critical Habitat
SHRIMP, VERNAL POOL FAIRY	Threatened	Crustacean	Critical Habitat
SHRIMP, VERNAL POOL TADPOLE	Endangered	Crustacean	Critical Habitat
SKIPPER, LAGUNA MOUNTAIN	Endangered	Insect	Critical Habitat

Species Detail by State for Preliminary Assessment

Apples (5), Pears (144), Tobacco (200)

Minimum of 50 Acres.

SNAIL, MORRO SHOULDERBAND	Endangered	Snail	Critical Habitat
VOLE, AMARGOSA	Endangered	Mammal	Critical Habitat
WOODRAT, RIPARIAN	Endangered	Mammal	Critical Habitat

Colorado

(1 affected species)

*FERRET, BLACK-FOOTED	Endangered	Mammal	Critical Habitat
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Connecticut

(4 affected species)

BAT, INDIANA	Endangered	Mammal	Critical Habitat
BEETLE, PURITAN TIGER	Threatened	Insect	Critical Habitat
MUSSEL, DWARF WEDGE	Endangered	Clam	Critical Habitat
*WHALE, NORTHERN RIGHT	Endangered	Mammal	Critical Habitat

Florida

(4 affected species)

*MANATEE, WEST INDIAN (FLORIDA)	Endangered	Mammal	Critical Habitat
SHRIMP, SQUIRREL CHIMNEY CAVE	Threatened	Crustacean	Critical Habitat
VOLE, FLORIDA SALT MARSH	Endangered	Mammal	Critical Habitat
*WHALE, NORTHERN RIGHT	Endangered	Mammal	Critical Habitat

Georgia

(12 affected species)

BANKCLIMBER, PURPLE	Threatened	Clam	Critical Habitat
BAT, GRAY	Endangered	Mammal	Critical Habitat
BAT, INDIANA	Endangered	Mammal	Critical Habitat
BAT, VIRGINIA BIG-EARED	Endangered	Mammal	Critical Habitat
CLUSHELL, SOUTHERN	Endangered	Clam	Critical Habitat
COMBSHELL, UPLAND	Endangered	Clam	Critical Habitat
KIDNEYSHELL, TRIANGULAR	Endangered	Clam	Critical Habitat
*MANATEE, WEST INDIAN (FLORIDA)	Endangered	Mammal	Critical Habitat

Species Detail by State for Preliminary Assessment

Apples (5), Pears (144), Tobacco (200)

Minimum of 50 Acres.

MOCCASINSHELL, GULF	Endangered	Clam	Critical Habitat
PIGTOE, OVAL	Endangered	Clam	Critical Habitat
POCKETBOOK, SHINY-RAYED	Endangered	Clam	Critical Habitat
THREERIDGE, FAT	Endangered	Clam	Critical Habitat

Idaho

(4 affected species)

SNAIL, BLISS RAPIDS	Threatened	Snail	Critical Habitat
SNAIL, SNAKE RIVER PHYSA	Endangered	Snail	Critical Habitat
SPRINGSNAIL, BRUNEAU HOT	Endangered	Snail	Critical Habitat
SPRINGSNAIL, IDAHO	Endangered	Snail	Critical Habitat

Illinois

(6 affected species)

AMPHIPOD, ILLINOIS CAVE	Endangered	Crustacean	Critical Habitat
BAT, GRAY	Endangered	Mammal	Critical Habitat
BAT, INDIANA	Endangered	Mammal	Critical Habitat
BUTTERFLY, KARNER BLUE	Endangered	Insect	Critical Habitat
PEARLYMUSSEL, HIGGINS' EYE	Endangered	Clam	Critical Habitat
POCKETBOOK, FAT	Endangered	Clam	Critical Habitat

Indiana

(11 affected species)

BAT, GRAY	Endangered	Mammal	Critical Habitat
BAT, INDIANA	Endangered	Mammal	Critical Habitat
BUTTERFLY, KARNER BLUE	Endangered	Insect	Critical Habitat
BUTTERFLY, MITCHELL'S SATYR	Endangered	Insect	Critical Habitat
FANSHELL	Endangered	Clam	Critical Habitat
MUSSEL, RING PINK (=GOLF STICK PEARLY)	Endangered	Clam	Critical Habitat
PEARLYMUSSEL, PINK MUCKET	Endangered	Clam	Critical Habitat

Species Detail by State for Preliminary Assessment

Apples (5), Pears (144), Tobacco (200)

Minimum of 50 Acres.

PEARLYMUSSEL, TUBERCLED-BLOSSOM	Endangered	Clam	Critical Habitat
PEARLYMUSSEL, WHITE CAT'S PAW	Endangered	Clam	Critical Habitat
PIGTOE, ROUGH	Endangered	Clam	Critical Habitat
POCKETBOOK, FAT	Endangered	Clam	Critical Habitat

Iowa

(4 affected species)

BAT, INDIANA	Endangered	Mammal	Critical Habitat
PEARLYMUSSEL, HIGGINS' EYE	Endangered	Clam	Critical Habitat
POCKETBOOK, FAT	Endangered	Clam	Critical Habitat
SNAIL, IOWA PLEISTOCENE	Endangered	Snail	Critical Habitat

Kansas

(1 affected species)

BEETLE, AMERICAN BURYING	Endangered	Insect	Critical Habitat
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Kentucky

(24 affected species)

BAT, GRAY	Endangered	Mammal	Critical Habitat
BAT, INDIANA	Endangered	Mammal	Critical Habitat
BAT, VIRGINIA BIG-EARED	Endangered	Mammal	Critical Habitat
CLUBSHELL	Endangered	Clam	Critical Habitat
COMBSHELL, CUMBERLAND	Endangered	Clam	Critical Habitat
FANSHELL	Endangered	Clam	Critical Habitat
MUSSEL, OYSTER	Endangered	Clam	Critical Habitat
MUSSEL, RING PINK (=GOLF STICK PEARLY)	Endangered	Clam	Critical Habitat
PEARLYMUSSEL, APPALACHIAN MONKEYFACE	Endangered	Clam	Critical Habitat
PEARLYMUSSEL, CRACKING	Endangered	Clam	Critical Habitat
PEARLYMUSSEL, CUMBERLAND BEAN	Endangered	Clam	Critical Habitat
PEARLYMUSSEL, DROMEDARY	Endangered	Clam	Critical Habitat

Species Detail by State for Preliminary Assessment

Apples (5), Pears (144), Tobacco (200)

Minimum of 50 Acres.

PEARLYMUSSEL, LITTLE-WING	Endangered	Clam	Critical Habitat
PEARLYMUSSEL, ORANGE-FOOTED	Endangered	Clam	Critical Habitat
PEARLYMUSSEL, PINK MUCKET	Endangered	Clam	Critical Habitat
PEARLYMUSSEL, PURPLE CAT'S PAW	Endangered	Clam	Critical Habitat
PEARLYMUSSEL, TUBERCLED-BLOSSOM	Endangered	Clam	Critical Habitat
PEARLYMUSSEL, WHITE WARTYBACK	Endangered	Clam	Critical Habitat
PEARLYMUSSEL, YELLOW-BLOSSOM	Endangered	Clam	Critical Habitat
PIGTOE, ROUGH	Endangered	Clam	Critical Habitat
POCKETBOOK, FAT	Endangered	Clam	Critical Habitat
RIFFLESHELL, NORTHERN	Endangered	Clam	Critical Habitat
RIFFLESHELL, TAN	Endangered	Clam	Critical Habitat
SHRIMP, KENTUCKY CAVE	Endangered	Crustacean	Critical Habitat

Maine

(1 affected species)

*WHALE, NORTHERN RIGHT	Endangered	Mammal	Critical Habitat
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Appendix VII: PRZM/EXAMS output

stored as Clothianidin_Turf_Granular.out

Chemical: Clothianidin

PRZM environment: FLturfC.txt

EXAMS environment: pond298.exv

Metfile: w12834.dvf

Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	0.07	0.07	0.07	0.06	0.06	0.04
1962	0.45	0.44	0.43	0.42	0.41	0.22
1963	0.77	0.76	0.74	0.74	0.72	0.51
1964	1.02	1.02	1.00	0.96	0.93	0.73
1965	1.36	1.35	1.32	1.26	1.22	0.88
1966	3.02	3.01	2.94	2.84	2.76	2.04
1967	2.45	2.44	2.39	2.31	2.25	1.93
1968	2.18	2.17	2.13	2.05	1.98	1.69
1969	1.76	1.75	1.74	1.70	1.66	1.44
1970	1.49	1.49	1.46	1.42	1.39	1.18
1971	1.57	1.56	1.53	1.51	1.49	1.21
1972	3.63	3.60	3.51	3.35	3.25	2.31
1973	2.14	2.13	2.11	2.05	2.02	1.79
1974	2.05	2.04	2.00	1.92	1.88	1.54
1975	1.61	1.60	1.58	1.52	1.48	1.25
1976	4.78	4.75	4.62	4.47	4.35	2.98
1977	2.93	2.92	2.90	2.84	2.80	2.52
1978	4.22	4.20	4.10	3.99	3.97	3.02
1979	2.85	2.84	2.80	2.70	2.65	2.41
1980	2.03	2.02	2.00	1.96	1.94	1.72
1981	1.45	1.45	1.44	1.40	1.40	1.27
1982	2.78	2.76	2.70	2.58	2.50	1.85
1983	3.80	3.78	3.70	3.59	3.50	2.68
1984	3.92	3.91	3.83	3.71	3.66	2.92
1985	2.56	2.55	2.51	2.43	2.40	2.14
1986	1.62	1.61	1.60	1.56	1.54	1.30
1987	2.33	2.32	2.26	2.17	2.10	1.57
1988	1.38	1.37	1.36	1.33	1.31	1.14
1989	1.13	1.12	1.10	1.06	1.03	0.86
1990	0.71	0.71	0.70	0.69	0.68	0.56

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.03	4.78	4.75	4.62	4.47	4.35	3.02
0.06	4.22	4.20	4.10	3.99	3.97	2.98
0.10	3.92	3.91	3.83	3.71	3.66	2.92
0.13	3.80	3.78	3.70	3.59	3.50	2.68
0.16	3.63	3.60	3.51	3.35	3.25	2.52
0.19	3.02	3.01	2.94	2.84	2.80	2.41
0.23	2.93	2.92	2.90	2.84	2.76	2.31
0.26	2.85	2.84	2.80	2.70	2.65	2.14
0.29	2.78	2.76	2.70	2.58	2.50	2.04

0.32	2.56	2.55	2.51	2.43	2.40	1.93
0.35	2.45	2.44	2.39	2.31	2.25	1.85
0.39	2.33	2.32	2.26	2.17	2.10	1.79
0.42	2.18	2.17	2.13	2.05	2.02	1.72
0.45	2.14	2.13	2.11	2.05	1.98	1.69
0.48	2.05	2.04	2.00	1.96	1.94	1.57
0.52	2.03	2.02	2.00	1.92	1.88	1.54
0.55	1.76	1.75	1.74	1.70	1.66	1.44
0.58	1.62	1.61	1.60	1.56	1.54	1.30
0.61	1.61	1.60	1.58	1.52	1.49	1.27
0.65	1.57	1.56	1.53	1.51	1.48	1.25
0.68	1.49	1.49	1.46	1.42	1.40	1.21
0.71	1.45	1.45	1.44	1.40	1.39	1.18
0.74	1.38	1.37	1.36	1.33	1.31	1.14
0.77	1.36	1.35	1.32	1.26	1.22	0.88
0.81	1.13	1.12	1.10	1.06	1.03	0.86
0.84	1.02	1.02	1.00	0.96	0.93	0.73
0.87	0.77	0.76	0.74	0.74	0.72	0.56
0.90	0.71	0.71	0.70	0.69	0.68	0.51
0.94	0.45	0.44	0.43	0.42	0.41	0.22
0.97	0.07	0.07	0.07	0.06	0.06	0.04

0.10	3.91	3.89	3.82	3.70	3.65	2.89
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Average of yearly averages: 1.59

Inputs generated by pe4.pl - 8-August-2003

Data used for this run:

Output File: CloTurfG

Metfile: w12834.dvf

PRZM scenario: FLturfC.txt

EXAMS environment file: pond298.exv

Chemical Name: Clothianidin

Description	Variable	Value	Units	Comments
n	Name			
Molecular weight	mwt	249.7	g/mol	
Henry's Law Const.	henry		atm-m ³ /mol	
Vapor Pressure	vapr	4.27E-10	torr	
Solubility	sol	300	mg/L	
Kd	Kd	0	mg/L	
Koc	Koc	188	mg/L	
Photolysis half-life	kdp	34	days	Half-life
Aerobic Aquatic Metabolism	kbacw	1483	days	Halfife
Anaerobic Aquatic Metabolism	kbacs	81	days	Halfife

Aerobic asm 744 days Halfife
 Soil
 Metabolis
 m
 Hydrolysis:
 pH 7

0

days
 Half-life
 Method: CAM 1 integer See PRZM manual
 Incorporati DEPI 0 cm
 on Depth:
 Applicatio TAPP 0.45 kg/ha
 n Rate:
 Applicatio APPEFF 1 fraction
 n
 Efficiency:
 Spray Drift DRFT 0 fraction of application rate applied to pond
 Applicatio Date 15-03 dd/mm or dd/mm or dd-mm or dd-mm
 n Date
 Record FILTRA
 17:
 IPSCND 1
 UPTKF
 Record PLVKRT
 18:
 PLDKRT
 FEXTRC
 Flag for IR Pond
 Index
 Res. Run
 Flag for RUNOFF none none, monthly or total(average of entire run)
 runoff
 calc.

stored as Clothianidin_Turf_Spray.out

Chemical: Clothianidin

PRZM environment: FLturfC.txt

EXAMS environment: pond298.exv

Metfile: w12834.dvf

Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	0.28	0.28	0.28	0.27	0.26	0.19
1962	0.92	0.91	0.89	0.87	0.84	0.55
1963	1.41	1.40	1.37	1.36	1.33	1.00
1964	1.93	1.92	1.89	1.81	1.76	1.39
1965	2.43	2.41	2.36	2.26	2.18	1.64
1966	4.23	4.20	4.12	3.97	3.88	2.97
1967	3.57	3.56	3.49	3.37	3.29	2.82

1968	3.47	3.45	3.39	3.25	3.15	2.65
1969	2.91	2.90	2.88	2.81	2.74	2.38
1970	2.57	2.55	2.51	2.43	2.38	2.02
1971	2.70	2.68	2.63	2.59	2.55	2.07
1972	5.63	5.60	5.45	5.20	5.05	3.65
1973	3.50	3.49	3.45	3.35	3.30	2.90
1974	3.24	3.22	3.16	3.04	2.97	2.45
1975	2.63	2.62	2.58	2.49	2.42	2.04
1976	6.43	6.39	6.22	6.02	5.86	4.10
1977	4.14	4.12	4.07	3.92	3.83	3.57
1978	5.61	5.58	5.46	5.32	5.28	4.09
1979	4.12	4.10	4.04	3.89	3.80	3.39
1980	3.06	3.05	3.01	2.97	2.93	2.57
1981	2.31	2.30	2.28	2.22	2.21	1.97
1982	3.75	3.73	3.66	3.50	3.39	2.57
1983	4.88	4.85	4.75	4.61	4.49	3.46
1984	5.31	5.29	5.19	5.03	4.96	3.93
1985	3.64	3.63	3.58	3.47	3.43	3.01
1986	2.34	2.33	2.30	2.24	2.23	1.99
1987	3.42	3.40	3.32	3.18	3.09	2.35
1988	2.09	2.09	2.06	2.01	1.99	1.80
1989	1.95	1.95	1.91	1.83	1.78	1.49
1990	1.36	1.35	1.33	1.30	1.27	1.09

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.03	6.43	6.39	6.22	6.02	5.86	4.10
0.06	5.63	5.60	5.46	5.32	5.28	4.09
0.10	5.61	5.58	5.45	5.20	5.05	3.93
0.13	5.31	5.29	5.19	5.03	4.96	3.65
0.16	4.88	4.85	4.75	4.61	4.49	3.57
0.19	4.23	4.20	4.12	3.97	3.88	3.46
0.23	4.14	4.12	4.07	3.92	3.83	3.39
0.26	4.12	4.10	4.04	3.89	3.80	3.01
0.29	3.75	3.73	3.66	3.50	3.43	2.97
0.32	3.64	3.63	3.58	3.47	3.39	2.90
0.35	3.57	3.56	3.49	3.37	3.30	2.82
0.39	3.50	3.49	3.45	3.35	3.29	2.65
0.42	3.47	3.45	3.39	3.25	3.15	2.57
0.45	3.42	3.40	3.32	3.18	3.09	2.57
0.48	3.24	3.22	3.16	3.04	2.97	2.45
0.52	3.06	3.05	3.01	2.97	2.93	2.38
0.55	2.91	2.90	2.88	2.81	2.74	2.35
0.58	2.70	2.68	2.63	2.59	2.55	2.07
0.61	2.63	2.62	2.58	2.49	2.42	2.04
0.65	2.57	2.55	2.51	2.43	2.38	2.02
0.68	2.43	2.41	2.36	2.26	2.23	1.99
0.71	2.34	2.33	2.30	2.24	2.21	1.97
0.74	2.31	2.30	2.28	2.22	2.18	1.80
0.77	2.09	2.09	2.06	2.01	1.99	1.64
0.81	1.95	1.95	1.91	1.83	1.78	1.49
0.84	1.93	1.92	1.89	1.81	1.76	1.39
0.87	1.41	1.40	1.37	1.36	1.33	1.09

0.90	1.36	1.35	1.33	1.30	1.27	1.00
0.94	0.92	0.91	0.89	0.87	0.84	0.55
0.97	0.28	0.28	0.28	0.27	0.26	0.19

0.10	5.58	5.55	5.43	5.19	5.04	3.90
Average of yearly averages:						2.40

Inputs generated by pe4.pl - 8-August-2003

Data used for this run:

Output File: CloTurfS

Metfile:

w12834.dvf

PRZM scenario: FLturfC.txt

EXAMS environment file: pond298.exv

Chemical Name: Clothianidin

Description	Variable Name	Value	Units	Comments
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Molecular weight	mwt	249.7	g/mol	
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Henry's Law Const.	henry		atm-m ³ /mol	
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Vapor Pressure	vapr	4.27E-10	torr	
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Solubility	sol	300	mg/L	
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Kd	Kd	0	mg/L	
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Koc	Koc	188	mg/L	
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Photolysis half-life	kdp	34	days	Half-life
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Aerobic Aquatic Metabolism	kbacw	1488	days	Halfife
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Anaerobic Aquatic Metabolism	kbacs	81	days	Halfife
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Aerobic Soil Metabolism	asm	744	days	Halfife
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Hydrolysis	pH 7	0	days	Half-life
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Method:	CAM	2	integer	See PRZM manual
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Incorporation Depth:	DEPI	0	cm	
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Application Rate:	TAPP	0.45	kg/ha	
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Application Efficiency:	APPEFF	0.99	fraction	
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Spray Drift	DRFT	0.01	fraction of application rate applied to pond	
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Application Date	Date	15-03	dd/mm or dd/mm or dd-mm or dd-mmm	
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Record	FILTRA			
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17: IPSCND 1
 UPTKF
 Record PLVKRT
 18: PLDKRT
 FEXTRC 0.5
 Flag for IR Pond
 Index
 Res. Run
 Flag for RUNOFF none none, monthly or total(average of entire run)
 runoff
 calc.

stored as Clothianidin_Apple_PA.out

Chemical: Clothianidin

PRZM environment: PAappleC.txt

EXAMS environment: pond298.exv

Metfile: w14737.dvf

Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	0.14	0.14	0.13	0.13	0.13	0.08
1962	0.43	0.42	0.41	0.40	0.39	0.26
1963	0.41	0.41	0.41	0.40	0.39	0.35
1964	0.81	0.80	0.79	0.76	0.74	0.56
1965	0.65	0.64	0.64	0.62	0.62	0.56
1966	0.59	0.59	0.59	0.57	0.57	0.50
1967	0.75	0.75	0.74	0.73	0.72	0.59
1968	2.14	2.13	2.08	2.05	2.01	1.42
1969	1.71	1.70	1.69	1.65	1.63	1.48
1970	1.31	1.31	1.30	1.28	1.26	1.17
1971	1.44	1.43	1.42	1.39	1.36	1.14
1972	1.54	1.53	1.51	1.48	1.47	1.26
1973	1.23	1.23	1.22	1.21	1.20	1.10
1974	1.34	1.33	1.31	1.29	1.27	1.08
1975	1.07	1.07	1.06	1.06	1.04	0.96
1976	0.88	0.88	0.87	0.86	0.86	0.78
1977	0.77	0.77	0.76	0.73	0.74	0.67
1978	1.03	1.03	1.02	0.98	0.96	0.77
1979	1.24	1.23	1.21	1.17	1.14	0.94
1980	1.17	1.17	1.15	1.13	1.11	0.96
1981	1.36	1.36	1.34	1.30	1.26	1.04
1982	1.36	1.36	1.35	1.31	1.28	1.11
1983	2.05	2.04	2.00	1.94	1.89	1.48
1984	1.70	1.69	1.68	1.65	1.62	1.44
1985	2.27	2.26	2.22	2.15	2.09	1.66
1986	3.53	3.51	3.44	3.34	3.26	2.52
1987	2.47	2.47	2.46	2.43	2.41	2.19
1988	2.04	2.04	2.01	1.96	1.92	1.76
1989	2.11	2.10	2.08	2.03	1.99	1.70

1990 1.88 1.87 1.85 1.79 1.77 1.58

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.03	3.53	3.51	3.44	3.34	3.26	2.52
0.06	2.47	2.47	2.46	2.43	2.41	2.19
0.10	2.27	2.26	2.22	2.15	2.09	1.76
0.13	2.14	2.13	2.08	2.05	2.01	1.70
0.16	2.11	2.10	2.08	2.03	1.99	1.66
0.19	2.05	2.04	2.01	1.96	1.92	1.58
0.23	2.04	2.04	2.00	1.94	1.89	1.48
0.26	1.88	1.87	1.85	1.79	1.77	1.48
0.29	1.71	1.70	1.69	1.65	1.63	1.44
0.32	1.70	1.69	1.68	1.65	1.62	1.42
0.35	1.54	1.53	1.51	1.48	1.47	1.26
0.39	1.44	1.43	1.42	1.39	1.36	1.17
0.42	1.36	1.36	1.35	1.31	1.28	1.14
0.45	1.36	1.36	1.34	1.30	1.27	1.11
0.48	1.34	1.33	1.31	1.29	1.26	1.10
0.52	1.31	1.31	1.30	1.28	1.26	1.08
0.55	1.24	1.23	1.22	1.21	1.20	1.04
0.58	1.23	1.23	1.21	1.17	1.14	0.96
0.61	1.17	1.17	1.15	1.13	1.11	0.96
0.65	1.07	1.07	1.06	1.06	1.04	0.94
0.68	1.03	1.03	1.02	0.98	0.96	0.78
0.71	0.88	0.88	0.87	0.86	0.86	0.77
0.74	0.81	0.80	0.79	0.76	0.74	0.67
0.77	0.77	0.77	0.76	0.73	0.74	0.59
0.81	0.75	0.75	0.74	0.73	0.72	0.56
0.84	0.65	0.64	0.64	0.62	0.62	0.56
0.87	0.59	0.59	0.59	0.57	0.57	0.50
0.90	0.43	0.42	0.41	0.40	0.39	0.35
0.94	0.41	0.41	0.41	0.40	0.39	0.26
0.97	0.14	0.14	0.13	0.13	0.13	0.08

0.10 2.26 2.25 2.21 2.14 2.09 1.75
 Average of yearly averages: 1.10

Inputs generated by pe4.pl - 8-August-2003

Data used for this run:

Output File: CloApplePA

Metfile:

w14737.dvf

PRZM scenario:

PAappleC.txt

EXAMS environment file:

pond298.exv

Chemical Name:

Clothianidin

Description	Variable Name	Value	Units	Comments
Molecular weight	mwt	249.7	g/mol	

Henry's Law Const.	henry		atm-m ³ /mol	
Vapor Pressure	vapr		4.27E-10 torr	
Solubility	sol		300 mg/L	
Kd	Kd		0 mg/L	
Koc	Koc		188 mg/L	
Photolysis half-life	kdp		34 days	Half-life
Aerobic Aquatic Metabolism	kbacw		1488 days	Halfife
Anaerobic Aquatic Metabolism	kbacs		81 days	Halfife
Aerobic Soil Metabolism	asm		744 days	Halfife
Hydrolysis	pH 7		0 days	Half-life
Method: Incorporation Depth: Application Rate: Application Efficiency: Spray Drift Application Date	CAM DEPI TAPP APPEFF DRFT		2 integer 0 cm 0.22 kg/ha 0.99 fraction 0.01 fraction of application rate applied to pond	See PRZM manual dd/mm or dd/mm or dd-mm or dd-mmm
Record 17:	FILTRA IPSCND UPTKF			
Record 18:	PLVKRT PLDKRT FEXTRC		1 0.5	
Flag for Index Res. Run	IR	Pond		
Flag for runoff calc.	RUNOFF	none		none, monthly or total(average of entire run)

stored as Clothianidin_Apple_OR.out

Chemical: Clothianidin

PRZM environment: ORappleC.txt

EXAMS environment: pond298.exv

Metfile: w24229.dvf

Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	0.51	0.51	0.50	0.48	0.46	0.29
1962	0.67	0.67	0.66	0.64	0.62	0.50
1963	0.78	0.77	0.76	0.74	0.72	0.60
1964	0.66	0.66	0.65	0.64	0.63	0.57
1965	1.06	1.06	1.04	1.00	0.98	0.77
1966	0.85	0.85	0.84	0.83	0.82	0.77
1967	0.77	0.77	0.76	0.75	0.73	0.68
1968	0.84	0.84	0.83	0.81	0.79	0.70
1969	0.75	0.75	0.75	0.73	0.72	0.68
1970	0.71	0.71	0.70	0.69	0.68	0.61
1971	0.74	0.73	0.72	0.70	0.69	0.60
1972	0.71	0.70	0.70	0.68	0.67	0.62
1973	0.62	0.62	0.62	0.60	0.59	0.54
1974	0.56	0.56	0.55	0.54	0.53	0.50
1975	0.60	0.60	0.60	0.59	0.58	0.52
1976	0.57	0.56	0.56	0.55	0.54	0.49
1977	0.53	0.53	0.52	0.51	0.51	0.47
1978	0.57	0.57	0.56	0.55	0.54	0.48
1979	0.63	0.63	0.62	0.61	0.59	0.51
1980	0.58	0.58	0.57	0.56	0.56	0.51
1981	0.57	0.57	0.56	0.55	0.54	0.50
1982	0.56	0.55	0.55	0.54	0.53	0.49
1983	0.57	0.57	0.57	0.55	0.54	0.50
1984	0.57	0.57	0.56	0.56	0.55	0.50
1985	0.83	0.83	0.81	0.78	0.76	0.61
1986	0.71	0.71	0.70	0.69	0.68	0.63
1987	0.66	0.66	0.66	0.64	0.63	0.58
1988	1.50	1.49	1.46	1.41	1.38	1.04
1989	1.21	1.21	1.20	1.18	1.17	1.06
1990	1.03	1.02	1.01	1.00	0.99	0.91

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.03	1.50	1.49	1.46	1.41	1.38	1.06
0.06	1.21	1.21	1.20	1.18	1.17	1.04
0.10	1.06	1.06	1.04	1.00	0.99	0.91
0.13	1.03	1.02	1.01	1.00	0.98	0.77
0.16	0.85	0.85	0.84	0.83	0.82	0.77
0.19	0.84	0.84	0.83	0.81	0.79	0.70
0.23	0.83	0.83	0.81	0.78	0.76	0.68
0.26	0.78	0.77	0.76	0.75	0.73	0.68

0.29	0.77	0.77	0.76	0.74	0.72	0.63
0.32	0.75	0.75	0.75	0.73	0.72	0.62
0.35	0.74	0.73	0.72	0.70	0.69	0.61
0.39	0.71	0.71	0.70	0.69	0.68	0.61
0.42	0.71	0.71	0.70	0.69	0.68	0.60
0.45	0.71	0.70	0.70	0.68	0.67	0.60
0.48	0.67	0.67	0.66	0.64	0.63	0.58
0.52	0.66	0.66	0.66	0.64	0.63	0.57
0.55	0.66	0.66	0.65	0.64	0.62	0.54
0.58	0.63	0.63	0.62	0.61	0.59	0.52
0.61	0.62	0.62	0.62	0.60	0.59	0.51
0.65	0.60	0.60	0.60	0.59	0.58	0.51
0.68	0.58	0.58	0.57	0.56	0.56	0.50
0.71	0.57	0.57	0.57	0.56	0.55	0.50
0.74	0.57	0.57	0.56	0.55	0.54	0.50
0.77	0.57	0.57	0.56	0.55	0.54	0.50
0.81	0.57	0.57	0.56	0.55	0.54	0.50
0.84	0.57	0.56	0.56	0.55	0.54	0.49
0.87	0.56	0.56	0.55	0.54	0.53	0.49
0.90	0.56	0.55	0.55	0.54	0.53	0.48
0.94	0.53	0.53	0.52	0.51	0.51	0.47
0.97	0.51	0.51	0.50	0.48	0.46	0.29
0.10	1.06	1.05	1.03	1.00	0.99	0.89
Average of yearly averages:						0.61

Inputs generated by pe4.pl - 8-August-2003

Data used for this run:

Output File: CloAppOr

Metfile:

w24229.dvf

PRZM scenario:

ORappleC.txt

EXAMS environment file:

pond298.exv

Chemical Name:

Clothianidin

Description	Variable Name	Value	Units	Comments
Molecular weight	mwt	249.7	g/mol	
Henry's Law Const.	henry		atm-m ³ /mol	
Vapor Pressure	vapr	4.27E-10	torr	
Solubility	sol	300	mg/L	
Kd	Kd	0	mg/L	
Koc	Koc	188	mg/L	
Photolysis half-life	kdp	34	days	Half-life
Aerobic Aquatic Metabolis	kbacw	1488	days	Halfife

m
 Anaerobic kbacs 81 days Halfife
 Aquatic
 Metabolis
 m
 Aerobic asm 744 days Halfife
 Soil
 Metabolis
 m
 Hydrolysis pH 7 0 days Half-life
 Method: CAM 2 integer See PRZM manual
 Incorporati DEPI 0 cm
 on Depth:
 Applicatio TAPP 0.22 kg/ha
 n Rate:
 Applicatio APPEFF 0.99 fraction
 n
 Efficiency:
 Spray Drift DRFT 0.01 fraction of application rate applied to pond
 Applicatio Date 15-04 dd/mm or dd/mm or dd-mm or dd-mm
 n Date
 Record FILTRA
 17:
 IPSCND 1
 UPTKF
 Record PLVKRT
 18:
 PLDKRT
 FEXTRC 0.5
 Flag for IR Pond
 Index
 Res. Run
 Flag for RUNOFF none none, monthly or total(average of entire run)
 runoff
 calc.

stored as Clothianidin_Pears.out

Chemical: Clothianidin

PRZM environment: CAfruitC.txt

EXAMS environment: pond298.exv

Metfile: w93193.dvf

Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day.	90 Day	Yearly
1961	0.11	0.11	0.11	0.10	0.10	0.06
1962	0.20	0.20	0.20	0.19	0.18	0.14
1963	0.23	0.23	0.23	0.22	0.21	0.17
1964	0.28	0.28	0.28	0.27	0.24	0.20
1965	0.34	0.34	0.33	0.32	0.31	0.27

1966	0.35	0.35	0.34	0.33	0.32	0.27
1967	0.91	0.90	0.88	0.84	0.81	0.56
1968	0.62	0.61	0.61	0.59	0.57	0.53
1969	0.61	0.61	0.60	0.58	0.57	0.50
1970	0.51	0.51	0.50	0.49	0.48	0.43
1971	0.87	0.87	0.85	0.82	0.80	0.62
1972	0.63	0.63	0.62	0.60	0.60	0.55
1973	0.58	0.58	0.57	0.55	0.54	0.48
1974	0.47	0.46	0.46	0.44	0.43	0.39
1975	0.46	0.46	0.45	0.44	0.43	0.37
1976	0.42	0.42	0.41	0.40	0.39	0.34
1977	0.44	0.44	0.43	0.42	0.41	0.36
1978	0.44	0.44	0.43	0.42	0.41	0.35
1979	0.38	0.38	0.38	0.36	0.35	0.30
1980	0.34	0.34	0.33	0.32	0.31	0.26
1981	0.35	0.35	0.34	0.33	0.32	0.26
1982	0.36	0.36	0.36	0.35	0.35	0.28
1983	0.81	0.80	0.79	0.75	0.73	0.53
1984	0.57	0.57	0.56	0.54	0.53	0.47
1985	0.46	0.46	0.45	0.44	0.43	0.37
1986	0.64	0.63	0.47	0.36	0.35	0.31
1987	0.85	0.85	0.83	0.80	0.77	0.65
1988	0.79	0.79	0.77	0.75	0.73	0.60
1989	0.63	0.63	0.62	0.60	0.58	0.51
1990	0.56	0.56	0.55	0.53	0.52	0.46

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.03	0.91	0.90	0.88	0.84	0.81	0.65
0.06	0.87	0.87	0.85	0.82	0.80	0.62
0.10	0.85	0.85	0.83	0.80	0.77	0.60
0.13	0.81	0.80	0.79	0.75	0.73	0.56
0.16	0.79	0.79	0.77	0.75	0.73	0.55
0.19	0.64	0.63	0.62	0.60	0.60	0.53
0.23	0.63	0.63	0.62	0.60	0.58	0.53
0.26	0.63	0.63	0.61	0.59	0.57	0.51
0.29	0.62	0.61	0.60	0.58	0.57	0.50
0.32	0.61	0.61	0.57	0.55	0.54	0.48
0.35	0.58	0.58	0.56	0.54	0.53	0.47
0.39	0.57	0.57	0.55	0.53	0.52	0.46
0.42	0.56	0.56	0.50	0.49	0.48	0.43
0.45	0.51	0.51	0.47	0.44	0.43	0.39
0.48	0.47	0.46	0.46	0.44	0.43	0.37
0.52	0.46	0.46	0.45	0.44	0.43	0.37
0.55	0.46	0.46	0.45	0.42	0.41	0.36
0.58	0.44	0.44	0.43	0.42	0.41	0.35
0.61	0.44	0.44	0.43	0.40	0.39	0.34
0.65	0.42	0.42	0.41	0.36	0.35	0.31
0.68	0.38	0.38	0.38	0.36	0.35	0.30
0.71	0.36	0.36	0.36	0.35	0.35	0.28
0.74	0.35	0.35	0.34	0.33	0.32	0.27
0.77	0.35	0.35	0.34	0.33	0.32	0.27
0.81	0.34	0.34	0.33	0.32	0.31	0.26

0.84	0.34	0.34	0.33	0.32	0.31	0.26
0.87	0.28	0.28	0.28	0.27	0.24	0.20
0.90	0.23	0.23	0.23	0.22	0.21	0.17
0.94	0.20	0.20	0.20	0.19	0.18	0.14
0.97	0.11	0.11	0.11	0.10	0.10	0.06

0.10	0.85	0.84	0.83	0.79	0.77	0.60
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Average of yearly averages: 0.39

Inputs generated by pe4.pl - 8-August-2003

Data used for this run:

Output File: CloPears

Metfile:

w93193.dvf

PRZM scenario:

CAfruitC.txt

EXAMS environment file:

pond298.exv

Chemical Name:

Clothianidin

Description	Variable Name	Value	Units	Comments
Molecular weight	mwt	249.7	g/mol	
Henry's Law Const.	henry		atm-m ³ /mol	
Vapor Pressure	vapr	4.27E-10	torr	
Solubility	sol	300	mg/L	
Kd	Kd	0	mg/L	
Koc	Koc	188	mg/L	
Photolysis half-life	kdp	34 days		Half-life
Aerobic Aquatic Metabolism	kbacw	1488 days		Halfife
Anaerobic Aquatic Metabolism	kbacs	81 days		Halfife
Aerobic Soil Metabolism	asm	744 days		Halfife
Hydrolysis	pH 7	0 days		Half-life
Method: Incorporation Depth:	CAM DEPI	2 integer 0 cm		See PRZM manual
Application Rate:	TAPP	0.22	kg/ha	
Application	APPEFF	0.99	fraction	

Efficiency:
 Spray Drift DRFT 0.01 fraction of application rate applied to pond
 Application Date 15-04 dd/mm or dd/mmm or dd-mm or dd-mmm
 n Date
 Record FILTRA
 17: IPSCND 1
 UPTKF
 Record PLVKRT
 18: PLDKRT
 FEXTRC 0.5
 Flag for IR Pond
 Index
 Res. Run
 Flag for RUNOFF none none, monthly or total(average of entire run)
 runoff
 calc.

stored as Clothianidin_Tobacco_NC.out
 Chemical: Clothianidin
 PRZM environment: NctobaccoC.txt

EXAMS environment: pond298.exv

Metfile: w13722.dvf

Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	0.12	0.12	0.12	0.11	0.11	0.07
1962	0.19	0.18	0.18	0.17	0.17	0.13
1963	0.30	0.30	0.29	0.28	0.27	0.21
1964	0.30	0.30	0.30	0.29	0.28	0.24
1965	0.30	0.30	0.30	0.29	0.28	0.24
1966	0.44	0.44	0.43	0.42	0.41	0.31
1967	0.74	0.74	0.73	0.71	0.69	0.51
1968	0.57	0.57	0.57	0.55	0.54	0.48
1969	0.48	0.48	0.47	0.46	0.46	0.40
1970	0.48	0.48	0.47	0.46	0.45	0.38
1971	0.43	0.43	0.42	0.42	0.41	0.35
1972	0.56	0.56	0.55	0.53	0.51	0.41
1973	1.02	1.02	0.99	0.95	0.92	0.67
1974	0.87	0.87	0.86	0.84	0.82	0.70
1975	0.69	0.68	0.68	0.66	0.65	0.58
1976	0.58	0.58	0.57	0.55	0.55	0.48
1977	0.50	0.50	0.49	0.48	0.47	0.41
1978	0.80	0.79	0.78	0.74	0.72	0.54
1979	0.60	0.59	0.59	0.58	0.57	0.51
1980	0.58	0.58	0.57	0.55	0.54	0.46
1981	0.49	0.49	0.49	0.48	0.47	0.41
1982	0.44	0.44	0.44	0.43	0.42	0.36
1983	1.96	1.94	1.89	1.79	1.73	1.15
1984	1.51	1.50	1.48	1.44	1.41	1.23
1985	1.23	1.23	1.21	1.17	1.15	1.02

1986	1.00	1.00	0.99	0.95	0.93	0.84
1987	2.76	2.74	2.67	2.55	2.46	1.71
1988	2.53	2.52	2.48	2.40	2.34	1.94
1989	1.75	1.74	1.73	1.69	1.66	1.52
1990	1.26	1.26	1.25	1.23	1.21	1.10

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.03	2.76	2.74	2.67	2.55	2.46	1.94
0.06	2.53	2.52	2.48	2.40	2.34	1.71
0.10	1.96	1.94	1.89	1.79	1.73	1.52
0.13	1.75	1.74	1.73	1.69	1.66	1.23
0.16	1.51	1.50	1.48	1.44	1.41	1.15
0.19	1.26	1.26	1.25	1.23	1.21	1.10
0.23	1.23	1.23	1.21	1.17	1.15	1.02
0.26	1.02	1.02	0.99	0.95	0.93	0.84
0.29	1.00	1.00	0.99	0.95	0.92	0.70
0.32	0.87	0.87	0.86	0.84	0.82	0.67
0.35	0.80	0.79	0.78	0.74	0.72	0.58
0.39	0.74	0.74	0.73	0.71	0.69	0.54
0.42	0.69	0.68	0.68	0.66	0.65	0.51
0.45	0.60	0.59	0.59	0.58	0.57	0.51
0.48	0.58	0.58	0.57	0.55	0.55	0.48
0.52	0.58	0.58	0.57	0.55	0.54	0.48
0.55	0.57	0.57	0.57	0.55	0.54	0.46
0.58	0.56	0.56	0.55	0.53	0.51	0.41
0.61	0.50	0.50	0.49	0.48	0.47	0.41
0.65	0.49	0.49	0.49	0.48	0.47	0.41
0.68	0.48	0.48	0.47	0.46	0.46	0.40
0.71	0.48	0.48	0.47	0.46	0.45	0.38
0.74	0.44	0.44	0.44	0.43	0.42	0.36
0.77	0.44	0.44	0.43	0.42	0.41	0.35
0.81	0.43	0.43	0.42	0.42	0.41	0.31
0.84	0.30	0.30	0.30	0.29	0.28	0.24
0.87	0.30	0.30	0.30	0.29	0.28	0.24
0.90	0.30	0.30	0.29	0.28	0.27	0.21
0.94	0.19	0.18	0.18	0.17	0.17	0.13
0.97	0.12	0.12	0.12	0.11	0.11	0.07
0.10	1.93	1.92	1.87	1.78	1.73	1.49
Average of yearly averages:						0.64

Inputs generated by pe4.pl - 8-August-2003

Data used for this run:

Output File: CloToba

Metfile:

w13722.dvf

PRZM scenario:

NCtobaccoC.txt

EXAMS environment file:

pond298.exv

Chemical Name:

Clothianidin

Description	Variable Name	Value	Units	Comments
Molecular weight	mwt	249.7	g/mol	
Henry's Law Const.	henry		atm-m ³ /mol	
Vapor Pressure	vapr	4.27E-10	torr	
Solubility	sol	300	mg/L	
Kd	Kd	0	mg/L	
Koc	Koc	188	mg/L	
Photolysis half-life	kdp	34	days	Half-life
Aerobic Aquatic Metabolism	kbacw	1488	days	Halfife
Anaerobic Aquatic Metabolism	kbacs	81	days	Halfife
Aerobic Soil Metabolism	asm	744	days	Halfife
Hydrolysis	pH 7	0	days	Half-life
Method: Incorporation Depth:	CAM DEPI	2 integer 0 cm		See PRZM manual
Application Rate:	TAPP	0.22	kg/ha	
Application Efficiency:	APPEFF	0.99	fraction	
Spray Drift Application Date	DRFT Date	0.01 fraction of application rate applied to pond 15-04	dd/mm or dd/mm or dd-mm or dd-mmm	
Record 17:	FILTRA			
	IPSCND	1		
	UPTKF			
Record 18:	PLVKRT			
	PLDKRT			
	FEXTRC	0.5		
Flag for Index	IR	Pond		
Res. Run Flag for runoff calc.	RUNOFF	none	none, monthly or total(average of entire run)	