Evaluation Report ERC2011-01

Clutch 50 WDG, Arena 50 WDG and Clothianidin Insecticides

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Overview

Registration Decision for Clothianidin

Health Canada's Pest Management Regulatory Agency (PMRA), under the authority of the *Pest Control Products Act* and Regulations, has granted conditional registrations for the sale and use of Clothianidin Technical Insecticide, Clutch 50 WDG Insecticide, Arena 50 WDG Insecticide and Clothianidin Insecticide, containing the technical grade active ingredient clothianidin, to control a variety of insects on potato, grape, pome fruits, stone fruits and turf.

An evaluation of available scientific information found that, under the approved conditions of use, the product has value and does not present an unacceptable risk to human health or the environment.

Although the risks and value have been found acceptable when all risk reduction measures are followed, the applicant must submit additional scientific information as a condition of registration.

This Overview describes the key points of the evaluation, while the Science Evaluation provides detailed technical information on the human health, environmental and value assessments of Clothianidin Technical Insecticide, Clutch 50 WDG Insecticide, Arena 50 WDG Insecticide and Clothianidin Insecticide.

What Does Health Canada Consider When Making a Registration Decision?

The key objective of the *Pest Control Products Act* is to prevent unacceptable risks to people and the environment from the use of pest control products. Health or environmental risk is considered acceptable[1] if there is reasonable certainty that no harm to human health, future generations or the environment will result from use or exposure to the product under its proposed conditions of registration. The Act also requires that products have value[2] when used according to the label directions. Conditions of registration may include special precautionary measures on the product label to further reduce risk.

To reach its decisions, the PMRA applies modern, rigorous risk-assessment methods and policies. These methods consider the unique characteristics of sensitive subpopulations in humans (e.g. children) as well as organisms in the environment (e.g. those most sensitive to environmental contaminants). These methods and policies also consider the nature of the effects observed and the uncertainties when predicting the impact of pesticides. For more information

1 "Acceptable risks" as defined by subsection 2(2) of the *Pest Control Products Act.*

2 "Value" as defined by subsection 2(1) of the *Pest Control Products Act*: "the product's actual or potential contribution to pest management, taking into account its conditions or proposed conditions of registration, and includes the product's (*a*) efficacy; (*b*) effect on host organisms in connection with which it is intended to be used; and (*c*) health, safety and environmental benefits and social and economic impact."

on how the PMRA regulates pesticides, the assessment process and risk-reduction programs, please visit the Pesticides and Pest Management portion of Health Canada's website at healthcanada.gc.ca/pmra.

What Is Clothianidin?

Clothianidin is the active ingredient contained in Clutch 50 WDG Insecticide, Arena 50 WDG Insecticide and Clothianidin Insecticide. It is an agricultural insecticide that can be applied to the foliage of plants or in-furrow to control a variety of important insect pests in several crops and turf. Clothianidin is a member of the neonicotinoid group of insecticides.

Health Considerations

Can Approved Uses of Clothianidin Affect Human Health?

Clothianidin is unlikely to affect your health when used according to label directions.

Exposure to clothianidin may occur through the diet (food and water) or when handling and applying the product. When assessing health risks, two key factors are considered: the levels where no health effects occur and the levels to which people may be exposed. The dose levels used to assess risks are established to protect the most sensitive human population (e.g., children and nursing mothers). Only uses for which the exposure is well below levels that cause no effects in animal testing are considered acceptable for registration.

Toxicology studies in laboratory animals describe potential health effects from varying levels of exposure to a chemical and identify the dose where no effects are observed. The health effects noted in animals occur at doses more than 100-times higher (and often much higher) than levels to which humans are normally exposed when clothianidin products are used according to label directions.

The technical grade active ingredient clothianidin was highly acutely toxic to mice when ingested. Consequently, the statement "Danger Poison" was required on the label for the technical grade active ingredient. Based on the acute toxicity data, no label requirements were necessary for the end-use products Clothianidin Insecticide, Clutch 50 WDG Insecticide and Arena 50 WDG Insecticide.

Clothianidin did not cause cancer in laboratory animals and is non-genotoxic. The first signs of toxicity in animals given daily doses of clothianidin over longer periods of time were decreased food consumption, body weights, and body weight gains. Target organs of toxicity included the liver, kidney and reproductive organs, as well as the gastrointestinal tract and immune system.

Clothianidin did not cause birth defects in laboratory animals. There was evidence in animals that the young are more sensitive to the effects of clothianidin than adults. Effects on the young were observed at doses lower than those that caused effects in parental animals. In addition, signs of neurotoxicity were also seen in young animals at dose levels lower than those given to parental animals. Because of these observations, extra protective factors were applied during the risk assessment to further reduce the allowable level of human exposure to clothianidin.

The risk assessment protects against these effects by ensuring that the level of human exposure is well below the lowest dose at which these effects occurred in animal tests.

Residues in Water and Food

Dietary risks from food and water are not of concern

The aggregate refined chronic dietary intake estimates (food plus water) revealed that infants, the subpopulation which would ingest the most clothianidin relative to body weight, are expected to be exposed to less than 66% of the acceptable daily intake. Based on these estimates, the chronic dietary risk from exposure to clothianidin residues is not of concern for any of the population sub-groups.

A single dose of clothianidin is not likely to cause acute health effects in the general population (including infants and children). An aggregate (food and water) dietary exposure estimate of 31% of the acute reference dose is not considered to be a health concern for any of the population sub-groups.

The *Food and Drugs Act* (FDA) prohibits the sale of adulterated food, that is, food containing a pesticide residue that exceeds the established maximum residue limit (MRL). Pesticide MRLs are established for FDA purposes through the evaluation of scientific data under the *Pest Control Products Act* (PCPA). Food containing a pesticide residue that does not exceed the established MRL does not pose an unacceptable health risk.

Crop field trials conducted in North American Free Trade Agreement (NAFTA) geographical representative regions using the end-use product containing clothianidin in/on grapes, pome fruits, and stone fruits were acceptable. The MRLs for this active ingredient can be found in the Science Evaluation section of this Evaluation Report.

Risks in Residential and Other Non-Occupational Environments

Exposure to the public in treated turfgrass areas, and treated orchard areas is considered acceptable when clothianidin-containing products are used according to label directions.

Exposure of the general population to residues of clothianidin could occur from entering treated residential and municipal turf areas. The postapplication exposure to adults, youths, and children were considered acceptable.

Exposure of the general population to residues of clothianidin from treated orchards could occur by participating in pick-your-own (U-pick) activities for apple, pear, peaches, nectarines, sweet or sour cherries, and plums. The exposures from such activities are considered acceptable for adults, youths, and children.

Occupational Risks from Handling Arena 50 WDG Insecticide, Clutch 50 WDG Insecticide and Clothianidin Insecticide

Occupational risks are not of concern when the end-use products are used according to the label directions, which include protective measures.

Farmers, custom applicators, or professional lawn care operators who mix, load or apply Arena 50 WDG Insecticide, Clutch 50 WDG Insecticide, or Clothianidin Insecticide, as well as field workers re-entering freshly treated turf (including sod farm, golf course, residential, municipal, and industrial sites), crop fields, orchards and vineyards, can come in direct dermal contact with clothianidin residues. Therefore, the label specifies that anyone mixing/loading and applying Arena 50 WDG Insecticide, Clutch 50 WDG Insecticide and Clothianidin Insecticide must wear a long-sleeved shirt, long pants, chemical-resistant gloves, socks and shoes; and, for aerial application, additional protective equipment of coverall, and goggles or faceshield. The label also requires that workers do not enter treated fields for 12 hours after application. Taking into consideration these label statements, the number of applications and the expectation of the exposure period for handlers and workers, the risk to these individuals is not a concern.

For bystanders, exposure is expected to be much less than that for workers and is not quantified. Therefore, health risks to bystanders are not of concern.

Environmental Considerations

What Happens When Clothianidin Is Introduced Into the Environment?

Clothianidin is largely stable in the environment and laboratory studies suggest it could leach to groundwater in certain types of soils. It will, however, not evaporate from soil or water. Field dissipation studies confirm clothianidin's persistence and show that a fraction of the applied active ingredient can remain in the top soil layers. Clothianidin is a systemic pesticide and can be up-taken from soil and transferred by plants into pollen and nectar.

Clothianidin is highly toxic to bees and mammals and moderately toxic to birds. In water, it is very highly toxic to aquatic invertebrates, but only slightly toxic to fish.

Because clothianidin is systemic, persistent and highly toxic to honey bees, the PMRA has requested additional data to fully assess the potential effects of chronic exposure of this pesticide, resulting from its potential movement into plant tissues and secretions such as pollen and nectar.

Value Considerations

What Is the Value of Clutch 50 WDG Insecticide, Arena 50 WDG Insecticide and Clothianidin Insecticide?

These end-use products control a variety of important insect pests on turfgrass, potatoes, grapes and pome and stone fruits.

Sufficient efficacy data were provided to support the three products for the control of a variety of insect pests in potato, pome fruit, stone fruit, grapes and turf. The efficacy data confirmed the lowest effective rate for major pests and the data supported the rates for additional pests. The data support multiple methods of application including in-furrow on potato, foliar on potato, pome fruit, stone fruit, grapes and turf, and aerial application on potatoes.

Measures to Minimize Risk

Labels of registered pesticide products include specific instructions for use. Directions include risk-reduction measures to protect human and environmental health. These directions must be followed by law.

The key risk-reduction measures being proposed on the labels of Arena 50 WDG Insecticide, Clutch 50 WDG Insecticide or Clothianidin Insecticide to address the potential risks identified in this assessment are as follows.

Key Risk-Reduction Measures

Human Health

Anyone mixing, loading and applying the end-use products must wear a long-sleeved shirt, long pants, chemical-resistant gloves, and socks and shoes. Aerial applicators must also wear coveralls and goggles or faceshield. No human flaggers are permitted. In addition, precautionary measures are required to protect against drift during application. A 12-hour restricted entry interval is required for all occupational post application tasks. There is no public access to treated areas until sprays have dried.

Environment

Hazard statements and precautionary measures are required to mitigate risk to aquatic organisms, wild mammals, bees and other beneficial insects. No-spray buffer zones are required to mitigate the risk to aquatic organisms. Precautionary measures are also required to mitigate concerns related to carryover, runoff and leaching.

What Additional Scientific Information Is Being Requested?

Although the risks and value have been found acceptable when all risk-reduction measures are followed, the applicant must submit additional scientific information as a condition of registration. More details are presented in the Science Evaluation of this Evaluation Report or in the Section 12 Notice associated with these conditional registrations. The applicant must submit the following information by September 30, 2012.

Environment

- A lysimeter study conducted in coarse textured soil with a water dispersible granule (WDG) formulation.

- A study of behaviour and fate of clothianidin in plants, including determination of concentrations in nectar and pollen.

- A hive study designed to assess the chronic toxicity of clothianidin to bees.

Other Information

As these conditional registrations relate to a decision on which the public must be consulted,[3] the PMRA will publish a consultation document when there is a proposed decision on applications to convert the conditional registrations to full registrations or on applications to renew the conditional registrations, whichever occurs first.

The test data cited in this Evaluation Report (i.e. the test data relevant in supporting the registration decision) will be made available for public inspection when the decision is made to convert the conditional registrations to full registrations or to renew the conditional registrations (following public consultation). If more information is required, please contact the PMRA's Pest Management Information Service by phone (1-800-267-6315) or by e-mail (pmra.infoserv@hc-sc.gc.ca).

[3] As per subsection 28(1) of the *Pest Control Products Act.*

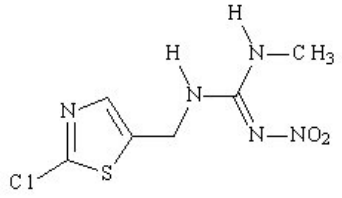
Science Evaluation

Clothianidin

Regulatory Note REG2004-06, *Clothianidin, Poncho 600 Seed Treatment Insecticide* provides a summary of data previously reviewed and the rationale for the regulatory decision for the use of clothianidin as a seed treatment. The information captured herein relates to new information provided to the PMRA in support of a registration for foliar uses on potatoes [foliar and in-furrow], grapes, pome fruits and stone fruits. It should be noted that an MRL has been proposed on potatoes and its processed commodities based on a seed piece treatment previously reviewed.

1.0 The Active Ingredient, Its Properties and Uses

1.1 Identity of the Active Ingredient

Active substance		Clothianidin
Function		Insecticide
Chemical name		
1.	**International Union of Pure and Applied Chemistry (IUPAC)**	(*E*)-1-(2-chloro-1,3-thiazol-5-ylmethyl)-3-methyl-2-nitroguanidine
2.	**Chemical Abstracts Service (CAS)**	[*C*(*E*)]-*N*-[(2-chloro-5-thiazolyl)methyl]-*N*'-methyl-*N*''-nitroguanidine
CAS number		210880-92-5
Molecular formula		$C_6H_8ClN_5O_2S$
Molecular weight		249.68
Structural formula		
Purity of the active ingredient		97.5%

1.2 Physical and Chemical Properties of the Active Ingredients and End-Use Product

Technical Product—Clothianidin Technical Insecticide

Property	Result
Colour and physical state	Clear, colourless solid
Odour	Odourless
Melting range	176.8°C
Boiling point or range	Not applicable
Density at 20°C	1.61 g/mL
Vapour pressure	1.3×10^{-10} Pa at 25°C 3.8×10^{-11} Pa at 20°C (extrapolated)
Henry's law constant at 20°C	9.8×10^{-16} atm·m^3 / mol
Ultraviolet (UV)-visible spectrum	λ_{max} = 265.5 nm in acidic and neutral solution. λ_{max} = 246.0 nm in basic solution
Solubility in water at 20°C	0.327 g/L
Solubility in organic solvents at 25°C	Solvent — Solubility (mg/L) heptane — < 0.00104 xylene — 0.0128 dichloromethane — 1.32 methanol — 6.26 octanol — 0.938 acetone — 15.2 ethyl acetate — 2.03
n-Octanol-water partition coefficient (K_{ow}) at 25°C	K_{ow} = 5 log K_{ow} = 0.7
Dissociation constant (pK_a) at 20°C	11.09
Stability	Stable for 12 months at 25°C and 6 months at 40°C

End-Use Products—Clutch 50 WDG Insecticide, Arena 50 WDG Insecticide and Clothianidin Insecticide

Property	Result
Colour	Dark brown
Odour	Similar odour to cardboard
Physical state	Solid
Formulation type	Water dispersible granule (WDG)
Guarantee	50.0%
Container material and description	25 g – 10 kg HDPE bottles
Density	0.60 g/cm^3
pH of 1% w/v emulsion in water	6.4
Oxidizing or reducing action	No apparent reaction with water, $(NH_4)H_2PO_4$, $KMnO_4$ and zinc. Conclusion: neither an oxidizing nor a reducing agent.
Storage stability	Stable for 2 years under commercial storage conditions
Corrosion characteristics	No corrosion to packaging material during 2-year commercial storage
Explodability	Not expected to be explosive

1.3 Directions for Use

Clothianidin is a commercial class insecticide to be used as foliar or in-furrow applications to control a variety of insect pests in several agricultural crops and turfgrass. Arena 50 WDG Insecticide is for use on turfgrass to control pests such as Japanese beetle, European chafer, chinch bug, and European crane fly (leather jackets). This product should be applied in sufficient water (4-8 L/100 m^2) to provide optimal distribution in the treated area. Clutch 50 WDG Insecticide is for use on potatoes, grapes, and pome and stone fruits. On potato, Clutch 50 WDG Insecticide can be applied by air or ground (foliar and in-furrow) applications to control Colorado potato beetle, aphids, and leafhoppers. On grapes, a maximum of two applications per year are approved to control leafhoppers, grape phylloxera, mealy bugs, and thrips. On pome and stone fruits, a maximum of two applications per year are approved to control pest such as Oriental fruit moth, aphids, plum curculio and leafhoppers. Similar to Arena 50 WDG Insecticide and Clutch 50 WDG Insecticide, Clothianidin Insecticide is for use on turfgrass and the agricultural crops listed above to control the same pests. Complete directions for use are located on the approved label for each product.

1.4 Mode of Action

Clothianidin is a member of the neonicotinoid (Group 4A) group of insecticides. It binds with the nicotinic acetylcholine receptor sites, located in the central nervous systems of insects, thus interfering with transmission of stimuli and eventually inhibiting reproduction of insects. This is not a new mode of action in Canada as other members of group 4A are currently registered for use on a variety of crops.

2.0 Methods of Analysis

A detailed review of the methods of analysis for clothianidin is summarized in Regulatory Note REG2004-06, *Clothianidin, Poncho 600 Seed Treatment Insecticide*. The method used for soil was extended to sediment.

3.0 Impact on Human and Animal Health

3.1 Toxicology Summary

A conditional registration for the Clothianidin Technical Insecticide was granted in 2004. At that time, a detailed review of the toxicological database for clothianidin was conducted and is summarized in Regulatory Note REG2004-06, *Clothianidin, Poncho 600 Seed Treatment Insecticide*. The previously identified cancer issue in rats has been addressed by data supplied by the registrant since issuance of the conditional registration. This information provided evidence that clothianidin was non-carcinogenic in rats and is non-genotoxic.

A developmental immunotoxicity study has been submitted in a separate application for the conversion of Clothianidin Technical Insecticide to full registration. Once reviewed, this study will be integrated into the toxicology risk assessment for clothianidin.

Clutch 50 WDG Insecticide, Arena 50 WDG Insecticide and Clothianidin Insecticide are of low toxicity to rats via the oral (LD_{50} between 2000 and 5000 mg/kg), dermal (LD_{50} >5000 mg/kg), and inhalation routes (LC_{50} >2.09 mg/L). They are minimally irritating to the eye and skin of rabbits. They are not dermal sensitizers in guinea pigs.

3.2 Determination of Acute Reference Dose

Refer to Regulatory Note REG2004-06, *Clothianidin, Poncho 600 Seed Treatment Insecticide* for full details.

3.3 Determination of Acceptable Daily Intake

Refer to Regulatory Note REG2004-06, *Clothianidin, Poncho 600 Seed Treatment Insecticide* for full details.

3.4 Occupational and Residential Risk Assessment

3.4.1 Toxicological Endpoints

Occupational exposure to clothianidin is characterized as short- to intermediate-term duration and is predominantly by the dermal and inhalation routes. Refer to Regulatory Note REG2004-06, *Clothianidin, Poncho 600 Seed Treatment Insecticide* for full details on endpoints.

3.4.1.1 Dermal Absorption

Refer to Regulatory Note REG2004-06, *Clothianidin, Poncho 600 Seed Treatment Insecticide* for previously reviewed data. A dermal absorption value of 1% is recommended, based on the secondary review of an acceptable *in vivo* rat study that was reviewed by the USEPA.

3.4.2 Occupational Exposure and Risk

3.4.2.1 Mixer/loader/applicator Exposure and Risk Assessment

Individuals have potential for exposure to clothianidin during mixing, loading and application. Dermal and inhalation exposure estimates for workers mixing/loading water dispersible granular formulations were generated from the Pesticide Handlers' Exposure Database (PHED) version 1.1. and Occupational Re-entry Task Force databases, in conjunction with area-treated-per-day information, and application rates.

Exposure to workers mixing, loading and applying Arena 50 WDG Insecticide, Clutch 50 WDG Insecticide, or Clothianidin Insecticide is expected to be short- to intermediate-term in duration and to occur primarily by the dermal and inhalation routes. Exposure estimates were derived for mixer/loaders/applicators applying Arena 50 WDG Insecticide or Clothianidin Insecticide to turfgrass using groundboom or hand-held equipment. The exposure estimates are based on mixers/loaders/applicators wearing a long-sleeved shirt, long pants, chemical-resistant gloves, and socks and shoes. Exposure estimates were derived for mixer/loaders/applicators applying Clutch 50 WDG Insecticide or Clothianidin Insecticide to orchard trees and vineyards using airblast equipment, and to potato crops (in-furrow and foliar application) using groundboom or aerial equipment. The exposure estimates are based on mixers/loaders/applicators wearing a long-sleeved shirt, long pants, chemical-resistant gloves, and socks and shoes. In addition, aerial mix and load workers must wear coveralls, and goggles or faceshield.

Chemical-specific data for assessing human exposures during pesticide handling activities were not submitted. Exposure values from generic databases were used.

Dermal exposure was estimated by coupling the unit exposure values with the amount of product handled per day and the dermal absorption value. Inhalation exposure was estimated by coupling the unit exposure values (for appropriate level of activity) with the amount of product handled per day with 100% inhalation absorption. Exposure was normalized to mg/kg bw/day by using 70 kg adult body weight.

Exposure estimates were compared to the toxicological endpoints (no observed adverse effects levels) to obtain the margin of exposure (MOE); the target MOE is 300 for intermediate-term exposure. The mixer/loader/applicator scenarios are acceptable with the personal protective equipment of long-sleeved shirt, long pants, and chemical-resistant gloves (Appendix I, Table 1).

3.4.2.2 Exposure and Risk Assessment for Workers Entering Treated Areas

There is potential for exposure to workers re-entering areas treated with Arena 50 WDG Insecticide or Clothianidin Insecticide. These activities include golf course and bowling green maintenance, sod farm scouting, maintenance, and turf harvesting, and scouting of treated residential, municipal, and industrial turf sites. There is potential for exposure to workers re-entering areas treated with Clutch 50 WDG Insecticide or Clothianidin Insecticide. These activities include scouting, irrigation, maintenance, and harvesting of orchards, vineyards, and potato field sites. Given the nature of activities performed, dermal contact with treated surfaces should not be of concern. When sprays have dried, clothianidin is not volatile, and therefore is not an inhalation concern. The duration of exposure is considered to be short-term (up to 30 days per year) to intermediate-term (up to 6 months per year) for all uses, and the primary route of exposure for workers re-entering treated areas would be through the dermal route.

Dermal exposure to workers entering treated areas is estimated by coupling dislodgeable foliar residue values with activity-specific transfer coefficients. Activity transfer coefficients are based on data from the USEPA Policy 3.1, *Agricultural Transfer Coefficients*, and Agricultural Re-entry Task Force reviewed studies. A default dislodgeable foliar residue (DFR) value of 20% of the application rate, and a 10% daily dissipation were used in the exposure assessment for foliar treatments, and a default transferable turf residue (TTR) value of 5% of the application rate, and a 10% daily dissipation were used in the exposure assessment for turf treatments.

Post-application tasks with the highest transfer co-efficients for each crop were compared to the toxicological endpoint to obtain the margin of exposure (MOE); the target MOE being 300. All use-site post-application exposure activities were acceptable, with no additional restrictions (Appendix I, Table 2).

3.4.3 Residential Exposure and Risk Assessment

3.4.3.1 Handler Exposure and Risk

There are no domestic products; therefore no residential handler risk assessment is required.

3.4.3.2 Postapplication Exposure and Risk

There is potential for post-application exposure to the general population re-entering areas treated with Arena 50 WDG Insecticide or Clothianidin Insecticide. These activities include golf courses, bowling greens, residential and municipal (including recreational turf such as schoolyards, parks, and sports fields) turf use. The duration of exposure is considered to be short-term (up to 30 days) after a single application to turf, and intermediate-term (up to 6 months) for agricultural uses, where several applications are possible. The primary route of

exposure for workers re-entering treated areas would be through the dermal route. Clothianidin is not volatile, and therefore, when sprays have dried, is not an inhalation concern. All post-application risk estimates for residential and municipal uses where non-workers may contact treated turf sites are not of concern (Appendix I, Table 3).

3.4.3.3 Bystander Exposure and Risk

Bystander exposure should be negligible since the potential for drift is expected to be minimal. Application is limited to residential areas and agricultural crops only when there is low risk of drift to areas of human habitation or activity such as houses, cottages, schools and recreational areas, taking into consideration wind speed, wind direction, temperature, application equipment and sprayer settings.

3.4.3.4 Aggregate Assessment

3.4.3.4.1 Residential Aggregate Assessment

A short duration residential aggregate assessment was conducted (Appendix I, Table 4) since there is potential for the co-occurrence of post-application exposure to residential and to municipal treated areas (including such areas as schoolyards and parks), and dietary intake of clothianidin residue. Golfing is not considered to be part of a residential aggregate, and not included in the assessment.

Taking into account that one application is applied to turf per year to any given area, there may be possible contact with residues over a short-term duration. Adult (dermal) and child (dermal and oral) exposures (children generally considered to be the most susceptible to toxic effects, based on a higher surface area to body weight ratio) are coupled with dietary intake (chronic-term, food and water for all clothianidin residues). The aggregate exposures are not of concern.

3.4.3.4.2 Acute Pick-Your-Own Aggregate Assessment

Since the pre-harvest interval (PHI) is 7 days, it is conceivable that the general public may be exposed to non-dissipated residues in pick-your-own operations. An appropriate quantitative measure for assessing exposure was through the Standard Operating Procedures for Residential Exposure Assessment. The transfer co-efficients (TC) for hand-harvesting apples or peaches are representative of exposure to foliar residue transfer from hand-harvesting. An exposure assessment (Appendix I, Table 5) was conducted using a single application at the maximum application rate. The application-day dislodgeable residue value of 20% of the application rate and 10% dissipation per day, 2-hour picking time, and pre-harvest interval of 7 days after the last application were included in exposure estimates.

An acute pick-your-own aggregate assessment was conducted. There is potential for the public to engage in performing post-application harvesting tasks for pome fruit (apple and pear) or stone fruit (peaches, nectarines, sweet and sour cherries, plums) crops in pick-your-own (U-pick) orchards.

The single-day co-occurrence of dermal exposure values calculated from picking treated apples or peaches (representing pick-your-own scenarios for the pome and stone fruits) were added to the single-day acute consumption of apples or peaches and chronic dietary exposure (dietary food and drinking water) representing background levels in all food and water. The total gives a single-day estimate of exposure to the public that pick the fruit and eat it on the same day.

The NOAEL of 25 mg/kg bw/day (target MOE = 100), from the acute neurotoxicity study in mice and the developmental study in rabbits, is considered to be appropriate for the acute pick-your-own scenario. Inhalation exposure was considered to be negligible and was not quantified, due to the low volatility of clothianidin and the outdoor dilution effect.

The post-application aggregate exposure and risk estimates associated with pick-your-own apple, pear, peach, nectarine, plum, and cherry scenario activities achieve acceptable Margins of Exposure (MOEs) for all sub-populations (Appendix I, Table 6). Therefore, pick-your-own operations are acceptable for orchards treated with Clutch 50 WDG Insecticide or Clothianidin Insecticide. There are no additional restrictions.

3.5 Food Residues Exposure Assessment

3.5.1 Residues in Plant and Animal Foodstuffs

The data gathering/enforcement analytical method is valid for the quantification of clothianidin residues in grapes, pome fruits, and stone fruits. Supervised residue trials conducted throughout the United States and Canada using end-use products containing clothianidin in or on grapes, stone fruits and pome fruits are sufficient to support the proposed maximum residue limits. Apples and grapes were processed using simulated commercial practices. There was no concentration of residues in apple juice or wet pomace. Residues of clothianidin concentrated in grape juice (1.1-fold), and raisins (1.6-fold). However, separate MRLs will not be required for the processed commodities as residues of clothianidin will be covered by the MRL on the respective raw agricultural commodities.

3.5.2 Dietary Risk Assessment

Acute and chronic dietary risk assessments were conducted using the Dietary Exposure Evaluation Model (DEEM–FCID™, Version 2.0), which uses updated food consumption data from the United States Department of Agriculture's Continuing Surveys of Food Intakes by Individuals, 1994–1996 and 1998.

3.5.2.1 Chronic Dietary Exposure Results and Characterization

The highest refined chronic dietary exposure from all supported clothianidin food uses (alone) for the total population, including infants and children, and all representative population subgroups are 4.8% of the acceptable daily intake (ADI) (Appendix I, Table 7). Aggregate exposure from food and water is considered acceptable. The highest chronic dietary exposure to clothianidin from food and water is estimated to be 66% of the ADI.

3.5.2.2 Acute Dietary Exposure Results and Characterization

The highest acute dietary exposure (food alone) for all supported clothianidin registered commodities for the total population, including infants and children, and all representative population subgroups is estimated to be 22% of the ARfD (95^{th} percentile, deterministic) (Appendix I, Table 7). Aggregate exposure from food and water is considered acceptable: 31% of the ARfD.

3.5.3 Maximum Residue Limits

The recommended maximum residue limits for residue of clothianidin are 0.6 ppm for grapes, 0.3 ppm for pome fruits and 0.8 ppm for stone fruits. For additional information on Maximum Residue Limits (MRL) in terms of the international situation and trade implications, refer to Appendix II. Analytical methodology, field trial data, and the acute and chronic dietary risk estimates are summarized in Appendix I, Table 8.

4.0 Impact on the Environment

4.1 Fate and Behaviour in the Environment

Data required to support an application to register, amend or conduct research with a pest control product depends on the nature of the product and the purpose of the application. The evaluation of the environmental fate and toxicity of pesticides used as spray require the review of additional data to that submitted to support the registration for seed treatment.

The environmental assessment of the clothianidin seed treatment uses is available in Regulatory Note REG2004-06, *Clothianidin, Poncho 600 Seed Treatment Insecticide*. Studies on long-term hydrolysis, leaching, acute oral toxicity to bumble bees and leaf-cutter bees, chronic toxicity to hives of honey bees under field conditions, acute oral toxicity to the red-winged blackbird, house sparrow and mallard duck, toxicity to wild birds under field use conditions have been submitted in a separate application for the conversion of Clothianidin Technical Insecticide to full registration. Once reviewed, these studies will be integrated into the environmental risk assessment for clothianidin.

Studies required for the expansion of clothianidin to foliar and in-furrow uses include phototransformation on soil, earthworm toxicity studies as well as aquatic fate and toxicity studies.

4.1.1 Terrestrial Environment

Clothianidin is stable to hydrolysis, will not volatilize from soil or water, but may photo-transform and could leach to groundwater in certain types of soils. Field dissipation studies show that clothianidin is persistent and can remain in the top soil layers for long periods after application. The field data indicate that, under some field use conditions, photodegradation does not constitute an important route of dissipation and that clothianidin's mobility needs to be further characterised. Refer to Appendix I, Table 9 in this document and Appendix V in Regulatory Note REG2004-06, *Clothianidin, Poncho 600 Seed Treatment Insecticide* for summaries of terrestrial fate data.

The leaching potential of clothianidin was examined using the criteria of Cohen et al. (1984) and the groundwater ubiquity score (GUS) (Gustafson, 1989). The criteria of Cohen et al. (1984) allows a general assessment of the leaching potential based on a number of properties determined by laboratory data. The potential for leaching is greater as more criteria are satisfied. Clothianidin meets most of these criteria (Appendix I, Table 10). Laboratory data indicate that clothianidin is very soluble in water, it does not adsorb strongly to soil, it is not expected to volatilize from moist soils or water and it is persistent when not exposed to sunlight. The GUS is based on the persistence and mobility of the compound in soil. Upper and a lower GUS values for clothianidin were calculated from the highest and lowest relevant field half-lives (365-1386 days) and laboratory K_{oc} (345-84 L/kg) values. Based on the above parameter values, clothianidin GUS values of 3.75 and 6.52 were calculated, which classify clothianidin as a probable leacher.

A new study, conducted with a water dispersible granule clothianidin formulation confirmed the persistence of clothianidin under field conditions. The calculated single first-order dissipation half-life (DT_{50}) was 341 days and the 90% dissipation period (DT_{90}) was 1130 days. Despite its high mobility profile predicted by laboratory studies, the highest clothianidin concentrations were found in the top soil layers through duration of the study.

A new lysimeter study is requested in order to better characterise clothianidin's mobility in the environment and address the apparent discrepancy between laboratory study data which predict that clothianidin should be highly mobile, and the available field study data, which show that a fraction of the applied clothianidin remains in the top soil layers, but generally fail to identify a dissipation pathway. Because some end-use product formulation ingredients are expected to influence the mobility of the active ingredient, this leaching study should be conducted with a relevant spray formulation.

4.1.2 Aquatic Environment

Although the use pattern of clothianidin does not include direct application to water, the possibility that aquatic systems will be exposed to clothianidin and its major transformation product, directly or indirectly, cannot be ruled out. Clothianidin may enter the aquatic environment through spray drift, run-off or groundwater recharge.

Clothianidin is very soluble in water but has a low potential for bioaccumulation (refer to Appendix V in Regulatory Note REG2004-06, *Clothianidin, Poncho 600 Seed Treatment Insecticide* for summary of data). It is expected to photodegrade in shallow clear water if it is exposed to sunlight, but laboratory studies indicate that it readily partitions to sediment where it can bind and persist (Appendix I, Table 11). Clothianidin's major photodegradation products include MG, TZMU, HMIO, MU, MIT, FA and CO_2 (Appendix I, Table 12). TMG was the only major clothianidin biotransformation product identified in water-sediment systems.

4.2 Environmental Risk Characterization

The environmental risk assessment integrates the environmental exposure and ecotoxicology information to estimate the potential for adverse effects on non-target species. This integration is achieved by comparing exposure concentrations with concentrations at which adverse effects occur. Estimated environmental concentrations are concentrations of pesticide in various environmental media, such as food, water, soil and air. The environmental concentrations are estimated using standard models which take into consideration the application rate(s), chemical properties and environmental fate properties, including the dissipation of the pesticide between applications. Ecotoxicology information includes acute and chronic toxicity data for various organisms or groups of organisms from both terrestrial and aquatic habitats including invertebrates, vertebrates, and plants. Toxicity endpoints used in risk assessments may be adjusted to account for potential differences in species sensitivity as well as varying protection goals (i.e. protection at the community, population, or individual level).

Initially, a screening level risk assessment is performed to identify pesticides and/or specific uses that do not pose a risk to non-target organisms, and to identify those groups of organisms for which there may be a potential risk. The screening level risk assessment uses simple methods, conservative exposure scenarios (e.g. direct application at a maximum cumulative application rate) and sensitive toxicity endpoints. A risk quotient (RQ) is calculated by dividing the exposure estimate by an appropriate toxicity value (RQ = exposure/toxicity), and the risk quotient is then compared to the level of concern (LOC = 1). If the screening level risk quotient is below the level of concern, the risk is considered negligible and no further risk characterization is necessary. If the screening level risk quotient is equal to or greater than the level of concern, then a refined risk assessment is performed to further characterize the risk. A refined assessment takes into consideration more realistic exposure scenarios (such as drift to non-target habitats) and might consider different toxicity endpoints. Refinements may include further characterization of risk based on exposure modelling, monitoring data, results from field or mesocosm studies, and probabilistic risk assessment methods. Refinements to the risk assessment may continue until the risk is adequately characterized or no further refinements are possible.

The screening level risk quotients for Clutch 50 WDG Insecticide, Arena 50 WDG Insecticide and Clothianidin Insecticide were assessed assuming single application at rates of 210 g a.i./ha, 350 g a.i./ha and 350 g a.i./ha, respectively. While a higher rate is proposed for Clutch 50 WDG Insecticide as an in-furrow treatment on potato to control Colorado potato beetle (224 g a.i./ha), airblast application in orchards and aerial application to potatoes are expected to lead to a greater environmental exposure and carry a higher environmental risk to most non-target organisms.

4.2.1 Risks to Terrestrial Organisms

Risk of clothianidin and its related end-use products to terrestrial organisms was based upon the use pattern for each end-use product and the evaluation of submitted toxicity data (Appendix I, Table 13) and the bird and mammal toxicity data summarized in Appendix V of Regulatory Note REG2004-06, *Clothianidin, Poncho 600 Seed Treatment Insecticide*.

The effects of clothianidin and its relevant transformation products on several terrestrial organisms were evaluated during the review of seed treatment uses for this active ingredient. Refer to Regulatory Note REG2004-06, *Clothianidin, Poncho 600 Seed Treatment Insecticide* for details on the effects of clothianidin on honey bees, birds and mammals. Study results for earthworm are presented below.

Mortalities were observed in earthworms exposed to clothianidin and the major transformation product, TZNG. The 14-day no-observable-effect-concentration (NOEC) and lethal concentration 50% (LC_{50}) for clothianidin were < 10 and 15.5 mg a.i. per kg dry substrate, respectively. The 14-day NOEC and LC_{50} for the transformation product TZNG were 125 and 982 mg per kg dry substrate, respectively. No mortalities were observed in earthworms exposed to clothianidin's transformation product MNG. The screening level risk quotients for all tested compounds, based on the above LC_{50}s and a single application rate of 350 g a.i./ha were under the level of concern (Appendix I, Table 14). The risks to earthworm associated with long term uses of clothianidin were not evaluated and remain an uncertainty.

Bees play an essential role in crop production and, during bloom, orchards also attract a wide variety of wild pollinators. Clothianidin is highly toxic to honey bees on both acute contact and oral basis, and severe losses may be expected if it is used at the maximum application rate in orchards (210 mg a.i./ha) when bees are present at treatment time or within a few days thereafter (Appendix I, Table 14). Furthermore, because clothianidin is a persistent systemic insecticide, the potential for chronic effects of exposure to residues translocated to plant tissues and secretions consumed by pollinators is of potential concern. Studies are therefore required to fully evaluate exposure scenarios linked with the translocation of clothianidin in treated plants and the potential for chronic effects of clothianidin to honey bee.

No laboratory studies on the toxicity of clothianidin to predatory or parasitic arthropod species have been submitted. However, because of the high contact toxicity to honey bees, clothianidin is expected to also be toxic to other non-target beneficial arthropods.

The concentration of pesticide on potential food items (vegetation, seeds, insects) eaten by birds and mammals was determined using a nomogram developed by the USEPA from the data of Hoerger and Kenaga (1972) and Kenaga (1973), and modified according to Fletcher et al. (1994). The nomogram provides both maximum and typical residue concentrations (which respectively correspond to the 90^{th} percentile and the median residue concentration values found in dataset). Maximum residue concentrations are used for the screening level assessment. However, when risk quotients exceed the level of concern, typical residue concentrations can also be used to further characterize the risk. Risk quotients calculated for birds and mammals are presented in Appendix I, Tables 15 to 18.

Risk quotients calculated at the screening level exceed the level of concern for large herbivorous birds and mammals of many sizes and food guilds. For birds, a potential concern for effects on reproduction was identified for large herbivorous birds feeding on leaves and leafy crops (RQ = 1.2). Given the number of conservative assumptions linked with the estimation of exposure during the screening level risk assessment for birds, and because no leafy crops are proposed to be treated with clothianidin, the risk to birds is believed to be negligible. By using less conservative residue estimates, this risk quotient falls below the level of concern (RQ = 0.4).

For mammals, a potential concern was identified for small insectivores (based on a reproduction endpoint), medium herbivores (based on acute, dietary and reproduction endpoints), and large herbivores (based on a reproduction endpoint). As discussed above, the risk to animals feeding on leaves and leafy crops may not be relevant, given that clothianidin will not be used on these types of crops. The acute and chronic risk quotients for mammals fall under the level of concern when residue concentrations are estimated using the median values (RQs: acute: 0.5, chronic: 0.5). The risk of toxic effects on reproduction, however, remains slightly above the level of concern for medium mammals feeding on short range grass treated with clothianidin (RQ using median residue values = 1.2).

The risk to birds and mammals, associated with the consumption of food items contaminated from spray drift outside the treated field was also assessed. The off-field estimated environmental concentrations on food items was calculated based on the percent deposition at one metre downwind according to the ground application model currently used to calculate buffer zones. This model predicts the percent deposition at one metre to be 11% for applications using a ground boom sprayer and a fine spray quality and between 59% and 74% for airblast equipment (Wolf and Caldwell, 1991). Considering the highest rate on turf (350 g a.i./ha), applied with ground equipment, the off-field risk quotients calculated for birds and mammals all fall below the level of concern. In orchards, however, because clothianidin is applied at a rate of 210 g a.i./ha with airblast equipment (expected drift: 59% to 74%), the highest off-field risk quotients for medium herbivorous mammals (based on reproduction endpoint) are 1.4 (short-range grass) and 1.3 (forage crops). The reproduction risk quotients for herbivorous mammals associated with foliar treatment of potatoes (52.5 g a.i./ha ×3) are only slightly exceeded when the most conservative parameters were used, i.e. upper-bound residue concentrations and a 35 days plant surface half-life (short range grass: 1.2, forage crops: 1.1).

Clothianidin had no effects on the seedling emergence of terrestrial plants sprayed at an application rate of 214 g a.i./ha. The screening assessment RQ, based on this NOEC and an application rate of 350 g a.i./ha is smaller than 1.64. As the EC_{25} is expected to be above the highest application rate, clothianidin is not expected to pose adverse effects to terrestrial plants.

4.2.2 Risks to Aquatic Organisms

The risk posed by clothianidin and its related end-use products to aquatic organisms was based upon the use pattern for each end-use product and toxicity studies conducted with aquatic invertebrates, fish and algae (Appendix I, Table 13).

The sensitivity to clothianidin varies among various aquatic invertebrates. While risk quotients based on toxicity studies conducted with water flea fall below the level of concern, the acute and chronic screening assessment risk quotients for clothianidin, based on toxicity tests performed with midge for an application rate of 350 g a.i./ha are 4.17 and 60.76 (Appendix I, Table 14). Similarly, in the marine environment, while risk quotients calculated from studies conducted with the Eastern oyster fall below the level of concern, the acute and chronic screening assessment RQs based on toxicity studies conducted with saltwater mysid are 1.72 and 8.58, respectively for an application rate of 350 g a.i./ha. Other lower application rates also result in RQs that exceed the level of concern for these toxicity endpoints. Refer to Appendix I, Table 14 for details.

Risk quotients calculated for fish, amphibians and aquatic plants are all below the level of concern (Appendix I, Table 14).

In summary, while the proposed uses for clothianidin are not expected to pose a risk to fish, amphibians or aquatic plants, buffer zones are required to mitigate the risk that this pesticide poses to sensitive freshwater and marine invertebrates.

5.0 Value

5.1 Effectiveness Against Pests

5.1.1 Acceptable Efficacy Claims

5.1.1.1 Tree fruits

The data were reviewed by pest, irrespective of crop, since crop grouping allows extrapolation between pome fruit and stone fruit. A substantial number of trials on apples, pears, cherries and peach were conducted in both Canada (ON and BC) and the United States (predominantly in Michigan, New York, Washington, Oregon, and California). The lowest effective rate was established to be 105 g a.i./ha for Oriental fruit moth/codling moth for tree fruits and a claim of suppression was considered to be appropriate due to the potential for an inconsistent response. On pome fruit, clothianidin should be applied at a rate range of 105-210 g a.i./ha for suppression of Oriental fruit moth and codling moth; a range of 70-105 g a.i./ha for control of aphids, leafhoppers, and leafminers; a rate of 105 g a.i./ha for control of plum curculio; and a range of 140-210 g a.i./ha for control of pear psylla. On stone fruit, clothianidin should be applied at a range of 105-210 g a.i./ha for suppression of Oriental fruit moth; a rate of 105 g a.i./ha for control of plum curculio; and a range of 70-105 g a.i./ha for control of aphids and leafhoppers.

Without exceeding a seasonal maximum of 210 g a.i./ha/year, two applications per season were considered acceptable. Many of these pests have multiple generations per year and may require multiple applications. As well, the reapplication interval was standardized between pome and stone fruit and was considered acceptable at 10 days for all pests except Oriental fruit moth, which should be 14 days.

5.1.1.2 Grapes

Of the 16 trials provided, only those with sufficient pest pressure were considered. Trials were conducted primarily in the northern United States (California, Oregon, Michigan, New York, and Washington). The data demonstrated that a rate of 50 g a.i./ha is the lowest effective rate for leafhoppers; however, there was insufficient data to consider a rate this low for the remaining pests. Data for the remaining pests, thrips, mealybug and phylloxera, demonstrated that clothianidin will provide control with a rate beginning at 70 g a.i./ha. When a rate range is supported, a higher rate is often required if pest pressure if high. On grapes, a range of 50-70 g a.i./ha should be applied to control leafhoppers; a rate of 70 g a.i./ha for control of thrips; and a range of 70-105 g a.i./ha for control of mealybugs and phylloxera.

Without exceeding the seasonal maximum of 210 g a.i./ha/year, no more than 2 applications can be made per year at an interval of 14 days. Multiple applications would accommodate pests that have multiple generations per year.

5.1.1.3 Potato – in furrow and foliar

Only trials that were considered to have high Colorado potato beetle pressure were evaluated, while all the trials submitted for aphids and leafhoppers were considered. Trials were conducted in a variety of potato growing regions in both Canada and the United States.

For in furrow treatments, the data indicated that rates lower than 120 g a.i./ha were not consistent; therefore, 133 g a.i./ha, was considered as the lowest effective rate for Colorado potato beetle when clothianidin was applied in-furrow. A range of 133-224 g a.i./ha was supported for Colorado potato beetle applied as an in-furrow treatment. For foliar treatment to control Colorado potato beetle, rates lower than 35 g a.i./ha did not demonstrate consistent control of larvae; therefore a rate range of 35-52.5 g a.i./ha was considered acceptable. As well, the efficacy data demonstrated that green peach aphid and potato aphid were controlled at the rate range of 35-52.5 g a.i./ha. Limited data for leafhopper were provided and pressure in the trials was low. The data indicated that clothianidin applications at 35-52 g a.i./ha may control potato leafhopper; however, the data were inconsistent. Despite this, sufficient data were reviewed for leafhoppers on grapes and these data indicated that leafhoppers can be controlled using clothianidin at rates of 35-52 g a.i./ha.

Due to the number of generations per year of aphids, Colorado potato beetle, and leafhoppers, a maximum of three foliar applications were supported; however, it was recommended that the reapplication interval be decreased to 7 from 10 days.

5.1.1.4 Turfgrass

Efficacy data from 36 small plot trials were evaluated, most conducted in Canada and the northern United States between 1998 and 2007. All of the evaluated treatments consisted of a single application with assessments of pest pressure and efficacy conducted at various intervals after treatment in different trials.

The submitted efficacy data provided support for most of the turf pests; however, in most cases lower application rates were shown to provide control and in a few cases appropriate application rates could not be established based on the limited data available. Applications against European chafer, Japanese beetle, masked chafers, Asiatic garden beetle, and/or oriental beetle should be made early in the season, targeting egg hatch, at application rates of 125-250 g a.i./ha; late season applications should use the upper application rate and may provide suppression only. Applications against hairy chinch bug should be made at rates of 175-250 g a.i./ha when populations reach treatment thresholds. Applications against annual bluegrass weevil should be made at rates of 275-350 g a.i./ha when populations reach treatment thresholds. Applications against bluegrass billbug should target egg-laying adults in the spring at the rate of 225 g a.i./ha. Applications against European crane fly may target either young larvae in the fall or mature larvae in the spring (before pupation) at the rate of 275 g a.i./ha.

5.2 Phytotoxicity to Host Plants

No specific trials were conducted for the purposes of evaluating phytotoxicity; however, this parameter was frequently assessed within the efficacy trials. When noted, there was no indication of phytotoxicity with the exception of one trial in turf where yellowing of the turf occurred one day after treatment at 375 g a.i./ha. The effect had disappeared 14 days after treatment. Despite this single incidence, phytotoxicity is not a concern when clothianidin is applied to the labelled crops.

5.3 Impact on Succeeding Crops

Not assessed.

5.4 Economics

Not assessed.

5.5 Sustainability

5.5.1 Survey of Alternatives

Alternative active ingredients vary depending on the specific pest and crop combination. Most alternatives are from different resistance management groups, though other neonicotinoid insecticides are registered for use on the registered crops.

Products containing a group 4A active ingredient are currently registered in Canada. For pests currently not present on any group 4A insecticide label, clothianidin could provide a new active ingredient with which to rotate for the prevention of resistance.

5.5.2 Compatibility with Current Management Practices Including Integrated Pest Management

The effect of clothianidin on commonly occurring predators and parasitoids of orchards and field vegetables was not assessed from a value perspective; therefore, no claim regarding the acceptability of Arena 50 WDG Insecticide, Clutch 50 WDG Insecticide or Clothianidin Insecticide in an integrated pest management system can be made.

5.5.3 Information on the Occurrence or Possible Occurrence of the Development of Resistance

Repeated use of insecticides with the same mode of action increases the probability of naturally selecting resistant biotypes within an insect population. Therefore, products containing clothianidin should be used in rotation with insecticides that have a different mode of action (i.e., not members of Group 4A).

The Clutch 50 WDG Insecticide, Arena 50 WDG Insecticide, and Clothianidin Insecticide labels include the resistance management statements, as per Regulatory Directive DIR99-06, *Voluntary Pesticide Resistance-Management Labelling Based on Target Site/Mode of Action*.

5.5.4 Contribution to Risk Reduction and Sustainability

Clothianidin controls a broad range of insect pests; however, there is similarity in the pest spectrum when the uses are compared to currently registered neonicotinoid insecticides. Clothianidin is the first group 4A insecticide registered for use on grape; therefore, it is a new active ingredient with which to rotate for resistance management. Prudent use of insecticides in this class should be observed to prevent the development of resistance because imidacloprid, thiamethoxam, thiacloprid, and acetamiprid are already registered for use on several of the labelled crops.

6.0 Pest Control Product Policy Considerations

6.1 Toxic Substances Management Policy Considerations

The Toxic Substances Management Policy (TSMP) is a federal government policy developed to provide direction on the management of substances of concern that are released into the environment. The TSMP calls for the virtual elimination of Track 1 substances (those that meet all four criteria outlined in the policy, i.e. CEPA-toxic or equivalent, predominantly anthropogenic, persistent and bio-accumulative).

Clothianidin and its transformation products have previously been assessed in accordance with the PMRA Regulatory Directive DIR99-03[4]. The PMRA had reached the following conclusions:

- Clothianidin does not meet all Track 1 criteria, and is not considered a Track 1 substance.
- Clothianidin is not expected to form any transformation products that meet all Track 1 criteria.

Refer to Regulatory Note REG2004-06, *Clothianidin, Poncho 600 Seed Treatment Insecticide* for full details.

6.2 Formulants and Contaminants of Health or Environmental Concern

During the review process, contaminants in the technical and formulants and contaminants in the end-use products are compared against the *List of Pest control Product Formulants and Contaminants of Health or Environmental Concern* maintained in the *Canada Gazette*[5]**.** The list is used as described in the PMRA Notice of Intent NOI2005-01[6] and is based on existing policies and regulations including: DIR99-03; and DIR2006-02[7], and taking into consideration the Ozone-depleting Substance Regulations, 1998, of the *Canadian Environmental Protection Act* (substances designated under the Montreal Protocol). The PMRA has reached the following conclusions:

- Technical grade clothianidin and the end-use products Clutch 50 WDG Insecticide, Arena 50 WDG Insecticide and Clothianidin Insecticide do not contain any formulants or contaminants of health or environmental concern identified in the *Canada Gazette.*
- The use of formulants in registered pest control products is assessed on an ongoing basis through PMRA formulant initiatives and Regulatory Directive DIR2006-02[8].

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4 DIR99-03, The Pest Management Regulatory Agency's Strategy for Implementing the Toxic Substances Management Policy

5 Canada Gazette, Part II, Volume 139, Number 24, SI/2005-114 (2005-11-30) pages 2641–2643: List of Pest Control Product Formulants and Contaminants of Health or Environmental Concern and in the order amending this list in the Canada Gazette, Part II, Volume 142, Number 13, SI/2008-67 (2008-06-25) pages 1611-1613. Part 1 Formulants of Health or Environmental Concern, Part 2 Formulants of Health or Environmental Concern that are Allergens Known to Cause Anaphylactic-Type Reactions and Part 3 Contaminants of Health or Environmental Concern.

6 NOI2005-01, List of Pest Control Product Formulants and Contaminants of Health or Environmental Concern under the New Pest Control Products Act.

7 DIR2006-02, PMRA Formulants Policy.

8 DIR2006-02, PMRA Formulants Policy.

7.0 Summary

7.1 Human Health and Safety

Anyone mixing, loading, or applying Arena 50 WDG Insecticide, Clutch 50 WDG Insecticide, or Clothianidin Insecticide, and workers re-entering treated areas (turf, orchards, vineyards, and potato crops) are not expected to be exposed to levels of clothianidin that will result in an unacceptable risk when the end-use products are used according to label directions. The personal protective equipment and the restricted entry interval on the product labels are adequate to protect workers.

Residential exposure to individuals entering and contacting treated areas, including pick-your-own orchards, is not expected to result in unacceptable risk when the end-use products are used according to label directions.

The nature of the residue in plants and animals is adequately understood. The residue definition is clothianidin. The use of clothianidin on grapes, pome fruits and stone fruits does not constitute an unacceptable chronic or acute dietary risk (food and drinking water) to any segment of the population, including infants, children, adults and seniors. Sufficient crop residue data have been reviewed to recommend maximum residue limits to protect human health. The recommended maximum residue limits for residue of clothianidin are 0.6 ppm for grapes, 0.3 ppm for pome fruits and 0.8 ppm for stone fruits.

7.2 Environmental Risk

The uses of Clutch 50 WDG Insecticide, Arena 50 WDG Insecticide and Clothianidin Insecticide present a low risk to earthworms, birds, terrestrial plants, fish, amphibians, algae and aquatic plants. However, clothianidin may pose a risk to bees and other beneficial arthropods, wild mammals, and marine and freshwater invertebrates. Precautionary label statements appear on the product labels to identify these hazards and mitigate risks. Buffer zones of 1 to 4 metres for ground applications and 1 to 40 metres for aerial applications are required to protect sensitive non-target aquatic organisms.

7.3 Value

The data submitted to register Arena 50 WDG Insecticide, Clutch 50 WDG Insecticide and Clothianidin Insecticides are adequate to describe their efficacy for use in tree fruits, grapes, potatoes, and turfgrass. These products offer control or suppression of a variety of insect pests when applied according to the directions for use identified on the label.

7.4 Unsupported Uses

Certain uses originally proposed by the applicant were not supported by the PMRA because the value was not adequately demonstrated. These uses include tarnished plant bug on stone fruit, Japanese beetle on grape, and sod webworm and black turfgrass atanius on turf (Appendix I, Table 19).

8.0 Regulatory Decision

Health Canada's PMRA, under the authority of the *Pest Control Products Act* and Regulations, has granted conditional registration for the sale and use of Clothianidin Technical Insecticide, Clutch 50 WDG Insecticide, Arena 50 WDG Insecticide and Clothianidin Insecticide, containing the technical grade active ingredient clothianidin, to control a variety of insects on potato, grape, pome fruits, stone fruits and turf.

An evaluation of available scientific information found that, under the approved conditions of use, the product has value and does not present an unacceptable risk to human health or the environment.

Although the risks and value have been found acceptable when all risk-reduction measures are followed, as a condition of these registrations, additional scientific information is being requested from the applicant to confirm clothianidin's fate in soil and to ensure there are no long-term effects on bees and other pollinators. For more details, refer to the Section 12 Notice associated with these conditional registrations. The applicant will be required to submit this information by September 30, 2012.

NOTE: The PMRA will publish a consultation document at the time when there is a proposed decision on applications to convert these conditional registrations to full registrations or on applications to renew the conditional registrations, whichever occurs first.

Environment

- A lysimeter study conducted in coarse textured soil with a water dispersible granule (WDG) formulation.
- A study of behaviour and fate of clothianidin in plants, including determination of concentrations in nectar and pollen.
- A hive study designed to assess the chronic toxicity of clothianidin to bees.

List of Abbreviations

µg	micrograms
a.i.	active ingredient
ACN	acetonitrile
ADI	acceptable daily intake
AR	applied radioactivity
ARfD	acute reference dose
atm	atmosphere
ATPD	area treated per day
bw	body weight
CAS	Chemical Abstracts Service
cm	centimetres
d	day(s)
DFR	dislodgeable foliar residue
DT_{50}	dissipation time 50% (the time required to observe a 50% decline in concentration)
DT_{90}	dissipation time 90% (the time required to observe a 90% decline in concentration)
EC_{15}	effective concentration on 15% of the population
EC_{25}	effective concentration on 25% of the population
EC_{50}	effective concentration on 50% of the population
EEC	estimated environmental exposure concentration
FDA	*Food and Drugs Act*
g	gram
GUS	groundwater ubiquity score
h	hour(s)
ha	hectare(s)
HAFT	highest average field trial
HDPE	high-density polyethylene
HPLC	high performance liquid chromatography
ILV	independent laboratory validation
IUPAC	International Union of Pure and Applied Chemistry
kg	kilogram
K_d	soil-water partition coefficient
K_{oc}	organic-carbon partition coefficient
K_{ow}	*n*–octanol-water partition coefficient
L	litre
LC	liquid chromatography
LC_{50}	lethal concentration 50%
LD_{50}	lethal dose 50%
LOC	level of concern
LOEC	low observed effect concentration
LOQ	limit of quantitation
m	metre(s)
mg	milligram
mL	millilitre

M/L	mixer/ loader
M/L/A	mixer/ loader/ applicator
MOE	margin of exposure
mol	mole(s)
MRL	maximum residue limit
MS	mass spectrometry
N/A	not applicable
NAFTA	North American Free Trade Agreement
ND	not detected
nm	nanometre(s)
NOAEL	no observed adverse effect level
NOEC	no observed effect concentration
Pa	pascal(s)
PCPA	*Pest Control Products Act*
PHED	Pesticide Handlers' Exposure Database
PHI	preharvest interval
pKa	dissociation constant
PMRA	Pest Management Regulatory Agency
ppm	parts per million
RAC	raw agricultural commodity
RQ	risk quotient
RTI	retreatment interval
$t_{½}$	first-order half-life
TC	transfer co-efficient
TSMP	Toxic Substances Management Policy
TTR	transferable turf residue
USEPA	United States Environmental Protection Agency
UV	ultraviolet
v/v	volume-to-volume (ratio)
WDG	water dispersible granule

Appendix I Tables and Figures

Table 1 Mixer, loader, applicator dermal and inhalation exposure estimates

Scenario			Mixer/Loader [b]	Applicator		
Crop	**Maximum Application rate (kg a.i./ha)**	**ATPD [a] (ha/day) or (L/day)**	**Scenario**	**Scenario**	**Total Dose [e] (mg/kg bw/day)**	**MOE [f] (target =300)**
potato (in-furrow) (custom, includes farmer)	0.224	30	M/L Dry flowable; open mix/load; Long-sleeved shirt, long pants, and chemical-resistant gloves	single layer + no gloves; groundboom, open-cab	3.79×10^{-4}	25900
potato (ground foliar, custom, includes farmer)	0.0525	300		single layer + no gloves; groundboom, open-cab	8.88×10^{-3}	11000
Potato (aerial foliar; farmer or custom)	0.0525	490		N/A	9.77×10^{-4}	10000
Potato (aerial foliar; farmer or custom)			N/A	Applicator: fixed or rotary winged aircraft, liquid single layer, no gloves	6.12×10^{-5}	160000
Pome fruit or Stone fruit (custom, includes farmer)	0.21	16	M/L Dry flowable; open mix/load; Long-sleeved shirt, long pants, and chemical-resistant gloves	single layer + gloves; airblast, open cab	6.76×10^{-4}	14500
Grape (farmer only)	0.105	16		single layer + gloves; airblast, open cab	3.38×10^{-4}	29000
Turf Sod farms, Golf courses, municipal and industrial sites	0.350	46.5		single layer + no gloves; groundboom, open cab	9.18×10^{-4}	10700

Scenario			Mixer/Loader [b]	Applicator		
Crop	**Maximum Application rate (kg a.i./ha)**	**ATPD [a] (ha/day) or (L/day)**	**Scenario**	**Scenario**	**Total Dose [e] (mg/kg bw/day)**	**MOE [f] (target =300)**
Professional LCO, golf course or bowling green maintenance, Municipal worker	0.350	2		M/L/A Backpack liquid/open-pour; single layer + gloves	1.19×10^{-3}	8220
	0.350	2.8	M/L/A Water dispersible granule; open mix/load; commercial low-pressure nozzle gun sprayer; Long-sleeved shirt, long pants, and chemical-resistant gloves	N/A	8.50×10^{-3}	11500

[a] Area-treated-per-day based on Canadian use pattern information.

[b] Using PHED v.1.1 scenarios for mixer/loader and applicator of water dispersible granular product (PHED dry flowable) using light inhalation; except backpack equipment, using moderate inhalation; commercial low-pressure sprayer using Outdoor Residential Exposure Task Force data.

[c] Adult body weight = 70kg; systemic dermal absorption is 1%; systemic inhalation absorption = 100%, and assuming that hand-held equipment has moderate inhalation, all other scenarios having light inhalation;

[d] Exposure (mg/kg bw/day) = [application rate x ((dermal unit exposure x dermal absorption) + (inhalation unit exposure x inhalation absorption)) x ATPD] / body weight (70kg);

[e] Total Dose = Mixer/Loader total body exposure + Applicator total body exposure, as appropriate

[f] MOE = NOAEL (mg/kg bw/d) / Total Dose exposure estimates (mg/kg/day); intermediate-term exposure for workers (< 6 months), using an oral NOAEL of 9.8 mg/kg bw/day from 2-generation reproduction study on rats for both dermal and inhalation exposure; target MOE is 300.

Table 2 Post-application exposure estimates for entry into treated turf, orchard, vineyard, and potato field crop areas

Crop	Expected Re-entry Activities	Maximum Transfer Coefficient [a] (cm^2/h)	DFR or TTR [b] 0 days after last application ($\mu g/cm^2$)	Exposure [c] (mg/kg/day)	MOE [d]
Golf course, bowling green, sod farm, residential, municipal, and industrial	Transplanting treated turf	6800	0.1750	1.36×10^{-3}	7200
Potato (foliar)	Scouting, irrigation	1500	0.1544	2.65×10^{-4}	37000
Potato (in-furrow)	No post-application exposure once covered with soil				
Pome fruit (apple, pear) OR stone fruit (peach, plum, prune, plumcot, nectarine, cherry (tart and sweet), apricot	Hand thinning	3000	0.4200 (single application at highest rate)	1.44×10^{-3}	6810
Grape	Cane turning and girdling	19300	0.2580	5.69×10^{-3}	1720

a Based on data reviewed from the *Agricultural Re-entry Task Force*; and *Agricultural Transfer Coefficients*, EPA Policy 3.1;

b Default DFR (20% dislodgeable foliar residue retained on the day of application, and 10% daily dissipation) and TTR (5% transferable turf residue on the day of application, and 10% daily dissipation);

c Dermal exposure (mg/kg/day) = DFR or TTR ($\mu g/cm^2$) x TC (cm^2/h) x 8 h workday x 1% dermal absorption (endpoint is oral) x conversion factor (1/1000 mg/µg) /body weight (adult = 70 kg);

d MOE = NOAEL/Exposure, short- to intermediate-term exposure for workers, dermal only, using oral NOAEL of 9.8 mg/kg bw/day from 2-generation reproduction study on rats; target MOE is 300

Table 3 Post-application exposure estimate and risk assessment for residential and municipal turf use

Population	Re-entry activity	TTR after last application [c] (µg/cm^2)	Residue route of entry	Transfer coefficient (cm^2/h)	Exposure (mg/kg/day)	MOE [h]
Adults	Residential or municipal turf [a]	0.1750	Dermal [a]	7300	3.65×10^{-4}	26800
Youth		0.1750	Dermal [a]	5028	4.51×10^{-4}	21700
Children (1 to <6)		0.1750	Dermal [a]	2600	6.07×10^{-4}	16200
			Hand-to-mouth [a]	N/A	4.67×10^{-3}	2100
			Incidental oral ingestion of turf [a]	N/A	2.92×10^{-4}	33600
			Ingestion of soil [d]	N/A	7.81×10^{-7}	12500000
			Combined	N/A	5.57×10^{-3}	1760
Adults	Golfing [b]	0.1750	Dermal [a]	500	5.0×10^{-5}	196000
Youths			Dermal [a]	345	6.2×10^{-5}	158000

[a] Standard Operating Procedures (SOPs) for Residential Exposure Assessments, December 1997; and Recommended revisions to the Standard Operating Procedures (SOPs) for Residential Exposure Assessments, 2001; Expected exposure duration for residential or recreational activities for all sub-populations is 2 hours; golfing 4 hours; Body weight is considered to be 70kg for an adult; 39 kg for a youth (10-12 yrs-old); and 15 kg for children (1-6 yrs-old); TC values (whole body exposure of adult) were adjusted for average body surface area of Children (5<6 yrs-old) 7890cm^2; Youth (10-12yr-old) 12700 cm^2, compared to adults 18440 cm^2; 1% dermal absorption (endpoint is oral)

[b] Based on Agricultural Re-entry Task Force data; the lowest TC for golf course workers conducting scouting activities was used, 500 cm^2/h for adult golfers, and adjusted for body surface area to Youth (10-12 years-old)

[c] Based on the default transferable turf residue value of 5% of application rate on day of application and 10% dissipation; maximum application rate of 3.5 µg a.i./cm^2 (350 g a.i./ha); entry on the same day as application, once residues have dried

[d] MOE = NOAEL/Exposure, short-term exposure, oral NOAEL of 9.8 mg/kg bw/day from 2-generation reproduction study on rats; target MOE is 300

Table 4 Residential aggregate exposure for adults and children to clothianidin residues from activities associated with turfgrass (excluding golf)

Sub-population (age range)	Post-application exposure [a] (mg/kg bw/day)	Chronic[b] dietary intake (mg/kg bw/day)	Aggregate exposure [c] (mg/kg bw/day)	Total MOE [d] (target =300)
Adults	3.65×10^{-4}	6.35×10^{-3}	6.711×10^{-3}	1460
Child (1 to <6)	5.57×10^{-3}	1.14×10^{-2}	1.70×10^{-2}	577

[a] Only dermal exposure for adults; includes dermal, hand-to-mouth activity, incidental oral ingestion of treated turf, and soil ingestion exposures for children

[b] From the Dietary Exposure Assessment values were presented as highly refined, daily chronic food + water background exposure (mg/kg bw/day);

[c] Aggregate exposure is the sum of dermal (from post-applicator scenarios), inhalation (not quantified), and active-specific, chronic dietary (from food and water) exposures;

[d] The NOAEL of 9.8 mg/kg bw/day, from the rat reproductive toxicity study, was considered to be the most protective for exposure (NOAEL for all routes, and all durations. The target MOE is 300. Margin of Exposure (MOE) calculated according to Science Policy Notice SPN2003-04.

Table 5 Acute dermal exposure estimates for post-application entry to treated pome fruit (represented by apple) or stone fruit (represented by peach) orchards for pick-your-own scenarios

Population	Application rate [b] (µg a.i./cm^2)	Transfer Co-efficient [a] (cm^2/h)	Dislodgeable foliar residue value (µg a.i./cm^2)	Daily dose [c] (mg a.i./kg bw/day)	Margin of Exposure [d]
Adult (non-worker)	2.1	1500	0.2009	8.61×10^{-5}	290000
Youth		1033		1.06×10^{-4}	235000
Child (6-9)		782		1.16×10^{-4}	215000
Child (1 to <6)		639		1.71×10^{-4}	14600

[a] Adult transfer co-efficient (TC) for hand-harvesting orchard fruit, from Agricultural Re-entry Task Force database; TC values (adults body weight of 70kg, and surface area of 18440 cm^2) were adjusted for average body surface area of Children (1-6, represented by 5-6yr-olds, 15kg) 7860 cm^2, Children (6-9yrs-old, 27kg) 9615 cm^2, Youth (10-12 yrs-old, 39kg) 12700 cm^2 (USEPA 1999)

[b] Assuming a single application at maximum application rate for pome or stone fruit with 14 days spray interval, and 7 days pre-harvest interval for both fruits

[c] EPA Standard Operating Procedures for Residential Exposure Assessment

[d] Margin of Exposure (MOE) = NOAEL/Exposure, based on a NOAEL of 25 mg/kg bw/day from a from a rat reproduction study; compared to the target Margin of Exposure of 100

Table 6 Aggregate exposure for adult, youth, and children performing pick-your-own hand-harvesting and eating pome fruit (represented by apples) or stone fruit (represented by peaches) treated with clothianidin on the same day

Sub-population (age range)	Dermally absorbed systemic dose (mg/kg bw/day)	Dietary (mg/kg bw/day)			Aggregate[c] exposure (mg/kg bw/day)	Total MOE [d] (target = 100)
		Acute [a]	Chronic [b]	Total		
Pome fruit						
Adults	8.6×10^{-5}	3.55×10^{-4}	6.20×10^{-3}	6.55×10^{-3}	6.64×10^{-3}	3770
Youth	1.06×10^{-4}	6.97×10^{-4}	6.74×10^{-3}	7.44×10^{-3}	7.55×10^{-3}	3310
Child (6-9)	1.16×10^{-4}	1.10×10^{-3}	6.74×10^{-3}	7.84×10^{-3}	7.96×10^{-3}	3140
Children (1 to <6)	1.71×10^{-4}	1.58×10^{-3}	1.11×10^{-2}	1.26×10^{-2}	1.28×10^{-2}	1950
Stone fruit						
Adults	8.6×10^{-5}	3.9×10^{-5}	6.20×10^{-3}	6.24×10^{-3}	6.32×10^{-3}	3950
Youth	1.06×10^{-4}	6.78×10^{-4}	6.74×10^{-3}	7.42×10^{-3}	7.53×10^{-3}	3320
Child (6-9)	1.16×10^{-4}	9.50×10^{-4}	6.74×10^{-3}	7.69×10^{-3}	7.81×10^{-3}	3200
Children (1 to <6)	1.71×10^{-4}	2.19×10^{-3}	1.11×10^{-2}	1.33×10^{-2}	$1.34x 10^{-2}$	1860

[a] From the Dietary Exposure Assessment, using the 95th percentile of maximum residue level from supervised residue trials , commodity-specific (fresh apple with peel) presented as a one-day exposure (mg/kg bw/day)

[b] From the Dietary Exposure Assessment values were presented as highly refined, daily chronic food + water background exposure (mg/kg bw/day)

[c] Aggregate exposure is the sum of dermal (from U-pick), acute dietary (commodity-specific) and chronic dietary (from food and water) exposures

[d] The offspring NOAEL of 25 mg/kg bw/day, from the rat developmental neurotoxicity study, was determined to be most protective of the acute dietary and short-term dermal and inhalation exposure. The target MOE (Uncertainty Factor) associated with this study is 100; Margin of Exposure (MOE) calculated according to Science Policy Notice SPN2003-04

Table 7 Food Residue Chemistry Overview of Metabolism Studies and Risk Assessment

DIETARY RISK FROM FOOD AND WATER			
	POPULATION	**ESTIMATED RISK % of ACCEPTABLE DAILY INTAKE (ADI)**	
		Food Only	**Food and Water**
Refined chronic non-cancer dietary risk **ADI = 0.033 mg/kg bw/day** **Estimated chronic drinking water concentration = 303 μg/L**	Total Population	1.1	20.5
	All Infants	2.6	66.0
	Children 1-2 yrs	4.8	33.5
	Children 3-5 yrs	3.4	30.3
	Children 6-12 yrs	1.9	20.4
	Youth 13-19 yrs	0.9	14.9
	Adults 20-49 yrs	0.7	18.8
	Adults 50+ yrs	0.7	19.7
	Females 13-49 yrs	0.7	18.7
	POPULATION	**ESTIMATED RISK % of ACUTE REFERENCE DOSE (ARfD)**	
		Food Only	**Food and Water**
Acute dietary exposure analysis, 95th percentile **Estimated acute drinking water concentration = 305 μg/L** **ARfD = 0.25 mg/kg bw**	Total Population	4.0	9.4
	All Infants	17.4	31.0
	Children 1-2 yrs	21.6	25.8
	Children 3-5 yrs	13.9	18.1
	Children 6-12 yrs	5.3	9.7
	Youth 13-19 yrs	2.7	6.5
	Adults 20-49 yrs	1.9	6.7
	Adults 50+ yrs	2.0	6.2
	Females 13-49 yrs	2.1	6.9

Table 8 Integrated Food Residue Chemistry Summary

Analytical Methodology			PMRA# 1544490
LC-MS/MS **Method 00552 was previously reviewed and accepted as** data gathering and enforcement method to determine residues of clothianidin in plant commodities. This method was used to quantify residues of clothianidin in stone fruits. The other analytical methods (RM-39-A, Meth-157 and Meth-164) are very similar to Method 00552. These data gathering methods were adequate for the determination of clothianidin and TMG (where applicable) based on acceptable concurrent recoveries of 70 to 120% for each analyte at spiking levels ranging from 0.01 to 1.0 ppm.			
Parameters	Plant Matrices		
Method ID	RM-39-A	Meth-157	Meth-164
Type	Data gathering	Data gathering	Data gathering and enforcement
Matrices	Pome fruits and processed commodities	Crops and processed commodities.	
Extractions Solvent	Acetonitrile (ACN):water (2:1; v/v).	ACN/water/guanidine-HCl (20:80:1 v/v/w).	
Cleanup Strategies	Varian ChemElut cartridge and eluted with hexane/ethyl acetate (1:1;v/v).	Clothianidin: ChemElut™ LLE column eluted with cyclohexane/ethyl acetate (1:1 v/v); TMG: ENVI-Carb™ SPE cartridge eluted with methanol/water/acetic acid (80:20:1 v/v/v).	
Analytes	Clothianidin	Clothianidin and TMG	
Instrumentation	HPLC C_{18} column with tandem mass spectrometry (MS/MS) detection; *m/z* 250 to 169 for clothianidin and *m/z* 205 to 132 for TMG.		
LOQ	0.01 ppm	0.02 ppm	0.02 ppm, except for raisins (0.04 ppm).
Standards	Clothianidin	Clothianidin and TMG	
ILV	Method-164 was successfully validated by an independent laboratory.		
Radiovalidation	Extraction efficiency was examined in weathered samples of corn forage, corn stover, corn grain and apples using Method-164.		

Residue Data from Crop Field Trials Treated with Clutch 50 WDG

Stone Fruits [Crop Group 12] | PMRA #1543290; 1543292; 1543295

Fifteen field trials were conducted in representative NAFTA growing regions 1(1 trial), 2 (4 trials), 5 (4 trials), 6 (1 trial), 10 (4 trials) and 11 (1 trial) in or on peaches. At each trial, one foliar application of Clutch™ 50 WDG at a rate of 213-235 g a.i./ha was applied. No adjuvant was added to the spray mixtures. The application was timed so that commercially mature peaches could be collected 6 to 7 days after the application. Five field trials were conducted in representative NAFTA growing regions 5 (3 trials), and 11 (2 trials) in or on cherries. Five field trials were conducted in representative NAFTA growing regions 1A (1 trial), 5 (3 trials), and 11 (1 trial) in or on plums. At each field trial, one foliar application of Clutch™ 50 WDG, at a rate of 219-233 g a.i./ha, was applied. No adjuvant was added to the spray mixtures. The application was timed so that commercially mature cherries and plums could be collected 6 to 8 days after the application.

Commodity	Total Applic. Rate (g a.i./ha)	PHI (days)	n	Clothianidin Residue Levels (ppm)					
				Min.	Max.	HAFT	Median	Mean	Std. Dev.
Peaches	213-235	6-7	30	0.023	0.997	0.819	0.066	0.120	0.199
Cherries	219-228	7-8	10	0.051	0.14	0.14	0.100	0.104	0.034
Plums	220-233	6-7	10	<0.02	<0.02	<0.02	<0.02	<0.02	--

Grapes | PMRA # 1544505

A total of 12 supervised crop field trial studies were conducted in NAFTA representative growing regions (1, 10 and 11) in or on grapes. Grapes were treated during fruit development with either one or two applications of Clutch™ 50 WDG insecticide (50% clothianidin by weight) at a rate of 226 g a.i./ha/season with a 0 day PHI. Additional grape samples from one trial site were harvested at 0, 7, 14 and 21 days after treatment to determine residue decline. Residues declined with increasing PHIs. No adjuvant was added to the spray mixture for all applications.

Commodity	Total Applic. Rate (g a.i./ha)	PHI (days)	n	Clothianidin Residue Levels (ppm)					
				Min.	Max.	HAFT	Median	Mean	Std. Dev.
Grapes [fruit]	220-226 [Foliar]	0	22	0.040	0.410	0.315	0.109	0.139	0.098
Grapes [fruit]	223 [Foliar]	0	2	0.136	0.139	0.138	--	0.138	--
		7	2	0.092	0.130	0.111	--	0.111	--
		14	2	0.073	0.082	0.078	--	0.078	--
		21	2	0.056	0.066	0.061	--	0.061	--

Pome Fruits [Crop Group 11] | PMRA # 1544498;1544500

A total of 20 supervised crop field trial studies were conducted, of which thirteen trials were in NAFTA representative growing regions (1, 2, 5, 9, 10 and 11) for apples and seven trials (1, 10 and 11) for pears, in support of crop group 11 (pome fruits). Apples and pears were treated with a single application of Clutch™ 50 WDG insecticide (50% clothianidin by weight) at a rate of 219 to 225 g a.i./ha with a 6-7 day PHI. Another treatment on apples and pears consisted of two applications (74 + 149 g a.i. /ha) for a total of 223 g a.i./ha/season. Additional apple and pear samples from one trial site were harvested at 3, 7, 14 and 21 days after treatment to determine residue decline. Residues declined with increasing PHIs. No adjuvant was added to the spray mixture for all applications.

Residue Data from Crop Field Trials Treated with Clutch 50 WDG									
Commodity	Total Applic. Rate (g a.i./ha)	PHI (days)	n	Clothianidin Residue Levels (ppm)					
				Min.	Max.	HAFT	Median	Mean	Std. Dev.
Pear [fruit]	221-224	6-7	14	0.041	0.176	0.163	0.125	0.110	0.046
Pear [fruit]	221	3	2	0.201	0.217	0.209	--	0.209	--
		7	2	0.142	0.150	0.146	--	0.146	--
		14	2	0.088	0.092	0.090	--	0.090	--
		21	2	0.062	0.080	0.071	--	0.071	--
Apple [fruit]	219-225	6-7	26	0.01	0.199	0.174	0.085	0.079	0.055
Apple [fruit]	220	3	2	0.122	0.133	0.128	--	0.128	--
		6	2	0.083	0.100	0.092	--	0.092	--
		14	2	0.016	0.026	0.021	--	0.021	--
		21	2	0.021	0.016	0.019	--	0.019	--

Processing Studies in/on Apples and Grapes Treated with Clutch 50 WDG — PMRA # 1544498; 1544505

Apple trees were treated with a single foliar air blast application of Clutch 50 WDG insecticide (50 % clothianidin by weight) at a rate of 664 g a.i./ha, which was approximately threefold the rate used in the magnitude of the residue studies. Apples were harvested 7 days after application and were then processed into apple juice and wet apple pomace.

RAC	Processed Commodity	Total Rate (g a.i./ha)	PHI (Days)	Residues (ppm)	Average Residues (ppm)	Processing Factor
Apple	RAC	664	7	0.371, 0.386	0.379	--
	Juice	664	7	0.052, 0.053	0.053	0.14
	Wet Pomace	664	7	0.091, 0.092	0.092	0.24

Clothianidin was applied to grapes using a water-dispersible granule (WDG) formulation (Clutch™ 50 WDG), as two foliar broadcast applications during fruit development at the rate of 0.544 and 0.567 kg a.i./ha/application, with a re-treatment interval (RTI) of 14 days, for a total application rate of 1.11 kg a.i./ha/season. Grapes were processed into juice and raisins.

RAC	Processed Commodity	Total Rate (kg a.i./ha)	PHI (days)	Residues (ppm)	Average Residues (ppm)	Processing Factor
Grape	RAC	1.11	0	0.738, 0.504	0.621	--
	Juice	1.11	0	0.712, 0.702	0.707	1.1
	Raisins	1.11	0	0.947, 1.02, 1.03, 0.992, 1.05, 1.07	1.02	1.6

Table 9 Fate and Behaviour in the Terrestrial Environment

Property	Test substance	Classification/ Parameter value/ Comments	Reference
Phototransformation on soil	Clothianidin	$t_{½}$ 8.2 days continous irradiation	1194678
Field dissipation and leaching	TI-435 50 WDG (50% clothianidin)	Ephrata, Washington, Ecoregion 10.1 DT_{50} 341 days DT_{90} 1130 days Carry-over residues: 69% of 0-day concentration (end of 4-6 month period for canola and corn). Maximum leaching depth: 45 cm Major transformation products: none Minor transformation products: TZMU	1544535

Table 10 Comparison of the Properties of Clothianidin with the Leaching Criteria of Cohen et al. (1984)

Property	Leaching Criteria	Clothianidin parameter value [a]
Solubility in water (mg/L)	>30	327
K_d	<5 and usually < 1 or 2	0.5 – 4.14
K_{oc} (L/kg)	<300	84-345
Henry's Law Constant (atm·m^3/mol)	< 10^{-2}	9.8×10^{-16}
pK_a	Negatively charged (either fully or partially) at ambient pH	11.09
Hydrolysis half-life (d)	> 140	Stable
Soil phototransformation half-life (d)	> 7	8,2
Half-life in soil (d)	> 14 - 21	990 (aerobic biotransformation)

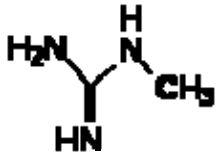
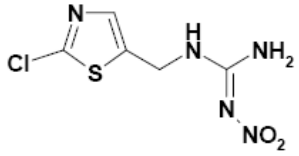
[a] Shaded cells indicate that the Cohen parameter is met or exceeded

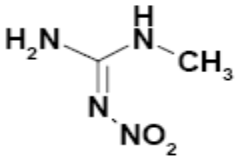
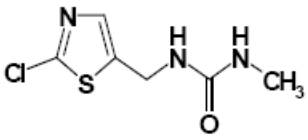
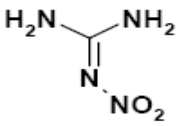
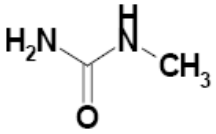
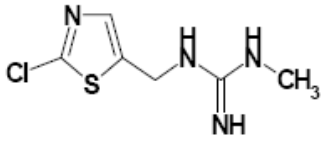
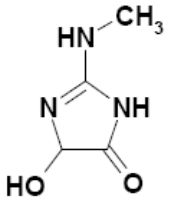
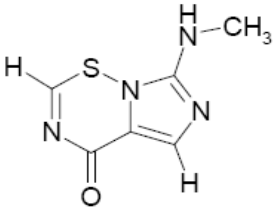
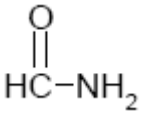
Table 11 Fate and Behaviour in the Aquatic Environment

Property	Test Substance/ System	Classification/Parameter Value/Comments References	
Abiotic transformation			
Phototransformation in water	Clothianidin	Expected to photodegrade in shallow water. $t_{½}$ 3.4 hours, continuous irradiation in sterile buffer solution, 28 hours under a natural sunlight cycle (9h light:15h dark), July/August in Germany, in natural water.	1194126, 1194139, 1194152
	TZMU	$t_{½}$ 24-27 days continuous irradiation	1194126, 1194152
	HMIO	$t_{½}$ 9.5 days continuous irradiation	1194126, 1194152
	MIT	$t_{½}$ 6 days continuous irradiation	1194126, 1194152
	FA	$t_{½}$ 10 days continuous irradiation	1194126, 1194152
	Transformation Products: (PMRA# 1194126, 1194206, 1194152): With the nitroimino-labelled clothianidin: MG (35% at 432 hours), TZMU (29% at 24 hours and decreased to 19% by 432 hours), HMIO (27% at 24 hours and decreased to 7% by 432 hours), MU (11% at 432 hours), MIT (7% at 264 hours), MIO (4% at 24 hours), TMG (2% at 4 hours). Additionally, six unidentified transformation products (<5%). With the thiazolyl-labelled clothianidin:C_{O2} (11% after 24 hours and 34% at 432 hours), TZMU (40% at 24 hours and decreased to 28% by 432 hours), MIT (12% at 24 hours and decreased to 2% by 432 hours), FA [Formamide] (16% at 120 hours and decreased to 14% by 432 hours), MAI (9% at 24 hours), TMG (3% at 24 hours). Additionally, five unidentified transformation products (≤8%).	
Biotransformation			
Biotransformation in aerobic water (no sediment)	Clothianidin	Persistent DT_{50}: > 181 d, extrapolated to 2085 d. Pond water (ca. pH 8.5, dissolved organic carbon 17.0 mg/L) with no sediment from Canada	1194208
	Transformation products: No major transformation products were observed.		

Property	Test Substance/ System	Classification/Parameter Value/Comments References	
Biotransformation in aerobic water/sediment system	Clothianidin	Pond water-loam sediment system water: DT_{50}: 11 d sediment: DT_{50}: 93 d whole system: DT_{50}: 19 d lake water-sandy loam sediment system water: DT_{50}: 26 d sediment: DT_{50}: 106 d whole system: DT_{50}: 50 d Aerobic conditions were not maintained.	1194209
	Transformation products: TMG was the only major transformation products, and it was detected in the sediment portion of both systems: in the loam system, a maximum of 23% of the applied radioactivity was measured on day 58 decreasing to 21% on day 100; while in the sandy loam system; the maximum of 21% was measured on day 100.		
Biotransformation in anaerobic water/sediment system	Clothianidin	Silt loam sediment flooded with pond water under nitrogen atmosphere water: DT_{50}: 14.2 d sediment: DT_{50}: 37.1 d whole system: DT_{50}: 26.7 d Nonextractable residues increased from 0.5% of the AR at day 0 to 46.6% of the AR at 30 days and 80.9% of the AR at 360 days. At 360 days, volatilized 14C-residues totaled <0.1% of the applied. Sediment binding was the primary route of dissipation.	1194210
	Transformation products: No major transformation products were observed.		

Table 12 Chemical Structures of Clothianidin Transformation Products

Abbreviation	Name	Chemical Structure	Terrestrial Environment	Aquatic Environment
MG	methylguanidin		Major transformation product (9%) in aerobic soil; increasing at end of study. ND in anaerobic soil.	Major transformation product in phototransformation study.
TZNG	thiazolyl nitro-guanidine		Moderate mobility. Minor transformation product in field dissipation study.	ND

Abbreviation	Name	Chemical Structure	Terrestrial Environment	Aquatic Environment
MNG	methyl nitro-guanidine		Very high mobility. Minor transformation product in field dissipation study.	ND
TZMU	thiazolyl methylurea		Very high to high mobility. Minor transformation product in field dissipation study.	Major transformation product in phototransformation study.
NTG	nitro-guanidine		Minor transformation product in soil biotransformation study.	ND
MU	methylurea		ND	Major transformation product in phototransformation study.
TMG	thiazolyl methyl-guanidine		Low mobility—immobile. Minor transformation product in field dissipation study.	Major transformation product in aquatic biotransformation study. Minor transformation product in phototransformation study.
HMIO	hydroxy methylamino imidazoline-5-one		ND	Major transformation product in phototransformation study.
MIT	methylamino imidazothiadiazinone		ND	Major transformation product in phototransformation study.
FA	Formamide		ND	Major transformation product in phototransformation study.

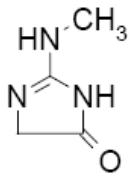
Abbreviation	Name	Chemical Structure	Terrestrial Environment	Aquatic Environment
MIO	methylamino imidazolinone		ND	Minor transformation product in phototransformation study.

Table 13 Effects of Clothianidin on Terrestrial and Aquatic Organisms

Organism	Type of test	Endpoint value	Degree of toxicity	Comments	Reference
Terrestrial invertebrates					
Earthworm *Eisenia foetida*	Clothianidin 14d LC_{50}	15.5 mg a.i./kg soil	N/A	NOEC: <10 mg a.i./kg soil	1194198
	MNG 14d LC_{50}	> 1000 mg/kg soil	N/A	NOEC: 320 mg/kg soil	1194199
	TZNG 14d LC_{50}	982 mg/kg soil	N/A	NOEC: (mortality): 125 mg/kg soil NOEC (bw): 63 mg/kg soil	1194200
Honey bee *Apis mellifera*	Clothianidin 48h contact LC_{50}	49.28 g a.i./ha	Highly toxic	LD_{50}: 0.044 µg a.i./bee [a]	1194190
	Clothianidin 48h oral LC_{50}	4.12 g a.i./ha	Highly toxic	LD_{50}: 0.00368 µg a.i./bee [a]	1194190
	TMG 48h LC_{50}	> 170240 g/ha	Relatively non-toxic	LD_{50}: >152 µg/bee [a]	1194193
	MNG 48h LC_{50}	171360 g/ha	Relatively non-toxic	LD_{50}: >153 µg/bee [a]	1194194
	TZMU 48h LC_{50}	126560 g/ha	Relatively non-toxic	LD_{50}: >113 µg/bee [a]	1194196
	TZNG 48h LC_{50}	4424 g/ha	Moderately toxic	LD_{50}: 3.95 µg/bee [a]	1194197
Terrestrial vascular plants					
Various species[b]	Clothianidin 50% WDG 14d EC_{25}	> 214 g a.i./ha	N/A	NOEC: 214 g a.i./ha	1194205

Organism	Type of test	Endpoint value	Degree of toxicity	Comments	Reference
Freshwater invertebrates					
Water flea *Daphnia magna*	Clothianidin 48h LC_{50}	> 119 mg a.i./L	Practically non-toxic	—	1194141
	TMG 48h LC_{50}	> 115.2 mg/L	Practically non-toxic	NOEC: 33.9 mg/L LOEC: 115.2 mg/L	1194142
	MNG 48h LC_{50}	> 100.8 mg/L	Practically non-toxic	—	1194144
	TZNG 48h LC_{50}	> 64 mg/L	Slightly toxic	NOEC: 11.2 mg/L LOEC: 36.4 mg/L	1194145
	Clothianidin 21d NOEC	0.12 mg a.i./L		No. of juvenile: LOEC: 0.37 mg a.i./L EC_{50}: 7.4 mg a.i./L 21 day LC_{50}: 17.3 mg a.i./L NOEC: 0.12mg a.i./L LOEC: 0.37 mg a.i./L	1194147
Midge *Chironomus riparius*	Clothianidin 48h LC_{50}	0.021 mg a.i./L	Very highly toxic	NOEC: 0.0068 mg a.i./L	1194168
	TZMU 48h LC_{50}	> 101 mg/L	Practically non-toxic	NOEC: 6.15 mg/L	1194168
	MU 48h LC_{50}	> 82 mg/L	Slightly toxic	NOEC: 4.28 mg/L	1194168
	TZNG 48h LC_{50}	0.386 mg/L	Highly toxic	NOEC: 0.247 mg/L	1194168
	MNG 48h LC_{50}	> 101 mg/L	Practically non-toxic	NOEC: < 5.99 mg/L	1194168
	Clothianidin 28d EC_{15}	0.00072 mg/L	N/A	EC_{50} (First instar larvae emergence rate): 0.001 mg a.i./L	1194187
	TMG 28d NOEC	< 0.1 mg/L	N/A		1194188
Marine invertebrates					
Mysid shrimp *Mysidopsis bahia*	Clothianidin 96h LC_{50}	0.051 mg a.i./L	Very highly toxic	NOEC: 0.04 mg a.i./L	1194202
	Clothianidin 39d NOEC	0.0051 mg a.i./L	N/A	EC_{50} (reproduction): 0.0076 mg/L.	1194204
Eastern oyster *Crassostrea virginica*	Clothianidin 96h EC_{50}	> 129.14 mg a.i./L	Practically non-toxic		1194203

Organism	Type of test	Endpoint value	Degree of toxicity	Comments	Reference
Freshwater fish					
Rainbow trout *Oncorhynchus mykiss*	Clothianidin 96h LC_{50}	> 101.5 mg a.i./L	Practically non-toxic	NOEC (mortality): 101.5 mg a.i./L	1194133
	TMG 96h LC_{50}	> 110 mg/L	Practically non-toxic	NOEC (mortality): 110 mg/L	1194135
	MNG 96h LC_{50}	> 105 mg/L	Practically non-toxic	NOEC (mortality): 105 mg/L	1194136
	TZNG 96h LC_{50}	> 116 mg/L	Practically non-toxic	NOEC (mortality): 116 mg/L	1194138
Bluegill sunfish *Lepomis macrochirus*	Clothianidin 96h LC_{50}	> 117 mg/L	Practically non-toxic	NOEC (mortality): 117 mg/L	1194134
Sheepshead minnow *Cyprinodon variegatus*	Clothianidin 96h LC_{50}	> 93.6 mg/L	Slightly toxic	NOEC (mortality): 93.6 mg/L	1194201
Fathead minnow *Pimephales promelas*	Clothianidin 33d NOEC	9.7 mg a.i./L	N/A	Hatching success, post-hatch (larval) survival, wet weight: NOEC: >20 mg a.i./L EC_{50}: >20 mg a.i./L LOEC: >20 mg a.i./L Length: EC_{50}: >20 mg a.i./L LOEC: 20 mg a.i./L Dry weight: EC_{50}: >20 mg a.i./L LOEC: 20 mg a.i./L	1194140
Freshwater algae					
Green algae *Selenastrum capricornutum*	Clothianidin 120h EC_{50}	64 mg a.i./L	Slightly toxic	NOEC: 3.5 mg a.i./L EC_{50} (cell density): 67 mg a.i./L	1194148
	TMG 96h EC_{50}	10 mg/L	Slightly toxic	NOEC: 1.46 mg/L	1194149
	MNG 96h EC_{50}	> 100.6 mg/L	Practically non-toxic	NOEC: 100.6 mg/L	1194150
	TZNG 96h EC_{50}	> 103 mg/L	Practically non-toxic	NOEC: <103 mg/L	1194158
Freshwater vascular plants					
Duckweed *Lemna gibba*	Clothianidin 14d EC_{50}	> 121 mg a.i./L	Practically non-toxic	NOEC: 59 mg a.i./L	1194189

[a] The LD_{50} in µg/bee is converted to the equivalent rate in kg/ha by multiplying 1.12 according to Atkins et al. (1981)
[b] Soybean, lettuce, radish, tomato, pinto bean and cabbage; monocotyledonous species: wheat, ryegrass, corn and onion

Table 14 Screening level risk assessment (direct overspray) on non-target species other than birds and mammals

Subject	Test	Test material	Toxicity	Exposure: Rate; EEC	RQ[a]
Terrestrial invertebrates					
Earthworm *Eisenia foetida*	Acute	Clothianidin	LC_{50}/2: 15.5 mg a.i./kg soil	350 g a.i./ha; 0.16 mg a.i./kg soil	0.02
		MNG	LC_{50}/2:>1000 mg/kg soil	350 g/ha; 0.16 mg/kg soil	<0.01
		TZNG	LC_{50}/2: 982 mg/kg soil	350 g/ha; 0.16 mg/kg soil	<0.01
Honey bee *Apis mellifera*	Contact	Clothianidin	LC_{50}: 49.28 g a.i./ha	210 g a.i./ha	4.26
	Oral	Clothianidin	LC_{50}: 4.122 g a.i./ha	210 g a.i./ha	50.95
		TMG	LC_{50}:>170240 g/ha	210 g/ha	<0.01
		MNG	LC_{50}: 171360 g/ha	210 g/ha	<0.01
		TZMU	LC_{50}: 126560 g/ha	210 g/ha	<0.01
		TZNG	LC_{50}: 4424 g/ha	210 g/ha	0.05
Terrestrial vascular plants					
Various species[b]	Emergence and vigour	Clothianidin 50% WDG	EC_{25}: >214 g a.i./ha	350 g a.i./ha	<1.64
Freshwater invertebrates					
Water flea *Daphnia magna*	Acute	Clothianidin	LC_{50}/2: >59.5 mg a.i./L	350 g a.i./ha; 0.044 mg a.i./L	<0.01
		TMG	LC_{50}/2: >57.6 mg/L	350 g/ha; 0.036 mg/L	<0.01
		MNG	LC_{50}/2: >50.4 mg/L	350 g/ha; 0.021 mg/L	<0.01
		TZNG	LC_{50}/2: >32 mg/L	350 g/ha; 0.036 mg/L	<0.01
	Chronic	Clothianidin	NOEC: 0.12 mg a.i./L	350 g a.i./ha; 0.044 mg/L	0.36

Subject	Test	Test material	Toxicity	Exposure: Rate; EEC	RQ[a]
Midge *Chironomus riparius*	Acute	Clothianidin	LC_{50}/2: 0.0105 mg a.i./L	350 g a.i./ha; 0.044 mg a.i./L	4.17
				210 g a.i./ha; 0.026 mg a.i./L	2.5
				52.5 g a.i./ha ×3; 0.017 mg a.i./L	1.6
		TZMU	LC_{50}/2: >50.5 mg/L	350 g/ha; 0.036 mg/L	<0.01
		MU	LC_{50}/2: >41 mg/L	350 g/ha; 0.013 mg/L	<0.01
		TZNG	LC_{50}/2: 0.193 mg/L	350 g/ha; 0.036 mg/L	0.18
		MNG	LC_{50}/2: >50.5 mg/L	350 g/ha; 0.021 mg/L	<0.01
	Chronic	Clothianidin	EC_{15}: 0.00072 mg a.i./L	350 g a.i./ha; 0.044 mg a.i./L	60.76
				210 g a.i./ha; 0.026 mg a.i./L	36.5
				52.5 g a.i./ha ×3; 0.017 mg a.i./L	24.0
		TMG	NOEC: <0.1 mg/L	350 g/ha; 0.036 mg/L	0.36
Marine invertebrates					
Mysid shrimp *Mysidopsis bahia*	Acute	Clothianidin	LC_{50}/2: 0.0255 mg a.i./L	350 g a.i./ha; 0.044 mg/L	1.72
				210 g a.i./ha; 0.026 mg a.i./L	1.0
	Chronic	Clothianidin	NOEC: 0.0051 mg a.i./L	350 g a.i./ha; 0.044 mg a.i./L	8.58
				210 g a.i./ha; 0.026 mg a.i./L	5.14
				52.5 g a.i./ha ×3; 0.017 mg a.i./L	3.38
Eastern oyster *Crassostrea virginica*	Acute	Clothianidin	EC_{50}: >129.14 mg a.i./L	350 g a.i./ha; 0.044 mg a.i./L	<0.01
Freshwater fish					
Rainbow trout *Oncorhynchus mykiss*	Acute	Clothianidin	LC_{50}/10: >10.15 mg a.i./L	350 g a.i./ha; 0.044 mg/L	<0.01

Subject	Test	Test material	Toxicity	Exposure: Rate; EEC	RQ[a]
	Acute	TMG	LC_{50}/10: >11 mg/L	350 g/ha; 0.036 mg/L	<0.01
	Acute	MNG	LC_{50}/10: >10.5 mg/L	350 g/ha; 0.021 mg/L	<0.01
	Acute	TZNG	LC_{50}/10: >11.6 mg/L	350 g/ha; 0.036 mg/L	<0.01
Bluegill sunfish *Lepomis macrochirus*	Acute	Clothianidin	LC_{50}/10: >11.7 mg/L	350 g/ha; 0.044 mg/L	<0.01
Sheepshead minnow *Cyprinodon variegatus*	Acute	Clothianidin	LC_{50}/10: >9.36 mg/L	350 g/ha; 0.044 mg/L	<0.01
Fathead minnow *Pimephales promelas*	Chronic	Clothianidin	NOEC: 9.7 mg a.i./L	350 g/ha; 0.044 mg/L	<0.01
Amphibians					
Sheepshead minnow *Cyprinodon variegatus* representing amphibians	Acute	Clothianidin	LC_{50}/10: >9.36 mg/L	350 g/ha; 0.2333 mg/L	0.02
Fathead minnow *Pimephales promelas* representing amphibians	Chronic	Clothianidin	NOEC: 0.97 mg a.i./L	350 g/ha; 0.2333 mg/L	0.02
Freshwater algae					
Green algae *Selenastrum capricornutum*	—	Clothianidin	EC_{50}/2: 32 mg a.i./L	350 g/ha; 0.044 mg/L	<0.01
		TMG	EC_{50}/2: 5 mg/L	350 g/ha; 0.036 mg/L	<0.01
		MNG	EC_{50}/2: >50.3 mg/L	350 g/ha; 0.021 mg/L	<0.01
		TZNG	EC_{50}/2: >51.5 mg/L	350 g/ha; 0.036 mg/L	<0.01
Freshwater vascular plant					
Duckweed *Lemna gibba*	—	Clothianidin	EC_{50}: >121 mg a.i./L	350 g/ha; 0.044 mg/L	<0.01

[a] Shaded cells indicate risk quotients larger than the level of concern. Risk quotient (RQ) = expected environmental concentration/toxicity endpoint. For fish, RQ = EEC in an 80 cm deep water body / (EC_{50} ÷ 10 or LC_{50} ÷ 10); for a chronic exposure: RQ = EEC in an 80 cm deep water body / NOEC; for amphibians, the EEC in a 15 cm deep water body is used. For aquatic invertebrates and plants, RQ = EEC in a 80 cm deep water body / (EC_{50} ÷ 2 or LC_{50} ÷ 2); for a chronic exposure: RQ = EEC in a 80 cm deep water body / NOEC. The endpoint values for the most sensitive fish species at the appropriate exposure scenario were used as surrogate data for the amphibian risk assessment.

[b] Soybean, lettuce, radish, tomato, pinto bean and cabbage; monocotyledonous species: wheat, ryegrass, corn and onion

Table 15 Risk Quotients for Birds for a Single 350 g a.i./ha Application

	On Field Risk Quotients (estimated with Upper/Typical residue concentrations)			Off-field Risk Quotients[a] (estimated with Upper/Typical residue concentrations)		
Food Guild	**Small (20g)**	**Medium (100g)**	**Large (1000g)**	**Small (20g)**	**Medium (100g)**	**Large (1000g)**
Acute toxicity endpoint value: 42.3 mg/kg bw/d						
short range grass	—	—	0.3 / 0.1	—	—	<0.1 / <0.1
leaves and leafy crops	—	—	0.6 / 0.2	—	—	<0.1 / <0.1
long grass	—	—	0.2 / <0.1	—	—	<0.1 / <0.1
forage crops	—	—	0.3 / 0.1	—	—	<0.1 / <0.1
small insects	0.4 / 0.2	0.3 / 0.2	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1
large insects	—	<0.1 / <0.1	<0.1 / <0.1	—	<0.1 / <0.1	<0.1 / <0.1
pods with seeds	—	—	<0.1 / <0.1	—	—	<0.1 / <0.1
grain and seeds	0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1
fruit	0.2 / <0.1	0.2 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1
Dietary toxicity endpoint value: 75.2 mg/kg bw/d						
short range grass	—	—	0.2 / <0.1	—	—	<0.1 / <0.1
leaves and leafy crops	—	—	0.4 / 0.1	—	—	<0.1 / <0.1
long grass	—	—	0.1 / <0.1	—	—	<0.1 / <0.1
forage crops	—	—	0.2 / <0.1	—	—	<0.1 / <0.1
small insects	0.2 / 0.1	0.2 / 0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1
large insects	—	<0.1 / <0.1	<0.1 / <0.1	—	<0.1 / <0.1	<0.1 / <0.1
pods with seeds	—	—	<0.1 / <0.1	—	—	<0.1 / <0.1
grain and seeds	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1
fruit	0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1
Reproduction toxicity endpoint value: 22.46 mg/kg bw/d						
short range grass	—	—	0.6 / 0.2	—	—	<0.1 / <0.1
leaves and leafy crops	—	—	1.2 / 0.4	—	—	0.1 / <0.1
long grass	—	—	0.4 / 0.1	—	—	<0.1 / <0.1
forage crops	—	—	0.6 / 0.2	—	—	<0.1 / <0.1
small insects	0.8 / 0.4	0.6 / 0.3	0.2 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1
large insects	—	0.2 / <0.1	<0.1 / <0.1	—	<0.1 / <0.1	<0.1 / <0.1
pods with seeds	—	—	<0.1 / <0.1	—	—	<0.1 / <0.1
grain and seeds	0.2 / <0.1	0.2 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1

	On Field Risk Quotients (estimated with Upper/Typical residue concentrations)			Off-field Risk Quotients[a] (estimated with Upper/Typical residue concentrations)		
Food Guild	**Small (20g)**	**Medium (100g)**	**Large (1000g)**	**Small (20g)**	**Medium (100g)**	**Large (1000g)**
fruit	0.4 / 0.2	0.3 / 0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1

[a] Risk quotient based on expected environmental concentrations (EEC) calculated assuming 11% drift deposition of fine droplets, one meter from the site of application, when applied using ground equipment. Shaded cells indicate risk quotients larger than the level of concern. Risk quotient (RQ) = expected environmental concentration/toxicity endpoint.

Table 16 Risk Quotients for Mammals for a Single 350 g a.i./ha Application

	On Field Risk Quotients (estimated with Upper/Typical residue concentrations)			Off-field Risk Quotients[a] (estimated with Upper/Typical residue concentrations)		
Food Guild	**Small (15g)**	**Medium (35g)**	**Large (1000g)**	**Small (15g)**	**Medium (35g)**	**Large (1000g)**
Acute toxicity endpoint value: 38.9 mg/kg bw/d						
short range grass	—	0.8 / 0.3	0.4 / 0.2	—	<0.1 / <0.1	<0.1 / <0.1
leaves and leafy crops	—	1.5 / 0.5	0.8 / 0.3	—	0.2 / <0.1	<0.1 / <0.1
long grass	—	0.5 / 0.2	0.3 / <0.1	—	<0.1 / <0.1	<0.1 / <0.1
forage crops	—	0.8 / 0.2	0.4 / 0.1	—	<0.1 / <0.1	<0.1 / <0.1
small insects	0.3 / 0.1	0.2 / 0.1	0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1
large insects	—	<0.1 / <0.1	<0.1 / <0.1	—	<0.1 / <0.1	<0.1 / <0.1
pods with seeds	—	—	<0.1 / <0.1	—	—	<0.1 / <0.1
grain and seeds	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1
fruit	0.1 / <0.1	0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1
Chronic toxicity endpoint value: 34.3 mg/kg bw/d						
short range grass	—	0.9 / 0.3	0.5 / 0.2	—	0.1 / <0.1	<0.1 / <0.1
leaves and leafy crops	—	1.7 / 0.6	0.9 / 0.3	—	0.2 / <0.1	0.1 / <0.1
long grass	—	0.6 / 0.2	0.3 / <0.1	—	<0.1 / <0.1	<0.1 / <0.1
forage crops	—	0.9 / 0.3	0.5 / 0.2	—	<0.1 / <0.1	<0.1 / <0.1
small insects	0.3 / 0.2	0.3 / 0.1	0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1
large insects	—	<0.1 / <0.1	<0.1 / <0.1	—	<0.1 / <0.1	<0.1 / <0.1
pods with seeds	—	—	<0.1 / <0.1	—	—	<0.1 / <0.1
grain and seeds	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1
fruit	0.1 / <0.1	0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1

	On Field Risk Quotients (estimated with Upper/Typical residue concentrations)			Off-field Risk Quotients[a] (estimated with Upper/Typical residue concentrations)		
Food Guild	**Small (15g)**	**Medium (35g)**	**Large (1000g)**	**Small (15g)**	**Medium (35g)**	**Large (1000g)**
Reproduction toxicity endpoint value: 9.8 mg/kg bw/d						
short range grass	—	3.2 / 1.2	1.7 / 0.6	—	0.4 / 0.1	0.2 / <0.1
leaves and leafy crops	—	6.1 / 2.0	3.3 / 1.1	—	0.7 / 0.2	0.4 / 0.1
long grass	—	2.0 / 0.6	1.1 / 0.3	—	0.2 / <0.1	0.1 / <0.1
forage crops	—	3.0 / 1.0	1.6 / 0.5	—	0.3 / 0.1	0.2 / <0.1
small insects	1.0 / 0.6	0.9 / 0.5	0.5 / 0.3	0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1
large insects	—	0.2 / 0.1	0.1 / <0.1	—	<0.1 / <0.1	<0.1 / <0.1
pods with seeds	—	—	0.1 / <0.1	—	—	<0.1 / <0.1
grain and seeds	0.3 / 0.1	0.2 / 0.1	0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1
fruit	0.5 / 0.2	0.5 / 0.2	0.2 / 0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1

[a] Risk quotient based on expected environmental concentrations (EEC) calculated assuming 11% drift deposition of fine droplets, one meter from the site of application, when applied using ground equipment. Shaded cells indicate risk quotients larger than the level of concern. Risk quotient (RQ) = expected environmental concentration/toxicity endpoint.

Table 17 Risk Quotients for Birds for a Single 210 g a.i./ha Application

	On Field Risk Quotients (estimated with Upper/Typical residue concentrations)			Off-field Risk Quotients[a] (estimated with Upper/Typical residue concentrations)		
Food Guild	**Small (20g)**	**Medium (100g)**	**Large (1000g)**	**Small (20g)**	**Medium (100g)**	**Large (1000g)**
Acute toxicity endpoint value: 42.3 mg/kg bw/d						
short range grass	—	—	0.2 / <0.1	—	—	0.2 / <0.1
leaves and leafy crops	—	—	0.4 / 0.1	—	—	0.3 / <0.1
long grass	—	—	0.1 / <0.1	—	—	<0.1 / <0.1
forage crops	—	—	0.2 / <0.1	—	—	0.1 / <0.1
small insects	0.3 / 0.1	0.2 / 0.1	<0.1 / <0.1	0.2 / 0.1	0.1 / <0.1	<0.1 / <0.1
large insects	—	<0.1 / <0.1	<0.1 / <0.1	—	<0.1 / <0.1	<0.1 / <0.1
pods with seeds	—	—	<0.1 / <0.1	—	—	<0.1 / <0.1
grain and seeds	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1
fruit	0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1
Dietary toxicity endpoint value: 75.2 mg/kg bw/d						
short range grass	—	—	0.1 / <0.1	—	—	<0.1 / <0.1

	On Field Risk Quotients (estimated with Upper/Typical residue concentrations)			Off-field Risk Quotients[a] (estimated with Upper/Typical residue concentrations)		
Food Guild	**Small (20g)**	**Medium (100g)**	**Large (1000g)**	**Small (20g)**	**Medium (100g)**	**Large (1000g)**
leaves and leafy crops	—	—	0.2 / <0.1	—	—	0.2 / <0.1
long grass	—	—	<0.1 / <0.1	—	—	<0.1 / <0.1
forage crops	—	—	0.1 / <0.1	—	—	<0.1 / <0.1
small insects	0.1 / <0.1	0.1 / <0.1	<0.1 / <0.1	0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1
large insects	—	<0.1 / <0.1	<0.1 / <0.1	—	<0.1 / <0.1	<0.1 / <0.1
pods with seeds	—	—	<0.1 / <0.1	—	—	<0.1 / <0.1
grain and seeds	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1
fruit	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1
Reproduction toxicity endpoint value: 22.46 mg/kg bw/d						
short range grass	—	—	0.4 / 0.1	—	—	0.3 / 0.1
leaves and leafy crops	—	—	0.7 / 0.2	—	—	0.5 / 0.2
long grass	—	—	0.2 / <0.1	—	—	0.2 / <0.1
forage crops	—	—	0.4 / 0.1	—	—	0.3 / <0.1
small insects	0.5 / 0.3	0.4 / 0.2	0.1 / <0.1	0.3 / 0.2	0.3 / 0.2	<0.1 / <0.1
large insects	—	<0.1 / <0.1	<0.1 / <0.1	—	<0.1 / <0.1	<0.1 / <0.1
pods with seeds	—	—	<0.1 / <0.1	—	—	<0.1 / <0.1
grain and seeds	0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1
fruit	0.2 / 0.1	0.2 / <0.1	<0.1 / <0.1	0.2 / <0.1	0.1 / <0.1	<0.1 / <0.1

[a] Risk quotient based on expected environmental concentrations (EEC) calculated assuming 74% drift deposition of fine droplets, one meter from the site of application, when applied using airblast equipment, early season. Shaded cells indicate risk quotients larger than the level of concern. Risk quotient (RQ) = expected environmental concentration/toxicity endpoint

Table 18 Risk Quotients for Mammals for a Single 210 g a.i./ha Application

	On Field Risk Quotients (estimated with Upper/Typical residue concentrations)			Off-field Risk Quotients[a] (estimated with Upper/Typical residue concentrations)		
Food Guild	**Small (15g)**	**Medium (35g)**	**Large (1000g)**	**Small (15g)**	**Medium (35g)**	**Large (1000g)**
Acute toxicity endpoint value: 38.9 mg/kg bw/d						
short range grass	—	0.5 / 0.2	0.3 / <0.1	—	0.4 / 0.1	0.2 / <0.1
leaves and leafy crops	—	0.9 / 0.3	0.5 / 0.2	—	0.7 / 0.2	0.4 / 0.1
long grass	—	0.3 / <0.1	0.2 / <0.1	—	0.2 / <0.1	0.1 / <0.1
forage crops	—	0.5 / 0.1	0.2 / <0.1	—	0.3 / 0.1	0.2 / <0.1

	On Field Risk Quotients (estimated with Upper/Typical residue concentrations)			Off-field Risk Quotients[a] (estimated with Upper/Typical residue concentrations)		
Food Guild	**Small (15g)**	**Medium (35g)**	**Large (1000g)**	**Small (15g)**	**Medium (35g)**	**Large (1000g)**
small insects	0.2 / <0.1	0.1 / <0.1	<0.1 / <0.1	0.1 / <0.1	0.1 / <0.1	<0.1 / <0.1
large insects	—	<0.1 / <0.1	<0.1 / <0.1	—	<0.1 / <0.1	<0.1 / <0.1
pods with seeds	—	—	<0.1 / <0.1	—	—	<0.1 / <0.1
grain and seeds	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1
fruit	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1
Chronic toxicity endpoint value: 34.3 mg/kg bw/d						
short range grass	—	0.6 / 0.2	0.3 / 0.1	—	0.4 / 0.1	0.2 / <0.1
leaves and leafy crops	—	1.0 / 0.3	0.6 / 0.2	—	0.8 / 0.3	0.4 / 0.1
long grass	—	0.3 / 0.1	0.2 / <0.1	—	0.3 / <0.1	0.1 / <0.1
forage crops	—	0.5 / 0.2	0.3 / <0.1	—	0.4 / 0.1	0.2 / <0.1
small insects	0.2 / <0.1	0.2 / <0.1	<0.1 / <0.1	0.1 / <0.1	0.1 / <0.1	<0.1 / <0.1
large insects	—	<0.1 / <0.1	<0.1 / <0.1	—	<0.1 / <0.1	<0.1 / <0.1
pods with seeds	—		<0.1 / <0.1	—	—	<0.1 / <0.1
grain and seeds	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1
fruit	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1	<0.1 / <0.1
Reproduction toxicity endpoint value: 9.8 mg/kg bw/d						
short range grass	—	1.9 / 0.7	1.0 / 0.4	—	1.4 / 0.5	0.8 / 0.3
leaves and leafy crops	—	3.7 / 1.2	2.0 / 0.6	—	2.7 / 0.9	1.4 / 0.5
long grass	—	1.2 / 0.4	0.6 / 0.2	—	0.9 / 0.3	0.5 / 0.2
forage crops	—	1.8 / 0.6	1.0 / 0.3	—	1.3 / 0.4	0.7 / 0.2
small insects	0.6 / 0.3	0.5 / 0.3	0.3 / 0.2	0.5 / 0.3	0.4 / 0.2	0.2 / 0.1
large insects	—	0.1 / <0.1	<0.1 / <0.1	—	0.1 / <0.1	<0.1 / <0.1
pods with seeds	—	—	<0.1 / <0.1	—	—	<0.1 / <0.1
grain and seeds	0.2 / <0.1	0.1 / <0.1	<0.1 / <0.1	0.1 / <0.1	0.1 / <0.1	<0.1 / <0.1
fruit	0.3 / 0.1	0.3 / 0.1	0.1 / <0.1	0.2 / 0.1	0.2 / <0.1	0.1 / <0.1

[a] Risk quotient based on expected environmental concentrations (EEC) calculated assuming 74% drift deposition of fine droplets, one meter from the site of application, when applied using airblast equipment, early season. Shaded cells indicate risk quotients larger than the level of concern. Risk quotient (RQ) = expected environmental concentration/toxicity endpoint

Table 19 Use (label) Claims Proposed by Applicant and Whether Acceptable or Unsupported

Applicant proposed label claims	Accepted label claims	Unsupported label claims
Control of Colorado potato beetle on potato when applied in-furrow	Accepted as proposed	
Control of Colorado potato beetle, aphids, and leafhoppers as a ground or aerial applied foliar application	Accepted as proposed	
Control of leafhoppers, grape phylloxera, thrips, mealybugs and Japanese beetle on grapes	Control of leafhoppers, grape phylloxera, thrips and mealybugs on grapes	Japanese beetle
Control of Oriental fruit moth, aphids, leafhoppers, plum curculio, leafminers, and pear psylla on pome fruit (Crop group 11)	Suppression of Oriental fruit moth and codling moth, control of aphids, leafhoppers, leafminers, plum curculio, and pear psylla on pome fruit (crop group 11)	
Control of Oriental fruit moth, plum curculio, and tarnished plant bug on stone fruit (crop group 12)	Suppression of Oriental fruit moth, control of plum curculio, aphids and leafhoppers on stone fruit (crop group 12)	Tarnished plant bug
Control of white grubs (including European chafer and Japanese beetle), hairy chinch bug, annual bluegrass weevil, bluegrass billbug, sod webworm, black turfgrass ataenius, and European crane fly (leather jackets) on all areas of turfgrass	Control of European chafer, Japanese beetle, masked chafers, Asiatic garden beetle, Oriental beetle, hairy chinch bug, annual bluegrass weevil, bluegrass billbug, European crane fly (leather jackets) on all areas of turfgrass.	Sod webworm and black turfgrass ataenius

Appendix II Supplemental Maximum Residue Limit Information International Situation and Trade Implications

Two of the specified Canadian maximum residue limits (MRLs) are the same as those in the United States. In one case (pome fruits), the MRL differs from the tolerance established in the US Electronic Code of Federal Regulations, 40 CFR Part 180.

Table 1 Comparison of Canadian MRLs, American Tolerances and Codex MRLs

Food Commodity	Canadian MRL (ppm)	American Tolerance (ppm)	Codex[a] MRL (ppm)
Peaches, nectarines	0.8	0.8	No MRL established
Apricots, plumcots, plums, prune plums, sweet cherries, tart cherries	0.8	No tolerance established	No MRL established
Grapes	0.6	0.6	No MRL established
Pome fruits	0.3	1.0	No MRL established

[a] Codex is an international organization under the auspices of the United Nations that develops international food standards, including MRLs.

MRLs may vary from one country to another for a number of reasons, including differences in pesticide use patterns and the locations of the field crop trials used to generate residue chemistry data. For animal commodities, differences in MRLs can be due to different livestock feed items and practices.

Under the North American Free Trade Agreement (NAFTA), Canada, the United States and Mexico are committed to resolving MRL discrepancies to the broadest extent possible. Harmonization will standardize the protection of human health across North America and promote the free trade of safe food products. Until harmonization is achieved, the Canadian MRLs specified in this document are necessary. The differences in MRLs outlined above are not expected to impact businesses negatively or adversely affect international competitiveness of Canadian firms or to negatively affect any regions of Canada.

Appendix III Crop Groups: Numbers and Definitions

Crop Group Number	Name of the Crop Group	Commodity
11	Pome Fruits	Apples Crabapples Loquats Mayhaws Oriental pears Pears Quinces
12	Stone Fruits	Apricots Nectarines Peaches Plumcots Plums Prune plums Sweet cherries Tart cherries

References

A. List of Studies/Information Submitted by Registrant

1.0 Chemistry

PMRA Document Number: 1140672
Reference: 2004, Chemistry requirements for the registration of Clothianidin Technical, Data Numbering Code: 2.1, 2.10, 2.11.1, 2.11.2, 2.11.3, 2.11.4, 2.12.1, 2.13.1, 2.13.2, 2.13.3, 2.13.4, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.9 Confidential Business Information

PMRA Document Number: 1194551
Reference: 2001, Analytical method for the determination of TI-435 and the degradates, TZNG, TZMU, MNG and TMG in soil by liquid chromatography with APCI MS/MS-detection, Data Numbering Code: 8.2.2.1

PMRA Document Number: 1194552
Reference: 2001, Independent laboratory validation of Bayer report number 110263 for the determination of TI-435 and the degradates TZNG, TZMU, MNG and TMG, in soil by high-performance liquid chromatography tandem mass spectrometry (HPLC/MS-MS), Data Numbering Code: 8.2.2.1

PMRA Document Number: 1194553
Reference: 2000, Radiovalidation of the TI-435 soil residue analytical method, Data Numbering Code: 8.2.2.1

PMRA Document Number: 1194554
Reference: 1999, Residue analytical method 00521 (MR-343/98) for determination of TI-435 and the metabolites TZNG, TZMU, MNG and TMG in soil by liquid chromatography with electrospray MS/MS-detection, Data Numbering Code: 8.2.2.1

PMRA Document Number: 1194556
Reference: 2001, Independent laboratory validation of Bayer report number 109586 for the determination of TI-435 and the degradates TZNG, TZMU, MNG and TMG, in soil by high-performance liquid chromatography tandem mass spectromethry (HPLC/MS/MS), Data Numbering Code: 8.2.2.1

PMRA Document Number: 1194557
Reference: 2000, Enforcement method 00659 for the determination of the residues of TI-435 in drinking and surface water, Data Numbering Code: 8.2.2.3

PMRA Document Number: 1256055
Reference: 2001, OECD Document M: Tier II Annex II: Summaries on the active substance clothianidin (TI-435), Data Numbering Code: 2 Confidential Business Information

PMRA Document Number: 1256056
Reference: 2001, Product chemistry of Clothianidin Technical, report BR 2069, Data Numbering Code: 2 Confidential Business Information

PMRA Document Number: 1256058
Reference: 2001, Product chemistry of Clothianidin Technical, report BR 2068, Data Numbering Code: 2 Confidential Business Information

PMRA Document Number: 1256079
Reference: 2000, Partition coefficient in octanol-water of TI435-TZNG, Data Numbering Code: 2 Confidential Business Information

PMRA Document Number: 1256089
Reference: 2000, Partition coefficient in octanol-water of TI435-MNG, Data Numbering Code: 2 Confidential Business Information

PMRA Document Number: 1256090
Reference: 2001, Partition coefficient in octanol-water of TI435-TZMU, Data Numbering Code: 2 Confidential Business Information

PMRA Document Number: 1256091
Reference: 2001, Partition coefficient in octanol-water of TI435-TMG, Data Numbering Code: 2 Confidential Business Information

PMRA Document Number: 1544430
Reference: 2007, Product identification for DACO 3.1.1 to 3.1.4 for Clothianidin Insecticide, Data Numbering Code: 3.1.1, 3.1.2, 3.1.3, 3.1.4

PMRA Document Number: 1544432
Reference: 2007, Description of starting materials for Clothianidin Insecticide, Data Numbering Code: 3.2.1 Confidential Business Information

PMRA Document Number: 1544433
Reference: 2001, Product identity, composition and analysis of TM-444 50 WDG, Physical/chemical properties of TM-444 50 WDG, Data Numbering Code: 3.2.2, 3.2.3, 3.3.1, 3.4.1, 3.4.2

PMRA Document Number: 1544436
Reference: 2001, Physical and chemical properties of V-10066 50 WDG, Data Numbering Code: 3.5.1, 3.5.2, 3.5.6, 3.5.7, 3.5.8

PMRA Document Number: 1544437
Reference: 2003, TM-44401: Determination of storage stability and corrosion characteristics, Data Numbering Code: 3.5.10, 3.5.14

PMRA Document Number: 1544439
Reference: 2001, TM-44401: Determination of odor, Data Numbering Code: 3.5.3

PMRA Document Number: 1544440
Reference: 2007, Formulation type and container material and description for Clothianidin Insecticide, Data Numbering Code: 3.5.4, 3.5.5

PMRA Document Number: 1544441
Reference: 2007, Waiver for the requirement of a viscosity study, flammability, explodability, miscibility and dielectric breakdown voltage for Clothianidin Insecticide, Data Numbering Code: 3.5.11, 3.5.12, 3.5.13, 3.5.15, 3.5.9

PMRA Document Number: 1544442
Reference: 2007, Submission of sample(s) of Clothianidin Insecticide, Data Numbering Code: 3.6

PMRA Document Number: 1544443
Reference: 2001, TM-44401: Determination of accelerated storage stability, Data Numbering Code: 3.7

2.0 Human and Animal Health

PMRA Document Number: 1543290
Reference: 2007, Clothianidin: Magnitude of the residue on plum, Data Numbering Code: 7.2.1, 7.3, 7.4.1

PMRA Document Number: 1543292
Reference: 2007, Clothianidin: Magnitude of the residue on cherry, Data Numbering Code: 7.2.1, 7.3, 7.4.1

PMRA Document Number: 1543295
Reference: 2007, Clothianidin: Magnitude of the residue on peach, Data Numbering Code: 7.2.1, 7.3, 7.4.1

PMRA Document Number: 1544445
Reference: 2000, V-10066 50 WDG: Acute oral toxicity study in rats, Data Numbering Code: 4.6.1

PMRA Document Number: 1544447
Reference: 2000, V-10066 50 WDG: Acute dermal toxicity study in rats, Data Numbering Code: 4.6.2

PMRA Document Number: 1544449
Reference: 2000, V-10066 50 WDG: Acute (4-hour) inhalation toxicity study in the rat via nose-only exposure, Data Numbering Code: 4.6.3

PMRA Document Number: 1544451
Reference: 2000, V-10066 50 WDG: Acute eye irritation study in rabbits, Data Numbering Code: 4.6.4

PMRA Document Number: 1544453
Reference: 2000, V-10066 50 WDG: Acute dermal irritation study in rabbits, Data Numbering Code: 4.6.5

PMRA Document Number: 1544455
Reference: 2000, V-10066 50 WDG: Skin sensitization study in guinea pigs (Buehler method), Data Numbering Code: 4.6.6

PMRA Document Number: 1544461
Reference: 2007, Summary of occupational exposure for Clothianidin Insecticide, Data Numbering Code: 5.1

PMRA Document Number: 1544465
Reference: 2007, Use description and scenario (mixer/loader/applicator and post-application) for Clothianidin Insecticide, Data Numbering Code: 5.2

PMRA Document Number: 1544466
Reference: 2007, Pesticide handlers exposure database assessment for Clothianidin Insecticide, Data Numbering Code: 5.3, 5.4, 5.5

PMRA Document Number: 1544468
Reference: 2007, Discussion of the requirement of a dermal absorption study for Clothianidin Insecticide, Data Numbering Code: 5.8

PMRA Document Number: 1544490
Reference: 2004, Independent laboratory validation for the determination of TM-444 and TMG in grapes, Data Numbering Code: 7.2.3

PMRA Document Number: 1544498
Reference: 2001, Magnitude of the residues of clothianidin in apples and apple processing products, Data Numbering Code: 7.2.1, 7.2.5, 7.3, 7.4.1, 7.4.2, 7.4.5

PMRA Document Number: 1544500
Reference: 2001, Magnitude of the residues of clothianidin in pears, Data Numbering Code: 7.2.1, 7.2.5, 7.4.1, 7.4.2

PMRA Document Number: 1544505
Reference: 2004, Magnitude of the residue of TM-444 and its metabolite in grape raw agricultural and processed commodities, Data Numbering Code: 7.2.1, 7.2.5, 7.3, 7.4.1, 7.4.2, 7.4.5

3.0 Environment

PMRA Document Number: 1194133
Reference: 1998, TI-435 technical: Fish (rainbow trout), acute toxicity test, 96 h, limit test, Data Numbering Code: 9.5.2.1

PMRA Document Number: 1194134
Reference: 2000, TI-435 technical: A 96-hour static acute toxicity test with the bluegill (*Lepomis macrochirus*), Data Numbering Code: 9.5.2.2

PMRA Document Number: 1194135
Reference: 2000, TI 435 – Thiaolylmethylguanidine – Acute toxicity (96 hours) to rainbow trout (*Oncorhynchus mykiss*) in a static test (limit test), Data Numbering Code: 9.5.2.1

PMRA Document Number: 1194136
Reference: 2000, N-Methylnitroguanidine – Acute toxicity (96 hours) to rainbow trout (*Oncorhynchus mykiss*) in a static test (limit test), Data Numbering Code: 9.5.2.1

PMRA Document Number: 1194138
Reference: TI 435 – Thiazolylnitroguanidine – Acute toxicity (96 hours) to rainbow trout (*Oncorhynchus mykiss*) in a static test (limit test), Data Numbering Code: 9.5.2.1

PMRA Document Number: 1194140
Reference: 2000, TI-435 technical: An early life-stage toxicity test with the fathead minnow (*Pimephales promelas*), Data Numbering Code: 9.5.3.1

PMRA Document Number: 1194141
Reference: 2000, TI-435 technical: a 48-hour static acute toxicity test with the cladoceran (*Daphnia magna*), Data Numbering Code: 9.3.2

PMRA Document Number: 1194142
Reference: 2000, Acute toxicity of TI 435-thiazolylmethylguanidine (techn.) to water fleas (*Daphnia magna*), Data Numbering Code: 9.3.2

PMRA Document Number: 1194144
Reference: 2000, Acute toxicity of n-methylnitroguanidine (techn.) to water fleas *(Daphnia magna*), Data Numbering Code: 9.3.2

PMRA Document Number: 1194145
Reference: 2000, Acute toxicity of TI 435-thiazolylnitroguanidine (techn.) to water fleas (*Daphnia magna*), Data Numbering Code: 9.3.2

PMRA Document Number: 1194147
Reference: 1998, TI 435 technical: *Daphnia magna* reproduction test (21 d), Data Numbering Code: 9.3.3

PMRA Document Number: 1194148
Reference: 2000, TI 435 technical: A 5-day toxicity test with the freshwater alga (*Selenastrum capricornutum*), Data Numbering Code: 9.8.2

PMRA Document Number: 1194149
Reference: 2000, TI 435-thiazolylmethylguanidine – Influence on the growth of the green alga, *Selenastrum capricornutum*, Data Numbering Code: 9.8.2

PMRA Document Number: 1194150
Reference: 2000, N-Methylnitroguanidine – Influence on the growth of the green alga, *Selenastrum capricornutum*, Data Numbering Code: 9.8.2

PMRA Document Number: 1194158
Reference: 2000, TI 435-thiazolylnitroguanidine – Influence on the growth of the green alga, *Selenastrum capricornutum*, Data Numbering Code: 9.8.2

PMRA Document Number: 1194168
Reference: 2001, TI-435: Comparative acute toxicity of *Chironomus riparius* with TZMU, MU, TZNG and MNG, Data Numbering Code: 9.3.4

PMRA Document Number: 1194187
Reference: 1999, Influence of TI 435 technical on development and emergence of larvae of *Chironomus riparius* in a water-sediment system, Data Numbering Code: 9.3.4

PMRA Document Number: 1194188
Reference: 1998, Influence of TMG (tech.) on development and emergence of larvae of *Chironomus riparius* in a water-sediment system, Data Numbering Code: 9.3.4

PMRA Document Number: 1194189
Reference: 2000, TI-435 Technical: A 14-day static-renewal toxicity test with duckweed (*Lemna gibba* G3), Data Numbering Code: 9.8.5

PMRA Document Number: 1194190
Reference: 1998, TI-435 technical: Acute contact and oral toxicity to honey bees, Data Numbering Code: 9.2.4.2

PMRA Document Number: 1194193
Reference: 2000, TI-435 metabolite TMG: Acute oral toxicity to honey bees (*Apis mellifera*), Data Numbering Code: 9.2.4.2

PMRA Document Number: 1194194
Reference: 2000, TI-435 metabolite MNG: Acute oral toxicity to honey bees (*Apis mellifera*), Data Numbering Code: 9.2.4.2

PMRA Document Number: 1194196
Reference: 2000, TI-435 metabolite TZMU: Acute oral toxicity to honey bees (*Apis mellifera*), Data Numbering Code: 9.2.4.2

PMRA Document Number: 1194197
Reference: 2000, TI-435 metabolite TZNG: Acute oral toxicity to honey bees (*Apis mellifera*), Data Numbering Code: 9.2.4.2

PMRA Document Number: 1194198
Reference: 1998, TI-435 technical: Acute toxicity to the earthworm *Eisenia foetida*, Data Numbering Code: 9.2.3.1

PMRA Document Number: 1194199
Reference: 2000, MNG: Earthworm (*Eisenia foetida*), Acute toxicity test in artificial soil, Data Numbering Code: 9.2.3.1

PMRA Document Number: 1194200
Reference: 2000, TZNG: Earthworm (*Eisenia foetida*), Acute toxicity test in artificial soil, Data Numbering Code: 9.2.3.1

PMRA Document Number: 1194201
Reference: 1999, TI-435 technical: Fish (sheepshead minnow), acute toxicity, limit test, 96h, semi-static, Data Numbering Code: 9.5.2.4

PMRA Document Number: 1194202
Reference: 2000, TI-435 technical: A 96-hour flow-through acute toxcity test with the saltwater mysid (*Mysidopsis bahia*), Data Numbering Code: 9.4.2

PMRA Document Number: 1194203
Reference: 1999, TI-435 technical: Oyster, acute toxicity test (shell deposition), limit test, flow-through, 96h, Data Numbering Code: 9.4.4

PMRA Document Number: 1194204
Reference: 2000, TI-435 technical: A flow-through life-cycle toxicity test with the saltwater mysid (*Mysidopsis bahia*), Data Numbering Code: 9.4.5

PMRA Document Number: 1194205
Reference: 2000, TI-435 50% WDG: A toxicity test to determine the effects of the test substance on seedling emergence of ten species of plants, Data Numbering Code: 9.8.4

PMRA Document Number: 1194678
Reference: 1999, Photolysis of [guanidine-^{14}C] TI-435 on soil surface, Data Numbering Code: 8.3.2.2.1

PMRA Document Number: 1544535
Reference: 2001, TI-435 – Terrestrial field dissipation study, Washington 1998, Data Numbering Code: 8.3.2.2

4.0 Value

PMRA Document Number: 1194890
Reference: 2001, OECD Document N: Tier III overall summaries and assessment on clothianidin (TI-435), Data Numbering Code: 10.1, 4.1, 5.1, 6.1, 7.1, 8.1, 9.1

PMRA Document Number: 1543296
Reference: 2007, Efficacy and toxicity of Clutch 50 WDG (clothianidin) for the control of plum curculio (*Conotrachelus nenuphar*), tarnished plant bug (*Lygus lineolaris*) and oriental fruit moth (*Grapholita molesta*) on stone fruits, Data Numbering Code: 10.1

PMRA Document Number: 1543297
Reference: 2007, Efficacy tables for clothianidin on stone fruits, Data Numbering Code: 10.2.3.1

PMRA Document Number: 1543298
Reference: 2005, Efficacy reports for clothianidin on stone fruits, Data Numbering Code: 10.2.3.3

PMRA Document Number: 1543299
Reference: 2004, Efficacy reports for clothianidin on apples, Data Numbering Code: 10.6

PMRA Document Number: 1544406
Reference: 2007, Efficacy tables for clothianidin on potatoes, turf, apples, pears, and grapes, Data Numbering Code: 10.1, 10.2.1, 10.2.2, 10.2.3, 10.2.3.1, 10.2.3.2, 10.2.3.3, 10.2.3.4, 10.3.1, 10.3.2, 10.3.3

PMRA Document Number: 1544407
Reference: 2008, Value summary for Clothianidin Insecticide, Data Numbering Code: 10.1, 10.2.1, 10.2.2, 10.2.3, 10.2.3.1, 10.2.3.2, 10.2.3.3, 10.2.3.4, 10.3.1, 10.3.2, 10.3.3, 10.4, 10.5.1, 10.5.2, 10.5.3, 10.5.4, 10.6

PMRA Document Number: 1544408
Reference: 2008, Turf efficacy studies, Data Numbering Code: 10.1, 10.2.1, 10.2.2, 10.2.3, 10.2.3.1, 10.2.3.2, 10.2.3.3, 10.2.3.4, 10.3.1, 10.3.2, 10.3.3, 10.4, 10.5.1, 10.5.2, 10.5.3, 10.5.4, 10.6

PMRA Document Number: 1735775
Reference: 2007, Efficacy tables for clothianidin on stone fruit trials, Data Numbering Code: 10.2.3.1

PMRA Document Number: 1735776
Reference: 2007, Efficacy of Clothianidin WDG against aphids in cherry, Data Numbering Code: 10.2.3.3

PMRA Document Number: 1735777
Reference: 2007, Efficacy of clothianidin for the control of aphids in peach, Data Numbering Code: 10.2.3.3

PMRA Document Number: 1735778
Reference: 2007, Efficacy of clothianidin for the control of aphids in sweet cherry, Data Numbering Code: 10.2.3.3

PMRA Document Number: 1735779
Reference: 2007, Efficacy of clothianidin for the control of aphids in sour cherry, Data Numbering Code: 10.2.3.3