Proposed Registration Decision PRD2016-27

4-Chloroindole-3-Acetic Acid

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Overview

Proposed Registration Decision for 4-Chloroindole-3-Acetic Acid

Health Canada's Pest Management Regulatory Agency (PMRA), under the authority of the *Pest Control Products Act* and Regulations, is proposing full registration for the sale and use of GHA-360 Selective Herbicide Technical and the associated domestic end-use products, Wilson Lawn WeedOut(1) Selective Weed Control, Wilson Lawn WeedOut(2) Selective Weed Control, Wilson Lawn WeedOut(1) Battery Powered, Wilson Lawn WeedOut(2) Battery Powered, Wilson Lawn WeedOut Concentrate 10X, Wilson Lawn WeedOut Concentrate 3X, Lawn WeedOut(1) Selective Weed Control, Lawn WeedOut(2) Selective Weed Control and the commercial end-use product WeedOut PRO, containing the technical grade active ingredient 4-chloroindole-3-acetic acid, to control small patches or individual broadleaf weeds as a spot treatment in 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.

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 360 Selective Herbicide Technical (containing 4-chloroindole-3-acetic acid) and the associated end-use products.

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 (for example, children) as well as organisms in the environment. These methods and

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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."

policies also consider the nature of the effects observed and the uncertainties when predicting the impact of pesticides. For more information 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.

Before making a final registration decision on 4-chloroindole-3-acetic acid, the PMRA will consider any comments received from the public in response to this consultation document.[3] The PMRA will then publish a Registration Decision[4] on 4-chloroindole-3-acetic acid, which will include the decision, the reasons for it, a summary of comments received on the proposed final registration decision and the PMRA's response to these comments.

For more details on the information presented in this Overview, please refer to the Science Evaluation of this consultation document.

What Is 4-Chloroindole-3-Acetic Acid?

4-Chloroindole-3-acetic acid is a member of the chemical class of chlorinated derivatives of indole-3-acetic acid. It is a naturally occurring plant hormone found in seeds of a variety of annual plants, and then is secreted from developing seeds into parent plants, triggering nutrient mobilization and translocation to seeds, followed by senescence of the parent plant. The herbicidal effect of 4-chloroindole-3-acetic acid was first reported in 1996. Symptoms and eventual death of plants treated with 4-chloroindole-3-acetic acid are thought to be induced by abnormal levels of ethylene in tissues.

End-use products containing 4-chloroindole-3-acetic acid are to be applied to small patches or individual broadleaf weeds as a spot treatment at 4.5 g active ingredient/L in turf for control of dandelion and plantain and top growth control of black medic, cinquefoil, fall hawkbit, and hawkweed. Applications should be made to actively growing weeds, any time during the year, until foliage is thoroughly wet, but not to the point of runoff. For hard to kill weeds, a repeat application is required after four to six weeks.

4-Chloroindole-3-acetic acid is classified as a Group 4 herbicide according to the Weed Science Society of America (WSSA) and as a Group O herbicide according to Herbicide Resistance Action Committee (HRAC).

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3 "Consultation statement" as required by subsection 28(2) of the *Pest Control Products Act*.

4 "Decision statement" as required by subsection 28(5) of the *Pest Control Products Act*.

Health Considerations

Can Approved Uses of 4-Chloroindole-3-Acetic Acid Affect Human Health?

4-Chloroindole-3-acetic acid is unlikely to affect human health when used according to label directions.

Exposure to 4-chloroindole-3-acetic acid can occur when handling and applying products containing the compound, or when coming into contact with treated turf. 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. Only uses for which the exposure is well below levels that cause no effects in animal testing are considered acceptable for registration.

In laboratory animals, 4-chloroindole-3-acetic acid was of low acute toxicity via the oral, dermal and inhalation routes of exposure. The compound was also minimally irritating to the eyes, non-irritating to the skin, and not a dermal sensitizer. Based on a review of submitted animal toxicity tests, information in waiver rationales, and Quantitative Structure Activity Relationship model predictions, 4-chloroindole-3-acetic acid is not expected to have any short- or long-term health effects.

The end-use products containing 4-chloroindole-3-acetic acid are considered to be of low acute toxicity via the oral, dermal, and inhalation routes of exposure. The end-use products are also considered to be minimally irritating to the eyes, non-irritating to the skin, and not dermal sensitizers.

Residues in Water and Food

Dietary risks from food and water are not of concern

No dietary risks are expected as the end-use products are not applied to food crops and spot treatment applications to lawns and turf are not expected to result in exposures or risks from drinking water.

Risks in Residential and Other Non-Occupational Environments

Estimated risks for non-occupational exposure is not of concern

Users of domestic end-use products containing 4-chloroindole-3-acetic acid can come in direct contact with end-use products when handling and applying ready-to-use products to turf, when mixing and loading the concentrated products, and during any clean-ups and repairs. Because of the toxicity profiles of 4-chloroindole-3-acetic acid and the end-use products, the methods of application, and the spot treatment use pattern, risks to users of domestic end-use products are not expected to be of concern when the products are applied according to label directions.

Recreational and other users of lawns and turf could be exposed to residues of 4-chloroindole-3-acetic acid when contacting surfaces treated with the domestic or commercial end-use products before sprays have dried. The labels for the products include advice on avoiding activities that

could result in skin contact with treated lawns or turf until residues have dried. Considering toxicity profiles of 4-chloroindole-3-acetic acid and the end-use products, the spot treatment use patterns, relatively low estimates of postapplication exposures, and the precautionary statements on the labels, risks to these individuals are not a concern.

Occupational Risks From Handling Products Containing 4-Chloroindole-3-Acetic Acid

Occupational risks are not of concern when the commercial end-use product, Weedout PRO, containing 4-chloroindole-3-acetic acid is used according to the proposed label directions, which include protective measures

Workers can come in direct contact with the commercial end-use product, Weedout PRO, containing 4-chloroindole-3-acetic acid when mixing, loading, and applying the end-use product, and during clean-ups and repairs. Also, potential exposures could be greater for the commercial end-use product because of the greater amounts of product handled and the repeated short-term use pattern.

Occupational risks to workers handling the commercial end-use product, Weedout PRO, are not expected to be of concern because of the toxicity profiles of 4-chloroindole-3-acetic acid and the commercial product, the amounts of active ingredient handled daily, the spot treatment pattern of use, and the label precautionary measures. Based on a similar reasoning and label precautionary statements on avoiding contact with treated turf surfaces, postapplication occupational exposures are not expected to be of concern.

Environmental Considerations

What Happens When 4-Chloroindole-3-Acetic Acid Is Introduced Into the Environment?

4-Chloroindole-3-acetic acid is not expected to pose risks of concern to the environment when used according to label instructions.

4-Chloroindole-3-acetic acid has low solubility and is not expected to breakdown in presence of water. 4-Chloroindole-3-acetic acid is transformed by microbes and is not expected to persist in the environment or to move through soil into groundwater. 4-Chloroindole-3-acetic acid will not build up in organisms and is not expected to be present in air. 4-Chloroindole-3-acetic acid is expected to be toxic to terrestrial and aquatic vascular plants. Exposure to other terrestrial and aquatic organisms will be minimal if use directions are followed, which includes the use of hand-held or back-pack application equipment. Use of 4-chloroindole-3-acetic acid as a spot treatment on weeds in turf is not expected to pose risks of concern to non-target terrestrial and aquatic organisms.

Value Considerations

What Is the Value of the Wilson Lawn WeedOut End-use Products?

Wilson Lawn WeedOut end-use products as a non-conventional herbicide may be used for control or top growth control of broadleaf weeds in domestic turf.

There are nine end-use products containing 4-chloroindole-3-acetic acid including eight domestic class products:

- Wilson Lawn WeedOut(1) Selective Weed Control
- Wilson Lawn WeedOut(2) Selective Weed Control
- Wilson Lawn WeedOut(1) Battery Powered
- Wilson Lawn WeedOut(2) Battery Powered
- Wilson Lawn WeedOut Concentrate 10X
- Wilson Lawn WeedOut Concentrate 3X
- Lawn WeedOut(1) Selective Weed Control
- Lawn WeedOut(2) Selective Weed Control

and one commercial class product:

- WeedOut PRO

The nine products share two basic formulations, but differ in spray device, product guarantee, and container size. These products provide control of dandelion and plantain and top growth control of black medic, cinquefoil, fall hawkbit, and hawkweed in turf with a spot application at 4.5 g active ingredient/L.

In recent years, several non-conventional herbicides have been registered for domestic weed management. Such herbicides include citric acid and lactic acid, corn gluten meal, *Sclerotinia minor*, ammonium soaps of fatty acids, sodium chloride, FeHEDTA, *Phoma macrostoma*, and *Streptomyces acidiscabies*. 4-Chloroindole-3-acetic acid, as a naturally occurring plant hormone, has been classified as a non-conventional herbicide. The registration of the Wilson Lawn WeedOut Herbicides may provide a tool with a different herbicidal mode of action for home owners and lawn care professionals to manage broadleaf weeds in domestic turf.

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 label of the end-use products to address the potential risks identified in this assessment are as follows.

Key Risk-Reduction Measures

Human Health

The toxicological profile of the technical grade active ingredient raises no hazards of concern. Each end-use product label contains a statement notifying users of the presence of a preservative, 1,2-benzisothiazolin-3-one (0.039%), in the product. For the commercial end-use product, the label includes the following precautionary statements to minimize human exposure during mixing, loading, application, clean-ups, and repairs: “Wear safety goggles, chemical resistant gloves, long pants and long-sleeved shirt, with shoes and socks during mixing, loading, application, clean-ups, and repairs.” and “Wash hands thoroughly with soap and water before eating, drinking or smoking. Remove protective equipment immediately after handling, wash thoroughly and change into clean clothing.” The following statements are included on the labels for all end-use products to minimize postapplication exposure to treated lawns and turf: “Avoid any activities that could result in skin contact with treated lawns or turf surfaces until residues have dried.”

Environment

4-Chloroindole-3-acetic acid is expected to be toxic to terrestrial and aquatic vascular plants. Hazard label statements are required.

Next Steps

Before making a final registration decision on 4-chloroindole-3-acetic acid, the PMRA will consider any comments received from the public in response to this consultation document. The PMRA will accept written comments on this proposal up to 45 days from the date of publication of this document. Please forward all comments to Publications (contact information on the cover page of this document). The PMRA will then publish a Registration Decision, which will include its decision, the reasons for it, a summary of comments received on the proposed final decision and the Agency’s response to these comments.

Other Information

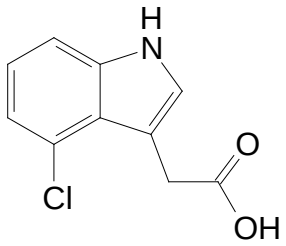
When the PMRA makes its registration decision, it will publish a Registration Decision on 4-chloroindole-3-acetic acid (based on the Science Evaluation of this consultation document). In addition, the test data referenced in this consultation document will be available for public inspection, upon application, in the PMRA’s Reading Room (located in Ottawa).

Science Evaluation

4-Chloroindole-3-Acetic Acid

1.0 The Active Ingredient, Its Properties and Uses

1.1 Identity of the Active Ingredient

Active substance	4-chloroindole-3-acetic acid
Function	Herbicide
Chemical name	
1. International Union of Pure and Applied Chemistry (IUPAC)	(4-chloro-1*H*-indol-3-yl)acetic acid
2. Chemical Abstracts Service (CAS)	1*H*-indole-3-acetic acid, 4-chloro-
CAS number	2519-61-1
Molecular formula	$C_{10}H_8ClNO_2$
Molecular weight	209.63
Structural formula	
Purity of the active ingredient	99.3%

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

Technical Product—GHA-360 Selective Herbicide Acid Technical

Property	Result
Colour and physical state	Beige to light brown
Odour	Odourless
Melting range	189-195°C
Boiling point or range	N/A

Property	Result
Bulk density	0.75 g/cm^3
Vapour pressure at 25°C	0.19 mPa
Ultraviolet (UV)-visible spectrum	pH λ (nm) ε (L·mol^{-1}·cm^{-1}) neutral 220 35314.5 280 6248.7 acidic 221 35762.3 279 6493.0 basic 224 33665.8 281 6147.0 No absorption at λ > 300 nm.
Solubility in water at 22°C	3.97 g/L (pH 7)
Solubility in organic solvents	Soluble in methanol, ethanol, acetone, dimethyl sulfoxide, lipids, isopropanol; insoluble in dichloromethane and hexanes.
n-Octanol-water partition coefficient (K_{ow})	Log K_{ow} = 2.13
Dissociation constant (pK_a)	4.7
Stability (temperature, metal)	Stable when stored between 4°C and 30°C, away from direct light. Not stable in the presence of strong oxidizing agents. The presence of high intensity UV light can result in oxidation.

End-Use Product—Wilson Lawn WeedOut Selective Weed Control, Wilson Lawn WeedOut Battery Powered and Lawn WeedOut Selective Weed Control

Property	Result
Colour	Amber (pale yellow)
Odour	N/A
Physical state	Liquid
Formulation type	Solution (SN)
Guarantee	4.5 g/L
Container material and description	High Density Polyethylene (HDPE) bottles
Density	1.03 g/cm^3
pH of 1% dispersion in water	7.5
Oxidizing or reducing action	Expected to be incompatible with oxidizers
Storage stability	Stable for one year when stored in HDPE containers at 25°C and 60% relative humidity
Corrosion characteristics	Non-corrosive to the HDPE packaging material
Explodability	Non-explosive

End-Use Product—Wilson Lawn WeedOut Battery Powered, Wilson Lawn WeedOut Selective Weed Control and Lawn WeedOut Selective Weed Control

Property	Result
Colour	Amber (pale yellow)
Odour	N/A
Physical state	Liquid
Formulation type	Solution (SN)
Guarantee	4.5 g/L
Container material and description	High Density Polyethylene (HDPE) bottles
Density	1.00 g/cm^3
pH of 1% dispersion in water	7.5
Oxidizing or reducing action	Expected to be incompatible with oxidizers
Storage stability	Stable for one year when stored in HDPE containers at 25°C and 60% relative humidity
Corrosion characteristics	Non-corrosive to the HDPE packaging material
Explodability	Non-explosive

End-Use Product—Wilson Lawn Weedout Concentrate 10X and Weedout PRO

Property	Result
Colour	Amber (pale yellow)
Odour	N/A
Physical state	Liquid
Formulation type	Solution (SN)
Guarantee	45 g/L
Container material and description	High Density Polyethylene (HDPE) bottles
Density	1.02 g/cm^3
pH of 1% dispersion in water	7.5
Oxidizing or reducing action	Expected to be incompatible with oxidizers
Storage stability	Stable for one year when stored in HDPE containers at 25°C and 60% relative humidity
Corrosion characteristics	Non-corrosive to the HDPE packaging material
Explodability	Non-explosive

End-Use Product—Wilson Lawn Weedout Concentrate 3X

Property	Result
Colour	Amber (pale yellow)
Odour	N/A
Physical state	Liquid
Formulation type	Solution (SN)
Guarantee	13.5 g/L
Container material and description	High Density Polyethylene (HDPE) bottles
Density	1.09 g/cm^3
pH of 1% dispersion in water	7.5
Oxidizing or reducing action	Expected to be incompatible with oxidizers
Storage stability	Stable for six months when stored in HDPE containers at 25°C and 60% relative humidity; the active content decreased slightly below specifications after one year.
Corrosion characteristics	Non-corrosive to the HDPE packaging material
Explodability	Non-explosive

1.3 Directions for Use

The Wilson Lawn WeedOut end-use products are used for the control of dandelion and plantain and top growth control of black medic, cinquefoil, fall hawkbit, and hawkweed in turf when applied as a spot treatment at 4.5 g active ingredient/L. Applications should be made to small patches or individual actively growing weeds, any time during the year, until foliage is thoroughly wet, but not to the point of runoff. For hard to kill weeds, a repeat application is required after four to six weeks.

1.4 Mode of Action

4-Chloroindole-3-acetic acid is a member of the chemical class known as chlorinated derivatives of indole-3-acetic acid found in seeds of a variety of annual plants, such as pea, bean, and lentil. It has been considered as hypothetic death hormones or senescence factors that are secreted from developing seeds into parent plants which are strongly inhibited and finally killed, and from which the nutrients are mobilized and then translocated to seeds.

The herbicidal effect of 4-chloroindole-3-acetic acid was first reported in 1996. It has been demonstrated that exogenous 4-chloroindole-3-acetic acid and its ester have strong herbicidal effects on pea in which they occur naturally and on white mustard, a dicotyledonous species, but not on barley, a monocotyledonous species. Its mechanism of herbicidal action is not well known, but symptoms and eventual death of the plants treated with 4-chloroindole-3-acetic acid are thought to be induced by abnormal levels of ethylene in tissues. Ethylene inhibits cell division, DNA synthesis, and meristematic growth of roots, shoots, and auxiliary buds. In addition, ethylene causes stomata to close, thus slowing down and even stopping photosynthesis, leading eventually to the death of plants.

4-chloroindole-3-acetic acid is classified as a Group 4 herbicide according to the WSSA and as a Group O herbicide according to HRAC.

2.0 Methods of Analysis

2.1 Methods for Analysis of the Active Ingredient

The methods provided for the analysis of the active ingredient and impurities in the technical product have been validated and assessed to be acceptable for the determinations.

2.2 Method for Formulation Analysis

The methods provided for the analysis of the active ingredient in the formulations have been validated and assessed to be acceptable for use as enforcement analytical methods.

3.0 Impact on Human and Animal Health

3.1 Toxicology Summary

The technical grade active ingredient, GHA-360 Selective Herbicide Technical, contains 99.7% w/w of the active ingredient (a.i.), 4-chloroindole-3-acetic acid. The submitted database of toxicology studies for 4-chloroindole-3-acetic acid and waiver rationales, along with (Quantitative) Structure Activity Relationship [(Q)SAR] model predictions were considered adequate to address the non-conventional pest control product information requirements for the technical grade active ingredient. Similarly, the database of waiver rationales for acute toxicity studies submitted for the end-use products (EPs) was considered adequate to address the non-conventional pest control product information requirements for the EPs. Results of the toxicity studies and waiver rationales for the EPs and 4-chloroindole-3-acetic acid are summarized in Appendix I, Tables 1 and 2, respectively.

When tested in laboratory animals, 4-chloroindole-3-acetic acid was of low acute toxicity via the oral, dermal and inhalation routes of exposure. 4-Chloroindole-3-acetic acid was also minimally irritating to the eyes, and non-irritating to the skin. The potassium salt of 4-chloroindole-3-acetic acid was not a skin sensitizer when tested at concentrations up to 50% in the Local Lymph Node Assay (LLNA). To support the extrapolation of the LLNA result from the potassium salt to the acid form of 4-chloroindole-3-acetic acid, (Q)SAR model predictions for the skin sensitization potential of 4-chloroindole-3-acetic acid, indole-3-acetic acid (IAA), and another structurally related compound, indole-3-butyric acid (IBA), were generated. The models produced mixed results, but all three compounds were not predicted to have protein binding potential and protein binding is a key mechanistic consideration for skin sensitization. Based on the LLNA for the potassium salt, the (Q)SAR model predictions for skin sensitization, the expected low skin absorption potential of 4-chloroindole-3-acetic acid, and the negative model predictions for protein binding, it is expected that 4-chloroindole-3-acetic acid is not a skin sensitizer.

Rationales were submitted to waive the requirements for acute toxicity testing on each of the EPs which were accepted by the PMRA. The rationales were based on the results of acute toxicity testing for 4-chloroindole-3-acetic acid and the types, and concentrations, of formulants included in each EP. It is expected that each of the EPs are of low toxicity via the oral, dermal, and inhalation routes. Each EP is also expected to be minimally irritating to the eyes and skin, and not to be a skin sensitizer.

A rationale was submitted to waive the requirement for short-term dermal toxicity testing of 4-chloroindole-3-acetic acid which was accepted by the PMRA. The rationale was based on the low acute dermal toxicity and lack of skin irritancy for 4-chloroindole-3-acetic acid, the low potential for dermal exposure to the TGAI during the manufacturing and formulation of the EPs, and recommendations for the use of PPE and hygiene practices on the label for the TGAI. The concentration of 4-chloroindole-3-acetic acid in each of the EPs as they are applied will be 220 times less than the concentration in the TGAI and the 4-chloroindole-3-acetic acid present in each of the EPs is likely to have a low potential for dermal absorption. Consequently, 4-chloroindole-3-acetic acid, is expected to have a low potential for short-term dermal toxicity.

In a prenatal developmental toxicity study, 4-chloroindole-3-acetic acid was administered to 24 female Hannover Wistar (CRLHan) rats/dose by gavage at dose levels of 0, 75, 160, 340, and 725 mg/kg bw/day from days 6 to 19 of gestation. The maternal lowest-observed-adverse-effect level (LOAEL) was estimated to be 340 mg/kg bw/day based on decreased body weights and weight gains, gravid uterine weights, and food consumption, and increased body weight losses. The maternal no-observed-adverse-effect-level (NOAEL) was estimated to be 160 mg/kg bw/day. The developmental LOAEL was estimated at 340 mg/kg bw/day based on decreased fetal body weights, skeletal variations, and a skeletal malformation not seen in the historical control database but only occurred at low incidences in the presence of maternal toxicity. The developmental NOAEL is estimated at 160 mg/kg bw/day. The risk assessment (see below) 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.

4-Chloroindole-3-acetic acid was negative for mutagenicity when tested in a bacterial reverse mutation assay using multiple strains of *Salmonella typhimurium* and *Eschericia coli* WP2uvrA with and without metabolic activation. Equivocal results were obtained for 4-chloroindole-3-acetic acid in an in vitro mammalian cell gene mutation assay using a mouse lymphoma L5178Y $TK^{+/-}$ model. To help clarify these results, predictions were made using (Q)SAR models for forward mutations in the hypoxanthine-guanine phosphoribosyl transferase (HGPRT) reporter gene and mouse lymphoma mutations. 4-Chloroindole-3-acetic acid was predicted to be negative in both models and negative predictions were also obtained for IAA and IBA. Taking into account the results of the in vitro mammalian cell mutagenicity assay in mouse lymphoma cells as well as the negative (Q)SAR predictions for 4-chloroindole-3-acetic acid, IBA, and IAA, 4-chloroindole-3-acetic acid is considered to be negative for in vitro mammalian cell mutagenicity.

Incident Reports

Since 26 April 2007, registrants have been required by law to report incidents, including adverse effects to health and the environment, to the PMRA within a set time frame. Information on the

reporting of incidents can be found on the Health Canada website. Since 4-chloroindole-3-acetic acid is a new active ingredient pending registration for use in Canada, there are no incident reports. Once products containing 4-chloroindole-3-acetic acid are registered, the PMRA will monitor for incident reports.

3.2 Occupational and Bystander Risk Assessment

3.2.1 Dermal Absorption

No information was submitted on the potential dermal absorption of 4-chloroindole-3-acetic acid. 4-Chloroindole-3-acetic acid is an aromatic compound with a low molecular weight (mw = 209.63), a relatively low Log K_{ow}value (2.13–2.22), a high water solubility (3.97 @ pH 7), and a pK_a value of 4.7. Therefore, 4-chloroindole-3-acetic acid in each of the EPs are expected to have a low potential for dermal absorption.

3.2.2 Use Description

With the exception of WeedOut PRO, all of the proposed EPs are domestic herbicides used to treat broadleaf weeds on residential lawns. WeedOut PRO is a commercial herbicide used to treat broadleaf weeds on residential and commercial lawns, non-crop areas including right-of-ways, golf courses, parks, cemeteries, and athletic fields. All of the EPs are applied as spot treatments at 4.5 g 4-chloroindole-3-acetic acid /L using short bursts of spray on small patches or individual broadleaf weeds, any time weeds are actively growing, until the foliage is wet, and not reaching the point of runoff. The products can be re-applied every 4–6 weeks for a maximum of 4 applications per year.

Wilson Lawn WeedOut (2) Selective Weed Control and Wilson Lawn WeedOut (1) Selective Weed Control are ready-to-use domestic products supplied in hand-held, trigger sprayer, high density polyethylene (HDPE) bottles. Wilson Lawn WeedOut (2) Battery Powered and Wilson Lawn WeedOut (1) Battery Powered are ready-to-use domestic products supplied in HDPE bottles with battery powered sprayers. Lawn WeedOut (2) Selective Weed Control and Lawn WeedOut (1) Selective Weed Control are ready-to-use domestic products supplied in HDPE cartridges that are used in a proprietary sprayer (i.e., SmartOnes Precision Sprayer). Two domestic products, Wilson Lawn WeedOut Concentrate 10X and Wilson Lawn WeedOut Concentrate 3X, and the commercial product, WeedOut PRO, are all concentrates supplied in HDPE bottles that need to be diluted with water before application by hand-held or backpack sprayers.

3.2.3 Mixer, Loader, and Applicator Exposure and Risk

The area to be treated, application rates, and amount of active ingredient (a.i.) handled per day for the commercial EP, WeedOut PRO, are 0.1–0.5 ha treated per day, 215–260 L EP/ha applied per day, and 970–5850 g a.i. handled/applied per day, respectively. As discussed previously, the commercial EP is supplied as a concentrate that is mixed/diluted with water and applied using a hand held or backpack sprayer. The same individual is expected to be responsible for mixing, loading, applications, clean-ups and repairs. Given the physical-chemical properties of the EPs (i.e. liquids with specific gravities and viscosities similar to water) and the a.i. (i.e. low Log K_{ow},

high water solubility, very low vapour pressure) and the activities involved in using the products, the expected route of exposure is dermal (i.e. potential skin contact with sprayed solutions or splashing and spills during dilution of the concentrate). Exposures from individual applications could be brief based on the spot treatment use pattern, but could also be short-term based on the daily application of the commercial EP to larger treatment areas and the corresponding greater amounts of a.i. handled. Because of this exposure pattern and the fact that the short-term dermal toxicity data requirement for 4-chloroindole-3-acetic acid was addressed by a waiver rationale, the following statements have been included in the Precautions section on the secondary display panel of the Weedout PRO: "Wear safety goggles, chemical resistant gloves, long pants and long-sleeved shirt, with shoes and socks during mixing, loading, application, clean-ups, and repairs." and "Wash hands thoroughly with soap and water before eating, drinking or smoking. Remove protective equipment immediately after handling, wash thoroughly and change into clean clothing."

Considering the toxicity profiles of the a.i. and Weedout PRO, the methods of application, the spot treatment use pattern, and the additional precautionary statements on the label, no unacceptable occupational exposures and risks from 4-chloroindole-3-acetic acid in Weedout PRO are expected for mixing, loading, application, clean-ups, and repairs.

3.2.4 Postapplication Exposure and Risk

Because the Weedout PRO is used for the spot treatment of weeds on turf, no unacceptable postapplication occupational exposures and risks from 4-chloroindole-3-acetic acid are expected. In addition, the Precautions section of the label for the product contains the follow statement to help mitigate postapplication exposures: "Avoid any activities that could result in skin contact with treated lawns or turf surfaces until residues have dried."

3.2.5 Residential and Bystander Exposure and Risk

A user of one of the domestic products could treat 5–80 m^2 (0.0005–0.0080 ha) of weeds per day depending on the severity of the infestation and the size of the lawn. Application rates for the domestic products range from 215–260 L/ha of Wilson Lawn WeedOut Concentrate 10X (45 g a.i./L) to 2150–2600 L/ha of Wilson Lawn WeedOut (2) Selective Weed Control (4.5 g a.i./L) which corresponds to 4.84–93.6 g a.i. handled/applied per day. As noted previously, the ready-to-use domestic products are applied via hand held plastic bottles with trigger sprayers, hand held plastic bottles with battery powered sprayers or proprietary cartridge sprayers. The concentrated products are diluted with water and applied using hand held or backpack sprayers. Similar to commercial pesticide applicators, the expected route of potential exposure to the a.i. for a domestic user will be dermal. Such exposures will involve limited quantities (i.e. spot treatments), be brief and will occur at a maximum of 4 times per year at a re-application interval of 4–6 weeks.

Taking into account the toxicity profiles of the a.i. and the EPs, the methods of application, and the spot treatment pattern of use, no unacceptable domestic user exposures and risks from 4-chloroindole-3-acetic acid are expected.

After application of the EPs, it is expected that recreational and other users of lawns and turf treated with the domestic and commercial EPs could experience acute or even short-term dermal exposures to residues of 4-chloroindole-3-acetic acid depending on the specific activities, weather conditions, and how long it takes residues to dry.

The PMRA generally follows a flexible qualitative or semiquantitative approach to assessing and mitigating potential residential and bystander postapplication exposures from non-conventional pest control products. Recognizing that recreational and other users could come into direct contact with treated turf, and given that a NOAEL value for maternal and developmental toxicity was identified from the prenatal developmental toxicity study of 4-chloroindole-3-acetic acid, screening level margin of exposure estimates (MOEs) were calculated for residential and bystander postapplication exposures. These MOE estimates were calculated by dividing the NOAELs from the developmental toxicity study by applicant generated postapplication exposure estimates, and assuming 100% dermal absorption for 4-chloroindole-3-acetic acid. Dermal MOEs ranged from 649 for toddlers engaged in high contact lawn activities 3 hours after application of the EPs to > 359000 for 11 to < 16 year olds who are mowing turf 24 hours after application. For accidental oral ingestion in toddlers the screening level MOEs range from > 31000 for hand to mouth exposure 3 hours after application to > 123×10^6 for accidental soil ingestion 24 hours after application. These screening level MOEs are high and are expected to be protective for recreational and other users of treated lawns and turf.

Considering the toxicity profiles of the a.i. and the EPs, the spot treatment pattern of use, the high MOEs calculated, and the previously noted postapplication precautionary statement on the labels for all EPs, no unacceptable postapplication residential and bystander exposures and risks from 4-chloroindole-3-acetic acid are expected.

3.3 Dietary Exposure and Risk Assessment

3.3.1 Food

No dietary risks are expected as the EPs are not applied to food crops.

3.3.2 Drinking Water

No risks due to exposure from drinking water are anticipated. The EPs are for spot treatment of turf surfaces and are not to be applied during or within a few hours before a rainfall. There is existing background exposure due to 4-chloroindole-3-acetic acid's natural occurrence in plants including food crops (e.g., peas, beans, lentils) and based on limited published information, the compound is expected to be metabolized similarly to another naturally occurring auxin, IAA. Finally, in a submitted turf transferable residues study, residues of 4-chloroindole-3-acetic acid transferred from turf treated with one of the EPs were 0.4% three hours after application, 0.06% after 24 hours, and less than the level of detection at 72 hours.

4.0 Impact on the Environment

4.1 Fate and Behaviour in the Environment

4-Chloroindole-3-acetic acid is a naturally occurring plant auxin hormone found primarily in the seeds of a variety of plants in the family, Fabaceae (peas, bean, and lentil). 4- chloroindole-3-acetic has low solubility, low volatility and is expected to be stable to hydrolysis. 4-Chloroindole-3-acetic is expected to undergo rapid microbial biotransformation and mineralisation in soil. If released to soil, 4-chloroindole-3-acetic acid is estimated to have very high to moderate mobility. However, based on limited environmental exposure through the proposed use pattern as spot treatment, and given its non-persistence, 4-chloroindole-3-acetic acid is not expected to move through soil to groundwater. If released into water, 4-chloroindole-3-acetic acid is not expected to adsorb to suspended solids and sediment. Its potential for bioconcentration in aquatic organisms is also estimated to be low. Environmental parameters are summarized in Appendix I,Table 4.

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 exposure concentrations (EECs) are concentrations of pesticide in various environmental media, such as food, water, soil and air. The EECs 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.

A quantitative risk characterization was not conducted for the environmental assessment of 4-chloroindole-3-acetic acid as the proposed use patterns are expected to result in limited environmental exposure. The estimated environmental concentrations in soil and water cannot be quantified as the spray solution is to be directed to targeted weeds over small areas and over-applying to the point of runoff is to be avoided. Furthermore, both the commercial and domestic products are applied using hand-held or back-pack application equipment which will also reduce the potential for exposure of non-target organisms. Applications are not to be made during rainfall, if rain is forecast in the next several hours, and areas should not to be watered for two hours after application. Thus, spray drift and runoff of 4-chloroindole-3-acetic acid is expected to be minimized. In addition, 4-chloroindole-3-acetic acid is not expected to persist in the environment as it is susceptible to microbial transformation and a repeat application is required after four to six weeks. Therefore, use of the products is not expected to result in significant deposition of the active ingredient on soil, adjacent water bodies, or non-target plants.

4.2.1 Risks to Terrestrial Organisms

4-Chloroindole-3-acetic acid is produced naturally in the seeds of various vascular plants. When released from the seeds, one of the modes of action of 4-chloroindole-3-acetic acid is to inhibit or kill the parent plant. This is accomplished by stimulating the production of ethylene which causes plant senescence. Toxicity data on the level of effects of 4-chloroindole-3-acetic acid to vascular plants was not provided. However, based on its reported mode of action, and the proposed claims of this active ingredient for use as a herbicide, 4-chloroindole-3-acetic acid is expected to be toxic to terrestrial and aquatic vascular plants. Label statements will be required to indicate this hazard and to direct users to avoid contact with non-target terrestrial vascular plants.

Based on the proposed use pattern, which consists of localized applications to small areas on turf, limited exposure to other non-target terrestrial organisms (bees, beneficial parasitic and predatory arthropods, birds and wild mammals) is expected.

4.2.2 Risks to Aquatic Organisms

Based on the proposed use pattern, consisting of localized applications to individual plants or small areas of weeds on turf by using hand-held application equipment, spray drift and runoff to adjacent bodies of water is not expected. Therefore risk to aquatic fish and aquatic invertebrates is not expected to pose a concern. Although no toxicity data were provided, toxicity to aquatic vascular plants is assumed based on the mode of action of 4-chloroindole-3-acetic acid and toxicity to terrestrial vascular plants. Therefore, precautionary label statements will be required to indicate this hazard and to direct users to avoid contact with water.

In conclusion, 4-chloroindole-3-acetic acid is not expected to pose risks of concern to non-target organisms in the environment when products proposed for this assessment are used according to label directions.

Further information on the environmental fate and toxicology of 4-chloroindole-3-acetic acid may be required should the use be expanded to other sites, hosts, application methods and/or pests.

5.0 Value

5.1 Effectiveness Against Pests

Efficacy information submitted included data from nine trials conducted on established turf in 2012 and 2013. These trials were conducted in Alberta at Olds College and in Quebec at Laval University.

Each of dandelion and plantain as the primary target weed was evaluated in two trials and each of hawkweed, fall hawkbit, black medic, and cinquefoil was evaluated in one trial. In each plot, five isolated weed plants at the 6-8 leaf stage were selected and marked for the herbicide treatments. Turf was mowed 2 days prior to treatment application. A second herbicide treatment

was applied when it was necessary in some trials. The second application was carried out on surviving weeds only, between four and six weeks after the first application.

In the remaining trial, dandelion as the target weed was evaluated in the year of treatment and the year following. In each plot, five isolated dandelion plants at the 6-8 leaf stage were marked for treatments. Only one application was made.

Herbicide treatments were applied using a Ready-to-Use (RTU) spray bottle in all trials. The applications were carried out when temperature was less than 30°C and with no precipitation expected for the next 24 hours. Each plant received three to five bursts of spray (equivalent to 3.5 to 6 mL) from the RTU bottle, sufficiently wetting all leaves of the plants.

5.1.1 Support for Efficacy Claims

Adequate information was submitted to support control claims for dandelion and plantain and top growth control claims for fall hawkbit, hawkweed, black medic, and cinquefoil when the Wilson Lawn WeedOut end-use products are applied at 4.5 g active ingredient/L to small patches or individual broadleaf weeds as a spot treatment.

5.2 Non-Safety Adverse Effects

Turf tolerance information was also collected in four of the nine efficacy trials described above. In addition, two dedicated turf tolerance trials were submitted.

The dedicated turf tolerance trials were conducted in Quebec at Laval University and Ontario at Brantford Distribution Center in 2013. Both trials were conducted on established turfgrass. Herbicide treatments were directly sprayed to turfgrass with a RTU spraying bottle. Each spot of grasses received four applications.

5.2.1 Support for Host Claim

Adequate information was submitted to demonstrate that turfgrass may exhibit an adequate margin of tolerance to the application of 4-chloroindole-3-acetic acid in accordance with the label directions, i.e., directly applied to small patches or individual broadleaf weeds at 4.5 g active ingredient/L as a spot treatment.

In addition, the label contains a warning that reads, “Grass that is accidentally treated may temporarily turn brown but will recover”.

5.3 Consideration of Benefits

5.3.1 Social and Economic Impact

The active ingredient, 4-chloroindole-3-acetic acid, is a naturally occurring plant growth hormone mainly produced in the seeds of the *Fabaceae* family. The registrations of 4-chloroindole-3-acetic acid containing end-use products may provide alternatives to conventional chemical pesticides for use on turf.

5.3.2 Survey of Alternatives

Manual removal of weeds from turfgrass, although time-consuming, is feasible on small individual properties. In large turf areas such as parks, athletic fields, and golf courses or when weed infestations are heavy, it is not practical to manually remove weeds. Application of herbicides has been the common practice if weed infestations become unmanageable. However, conventional herbicides are not currently available to domestic users in certain jurisdictions that have enacted legislation restricting pesticide availability for non-essential or cosmetic uses. There are limited options left for combating weeds on turfgrass, including home yards, sports field, parks, school yards, and playgrounds.

In recent years, several non-conventional herbicides have been registered for domestic weed management. Such herbicides include citric acid and lactic acid, corn gluten meal, *Sclerotinia minor*, ammonium soaps of fatty acids, sodium chloride, FeHEDTA, *Phoma macrostoma*, and *Streptomyces acidiscabies*.

The availability of the Wilson Lawn WeedOut end-use products may provide both homeowners and lawn care professionals with another option with a different herbicide mode of action for control or top growth control of broadleaf weeds, especially in situations where the use of conventional chemicals is not desirable.

5.3.3 Compatibility with Current Management Practices Including Integrated Pest Management

In general, a well maintained and healthy lawn is less likely to suffer from pest problems or need pesticides. Healthy lawn care practices include mowing at the right height and frequency, maintaining good soil structure by adding organic matter (top-dressing), leaving clippings on the turf to provide nutrients, applying the right amount of fertilizer and at the right time, deeply watering to encourage development of root system, annually aerating compacted or heavy clay soils, removing thatch from lawn surface, and so on.

Applications of the Wilson Lawn WeedOut Herbicides are compatible with good turf management practices. This non-conventional herbicide can be used to treat small patches or individual weeds and provide a solution to weed infestations in lawns. It can also be used as part of a weed management program in combination with other herbicides.

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

Development of resistance to this naturally occurring hormone is expected to be low based on the relatively low incidence of resistance that has been reported to other auxin-type herbicides. The introduction of this new active ingredient as an alternative for already available products on turf may provide a new tool and opportunity in the management of herbicide resistance.

5.4 Supported Uses

Control of dandelion and plantain and top growth control of fall hawkbit, hawkweed, black medic, and cinquefoil in turfgrass are supported for a spot application of the Wilson Lawn WeedOut end-use products at 4.5 g active ingredient/L.

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. persistent (in air, soil, water and/or sediment), bio-accumulative, primarily a result of human activity and toxic as defined by the *Canadian Environmental Protection Act*].

During the review process, 4-chloroindole-3-acetic acid was assessed in accordance with the PMRA Regulatory Directive DIR99-03[5] and evaluated against the Track 1 criteria. The PMRA has reached the following conclusions:

- 4-Chloroindole-3-acetic acid does not meet Track 1 criteria, and is not considered a Track 1 substance. See Appendix I, Table 3 for comparison with Track 1 criteria.

- 4-Chloroindole-3-acetic acid does not form any transformation products that meet all Track 1 criteria

- GHA-360 Selective Herbicide Technical and its associated end-use products 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.[6]

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*.[7] The list

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

6 DIR2006-02, *Formulants Policy and Implementation Guidance Document.*

7 *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

is used as described in the PMRA Notice of Intent NOI2005-01[8] and is based on existing policies and regulations including: DIR99-03; and DIR2006-02, 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:

- GHA-360 Selective Herbicide Technical, containing the active ingredient 4-chloroindole-3-acetic acid, and the end-use products Wilson Lawn Weedout Selective Weed Control, Wilson Lawn Weedout Battery Powered, Wilson Lawn Weedout Battery Powered, Wilson Lawn Weedout Concentrate 10X, Wilson Lawn Weedout Concentrate 3X, Wilson Lawn Weedout Selective Weed Control, Weedout PRO, Lawn Weedout Selective Weed Control and Lawn Weedout Selective Weed Control 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.

7.0 Summary

7.1 Human Health and Safety

The submitted database of toxicology studies for 4-chloroindole-3-acetic acid is adequate to characterize the majority of toxic effects that could result from exposure. 4-Chloroindole-3-acetic acid is of low acute toxicity via the oral, dermal, and inhalation routes. It is minimally irritating to the eye and is not a skin irritant. Considering the results of an LLNA assay, low dermal absorption potential, and (Q)SAR model predictions, 4-chloroindole-3-acetic acid is not considered to be a skin sensitizer. The requirement for a short-term dermal toxicity study was waived based on the acute toxicity testing results for 4-chloroindole-3-acetic acid and the expected low dermal absorption of the compound. In a developmental toxicity study of 4-chloroindole-3-acetic acid, effects at the LOAEL included decreased fetal body weights, skeletal variations and a low incidence of a skeletal malformation not seen in historical controls. These effects occurred at a dose that caused toxicity to the maternal animals. Based on the results of bacterial mutagenicity testing, in vitro mammalian cell mutagenicity assay, and (Q)SAR model predictions, 4-chloroindole-3-acetic acid is not expected to be genotoxic. Based on the submitted studies for 4-chloroindole-3-acetic acid and the types and concentrations of formulants used, domestic and commercial EPs containing 4-chloroindole-3-acetic acid are expected to be of low acute toxicity via the oral, dermal, and inhalation routes, minimally irritating to the eyes and skin, and are not expected to be skin sensitizers.

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.*

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

Worker, bystander and residential exposures to 4-chloroindole-3-acetic acid as a result of the use pattern are not expected to result in unacceptable risk when Weedout PRO is used according to label directions.

No dietary risks are expected as the EPs are not applied to food crops and no risks due to exposure from drinking water are expected.

Domestic user, bystander and residential exposures to 4-chloroindole-3-acetic acid as a result of the use pattern are not expected to result in unacceptable risk when the domestic EPs are used according to label directions.

7.2 Environmental Risk

4-Chloroindole-3-acetic acid is a naturally occurring plant hormone found in seeds of a variety of plants. 4-Chloroindole-3-acetic acid is not expected to persist in the environment. Limited environmental exposure is expected from the use as a spot-treatment for weeds in turf, applied by hand-held or back-pack spray equipment. 4-Chloroindole-3-acetic acid, when used according to the label directions of the end-use products, is not expected to pose risks of concern to the environment.

7.3 Value

The information submitted is adequate to characterize the efficacy of the Wilson Lawn WeedOut Herbicides at 4.5 g active ingredients/L for control of dandelion and plantain and top growth control of fall hawkbit, hawkweed, black medic, and cinquefoil in turf. Applications should be made to small patches or individual actively growing weeds, any time during the year, until foliage is thoroughly wet, but not to the point of runoff. For hard to kill weeds, a repeat application is required after four to six weeks.

The information is also adequate to demonstrate that turfgrass may exhibit an adequate margin of tolerance to the application of 4-chloroindole-3-acetic acid in accordance with the label directions. In addition, the label contains the warning that reads, “Grass that is accidentally treated may temporarily turn brown but will recover”.

A limited number of herbicides are available for domestic weed management. 4-chloroindole-3-acetic acid, as a naturally occurring plant hormone, has been classified as a non-conventional herbicide. The registration of the Wilson Lawn WeedOut end-use products may provide an alternative tool with a different mode of action for home owners and lawn care professionals to manage broadleaf weeds in domestic turf, especially in situations where the use of conventional chemicals is not desirable.

8.0 Proposed Regulatory Decision

Health Canada's Pest Management Regulatory Agency (PMRA), under the authority of the *Pest Control Products Act* and Regulations, is proposing full registration for the sale and use of GHA-360 Selective Herbicide Technical and the associated domestic end-use products, Wilson Lawn WeedOut(1) Selective Weed Control, Wilson Lawn WeedOut(2) Selective Weed Control, Wilson Lawn WeedOut(1) Battery Powered, Wilson Lawn WeedOut(2) Battery Powered, Wilson Lawn WeedOut Concentrate 10X, Wilson Lawn WeedOut Concentrate 3X, Lawn WeedOut(1) Selective Weed Control, Lawn WeedOut(2) Selective Weed Control and the commercial end-use product WeedOut PRO, containing the technical grade active ingredient 4-chloroindole-3-acetic acid, to control small patches or individual broadleaf weeds as a spot treatment in 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.

List of Abbreviations

a.i.	active ingredient
BAF	bioaccumulation factor
BCF	bioconcentration factor
bw	body weight
CAA	4-chloroindole-3-acetic acid
CEPA	Canadian Environmental Protection Act
DT_{50}	dissipation time 50% (the time required to observe a 50% decline in concentration)
EEC	estimated environmental concentration
EP	end-use product
K_{oc}	organic-carbon partition coefficient
K_{ow}	octanol water partition coefficient
GEF	global evaluation factor
HDPE	High-density polyethylene
HGPRT	Hypoxanthine-guanine phosphoribosyltransferase gene
HRAC	Herbicide Resistance Action Committee
IAA	indole-3-acetic acid
IBA	indole-3-butyric acid
IMF	induced mutation frequency
kg	kilogram
LC_{50}	lethal concentration to 50%
LD_{50}	lethal dose to 50%
LOAEL	lowest-observed-adverse-effect-level
mg	milligram(s)
MAS	maximum average score for 24, 48 and 72 hours
MF	mutation frequency
NA	not applicable
NOAEL	no-observed-adverse-effect-level
PCPA	*Pest Control Product Act*
PPE	Personal protective equipment
PMRA	Pest Management Regulatory Agency
(Q)SAR	(Quantitative) Structure Activity Relationship
RTU	ready to use
SI	stimulation index
TGAI	technical grade active ingredient
TSMP	Toxic Substances Management Policy
WSSA	Weed Science Society of America

Appendix I Tables and Figures

Table 1 Toxicity Profile for End-use Products (EPs) Containing the Potassium Salt of 4-Chloroindole-3-acetic acid (CAA): Wilson Lawn WeedOut (2) Selective Weed Control, Wilson Lawn WeedOut (2) Battery Powered, Wilson Lawn WeedOut (1) Battery Powered, Wilson Lawn WeedOut Concentrate 10X, Wilson Lawn WeedOut Concentrate 3X, Wilson Lawn WeedOut (1) Selective Weed Control, WeedOut PRO, Lawn WeedOut (2) Selective Weed Control, and Lawn WeedOut (1) Selective Weed Control

(Effects are known or assumed to occur in both sexes unless otherwise noted; in such cases, sex-specific effects are separated by semi-colons)

Study Type/Animal/PMRA #	Study Results
Acute oral toxicity Acute dermal toxicity Acute inhalation toxicity Eye irritation Dermal irritation Dermal sensitization PMRA #s 2370221, 2370569, 2370611, 2370431, 2411310	Detailed waiver requests were submitted along with supporting documentation including a rationale for extrapolating submitted acute toxicity testing results for the acid form of CAA to the potassium salt form present in each of the EPs. Based on all of the available information, the acute oral, dermal, and inhalation toxicity of each of the EPs is expected to be low. Each of the EPs is expected to be minimally irritating to the eyes and skin, but not a dermal sensitizer. The waiver requests were accepted.

Table 2 Toxicity Profile of 4-Chloroindole-3-acetic acid (CAA)

(Effects are known or assumed to occur in both sexes unless otherwise noted; in such cases, sex-specific effects are separated by semi-colons)

Study Type/Animal/PMRA #	Study Results
Acute oral toxicity Rat (Sprague Dawley) PMRA # 2370077	♀ LD_{50} > 2000 mg/kg bw Low toxicity
Acute dermal toxicity Rat (Sprague Dawley) PMRA # 2370079	♂ + ♀ LD_{50} > 5000 mg/kg bw Low toxicity
Acute inhalation toxicity (nose only exposure) Rat (Sprague Dawley) PMRA #2370081	♂ + ♀ LC_{50} > 2.05 mg/L Low toxicity
Eye irritation Rabbit (New Zealand albino) PMRA # 2370082	MAS = 8.1/110 Minimally irritating

Dermal irritation Rabbit (New Zealand albino) PMRA # 2370084	MAS = 0/8 Non-irritating
Dermal sensitization (Local lymph node assay) PMRA # 2370086	10, 25, and 50% potassium salt of CAA tested SI < 3 for all concentrations (negative) Based on a consideration of the negative assay results obtained for the potassium salt of CAA; mixed (positive and negative) (Q)SAR model predictions for skin sensitization obtained for CAA, IAA, and IBA; the low potential for skin absorption of CAA and its potassium salt, and (Q)SAR model predictions of a lack of protein binding potential for CAA, IAA, and IBA; CAA is not a dermal sensitizer.
Short-term oral toxicity PMRA # 2370062	A detailed waiver request was submitted. Based on all of the available information, the short term oral toxicity is expected to be low. The request for a waiver was accepted.
Genotoxicity: bacterial reverse mutation assay *Salmonella typhimurium* TA1535, TA1537, TA98, TA100 and *Escherichia coli* WP2/uvrA PMRA # 2470980	Negative
Genotoxicity: *in vitro* mammalian cell assay L5178Y $TK^{+/-}$ mouse lymphoma cells PMRA # 2470982	Assay results were equivocal. Based on a consideration of the assay results and negative (Q)SAR model predictions for CAA, IAA, and IBA in HGPRT and mouse lymphoma mutations models, CAA is negative for mutagenicity in mammalian cells *in vitro*.
Prenatal developmental toxicity (rodent) Rat (Hannover Wistar) PMRA # 2606110	<u>Maternal:</u> NOAEL = 160 mg/kg bw/day LOAEL = 340 mg/kg bw/day Effects at the LOAEL: ↓ body weight/body weight gain, ↓ gravid uterine weights, ↓ food consumption; ↑ body weight loss <u>Developmental:</u> NOAEL = 160 mg/kg bw/day LOAEL = 340 mg/kg bw/day Effects at the LOAEL: ↓ fetal body weight, ↑ skeletal variations, low and not statistically significant incidence of a skeletal malformation (humerus, radius, ulna, short, bent)

Table 3 Toxic Substances Management Policy Considerations-Comparison to TSMP Track 1 Criteria

TSMP Track 1 Criteria	TSMP Track 1 Criterion value	GHA-360 Selective Herbicide Technical Endpoints
CEPA toxic or CEPA toxic equivalent[1]	Yes	Yes

TSMP Track 1 Criteria	TSMP Track 1 Criterion value		GHA-360 Selective Herbicide Technical Endpoints
Predominantly anthropogenic[2]	Yes		No
Persistence[3]:	Soil	Half-life ≥ 182 days	No
	Water	Half-life ≥ 182 days	No
	Sediment	Half-life ≥ 365 days	No
	Air	Half-life ≥ 2 days or evidence of long range transport	No
Bioaccumulation[4]	Log K_{OW} ≥ 5		2.13 (estimated using EpiSuite)
	BCF ≥ 5000		NA
	BAF ≥ 5000		NA
Is the chemical a TSMP Track 1 substance (all four criteria must be met)?			No, does not meet TSMP Track 1 criteria.

[1]All pesticides will be considered CEPA-toxic or CEPA toxic equivalent for the purpose of initially assessing a pesticide against the TSMP criteria. Assessment of the CEPA toxicity criteria may be refined if required (i.e., all other TSMP criteria are met).
[2]The policy considers a substance "predominantly anthropogenic" if, based on expert judgement, its concentration in the environment medium is largely due to human activity, rather than to natural sources or releases.
[3] If the pesticide and/or the transformation product(s) meet one persistence criterion identified for one media (soil, water, sediment or air) than the criterion for persistence is considered to be met.
[4]Field data (e.g., BAFs) are preferred over laboratory data (e.g., BCFs) which, in turn, are preferred over chemical properties (e.g., log K_{OW}).

Table 4 Summary of information, including EPI Suite 4.1 estimates, describing the fate and behaviour of 4-Chloroindole-3-acetic acid in the environment

Parameters	Value	EPI Suite 4.1 Module	Comment
Log K_{ow}	2.13	KOWWIN v1.68	NA
Vapour pressure (mm Hg,25 ºC)	1.44E-006	MPBPVP	Low potential for volatilization
K_{oc} (L/kg)	21.57-287.1	KOCWIN v2.00	very high to moderate mobility in soil
Hydrolysis (25 ºC)	-*	HYDROWIN v2.00	Stable to hydrolysis
Bioconcentration Factor (L/kg wet-wt)	BCF = 3.162 - 13.83	BCFBAF v3.01	NA
Biotransformation half-life (days)	0.4664	BCFBAF v3.01	Non persistent
	Potential for microbial transformation of indole has been described in published literature [1]	Assumed to be similar for 4-chloroindole-3-acetic acid; a DT_{50} of 3 days in non-sterile soil of pine forest soil was reported for indole-3-acetic acid.[2]	[1] PMRA#2471020; PMRA#2645852; PMRA#2645854 [2] PMRA#2645853
Atmospheric Oxidation half-life (25 ºC) (hours)	1.39	AopWin v1.92	A long-range transport is unlikely
Half-Life (hours)	17.3 (water) 82.5 (soil) 0.217 (sediment)	Level III Fugacity Model	Non persistent
*-: can NOT be estimated			

Table 5 List of Supported Uses

Items	Proposed label claims	VRD supported use claims
Application rates	At a concentration of 4.5 g/L	As proposed
Weed claims	Control of broadleaf weeds such as black medic, cinquefoil, dandelion, hawkbit, hawkweed, plantain, thistle, and more.	Control of dandelion and plantain and top growth control of fall hawkbit, hawkweed, black medic, and cinquefoil.
Host claims	Turf	As proposed.
Application timing	Anytime when weeds are actively growing.	As proposed.
Application method	Directly applied to small patches and individual broadleaf weeds as a spot treatment. Wet foliage of the weeds, but not to the point of runoff.	As proposed.

References

A. List of Studies/Information Submitted by Registrant

1.0 Chemistry

2370045	2013, Product Identification of GHA-360 Selective Herbicide Technical, DACO: 2.0,2.1,2.2,2.3,2.3.1,2.4,2.5,2.6,2.7,2.8,2.9 CBI
2370046	2013, Manufacturing methods of GHA-360 Selective Herbicide Technical, DACO: 2.11,2.11.1,2.11.2,2.11.3,2.11.4 CBI
2370047	2013, Establishing Certified Limits of GHA-360 Selective Herbicide Technical, DACO: 2.12,2.12.1
2370048	2013, Preliminary Analysis of GHA-360 Selective Herbicide Technical, DACO: 2.13,2.13.1,2.13.2,2.13.3,2.13.4 CBI
2370049	2013, GHA-360: Characterization of a Sample of Test Substance, DACO: 2.13.1,2.13.2 CBI
2370050	2013, HPLC Chromatograms CDU-9-159_160_162, DACO: 2.13.2,2.13.3 CBI
2370051	2013, GHA-360 5-Batch Calculations purity a.i. impurities, DACO: 2.13.3 CBI
2370052	2013, Chemical and Physical Properties of TGAI GHA-360 Selective Herbicide Technical, DACO: 2.14,2.14.1,2.14.10,2.14.11,2.14.12,2.14.13,2.14.14,2.14.15,2.14.2,2.14.3,2.14.4,2.14.5,2.14.6,2.14.7,2.14.8,2.14.9,830.7000
2370058	National Library of Medicine s TOXNET system, 2013, Hazardous Substances Data Bank (HSDB): Acetic Acid, DACO: 2.14.10
2370059	ChemSpider Search and share chemistry, 2013, (4-Chloro-1H-indol-3-yl)acetic acid, DACO: 2.14.11,2.14.9
2370060	2013, Sample of Analytical Standard of GHA-360 Selective Herbicide Technical, DACO: 2.15
2370063	2013, Progress Report (DELRD-0 605), DACO: 2.11.2,2.11.3,2.13.2,2.13.3 CBI
2370064	2013, Development Report (DELRD-0548), DACO: 2.11.2,2.11.3 CBI
2370065	Health Canada, 1999, Impurities: Guideline for Residual Sovents, DACO: 2.11.4
2370066	2013, HPLC Method for the Identification, Assay and Determination of purity of GHA-360, DACO: 2.13.1 CBI
2370067	2013, Validation of a HPLC Method for the Assay of GHA-360, DACO: 2.13.1 CBI
2370068	2013, Reports of Analysis 5 batch data GHA-360, DACO: 2.13.3 CBI
2370069	2013, GHA-360: Determination of pH, DACO: 2.14.15,830.7000
2370071	2013, GHA-360: Determination of Bulk Density, DACO: 2.14.6
2370072	2013, GHA-360: Physical and Chemical Characteristics: UV/Visible Absorption and Water Solubility, DACO: 2.14.12,2.14.7 CBI
2370073	Milan Soskic and Volker Magnus, 2007, Binding of ring-substituted indole-3-acetic acids to human serum albumin, DACO: 2.14.8
2370074	Waldemar Karcz, Hartwig Luthen, Michael Bottger, 1999, Effect of IAA and 4-Cl-IAA on growth rate in maize coleoptile segments, DACO: 2.14.8

2370075	Suzanne E. Morris, Marjolein C.H. Cox, John J. Ross, Santi Krisantini, Christine A. Beveridge, 2005, Auxin Dynamics after Decapitation Are Not Correlated with the Initial Growth of Axillary Buds, DACO: 2.14.8
2370076	P. H. Rubery, A. R. Sheldrake, 1974, Carrier-mediated Auxin Transport, DACO: 2.14.10
2370077	2013, Acute Oral Toxicity Study (Up-and-Down Procedure) in Rats of 4-Cl-IAA, DACO: 2.14.8,4.2.1
2370078	2013, Acute Oral Toxicity Study (Up-and-Down Procedure) in Rats of 4-Cl-IAA, DACO: 2.14.8,4.2.1 CBI
2425962	2014, Revised manufacturing methods for the TGAI, DACO: 2.11 CBI
2425963	2014, Production report on [CBI Removed], DACO: 2.11 CBI
2425964	2014, HPLC Method for the Identification, Assay and Determination of Purity of GHA-360, DACO: 2.13.1 CBI
2425966	2014, Calculations of impurities UCL and guarantee of a.i. using 5 batches of GHA-360, DACO: 2.13.3 CBI
2425967	2014, Revised Chemical and Physical Properties of TGAI, DACO: 2.14.4 CBI
2425968	2013, Progress Report DELRD-0 621 version 2, DACO: 2.11.3,2.14.4 CBI
2474136	2014, Manufacturing Methods of GHA-360 Selective Herbicide Technical, DACO: 2.11,2.11.1,2.11.2,2.11.3,2.11.4 CBI
2474137	2014, Production Report on 4-chloroindole-3-acetonitrile , DACO: 2.11,2.11.1,2.11.2,2.11.3,2.11.4 CBI
2474138	2014, Production Report on 4-chloroindole-3-aceticacid, DACO: 2.11,2.11.1,2.11.2,2.11.3,2.11.4 CBI
2474139	2014, 5-Batch Data, DACO: 2.13.3 CBI
2480422	2014, Calculations for SPSF02-1, DACO: 2.12 CBI
2480423	2014, HPLC Method for the Identification, Assay, Purity and Determination of Impurities of GHA-360, DACO: 2.13.1 CBI
2480424	2014, Qualification of a HPLC Method for the Identification, Assay and Determination of Purity, Impurities and related Substances in GHA-360, DACO: 2.13.1 CBI
2480425	2014, Method of Analysis Residual Solvent, DACO: 2.13.1 CBI
2480426	2014, Solvent Chromatograms - Blanks and Standard Solutions, DACO: 2.13.1 CBI
2480427	2014, Solvent Chromatograms - VOL024V0040914, DACO: 2.13.1 CBI
2480428	2014, Solvent Chromatograms - VOL024V0050914, DACO: 2.13.1 CBI
2480429	2014, Solvent Chromatograms - VOL024V0060914, DACO: 2.13.1 CBI
2480430	2014, Solvent Chromatograms - VOL024V0070914, DACO: 2.13.1 CBI
2480431	2014, Solvent Chromatograms - VOL024V0080914, DACO: 2.13.1 CBI
2491370	2015, GLP Statement, DACO: 2.13.1 CBI
2370195	2013, Product Identification of Wilson Lawn WeedOut(2) Selective Weed Control, DACO: 3.0,3.1,3.1.1,3.1.2,3.1.3,3.1.4

2370197	2013, Formulation Process of Wilson Lawn WeedOut(2) Selective Weed Control, DACO: 3.2,3.2.1,3.2.2,3.2.3 CBI
2370199	Innophos Inc., 2008, Technical Sheet [CBI Removed] Food Chemicals Codex Grade, DACO: 3.2.1 CBI
2370200	Innophos Inc., 2009, Technical Sheet [CBI Removed] Food Chemical Codex, DACO: 3.2.1 CBI
2370202	Innophos Inc, 2013, MSDS [CBI Removed], DACO: 3.2.1 CBI
2370204	2010, MSDS [CBI Removed], DACO: 3.2.1 CBI
2370206	Univar Canada Ltd., 2012, MSDS [CBI Removed], DACO: 3.2.1 CBI
2370207	Yara Canada Inc., 2010, MSDS [CBI Removed], DACO: 3.2.1 CBI
2370209	2013, Specifications of Wilson Lawn WeedOut(2) Selective Weed Control, DACO: 3.3.1
2370211	2013, Product Analysis of Wilson Lawn WeedOut(2) Selective Weed Control, DACO: 3.4,3.4.1,3.4.2 CBI
2370213	2013, HPLC Method for GHA-360 in [CBI Removed], DACO: 3.4.1 CBI
2370216	2013, Chemical and Physical Properties of Wilson Lawn WeedOut(2) Selective Weed Control, DACO: 3.5,3.5.10,3.5.11,3.5.12,3.5.13,3.5.14,3.5.15,3.5.2,3.5.4,3.5.5,3.5.6,3.5.7,3.5.8,3.5.9 CBI
2370218	IUCLID, 2000, Dataset 57-13-6, DACO: 3.5.11,3.5.12 CBI
2370219	2013, Certificate of Analysis # 1311121527, DACO: 3.5.6,3.5.9 CBI
2425979	2014, Validation of a HPLC method for the assay of GHA-360 in end-use product, DACO: 3.4.1 CBI
2425980	2014, Revised Chemical and physical properties of Wilson Lawn WeedOut(2) Selective Weed Control, DACO: 3.5 CBI
2425981	2013, Certificate of analysis, DACO: 3.5.6,3.5.9 CBI
2606113	2015, STORAGE STABILITY (25¿¿C) AND CORROSION CHARACTERISTICS OF WILSON LAWN WEEDOUT (2) SELECTIVE WEED CONTROL AND WILSON LAWN WEEDOUT CONCENTRATE 3X, DACO: 3.5.10,3.5.14 CBI
2370272	2013, Product Identification of Wilson Lawn WeedOut(2) Battery Powered, DACO: 3.0,3.1,3.1.1,3.1.2,3.1.3,3.1.4
2370274	2013, Specifications of Wilson Lawn WeedOut(2) Battery Powered, DACO: 3.3.1
2425991	2014, Validation of a HPLC method for the assay of GHA-360 in end-use product, DACO: 3.4.1 CBI
2425992	2014, Revised Chemical and physical properties of Wilson Lawn WeedOut(2) Selective Weed Control, DACO: 3.5 CBI
2425994	2013, Certificate of analysis, DACO: 3.5.6,3.5.9 CBI
2370329	2013, Product Identification of Wilson Lawn WeedOut(1) Battery Powered, DACO: 3.0,3.1,3.1.1,3.1.2,3.1.3,3.1.4 CBI
2370333	2013, Specifications of Wilson Lawn WeedOut(1) Battery Powered, DACO: 3.3.1

2370421	2013, Product Identification of Wilson Lawn WeedOut Concentrate 10X, DACO: 3.0,3.1,3.1.1,3.1.2,3.1.3,3.1.4 CBI
2370423	2013, Formulation Process of Wilson Lawn WeedOut Concentrate 10X, DACO: 3.2,3.2.1,3.2.2,3.2.3 CBI
2370425	2013, Specifications of Wilson Lawn WeedOut Concentrate 10X, DACO: 3.3.1
2370427	2013, Product Analysis of Wilson Lawn WeedOut Concentrate 10X, DACO: 3.4,3.4.1,3.4.2 CBI
2370429	2013, Chemical and Physical Properties of Wilson Lawn WeedOut Concentrate 10X, DACO: 3.5,3.5.10,3.5.11,3.5.12,3.5.13,3.5.14,3.5.15,3.5.2,3.5.4,3.5.5,3.5.6,3.5.7,3.5.8,3.5.9 CBI
2370448	2013, HPLC Method for GHA-360 in [CBI Removed], DACO: 3.4.1 CBI
2370450	2013, Certificate of Analysis # 1311121527, DACO: 3.5.6,3.5.9 CBI
2370451	Innophos Inc, 2010, MSDS [CBI Removed], DACO: 3.2.1 CBI
2370453	Innophos Inc, 2013, MSDS [CBI Removed], DACO: 3.2.1 CBI
2370455	Univar Canada Ltd., 2012, MSDS [CBI Removed], DACO: 3.2.1 CBI
2370456	Innophos Inc., 2009, Technical Sheet [CBI Removed] Food Chemical Codex, DACO: 3.2.1 CBI
2370458	Innophos Inc., 2008, Technical Sheet [CBI Removed] Food Chemicals Codex Grade, DACO: 3.2.1 CBI
2426008	2014, Validation of a HPLC method for the assay of GHA-360 in end-use product, DACO: 3.4.1 CBI
2426009	2014, Revised Chemical and physical properties of Wilson Lawn WeedOut Concentrate 10X, DACO: 3.5 CBI
2426011	2013, Certificate of analysis, DACO: 3.5.6,3.5.9 CBI
2606141	2015, STORAGE STABILITY (25¿¿C) AND CORROSION CHARACTERISTICS OF WILSON LAWN WEEDOUT (1) SELECTIVE WEED CONTROL AND WILSON LAWN WEEDOUT CONCENTRATE 10X STUDY LREM-SN-1559, DACO: 3.5.10,3.5.14 CBI
2370550	2013, Product Identification of Wilson Lawn WeedOut Concentrate 3X, DACO: 3.0,3.1,3.1.1,3.1.2,3.1.3,3.1.4 CBI
2370551	2013, Formulation Process of Wilson Lawn WeedOut Concentrate 3X, DACO: 3.2,3.2.1,3.2.2,3.2.3 CBI
2370553	Univar Canada Ltd., 2012, MSDS [CBI Removed], DACO: 3.2.1 CBI
2370556	Innophos Inc, 2013, MSDS [CBI Removed], DACO: 3.2.1 CBI
2370557	2010, MSDS [CBI Removed], DACO: 3.2.1 CBI
2370559	2010, MSDS [CBI Removed], DACO: 3.2.1 CBI
2370560	Innophos Inc., 2008, Technical Sheet [CBI Removed] Food Chemicals Codex Grade, DACO: 3.2.1 CBI
2370561	Innophos Inc., 2009, Technical Sheet [CBI Removed] Food Chemical Codex, DACO: 3.2.1 CBI
2370562	2013, Specifications of Wilson Lawn WeedOut Concentrate 3X, DACO: 3.3.1
2370564	2013, Product Analysis of Wilson Lawn WeedOut Concentrate 3X, DACO: 3.4,3.4.1,3.4.2 CBI

2370565	2013, HPLC Method for GHA-360 in [CBI Removed], DACO: 3.4.1 CBI
2370566	2013, Chemical and Physical Properties of Wilson Lawn WeedOut Concentrate 3X, DACO: 3.5,3.5.10,3.5.11,3.5.12,3.5.13,3.5.14,3.5.15,3.5.2,3.5.4,3.5.5,3.5.6,3.5.7,3.5.8,3.5.9 CBI
2370567	IUCLID, 2000, Dataset 57-13-6, DACO: 3.5.11,3.5.12 CBI
2370568	2013, Certificate of Analysis # 1311121527, DACO: 3.5.6,3.5.9 CBI
2426043	2014, Validation of a HPLC method for the assay of GHA-360 in end-use product, DACO: 3.4.1 CBI
2426044	2014, Revised Chemical and physical properties of Wilson Lawn WeedOut Concentrate 3X, DACO: 3.5 CBI
2426045	2013, Certificate of analysis, DACO: 3.5.6,3.5.9 CBI
2426088	2014, Validation of a HPLC method for the assay of GHA-360 in end-use product, DACO: 3.4.1 CBI
2426089	2014, Revised Chemical and physical properties of Wilson Lawn WeedOut(1) Selective Weed Control, DACO: 3.5 CBI
2426090	2013, Certificate of analysis, DACO: 3.5.6,3.5.9 CBI
2606151	2015, STORAGE STABILITY (25¿¿C) AND CORROSION CHARACTERISTICS OF WILSON LAWN WEEDOUT (2) SELECTIVE WEED CONTROL AND WILSON LAWN WEEDOUT CONCENTRATE 3X, DACO: 3.5.10,3.5.14 CBI
2370601	2013, Product Identification of Wilson Lawn WeedOut(1) Selective Weed Control, DACO: 3.0,3.1,3.1.1,3.1.2,3.1.3,3.1.4 CBI
2370603	2013, Formulation Process of Wilson Lawn WeedOut(1) Selective Weed Control, DACO: 3.2,3.2.1,3.2.2,3.2.3 CBI
2370605	2013, Specifications of Wilson Lawn WeedOut(1) Selective Weed Control, DACO: 3.3.1
2370607	2013, Product Analysis of Wilson Lawn WeedOut(1) Selective Weed Control, DACO: 3.4,3.4.1,3.4.2 CBI
2370609	2013, Chemical and Physical Properties of Wilson Lawn WeedOut(1) Selective Weed Control, DACO: 3.5,3.5.10,3.5.11,3.5.12,3.5.13,3.5.14,3.5.15,3.5.2,3.5.4,3.5.5,3.5.6,3.5.7,3.5.8,3.5.9 CBI
2370633	2013, HPLC Method for GHA-360 in [CBI Removed], DACO: 3.4.1 CBI
2370635	2013, Certificate of Analysis # 1311121527, DACO: 3.5.6,3.5.9 CBI
2370637	Innophos Inc, 2010, MSDS [CBI Removed], DACO: 3.2.1 CBI
2370639	Innophos Inc, 2013, MSDS [CBI Removed], DACO: 3.2.1 CBI
2370642	Univar Canada Ltd., 2012, MSDS [CBI Removed], DACO: 3.2.1 CBI
2370644	Innophos Inc., 2009, Technical Sheet [CBI Removed] Food Chemical Codex, DACO: 3.2.1 CBI
2370646	Innophos Inc., 2008, Technical Sheet [CBI Removed] Food Chemicals Codex Grade, DACO: 3.2.1 CBI
2426066	2014, Validation of a HPLC method for the assay of GHA-360 in end-use product, DACO: 3.4.1 CBI
2426068	2014, Revised Chemical and physical properties of Wilson Lawn WeedOut(1) Selective Weed Control, DACO: 3.5 CBI

2426069	2013, Certificate of analysis, DACO: 3.5.6,3.5.9 CBI
2606157	2015, STORAGE STABILITY (25¿¿C) AND CORROSION CHARACTERISTICS OF WILSON LAWN WEEDOUT (1) SELECTIVE WEED CONTROL AND WILSON LAWN WEEDOUT CONCENTRATE 10X STUDY, DACO: 3.5.10,3.5.14 CBI
2370841	2013, Product Identification of WeedOut PRO, DACO: 3.0,3.1,3.1.1,3.1.2,3.1.3,3.1.4 CBI
2370844	2013, Specifications of WeedOut PRO, DACO: 3.3.1
2426023	2014, Validation of a HPLC method for the assay of GHA-360 in end-use product, DACO: 3.4.1 CBI
2426024	2014, Revised Chemical and physical properties of Wilson Lawn WeedOut Concentrate 10X, DACO: 3.5 CBI
2426026	2013, Certificate of analysis, DACO: 3.5.6,3.5.9 CBI
2370955	2013, Product Identification of Lawn WeedOut(2) Selective Weed Control, DACO: 3.0,3.1,3.1.1,3.1.2,3.1.3,3.1.4
2370959	2013, Specifications of Lawn WeedOut(2) Selective Weed Control, DACO: 3.3.1
2426000	2014, Validation of a HPLC method for the assay of GHA-360 in end-use product, DACO: 3.4.1 CBI
2426001	2014, Revised Chemical and physical properties of Wilson Lawn WeedOut(2) Selective Weed Control, DACO: 3.5 CBI
2426002	2013, Certificate of analysis, DACO: 3.5.6,3.5.9 CBI
2371028	2013, Product Identification of Lawn WeedOut(1) Selective Weed Control, DACO: 3.0,3.1,3.1.1,3.1.2,3.1.3,3.1.4 CBI
2371033	2013, Specifications of Lawn WeedOut(1) Selective Weed Control, DACO: 3.3.1
2426080	2014, Validation of a HPLC method for the assay of GHA-360 in end-use product, DACO: 3.4.1 CBI
2426081	2014, Revised Chemical and physical properties of Wilson Lawn WeedOut(1) Selective Weed Control, DACO: 3.5 CBI
2426082	2013, Certificate of analysis, DACO: 3.5.6,3.5.9 CBI

2.0 Human and Animal Health

2370062 2013, Toxicology of GHA-360 Selective Herbicide Technical, DACO: 4.1,4.2,4.2.1,4.2.2,4.2.3,4.2.4,4.2.5,4.2.6,4.3,4.3.4,4.5.2,4.5.4,4.5.5

2370077 2013, Acute Oral Toxicity Study (Up-and-Down Procedure) in Rats of 4-Cl-IAA, DACO: 2.14.8,4.2.1

2370078 2013, Acute Oral Toxicity Study (Up-and-Down Procedure) in Rats of 4-Cl-IAA, DACO: 2.14.8,4.2.1 CBI

2370079 2013, GHA-360: Acute Dermal Toxicity Study in Rats - Limit Test, DACO: 4.2.2

2370080 2013, GHA-360: Acute Dermal Toxicity Study in Rats - Limit Test, DACO: 4.2.2 CBI

2370081 2013, GHA-360: Acute Inhalation Toxicity Study in Rats - Limit Test, DACO: 4.2.3

2370082 2013, GHA-360: Primary Eye Irritation Study in Rabbits, DACO: 4.2.4

2370083 2013, GHA-360: Primary Eye Irritation Study in Rabbits, DACO: 4.2.4 CBI

2370084 2013, GHA-360: Primary Skin Irritation Study in Rabbits, DACO: 4.2.5

2370085 2013, GHA-360: Primary Skin Irritation Study in Rabbits, DACO: 4.2.5 CBI

2370086 2013, GHA-360S1: Local Lymph Node Assay (LLNA) in Mice, DACO: 4.2.6

2370221 2013, Toxicology of Wilson Lawn WeedOut(2) Selective Weed Control, DACO: 4.6,4.6.1,4.6.2,4.6.3,4.6.4,4.6.5,4.6.6 CBI

2370223 Health Canada - Pest Management Regulatory Agency, 2010, PMRA List of Formulants, DACO: 4.6.1,4.6.2,4.6.3,4.6.4,4.6.5,4.6.6

2370225 U.S. Food and Drug Administration, 2006, Potassium phosphate dibasic. Database of Select Committee on GRAS Substances (SCOGS) Reviews, DACO: 4.6.1,4.6.2,4.6.3,4.6.4,4.6.5,4.6.6 CBI

2370227 2013, Acute Oral Toxicity Study in Rats of 4-Cl-IAA, DACO: 4.6.1

2370229 2013, Acute Oral Toxicity Study in Rats of 4-Cl-IAA, DACO: 4.6.1 CBI

2370247 2013, Use Description Scenario of Wilson Lawn WeedOut(2) Selective Weed Control, DACO: 5.2

2370278 2013, Use Description Scenario of Wilson Lawn WeedOut(2) Battery Powered, DACO: 5.2

2370339 2013, Use Description Scenario of Wilson Lawn WeedOut(1) Battery Powered, DACO: 5.2

2370431 2013, Toxicology of Wilson Lawn WeedOut Concentrate 10X, DACO: 4.6,4.6.1,4.6.2,4.6.3,4.6.4,4.6.5,4.6.6 CBI

2370433 2013, Use Description Scenario of Wilson Lawn WeedOut Concentrate 10X, DACO: 5.2

2370460 Health Canada - Pest Management Regulatory Agency, 2010, PMRA List of Formulants, DACO: 4.6.1,4.6.2,4.6.3,4.6.4,4.6.5,4.6.6

2370464 U.S. Food and Drug Administration, 2006, Potassium phosphate dibasic. Database of Select Committee On GRAS Substances (SCOGS) Reviews, DACO: 4.6.1,4.6.2,4.6.3,4.6.4,4.6.5,4.6.6 CBI

2370466 2013, Acute Oral Toxicity Study in Rats of 4-Cl-IAA, DACO: 4.6.1

2370469 2013, GHA-360: Acute Dermal Toxicity Study in Rats - Limit Test, DACO: 4.6.2

2370472 2013, GHA-360: Acute Dermal Toxicity Study in Rats - Limit Test, DACO: 4.6.2 CBI

2370474 2013, GHA-360: Acute Inhalation Toxicity Study in Rats - Limit Test, DACO: 4.6.3

2370476 2013, GHA-360: Primary Eye Irritation Study in Rabbits, DACO: 4.6.4

2370478 2013, GHA-360: Primary Eye Irritation Study in Rabbits, DACO: 4.6.4 CBI

2370480 2013, GHA-360: Primary Skin Irritation Study in Rabbits, DACO: 4.6.5

2370482 2013, GHA-360: Primary Skin Irritation Study in Rabbits, DACO: 4.6.5 CBI

2370484 2013, GHA-360S1: Local Lymph Node Assay (LLNA) in Mice, DACO: 4.6.6

2370569 2013, Toxicology of Wilson Lawn WeedOut Concentrate 3X, DACO: 4.6,4.6.1,4.6.2,4.6.3,4.6.4,4.6.5,4.6.6 CBI

2370570 2013, Acute Oral Toxicity Study in Rats of 4-Cl-IAA, DACO: 4.6.1

2370571 2013, Acute Oral Toxicity Study in Rats of 4-Cl-IAA, DACO: 4.6.1 CBI

2370572 Health Canada - Pest Management Regulatory Agency, 2010, PMRA List of Formulants, DACO: 4.6.1,4.6.2,4.6.3,4.6.4,4.6.5,4.6.6

2370573 U.S. Food and Drug Administration, 2006, Potassium phosphate dibasic. Database of Select Committee On GRAS Substances (SCOGS) Reviews, DACO: 4.6.1,4.6.2,4.6.3,4.6.4,4.6.5,4.6.6 CBI

2370574 2013, GHA-360: Acute Dermal Toxicity Study in Rats - Limit Test, DACO: 4.6.2

2370575 2013, GHA-360: Acute Dermal Toxicity Study in Rats - Limit Test, DACO: 4.6.2 CBI

2370576 2013, GHA-360: Acute Inhalation Toxicity Study in Rats - Limit Test, DACO: 4.6.3

2370577 2013, GHA-360: Primary Eye Irritation Study in Rabbits, DACO: 4.6.4

2370578 2013, GHA-360: Primary Eye Irritation Study in Rabbits, DACO: 4.6.4 CBI

2370579 2013, GHA-360: Primary Skin Irritation Study in Rabbits, DACO: 4.6.5

2370580 2013, GHA-360: Primary Skin Irritation Study in Rabbits, DACO: 4.6.5 CBI

2370581 2013, GHA-360S1: Local Lymph Node Assay (LLNA) in Mice, DACO: 4.6.6

2370582 2013, Use Description Scenario of Wilson Lawn WeedOut Concentrate 3X, DACO: 5.2

2370611 2013, Toxicology of Wilson Lawn WeedOut(1) Selective Weed Control, DACO: 4.6,4.6.1,4.6.2,4.6.3,4.6.4,4.6.5,4.6.6 CBI

2370613 2013, Use Description Scenario of Wilson Lawn WeedOut(1) Selective Weed Control, DACO: 5.2

2370651 Health Canada - Pest Management Regulatory Agency, 2010, PMRA List of Formulants, DACO: 4.6.1,4.6.2,4.6.3,4.6.4,4.6.5,4.6.6

2370652 U.S. Food and Drug Administration, 2006, Potassium phosphate dibasic. Database of Select Committee On GRAS Substances (SCOGS) Reviews, DACO: 4.6.1,4.6.2,4.6.3,4.6.4,4.6.5,4.6.6 CBI

2370654 2013, Acute Oral Toxicity Study in Rats of 4-Cl-IAA, DACO: 4.6.1

2370656 2013, Acute Oral Toxicity Study in Rats of 4-Cl-IAA, DACO: 4.6.1 CBI

2370658 2013, GHA-360: Acute Dermal Toxicity Study in Rats - Limit Test, DACO: 4.6.2

2370660 2013, GHA-360: Acute Dermal Toxicity Study in Rats - Limit Test, DACO: 4.6.2 CBI

2370661 2013, GHA-360: Acute Inhalation Toxicity Study in Rats - Limit Test, DACO: 4.6.3

2370663 2013, GHA-360: Primary Eye Irritation Study in Rabbits, DACO: 4.6.4

2370666 2013, GHA-360: Primary Eye Irritation Study in Rabbits, DACO: 4.6.4 CBI

2370668 2013, GHA-360: Primary Skin Irritation Study in Rabbits, DACO: 4.6.5

2370670 2013, GHA-360: Primary Skin Irritation Study in Rabbits, DACO: 4.6.5 CBI

2370671 2013, GHA-360S1: Local Lymph Node Assay (LLNA) in Mice, DACO: 4.6.6

2370852 2013, Use Description Scenario of WeedOut PRO, DACO: 5.2

2370968 2013, Use Description Scenario of Lawn WeedOut(2) Selective Weed Control, DACO: 5.2

2371043 2013, Use Description Scenario of Lawn WeedOut(1) Selective Weed Control, DACO: 5.2

2394530 2013, Toxicology of Wilson Lawn WeedOut Concentrate 3X, DACO: 4.6,4.6.1,4.6.2,4.6.3,4.6.4,4.6.5,4.6.6 CBI

2394538 2013, Toxicology of Wilson Lawn WeedOut(1) Selective Weed Control, DACO: 4.6,4.6.1,4.6.2,4.6.3,4.6.4,4.6.5,4.6.6 CBI

2394579 2013, Toxicology of Wilson Lawn WeedOut(2) Selective Weed Control, DACO: 4.6,4.6.1,4.6.2,4.6.3,4.6.4,4.6.5,4.6.6 CBI

2394614 2013, Toxicology of Wilson Lawn WeedOut Concentrate 10X, DACO: 4.6,4.6.1,4.6.2,4.6.3,4.6.4,4.6.5,4.6.6 CBI

2411061 2014, Waiver rationale for toxicology studies, DACO: 4.5.2,4.5.4,4.5.5

2411062 John JA, Blogg CD, Murray FJ, Schwetz BA, Gehring PJ., 1979, Teratogenic Effects of the Plant Hormone Indole-3-Acetic Acid in Mice and Rats., DACO: 4.5.2

2411064 U.S. EPA, 2011, Pyrethrins/Pyrethroid Cummulative Risk Assessment: Appendix 7 - Residential Exposure Tables, DACO: 4.5.2,4.5.4,4.5.5

2411066 Vang & Dragsted (Nordic Council of Ministers), 1996, Naturally Occurring Antitumourigens: Indoles, DACO: 4.5.2,4.5.4,4.5.5

2411067 World Health Organization, 2006, Environmental Health Criteria 235: DERMAL ABSORPTION, DACO: 4.5.2,4.5.4,4.5.5

2411308 World Health Organization, 2006, Environmental Health Criteria 235: DERMAL ABSORPTION, DACO: 4.6.1,4.6.2,4.6.3,4.6.4,4.6.5,4.6.6

2411310 2014, Waiver rationale for acute toxicology studies of the end-use products, DACO: 4.6.1,4.6.2,4.6.3,4.6.4,4.6.5,4.6.6

2470980 2014, Reverse Mutation Assay using Bacteria (Salmonella typhimurium and Escherichia coli) with GHA-360, DACO: 4.5.2,4.5.4

2470982 2014, In vitro Mammalian Cell Gene Mutation Assay (Thymidine Kinase Locus/TK+-) in Mouse Lymphoma L5178Y Cells with GHA-360, DACO: 4.5.2,4.5.5

2470985 2014, Waiver Rationale Prenatal Developmental Toxicity (Rodent), DACO: 4.5.2

2470987 2014, USEPA Residential SOPs Lawn Calculations_Day 1, DACO: 4.5.2

2470990 2014, USEPA Residential SOPs Lawn Calculations_Day 0, DACO: 4.5.2

2470992 Agriculture and Agri-Food Canada, 2010, Lentils: Situation and Outlook. Market Outlook Report., DACO: 4.5.2

2470995 Bekkering E., 2014, Canadian Agriculture at a Glance: Pulses in Canada, DACO: 4.5.2

2470997 2014, Indoleacetic Acid, DACO: 4.5.2

2470998 Cheng W., 2010, Safety Assessment of IBA on Food Plants, DACO: 4.5.2

2470999 Dorff E., 2014, Canadian Agriculture at a Glance: The changing face of the Canadian fruit and vegetable sector: 1941 to 2011., DACO: 4.5.2

2471000 Engvild K.C., 1994, The Chloroindole Auxins of Pea, Strong Plant Growth Hormones or Endogenous Herbicides?, DACO: 4.5.2

2471003 Ernstsen A, Sandberg G., 1986, Identification of 4-chloroindole-3-acetic acid and indole-3-aldehyde in seeds of Pinus sylvestris., DACO: 4.5.2

2471005 Folkes LK, Dennis MF, Stratford MRL, Candeias LP, Wardman P., 1999, Peroxidase-catalyzed Effects of Indole-3-Acetic Acid and Analogues on Lipid Membranes, DNA, and Mammalian Cells In Vitro., DACO: 4.5.2

2471006 Folkes LK, Wardman P., 2001, Oxidative activation of indole-3-acetic acids to cytotoxic species: a potential new role for plant auxins in cancer therapy., DACO: 4.5.2

2471007 Fuller R., Klonne D., Rosenheck L., Eberhart D., Worgan J., Ross J., 2001, Modified California Roller For Measuring Transferable Residues on Treated Turfgrass., DACO: 4.5.2

2471008 Gandar JC, Nitsch C., 1967, Isolement de l'ester methylique d'un acide chloro-3-indolylacetique a partir de graines immatures de pois, Pisum sativum L., DACO: 4.5.2

2471010 Gribble G.W., 1998, Naturally Occuring Organohalogen Compounds., DACO: 4.5.2

2471013 Gribble G.W., 2010, Naturally Occuring Organohalogen Compounds - A Comprehensive Update, DACO: 4.5.2

2471016 Hattori H., Marumo S., 1972, Monomethyl-4-Chloroindolyl-3-Acetyl-L-Aspartate and Absence of Indolyl-3-Acetic Acid in Immature Seeds of Pisum sativum., DACO: 4.5.2

2471017 Health Canada, 2011, Eating Well with Canada's Food Guide, DACO: 4.5.2

2471020 Jensen J.B., Egsgaard H., Van Onckelen H., Jochimsen B.U., 1995, Catabolism of Indole-3-Acetic Acid and 4- and 5-Chloroindole-3-Acetic Acid in Bradyrhizobium japonicum, DACO: 4.5.2

2471021 John JA, Blogg CD, Murray FJ, Schwetz BA, Gehring PJ., 1979, Teratogenic Effects of the Plant Hormone Indole-3-Acetic Acid in Mice and Rats., DACO: 4.5.2

2471022 Kai K., Horita J., Wakasa K., Miyagawa H., 2007, Three oxidative metabolites of indole-3-acetic acid from Arabidopsis thaliana., DACO: 4.5.2

2471025 Katekar G.F., Geissler A.E., 1982, Auxins II: The effect of chlorinated indolylacetic acids on pea stems., DACO: 4.5.2

2471027 Kowalczyk M, Sandberg G., 2001, Quantitative Analysis of Indole-3-Acetic Acid Metabolites in Arabidopsis., DACO: 4.5.2

2471028 Ljung K., 2013, Auxin metabolism and homeostasis during plant development., DACO: 4.5.2

2471030 Magnus V, Ozga JA, Reinecke DM, Pierson GL, Larue TA, Cohen JD, Brenner ML., 1997, 4-chloroindole-3-acetic acid and indole-3-acetic acids in Pisum sativum, DACO: 4.5.2

2471032 Marumo S, Hattori H, Abe H, Munakata K., 1968, Isolation of 4-Chloroindolyl-3-acetic Acid from Immature Seeds of Pisum sativum., DACO: 4.5.2

2471034 Normanly J, 2010, Approaching Cellular and Molecular Resolution of Auxin Biosynthesis and Metabolism., DACO: 4.5.2

2471036 Ostin A, Kowalyczk M, Bhalerao RP, Sandberg G., 1998, Metabolism of Indole-3-Acetic Acid in Arabidopsis., DACO: 4.5.2

2471038 Park S., Ozga J.A., Cohen J.D., Reinecke D.M., 2010, Evidence of 4-Cl-IAA and IAA Bound to Proteins in Pea Fruit and Seeds., DACO: 4.5.2

2471040 Peer WA, Cheng Y, Murphy AS, 2013, Evidence of oxidative attenuation of auxin signalling, DACO: 4.5.2

2471043 Pless T, Böttger M, Hedden P, Graebe J., 1984, Occurence of 4-Cl-Indoleacetic Acid in Broad Beans and Correlation of Its Levels with Seed Development, DACO: 4.5.2

2471045 Michael Ramek, Sanja Tomic, Biserka Kojic-Prodic, 1996, Comparative Ab Initio SCF Conformational Study of 4-Chloro-indole-3-acetic Acid and Indole-3-acetic Acid Phytohormones (Auxins), DACO: 4.5.2

2471047 Reinecke D.M., 1999, 4-Chloroindole-3-acetic acid and plant growth, DACO: 4.5.2

2471049 Ross J.J., Tivendale N.D., Davidson S.E., Reid J.B., Davies N.W., Quittenden L.J., Smith J.A., 2012, A mutation affecting the synthesis of 4-chloroindole-3-acetic acid, DACO: 4.5.2

2471050 Rossiter S, Folkes LK, Wardman P., 2002, Halogenated Indole-3-acetic Acids as Oxidatively Activated Prodrugs with Potential for Targeted Cancer Therapy., DACO: 4.5.2

2471053 Seidel C., Walz A., Park S., Cohen J.D., Ludwig-Mller J., 2006, Indole-3-Acetic Acid Protein Conjugates: Novel Players in Auxin Homeostasis, DACO: 4.5.2

2471055 Simon S., Petrášek J., 2011, Why plants need more than one type of auxin., DACO: 4.5.2

2471057 Šoškic M., Magnus V., 2007, Binding of ring-substituted indole-3-acetic acids to human serum albumin, DACO: 4.5.2

2471058 Sztein A.E., Cohen J.D., Slovin J.P. ,Cooke T. J., 1995, Auxin Metabolism in Representative Land Plants, DACO: 4.5.2

2471059 Tam YY, Epstein E, Normanly J., 2000, Characterization of Auxin Conjugates in Arabidopsis. Low Steady-State Levels of Indole-3-Acetyl-Aspartate, Indole-3-Acetyl-Glutamate, and Indole-3-Acetyl-Glucose, DACO: 4.5.2

2471062 Tivendale N.D., Davidson S.E., Davies N.W., Smith J.A., Dalmais M., et al, 2012, Biosynthesis of the Halogenated Auxin, 4-Chloroindole-3-Acetic Acid., DACO: 4.5.2

2471063 USEPA, 1992, R.E.D. FACTS: Indole-3-Butyric Acid, DACO: 4.5.2

2471064 USEPA, 2010, Indole-3-Butyric Acid Preliminary Workplan and Summary Document, DACO: 4.5.2

2471066 Vetter W., Gribble G.W., 2007, Anthropogenic persistent organic pollutants - Lessons to learn from halogenated natural products., DACO: 4.5.2

2471067 Winterton N., 2000, Chlorine: the only green element - towards a wider acceptance of its role in natural cycles., DACO: 4.5.2

2471069 Woodward AW, Bartel B., 2005, Auxin: Regulation, Action, and Interaction, DACO: 4.5.2

2472502 Gribble G.W., 1996, The diversity of natural organochlorines in living organisms., DACO: 4.5.2

2472504 2014, Determination of Turf Transferable Residues of 4-Cl-IAA Following a Spot Treatment Application on Turf, DACO: 4.5.2

2472506 2014, Turf Transferable Results and Calculations, DACO: 4.5.2

2472509 Sauer M., Robert S., Kleine-Vehn J.K., 2013, Auxin: simply complicated, DACO: 4.5.2

2472510 Sysco, 2014, Produce Facts - Peas - Green Peas, DACO: 4.5.2

2472512 TOXNET, 2004, Full Record Display of Indole-4-Butyric Acid, DACO: 4.5.2

2472515 USA Dry Pea & Lentil Council, 2010, USA Dry Peas, Lentils & Chickpeas: Processing Information & Technical Manual, DACO: 4.5.2

2472516 USEPA, 2012, Standard Operating Procedures for Residential Pesticide Exposure Assessment, DACO: 4.5.2

2479746 2014, Determination of Turf Transferable Residues of 4-Cl-IAA Following a Spot Treatment Application on Turf, DACO: 4.5.2 CBI

2606110 2016, GHA-360: Prenatal Developmental Toxicity Study Following Oral Administration in Hannover Wistar Rats, DACO: 4.5.2

3.0 Environment

2370227	2013, Acute Oral Toxicity Study in Rats of 4-Cl-IAA, DACO: 4.6.1
2370885	1996, Herbicidal activity of 4-chloroindoleacetic acid and other auxins on pea, barley and mustard, DACO: 10.2.1
2471020	1995, Catabolism of Indole-3-Acetic Acid and 4- and 5-Chloroindole-3-Acetic Acid in *Bradyrhizobium japonicum*, DACO: 4.5.2
2471021	1979, Teratogenic Effects of the Plant Hormone Indole-3-Acetic Acid in Mice and Rats., DACO: 4.5.2
2471064	USEPA, 2010, Indole-3-Butyric Acid Preliminary Workplan and Summary Document, DACO: 4.5.2

4.0 Value

2370107 2013, Value summary of Wilson Lawn WeedOut(2) Selective Weed Control, DACO: 10.1.

2370110 2013, Description and mode of action of Wilson Lawn WeedOut(2) Selective Weed Control, DACO: 10.2.1

2370174 2013, Description of pest problem of Wilson Lawn WeedOut(2) Selective Weed Control, DACO: 10.2.2.

2370185 2013, Summary tables of Wilson Lawn WeedOut(2) Selective Weed Control, DACO: 10.2.3.1.

2370187 2013, Efficacy of Wilson Lawn WeedOut(2) Selective Weed Control against broadleaf weeds in turf, DACO: 10.2.3.3(B).

2370188 2013, Appendix – 1: Efficacy of Wilson Lawn WeedOut(2) Selective Weed Control against broadleaf weeds in turf, DACO: 10.2.3.3(B).

2370192 2013, Non-safety adverse effect of Wilson Lawn WeedOut(2) Selective Weed Control on turf, DACO: 10.3.2.

2370194 2013, Appendix – 1: Non-safety adverse effect of Wilson Lawn WeedOut(2) Selective Weed Control on turf, DACO: 10.3.2.

2370131 1996. Herbicidal activity of 4-chloroindoleacetic acid and other auxins on pea, barley and mustard. DACO: 10.2.1.

2370147 1997. 4-chloroindole-4-acetic and indole-3-acetic acids in *Pisum sativum*. DACO: 10.2.1.

2370159 1995. Effect of halogen substitution of indole-3-acetic acid on biological activity in pea fruit. DACO: 10.2.1.

2370170 1994. The chloroindole auxins of pea, strong plant growth hormones or endogenous herbicides. DACO: 10.1, 10.2.1.

B. Additional Information Considered

i) Published Information

1.0 Chemistry

2.0 Human and Animal Health

3.0 Environment

2645854	Arora P.K., Sharma A. and Bae H. 2015. Microbial degradation of indole and its derivatives. Hindawi J. Chem. Volume 2005,13 pages, DACO: 8.6
2645852	Arora P. K. and Bae H. 2015. Biodegradation of 4-chloroindole by *Exiguobacterium*sp. PMA. Journal of Hazardous Materials 284: 261–268, DACO: 8.6
2645853	Raczkowska-Blach E., Rozycki H., Strzelczyk E. and Pokojska A. 1995. Decomposition of indoleacetic acid (IAA) in soil and by bacteria strains isolated from soil and from the root zone of Scot pine (*Pinus sylvestris* L.). Microbiol Res 150:265-270, DACO: 8.6

4.0 Value

ii) Unpublished Information

1.0 Chemistry

2.0 Human and Animal Health

3.0 Environment

4.0 Value