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CASE STUDY

# Herbicide Use in Wild Parsnip and Giant Hogweed Control

January, 2020

## Key Messages

- Direct contact with wild parsnip and giant hogweed may result in a painful skin rash with blisters that can leave a scar.
- No evidence of adverse effects on human health from residual or low environmental level exposures to aminopyralid and metsulfuron-methyl, was identified during this review.
- Integrated pest management of invasive species like wild parsnip and giant hogweed focuses on the long-term prevention of pests through a combination of strategies that may include the use of herbicides, manual removal and public awareness.

# About Case Studies

The Environmental and Occupational Health team provides scientific and technical advice and support to the health care system and the Government of Ontario. We created the case study series to share the diverse environmental health issues we have encountered and to encourage dialogue in these areas. The following issue was selected as a case study because of concern about herbicide use to control invasive poisonous plant species such as wild parsnip and giant hogweed in roadside ditches and rights-of-way.

# Background to the Request

We prepared this case study after a request from a health unit to inform community decision-making. It was not within the scope of the case study to consider adverse effects to ecosystems from either the occurrence or destruction of the weeds or herbicide application. Consideration of the relative effectiveness of different weed management strategies and potential issues related to application procedures, timing of application, and public notification were not part of this review.

We reviewed scientific literature on the following in the preparation of this document:

- evidence of human health effects from exposure to wild parsnip and giant hogweed
- evidence of movement in the environment and effects on human health from exposure to aminopyralid and metsulfuron-methyl
- evidence of health effects associated with the use of adjuvants along with aminopyralid and metsulfuron-methyl

# Methods

PHO Library Services conducted literature searches using keywords, ClearView™ herbicide, aminopyralid, metsulfuron-methyl, furanocoumarins, adjuvants, wild parsnip, giant hogweed and health effects in relevant databases (MEDLINE, BIOSIS, Inspec, Environment Complete, TOXINZ and Scopus). Additionally, a number of grey literature resources were reviewed including the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) and Health Canada's Pesticide Management Regulatory Agency (PMRA), United States Environmental Protection Agency (US EPA), European Union, European Food Safety Authority (EFSA). Relevant references from grey literature were also reviewed. The detailed search strategy and complete results are available upon request.

# Target Plant Species and Their Health Effects

Wild parsnip (*Pastinaca sativa*) and giant hogweed (*Heracleum mantegazzianum*) are two invasive perennial plant species increasingly found in Southern Ontario**,** growing wild in roadsides, railroads, ditches, streams, old fields and native woodlands**.**[1,2] Wild parsnip is a plant with a yellow cluster of flowers that rise from a main stalk of stems and a long root that can grow up to 1.5 meters in depth.[3] Giant hogweed is identified by its white clusters of flowers atop tall green stalks and its large size, growing up to 5.5 metres tall with flower heads up to 1 metre wide.[1] For both species, new plants are established once they mature, forming a shoot and flowers to release seeds; the plant then dies**.**[1,2,] The majority of seeds are dispersed in the immediate vicinity to the plant; however, seeds can be spread

further though water in ditches, tires on vehicles, trapped on animal fur, and in high winds.[1,2,4] The best strategy for limiting the growth and spread of wild parsnip and giant hogweed is to stop the spread of their seed.[1,2]

Wild parsnip and giant hogweed can be hazardous to human health. Both plant species contain chemical compounds in their sap that react after direct contact on human skin and exposure to ultraviolet (UV) light in sunlight, which can cause a skin reaction called phytophotodermatitis.[3-5] Contact with various parts of the plant, including leaves, stems and peeling roots can be a route of exposure to the sap.[4]

Although initial contact with these plants is painless, skin reactions can occur in as little as 15 minutes after exposure to sunlight, and on average between 30 to 120 minutes after exposure to sunlight.[6] Initial health effects typically occur within 24 hours and include swelling and redness of the skin. While it may be mild enough to go undetected, in many cases this is followed by inflammation and formation of vesicles and blisters within 72 hours.[7] Increased pigmentation of the affected area usually occurs within one week, which can lead to scarring and skin sensitivity in the area for several months.[8] In severe cases, patients have required inpatient hospital admission for treatment, including cleaning of the wound and removal of damaged skin.[9,10] One limitation of the current literature is that it does not report on the frequency of these health outcomes. Blindness is often reported in the media as a potential health outcome; however, in our review of scientific literature we did not come across any documented cases of blindness occurring in individuals exposed to the sap of wild parsnip or giant hogweed.[11]

Certain subgroups of the population are at higher risk of exposure including gardeners and landscape workers  who may weed or use power tools without adequate personal protective equipment (e.g., gloves).[12] Children are also at higher risk as they may use the plants to play (e.g., hollow stems as a spyglass or sword).4 Due to their toxicity to skin, manual removal of these plants from roadsides and rights-of-way may be hazardous to workers.[13] Herbicides can be part of an integrated pest management strategy to control wild parsnip, giant hogweed and other noxious species.[1,2]

# Environmental Toxicology and Health Effects

Herbicides used to control wild parsnip and giant hogweed growth may be composed of a mixture of two active ingredients: aminopyralid and metsulfuron-methyl.[14] Active ingredients are the chemicals that repel or kill the target species, while inactive ingredients such as water or isopropanol are mainly used as stabilizers, carriers, or solvents to assist in the application process.[15] For example, ClearView™ is registered in Canada by Health Canada's Pest Management Regulatory Agency (PMRA) under the *Pest Control Products Act* for use in the control of broadleaf weeds and woody plants in roadside, rights-of-way and other non-crop areas.[14,16] This includes wild parsnip and giant hogweed.

## Plant Toxicity

Aminopyralid and metsulfuron-methyl are absorbed by plant leaves and roots, and then move throughout the plant disrupting metabolic functions and cell division, causing it to die.[17-19] Aminopyralid and metsulfuron-methyl are considered to be of low toxicity to most non-plant species, and have a low potential to bioaccumulate in the environment.[20-23]

## Exposure Profile

The use of any herbicide according to the label directions will minimize exposures to the public. The herbicide label outlines the need for personal protective equipment, spray drift precautions, operator use precautions and environmental hazards to consider prior to application.[24]

Improper application may result in exposure to people nearby through spray drift. Entry to freshly sprayed areas may result in exposure through skin contact. From our review of the literature, there are no records of impact on food or drinking water sources significant enough to result in toxic effects. Application to crops would be contrary to the label recommendations, although it can occur through improper feeding of livestock, use of affected manure, and soil re-location.[24]

## Aminopyralid

Aminopyralid has been registered for use in Canada since 2007; it is also registered for use in the United States and in Europe.[20,25,26]

### MECHANISM OF ACTION

Aminopyralid is a selective systemic pyridine carboxylic acid herbicide that acts on target plant species by mimicking auxin, a natural growth inhibiting hormone in plants.[17,22,25] It is used in the control of broadleaf weeds including noxious and invasive species.[17,20,22,25] Uptake into target plants results in the disruption of metabolic pathways leading to inhibited growth.[17,22] Aminopyralid is not readily metabolized in humans with the majority excreted unchanged through urine and feces.[17,22,25]

### HEALTH EFFECTS

Aminopyralid is considered a low acute toxicity herbicide.[20, 22,25,26] According to EFSA, in acute exposure scenarios, aminopyralid has a low toxicity if individuals accidentally eat, touch or inhale residues. [27] In animal toxicity studies, aminopyralid formulated products were not found to cause eye irritation, pose a significant mutagenic risk, or cause reproductive or developmental effects to offspring.[20,27] The US EPA has classified aminopyralid as “not likely to be carcinogenic to humans” and in their assessment concluded that “there is a reasonable certainty that no harm will come from aggregate exposure to aminopyralid residues”.[25] Similarly, EFSA’s peer review of aminopyralid did not identify any harmful effects on human health or unacceptable influence on the environment.[26]

### FATE AND TRANSPORT IN THE ENVIRONMENT

Aminopyralid is highly water soluble, soil mobile and non-volatile. It is persistent in aquatic systems under aerobic and anaerobic conditions.[20] The half-life depends on factors such as soil microbes or sunlight that can cause more rapid breakdown, or cold temperatures and snow cover that can increase this time.The PMRA classifies it as non-persistent to slightly persistent in most soils (half-life of 6 to 39 days).[20] Dissipation in soil occurs mainly through microbial mineralization.[17] While aminopyralid does move through the soil, and is highly soluble in water, the PMRA concluded that if precautionary measures are taken and the product is used as intended, leaching of aminopyralid into groundwater “may be offset”.[20] Additionally, through field dissipation studies in California and Mississippi, the US EPA determined there is minimal leaching of aminopyralid below the 15 to 30 cm soil depth.[25] Its potential to bioaccumulate in the environment or bioconcentrate up the food chain is low.[17,20]

## Metsulfuron-methyl

Metsulfuron-methyl has been registered for use in Canada since 2006; it is also registered for use in Europe and the United States.[21,28,29]

### MECHANISM OF ACTION

Metsulfuron-methyl acts on target plant species by inhibiting an essential plant enzyme, acetolactate synthase. Without this enzyme, plant cell division and growth stops, causing the plant to die.[18,23,30] This mode of action is specific to plants and microorganisms; it is considered a low toxicity herbicide to humans and animals.[23,31] It is used in the control of broadleaf weeds, brush, woody plants and some annual grasses.[18,21]

### HEALTH EFFECTS

According to EFSA, in acute exposure scenarios metsufuron-methyl has a low toxicity if individuals accidentally eat, touch, or inhale residues.[31] Metsulfuron-methyl is poorly metabolized and rapidly excreted mainly via urine; no potential for bioaccumulation has been observed.[18,31] Severe toxicity has only been reported in humans after deliberate ingestion resulting in nausea, vomiting, abdominal pain, diarrhea and rarely, methemoglobinemia, a blood disorder that inhibits the delivery of oxygen to cells in the body.[23] Acute exposures to the concentrated product cause moderate skin and eye irritation.[18,23,31] The US EPA has classified metsulfuron-methyl as "not likely to be carcinogenic to humans".[32] Assessments by the US EPA and Health Canada both concluded that combined exposures to metsulfuron-methyl from food residues and drinking water would not pose adverse health effects to humans.[21,33]

Although the expected exposure associated with metsulfuron-methyl sprayed in ditches or rights of way should not result in adverse human health effects, the product label cautions that individuals should not enter areas where product has been sprayed within 12 hours of application.[24] Directions for use recommend buffer zones, such that application or drift does not directly impact areas of human activity, or aquatic habitats.[24]

### FATE AND TRANSPORT IN THE ENVIRONMENT

Metsulfuron-methyl is classified as non-persistent in soil with a half-life ranging from 14-180 days, with a typical length of 30 days.[18,23] It breaks down faster in moist, warm soil, while cold temperatures and snow cover can increase its half-life.[18] It is also relatively stable in water, with a half-life of approximately three weeks. Chemicals formed from the breakdown of metsulfuron-methyl persist for a longer period of time in the environment.[21] Both metsulfuron methyl and its breakdown products are mobile and can move freely in soil.[21] Field studies have not shown any evidence that these residues in the soil will contaminate groundwater.[21] Water runoff on the soil surface can move the residues into nearby bodies of water such as ponds and rivers.[21] The PMRA concluded that "the monitoring of these bodies of water have revealed residues, but at concentrations below levels of concern".[21] Similarly, the European Commission review concluded that under the proposed and supported conditions of use of metsulfuron-methyl that there are no unacceptable effects on the environment.[29]

## Non-active Ingredients

In Canada, any substance that is a component of a pesticide other than the active ingredients is known as a formulant.34 In addition to, aminopyralid and metsulfuron-methyl, the following are listed as components of herbicides used to control wild parsnip and giant hogweed[14]:

| Formulant | Percent Composition (%) | Other uses |
|---|---|---|
| Sodium Carbonate | 9.9 | Commonly known as soda ash or washing soda, it is used in soaps, detergents, chemical manufacture and as a food additive, as a anticaking agent and stabilizer.[35,36] |
| Kaolin | 5.2 | Natural and man-made white clay, used in diarrhea and cholera medicines.[37] |
| Titanium dioxide | 0.1 | Pigment or filler in paints, paper, ceramics and foods such as flours and dairy products. It is also present in sunscreen.[38] |
| Unknown/proprietary | 13.22 | Not available |

The PMRA registers formulants for end-use in products and as part of this policy categorizes formulants based on their level of concern to human health and the environment.[39] Sodium carbonate and titanium dioxide are classified as “of minimal concern under specific conditions of use”, while kaolin is classified as “of minimal toxicologic concern”.[39] Similarly, in the United States, non-active ingredients must be approved prior to being used in a pesticide.[15] Sodium carbonate, kaolin and titanium dioxide are all listed as being exempt from a tolerance for pesticide chemical residues in food by the US EPA because , “an exemption from a tolerance shall be granted when it appears that the total quantity of the pesticide chemical in or on all raw agricultural commodities for which it is useful under conditions of use currently prevailing or proposed will involve no hazard to the public health”.[40-43]

## Adjuvants

An adjuvant is a chemical that can be added to enhance the performance of a pesticide. For adjuvants sold separately from the pesticide, the requirement for registration in Canada depends on its intended use. "Activator or spray modifier" adjuvants directly improve efficacy or enhance herbicide performance; these adjuvants are subject to registration provisions of the Pest Control Products Act (PCPA) and are regulated by the PMRA.[34] "Utility modifier" adjuvants (e.g. buffering agents or antifoam agents) do not directly improve herbicide efficacy but instead widen the conditions under which a herbicide is useful or to maintain spray diluent integrity; these adjuvant types are not typically subject to registration and regulation.[44]

There was very little literature identified on the use of pesticides and adjuvants and whether the combined toxic effects of using adjuvants with pesticides are different than when used they are used on their own. While additional information of toxicity of mixtures and adjuvants might be useful, the PMRA has a system in place for reporting adverse effects from use of registered pesticides which provides an alert to any effects that may not have been anticipated during the registration process. Furthermore, risk of adervse effects is a function of toxicity and exposure. Directions for use on pesticide labels are provided to prevent exposures that result in harm.

# Discussion and Conclusions

Direct contact with wild parsnip and giant hogweed may result in a painful skin rash with blisters that can leave a scar. Gardeners and landscape workers who manually weed or use power tools without adequate personal protective equipment (e.g., gloves) are at higher risk of exposure.[12] Children may also be at higher risk if they use the plants to play (e.g., hollow stems as a spyglass, sword).[4] Herbicides can be part of an integrated pest management strategy to control wild parsnip, giant hogweed and other noxious species.[1]

Evidence of adverse effects on human health from residual or low environmental level exposures to aminopyralid and metsulfuron-methyl was not identified.

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# Specifications and Limitations of Case Study

The purpose of this Case Study is to investigate a research question to inform decision making. The Case Study presents key findings, based on a systematic search of the best available evidence near the time of publication, as well as systematic screening and extraction of the data from that evidence. It does not report the same level of detail as a full systematic review. Every attempt has been made to incorporate the highest level of evidence on the topic. There may be relevant individual studies that are not included; however, it is important to consider at the time of use of this document whether individual studies would alter the conclusions drawn from the document.

# Authors

Tanya Lalvani, M.Env.Sc., DABT, Environmental Science Specialist, Toxicology
John Minnery, MPH, PhD, P. Eng, Senior Environmental Science Specialist
Nicole Somers, MPH, Environmental Health Analyst
Austin Zygmunt, MSc, MD, Public Health Resident

# Acknowledgements

Alvin Ching Wai Leung, M.Env.Sc., Environmental Health Analyst, Toxicology
Beata Pach, Manager, Library Services, Knowledge Services
Sarah Morgan, Library Operations Technician, Knowledge Services

# Reviewers

Rena Chung, MES, DABT, Manager, Toxicology and Exposure Assessment
Ray Copes, MD, Chief, Environmental and Occupational Health
Elaina MacIntyre, PhD, Epidemiologist Specialist

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# For Further Information

Environmental and Occupational Health
Email: eoh@oahpp.ca

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