Frequently Asked Questions (FAQs)
On the Use of Herbicides in Canadian Forestry

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Introduction

General reviews of forest vegetation management and forest regeneration have been previously published and readers are directed to these sources (1, 2) for broader contextual information. The focus of this FAQ document is primarily on the use of herbicides and potential risks, particularly to wildlife, that may be associated therewith. In considering the potential direct effects of any chemical on any biological organism, it is necessary to take into account three fundamental principles of toxicology:

1) *all chemicals are toxic (e.g., herbicides, caffeine, alcohol, acetylsalicylic acid [ASA], nicotine, sodium chloride [table salt]), but some are more toxic than others*;

2) *the degree to which a toxicological effect is expressed depends on exposure or dose, both in terms of the actual amount and the time frame over which it occurs (as an analogy, think of the difference in effect resulting from consuming several glasses of alcohol in say an hour, versus the same amount over an entire day or versus a smaller amount and frequency of occurrence such as an occasional glass of wine with dinner)*

3) In simple terms, if there is no exposure, there can be no dose, and therefore no effect.

In a manner analogous to the human consumption of alcohol noted above, the potential effects of a herbicide on either humans or any wildlife species is largely dependent on the magnitude, duration, frequency and route of exposure as the primary determinants of dose and therefore effect. Just as there are levels of alcohol or caffeine that may be consumed without any noticeable or measurable effect, there are levels of exposure for wildlife or humans to herbicides for which we also cannot observe or measure a direct or indirect deleterious effect. As applied to a particular forest-use herbicide such as glyphosate, the science of ecotoxicology is focused on estimating the "no-observable effect level (NOEL)" for any type of biological response (e.g. mortality, reproductive impairment). Subsequently, best management practices are designed to establish application rates and techniques and mitigation strategies (e.g. buffer zones) that ensure herbicide applications result in silvicultural objectives being met while at the same time ensuring that toxicological exposure threshold (NOEL) levels for resident wildlife species will not be exceeded with any substantive level of probability.

1. Why is it necessary to control competing vegetation following harvesting in forestry? Stands of pine and spruce are natural components of boreal and Great Lakes-St. Lawrence landscapes. Following harvest, numerous pioneer plant species (e.g. Canada blue-joint grass, raspberry, trembling aspen) which are well-adapted to disturbed sites and open growing conditions, easily outcompete newly planted crop tree seedlings (e.g. spruce and pine species) for nutrients, light, water and growing space (3). In a manner analogous to growing vegetables in the home garden, reduced crop growth or outright crop failure will occur if weeds are not controlled effectively. Of course in contrast to the home garden, the scale at which forestry operations occur makes hand-weeding highly impractical.

2. Instead of intervening to control competing vegetation, why not simply leave harvested sites to regenerate naturally?
On many sites, that is in fact what is done. For example, ~36 % of the forest area harvested annually in Canada is allowed to regenerate naturally (4). In Ontario, even when the use of artificial regeneration was at its peak in the early 1990s, only half of the cutover area was planted or direct seeded and the rest was left for natural regeneration (5). During 2001-2005 in Ontario, the area of Crown forest regenerated ranged from 180,381 to 240,435 hectares per year but only 32.6 to 38.4% of the area received a chemical tending treatment (6). It is well recognized by professional foresters that natural regeneration of conifers cannot be applied on all site types, in many cases (with the notable exception of winter-harvested lowland black spruce) natural regeneration is often not effective on cutover sites > 10 ha (i.e. well below the typical scale of typical operational cut block areas). As a direct result of ineffective historical regeneration (both natural and artificial), there has been a longstanding loss of conifer-dominated stands on the landscape. For example early surveys (1986-1988) conducted on artificially regenerated stands 10-15 years post-planting in Ontario (7,8) showed that 20% of jack pine, black spruce and white spruce and even greater proportions of 30 to 50% of areas regenerating to red and white pine failed to meet free-to-grow standards consistent with sustainable use of those conifer species, which were reportedly invariably replaced by balsam fir and hardwood species such as, poplars and birch (9). The loss of pine and spruce dominated stands across the landscape was further verified in a subsequent independent audit(10) and continues to be recognized as a major challenge.

3. Why do foresters use herbicides as opposed to other non-chemical alternatives?
As a simplifying generalization, there are no alternatives which are as cost-effective, efficient or reliable as modern chemical herbicides in many forest regeneration scenarios. However, non-chemical techniques are in fact employed on a large portion of the forest land base. For example, in the province of Ontario, the majority (~60%) of the forest area harvested annually is regenerated using non-chemical techniques (4). Non-chemical methods may involve planned natural regeneration, mechanical site preparation, brush saw, prescribed fire, controlling the season of harvest to reduce aspen sprouting (11), matching the silvicultural system to the species (e.g., using shelterwood for white pine to retain shade), careful site selection (e.g., planting on less competitive sites), or a combination of such methods, depending upon site specific prescriptions (2).

4. Given that herbicide use is largely on conifer plantations in northern regions, what would happen if herbicide use on those sites was prohibited or discontinued? This depends upon a wide range of crop, site, soil and competing vegetation variables. However, without the aid of chemical herbicides many plantations have a high probability of failing to regenerate to conifer dominated stands within the time required to meet sustainability requirements. Ultimately, this would lead to significantly increased deficits in the natural proportion of conifer-dominated stand types on the landscape, deficits which already exist in many areas as exemplified in the response to question two above. A detailed audit recently conducted on regeneration sites in Nova Scotia, where a decision was taken not to use herbicides, provides good evidence of the probable outcomes. In this case, results showed 87% of the conifer plantations as outright failures, with an additional 10% which did not meet free to grow standards 6-8 yrs post-harvest (12). An important aspect to emphasize is that the impact of such decisions may not be clearly evident until several years after they are made. Similar outcomes have been observed in research trials conducted in other forest ecosystems (13, 14).

5. Have scientists really made a legitimate effort to seek out and test non-chemical alternatives to herbicides? Yes. Federal and provincial government scientists, as well as academics across the country, have expended a tremendous amount of time and energy (not to mention your tax dollars) seeking to discover, investigate and develop non-chemical alternatives that would be effective in Canadian forestry scenarios. These efforts have focused on everything from natural regeneration and mulch mats, through biocontrols to using grazing livestock. The Vegetation Management Alternatives Program established by the Ontario Ministry of Natural Resources in the early 1990s is an excellent example of the effort. Unfortunately, while some of these techniques have potential under very specific conditions (3)and may be employed to varying degree in spatially integrated strategies across different sites (3), none compete with modern herbicides, such as glyphosate, when evaluated against the key criteria of efficacy, cost-effectiveness, reliability and even in terms of environmental acceptability. As an example, a national effort was undertaken to develop and register the indigenous (native) fungus *Chondrostereum purpureum* (15-17) as a microbial biocontrol agent for forest vegetation management. Results of nationally coordinated trials showed it to be highly effective in controlling re-sprouting of some woody competitive species. Two derivative commercial products were ultimately registered for use. However, use of these products has been minimal in operational forest practice for several reasons including: total lack of efficacy on herbaceous competitor species, ineffectiveness on some particular woody species, and the need for manual or mechanical cutting immediately prior to application of the fungus which increases overall operational costs. Other alternative approaches, such as the use of mulch mats have also generally proven to be both ineffective and far too costly (18, 19) for widespread use in operational forestry.

6. Even if alternatives are more costly and maybe don't work as well as herbicides, wouldn't it still be better to use them because they are safer?

Not necessarily. Literally all options carry some inherent degree of risk either to environmental or human health. The actual risks for other options are relatively less well-studied and defined, a fact which is not necessarily a good thing. Risks of other potentially deleterious effects are technique specific. For example, mechanical site preparation with large machinery carries risks associated with harm to wildlife, potential soil compaction, increased erosion and also excessive burning of fossil fuels. Manual clearing with brush saws involves unequivocal risk to workers associated with repetitive direct exposure to proven carcinogens such as benzene in exhaust fumes, as well as demonstrable risks for stress and strain type injuries. Prescribed fire also has risks associated with the safety of workers and the possibility that the fire will escape. With herbicide use, risks are generally associated with the potential for direct or indirect effects on wildlife species or to humans that may be inadvertently exposed to herbicide residues. However, such risks are significantly mitigated by the extensive scientific research that is invoked to enhance our understanding and define biological effects thresholds and the operational practices that are put into place to reduce the probability that actual exposures will exceed such thresholds (e.g. buffer zones, signage, use of minimum effective rates, advanced application technologies to optimize targeting and reduce drift potential etc.). There are important differences between scientifically quantifiable risk or probability of occurrence, and the willingness of an individual or particular segment of society to tolerate those risks and probabilities. Risk tolerance varies dramatically from one segment of society to another and often directly reflects familiarity and knowledge (20).

7. Who is responsible for ensuring that herbicides used in Canadian forestry do not pose significant risks to human or environmental health?

Primary responsibility lies with the Pest Management Regulatory Agency (PMRA) of Health Canada which reviews and regulates all pesticide use in this country under the federal Pest Control Products Act. Such registration indicates that, based on extensive expert review of all available scientific evidence, registered products have no potential for significant effects on human or environmental health when used in accordance with specifications provided on the label which are available from the PMRA website (http://www.hc-sc.gc.ca/cps-spc/pest/index-eng.php). Additional agencies in each Canadian province, such as the Ontario Ministry of Environment and the Ontario Ministry of Natural Resources in Ontario, impose significant additional review, regulation and operational management requirements on the use of herbicides in forestry under a variety of different provincial legislative acts (e.g. Ontario Pesticides Act).

8. How are the scientific data on herbicide effects on environmental or human health generated?

The bulk of the data used in initial regulatory review and registration of an herbicide is provided by the registrant (typically the manufacturer). This may be generated within their own research laboratories or by third-party, independently-certified laboratories. A good deal of additional scientific research is conducted by independent academic, federal and provincial government scientists across Canada who work under a specific mandate of conducting research in the public good. Often this work focuses on field studies to determine the behavior and potential effects of herbicides under specific conditions of Canadian forest use or to address specific public concerns (for example potential effects on amphibians, or the effectiveness of buffer zones as a risk mitigation technique).

9. How many herbicides are registered for use in Canadian forestry?

There are six herbicide active ingredients registered for use in Canadian forestry (2,4-D, hexazinone, simazine, triclopyr, glyphosate and imazapyr). However, in Canadian forestry, glyphosate has accounted for more than 93% of the forest area treated for more than a decade. Thus, use of all other herbicides is so minor that they do not warrant further discussion here. Detailed statistics on pesticide use in Canadian forestry are freely available through the National Forestry Database Program website (http://nfdp.ccfm.org/). Since the patent has expired on glyphosate, several manufacturers now produce various end-use formulations of this compound and they are sold in the forest market under trade names such as Vision, VisionMax, Forza and Vantage. While all of these formulated products contain glyphosate as the active ingredient and a surfactant to enhance uptake across plant cuticles, the actual chemical constitution of each formulation may vary (i.e. one formulated glyphosate product does not necessarily equal another).

10. Where can I find the actual toxicological and environmental fate data available for specific herbicides used in Canada?

There are many sources of factual, accurate and peer-reviewed scientific information on the internet. Unfortunately, there is even more unsubstantiated personal opinion, myth and outright inaccuracies or misrepresentations circulating through that medium. One should always be very cautious in accepting any singular piece of information as fact (including our own scientific publications) and require presentation of solid data to substantiate a viewpoint. Good science and derivative policies are founded on replication, peer review and the weight of scientific evidence principle. It is the balance of this weight of scientific evidence that should form the basis of an informed opinion. With specific reference to the question here, reliable detailed information on the general toxicological and environmental fate of herbicides can be easily found by using keywords to search the Pesticide Information Profile (PIPs) section of the EXTOXNET website (http://extoxnet.orst.edu/) maintained by a consortium of universities in the USA. Regulatory review and decision documents pertinent to any herbicide used in Canada can be found by searching the PMRA website as noted above. Short abstracts of almost all of the primary scientific information directly pertinent to herbicides as used in Canadian forestry can be directly accessed free by searching the Canadian Forest Management Database maintained by the Canadian Forest Service (http://www.glfc.forestry.ca/cfpm/).

11. What is the typical use pattern for glyphosate-based products?

Herbicides are applied under two different strategies, either prior to planting (chemical site preparation) or after seedlings are planted (tending or release). Owing to the remoteness and difficult access characteristic of many treatment sites, and the cost-effectiveness of the technique, aerial application using either fixed-wing or rotary wing aircraft, is the most common method of distributing herbicides to target sites. Typically herbicides are applied within the first five years post-harvest and any given site receives one or maximally two treatments in a rotation period of 50-80 years depending largely upon crop species and site quality. In Ontario, which has historically treated the most forest area on an annual basis, ~ 70,000 ha are treated each year, an area essentially equal to the area planted. This equates to approximately 38.5% of the area harvested annually or about 0.28% of the total productive forest land base in the province. The typical use rate for glyphosate in conifer release programs in Ontario is 1.9 kg a.e /ha (21). A provincial ban on herbicide use in forests was invoked in the province of Quebec in 2001. In contrast the use of glyphosate in the province of Alberta has been increasing, largely as the result of stringent new requirements to meet "free to grow" standards and sustainable use goals.

12. Doesn't aerial application of glyphosate pose a high risk of drift and contamination of environmentally sensitive non-target areas such as streams, ponds or lakes?

No. While such risks do exist, the combination of professional aerial applicator training and licensing, modern application technologies such as low drift nozzles and electronic guidance systems and the legislative requirement for buffer zones mitigates these risks to very low levels. A recent study investigating the advantages of modern aerial application technologies concluded that under typical aerial application scenarios in Ontario, toxicologically significant deposits of glyphosate are very unlikely to occur at any distance beyond ~ 30 to 50 m from target zone boundaries, thus confirming the protective value of the 60 or 120 meter buffers imposed to protect various aquatic ecosystems (22). A previous study (21) monitoring numerous aerial spray operations across Ontario, demonstrated that water-bodies adjacent to aerially treated sites and protected by standing timber buffers do not contain glyphosate residues in the water at concentrations above known toxicological significance thresholds.

13. Why is glyphosate such a dominant herbicide in Canadian forestry?

There are three key reasons: a) its excellent record of efficacy and reliability in controlling most competitive species including those that resprout through rhizomes, root or basal buds b) its relatively favourable environmental behaviour profile (e.g. non-persistent in soils, vegetation and water, non-bioaccumulatory, very low leaching potential) and c) its relatively low innate toxicity to humans and wildlife. For many of these same reasons glyphosate is a dominant herbicide used in both forestry and agriculture internationally.

14. How does glyphosate kill plants?

Glyphosate is a nonselective, systemic herbicide, that translocates (or moves throughout) plants very effectively once it penetrates the waxy cuticle of plant leaves or stems. As such it is particularly useful for control of weedy plant species that re-sprout from roots, rhizomes or cut stumps and it exhibits a high degree of effectiveness on most of the key competitive species in Canadian forest regeneration sites. Glyphosate kills plants by inhibiting a very specific enzyme by which plants (and some microbial species) convert shikimic acid into aromatic amino acids. This enzyme is not found in higher animals. Since glyphosate is very polar and water soluble it doesn't penetrate waxy cuticles very well at all and thus end-use products typically contain, or are mixed with, a surfactant (a detergent) to effectively overcome this limitation. Glyphosate is also very strongly bound to organic matter and clay particles in soils. As such, it is essentially deactivated by soils and has essentially no ability to control plants sprouting from seeds in the soil seed bank or from roots or rhizomes of untreated plants. Glyphosate does not easily kill conifers, particularly after they have had a chance to fully develop their characteristic natural waxy film (cuticular wax) that protects the needles from disease and dehydration and which effectively prevents the plant from absorbing a dose sufficient to injure the tree.

15. What about potential effects of glyphosate-based herbicides on humans?

Based on regulatory risk assessments conducted by the PMRA and several other international reviews, the use of glyphosate based herbicides in relation to registered uses and when applied in accordance with the specific product labels does not pose a significant risk to either applicators or others who might be inadvertently exposed. All of the fundamental principles of toxicology as described above apply, and in particular the key point that no exposure means no dose and therefore no effect.

Individuals directly involved in the herbicide application (e.g. mixer/loaders, pilots, those applying herbicide by backpack) have the greatest probability, magnitude and frequency of potential exposures and therefore the highest potential risk. For this reason, all applicators must be specifically trained and licensed in the safe handling and application of pesticides and all are required to wear appropriate personal protective equipment (e.g. goggles, chemically resistant gloves, long-sleeved shirts etc.) as identified on the product label. The express intent of these precautions is to minimize their exposure to essentially nil. Modern equipment and technology used to mix and load herbicides into spray aircraft are also specifically designed to minimize any potential human exposure. Finally, it should be noted glyphosate itself is poorly absorbed via dermal penetration through skin tissues (23) or across membranes in the digestive tract. This fact inherently limits the potential dose to other critical body organs and tissues, making lab studies which involve direct application to such organs or tissues and which do not account for this aspect essentially irrelevant in terms of real-world toxicological risk estimation.

16. What practices are employed to minimize the potential for accidental exposure of other individuals who may be in the area?

First, it should be recognized that given the small proportion of the total forest area treated in any given year, the low frequency of treatments to any given site, the relatively short time window (say six weeks during August to mid September) when applications are made, and the typical remote and difficult to access characteristic of most treatment sites, there is an exceedingly low probability of direct exposure for individuals other than those directly involved in the spray operation Nonetheless, numerous protective measures are taken in all provinces to further protect against any potential accidental exposures. For example in the province of Ontario the Ministry of Natural Resources and Sustainable Forest License holders take the following specific actions:

a) mapping and establishing no spray buffers around areas of human habitation, including inhabited trappers cabins, during the planning process;
b) the MNR district manager issues public notices detailing herbicide spray programs at least 30 days before the anticipated date of application and again 7 days prior to start, normally in the form of advertisements in the local media;
c) direct written notice is provided by the MNR to landowners or occupants within one kilometer of the proposed treatment area;
d) all treatment sites are posted in multiple languages at access points at the time of application and at least 30 days subsequent thereto, note that the signs specifically advise not to eat berries from the treated site until the following year; however, that extended “wait period” does not necessarily reflect a high level of risk. In fact residues in wild berries taken

even immediately after treatment in over sprayed sites (24, 25) are likely to be in same range as residue levels on many agricultural commodities (e.g. soybeans and sugar beets) which are considered safe for routine consumption. The advisory not to eat treated berries is an easy and effective extra precautionary measure (no exposure= no dose = no effect)
e) during the actual period of treatment, access roads to the mixing/loading location or specific sites being treated may be temporarily blocked;
f) ground or aerial reconnaissance is conducted immediately prior to application to each individual site to ensure that no individuals are inadvertently within the treated sites scheduled to be sprayed.

17. What mechanisms are used to enhance public awareness about local herbicide use in forestry or to allow them to voice theirs specific concerns?

Such mechanisms may vary from province to province. In Ontario, all management activities on Crown forests are subject to the Environmental Assessment Approval for Forest Management on Crown Lands (Class EA) http://www.ene.gov.on.ca/envision/env_reg/er/documents/2003/RA03E0004.pdf. which includes provisions for citizens or stakeholder to be involved in the forest management process. The planning phase identifies where, when and why herbicides might be used to control competing vegetation and these plans are available at any time for public review. To further enhance awareness of forest management activities, local citizens committees (LCC) have been established in each district. The LCCs provide a good mechanism for the general public to raise specific issues or concerns and have them addressed. Representatives of the OMNR who are appointed to these committees or local Sustainable Forest License holders who attend LCC sessions may address these concerns directly or in other cases bring in others with specific knowledge to provide further information or address highly technical questions in more detail. Both provincial and federal government researchers have made numerous presentations relating to various aspects of herbicide use to many different LCCs throughout the province as a key mechanism of knowledge transfer and open discussion.

18. I've read on the internet that glyphosate causes cancer and is an endocrine disruptor, is that true?

No. Based on the weight of available scientific evidence, several regulatory and independent scientific review panels conclude that glyphosate is non-carcinogenic, non-teratogenic, non-mutagenic and does not act as an endocrine disruptor in whole animal systems under realistic exposure regimes (26, 27). It is important to note that such reviews conducted by highly qualified professional toxicologists and risk assessment specialists are the most credible and reliable source of information. This contrasts sharply with poorly or completely unsubstantiated mis-information which unfortunately is often widely circulated, intentionally or unintentionally, via the internet. Several examples of this general problem actually relate directly to this question and involve individual laboratory studies that are being inappropriately used to support the contention of such risks, while professional toxicologists examining the same data provide clear and convincing evidence refuting such claims.

19. What is known about the fate and behaviour of glyphosate in Canadian forest ecosystems?

Laboratory and field studies in Canadian forest ecosystems have demonstrated that glyphosate is rapidly degraded by naturally occurring micro-organisms such as bacteria. Bioaccumulation or biomagnification of glyphosate has not been shown to occur in the food chain. The environmental fate and behaviour of glyphosate under typical use conditions has been studied extensively. During a typical aerial application, almost all of the spray is deposited directly within the target area and is intercepted by the leaves of the plants it is intended to control. Very little spray reaches the forest floor (28). It takes about 2 days for half of the spray to be absorbed and moved within the vegetation. The remainder of the spray is absorbed or degraded (29). The degradation pathways for glyphosate are well understood and initially result in break up of the molecule into the first stage degradation product aminomethylphosphonic acid (AMPA). When the process is complete, only organic carbon, nitrogen and phosphorous will be left. Studies show that glyphosate is:

a) rapidly degraded, principally by micro-organisms and therefore non-persistent in soil and water with time required for the chemical to dissipate by half ranging from days to a few weeks depending upon the medium and specific environmental conditions involved(28-36)
b) strongly attached to organic carbon and clay particles and thus generally not susceptible to leaching downward into groundwater or being washed into surface water (30, 31, 34).

20. What about the potential effects of glyphosate on wildlife?

A wealth of scientific information exists pertaining to the potential effects of glyphosate on a wide variety of wildlife species including birds, small mammals, large mammals, amphibians, insects, microbial organisms and others. Numerous scientific and regulatory reviews have evaluated the available data on this aspect generally and all of these reviews consistently conclude that the use of glyphosate products in accordance with product labels does not pose a significant risk to wildlife species in terms of either direct acute or chronic toxicity or through various potential sub-chronic or indirect effects. Numerous field studies on this topic have been undertaken directly in Canadian forest ecosystems and in general indicate that typical uses of formulated glyphosate products in forestry do not: a) generate plant monocultures b) result in direct acute toxicity to birds, fish, aquatic invertebrates, small mammals, large mammals or amphibians or c) cause reduction in soil microbial populations or significantly impair their function. Short-term reductions in numbers of some wildlife species (e.g. small mammals or birds) are known to occur in some cases (30, 31), as an indirect result of changes in their optimal vegetative habitat. Such changes are typically quite transient, with numbers returning to normal levels within 2-3 years as vegetation and preferred habitat or food re-establishes on the treated site.

Similar scenarios may occur with large mammal species (e.g. moose, deer) which may avoid treated sites for a few years post-treatment while the supply of their favoured browse species is reduced but then seek out those sites preferentially in later years when their browse species re-establishes on the site (32, 33).

21, I've seen scientific studies that indicate that the surfactant used in glyphosate formulations kills frogs, is that true?

Yes and no. Let us recall the fundamental principles of toxicology, all compounds are toxic, some more so than others and it's really all a matter of dose or exposure. All applications of glyphosate in forest management require the use of a surfactant to enhance uptake of glyphosate across the waxy cuticle of plants. For glyphosate formulations which contain the POEA surfactant (e.g. Vision and others) it is commonly accepted that it is the POEA surfactant which is the primary toxicant for aquatic organisms like fish and amphibian (tadpoles) rather than glyphosate itself. Lab studies have shown that amphibians, particularly their aquatic larvae or the tadpole stages, are highly sensitive to glyphosate formulations containing the surfactant POEA, a detergent similar to others used in cosmetics and household products. In fact the role of the POEA surfactant in toxicity to both larval fish and amphibians has been established from laboratory studies for quite some time. However, to date all the available information indicates that toxic effects on amphibians that are demonstrated in lab experiments only occur at exposure levels well above exposure levels observed in wetlands or stream environments typical of real world amphibian breeding habitat, this is true in both the agriculture and forest sector. In fact, both manipulative and operational field studies conducted in northern Ontario show no direct toxic effects, growth impairment or abnormal behaviour response for various species of amphibians at environmentally realistic exposures (21, 34). Further research on the possible effects on amphibians is ongoing, but is now focused primarily on investigating the potential for very subtle indirect effects on wetland habitat quality and potential interactive effects with other types of stressors, since these potential effects are widely considered to be more plausible in the real world than are direct acute toxic effects.

22. I read on the internet that glyphosate may be contaminating game meat and therefore there is substantial risk to first nations peoples and other hunters who consume wild game, is that true?

There are no credible scientific data supporting the contention that glyphosate residues may contaminate wild game tissues, particularly at levels that may be toxicologically significant to humans. Based on laboratory studies, glyphosate is known to be rapidly excreted in the urine and feces of experimental animals even when exposed at very high experimental dose levels and has not been shown to accumulate in organ or muscle tissues following exposure at realistic levels. Field studies conducted in different forestry scenarios (32, 35, 36) confirm that glyphosate residues are not accumulated in the flesh of game animals (e.g. moose, deer, hare) or other wildlife species taken from within or near glyphosate treated areas.

23. If the available scientific data demonstrate that the use of glyphosate or other pesticides do not pose any risk to the environment or human health, why are there bans such as that against herbicide use in forestry in Quebec, or the on the use of "cosmetic" pesticides in Ontario?

It is important to recognize that decisions to "ban" pesticides are not necessarily based purely on science. Legislation may also reflect societal norms and tolerances, which may vary from time to time or region to region. This is reflected by the simple fact that bans occur in some jurisdictions and not others, even though the same scientific information is available to both. While Quebec has chosen to ban the use of forest herbicides in that province, most other provinces in Canada including Ontario, British Columbia, and New Brunswick utilize herbicides (particularly glyphosate) to ensure effective and efficient regeneration, which in turn contributes to overall sustainable forest management. Forest herbicides are used to meet very specific silvicultural objectives and cannot in any way be conceived as "cosmetic". As such, forest uses are specifically excluded from the ban on "cosmetic" pesticides in Ontario. The provincial ban on cosmetic pesticides in Ontario was invoked in part to supersede a diverse set of bylaws that were being implemented by various municipalities and provide a singular, clearer set of rules.

24. Is it true that herbicides cannot be used in forests certified independent third party agencies, such as that of the Forest Stewardship Council (FSC)?

No. It is true that FSC seeks to reduce over-reliance on herbicides and requires forest managers to show evidence of seeking or using non-chemical alternatives as well as other approaches in an attempt to reduce herbicide use over the longer term. However, such certification systems are intended to ensure that the certified forests are managed sustainably. This of course requires effective and efficient regeneration. In fact, several major forests in Canada, including one of the largest in Ontario, which have held FSC certification for some time, continue their appropriate use of herbicides such as glyphosate to meet regeneration and sustainability requirements.

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