

Type	Terrestrial herbicide - systemic (absorbs into the plant and is circulated to kill entire plant).
Controls	Non-selective - will kill nearly all types of vegetation; annuals, perennials, vines, brush, etc.
Mode of Action	Disrupts the shikimic acid pathway which ultimately leads to the inhibition of the aromatic amino acid biosynthesis pathway that is vital for protein synthesis and plant growth (Reference 5).

Thurston County Review Summary:

Herbicide products with the active ingredient glyphosate are probably the most commonly used in all the world. The risk for toxicity from the use of herbicide products with glyphosate as the only active ingredient is considered low, however, the International Agency for Research on Cancer has classified glyphosate as a probable human carcinogen which contrasts the EPA's determination that it is not carcinogenic. Since IARC and the EPA are both used by Thurston County as authoritative sources for cancer classification, glyphosate is conservatively rated high in hazard and fails Thurston County's pesticide review criteria.

MOBILITY

Property	Value	Reference	Value Rating
Water Solubility (mg/L)	12,000	5	High
Soil Sorption (Kd=mL/g)	312	1	Low
Organic Sorption (Koc=mL/g)	21,699	3	Low

Mobility Summary:

Glyphosate is considered highly water soluble, which gives it the potential to mix and move with water. However, it has a very strong adherence to all soil types. Because glyphosate binds so well to soil, it is not expected to leach deeply into soils or migrate from the application site. The use of products with a surfactant or adding a surfactant to a product can increase the mobility of glyphosate by decreasing its ability to adhere to soil. The mobility hazard of the active ingredient glyphosate, by itself, is considered low.

PERSISTENCE

Property	Value	Reference	Value Rating
Vapor Pressure (mm Hg)	0.0000001 (acid)	3	High
Biotic or Aerobic Half-life (days)	2	1	Low
Photolysis Half-life (days)	89	3	High
Terrestrial Field Test Half-life (days)	3 - 141 (mean = 14)	1	Moderate
Hydrolysis Half-life (days)	"stable"	1	High
Anaerobic Half-life (days)	8	1	Moderate
Aquatic Field Test Half-life (days)	7.5 (water) and 120 (sediment)	1	Low (water) High (sediment)

Persistence Summary:

The active ingredient glyphosate is considered moderately persistent (expected to break down to half of the applied concentration within 60 days).

BIOACCUMULATION

Property	Value	Reference	Value Rating
Bioaccumulation Factor	Not found		
Bioconcentration Factor	248 to 430	5	Moderate
Octanol/Water Partition Coefficient	-2.8 to -0.6	5	Low

Bioaccumulation Summary:

The small octanol/water partition coefficient (log Kow value less than 2.5) indicates a low potential to bioaccumulate and laboratory studies calculate a bioconcentration factor that indicates a moderate potential to bioaccumulate (BCF = 248 to 430). In metabolism studies, single doses of glyphosate in mammals are rapidly excreted with up to 99% elimination within days (Reference 5). The calculated elimination half-life of glyphosate in mammals was about 14 hours and the elimination half-life of the degradation chemical aminomethyl phosphonic acid (AMPA) was about 15 hours (Reference 5). Degradation chemical AMPA has a log Kow = -2.36 to -1.61, which also indicates a low potential to bioaccumulate (Reference 5).

The bioaccumulation potential of glyphosate and its degradation chemical AMPA is rated low in hazard.

ACUTE WILDLIFE TOXICITY VALUES and Risk Assessment

Test Subject	Value	Reference	Toxicity Rating
Mammalian (LD50)	>5,000 mg/kg	1	Low
Avian (LD50)	>1,000 ppm	1	Moderate
Honey bee or insect (LD50)	>100 ug/bee	1	Low
Annelida -worms (LC50)	>2,000 mg ae/kg soil	5	Low
Fish (LC50)	86 ppm	1	Moderate
Crustacean (LC50)	281 ppm	1	Low
Mollusk (LC50)	>10 mg/L	1	Moderate
Amphibian (LD50 or LC50)	Not found		

Acute Toxicity Testing and Ecotoxicity Summary:

Glyphosate testing indicates that it is low in toxicity to animals, insects and worms but moderately toxic to some birds, fish and other aquatic organisms. Toxicity to aquatic organisms may increase depending on the glyphosate product chosen because some of the other ingredients and surfactants that are added. Glyphosate products are considered low in mobility hazard so, are not considered likely to reach aquatic environments after a land application. Glyphosate products specifically formulated to be used around water bodies typically contain water as their other ingredient, which decreases the acute toxicity hazards to all organisms.

ACUTE HUMAN TOXICITY - Risk Assessment

Subject and Scenario	Route	Dose of Concern	Exposure	Margin of Safety	Reference	Risk Rating
Applicator / handler exposure not evaluated						
Toddler contact with treated vegetation	Hand-to-mouth ingestion	1.75 mg/kg/day	0.024 mg/kg bw/day	73	2	Low
Other post-application exposures not evaluated						
Child's contact with treated vegetation + diet	Hand-to-mouth + diet	1.75 mg/kg/day	0.092 mg/kg bw/day	19	2	Low

Acute Toxicity Risk Assessment Summary:

Short-term risk assessments were calculated using a a value of 175 mg/kg-bw based on mortality of test animals and an uncertainty factor of 100 to create a dose of concern of 1.75 mg/kg-bw.

The short-term risk assessment calculated for a child playing in treated vegetation and having an exposure through hand-to-mouth activities was calculated to be 70 times less than the EPA's dose of concern and is rated low in hazard. The same potential exposure combined with exposure through diet was calculated to be 18 times less than the EPA's dose of concern, and is also rate low in hazard (Reference 2). The risk of toxicity from the short-term risk assessment indicates a low hazard from post-application exposures from residential applications.

CHRONIC HUMAN TOXICITY HAZARDS

Property	Value	Adverse Effect	Reference	Rating
Carcinogenicity	E (EPA) - 2A (IARC)	Contradicting classifications	1 and 6	Low and High
Mutagenicity	Positive (human cells)	DNA and chromosomal damage	6	High
Neurotoxicity - (NOAEL)	Not required	--	2	Low
Endocrine Disruption	Many concentrations tested	"No convincing evidence"	7	Low
Developmental Toxicity (NOAEL)	500 mg/kg/day	Decreased body weights	2	Check risk
Reproductive Toxicity (NOAEL)	30 mg/kg/day	Decreased body weights	5	High
Chronic Toxicity (NOAEL)	175 mg/kg/day	Mortality	2	Check risk

Chronic Toxicity Hazard Summary:

The International Agency for Research on Cancer (a branch of the World Health Organization) classified glyphosate as a probable human carcinogen and stated that it caused DNA and chromosomal damage in human cells (Reference 6). The EPA classified glyphosate in Group E - "evidence of non-carcinogenicity in humans" (Reference 1). Chemical mutagenicity and classification as a probable human carcinogen are rated high in hazard by Thurston County's pesticide review criteria, whereas the EPA's classification is rated low in hazard. Glyphosate will be conservatively rated high in hazard. A three generation reproductive toxicity test elicited a toxic effect to the third generation male pups at 30 mg/kg/day and the parental LOAEL was >30 mg/kg/day - although, the EPA stated that other studies found toxicity to the salivary glands of adult animals at the same concentration (and salivary gland toxicity was not assessed as part of the multi-generational study). Reproductive toxicity without parental toxicity is also rated high in hazard. The EPA concluded that Tier I testing for endocrine disruption did not produce convincing evidence of potential interaction with the estrogen, androgen or thyroid pathways so it is not considered an endocrine disrupting chemical (Reference 7).

It should be noted that since the EPA is still reviewing toxicity data for glyphosate re-registration, the products currently registered for use utilize the previous risk assessments based on a higher toxicity value of 175 mg/kg-bw and not the lower value used by Canada in 2015 - which was 30 mg/kg-bw. If the EPA adopts a lower toxicity value for future risk assessments, this section will be updated.

CHRONIC HUMAN TOXICITY - Risk Assessment

Subject and Scenario	Route	Dose of Concern	Exposure	Margin of Safety	Reference	Risk Rating
Exposure to treated vegetation not evaluated						
Child (1- 12) contacted treated vegetation + diet	Incidental + Dietary ingestion	1.75 mg/kg/day	0.023 mg/kg/day	76	2	Low
Drinking water exposure not evaluated						
Child (1- 6) eating treated crops	Dietary ingestion	1.75 mg/kg/day	0.068 mg/kg/day	25.7	2	Low

Chronic Toxicity Risk Assessment Summary:

Long-term risk assessments were calculated using the same dose of concern as the short-term risk assessments (1.75 mg/kg/day). The worst-case scenarios for potential long-term exposures to glyphosate were calculated from eating food with residual herbicide on it. The risk was calculated to be low in hazard. The dietary exposure, combined with potential exposures from contacting treated vegetation, is also rated low in hazard.

Metabolites and Degradation Products:

Aminomethyl phosphonic acid (AMPA) is the major degradation product of glyphosate in aerobic soil, aquatic environments, and plant metabolite (Reference 1). AMPA is considered low in hazard for mobility and bioaccumulation but, high in hazard for persistence (Reference 3). It is considered moderate in toxicity to fish and other aquatic organisms (Reference 4).

Comments:

Glyphosate is a moderate eye and skin irritant.

References

- USEPA. Office of Prevention, Pesticides and Toxic Substances. Reregistration Eligibility Decision (RED) - Glyphosate. EPA 738-R-93-014. September 1993.
- USEPA. Federal Register / Vol. 67, No. 188 / Friday, September 27, 2002 / Rules and Regulations. 40 CFR Part 180. [OPP-2002-0232; FRL-7200-2] Glyphosate; Pesticide Tolerance.
- European Commission, Health & Consumer Protection Directorate-General. Glyphosate. 6511/VI/99-Final. 21 January 2002.
- International Union of Pure & Applied Chemistry (IUPAC). Pesticide Properties Database, Glyphosate (Ref: Mon 0573). <http://sitem.herts.ac.uk/aeru/iupac/>
- Health Canada. Pest Management Regulatory Agency. Proposed Re-evaluation Decision. PRVD2015-01. Glyphosate. April 13, 2015.
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- USEPA. Office of Pesticide Programs. EDSP: Weight of Evidence Analysis of Potential Interaction with the Estrogen, Androgen or Thyroid Pathways. Chemical: Glyphosate. June 29, 2015.