

Pesticide Use in Denver Parks and Mitigating the Risks of Pesticide Use

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Presentation adopted from Thia Walker CSU Extension Specialist-Pesticide Safety Education

What are Pesticides?

- Pesticide law defines a "pesticide" (with certain minor exceptions) as:
 - Any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest.
 - Any substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant.
 - Any nitrogen stabilizer.
- Pesticides include:
 - Herbicides
 - Insecticides
 - Fungicides
 - Bactericides
 - Rodenticides

Introduction and My Relationship With Pesticides

- I grew up here in Denver
- College and my organic farming stage
- I also obtained a M.S. in Soil and Crop Sciences from CSU and worked in the horticulture department on an organic research farm
- Worked at the Colorado Department of Agriculture as an inspector for the Plant Industry Division and worked closely with commercial and public pesticide applicators
- Since April 2015, I have worked at CSU Extension here in Denver as the Horticulture Agent

Understanding why people may fear or dislike the use pesticides

- Health
 - Birth defects, cancer, poisonings
- Food Residues
- Environment
 - Bioaccumulation, wildlife, groundwater & surface water contamination, pet exposures

IT IS THE LACK CONTROL OVER PESTICIDE APPLICATIONS THAT MAY AFFECT THEM!

What are some of the benefits of using pesticides?

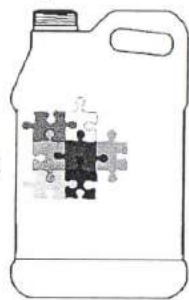
- Safer, More Consistent Food Supply
- Protect our Health
- Productivity of Agriculture
- Labor Savings
- Recreational
- Wildlife Habitat /Environmental

Using 'RITE' to protect ourselves and others

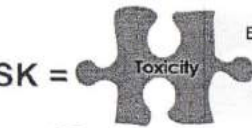
Risk
Is equal to
Toxicity times
Exposure

How do you measure RISK when using pesticides? Use RITE...

Risk
Is equal to
Toxicity times
Exposure



RISK =



Exposure



The degree or extent to which a chemical is poisonous

No exposure = No RISK!

FIFRA: Federal Insecticide, Fungicide and Rodenticide Act

- Regulates:
 - Registration
 - Manufacture
 - Sale
 - Transportation
 - Use of pesticides

This act set the standard for labeling pesticides



Federal Food, Drug, Cosmetic Act

- ▶ **"SAFE"** - reasonable certainty that no harm will result from aggregate exposure to the pesticide residue.
- ▶ Considers:
 - toxicity of the pesticide and its break-down products
 - aggregate exposure to the pesticide in foods and from other sources of exposure
 - any special risks posed to infants and children



FQPA: Food Quality Protection Act

- ▶ Set health based standard for pesticide risk
 - ▶ Based on **aggregate** and **cumulative** risks
 - ▶ Includes **children's risk** when setting tolerances (additional 10-fold safety factor)
- ▶ Requires testing of toxicity as **'endocrine disrupters'**
- ▶ **Re-review older pesticides** based on new standard



EPA Tests Required

Grouping	Number of tests in grouping
Product Performance	8
Product Properties	35
Fate, Transportation, & Transformation	42
Spray Drift	2
Ecological Effects	51
Residue Characteris	17
Health Effects	49
Occupational & Residential Exposure	13
Biochemicals	7
Microbial Pesticides	41
Endocrine Disruptor Screening	11
Total	276

<http://www.epa.gov/ocsp/pubs/fts/home/guidelin.htm>

But how safe is 'safe enough'?

LD₅₀
Median Lethal Dose
 Amount of a substance required to kill 50% of a test population

mg substance/kg body wt

<http://www.compoundchem.com/>



<http://www.compoundchem.com/>

Material	Why it's a problem	LD50 (mg/kg)	Toxicity Category
water	You know this one...and this one. Refined from sugar cane or sugar beets	50000	practically non-toxic
sucrose	A chemical in citrus fruits (lemons, oranges, etc)	30000	practically non-toxic
citric acid	HCl	12000	slightly toxic
ethanol (component in many beverages)	A broad-spectrum systemic herbicide used to kill weeds brought to market under the name Roundup	7000	slightly toxic
glyphosate	One word: Biscuits	5600	slightly toxic
sodium bicarbonate (baking soda)	Not too much now...	4220	moderately toxic
sodium chloride (table salt)	Whoa...I'm getting a headache	3000	moderately toxic
acetaminophen	Common household product often used industrially for drinking water and waste water treatment	1944	moderately toxic
hydrogen peroxide	Is a bitter alkaloid of the cacao plant in CHOCOLATE (What the heck is this doing on this list?)	1580	moderately toxic
theobromine	A broad-spectrum insecticide and pesticide approved for use in organic production	1265	moderately toxic
rotenone	A compound approved for use in organic production as a fungicide	132-1500	very toxic
copper sulfate	Gasp. See italicized comment on chocolate*	300	very toxic
caffeine	Tasteless and almost odorless chemical known for its insecticidal properties. Was used in WWII to control malaria and typhus.	192	very toxic
DOT		111-800	very toxic

Nicotine	A potent alkaloid found in the nightshade family of plants (Solanaceae) and a stimulant drug and a major contributing factor to the dependence-forming properties of tobacco smoking.	50	extremely toxic
Cyanide	Cyanides are produced by certain bacteria, fungi, and algae and are found in a number of plants - used in mining, industrial organic chemistry and for pest control.	10	extremely toxic
Vitamin D	Vitamin D toxicity can occur when you have excessive amounts of vitamin D in your body by megadoses of vitamin D supplements (not by diet or exposure to the sun).	10	extremely toxic
Strychnine	is a highly toxic, colorless, bitter crystalline alkaloid used as a pesticide, particularly for killing small vertebrates such as birds and rodents.	1-2	super toxic
Aflatoxin	Naturally occurring mycotoxins produced by species of fungi. 14 different types of aflatoxin are produced in nature. They can colonize and contaminate grain before harvest or during storage.	0.003	super toxic
botulin	A protein and neurotoxin produced by a bacterium. In its pure form, it is the most acutely toxic substance known. Preparations of the toxin can be effectively used for therapeutic or cosmetic purposes.	0.00001	super toxic

Even Pesticides used in Organic Production can be toxic to bees.

<http://www.xerces.org/wp-content/uploads/2009/12/xerces-organic-approved-pesticides-factsheet.pdf>

PESTICIDE	NON-TOXIC	LOW TOXICITY	HIGHLY TOXIC
Insecticides/Repellents/Pest Barriers			
Bacillus thuringiensis (Bt)			
Beauveria bassiana			
Benic Acid			
Cyba pomonella granulata			
Diatomaceous Earth			
Garlic			
Insecticidal Soap*			
Kaolin Clay			
Lime Sulfur*			
Neem*			
Horticultural Oil**			
Pyrethrin*			
Rotenone*			
Ryania/Ryanoline			
Sabadilla*			
Spyrosum			
Herbicides/Plant Growth Regulators/Adjuvants			
Adjuvants			
Coax Glucos			
Glyphosate Acid			
Horticultural Vinegar			
Fungicides/Bactericides			
Copper			
Copper Sulfate			
Lime Sulfur*, Sulfur**			

*Low risk to bees if applied at night when bees are inactive.
 **Some horticultural oils such as for mites and ticks or secondary oil products sold as fungicides.
 **Retain 1 day. In greenhouse setting, bees should be removed prior to spray and not replaced before 15 days after spray.
 *Long residual toxicity (1 - 7 days).

Everything is poison. There is poison in everything. Only the dose makes a thing not a poison.

Paracelsus
1493-1541

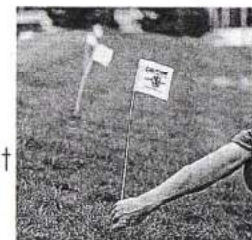
Father of Toxicology



Chemical toxicity is a sliding scale. Not black and white - and whether a chemical is naturally occurring or man-made tells us NOTHING about it's toxicity.

How do applicators protect the public?

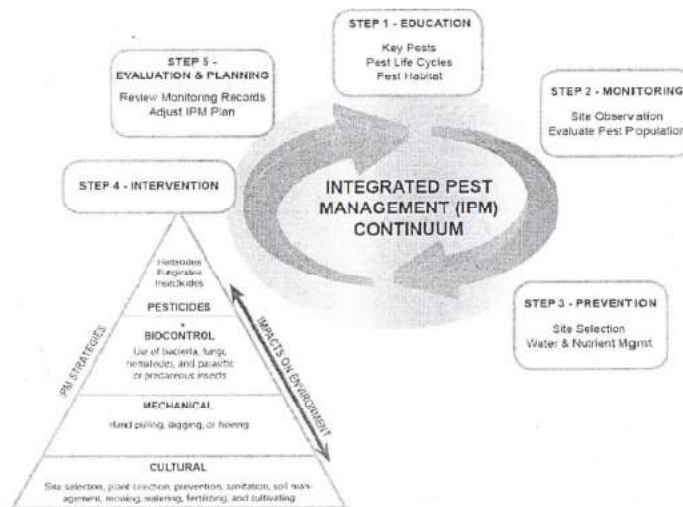
- Following label instructions
- Not apply when people are present
- Posting treated areas
 - Remove after REI
- Target application sites
 - Spot spray versus broadcast



Other ways applicators mitigate pesticide risk

- Use IPM, apply the least toxic, effective pesticide, if necessary
- Spot treat when possible
- Use FieldWatch to identify hives near treatment areas
- Do not apply when pollinators are present
 - Apply early morning or around dusk
- Do not leave 'puddles' of rinsates when cleaning equipment

Using Integrated Pest Management



We mitigate the risks of pesticides through the Product label!



The Label is a **LEGAL** and enforceable document!

- First Aid statements
- Precautionary Statements
 - Hazards to Humans & Domestic Animals
 - Hazards to the Environment
 - Chemical & Physical Hazards

MERIT® 75 WSP

INSECTICIDE

STOP - READ THE LABEL BEFORE USE
KEEP OUT OF REACH OF CHILDREN
CAUTION

PARA EL USUARIO: Si usted no lee o entiende inglés, no use este producto hasta que le hayan explicado completamente las instrucciones que figuran en la etiqueta.
 (TO THE USER: If you cannot read or understand English, do not use this product until the label has been fully explained to you.)
 For MEDICAL And TRANSPORTATION Emergencies ONLY Call 24 Hours A Day 1-800-334-7577
 For PRODUCT USE Information Call 1-800-331-2867

FIRST AID	
If swallowed:	<ul style="list-style-type: none"> • Call a poison control center or doctor immediately for treatment advice. • Have person sip a glass of water if able to swallow. • Do not induce vomiting unless told to do so by a poison control center or doctor. • Do not give anything by mouth to an unconscious person.
If on skin or clothing:	<ul style="list-style-type: none"> • Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15 to 20 minutes. • Call a poison control center or doctor for treatment advice.
If in eyes:	<ul style="list-style-type: none"> • Hold eye open and rinse slowly and gently with water for 15 to 20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. • Call a poison control center or doctor for treatment advice.
In case of emergency call toll free the Bayer Environmental Science Emergency Response Telephone No. 1-800-334-7577. Have a product container or label with you when calling a poison control center or doctor, or going for treatment.	
NOTE TO PHYSICIAN: No specific antidote is available. Treat the patient symptomatically.	

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION
Harmful if swallowed, inhaled, or absorbed through skin. Causes eye irritation. Avoid contact with skin, eyes, or clothing. Avoid breathing dust or vapor. Wash thoroughly with soap and water after handling. Remove contaminated clothing and wash before reuse. Keep children or pets off treated area until spray is dry.

PERSONAL PROTECTIVE EQUIPMENT (PPE):

- WPS USES:** Applicators and Other Handlers who handle this product for any use covered by the Worker Protection Standard (40 CFR part 170) - in general, agricultural plant uses e.g. use in soil farms, must wear:
- Long-sleeved shirt and long pants
 - Chemical-resistant gloves made of any waterproof material such as barrier laminate, butyl rubber, nitrile rubber, neoprene rubber, natural rubber, polyethylene, polyvinylchloride (PVC) or viton. If you want more options, follow the instructions for category A on an EPA chemical-resistance category selection chart.
 - Shoes plus socks

- Routes of possible exposure
- Restricted Entry Information
- Personal Protective Equipment

MERIT® 75WSP

INSECTICIDE

DIRECTIONS FOR APPLICATION TO OUTDOOR ORNAMENTALS IN RESIDENTIAL, COMMERCIAL, AND INDUSTRIAL LANDSCAPE AREAS

SITE	PEST	APPLICATION RATE
Trees Shrubs Evergreens Flowers Foliage plants Groundcovers	Adelgids (including hemlock woolly adelgid), Aphids Leaf-feeding beetles (Japanese beetle, emerald ash borer and vine weevil adults) Leafhoppers, planthoppers, sharpshooters (including glassy-winged sharpshooter) and spittle bugs	1.6 oz (1 packet) per 300 gallons of water
Foliar Applications: Start treatments prior to establishment of high pest populations and reapply on an as needed basis.		
	White grub larvae (such as Japanese beetle larvae, Chafers, <i>Phyllophaga</i> spp. Asiatic garden beetle, Oriental beetle)	1.6 oz (1 packet) per 8,250 to 11,000 sq ft
Broadcast Applications: Mix required amount of product in sufficient water to uniformly and accurately cover the area being treated. Do not use less than 2 gallons of water per 1,000 sq ft. For optimum control, irrigate thoroughly to incorporate Merit 75 WSP insecticide into the upper soil profile.		

RESTRICTIONS:

- Follow application restrictions for **Non-Agricultural Uses** on page 1 to protect bees and other insect pollinators
- Do not apply more than 0.53 oz (0.4 lb of active ingredient) per acre per year.
- Keep children and pets off treated area until dry.
- Do not apply this product, by any application method, to Linden, basswood, or other Tilia species.

Toxicity to aquatic invertebrates and bees, groundwater/surface water contamination

ENVIRONMENTAL HAZARDS

This product is highly toxic to aquatic invertebrates. Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwaters. This product is highly toxic to bees exposed to direct treatment or residues on blooming crops/plants or weeds. Do not apply this product or allow it to drift to blooming crops/plants or weeds if bees are foraging the treatment area. This chemical demonstrates the properties and characteristics associated with chemicals detected in groundwater. The use of this chemical in areas where soils are permeable, particularly where the water table is shallow, may result in groundwater contamination.

PROTECTION OF POLLINATORS

APPLICATION RESTRICTIONS EXIST FOR THIS PRODUCT BECAUSE OF RISK TO BEES AND OTHER INSECT POLLINATORS. FOLLOW APPLICATION RESTRICTIONS FOUND IN THE DIRECTIONS FOR USE TO PROTECT POLLINATORS.



Look for the bee hazard icon



in the Directions for Use for each application site for specific use restrictions and instructions to protect bees and other insect pollinators.

This product can kill bees and other insect pollinators.

Bees and other insect pollinators will forage on plants when they flower, shed pollen, or produce nectar.

Bees and other insect pollinators can be exposed to this pesticide from:

- Direct contact during foliar applications, or contact with residues on plant surfaces after foliar applications
- Ingestion of residues in nectar and pollen when the pesticide is applied as a seed treatment, soil, tree injection, as well as foliar applications.

When Using This Product Take Steps to:

- Minimize exposure of this product to bees and other insect pollinators when they are foraging on pollinator attractive plants around the application site.
- Minimize drift of this product on to beehives or to off-site pollinator attractive habitat. Drift of this product onto beehives or off-site to pollinator attractive habitat can result in bee kills.

Information on protecting bees and other insect pollinators may be found at the Pesticide Environmental Stewardship website at:

<http://pesticides.ehponline.org/PollinatorProtection/Pages/default.aspx>

Pesticide incidents (for example, bee kills) should immediately be reported to the state/tribal lead agency. For contact information for your state, go to: www.aapcc.org/officials.html. Pesticide incidents should also be reported to the National Pesticide Information Center at: www.npic.orst.edu or directly to EPA at: beekills@epa.gov

Making Policies for Pesticide Use

- Establish goals and thresholds
- Sources of information
 - Avoid anecdotal evidence
 - Use GOOD science...and scientists as resources.
- Determine benefits/risks and costs
 - Risk assessment/costs
 - Collateral damage?
- Make the decision, set standards and adopt policies
- Implement the decision
- Review and correct errors

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Any questions about the information you just heard?



Glyphosate: Resistance Risk, Safe Use & Public Perception

Dr. Todd Gaines

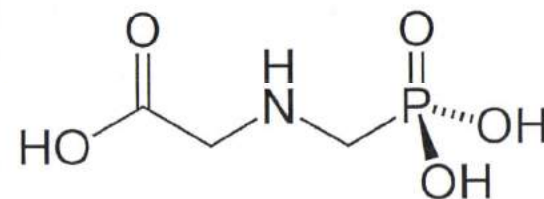
Bioagricultural Sciences & Pest Management

Outline

- Glyphosate mode of action
- Toxicology profile
- Glyphosate and cancer

Glyphosate

- Non-selective herbicide, reported in 1971
- Globally important
- Used in fallow, orchards, vineyards, and glyphosate-resistant crops
- Low environmental toxicity



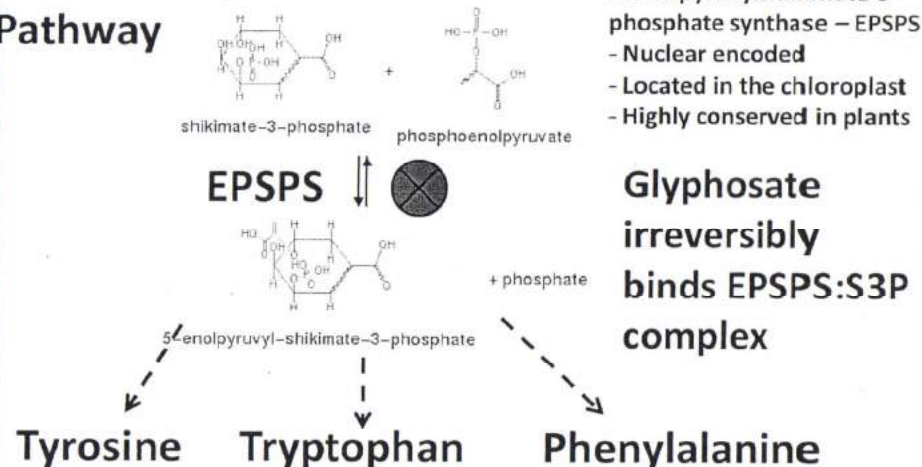
Movement in Plant

- Used post-emergence on growing plants
- Absorbed across cuticle
- Rapid translocation to growing points
- Growth inhibition and general chlorosis and necrosis within 4 to 20 days
- Rapidly and tightly adsorbed to soil
 - No crop planting restrictions

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Glyphosate MOA

Shikimic Acid Pathway



Mode of Action Summary

- Structure similar to glycine (amino acid) and PEP
- Inhibits EPSPS
- Only found in plants, fungi, and bacteria
 - Only plant EPSPS sensitive to glyphosate

Toxicology

- Eye exposure – flush with water
- If ingested, drink water to dilute

Acute

Species	LD50
Rat	5600 mg/kg (oral)
Rabbit	>5000 mg/kg (dermal)

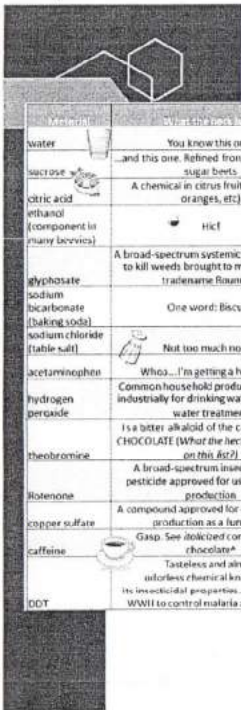
68 kg person (150 lb)
27.2 g/day of pure glyphosate
(0.96 oz/day)

Chronic

NOEL: No Observable Effect Limit

Species	24 month diet NOEL	Observations
Mouse	4500 mg/kg/day	Microscopic liver changes at 4500 mg/kg/d; not carcinogenic
Rat	400 mg/kg/day	Reduced weight gain at 1000 mg/kg/day

Herbicide Handbook, 10th Edition, 2014



Ingredient	LD50 (mg/kg)	Toxicity
Water	90000	practically non-toxic
sucrose	30000	practically non-toxic
citric acid	12000	slightly toxic
ethanol (component in many beverages)	7000	slightly toxic
glyphosate	5600	slightly toxic
sodium bicarbonate (baking soda)	4220	moderately toxic
sodium chloride (table salt)	3000	moderately toxic
acetaminophen	1944	moderately toxic
hydrogen peroxide	1580	moderately toxic
theobromine	1265	moderately toxic
Rotenone	132-1500	very toxic
copper sulfate	300	very toxic
caffeine	192	very toxic
DDT	113-800	very toxic

Ingredient	LD50 (mg/kg)	Toxicity
Nicotine	50	extremely toxic
Cyanide	10	extremely toxic
Vitamin D	10	extremely toxic
Strychnine	1-2	super toxic
Aflatoxin	0.003	super toxic
Botulin	0.0001	super toxic



Toxicology

Teratogenicity NOEL: No Observable Effect Limit

Species	NOEL
Rat	1000 mg/kg/day
Rabbit	175 mg/kg/day

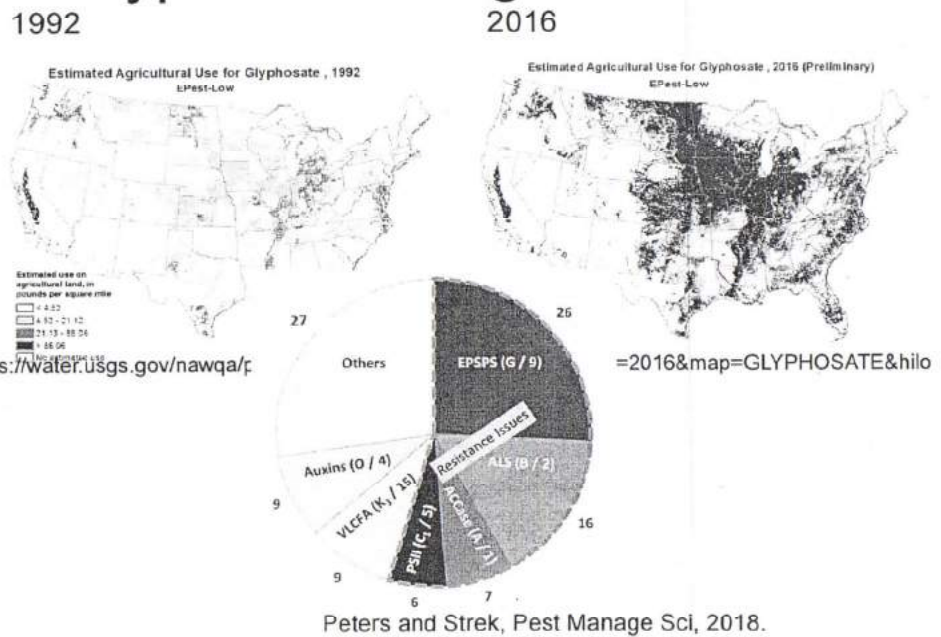
68 kg person (150 lb)
11.9 g/day of pure glyphosate (0.42 oz/day)

Mutagenicity

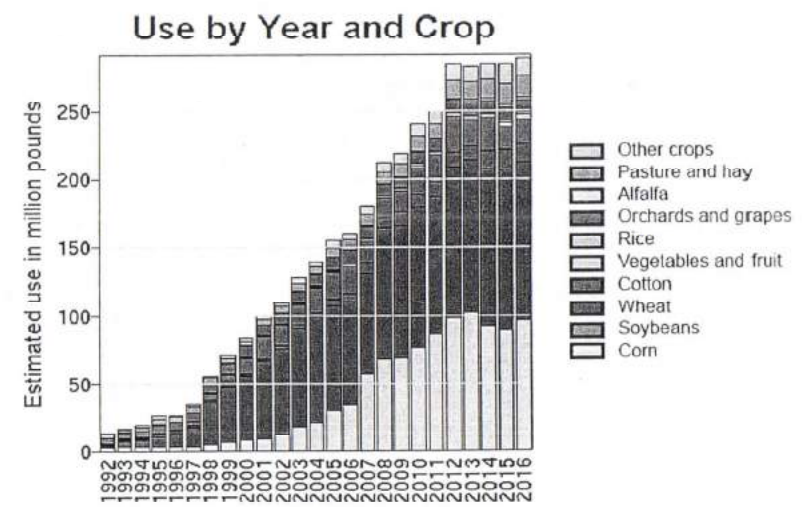
Test	Result
Gene mutation	Negative
Structural chromosomal aberration	Negative
DNA damage/repair	Negative

Herbicide Handbook, 10th Edition, 2014

Glyphosate usage in the U.S.



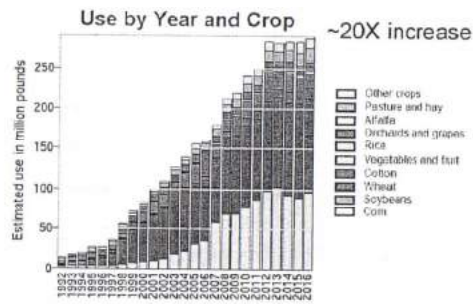
Glyphosate usage in the U.S.



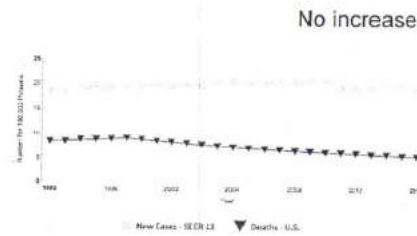
ips://water.usgs.gov/nawqa/pnsp/usage/maps/show_map.php?year=2016&map=GLYPHOSATE&hilo=L

Comparison between Glyphosate Usage & Non Hodgkin Lymphoma Incidence in U.S. from 1992 to 2016

Glyphosate usage



NHL incidence & mortality



https://water.usgs.gov/nawqa/pnsp/usage/maps/show_map.php?year=2016&map=GLYPHOSATE&hilo=L

<https://seer.cancer.gov/statfacts/html/nhl.html>

IARC Group 2A Classification of Glyphosate

Does glyphosate cause cancer?

Hazard Assessment What is the potential to cause harm, regardless of dose or exposure?

International Agency for Research on Cancer
World Health Organization

"Limited evidence in humans for the carcinogenicity of glyphosate... Evidence in humans is from studies of exposures, mostly agricultural [e.g. not from dietary exposure]... A positive association has been observed for non-Hodgkin lymphoma... There is 'strong' evidence that exposure to glyphosate or glyphosate-based formulations is **genotoxic**"

IARC placed glyphosate in its hazard category "Group 2A: probably carcinogenic to humans" along with red meat, hot beverages, and working as a barber. The evidence on carcinogenicity was less robust than for agents such as bacon, salted fish, oral contraceptives and wine.

2015

International Agency for Research on Cancer

- Glyphosate added to list of agents that are **"probably carcinogenic to humans"**
- March 2015
- IARC group 2A classification
- Lancet paper stated "evidence in humans" is "limited"
- Cancer site stated was non-Hodgkin lymphoma (NHL)

IARC Group 2A Agents

- Are **problematic for occupational exposure**
 - Meaning people who work with or around the chemical on a regular basis over a long period of time
- General public is highly unlikely to see ill effects from any agent with this classification based on available evidence
- Group 2A does not mean that a chemical will definitely cause cancer
- Other 2A agents: wood smoke, working night shifts, and hot mate (the South American drink)
- "Probably causes cancer" video explanation:
- <https://www.youtube.com/watch?v=CbBk81ySxQ>

What do Regulatory Agencies Say?

 United States Environmental Protection Agency	"Human health risk assessment concludes that glyphosate is not likely to be carcinogenic to humans... [and] no other meaningful risks to human health when the product is used according to the pesticide label"	2017
 Health Canada  Longitudinal Study	"Products containing glyphosate do not present unacceptable risks to human health or the environment when used according to the revised product label directions... Risks to [occupational] handlers are not of concern for all scenarios" "Available data do not show carcinogenic or mutagenic properties of glyphosate nor that glyphosate is toxic to wildlife, ecosystems or..."	2017
 Agricultural Health Study	"No association was apparent between glyphosate and any solid tumors or lymphoid malignancies overall, including non-Hodgkin's lymphoma and its subtypes... some evidence of increased risk of AML [acute myeloid leukemia] among the highest exposed group that requires confirmation"	2018
Veterinary Medicines Authority  Environmental Protection Authority	"Unlikely to be carcinogenic to humans or genotoxic (damaging to genetic material or DNA) and should not be classified as a mutagen or carcinogen"	2016
 World Health Organization  Food and Agriculture Organization of the United Nations	"Glyphosate is unlikely to be genotoxic at anticipated dietary exposures. Glyphosate is unlikely to pose a carcinogenic risk to humans from exposure through the diet"	2016
 World Health Organization Drinking-water quality guidelines	"Under usual conditions, the presence of glyphosate and AMPA [aminomethylphosphonic acid, glyphosate's primary metabolite] in drinking water does not represent a hazard to human health"	2004
 World Health Organization International Programme on Chemical Safety	"Available data on occupational exposure for workers applying Roundup indicate exposure levels far below the NOAELs [no observed adverse effect levels] from the relevant animal experiments"	1994

Conclusion to Date

- Based on these data, there does not seem to be a basis for alarm
- IARC 2A classification means "take care"
- Glyphosate is a pesticide
- As with all pesticides, proper personal protective equipment should be worn and proper procedures followed
- No strong evidence to suggest that exposure to glyphosate causes cancer