

## Understanding the Glyphosate Issue and Addressing Public Concerns

CHRIS MARBLE  
UNIVERSITY OF FLORIDA/IFAS  
MID-FLORIDA RESEARCH AND EDUCATION CENTER

1

## Why so much attention on glyphosate?

Most widely used due to many advantages

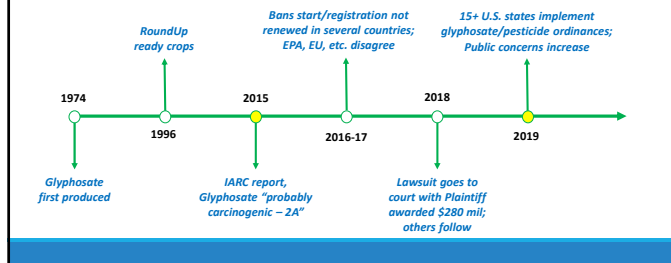
- Non-selective
- Non-volatile
- No odor or staining
- Very effective
- Inexpensive
- No residual, plant back immediately

Most people are familiar with glyphosate

-Aquatics, athletic fields, ornamentals, agronomic crops, homeowners

2

## How did we get here?



3

## International Agency for Research on Cancer (IARC)

- Global organization of experts
- Part of World Health Organization (WHO)
- Conducts epidemiological (surveillance/survey) and laboratory research
- Examines agents (substances, activities, etc.) where a cancer link is possible/suspected

4

## International Agency for Research on Cancer (IARC)

- Classified glyphosate as "probably" carcinogenic, or a "probable carcinogen"
- "Limited evidence of carcinogenicity in humans and sufficient evidence in experimental animals" based on available data
- 2A carcinogen – Probably carcinogenic to humans
- IARC assesses **hazard** – an agent is **capable** of causing cancer – Does not evaluate **risk** (estimate of the **probability** that cancer will occur given some level of exposure to a cancer hazard)

5

## RISK vs. HAZARD as defined by IARC

*"The distinction between hazard and risk is important. An agent is considered a cancer hazard if it is capable of causing cancer under some circumstances. Risk measures the probability that cancer will occur, taking into account the level of exposure to the agent."*

*The Monographs Program may identify cancer hazards even when risks are very low with known patterns of use or exposure."*

- Risk asks: "How likely is it that a substance would cause harm?"
- Hazard asks: "Is there potential to cause harm, regardless of dose or exposure?"

**IARC does not make recommendations, but provides reports so that risk assessments can be done by governments, agencies, etc.**

<https://www.iarc.fr/wp-content/uploads/2018/07/Monographs-QA.pdf>

6

## International Agency for Research on Cancer

Group 1	Group 2A	Group 2B	Group 3
<b>Carcinogenic</b>	<b>Probably carcinogenic</b>	<b>Possibly Carcinogenic</b>	<b>Not classifiable</b>
Alcoholic drinks	Glyphosate	Gasoline	Polyvinyl chloride (PVC)
Smoking	Very hot beverages	Aloe Vera leaf extract	Fluorescent lighting
Ultra-violet radiation	Working night shift	Pickled vegetables	Dying your own hair
Arsenic	Glass manufacturing	Diesel fuel	Manufacturing leather
Asbestos	Act of frying foods	Being a firefighter	Tea and coffee

<https://monographs.iarc.fr/wp-content/uploads/2019/07/Preamble-2019.pdf>

7

## IARC Classifications

Classification	Number of Agents
Group 1 – Carcinogenic to humans	111
Group 2A – Probably carcinogenic to humans	66
Group 2B – Possibly carcinogenic to humans	285
Group 3 – Not classifiable as carcinogenic to humans	505
Group 4 – Probably not carcinogenic to humans*	0*

**So everything they have reviewed has a chance of causing cancer?!**

- Only reviews agents where there is some evidence of possible carcinogenicity – Group 4 no longer exists (agents can be only carcinogenic, probably, possibly, or not classifiable/unknown)

\*Making a definitive evaluation of an absence of potential carcinogenic hazard to humans on the basis of epidemiological studies requires assurances that all susceptible populations, exposure circumstances, cancer outcomes, and relevant variables are captured in available studies...such assurances are nearly impossible to obtain." ---IARC [https://monographs.iarc.fr/wp-content/uploads/2019/09/Preamble-AG-Report\\_Final-web.pdf](https://monographs.iarc.fr/wp-content/uploads/2019/09/Preamble-AG-Report_Final-web.pdf)

8

## Stances when assessing RISK (probability)

AGENCY	Country	Finding
Environmental Protection Agency	U.S.	"Not likely to be carcinogenic...no other meaningful risks to human health"
National Toxicology Program	U.S.	"Little evidence of toxicity.... no evidence of glyphosate causing DNA damage"
Health Canada	Canada	"Do not present unacceptable risks to human health or the environment....No pesticide regulatory authority in the world considers glyphosate to be a cancer risk to humans at levels which humans are currently exposed"
European Chemicals Agency	Europe	"No hazard classification for carcinogenicity is warranted"
Bundesinstitut für Risikobewertung	Germany	"Available data do not show carcinogenic or mutagenic properties"
Federal Food Safety and Vet. Office	Switzerland	"Residues of glyphosate in the foods investigated do not represent a risk of cancer"
Australian Pesticides Authority	Australia	"Glyphosate does not pose a carcinogenic risk to humans"
Environmental Protection Authority	New Zealand	"Unlikely to be carcinogenic to humans or genotoxic and should not be classified as a carcinogen"
ANVISA	Brazil	"No evidence to indicate that the herbicide glyphosate is carcinogenic"
Food Safety Commission of Japan	Japan	"No neurotoxicity, carcinogenicity, reproductive toxicity, teratogenicity, and genotoxicity"
Rural Development Administration	Korea	"Epidemiological studies on glyphosate found no cancer link"
World Health Organization	Global	"Available data on occupational exposure for workers applying Roundup indicate exposure levels for below NQALs from relevant animal experiments"

Compiled by K. Schreiber, M. Pinazzi, and L. Ruishalme; Genetic Literacy Project, 2019.  
[https://geneticliteracyproject.org/wp-content/uploads/2019/03/GlyphosateInfographic\\_GLP-1.pdf](https://geneticliteracyproject.org/wp-content/uploads/2019/03/GlyphosateInfographic_GLP-1.pdf)

9

## Communicating with the public

- Can we explain the science?
- Many people are concerned and want alternatives
- Many companies are also concerned about liability and lawsuits
- Need to know alternatives and trade-offs associated with alternatives

10

Postemergence			Selective Alternatives			Preemergence		
Active ingredient	Signal word	OMRI?	Active ingredient	Signal word	OMRI?	Active ingredient	Signal word	OMRI?
Acetic acid (vinegar)	Danger	Yes	Bentazon	Caution	No	Dithiopyr	Warning	No
Ammoniated soap of fatty acids	Warning	Yes	Clethodim	Caution	No	Oryzalin	Caution	No
Ammonium nonanoate (i.e. pelargonic acid)	Warning	Yes	Clopyralid	Caution	No	Pendimethalin	Caution	No
Caprylic + Capric acids	Caution/Warning	Yes	Fenoxprop	Caution	No	Proflamline	Caution	No
Citric acid + clove oil	Danger	No	Fluazifop	Caution	No	Trifluralin	Caution	No
Clove oil + cinnamon oil	Caution	Yes	Halosulfuron	Caution	No	Rumexacetabiprol	Caution	No
Diquat	Caution	No	Imazaquin	Caution	No	Quinclorac	Warning	No
d-limonene (citrus oil)	Caution	Yes	Sethoxydim	Caution	No	Dimethenamid	Warning	No
Esganol	Caution	Yes	Sulfentrazone	Caution	No	Metolachlor	Caution	No
glufosinate	Warning	No	Sulfosulfuron	Caution	No	Isoxaben	Caution	No
Pelargonic acid	Warning	No				Indaziflam	Caution	No

11

## Calculate out costs

HERBICIDE A	HERBICIDE B
• 2.5 liter jug	• 2.5 liter jug
• \$100 cost (\$40/gal or \$0.31 per fluid ounce)	• \$250 cost (\$100/gal or \$0.78 per fluid ounce)
• 20% dilution required	• 5% dilution required
• \$7.94 per gallon of spray	• \$4.99 per gallon of spray
• 25.6 fl. oz. × \$0.31	• 6.4 fl. oz. × \$0.78

12

## Keys to Successful Use of Alternatives

### NON-SELECTIVE ALTERNATIVES

- Most are contact-action, fast symptom development
- Higher concentrations and application volumes (35 to 400 gpa some products)
- Reduced control of grasses/sedges, large perennial broadleaf weeds
- Repeat applications usually necessary

### SELECTIVE ALTERNATIVES

- Many as or more effective than glyphosate
- Spectrum of control is lacking
- Costs and time, multiple products needed

### PREEMERGENCE HERBICIDES

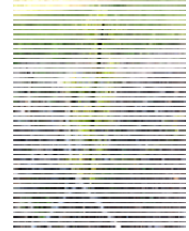
- Become more important tool
- Most turf PRE products can be used in planting beds/applied over-the-top



13

## Summary

- Current data shows no evidence of a glyphosate cancer risk
- This will continue to be investigated
- Still recommended as *part* of an integrated weed management program
- Upside to controversy may be more emphasis placed on IPM
- Glyphosate has downsides
  - Resistance development, non-selectivity, permanent damage to non-target plants
- Alternatives are available, but there are tradeoffs



14