Dealing with the Public Health Consequences of the Herbicide Use Treadmill

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ED Heartland Health Research Alliance (HHRA)

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What Is Driving Rising Herbicide Use?

GMO Crops → The Herbicide Treadmill

GMO crop systems usually work well for a few years, but then resistance emerges and conventional farmers are drawn onto the herbicide-use treadmill.

Spray more pesticides, more often & at higher rates

Increased use

Increased selection pressure on pest populations

More resistance

Organic farming pulls the plug on the herbicide treadmill. Regenerative ag... who knows?
Spread of GLY-Resistant Weeds Creates New Biz Opportunities – Dicamba Use Up Over 12-Fold

Dicamba Applied to Major Crops on National Acres

A Failing Technology

High-cost GE seeds resistant to multiple herbicides are the only game in town. Farmers are locked into technology that is failing. Resistance management boils down to spraying multiple modes of action (good for biz).
Dicamba Applied to Major Crops

Herbicides Used On Soybeans (% acres treated by year)

What is the Most Hazardous Herbicide Used in Iowa?

Paraquat, the Deadliest Chemical in US Agriculture, Goes on Trial

Amid lawsuits filed by thousands of farmers linking the herbicide to Parkinson’s disease, the EPA is reconsidering its analysis of paraquat’s risks.

BY GREY MORAN • MARCH 22, 2023

Tradeoffs and Competition Between Glyphosate-based Herbicides (GBHs) and Paraquat

Both kill most everything green with roughly equal efficacy

• Marketed initially for pre-plant weed control, especially in no-till systems, and post-harvest for field cleanup

GBHs: Low-tox, hardly any restrictions

Paraquat: Highly hazardous, restricted use
Rates and Costs

Slipping GBH efficacy is starting to increase demand for paraquat despite higher paraquat costs per acre treated.

Soybean Weed Management Technology

What's New for Agronomic Weed Control in 2023

New herbicide products, label updates, and industry news about weed management are highlighted in the article.

"XtendFlex and Enlist E3 soybean technologies are being used often in our area and around the country."

"In general, while the XtendFlex soybean acres continue to have a strong base, more farmers are opting for Enlist E3 varieties for various reasons. In some parts of the Mid-Atlantic region, 70% or more of the acres will be planted to E3."

"Keep in mind that if you plan to use registered dicamba-based herbicides (e.g., Xtendimax, Engenia) in XtendFlex varieties, you must complete the annual dicamba training. If you plan to use Enlist One or Duo in the E3 system, currently no training is required."

https://extension.psu.edu/whats-new-for-agronomic-weed-control-in-2023
What's New for 2023?

[Kyro](https://www.agweb.com/news/crops/corn/kyro-corteva-newest-corn-herbicide) is a novel formulation—the first of its kind to market—combining the active ingredients acetochlor, topramezone and clopyralid into one premix.

“Resicore XL herbicide (another new Corteva product) applied preemergence and Kyro herbicide applied post to help ensure clean cornfields through crop canopy for maximum yield potential.”

What is in Resicore XL
- Acetochlor
- Mesotrione
- Clopyralid

So, a farmer taking advantage of these two new Corteva products would apply:
- Five active ingredients
- Two applications of two herbicides (clopyralid and acetochlor)
- Cost per acre...take a deep breathe, next slide...

No doubt at least one application of a GBH will also be applied on most fields!

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How High Will Iowa Herbicide Costs Go?

“The days of making $3-an-acre glyphosate applications to control weeds are long gone and won’t be coming back.”

- “On the low side – depending on your specific weed spectrum and infestation level – a robust weed-control program in the Midwest will cost you at least **$50 an acre in 2023**” - Bill Johnson, Purdue University weed scientist.

- “For the mid-South and South, where farmers often overlap herbicides and make three or four applications during the season, Butts says **$85** will be a typical investment. - Tommy Butts, University of Arkansas Extension weed scientist

- “Furthermore, both he and Johnson say **$100 per acre** – just for products alone – will be a common investment for a broad-spectrum weed control program in corn and soybean crops.”

Trends in "Chemical" Costs per Acre in Soybean Production in the Heartland Region

- "Golden Era" of Iowa soybean weed management: 2002-2011
- Costs have risen nearly 5-fold since the mid-1980s and 4-fold since 2011
- RR technology and drop in post-patent GBH prices reduced costs from the late 1990s through 2005 when resistant weeds began emerging across Iowa crop fields

Changes in Soybean Herbicide Use and Costs in Iowa

<table>
<thead>
<tr>
<th></th>
<th>Golden Era: 2002-2011</th>
<th>Crop Year 2023</th>
<th>Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Herbicides Applied</td>
<td>1.4 to 2</td>
<td>4 to 7</td>
<td>3.2 fold</td>
</tr>
<tr>
<td>Number Acre Treatments</td>
<td>1.8 to 2.4</td>
<td>6 to 9</td>
<td>3.6 fold</td>
</tr>
<tr>
<td>Pounds Applied</td>
<td>1.1 to 1.6</td>
<td>3 to 5</td>
<td>3 fold</td>
</tr>
<tr>
<td>Herbicide Cost/Acre</td>
<td>$14 to $17</td>
<td>$50 to $80</td>
<td>4.2 fold</td>
</tr>
<tr>
<td>Seed Cost/Acre</td>
<td>$12 to $13</td>
<td>$65 to $85</td>
<td>6 fold</td>
</tr>
</tbody>
</table>

Pre-GMO Era
Solid-Encapsulated Technology

First-Ever Solid-Encapsulated Herbicide For Pre and Post Weed Control in Corn

By RHONDA BROOKS March 9, 2023

- To expand sales and increase prices of pre-emerge herbicides in fields planted to multi-herbicide tolerant varieties, companies needed to extend efficacy.
- Bingo – encapsulated herbicides hit the market in 2023, the same solution adopted to extend efficacy of seed treatments, but there are downsides...
  - cost, extended period in soil (leaching, soil health, selection pressure)

Key Public Health Questions

- Is rising herbicide use in the Midwest impairing children’s development?
- Are problem pregnancies and adverse birth outcomes becoming more frequent and/or more serious?
- Will simultaneous application of multiple herbicides (e.g. ExTend and DuoEnlist technology; 3 and 4-way premixes) magnify risks?

We hope not, but new science is needed now to prevent possible generation-long impacts.
The Heartland Study

Welcome University of Iowa!

• Quantifying herbicide levels -- glyphosate, glufosinate, dicamba, and 2,4-D -- in maternal urine samples
• Identifying impacts of prenatal herbicide exposures in newborns (Phase 1)
• Tracking health and developmental outcomes through regular, standardized medical follow-up of children (Phase 2)
• Heartland Study goal – enroll our 2,000th mother-infant pair in early 2025

Meet the Santillans

Co-PIs of the Heartland Study Site at the University of Iowa Hospital

LINK
Human exposure to herbicides comes through three major routes:

1. Food and beverages, especially drinking water (relatively steady year-round)
2. When spray solution lands on skin, i.e. dermal exposure (spray season)
3. Inhalation exposure (growing concern with volatile herbicides during spray season)

On most days, the average Iowan in farm country is exposed to 5-10 herbicide active ingredients and metabolites in the spring-fall
- GLY and AMPA
- 2,4-D
- Dicamba
- Triazines
- Acetanilides
- Glufosinate and 3-MPPA

Risk = Exposure x Toxicity

Percent of Urine Samples from Pregnant Women in the Midwest with Dicamba and 2,4-D Residues

Key Finding: Over a 50% increase in the frequency of detectable levels of dicamba in women's urine
Average 2,4-D and Dicamba Residue Levels

Key Finding: More than three-fold increase in the average level of dicamba in urine in just ~10 years, 45% increase in 2,4-D levels

New Science is Rocking the Boat

Published papers:

Glyphosate Exposure and Urinary Oxidative Stress Biomarkers in the Agricultural Health Study
Vicky C. Chang, Phd, Gabriella Andreotti, Phd, Maria Osprina, Phd, Christine G. Parks, Phd, Deming Liu, Phd, Joseph J. Sooher, Phd, Nathaniel Rothman, MD, MPH, Debra T. Silverman, ScD, Dale P. Sandler, Phd, Antonia M. Calafat, Phd ... Show more
JNCI: Journal of the National Cancer Institute, djpc342, https://doi.org/10.1093/jnci/djpc342
Published: 11 January 2023 Article History +

Down the River: Glyphosate Use in Agriculture and Birth Outcomes of Surrounding Populations
Mateus Dias, Rudi Rocha, Rodrigo R. Soares
Published: 06 February 2023 Article history +
More New Science

The association between urinary glyphosate and aminomethyl phosphonic acid with biomarkers of oxidative stress among pregnant women in the PROTECT birth cohort study

Jarrod L Eaton 1, Amber L Cathey 1, Jennifer A Fernandez 3, Deborah J Watkins 1, Monica K Silver 1, Ginger L Milne 2, Carmen Velez-Vega 3, Zaika Rosario 3, Jose Cordero 4, Akram Alshawabkeh 5, John D Meek 6

Glyphosate exposure in early pregnancy and reduced fetal growth: a prospective observational study of high-risk pregnancies

Roy A. Genova 1, Illi L. Reiter, Igor Zakharenkov, Cathy Proctor, Jun Yang, Rubina Message, Michael Antoniou 1 & Paul D. Winchester 7

More New Science

Exposure of children to glyphosate in Morocco: Urinary levels and predictors of exposure

Imane Bemi 1, & 2, Azza Menarous 1, 4, Matteo Creta 1, Ibrahim El Ghiba 1, Redou Comoly-Duck 1, 2, Lode Goddeeris 1, and Samir El Jadi 1, 2

Effects of exposure to glyphosate on oxidative stress, inflammation, and lung function in maize farmers, Northern Thailand

Suttisinee Siththaw 1, Satana Somporn 1, Chacharn Potrath 1, Krittan Vunwasak 1 & Supakit Khocha-asana 1

BMC Public Health 32, Article number: 1343 (2022) | Cite this article

1677 Accesses | 2 Citations | 57 Altmetric | Metrics

More New Science

A Human Biomonitoring Study AssessingGlyphosate and Aminomethylphosphonic Acid (AMPA) Exposures among Farm and Non-Farm Families

by Alston Connolly 1, 2, 3, 4, 5, Holger M. Koch 6, 7, Daniel Bury 8, 9, Stephan Kositz 1, 2, Markus Kolossa-Gehring 1, 2, André Conrad 2, 5, Alina Maroswski 1, 2, James A. McGrath 1, 2, Michelle Leahy 1, 2, Thomas Brüning 2 and Maria A. Coggins 1

International Journal of Hygiene and Environmental Health 246, September 2022, 11483

Higher proportion of agricultural land use around the residence is associated with higher urinary concentrations of AMPA, a glyphosate metabolite


Urinary concentrations and determinants of glyphosate and glufosinate in pregnant Canadian participants in the MIREC study

Jillian Ashley-Martin 3, *, Ron Hwang 2, Susan MacPherson 3, *, Orly Bron 4, James Owen 5, Eric Gaudreau 6, Jean-Francois Bienvenu 7, Mandy Fisher 8, Michael M Borghese 3, Maryse F. Bouchard 8, Bruce Laplante 9, Warren G. Foster 8, Tye E. Atwood 10

Affiliations | + expand

PmID: 356108462 | DOI: 10.1016/j.enrv.2022.114842

Find more research on our bibliographies page

https://hh-ra.org/project-bibliography/
THANK YOU
FIND OUT MORE AT HH-RA.ORG

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For more on herbicide biomonitoring, see:
For more on The Heartland Study see:
hh-ra.org

Citations


