Global Glyphosate Use, 1990-2014

Source: Benbrook 2016
Number of weed species (globally) that have become resistant to glyphosate, 1996-2018

Changing geographic distribution in the US

Source: USGS
Drivers of growing glyphosate use

**Initial Situation** (1974-1985)
- Glyphosate one of many nonselective herbicides

**Phase 1** (1985-2000)
- Repurposing of glyphosate with GM crops

**Phase 2** (2000-2015)
- Rise in use – GM approvals, generics, and new uses

**Phase 3** (2015-)
- Growing contestation and precision agriculture

**Underlying Dynamics** (1970s-today)
- Growing corporate concentration and power constrains innovation in alternative weed control technologies

*Source: Clapp 2021*
1974-1985: glyphosate as a general herbicide

- Glyphosate is ‘non-selective’ herbicide
- Typically used to clear fields before or after harvest
- Until mid 1990s- it was just one of many pesticides on the market that could serve that function
1985-2000: The ‘repurposing’ of glyphosate

- Growing cost and time for herbicide development due to regulations
- Technological developments in genetically modified seeds that are less costly than herbicide development
- Expiry of glyphosate patent in 2000
- Firms engineered seeds to be resistant to glyphosate
Costs and Time to Develop and Bring a New Pesticide to Market, 1975-2014

Text:

Cost & time to develop a new crop protection chemical vs. a new genetically modified crop tolerant to existing herbicides, 1995

<table>
<thead>
<tr>
<th></th>
<th>R&amp;D Costs</th>
<th>Time</th>
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<tbody>
<tr>
<td>New crop protection active ingredient</td>
<td>$152m</td>
<td>8.3 years</td>
</tr>
<tr>
<td>New genetically modified crop</td>
<td>$10m</td>
<td>6 years</td>
</tr>
</tbody>
</table>


2000-2015: Rapid rise in global glyphosate use

- Expansion of regulatory approval for GM crops globally

Source: ISAAA 2018
Generics:

Glyphosate patent expiry opens the global herbicide market to competition with generic brands, mainly from China.
New uses for glyphosate expand because the chemical is cheap and available:

- No-till agriculture

- Pre-harvest crop desiccant

USDA https://www.flickr.com/photos/160831427@N06/40845028643/in/photostream/
Hartley 8657 - https://www.flickr.com/photos/chafermachinery/14618680295
2015-Present: Contestation and Response

- 2015 – IARC of the WHO states glyphosate is ‘probably carcinogenic’
- Re-registration processes launched/approved in the EU, Canada and US
- Monsanto pursues major PR campaign to defend the chemical

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**International Agency for Research on Cancer**

World Health Organization

IARC Monographs Volume 112: evaluation of five organophosphate insecticides and herbicides

Lyon, France, 20 March 2015 – The International Agency for Research on Cancer (IARC), the specialized cancer agency of the World Health Organization, has assessed the carcinogenicity of five organophosphate pesticides. A summary of the final evaluations together with a short rationale have now been published online in The Lancet Oncology, and the detailed assessments will be published as Volume 112 of the IARC Monographs.

**What were the results of the IARC evaluations?**

The herbicide *glyphosate* and the insecticides *malathion* and *diazinon* were classified as *probably carcinogenic to humans* (Group 2A).
A growing number of countries banning or restricting use of glyphosate

- Many restrictions on nonagricultural use
- Many countries encountering industry resistance especially for restrictions on agricultural use
Response from industry: Digital agriculture

- Precision herbicide spraying
- Gene editing plants to be resistant to glyphosate
- Firms frame as environmentally sound
- Cheaper than herbicide or biotech development
Continual corporate consolidation 1970s-Today

- Constant mergers and acquisitions have consolidated the industry over the course of decades
- Now just four firms dominate the market
Concentration creates barriers to entry that dampen innovation

- No new active ingredients for herbicides developed over a 30-year period
- No attention to R&D for alternatives to herbicides

Market share of the top 4 firms in agrochemicals, 1994-2018

Sources: Compiled from data in Fuglie et al. 2011; ETC Group data: www.etcgroup.org
Thank you

References


