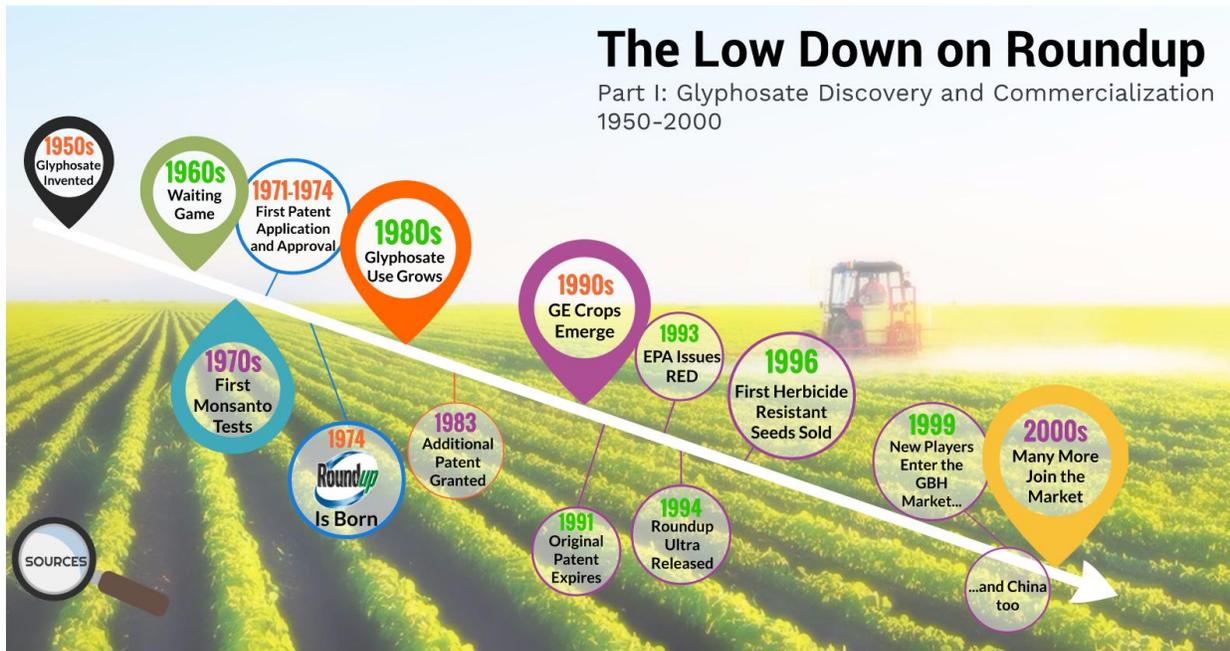


The Low Down on Roundup

Part I: Glyphosate Discovery and Commercialization



Sources:

Project Sources

Our project team combed through a mountain of EPA documents and herbicide use data to create these timelines, and we are sharing it all with you!

Reference List (PDF):
<http://cehn-healthykids.org/wp-content/uploads/2017/07/The-Lowdown-on-Roundup-References.pdf>

Online Bibliography for Part I:
<http://cehn-healthykids.org/bibliography-tag/lowdown-part1/>

Our project team combed through a mountain of EPA documents and herbicide use data to create these timelines, and we are sharing it all with you!

Reference List (PDF):

<http://cehn-healthykids.org/wp-content/uploads/2017/07/The-Lowdown-on-Roundup-References.pdf>

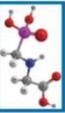
Online Bibliography for Part I:

<http://cehn-healthykids.org/bibliography-tag/lowdown-part1/>

1950: Glyphosate Invented

1950s

GLYPHOSATE



Glyphosate was first synthesized in 1950 by Cilag, a small Swiss pharmaceutical company.

No medical applications were identified, so the formula was shelved.

Glyphosate was first synthesized in 1950 by Cilag, a small Swiss pharmaceutical company.

No medical applications were identified, so the formula was shelved.

1960s: Waiting Game

1960s

Ten years later, Aldrich Chemical Co., a distributor of laboratory research chemicals, obtained the molecule through an acquisition.

 Meanwhile, Monsanto was looking for new phosphonic acid-based water softening agents related to aminomethylphosphonic acid (AMPA, glyphosate's major metabolite).

The company purchased dozens of chemicals from Aldrich to test, including glyphosate.

Ten years later, Aldrich Chemical Co., a distributor of laboratory research chemicals, obtained the molecule through an acquisition.

Meanwhile, Monsanto was looking for new phosphonic acid-based water softening agents related to aminomethylphosphonic acid (AMPA, glyphosate's major metabolite).

The company purchased dozens of chemicals from Aldrich, including glyphosate.

1970s: First Monsanto Tests

1970s



Monsanto acquires the formula for glyphosate and conducts the first tests for herbicidal activity in 1970.

It stood out as uniquely promising. Intensive work began on synthesis, patenting, and preparation for commercial introduction.

Monsanto acquires the formula for glyphosate and conducts the first tests for herbicidal activity in 1970.

It stood out as uniquely promising. Intensive work began on synthesis, patenting, and preparation for commercial introduction.

1971-1974: First Patent Application and Approval

1971

Monsanto files patent application for glyphosate herbicide (U.S. Patent # 3,799,758)



1974



Monsanto files patent application for glyphosate herbicide (U.S. Patent # 3,799,758).

1971-1974, Subtopic: 1974

1974



Monsanto's initial glyphosate patent was approved in 1974 (Franz, 1974), and several others followed over the next decade.

Via its patents, Monsanto controlled the glyphosate market in the U.S. from 1974-2000.

Monsanto's initial glyphosate patent was approved in 1974 (Franz, 1974), and several others followed over the next decade.

Via its patents, Monsanto controlled the glyphosate market in the U.S. from 1974-2000.

1974: Roundup is Born

1974



Monsanto introduces the first glyphosate herbicide: Roundup.

Original Roundup herbicide contained the isopropylammonium (IPA) sodium and ammonium salt form of glyphosate.

Unnamed "inert ingredients" made up about two-thirds of the herbicide by weight.

Monsanto introduces the first glyphosate herbicide: Roundup.

Original Roundup contained the isopropylammonium (IPA) sodium and ammonium salt form of glyphosate.

Unnamed "inert ingredients" made up about two-thirds of the herbicide by weight.

1980s, Stacked Slide (1/2): Glyphosate Use Grows

1980s



Over the first decade, glyphosate use by U.S. farmers totaled a modest 37 million lbs (16 million kgs).

1987: 7 million pounds (3 million kgs) of glyphosate was applied, making it #17 on the EPA's list of the top 25 pesticides by pounds applied.

#1 on the EPA List: The herbicide atrazine, with about 73 million pounds (33 million kgs) applied in 1987, 10-times more than glyphosate (Benbrook, 2016).

Over the first decade, glyphosate use by U.S. farmers totaled a modest 37 million lbs (16 million kgs).

1987: 7 million pounds (3 million kgs) of glyphosate was applied, making it #17 on the EPA's list of the top 25 pesticides by pounds applied.

#1 on the EPA List: The

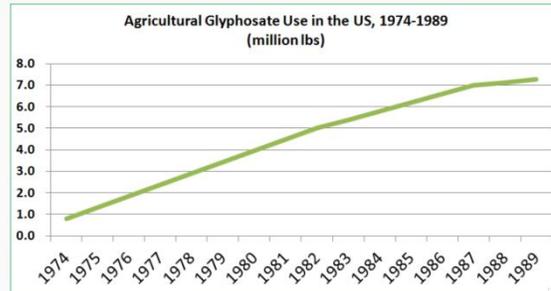
herbicide atrazine, with about 73 million pounds (33 million kgs) applied in 1987, 10-times more than glyphosate (Benbrook, 2016).

1980s, Next Slide (2/2):



By 1990, use had almost doubled compared to 1980, steady but not spectacular growth (Benbrook, 2016).

1980: Only 4 million pounds (1.8 million kgs) of glyphosate active ingredient was used by U.S. farmers and ranchers.



1980: Only 1.8 million pounds of glyphosate active ingredient was used by U.S. farmers and ranchers.

By 1990, use had almost doubled compared to 1980, steady but not spectacular growth (Benbrook, 2016).

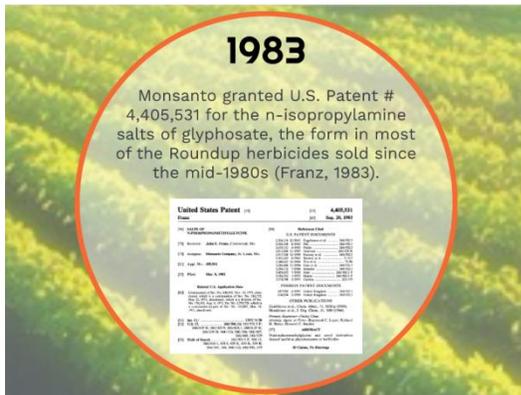
Animation (zooms to):



What will happen to pounds applied over the next 20 years? See Part III of "The Lowdown on Roundup."

What will happen to pounds applied over the next 20 years? See Part III of "The Lowdown on Roundup."

1983: Additional Patent Granted



Monsanto granted U.S. Patent # 4,405,531 for the n-isopropylamine salts of glyphosate, the form in most of the Roundup herbicides sold since the mid-1980s (Franz, 1983).

1990: GE Crops Emerge

1990s

Big changes hit U.S. agriculture in the 1990s!



The first crops genetically engineered (GE) to resist herbicides are introduced in 1996. Farmers can now spray glyphosate over the top of "Roundup Ready" (RR) soybeans and cotton, killing weeds but leaving their crop unharmed.

Also in 1996 -- the first glyphosate-resistant weed, rigid ryegrass (*Lolium rigidum*) is identified in Australia (see <http://www.weedscience.org>).

Big changes hit U.S. agriculture in the 1990s!

The first crops genetically engineered (GE) to resist herbicides are introduced in 1996. Farmers can now spray glyphosate over the top of "Roundup Ready" (RR) soybeans and cotton, killing weeds but leaving their crop unharmed.

Also in 1996 -- the first glyphosate-resistant weed, rigid ryegrass (*Lolium rigidum*) is identified in Australia (see <http://www.weedscience.org>).

1991: Original Patent Expires

1991

EXPIRED

Monsanto's original glyphosate patent expires.

Other companies begin marketing glyphosate-based herbicides (GBHs) internationally.

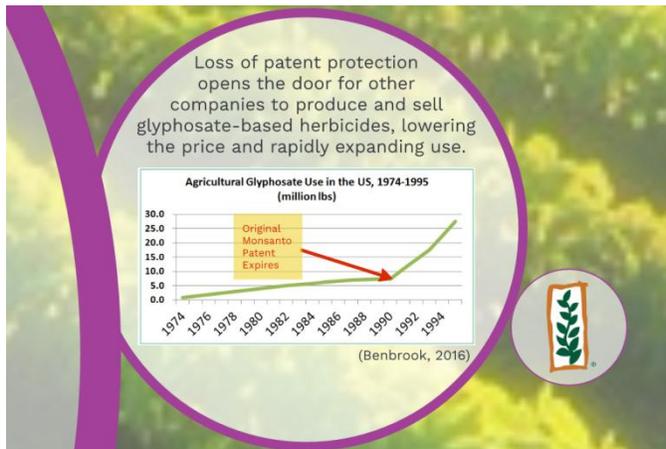
GBHs manufactured outside the U.S. can now be imported.

Monsanto's original glyphosate patent expires.

Other companies begin marketing glyphosate-based herbicides (GBHs) internationally.

GBHs manufactured outside the U.S. can now be imported.

1991, First Subtopic (arrows):



Loss of patent protection opens the door for other companies to produce and sell glyphosate-based herbicides, lowering the price and rapidly expanding use.

Chart Source: (Benbrook, 2016)

1991, First Subtopic, Secondary Subtopic:

Still, Monsanto will retain substantial market share by:

- Developing and patenting new formulations,
- Gaining registrations essential for use on GE, herbicide-resistant crops, and
- Offering marketing incentives for farmers buying Monsanto-brand Roundup along with Monsanto GE-RR seeds.

Still, Monsanto will retain substantial market share by:

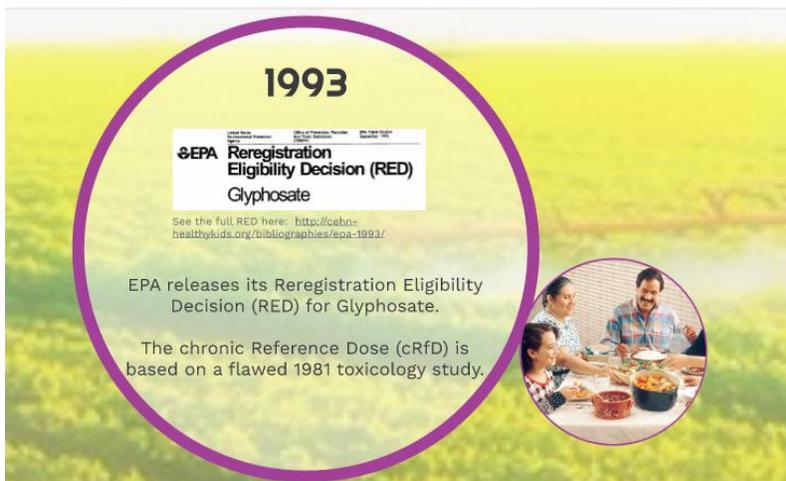
- Developing and patenting new formulations,
- Gaining registrations essential for use on GE, herbicide-resistant crops, and
- Offering marketing incentives for farmers buying Monsanto-brand Roundup along with Monsanto GE-RR seeds.

1991, Second Subtopic (molecule):



Monsanto retains patent protection for n-isopropylamine salt glyphosate formulations in the U.S. until 2000.

1993: EPA Issues RED



EPA releases its Reregistration Eligibility Decision (RED) for Glyphosate (EPA, 1993).

The chronic Reference Dose (cRfD) is based on a flawed 1981 toxicology study.

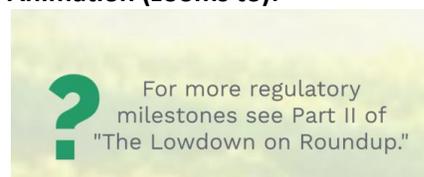
1993, Subtopic:



Glyphosate use remains moderate and residues in food and water are rare, and typically very low.

Little attention is paid to the science behind the dietary exposure and risk assessment in the 1993 RED.

Animation (zooms to):



1994: Roundup Ultra Released



Monsanto registers Roundup Ultra.

Click this link to view the first EPA approved label:

<https://goo.gl/juwuez>

1996: First Herbicide Resistant Seeds Sold



Monsanto sells the first Roundup Ready soybeans, genetically engineered to be immune to Roundup herbicides.

New Roundup labels allow applications well into the soybean growth cycle, significantly expanding the time period when the herbicide can be used, as well as the potential for human exposure.

Click this link to view one of the first Roundup Ready labels approved by the EPA:

<https://goo.gl/28eXPd>

1999: New Players Enter GBH Market...

1999

With Monsanto's glyphosate patents expired, other agrochemical companies enter the market.

Dow Agrochemical and BASF subsidiary Micro Flo register GBHs this year.

Click the links below to view the labels:

- Dow - <https://goo.gl/KG2OLf>
- BASF - <https://goo.gl/9cMS4w>

Dow **BASF**
Dow AgroSciences We create chemistry

With Monsanto's glyphosate patents expired, other agrochemical companies enter the market.

Dow Agrochemical and BASF subsidiary Micro Flo register GBHs this year.

Click the links below to view the labels:

- Dow - <https://goo.gl/KG2OLf>
- BASF - <https://goo.gl/9cMS4w>

...and China too

Chinese glyphosate manufacturing capacity expanded throughout the 1990s and reached --

- 323,400 tons by 2007
- 835,900 tons by 2010

By 2012 China has enough glyphosate production capacity to meet global demand by itself (Szekács and Darvas, 2012).

Chinese glyphosate manufacturing capacity expanded throughout the 1990s and reached -

- 323,400 tons by 2007
- 835,900 tons by 2010.

By 2012 China has enough glyphosate production capacity to meet global demand by itself (Szekács and Darvas, 2012).

2000: Many More Join the Market

2000s

Additional GBHs will be introduced over the course of the decade, including:

- Monsanto's Roundup UltraMax II in 2002 (<https://goo.gl/u9OijH>) and Powermax in 2005 (<https://goo.gl/Wmq0NY>)
- Syngenta's glyphosate herbicide Touchdown in 2000 (<https://goo.gl/Se24jN>)
- Bayer's formula in 2002 (<https://goo.gl/LRN1of>)

Click the above links for the full PDF.




	U.S. ENVIRONMENTAL PROTECTION AGENCY Office of Pesticide Programs Registration Division (RD02) 4800 Reservoir Road Washington, D.C. 20460	EPA Reg. Number: 10182-001 437	Date of Issuance: 11-8-00
NOTICE OF PESTICIDE: Registration Retriggering		Type of Review: Conditional	Name of Pesticide Product: Glyphosate Technical

Under FIFRA, no animals!

Name and Address of Registrant (Include ZIP Code):
Seneca Ag Products
Becky Rhodes
Regulatory Product Manager
P.O. Box 15458
Wilmington, DE 19850-5458

An example label, from Zeneca Ag Products, now a subsidiary of Syngenta

Click the above links for the full PDF.

Many more GBHs will be introduced over the course of the decade, including:

- Monsanto's Roundup UltraMax II in 2002 (<https://goo.gl/u9OijH>) and Powermax in 2005 (<https://goo.gl/Wmq0NY>)
- Syngenta's glyphosate herbicide Touchdown in 2000 (<https://goo.gl/Se24jN>)
- Bayer's formula in 2002 (<https://goo.gl/LRN1of>)