

# Confusing Aspects About Roundup® and Other Herbicides

## Their Impacts on Nurseries and Landscapes

### INTRODUCTION

Glyphosate, the original Roundup, is the most successful herbicide of all time in terms of usage and sales. In fact, it is the most successful agriculture chemical ever when all “pesticides” (herbicides, insecticides, fungicides, rodenticides, algaecides, nematocides, etc.) are considered. Over the past couple of decades, however, Glyphosate has met with controversy on several fronts. This article will hopefully provide some clarity regarding confusion about Roundup/Glyphosate and other herbicides (Photos 1A & 1B).



**PIA**



**PIB**



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Dr. Roberts retired from Michigan State University in 2018 after committing over four decades to advancing MSU's Land Grant Mission, originally signed into law by President Abraham Lincoln during the midst of the American Civil War. He received his B.S. (1975) and M.S. (1977) from The Ohio State University and his Ph.D. from Michigan State University. Over the decades, Dr. Roberts has published hundreds of articles and has taught hundreds of lectures and workshops. He has re-searched many issues in Michigan's plant industry including Dutch Elm Disease, *Diplodia* Tip Blight of Pines, along with variety of cultural problems such as plant nutrition and herbicide toxicity. Dr. Roberts has worked on Oak Wilt for 40 years, inventing several new and innovative remediation techniques. During his career, he has discovered a variety of new diseases and pests such as *Phomopsis* Canker of Spruce and the first bacterial wilt disease of turfgrasses in North America. His discovery of a bacterial biological herbicide for weed grasses resulted in several patents with MSU. His research on greenhouse and nursery crops disclosed the first fungicide-resistant strains of the *Pythium*, a root rot fungus, altering management methods for crop preservation. In the early 2000s, his research on Ash Decline in Southeast Michigan led to the discovery of the invasive Emerald Ash Borer in North America. In his retirement, Dr. Roberts intends to remain active with the Arboriculture/Landscape/Nursery Industries while hoping to have more time for his hobbies. Dr. Roberts is President, CEO and CBW (Chief Bottle Washer) of The Plant Doctor, LLC... aka The Tree Doctor. Contact information:  
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**P1A & B** The dying oak trees in this landscape near Muskegon, Michigan were initially diagnosed by three separate arborist/landscape companies as Oak Wilt (Photo 1A). The property owners didn't like those diagnoses because it would entail costly trenching and the sacrifice/destruction of many healthy trees on their and their neighbors' properties. Photo 1B shows a satellite image of the properties; the affected trees (gray) can be seen in the center of the photo. The yellow circle represents approximately where two trench lines would be installed, accompanied by destruction of all trees within, to complete the requirements of the Bruhn Model officiated by the Michigan DNR and Oak Wilt Qualification program for Oak Wilt remediation. A fourth arborist, having attended my lectures and read my articles about herbicide phytotoxicity, believed it might be herbicide injury rather than Oak Wilt; he invited me to confirm it. Roundup 365 had been applied to the landscape; it was the Imazapic component of this herbicide, not Glyphosate, and not Oak Wilt that caused the

## A Brief History of Glyphosate

The chemical we know as Glyphosate has a very interesting history. Believe it or not, Glyphosate was first patented in the 1950s as an antibiotic by a pharmaceutical company. Apparently, its use as an antibiotic, not unexpectedly today with all of the controversy surrounding its impact on human health, didn't work out. So, it was patented again in the 1960s as a descaling agent for pipes because of its ability to dissolve mineral deposits. Then, in 1970, John Franz, a scientist whose position at Monsanto was to test chemicals for possible usage as agricultural products, discovered that Glyphosate possessed amazing herbicidal properties. Monsanto patented Glyphosate and the rest is history... well, almost.

## Roundup History Chapter #1: Stellar Success

Roundup, the product name for Glyphosate, was released in 1974. "Roundup" should not be confused with other Roundup products (Photo 2). Many

farmers, including my Dad, began using Roundup herbicide as an effective



broad-spectrum herbicide for control of weeds. Farmers were advised to be patient after application because Glyphosate would take 1-2 weeks to

kill plants as it becomes systemic, working on enzymatic pathways to eventually kill the offending plant including its roots. Roundup was not only amazing as an herbicide but became an unimaginable success story.

## Roundup History Chapter #2: Enhanced Glyphosate Products

Glyphosate's patent expired in 2000, which meant every chemical manufacturer in the Universe could now produce Glyphosate and sell it under their own brand name. Monsanto, in its effort to



tree losses. Because the cause of the problem was Imazapic and not Oak Wilt, no further tree losses have occurred in the past three years.

**P2** These Roundup candy cigarettes from decades ago enabled children to mimic their parents who adopted smoking as a fashionable cultural trend similar to Hollywood's glamorous movie stars. Perhaps it could be argued that sugar ("white death") was a gateway drug to smoking, which may be more harmful to human health than Glyphosate?

**F1** This figure shows a tiny fraction of the products that contained Glyphosate after Monsanto's

patent expired. Except for the white bottle of Roundup, all products pictured herein also contain Imazapyr/Imazapic, a deadly herbicide that has inadvertently killed many trees and shrubs throughout Michigan. Other herbicides such as the contacts, Pelargonic Acid and Diquat Dibromide, were also frequently added to these and other products for "visible results within hours", to satisfy applicators' need for immediate gratification because Glyphosate and Imazapyr are rather slow acting. In the author's opinion, Glyphosate's use in landscape and nursery environments is relatively safe from a plant health perspective.

hold market share, and perhaps even expand it, began adding other herbicides to Roundup products to enhance and broaden Roundup’s capabilities and market appeal; other manufacturers quickly followed with similar competitive products (Figure 1). These enhancement chemicals added to Glyphosate-containing products have caused much confusion and plant deaths in nurseries and landscapes (Photos 1A, 1B, & Photo 3). Some of the products that

were added to Roundup and other competitors’ products, *or later substituted for Glyphosate*, are presented in Table 1.

### Roundup History Chapter #3: Legal Woes & Transition Away from Glyphosate

Although Glyphosate products were considered “safe” to human health for decades, according to World Health Organizations and other sources, in the late 2010s a report was released indicating Glyphosate *may be linked* to Non-Hodgkin’s Lymphoma. Most of us have seen those late evening advertisements by law firms as they try to cash in on their legal efforts for themselves and their clients. You may have noticed that these ads almost always target the “Roundup” name and not other companies’ Glyphosate products that have been manufactured for 25 years since Monsanto’s patent on Glyphosate expired. Why target “Roundup” and not other glyphosate-containing products? Obviously, “Roundup” is an instantaneously recognizable brand name worldwide. Furthermore, Monsanto was purchased by Bayer for \$63 Billion in 2018, and I think it is assumed that Bayer has the deepest pockets for lawsuits involving Roundup, er uh, Glyphosate. It is also important to understand that many chemicals, including many pesticides, may be associated with Non-Hodgkins

Lymphoma. As a result of these legal issues, Bayer (Monsanto) has transitioned away from including Glyphosate in some of their products for certain markets (Table 1), especially homeowners, but has kept the immediately recognizable Roundup name for a diverse variety of products (Figure 2).

### Herbicide Confusion: What’s in a Name?

There appears to be widespread confusion about herbicides among the public and for good reason. And the same can be said for professional applicators as well. First, there are matters involving herbicide labels, which are often confusing (Photo 4). And then, the products and their active ingredients have changed quite frequently over the last several years (Figure 2, Photo 5, 6A, 6B & 6C). I know I am guilty of frequently using the terms Glyphosate and Roundup interchangeably; this could lead to not only confusion but mistakes. Because the name “Roundup” is targeted most frequently in legal claims, it is likely that the public will confuse many Roundup products, even those that contain no Glyphosate, with “Roundup” legal issues. We need to look at the labels and their active ingredients every time we use a product.

### Diagnosing Herbicide Phytotoxicity

Distinguishing herbicide injury from other plant maladies can be difficult, or at least it seems to be so. It can take years of experience to accurately differentiate not only herbicide injury on plants from diseases, pests and disorders, but it can also be challenging to distinguish which herbicide may be involved in a particular issue. Over the years, various articles



Chemical	Description	T1
Triclopyr	Dicotyledonous (Broadleaf) , Systemic, Persistent, Water-Soluble Herbicide used extensively for tree and shrub control in Right-Of-Way (Power Service, Railroads, Drain Commission, etc.). Lower concentrations use for Lawns.	
Imazapyr/ Imazapic	Non-Selective, Systemic, Long Persistent, Water-Soluble Herbicide, from Carboxylic Acid group of herbicides like Triclopyr, Imprelis, Aminopyralid, etc. Leaches and moves with water often away from target site. Used extensively in Invasive Plant control but very dangerous for nontarget trees and shrubs.	
2, 4-D <small>(2,4-Dichlorophenoxyacetic Acid)</small>	Growth Regulator (Auxin) “Phenoxy” Herbicide, Systemic, Active on many broadleaf plants, Commonly used for Broadleaf weeds in turf and pastures. Potential phytotoxicity to trees and shrubs is common but generally not lethal, Foliar uptake from drift and root uptake are common.	
Dicamba	Similar to 2,4-D, Growth Regulator (Auxin) “Phenoxy” Herbicide, Systemic, Active on many broadleaf plants, Commonly used for Broadleaf weeds in turf and pastures. Potential phytotoxicity to trees and shrubs is common but generally not lethal, Foliar uptake from Drift and Root Uptake are common! More toxic to woody non-target plants and longer persistence than 2,4-D.	
Fluazifop- P-Butyl	Herbicide for Monocotyledonous (Grass) plants, Systemic, Selective for grasses and will generally not harm broadleaf plants. Sold as various trade names such as Fusilade, Ornamec, etc.	
Fatty Acids	Non-Selective, Non-Persistent, Non-Systemic Herbicides used solely or in combination with other herbicides. Common examples include Pelargonic Acid and Ammonium Nonanoate. Visible symptoms on target plants within hours-what immediate gratification applicators love.	

**P3** Tree decline/death in Bayfront Park (Petoskey, MI) was caused by an Imazapyr-containing product applied by licensed professional applicators to tree grates and pavers for weed control. The applicators and city personnel had no idea their herbicide applications were killing city trees; this phenomenon was prevalent all over Michigan. As expected, maple trees in lawn areas where Imazapyr was not applied are doing just fine (background). Common replacements for the maples were Bradford Pears (Oh no!), which were also succumbing.

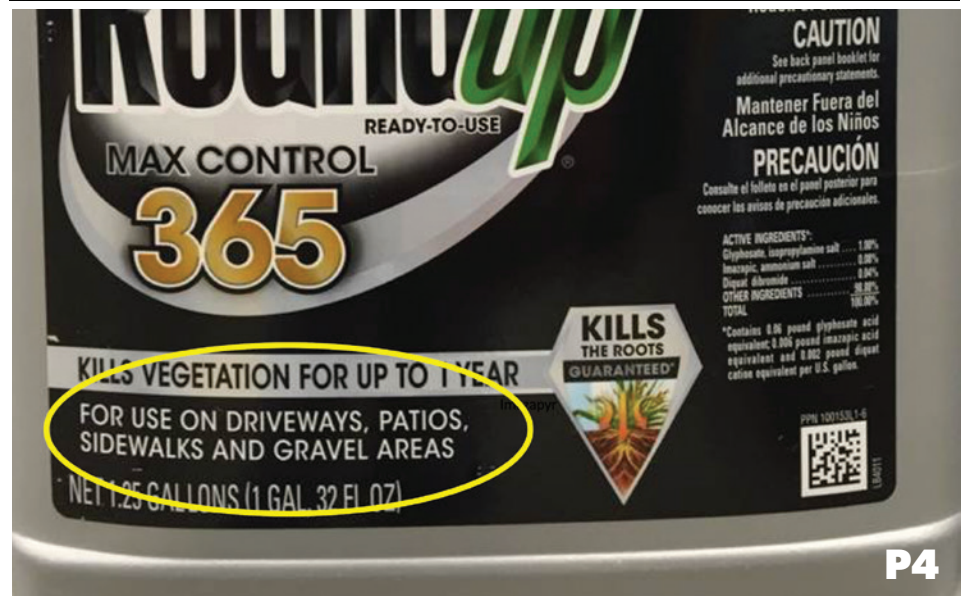
**T1** Here are a few herbicides that have been added to Glyphosate products to enhance their capabilities, and later substituted for Glyphosate in herbicidal products when Glyphosate was transitioned out of products by various companies.

regarding herbicides have been published in *The Michigan Landscape*. These articles are available on my website (plantdoctorllc.com) or from MNLA. Perhaps one of the more useful articles from a symptomatology standpoint is “*Diagnosing Herbicide Injury on Trees and Landscape Plants*”, *The Michigan Landscape*, January/February 2019. It is vitally important that we as professionals in the nursery and landscape industry learn to recognize symptoms of herbicide injury. It is literally our job and in our best interest to do so. We could be blamed for others’ mistakes. Sometimes our clients are applying herbicides, and we do not know why trees and shrubs we are responsible for are in decline. Often, our clients will never admit to applying anything, representing a very challenging situation. Be wary of trying something new or at the recommendation of a supplier if you are not intimately familiar with the product and its active ingredients. It is imperative that we read and follow label recommendations even though they may be vague (Photo 4). It is my assumption that many people in our

**F2** The transition away from Glyphosate spawned many new “Roundup” products, which are likely confusing to the public. Formula 1 (F1) is the original Glyphosate with Pelargonic Acid added for fast symptom expression, “visible within hours”. F2 for Poison Ivy Control and containing Glyphosate morphed into F3 without Glyphosate. F4 for “Weed and Grass” control contains three chemicals to replace the original F1 Glyphosate and, in the author’s opinion, is not nearly as effective. F5 (absent Glyphosate) is for lawns, which means it will kill broadleaf plants and not kill turf. F6 & F7 are of particular interest because they replaced the older Roundup Extended Control and Roundup 365; while neither contain Glyphosate, they do retain the deadly (for trees and shrubs) Imazapic/Imazapyr.

**P4** The front of this Roundup 365 package indicates that the product can be applied to driveways, patios, sidewalks, and gravel areas. These advised application areas are also where the roots of trees reside. Is the front of this package the label? Or are there warnings about tree roots deep in the fine print? The active ingredient in this product, Imazapic (not Glyphosate), has killed many trees, shrubs, and other plants in Michigan and around the United States.

**P5** A friend of mine loves Roundup (Glyphosate) and has used it for years. I swear she has stock in the company! When she applied Roundup last summer (2024) for control of Giant Foxtail and other grasses near a shed, she was surprised when she saw results within a couple of days; she wasn’t accustomed to such fast results. In looking at the package, she discovered that Roundup’s “Weed and Grass Killer” new formulation (lower) contained no Glyphosate compared to the older formulation (upper). She believed the newer formulation was not nearly as effective as the older one; while the grasses developed necrotic spots, they never died as they would have with Glyphosate applications.



**Glyphosate  
Pelargonic Acid  
(Older Formulation)**



**Triclopyr  
Fluazifop-P-butyl  
Diquat Dibromide  
(Newer Formulation)**





industry who are seeking pesticide credits are not often taught about recognizing herbicide symptoms on plants. Rather, safety is the focus, which is a good thing but which may leave us unprepared for the real world. Experience with the product really helps. Lastly, I am available to help if desired.

### Rebecca's Dilemma

Last summer (2024), I received a phone call from Rebecca who claimed that her ornamental pears were dying. According to Rebecca, other experts (arborists, landscapers, county extension) in her Southwest Michigan region could not determine the cause of the "pear disease", but one of them recommended me. A national chain "professional lawn and landscape company" had sprayed four of her neighbor's (Ted) pears with the same "disease" for \$500. I asked Rebecca what malady her neighbor's trees were sprayed for; neither she nor her neighbor knew. Rebecca was conflicted about the cost to have me come down or proceed as her neighbor did and simply have her trees sprayed; she had many more afflicted trees than Ted. After explaining to her that it might be best to make an accurate diagnosis before applying pesticides, just as it would be prudent for the accurate diagnosis of a person's pain before their Doctor starts removing organs, she decided to have me visit her home. One of my pleasures is meeting new people and experiencing their various landscapes and trees. Upon arriving at Rebecca's home, I encountered an expansive landscape of 4-5 acres with all kinds of species of plants and hardscapes, such as sheds/barns, a pavilion for weddings and family reunions, an outdoor pool and so forth. One of the more interesting structures was a farmer's old grain storage bin converted by Rebecca's husband into an outdoor bar, which was furnished with old tools, oil cans, cast iron tractor seats, etc. (Photo 7A).



When we examined her trees, I knew immediately the cause of the problem: a broadleaf weed herbicide, almost certainly 2,4-D (Photo 7B). Most of the trees on her property exhibited symptoms of 2,4-D, which was confirmed when she presented the package of 2,4-D Amine herbicide. Apparently, Rebecca and her neighbor were so concerned about the white clover in their lawns that they operated their

### P6C Herbicide Labels: They are a Changin'

<u>Old Formulation</u>	<u>New Formulation</u>	<u>Newest Formulation</u>
Glyphosate + Imazapyr	Pelargonic Acid + Imazapyr	Ammonium Nonanoate

sprayers extra slow to literally drench their lawns with 2,4-D. I felt responsible to inform Rebecca that 2,4-D does not control white clover. While Rebecca was elated that her trees would recover next year and that she didn't need to hire the "professional lawn and landscape company" to spray her trees for (potentially) \$100s-\$1000s, she was embarrassed that she had caused the problem all by herself.

### Klover Killer Karen

Another site I visited in 2024 involved some strange symptoms on a Crimson King Norway Maple (Photo 8). In investigating the details, like Rebecca, Karen viewed white clover as the bane of a meticulously maintained lawn and landscape. She applied Ortho's Weed B Gone twice in one week at a rate 2-3X the label each time. Like many DIY homeowners, she reasoned that if the label rate is X, then two or three times the label rate would provide even better results. She "fried" her maple tree with the active ingredient Triclopyr (Photo 8 Inset), a broadleaf herbicide that at certain rates is used to kill trees and bushes in Right-Of-Ways (Power Supply, Railroads) and at other rates in lawns to control broadleaf "weeds" such as dandelions... and white clover (Photo 8).



**P6A B&C** At the suggestion from an arborist, Michael contacted me to remediate an Oak Wilt-infected tree (Photo 6A, yellow arrow) at his home near Rochester Hills so that the disease would not spread throughout his landscape; I used my Stump Cup technique with concentrated Glyphosate (Photo 6A Inset). While preparing for the procedure I learned that Michael was involved in one of the "Roundup" legal claims; with this revelation, I indicated that, perhaps, we should not use Glyphosate? But he replied, "No, its fine." After completing the procedure, I also learned that Michael had just made an application of Ortho GroundClear to the mulched areas in his landscape (Photo 6B Inset). I warned Michael about the dangers of Imazapyr in the Ortho product, and sure enough, the following year he had widespread tree death in his landscape (Photo 6B). In just the 2-3 years I knew Michael, Ortho's GroundClear transitioned from Glyphosate + Imazapyr to Pelargonic Acid + Imazapyr to (only) Ammonium Nonanoate (Photo 6C). Ammonium Nonanoate is not systemic and thus will not kill roots, is not persistent, and is about as innocuous as we can attain compared to the previous renditions of GroundClear.

spray his pears... for some unknown "disease". Rebecca deliberated about whether to have her trees sprayed as well or have me visit her trees for a second opinion. Upon my arrival, I saw an exceptionally large landscape with abundant flora and hardscapes, including, interestingly, an outdoor bar created from a farmer's old grain bin (Photo 7A); the bar was furnished with various old tools, tractor seats, oil cans and other paraphernalia (Photo 7A Inset). In examining her troubled pear trees, I knew immediately that the culprit was a broadleaf weed killer, likely 2,4-D, which was confirmed when she proffered the 2,4-D Amine package. Most trees in her landscape were exhibiting herbicide symptoms (Photo 7B): pear (upper left), red oak (lower left), red maple (upper right), crabapple (lower right). Note twisted and cupped foliage on each species typical of a growth regulator herbicide like 2,4-D. Turns out she had applied a drenching dose of 2,4-D Amine to her lawn to zap white clover, which, unfortunately, is not controlled by 2,4-D.

**P7A &B** Rebecca believed her Ornamental Pear trees were dying; her neighbor had already hired a national chain lawn and landscape company to

**P8** Like Rebecca (Photo 7A & 7B), Karen was also extremely worried about white clover to such an extent that, "It Means War!" Karen got the correct herbicide in Weed-B-Gone (Triclopyr) but applied the product twice in one week at 2-3 times the label rate with each application. Her Crimson King Maple was "toast".