EXTENSION

Bermudagrass Suppression Methods for Oklahoma Home Gardens

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Bermudagrass is an aggressive, warm-season turfgrass species that rapidly spreads by above-ground stolon and below-ground rhizome stem tissue. It has excellent heat and drought resistance and therefore is a durable choice for a typical Oklahoma yard. However, the traits that make it an excellent turfgrass, unfortunately, make it a very problematic weed in home gardens, which may lead a gardener to ask "How can I control bermudagrass in my garden?" This factsheet will provide options for home gardeners trying to eradicate or suppress bermudagrass from a home vegetable garden plot.

Bermudagrass often has a strong and aggressive root system. Therefore, when the upper vegetation (where photosynthesis occurs) is lost, the root system can quickly re-establish the vegetation. Utilizing energy reserves from the roots comes at a temporary cost to the plant. Once the plant has vegetation again and can photosynthesize, the root system's energy reserves will be restored, assuming all other plant needs are being met (sunlight, nutrients, water, etc.). Reducing any of these plant needs can inhibit a plant's ability to photosynthesize, causing the plant to draw upon stored reserves. Because bermudagrass has rhizomes and stolons, it often has vast energy reserves available; therefore, it can require a long and continuous period of poor growing conditions and abuse before the plant succumbs. In other words, you can think of the roots as a savings account for the plant. While the plant is doing its job (photosynthesizing), it is earning an income and not having to use its savings. However, when it loses its vegetation and cannot perform its job, the plant is no longer bringing in an income and needs to use some of its savings' account (energy in the roots) to survive. Depending on how much savings the plant has stored up (how healthy) and the length of time the plant needs to use those reserves will determine how long it will take to kill the plant.

As we try to eradicate or, more appropriately, suppress bermudagrass, we are looking at which methods will deplete the stored reserves. However, homeowners may qualify their desire to suppress bermudagrass with other priorities such as fastest, most environmentally friendly, least labor intensive, or cheapest way possible. Therefore, what may work for one person may not be the best fit for another.

In September of 2019, a demonstration began to determine possible treatments a home gardener could use to suppress bermudagrass in their gardens. A site was selected at the Cimarron Valley Research Station in Perkins, OK that represented an average home garden site. It was a flat site consisting of mixed grasses and broadleaf weeds. Thirty treatments were replicated three times in ten by five-foot plots. Of these 30 treatments, 13 were spray chemical treatments and 15 were mechanical treatments. Additionally, two control treatments were included; one in both the chemical side and the mechanical side. This resulted in a total of 90 plots (Figure 1). Treatments included synthetic, natural, mechanical, and Organic Materials Review Institute (OMRI) listed organic options (Table 1). Figure 2 identifies the treatment locations and is oriented the same as Figure 1 for visual comparison.

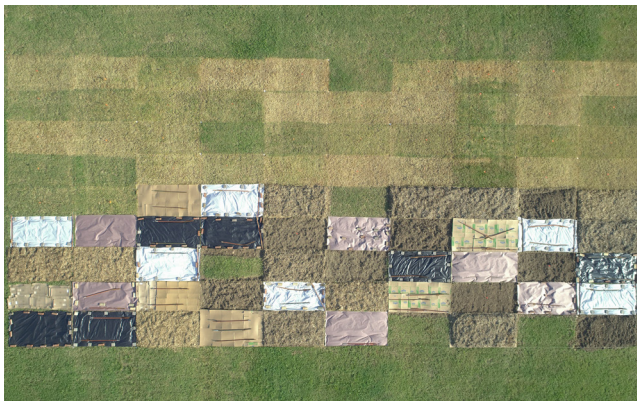

Figure 1: Aerial view of ninety 10 x 5' plots of 30 treatments for bermudagrass eradication.

#	Chemical Treatments	Treatment Trade Name	Rate
1	Control - untreated bermudagrass	NA	NA
2	Glyphosate 41%	Roundup®	5 quarts/Acre or 2% handheld sprayer
3	Glyphosate (18%) & Diquat (0.73%)	Roundup® Concentrate Plus	6 fl oz/gallon water/300 sq. ft.
4	d-Limonene (citrus oil) 70%	Avenger Weed Killer Concentrate (OMRI Listed)	1:3 ratio (1 quart Avenger: 3 quarts water)
5	Ammonium Nonanoate (40%)	BioSafe Concentrate (OMRI Listed)	15% V:V (1.2 pints Biosafe: 6.8 pints water)
6	Citric Acid (24%) & Clove Oil (8%)	BONIDE Burnout Weed & Grass Killer Concentrate	1:2 ratio (8 fl oz product with 16 fl oz water)
7	Citric Acid (20%), Clove Oil (15%), and Malic Acid (10%)	Phydura Concentrate (OMRI Listed)	1:2 ratio (8 fl oz product with 16 fl oz water)
8	Cinnamon Oil (45%) & Clove Oil (45%)	SaferGro Weed Zap (OMRI Listed)	6.4 fl oz Weed Zap with 121.6 fl oz water
9	Citric Acid (10%) & Sodium Lauryl Sulfate from Palm Kernel Oil (4%)	SNS WeedRot Concentrate	24 fl oz WeedRot with 104 fl oz water
10	Vinegar (Acetic Acid) (10%), Orange Oil (1%), Molasses (1%), and a natural surfactant	Soil Mender Enhanced Vinegar Ready to Use	Premixed/Ready to Use
11	Acetic Acid (23%) & Citric Acid (14%)	Summerset AllDown Concentrate (OMRI Listed)	1:2 ratio (8 fl oz product with 16 fl oz water) or 15 fl oz/100 sq. ft.
12	Mint Oil (5%), Sodium Lauryl Sulfate (5%), Potassium Sorbate (5%)	Torched Weed Killer	10 fl oz/gallon water
13	Eugenol (6%)	Weed Slayer	2-3% dilution, apply 2.5 product and 125.5 fl oz water or up to 3.8 fl oz product with 124.2 fl oz water
14	Ammoniated Soap of Fatty Acids (3.68%) & Maleic hydrazide (0.50%)	Natria Grass & Weed Control Ready to Use	Premixed/Ready to Use

#	Mechanical Treatments	Method	Date
15	Control - untreated bermudagrass	NA	NA
16	Natural Cellulose Fiber - Heavy Weight	WeedGuard Plus® Organic - Heavy Weight (OMRI Listed)	NA
17	Soil Solarization with clear plastic 6 mil	Clear 6 mil Plastic Sheeting	NA
18	Occultation/Tarping with black plastic 6 mil	Black 6 mil Plastic Sheeting	NA
19	Mulch	4-inch layer tree bark mulch	NA
20	Cardboard	2 layers of large cardboard boxes	NA
21	Cardboard plus Mulch	2 layers of large cardboard boxes + 4-inch layer mulch	NA
22	Tillage only	Tillage in September & February	NA
23	Tillage + Winter Cover Crop	Tillage in September (pre-plant) & February	NA
24	Tillage + Summer Cover Crop	Tillage in September & February	NA
25	Tillage + Clear Plastic	Tillage in September & February + clear plastic 6 mil	NA
26	Tillage + Black Plastic	Tillage in September & February + black plastic 6 mil	NA

27	Tillage + Cardboard	Tillage in September + 2 layers of large cardboard boxes	NA
28	Tillage + Mulch	Tillage in September + 4-inch layer mulch	NA
29	Tillage + Cardboard + Mulch	Tillage in September + 2 layers of large cardboard boxes + 4-inch layer mulch	NA
30	Tillage + Natural Cellulose Fiber Heavy Weight	Tillage in September & February + WeedGuard Plus Organic - Heavy Weight	NA

Table 1. Cimarron Research Station Bermudagrass Removal Demonstration 2019-2020 Treatments

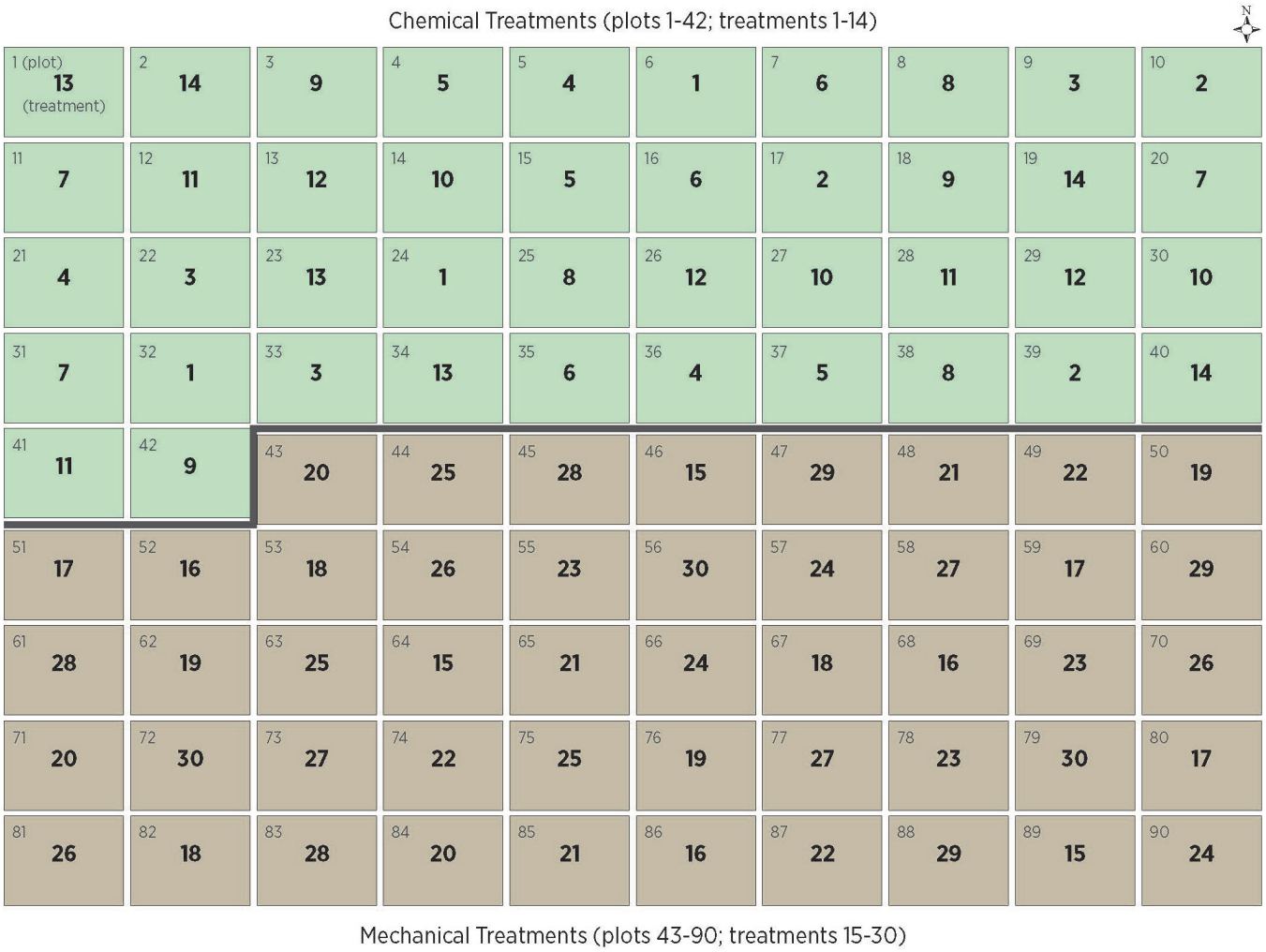

Figure 2: Treatment guide to plots.

Demonstration

Chemical Treatments

There are a variety of chemicals that claim to have effective control on bermudagrass. The chemical treatments for this demonstration were selected based on their claims and popularity. Vinegar is often mentioned as a home remedy, while glyphosate is often the most utilized synthetic chemical control method. This demonstration looked at year-long results of these treatments first applied in September and repeated quarterly throughout the year.

Mechanical Treatments

Several mechanical treatments which create a physical barrier have also gained popularity for suppressing bermudagrass growth. These treatments include methods employing occultation, solarization, tillage, and cover crops. Some of these treatments have the potential to add valuable organic matter to the soil as well.

Occultation comes from the Greek word "*occult*," which means to cover or hide from view. In this demonstration, plastic, paper, and cardboard were used to occult the plot from sunlight. Occultation is intended to trap warmth and moisture underneath to promote weed seed germination. Seedlings will sprout into darkness and then have insufficient sunlight to continue growing. This should cause the weeds to die and decompose back into the soil while depleting the seed bank and energy reserves of rhizomes and stolons.

Solarization is a practice in which solar heat is captured upon the soil surface creating extreme temperatures that are unsuitable for weeds, bacteria, nematodes, and insects within the upper soil profile. With sunlight being an essential component, the practice is most effective in the summer months that provide hotter temperatures and more sun exposure. This practice utilizes clear plastic allowing the sun to penetrate onto the soil surface. It is imperative to completely seal the edges of the plastic by burying it under soil, to capture the heat and prevent any loss. In addition to sunlight/temperature and time of year, there are other factors that can greatly influence the efficacy of solarization, such as the soil texture, soil moisture, and containment of the solar heat. For more information about soil solarization, see Soil Solarization for Control of Soilborne Diseases EPP-7640.

Tillage is often used in garden bed preparation. In this demonstration, tillage was utilized for initial bed prep for seeding cover crops, incorporating cover crops, and exposing bermudagrass rhizomes to freezing temperature for an extended time during winter months.

Cover crops have many beneficial functions in the garden, such as reducing soil erosion, adding organic matter, and retaining soil nutrients. In this demonstration, cover crops were used as competition against bermudagrass. Utilizing cover crops can deplete resources such as water and nutrients that otherwise would be more available to the unwanted bermudagrass or other weeds. Taller cover crops, such as sorghum-sudan, can further exhaust bermudagrass from its desired full sun requirements by blocking sunlight exposure. For more information about cover crops see Cover Crops for Weed Management in Oklahoma PSS-2792, Benefits of Using Cover Crops in Oklahoma No-Till PSS-2161, and Healthy Garden Soils HLA-6436.

Mulch is a readily available material accessible in small to large quantities. It is valuable in the garden as it enhances soil quality, reduces water loss, suppresses soil erosion, moderates soil temperatures, and decreases weed growth. These benefits can vary depending on factors such as existing landscape and depth of mulch cover.

Results

Chemical Treatments

Upon application, some chemical treatments saw a rapid effect, with vegetation quickly burning. However, looking at long-term suppression of the 13 chemical sprays applied, only three treatments had any degree of bermudagrass suppression: Roundup® (Glyphosate at 41.0%), Roundup® Concentrate Plus (Glyphosate at 18.0% with Diquat at 0.73%), and Torched Weed Killer (Mint Oil (5%), Sodium Lauryl Sulfate (5%), Potassium Sorbate (5%))

Glyphosate, the main active ingredient in Roundup®, is a systemic herbicide absorbed by the foliage then translocated through the plant to the shoots and roots. Its systemic nature makes it a functional herbicide for controlling bermudagrass stolons and rhizomes. Diquat is a contact herbicide that causes desiccation and defoliation, providing quick visible results. Torched Weed Killer claims to be an all-natural product with low-risk ingredients and is therefore not registered by the Environmental Protection Agency (EPA) like other pesticides.

Although, chemicals are often assumed to be "the quick fix", the three chemical treatments which showed the best results required additional applications to suppress the regrowth of bermudagrass. Bermudagrass regrowth in treated areas depends on many environmental factors such as time of year, moisture, temperature, nearby competition, and the health and vigor of the bermudagrass stand.

Many of the other chemical treatments had ingredients such as acids and oils. Vinegar, often associated with claims of being a weed killer, is an acid that causes some desiccation to the exposed vegetation. However, it does not affect the vigorous underlying roots and rhizomes of bermudagrass. Similarly, plant-based oils can cause some desiccation to the treated vegetation by coating the tissue surface and burning it without deterring the roots and rhizomes of bermudagrass. While the vegetation may appear as if some of these treatments successfully kill the bermudagrass, they are often a very temporary sense of control.

Mechanical Treatments

Essentially, we used three different materials for occultation – plastic, cellulose, and cardboard. They each had similar results regarding the bermudagrass suppression, however, they each had some benefits and drawbacks. Cardboard is a good material that is cheap, readily available, and provides an opportunity to recycle what otherwise might be trash. It is recommended to get larger cardboard pieces to reduce gaps and overlap multiple layers. Leaving the cardboard unmulched reduced the amount of bermudagrass regrowth on top of the cardboard. However, this cardboard had a very tattered look due to the exposure to the weather. Cellulose fiber is a certified organic product. The price of this product depends on the length, width, and thickness that is purchased. It is easy to install and held up quite well in the garden. While the

elements did break down the cellulose fiber eventually, it had a much tidier appearance than the cardboard. An additional benefit to utilizing cardboard or cellulose product is that they are biodegradable, ultimately adding to the soil and not requiring any removal later, unlike plastic. The plastic we used was beneficial in suppressing growth and had a cleaner look as it did not tatter like the cardboard. However, being black and opaque, it looked unnatural in the garden. Substantial reduction of bermudagrass and other vegetation was noticed under the 6 mm black plastic, however, some blanched rhizomes were still viable underneath the plastic.

In each of the four treatments utilizing mulch, the mulch was more detrimental than beneficial as it served as a substrate for bermudagrass to re-establish itself in the plot. Mulch can be beneficial for anchoring and camouflaging other materials such as cellulose or cardboard and eventually improve the organic matter content in the soil. However, it should be applied extremely thick and monitored frequently and consistently (daily/weekly) to remove advancing bermudagrass by hand. The combination of tillage, cardboard, and mulch slightly suppressed the bermudagrass better than the other three treatments alone. Applying only four inches of mulch over tilled soil or on top of bermudagrass was not beneficial for suppressing the bermudagrass.

While mulch is one way of adding organic matter into the soil, planting a cover crop is another option. If improving soil health is a priority, then cover cropping may be the best option. It would be best to plant a taller cover crop to help shade out the bermudagrass. For this demonstration, only a single crop was planted, but cover crop seed can often be planted together to gain more beneficial qualities. The sorghum-sudan grass did suppress the season's bermudagrass growth, however, it is an extremely tall cover crop (6-10') to use in an urban garden. We were able to maintain a shorter height of 2.5' by regular trimming, but again this added to the labor input and garden debris. While it reduced some growth, bermudagrass was still growing among the cover crops.

Tillage alone did not reduce the bermudagrass growth. While it momentarily delayed it, it quickly recovered. However, tillage did aid in the suppression under occultation of plastic, cardboard, and cellulose fiber.

Of the mechanical treatments, it is hard to say which is most effective as it varies based on time of application, duration of treatment, and other environmental factors that may be out of the homeowner's control (i.e., temperature, soil texture). When deciding on which mechanical treatment to utilize, it is best to evaluate the time of year and the pros and cons of each of the treatments (See Table 2).

Discussion

As concern grows over chemical use, more people are looking for alternatives to suppressing bermudagrass in their home gardens. While none of the chemical or mechanical options proved to be one-and-done solutions, gardeners have viable options depending on their budgets, time commitment, or gardening practices.

To gain the benefits of cover crops, it is important to consider how the crop will be terminated. There are various ways and reasons to stop the growth of cover crops. Often winter cover crops are terminated in late winter/early spring before they produce seed to retain the nutrients in the plants, prevent the seeds from becoming a weed problem later, and open garden space for planting. Some cover crops may be cut and incorporated into the soil, while others may be broken or laid over and left on the soil surface as a type of green mulch. The best option should be based on which cover crop is planted and the intention for using it. To find more information about cover crops see factsheet Healthy Garden Soils HLA 6436.

Oklahoma winds can be challenging; therefore, it is important to securely anchor materials to work as intended. It may be tempting to look around your home for something that has bulk and weight but avoid things that have points. T-posts may seem like a good option to lay on top of the cellulose or plastic as it can span a good length, but when the wind blows, the points and ends of the post can quickly put holes in the material. These holes and tears lead to opportunities for bermudagrass and weed regrowth. Rocks, bricks, and pavers may also seem like good options, however, the added weight on the cellulose product increased its deterioration due to the close contact with the soil surface. Landscape staples were effective for holding down cardboard and cellulose. They are cheap and found at most garden supply centers. However, landscape staples did not provide an adequate seal to capture the solar heat for solarization. Instead, it is best to completely cover the edge of the plastic with soil. Dogs can be a concern when using plastic, either for solarization or occultation. Their toenails can create punctures that may either allow the heat to escape in solarization or allow sunlight to penetrate through the occultation.

When utilizing occultation, a key factor is reducing the breaks in the material to prevent as much sunlight as possible. This can be achieved by using a larger sheet of plastic, cardboard, or cellulose fiber to cover the given area rather than needing to overlap multiple pieces, allowing for potential opening for bermudagrass to grow.

There is no one solution to fix all the bermudagrass weed problems Oklahoma gardeners face. And unfortunately, even if it is possible to eradicate existing bermudagrass, weeds (bermudagrass and others) will always be an ongoing battle because where there is bare soil, there is an opportunity for seeds to blow in and grow. Selecting a method to control bermudagrass depends on many variables – how much manual labor the gardener is willing to invest, cost of materials, expectations of results (time and level of suppression), time of year, the purpose of eradication, etc. Figure 3 can aid homeowners in determining the best approach by selecting priorities of interest.

This demonstration was intended for identifying specific merits and drawbacks of common individual treatments. This demonstration did not utilize the possibility of applying both chemical and mechanical treatments together, which could be a viable option for homeowners. For example, perhaps an initial spray of Roundup® or Torched followed by cellulose treatment would allow a homeowner to have the quickest initial control and then be able to maintain it in a more environmentally friendly way. Although bermudagrass is a formidable opponent, the good news is Oklahoma gardeners have several options to employ.

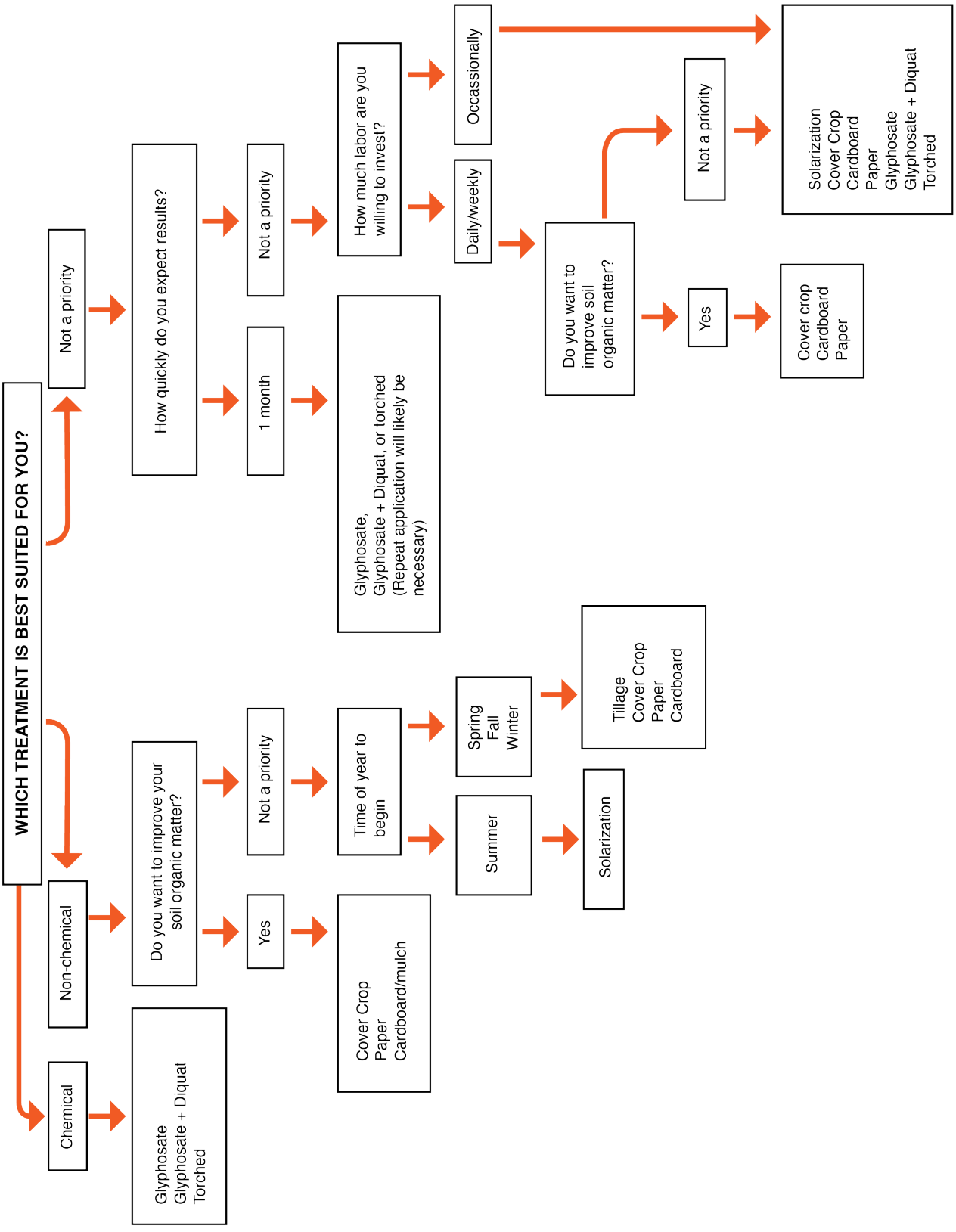

Figure 3: Flow chart to help guide homeowners toward an appropriate solution to suppress bermudagrass based on their interests.

Treatment	Pros	Cons
Roundup® **Roundup® + Diquat**	• Quickly kills upper vegetative growth. • Systemic so chemical will translocate down into underground plant tissue.	• Not organic. • Repeat applications are necessary.
Torched	• Claims to be “natural”. • Quickly kills upper vegetative growth.	• Not organic. • Repeat applications are necessary.
Cardboard	• Suppresses some vegetative growth through occultation. • Will break down. • Free/Inexpensive.	• Has varying degrees of success. • Requires regular maintenance. • Will break down and can look unsightly.
Cardboard + Mulch	• Suppresses some vegetative growth through occultation. • Will break down. • Free/Inexpensive. • Mulch helps hold down cardboard and reduces its unsightly appearance.	• Has varying degrees of success. • Requires regular maintenance. • Will break down and can look unsightly. • Mulch allows bermudagrass to quickly re-establish on top of cardboard.
Cellulose	• Certified organic. • Suppresses vegetative growth through occultation. • Will break down. • Can use it as a weed barrier around plants. • Has a cleaner appearance than cardboard.	• Will break down and can look unsightly. • Can be difficult to anchor.
Black Plastic/Occultation	• Suppresses some vegetative growth through occultation. • Inexpensive.	• Has varying degrees of success. • Can tear and look unsightly. • Tears/holes reduce effectiveness. • Can be difficult to anchor. • May require additional maintenance.
Clear Plastic/Solarization	• Inexpensive. • Can reduce seed bank due to heat. • Can help control soil-borne diseases, insects, nematodes, and weeds.	• Has varying degrees of success. • Can tear and look unsightly. • Tears/holes reduce effectiveness. • Can be difficult to anchor. • May require additional maintenance. • Can only be done in the heat of the summer.
Cover Crop	• Competes with bermudagrass for resources. • Adds organic matter back into the soil. • Can be used in winter or summer.	• Cover crop will need to be terminated at the end of the season. • Will likely take more than 1 season to outcompete bermudagrass. • Requires additional maintenance.
Tillage	• Can kill underground rhizomes when exposed to freezing conditions.	• Has varying degrees of success. • Has the potential to spread rhizomes and expose new seeds. • Timing is critical. • Requires additional maintenance.

Table 2: Viable bermudagrass suppression treatments with pros and cons.

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"Selecting a Lawn Grass for Oklahoma - Oklahoma State University." *Selecting a Lawn Grass for Oklahoma | Oklahoma State University*, extension okstate.edu/fact-sheets/selecting-a-lawn-grass-for oklahoma.html.

"Occult." Wiktionary, en.wiktionary.org/wiki/occult.

"Who We Are." Organic Materials Review Institute, www omri.org/about.

Additional Resources

Soil Solarization for Control of Soilborne Diseases EPP-7640.
https://extension.okstate.edu/fact-sheets/soil-solarization-for-control-of-soilborne-diseases.html

Cover Crops for Weed Management in Oklahoma PSS-2792
https://extension.okstate.edu/fact-sheets/cover-crops-for-weed-management-in-oklahoma.html

Benefits of Using Cover Crops in Oklahoma No-Till PSS-2161
https://extension.okstate.edu/fact-sheets/benefits-of-using-cover-crops-in-oklahoma-no-till.html

Healthy Garden Soils HLA-6436
https://extension.okstate.edu/fact-sheets/healthy-garden-soils.html

Videos:

Turfgrass Eradication Research
https://youtu.be/ym0WDvUYoto

Mechanical Bermudagrass Eradication
https://youtu.be/INTuKPufEwQ

Bermudagrass Eradication Spring
https://youtu.be/xDKGCvwsTbs

Mulch Bermudagrass Eradication
https://youtu.be/D3uHXigq_po

Bermudagrass Eradication Study – Early Natural Product Results
https://youtu.be/aSvnaVEUVMk

Bermudagrass Solarization
https://youtu.be/5yvEykWJ0jo

Bermudagrass Eradication using Cover Crops and OMRI Paper
https://youtu.be/CJRBwkBiIVU

Solarization Update in Eradicating Bermudagrass
https://youtu.be/o70WSLUtrMA

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