



A Soybean Postemergence Herbicide Failed to Perform

IS RETREATMENT WARRANTED?

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A close-up photograph of a plant stem with several green, fuzzy, elongated pods. The pods are covered in fine, light-colored hairs. The background is a soft-focus green, suggesting a natural outdoor setting. A dark rectangular box is overlaid on the center of the image, containing white text.

Successful Herbicide Applications Depend on Many Factors



In summer, most soybean acres require timely POST herbicide applications to control emerging weeds.

Farmers and agronomists know that smaller weeds are easier to control with postemergence herbicides than larger weeds. Unfortunately, high winds, excessive rain, or other challenges like equipment failures can often delay postemergence herbicide applications to soybean fields by days or even weeks.

Weeds, however, don't stop growing while the application equipment is parked. Under these circumstances, growers often have little choice but to apply the herbicides even if the weeds are larger than what herbicide labels recommend.

Fortunately, herbicide applications often provide adequate control even when made under less-than-ideal conditions. However, there are times when weed control is unacceptable, and fields may require a second application to achieve acceptable control of the remaining weeds. There is a problem if the first postemergence (POST) attempt in soybean fields provides poor weed control. There are fewer herbicide options as soybeans continue to develop and the calendar marches on.

A number of questions arise when considering whether to make a second herbicide treatment in soybeans, including:

- Do I spray as soon as I notice that too many weeds are still green?
- Do I let injured weeds regrow a little to get new leaf tissue?
- Which herbicide should I use and why?

This publication addresses these questions by providing guidelines about timing second applications in soybean and about how to select herbicide options that work

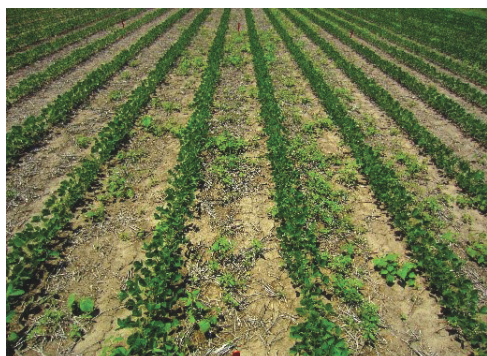
best based on university research and the experience of agronomists in the crop protection industry. Specifically, the recommendations we provide focus primarily on controlling waterhemp and Palmer amaranth, because the herbicide programs that control them are complex and both species have resistance-related challenges in soybean.

HERBICIDES ARE AN IMPORTANT WEED MANAGEMENT TOOL

Growers rely heavily on herbicides to control weeds in soybean. There are several application factors to consider to ensure herbicides work best. The most successful control meets all these factors:

- The right herbicide
- The right rate
- The right adjuvants
- The right timing
- The right equipment calibration
- The right environmental conditions

Herbicides interfere with a weed's biological processes, and plant death requires the herbicide mixture to overcome a number of physical and chemical barriers. For POST-applied herbicides to be successful, a target plant must intercept a sufficient amount of the spray solution's active ingredient, absorb that ingredient into its leaves, and then translocate the ingredient to the site of action where it disrupts plant growth. Any reduction in the amount of herbicide that reaches the target site can reduce weed control.



Weeds have rapid vegetative growth. The weeds on the (left) have less than 4 inches of growth, which is near the perfect time to receive a first POST application. One week later (right) the weeds have grown quickly leaving little time to delay the POST herbicide application.

For postemergence applications always add one of the following, except in tank mix with products prohibiting spray additives

Crop Oil Concentrate (COC) or Methylated Seed Oil (MSO): Use a nonphytotoxic COC or MSO containing 15-20% approved emulsifier at 0.5-1% v/v (2-4 qt/100 gal) of finished spray volume. COC or MSO can improve weed control but may slightly reduce crop safety.

Nonionic Surfactant (NIS): Use NIS containing at least 80% active ingredient at 0.25-0.5% v/v (1-2 qt/100 gal) of finished spray volume.

This excerpt from the Flexstar® label discusses adjuvant recommendations.

Adjuvant	<ul style="list-style-type: none"> • Ammonium sulfate (AMS) can be used at 1.5 lbs/A to 3 lbs/A. Rates are dependent on tank mix partners, environmental conditions, temperatures and potential for leaf burn. • AMS has shown to improve weed control of difficult-to-control weeds, like velvetleaf and lambsquarters, under difficult environmental conditions (low relative humidity) or hard water. • Anti-foam agent is advised.
Surfactants/ Oils	<ul style="list-style-type: none"> • The use of additional surfactants or crop oils may increase the risk of crop response. Please refer to surfactant label for more detailed directions.
Spray Volume	<ul style="list-style-type: none"> • 15 GPA minimum • If dense canopy, large weeds or unfavorable growing conditions are present, increase water volume to a minimum of 20 GPA.
Nozzle Spray Quality	<ul style="list-style-type: none"> • Liberty® 280 SL herbicide is a contact herbicide and requires proper nozzles with uniform, thorough spray coverage to achieve optimum weed control.

This excerpt from the Liberty® label recommends the right adjuvant, spray volume, and nozzle for effective control.



This weed is regrowing after a contact herbicide application. Notice how the main growing point is dead, but the plant is growing multiple side shoots.

Other factors that are largely beyond an applicator's control can also reduce how well herbicides work.

The first factor is how quickly the plant absorbs the herbicide. Plants absorb some herbicides in less than an hour, while others require several hours for adequate absorption. A rule of thumb is to assume that herbicides need four hours to penetrate a plant and reach the site of action. If it rains while the herbicide is on the plant's surface, the herbicide will be less likely to perform as intended.

Environmental factors (such as drought or extreme heat) can influence herbicide absorption rates. Under drought conditions, plants produce thicker wax on their leaves called cuticles, which help prevent water loss to the atmosphere. The thicker wax may also reduce the amount of herbicide that plants absorb. Under extreme heat, plants stop active growth to endure heat stress, which in turn may reduce herbicide translocation in the plant. In short, drought and extreme heat can reduce the amount of herbicide that reaches the target site.

The final factor that reduces herbicide activity is herbicide resistance in weeds. Resistance is the ability of weeds to survive exposure to active ingredients in herbicides that would have normally killed the weed. After repeated herbicide use, individual plants with a genetic resistance trait (which is initially extremely low in frequency in the overall plant population) will survive while the susceptible plants are killed. Those herbicide-resistant plants are left to produce seed and can quickly multiply, increasing the frequency of resistance within a weed population. With time, those weeds can take over a field and lead to failures of herbicides to control the population.

Weeds such as giant ragweed, marestail (horseweed), and waterhemp have evolved resistance to glyphosate in most fields in Indiana. Applicators frequently use PPO-inhibiting herbicides (Group 14, such as Flexstar®, Cobra®, and Blazer®) to control glyphosate-resistant species such as waterhemp, Palmer amaranth, and giant ragweed in soybean. Unfortunately, repeated use of PPO-inhibiting herbicides as a glyphosate alternative has given rise to PPO resistance developing in waterhemp and Palmer amaranth.

It is essential to follow best management practices that

include using multiple, effective herbicide modes of action to delay the evolution of herbicide resistance in weeds. Many growers already use preemergence herbicides and multiple modes of action to control glyphosate-resistant weed species in soybean.

Find Out More

More information about the resistance for specific weed species and herbicides are available at weedsience.org.

05027-00-10

GROUP 9 HERBICIDE

Roundup POWERMAX HERBICIDE

Complete Directions for Use
Herbicide for Roundup Ready® Crops

Selective broad-spectrum weed control in Roundup Ready® crops.

Non-selective, broad-spectrum weed control for many agricultural systems and forage crops.

Read the entire label before using this product. Use only according to label directions.

AVOID CONTACT OF THIS HERBICIDE WITH FOLIAGE, GREEN STEMS, EXPOSED NON-WOODY ROOTS OR FRUIT OF CROPS, DESIRABLE PLANTS AND TREES, EXCEPT AS DIRECTED FOR USE ON ROUNDUP READY® CROPS. AS SEVERE PLANT INJURY OR DESTRUCTION COULD RESULT.

THIS IS AN END-USE PRODUCT. ADVANTAGE COMPANY DOES NOT INTEND AND HAS NOT REGISTERED IT FOR REFORMULATION. SEE INDIVIDUAL CONTAINER LABEL FOR REFORMULATING LIMITATIONS.

Read the "LIMIT OF WARRANTY AND LIABILITY" statement at the end of the label before buying or using. If terms are not acceptable, return at once unopened.

Not all products in this line are registered for use in California. Check the registration status of each product in California before using.

1.0 INGREDIENTS

FIRST AID

IF IN EYES

- Hold eyes open and rinse slowly and gently with water for 15 to 20 minutes.
- Remove contact lenses, if present, after the first 5 minutes then continue rinsing eyes.
- Call a poison control center or doctor for treatment advice.

IF ON SKIN OR CLOTHING

- Take off contaminated clothing.
- Rinse skin immediately with plenty of water for 15 to 20 minutes.
- Call a poison control center or doctor for treatment advice.

DOMESTIC ANIMALS: This product is considered to be relatively nontoxic to dogs and other domestic animals; however, ingestion of this product or large amounts of freshly sprayed vegetation could result in temporary gastrointestinal irritation (vomiting, diarrhea, colic, etc.). If such symptoms are observed, provide the animal with plenty of fluids to prevent dehydration. Call a veterinarian if symptoms persist for more than 24 hours.

Personal Protective Equipment (PPE)

Some of the materials that are chemical-resistant to this product are listed below:

Suits, Liners, Other Handwear and Applicators, when handling this concentrated product or its application solutions of 30 percent concentration or greater, must wear long-sleeved shirt and long pants, socks and shoes, and chemical-resistant gloves made of any waterproof material, such as polyethylene or polyvinyl chloride.

Applicators, when handling only spray solutions where concentration is 30 percent of this product or less, must wear long-sleeved shirt and long pants, socks and shoes.

Follow manufacturer's instructions for cleaning/maintaining PPE (Personal Protective Equipment). If there are no instructions for washing/maintaining PPE, use detergent and hot water. Keep and wash PPE separately from other laundry.

When handling use closed systems, sealed tanks, or a system in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides (40 CFR 170.240 (d) (4-6)), the handler PPE requirements may be reduced or modified as specified in the WPS.

IMPORTANT: When reduced PPE is worn because a closed system is being used, handlers must be provided at PPE specified above for applicators and other handlers and have such PPE immediately available for use in an emergency, such as a spill or equipment breakdown.

User Safety

Users should:

- Wash hands well.
- Remove clothing.

3.2 Environmental

Do not apply directly to water.

GROUP 9 HERBICIDE

All herbicide labels include the product's mode of action Group number. Combine and rotate products with multiple effective modes of action to control resistant weeds and delay resistance development.



Identify Herbicide
Failure as Soon
as Possible

We have discussed situations that maximize herbicide performance and some of the factors that cause POST herbicides to fail. Everybody tries to maximize herbicide effectiveness and minimize trips through the field. Unfortunately, herbicide failures will still happen when applicators need to treat millions of soybean acres in a four- to six-week period.

It is critical to scout soybean fields following POST applications in a timely fashion to identify poor herbicide

performance. When to scout depends on the herbicide that was sprayed. For contact herbicides (such as Liberty® and Flexstar®), scout soybean fields as early as three to five days after applications because they act quickly. However, systemic herbicides (such as glyphosate and dicamba) act more slowly, so herbicide failure may not be evident for two to three weeks. This means you should begin scouting one week after applications and you should revisit fields at least once to confirm that herbicides are working.



This photo shows waterhemp plants seven days after a failed Liberty® application. Although all plants are severely injured, some stems are brown and collapsing while others are still green. Keep an eye on the green-stemmed weeds, because they can regrow. The difference between these two is subtle, yet detectable and very important.



(Left) This photo shows waterhemp three days after a glufosinate (Liberty®) application. The symptoms have not progressed enough to determine whether the application succeeded or failed. (Right) The same area seven days later reveals that many of the plants have died, but several others have begun to regrow.



This image shows a recovering plant and a dead one after a dicamba application. Numerous branches are emerging from the recovering plant even while it is still showing twisting and cupping symptoms.



This photo shows a plant that is recovering from a dicamba application. Injured plants can be more difficult to control even with a second POST application.

When you scout fields after applications, closely examine sprayed weeds and determine if they are showing herbicide injury symptoms, and then determine if they appear to be dying or if they appear to be producing new tissue. Each herbicide group has its own characteristic injury symptoms. The key to identifying herbicide failure is to look for signs of plant recovery even if you see injury symptoms. See the Symptoms and Signs of Herbicide Injury table (page 11) for guidance on when you should scout and the symptoms you should look for.



This photo shows waterhemp plants 10 days after a failed Flexstar® application. You can see some of the plants are dead while others are regrowing.



This single Palmer amaranth plant survived a glyphosate application. It is important to control these few remaining individuals, so they do not produce seed and populate the field with more resistant plants.



This Palmer amaranth survived a fomesafen application. The plants looked like they were controlled but regrew from the surviving meristems.



(Left) Palmer amaranth four days after a glyphosate application in the greenhouse and (right) seven days after application. Even after just four days, the resistant plant is noticeable in the group.

If you observe any new growth after applying contact herbicides (Groups 10 and 14), it likely means the plant will survive. Dead plants will have brown and desiccated stems. Use a knife to split the stems between active growing points to determine if the plant is dead or has the potential to regrow.

It is more difficult to evaluate regrowth potential with systemic herbicides, especially Group 4 (synthetic auxins) herbicides. If symptoms on injured weeds do not progress

for an entire week, then it is likely the application was unsuccessful. We suggest looking further down plant stems when you evaluate Group 4-treated plants. The tops of plants may not recover, but new growth from lower nodes often looks healthier and can indicate escaped plants.

The Symptoms and Signs of Herbicide Injury table provides the main herbicide mode of action groups used in soybeans, what symptoms to look for, when symptoms may be expected to develop, and signs of herbicide failure.

SYMPTOMS AND SIGNS OF HERBICIDE INJURY

Herbicide Mode of Action Group	Main Symptoms	Begin Field Scouting	Failure Is Evident By	Signs of Failure
Group 10 and Group 14 Liberty®, Flexstar®, others	Contact damage, rapid leaf burning	3 to 5 days after treatment	1 week after application	New and green growth from leaf nodes or the main growing point
Group 2 and Group 9 glyphosate, Pursuit®, Classic®, others	Plant stunting and yellowing	1 week after application	2-3 weeks after application	Return of healthy, green color; new growth from leaf nodes or main growing point
Group 4 2,4-D, dicamba	Leaf and stem twisting and curling	1 week after application	2-3 weeks after application	New growth, lack of symptom progression

A photograph of a vast field of yellow wildflowers, likely goldenrod, in full bloom. The field stretches towards a line of trees in the distance under a clear sky. A dark, textured rectangular box is overlaid on the middle of the image, containing the title text.

Respray Decision Making

The two most important factors that determine whether you should respray a field are:

1. The number of uncontrolled weeds
2. The cost of a second application

You should not only consider the potential financial return for preserving soybean yield, but also the benefits of reducing next year's weed seed bank. In practice, this means that respraying is the correct decision for any weed that has documented herbicide resistance, is difficult to control, and/or will produce enough seed to increase the cost of herbicide applications in future years.

Weeds specialize in producing seed under the most adverse conditions, including after herbicide applications. In general, the more a plant is injured, the fewer seeds it produces. If you consider that a single female waterhemp or Palmer amaranth plant can produce up to 500,000 seeds, then you can see how leaving a number of these weeds uncontrolled can significantly add to the weed seedbank in the soil. If those seed-producing weeds are also herbicide-resistant, then that population will be more abundant and more difficult to control in subsequent years. For this reason, troublesome weeds (such as Palmer amaranth and waterhemp) should prompt growers to take extra control measures that will minimize their seed production — not simply reduce competition.

QUESTIONS YOU SHOULD ASK

When follow-up herbicide treatments are warranted due to herbicide failures, it's important to consider your herbicide choice, proper herbicide rate, timing, and sprayer setup. Before you do anything, try to diagnose the reasons why the herbicide failed to control the weeds in the first place, so you do not repeat the same costly mistake twice. If the problem was the wrong nozzle, too low of carrier volume, wrong herbicide rate, wrong herbicide product, wrong adjuvant, adverse weather conditions, or the weeds were just too large, then correct those mistakes where possible or you can expect similar poor results.

After considering the cause of the problem, the next most important step is to thoroughly assess the current situation. Critical questions you should answer include:

- What is the current soybean growth stage?
- How large are the weeds?
- How much have weeds regrown?
- How many days have passed since the first application?
- What was sprayed on the first pass?

After answering these questions, secondary questions will arise.

- What herbicides will provide the level of control needed for this particular field? Your respray options need to be effective this time, because the weeds are now larger and possibly damaged.
- Is it possible I can do more harm to the soybean crop — by driving through the closed canopy or spraying during the crop's reproductive growth phases — than what I will gain by controlling the weeds?
- Are these weeds small enough to get good coverage?
- Will the respray herbicide interfere with my crop rotation?

Be prepared for the possibility that another herbicide pass cannot adequately solve this problem. Perhaps hand weeding, some other mechanical intervention, destroying the crop (or a section of it), or doing nothing will be the best option.

Weeds that are greater than 12 inches tall will be very difficult to control on either the first or the second pass. If you missed the opportunity to spray at the optimal time, you may consider a planned respray application to achieve adequate control. However, there is a point when it becomes too late to apply herbicides, especially after weeds reach flowering stages. Several studies have shown that "revenge spraying" is ineffective for both weed control and yield protection and that it is only moderately effective at reducing seed production.

WHAT DO THE LABELS SAY ABOUT RESPRAY APPLICATIONS?

All POST herbicides have a preharvest interval (PHI) and/or a soybean growth stage restriction. These restrictions are in place to reduce potential crop damage, limit carryover to rotational crops, and prevent pesticide residue in the seed at harvest. Many herbicide labels limit applications up to early reproductive stages — such as the initiation of flowering (R1) or full bloom (R2). As a result, herbicide respray options are very limited after these stages.

Most herbicide labels offer limited guidance for the correct timing for resprays. For instance, one label states that you can make a second application 14 days after the first application, but the label implies that timing is more about minimizing soybean injury than it is about maximizing efficacy on weeds. In general, we should emphasize that the respray intervals listed on most labels are often more about preventing crop injury than maximizing weed control.

Beyond growth stage limitations, product labels can limit the number of herbicide applications and the total amount of active ingredient you can apply per acre per year (or growing season). These restrictions may further limit respray and rescue treatment options.

APPLICATION RESTRICTIONS FOR SELECTED HERBICIDES

Herbicide	Soybean Growth Stage Cutoff	Calendar Date Cutoff or Pre-harvest Interval (PHI) Cutoff	Herbicide Rate or Number of Applications
Liberty®	Bloom or R1 growth stage	70-day PHI	3 applications or 87 fl oz/A
Flexstar®	—	45-day PHI 10-month rotation to corn	1.3 pt/A or 1.6 pt/A, depending on the region
Cobra®	Do not apply after R6 (full seed)	45-day PHI	25 fl oz/A per season
Engenia®	—	Do not apply later than June 20 in Indiana. Other state policies may differ.	Up to 2 postemergence applications. Allow at least 7 days between applications. Do not apply more than a maximum cumulative total of 25.6 fl oz/A postemergence.
Xtendimax®	Bloom or R1 growth stage	Do not apply later than June 20 in Indiana. Other state policies may differ.	Limit of 2 in-crop applications. Total of all applications may not exceed 44 fl oz/A.
Enlist One®	Through the R1 growth stage (before R2)	30-day PHI	No more than 2 postemergence applications per season. No more than 6 pt/A per season. Do not apply more than 2 pts per acre per application.

WHAT DOES THE RESEARCH SAY?

Insufficient research accurately describes the timing of resprays, or what the optimum product choices are for given herbicide failure situations. This presented an opportunity for Purdue weed scientists to conduct field and greenhouse experiments to provide some guidance.

The researchers simulated herbicide failures by applying reduced herbicide rates of Flexstar®, Liberty®, 2,4-D (Enlist One®), or dicamba (Engenia®) to 12-inch waterhemp, Palmer amaranth, and giant ragweed in the field. Of course, these methods would not be acceptable for commercial application and were used to create an artificial failure around 50 percent overall weed control.

The researchers identified subsequent herbicide respray treatments based on the most commonly used products and herbicide groups used for postemergence applications

in soybeans: Liberty®, Flexstar®, Enlist One®, Engenia®, and Cobra®. Each herbicide was applied with appropriate adjuvants at different intervals following the initial application.

After initial treatment with Liberty® or Flexstar®, respray intervals included three (early), seven (middle), and 11 (late) days.

After initial treatment with dicamba or 2,4-D, respray intervals included seven (early), 14 (middle), and 21 (late) days.

The respray intervals roughly corresponded to a respray during the period when efficacy was uncertain and regrowth was not evident (early), a respray following the first signs of regrowth (middle), and a respray after substantial regrowth (late).



This photo shows weeds that were initially treated with Flexstar® (which failed), and then resprayed with Liberty®. The respray provided high levels of control. Notice the center area where nearly all the surviving waterhemp plants have been controlled.



This photo shows Palmer amaranth plants that were initially treated with dicamba (which failed), and then resprayed with dicamba again 21 days after the initial application. Notice numerous weeds survived the second application.



This photo shows Palmer amaranth plants that were initially treated with dicamba (which failed), and then resprayed with Liberty® seven days after the initial application. The second application provided excellent control of surviving weeds.

FINDINGS AND RECOMMENDATIONS FROM THE FIELD STUDIES

Initial Herbicide	Respray Herbicide	Respray Efficacy
Liberty®	Liberty®	Excellent
	Flexstar®	Excellent
	Cobra®	Fair
	Enlist One®	Good
	Engenia®	Fair
Flexstar®	Liberty®	Excellent
	Flexstar®*	Fair
	Cobra®	Poor
	Enlist One®	Good
	Engenia®	Fair
Enlist One®	Liberty®	Excellent
	Flexstar®	Excellent
	Enlist One®	Excellent
	Engenia®*	Good
Engenia®	Liberty®	Excellent
	Flexstar®	Good
	Enlist One®	Good
	Engenia®	Poor

* This sequential herbicide combination is off-label and is not a recommendation. Be sure to consult all label directions and restrictions before making a respray herbicide applications.

Herbicide

Purdue Weed Science researchers found that Liberty® resprays were the most effective following initial herbicide failure with Liberty® or Flexstar®. Cobra® is often the only option for respray applications to soybeans because labels limit the use of other herbicides. Unfortunately, Cobra® was the least effective and least consistent of all the herbicides tested. Flexstar®, Engenia®, and Enlist One® provided fair or good weed control after a respray in most situations. following failed applications of dicamba or 2,4-D, Flexstar® and Liberty® provided better weed control than Xtendimax® or Enlist One®.

Purdue Weed Science researchers rated respray products on Palmer amaranth and waterhemp. They derived the rankings from a combination of both experimental data and best management practices.

In general, Liberty® was the best respray herbicide regardless of initial herbicide, but we recommend against sequential applications of Liberty® both to manage herbicide resistance and the fact that Flexstar® can also provide good to excellent control of surviving weeds.

If Liberty® is not a viable option, use Flexstar® if soybean growth stage and calendar date restrictions allow (avoid applications within 10 months of planting corn to reduce Flexstar® carryover concerns). If Flexstar® is not a viable option, use 2,4-D or dicamba for resprays if allowed by soybean traits, calendar dates (do not apply dicamba after June 20 in Indiana), and growth stage (do not apply at or after R1).

Does Initial Damage Affect Respray Success?

Purdue Weed Science researchers conducted greenhouse experiments to evaluate whether the level of initial plant injury from herbicide applications affected respray success.

Researchers used Liberty® as the first spray at different rates on waterhemp and the weeds were allowed to regrow. They then made respray applications with different herbicides including Liberty®, 2,4-D, dicamba, Cobra® and Flexstar®. Regardless of the respray herbicide used, the more injured the plants, the better the results from resprays.

Therefore, there is a better chance to control weeds with a respray in cases when the weeds are very injured but still growing, than when the weeds are barely injured and begin regrowth quickly after the initial application.



Purdue Weed Science Respray Rankings

You can apply Cobra® as a last resort for respray if trait technology is a limiting factor. In many circumstances, Cobra® will be the only option because its label has the fewest restrictions concerning soybean growth stage, calendar date, and rotations. Despite its flexibility, Cobra® respray treatments only had moderate or poor results on large pigweed species. There is a point where the trouble of respraying may not be worth the added weed control, but users must decide that on a case-by-case basis.

Ultra Blazer® is another PPO inhibitor that has similar flexibility as Cobra®. We did not include it in our experiments, but in our experience, it performs similarly to Cobra® on waterhemp and Palmer amaranth.

While the results for Palmer amaranth and waterhemp indicate that repeated applications of the same herbicide can provide good weed control in soybeans (especially Liberty®) be aware that this action directly contradicts best weed management practices that aim to delay resistance evolution. Repeat applications of the same herbicide increases the risk of selecting for herbicide-resistant weeds, especially when dealing with species such as Palmer amaranth or waterhemp. That risk should be an important factor when choosing a respray product to use.

Based on Purdue Weed Science field and greenhouse testing, these are our ranked recommendations for respray products. These recommendations are for weeds after an initial herbicide failure in soybeans.

Be sure to consult *all* label directions before applying any herbicides. Pay careful attention to restrictions for the number of applications per year, soybean growth stage, calendar dates, crop rotations, and amount of product per acre.

Herbicide recommendations following Liberty® failure:

1. Flexstar®
2. Liberty®
3. 2,4-D or dicamba
4. Cobra®

Herbicide recommendations following Flexstar® or Cobra® failure:

1. Liberty®
2. 2,4-D or dicamba
3. Flexstar® or Cobra® (opposite of initial herbicide)

Herbicide recommendations following 2,4-D or dicamba failure:

1. Liberty®
2. Flexstar®
3. Cobra®
4. 2,4-D or dicamba

These photos show examples of plants just before a respray herbicide application. Plants with more injury (from left) are more easy to control than plants with less injury. The first application often determines how effective the second application will be.



Timing

Optimal timing for resprays varies by product.

Following failed applications of dicamba and 2,4-D (systemic, auxin herbicides), researchers observed that intervals of seven to 14 days were more effective than resprays made 21 days after the initial failed application.

Following failed applications of non-systemic herbicides (including Flexstar® and Liberty®), researchers observed that intervals of three days resulted in poor performance in certain cases. For contact herbicides, maximum weed control was achieved when weeds were resprayed seven to 11 days after the initial application for contact herbicides. During this period, researchers observed new buds or leaves and as much as 1 to 2 inches of new growth. This is the ideal trigger for a respray since plant response to stress can be variable.

We recommend resprays based on plant appearance rather than the calendar date, because the optimal amount of regrowth can vary by a few days depending on conditions. This is why field scouting is so important to observe the progression of weed control. In the future, remote sensing such as drones, may play a role in assessing herbicide performance and helping growers decide what, if any, tactics they should implement to manage escaped weeds.



This photo shows a field with waterhemp 11 days after a failed Liberty® application. The regrowth is evident, but still manageable.



This photo shows a giant ragweed plant that is beginning to regrow. This is the ideal stage to respray.






This waterhemp plant has regrown excessively after a failed herbicide application. It may be too late to make an effective respray application to control plants of this size in a field.

RESPRAY TIMING RECOMMENDATIONS¹

Herbicide Failure	Days After Failed Application																			
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
Liberty®	Yellow	Yellow	Yellow	Yellow	Green	Green	Green	Green	Green	Yellow	Yellow	Yellow	Red	Red	Red	Red	Red	Red	Red	
Flexstar®	Yellow	Yellow	Yellow	Yellow	Green	Green	Green	Green	Green	Yellow	Yellow	Yellow	Red	Red	Red	Red	Red	Red	Red	
Enlist One®	Red	Red	Red	Yellow	Green	Green	Green	Green	Green	Green	Green	Green	Yellow	Yellow	Yellow	Yellow	Red	Red	Red	
Engenia® or Xtendimax®	Red	Red	Red	Yellow	Green	Green	Green	Green	Green	Green	Green	Green	Yellow	Yellow	Yellow	Yellow	Red	Red	Red	

¹ This table does not provide specific control values because every respray situation is unique. Specific results will depend on weed size, species, and environmental conditions. As weeds get larger, expect less weed control even with optimal spray timing and conditions.

	= Complete or high levels of control
	= Mediocre or inconsistent control
	= Diminished control





Conclusions

Applicators can influence how well herbicide programs work, so it is critical to take as much care as possible when making the initial POST herbicide application in soybean. As we've learned, the options for resprays can be limited.

Follow these guidelines when you make initial postemergence herbicide applications:

- Focus your attention on putting on the right herbicide, at the right rate, applied to weeds less than 4 inches tall to deal with the weed complex in your soybean field.
- Resist the temptation to wait and "let all the weeds emerge." If you do, it will mean that the weeds that emerged first will be too large to control effectively.
- Pay attention to the most problematic weeds that are known to be herbicide resistant or difficult to control. These weeds should drive herbicide application decisions.

There are many factors that may cause foliar herbicide applications to fail. Follow these guidelines when deciding whether to respray in soybean:

- Scout fields to inspect herbicide activity and signs of weed recovery.
- Determine whether the weed pressure or weed seed production of the surviving weeds are enough to justify the additional expense of additional herbicide applications or if there are opportunities to implement other weed control tactics.
- Read herbicide labels and ask your county extension educator, agricultural retailer, herbicide manufacturer, or seed dealer about the potential damage from a respray to soybean yields.
- Understand and consider all label restrictions before respray applications to avoid carryover, crop injury, off-target movement, and label violations.
- Use herbicide group numbers (modes of action) that are different than the group number used for initial applications if they will be equally effective.
- Choose herbicides carefully. In short, Liberty® is currently the best option for resprays in most circumstances. However, resistance management considerations make Flexstar® the best choice for resprays when Liberty® fails. However, you cannot apply Liberty® as soon as the first soybean flowers are observed (up to, but not including the R1 growth stage).
- As a rule of thumb, respray weeds seven to 14 days after the first application (see the Respray Timing Recommendations table, page 19).

If herbicide options do not exist for controlling the remaining weeds in your field, then follow these guidelines for your future weed control program:

- Use the full rate of preemergence herbicides that have multiple effective modes of action.
- Use complementary tank mixes of postemergence herbicides to improve weed control consistency.
- Combine an overlapping residual with the postemergence herbicide application to prevent any late-emerging weeds.
- Consider planting cover crops or using other integrated weed management approaches to help suppress weeds.
- Rotate to field corn to utilize different herbicides that have other modes of action, such as atrazine and Group 27 herbicides (HPPD's).
- Harvest weed-infested areas last and clean the combine thoroughly before leaving the infested fields.

Effective weed management requires proactive approaches that involve many complex decisions requiring multiple considerations. In order to make effective respray applications in soybean after initial applications fail, you must have the right product combination and timing. Timely field scouting, considering costs, understanding viable control tactics, and setting long-term weed management goals are important steps that help you develop a sustainable approach to tackling problematic weeds.





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