

Optimizing Post Respray Applications After Herbicide Failure

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What Causes Herbicide Failure?

Herbicides are often applied under less than ideal conditions

- Weeds
 - Too big
 - Resistance
 - Antagonism
- Conditions
 - Drought
 - Rain after application
- Applicator
 - Malfunctioning or poorly calibrated sprayers
 - Mixing errors like wrong rate or adjuvant.

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Now what can I do?

Do I spray as soon as I notice something is wrong or do I let the injured weeds regrow to get coverage?

Which herbicide should I use and why?

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Today's Talk

- Herbicide failure and what can cause it
- Characteristics of a successful herbicide application
- Identifying herbicide failure as soon as possible
- What to do about herbicide failure (spray it again)
- Recommendations for respray applications

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Successful Herbicide Applications



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Successful Herbicide Applications

- Effective herbicide
- Correct rate
- Optimum adjuvants
- Proper timing
- Calibrated equipment
- Good environmental conditions



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Rate and Adjuvants

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.

Excerpt from Flexstar® label

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.

- Labels are designed to maximize herbicide effectiveness
- Consider tradeoffs of crop response and weed control
- Higher rates lead to greater weed control
- Use a PRE herbicide

Excerpt from Liberty® label

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Mixing and Calibration

- Carrier Volume
- Droplet size
- Coverage



Photo: United Soybean Board



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Proper Herbicide Timing



One
Week
Later



- Weeds grow rapidly
- 4 inches is max height on many labels
- Do not delay POST app in order to “get them all”

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Proper Herbicide Timing

PURDUE
EXTENSION

Travis Legleiter
Weed Science Program Specialist
Bill Johnson
Professor of Weed Science
June 8, 2015

Giant Ragweed Should be a Driver Weed For Many Indiana Farmers

- ALS-resistant giant ragweed is very difficult to control PRE in soybean
- Often 6-12 inches by the time waterhemp is ready to spray



A 6-inch tall giant ragweed in a corn field with multiple grass species ranging from 1-2 inches in height.

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Environmental Conditions

Good for herbicide activity:

- High humidity
- Moderate temperature
- Soil moisture

Bad for herbicide activity:

- Exceptionally high temperature
- Drought
- Rainfall within 4 hours



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Identifying Herbicide Failure

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Identify Failure as Soon As Possible

- 5.6 million acres need sprayed in 4-6 weeks - There will be herbicide failures
- Success of a respray herbicide is dependent on identifying lack of control as soon as possible
- Diligent scouting is critical

Treat herbicide failure that looks like this



So that you don't have to deal with this

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What does it look like?



Regrowth after dicamba application

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What does it look like?



Regrowth after Flexstar application

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What does it look like?



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What does it look like?



- Herbicide failure can be difficult to spot early on
- Get out of the truck when you scout fields

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Herbicide Failure Looks Different for Each Group

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

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Liberty Regrowth



- Waterhemp 3 days after a Liberty® application.
- Symptoms have not progressed enough to determine success or failure.



- The same area 7 days later.
- Many of the plants have died, but others have begun to regrow.

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Glyphosate



Photo: Larry Steckel, University of Tennessee

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Glyphosate



- Palmer amaranth 4 (left) and 7 (right) days after glyphosate application in the greenhouse.
- Even at just 4 days after application, the resistant plant is noticeable in the group

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Glyphosate



- Palmer amaranth 4 (left) and 7 (right) days after glyphosate application in the greenhouse.
- Even at just 4 days after application, the resistant plant is noticeable in the group

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PPO-Inhibitor



- Palmer amaranth that survived a fomesafen application.
- These plants looked like they were controlled, but regrew from the surviving meristems.

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2,4-D or Dicamba



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Respray Decision Making

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Respray Decision Making

Fully Assess the situation

- Crop growth stage?
- Weed size?
- How much regrowth?
- How many days since the last application?
- What was sprayed on the first pass?
- What caused the initial herbicide to fail?

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Respray Decision Making

Secondary Questions

- What herbicides will provide the control needed for this field?
- Is it possible to do more harm than good?
- Are these weeds small enough to control?
- Will this respray interfere with my crop rotation?

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Respray Decision Making

Another herbicide application may not be the best option

- Hand weeding or other mechanical practice
- Crop destruction
- Weeds greater than 12 inches will be very difficult to control
- Planned sequential applications can be effective
- Revenge spraying does not work for weed control and only moderately reduces seed production

Try to alleviate or work around the initial failure.

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Fixing the Cause of Failure

- Best case scenario is they were slightly too big or the application was not optimized
 - Check sprayer function and mixing records
 - Make a good respray app
- Often there is no immediate fix
 - Drought
 - Herbicide resistance
 - There several herbicide options (for now)

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Consult the Herbicide Labels

- Options become very limited after soybean reproductive stages
- Cobra® and Blazer® are the only options for later reproductive stages
- Consider calendar date restrictions and number of applications per year

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Application Restrictions

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.

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The Research

- Research about resprays and sequential POST applications is lacking
- Field and greenhouse trials under adequate water conditions
- Sprayed reduced rate of Liberty®, Flexstar®, Enlist One®, and Engenia®.
 - Respray at different timings
 - Respray with different herbicides

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Flexstar® Resprayed with Liberty®



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Engenia® Resprayed with Engenia®



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Engenia® Resprayed with Liberty®



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Field Trial Results

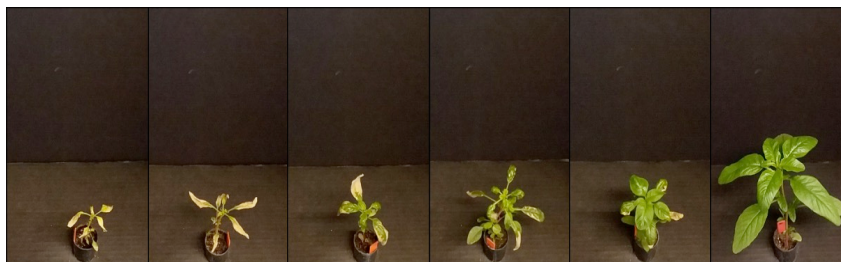
Initial Herbicide	Respray Herbicide	Respray Efficacy
Liberty®	Liberty®	Excellent
	Flexstar®	Excellent
	Cobra®	Fair
	Enlist One®	Good
	Engenia®	Fair
Flexstar®	Liberty®	Excellent
	Flexstar**	Fair
	Cobra®	Poor
	Enlist One®	Good
	Engenia®	Fair
Enlist One®	Liberty®	Excellent
	Flexstar®	Excellent
	Enlist One®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

-This is species and resistance dependent

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How Does the Amount of Regrowth Effect Respray Efficacy?



- Example plants just before respray herbicide application.
- Is coverage an issue?
- Greater control from the first application means that resprays are more likely to be effective

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Purdue Respray Recommendations

Herbicide recommendations following each herbicide failure scenario		
Liberty®	Flexstar® or Cobra®	2,4-D or Dicamba
<ol style="list-style-type: none"> 1. Flexstar® 2. Liberty® 3. 2,4-D or dicamba 4. Cobra® 	<ol style="list-style-type: none"> 1. Liberty® 2. 2,4-D or dicamba 3. Flexstar® or Cobra® (opposite of initial herbicide) 	<ol style="list-style-type: none"> 1. Liberty® 2. Flexstar® 3. Cobra® 4. 2,4-D or dicamba

Respray recommendations after initial herbicide failure in soybeans. Numbers indicate our rank of the potential options based on field and greenhouse studies¹.

¹ Be sure to consult ALL label directions before making a herbicide application, including number of applications per year, soybean growth stage, calendar date, crop rotations, and pounds per acre restrictions.

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Tank Mix Combinations

- Tank Mix combinations can enhance weed control
 - Liberty® + Flexstar®
 - Liberty® + Enlist One®
- Many combinations are antagonistic
 - Dicamba + Liberty®
 - Drift reduction requirements compromise Liberty® applications
 - Glyphosate + Liberty®
 - Formulation incompatibility

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Respray Timing



- Waterhemp 7 days after Liberty® application.
- At first glance, weed control may look good.
- These plants are not dead as indicated by some remaining leaves and dormant buds that are beginning to break

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Respray Timing



- Giant ragweed plant that is beginning to regrow.
- Ideal stage to make a respray application



- Excessive regrowth after a failed herbicide application.
- This is too late to make an effective respray application

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Respray Timing Recommendations

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	Green	Yellow	Yellow	Yellow	Red	Red	Red	Red	Red	Red	Red	
Flexstar®	Yellow	Yellow	Yellow	Yellow	Green	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	Yellow	Yellow	Yellow	Yellow	
Engenia® or Xtendimax®	Red	Red	Red	Yellow	Green	Green	Green	Green	Green	Green	Green	Green	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	

* 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

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Special cases?

- Our research was done under well watered conditions on 12 inch weeds
- Recommendations are based on Palmer and waterhemp
 - Giant ragweed - Use 2,4-D or Dicamba
 - Summer annual marestail - Use Liberty®
- Drought
 - Wait for a rain (within reason)
 - Consider saving your money
 - Free respray applications should adhere to recommendations
- Resistance
 - Use a different respray herbicide in all cases where you suspect resistance
 - Be on the lookout for Liberty® resistance
 - PPO-resistance is very common and evolving

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Special cases?

- Purdue has identified several PPO resistant waterhemp populations
 - They do not have previously characterized resistance mechanism
 - Better able to regrow and recover
- Unclear if this transfers to other herbicides
- Difficult to decide if this is resistance or just herbicide failure
- According to our previous research, the “regrowth-type” plants should be easier to control because of the increased severity of injury.

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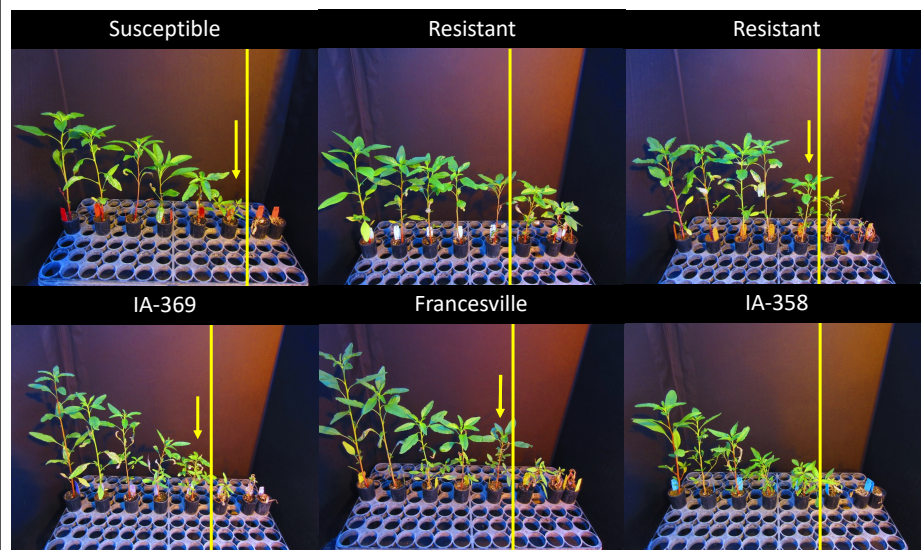
New PPO-resistance in Waterhemp

Flexstar® - 24 hours after treatment



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Conclusions

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Conclusions

- Make good herbicide applications the first time around
- Spray when the biggest weeds need sprayed
- Make decisions based on the hardest weeds to control

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Conclusions

- Scout fields early and often to look for signs of recovery
- Evaluate weed competition and potential seed production to see if it justifies spraying again
- Consult herbicide labels, retailers, extension agents and other resources for possible respray options
- Use different Mode of action group numbers when possible
- Herbicide options become limited quickly after reproductive stages
- Have realistic expectations

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Conclusions

- Liberty is the best respray herbicide in most situations
- Do not respray Liberty® followed by Liberty® if possible
- Respray 7-14 days after the first application for best results

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Final Thoughts

- Effective weed management requires proactive approaches and many complex decisions
- Respray decisions are no different
- Strive to achieve sustainable approaches
 - Timely scouting
 - Considering costs
 - Understanding viable control options
 - Setting long term goals