Weed Management Programs for Mississippi Soybean Production
Mississippi Soybean Promotion Board Project 20-2019 Annual Report
Jason A. Bond (jbond@drec.msstate.edu)

Background and Objectives:

Glyphosate-resistant Palmer amaranth is the most troublesome weed in Mississippi soybean. Palmer amaranth competes for nutrients, water, light, and space because of its rapid, upright growth habit and allelopathic properties. Barnyardgrass is one of the more problematic weeds in U.S. soybean production. Recently, Mississippi and Tennessee became the first states to confirm GR barnyardgrass. Mixing herbicides representing different modes of action provides the potential for increased weed control and a reduction in application costs. However, some components of herbicide mixtures can synergize or antagonize others. It is important to identify effective programs for broad-spectrum weed control in these technologies. Recommendations for weed control in Mississippi soybean will originate from this research.

Manipulation of row spacing to supplement weed control has been well documented. When only considering weed control, soybean planted with a grain drill in rows spaced 6 to 10 inches apart has been shown to be optimal. However, agronomic research indicates drilled soybean often do not perform to the level of soybean planted with a precision planter in wide row configurations of ≥30 inches.

Planting multiple rows (>2) on a raised bed with a grain drill has not been accepted in Mississippi; however, a twin row configuration on a raised bed is used extensively. There is growing interest among Mississippi growers in transitioning to a bedded system where the beds are 60 to 80 inches wide. Currently, if the wider bed configuration is utilized, soybean are planted with a twin-row planter. Although irrigation could possibly be improved, a system such as this does not enhance weed control because the "twin rows" are planted on the same spacing as used when beds are 30 to 40 inches.

OBJECTIVE(S):

1. Evaluate new and/or currently registered herbicides and herbicide-resistant technologies for positioning into Mississippi weed management programs.
2. Refine soybean production practices by (a) characterizing the agronomic benefits of combining the Roundup Ready 2 Xtend System with narrow row spacing on a raised, wide bed in irrigated soybean, and (b) defining herbicide programs that optimize GR Palmer amaranth control when Roundup Ready 2 Xtend soybean are grown in a raised, wide bed system.
3. Strengthen suggestions for control of grass weed species by (a) identifying reasons for poor grass control in current soybean herbicide programs, and (b) designing grass control strategies that fit into current herbicide programs in Mississippi soybean.

Report of Progress/Activity:

Objective 1 – 2019

Thirteen studies were conducted at the Delta Research and Extension Center in 2019 to evaluate new and/or currently registered herbicides and herbicide-resistant soybean technologies for positioning into Mississippi weed management programs. Unfortunately, many of these studies focused on the efficacy of pre-mixes of currently registered herbicides or generic formulations of commercial herbicides. Use of Engenia, Xtendimax with VaporGrip, FeXapan with VaporGrip, or Tavium with VaporGrip (dicamba plus *s*-metolachlor) continue to be evaluated in Roundup Ready 2 Xtend soybean. Additionally, weed control with Enlist Duo (glyphosate plus 2,4-D choline) and Enlist One (2,4-D choline) in E3 soybean are a focus area.

Research has been conducted annually since 2010 at different sites in the Mississippi Delta to evaluate weed control programs in the Roundup Ready Xtend weed control system, which was developed by Bayer Crop Science (formerly Monsanto Company). The Enlist (E3) weed control system, which was developed by Corteva Agrisciences (formerly Dow Agrosciences), has been evaluated at the Delta Research and Extension Center; however, this system has not been studied as thoroughly as the Roundup Ready Xtend weed control system. Furthermore, most previous research with these systems focused on herbicide programs for each technology. However, little work has been done comparing weed control between the two systems.

One study evaluated weed control with herbicide programs containing PRE and POST applications in E3 weed control system. Trivence (Valor EZ plus TriCor plus Classic) was applied PRE to all plots. Postemergence treatments included mixtures with Enlist Duo, Enlist One, or Liberty 280 SL. Trivence controlled barnyardgrass and Palmer amaranth ≥ 96% 3 wk after PRE treatment (Table 1). By 4 wk after POST treatment, barnyardgrass control was 75 to 91% in all plots receiving a POST treatment. For comparison, Trivence controlled barnyardgrass 60% at the same evaluation. Palmer amaranth control was ≥ 90% at 4 wk after POST treatment with all programs containing a POST treatment. Although differences in soybean yield were detected, yields were ≥ 67 bushels/A following herbicide programs containing PRE and POST applications. No explanation for the differences in soybean yield was evident.

Postemergence treatments included one to three herbicide modes of action (Table 1). Although no differences among POST treatments were detected for barnyardgrass or Palmer amaranth control, this does not mean that multiple effective modes of action should not be utilized in POST treatments. The lack of differences among treatments at POST evaluation intervals appeared to be due to the excellent control with Trivence PRE. Weed size and density was low at time of POST treatment, and this led to excellent control with the herbicide programs evaluated in this study.

Table 1. Weed control with herbicide programs containing PRE and POST applications in E3 weed control system at Stoneville, MS, in 2019.

	Treatment	Rate	Rate Unit	Timing	Barnyardgrass control (%)		Palmer amaranth control (%)		Yield (BU/A)
					3 wk after PRE	4 wk after POST	3 wk after PRE	4 wk after POST	
1	Nontreated				0 c	0 c	0 B	0 c	44 c
2	Valor EZ	2.14	FL OZ/A	PRE	98 a	60 b	98 A	53 b	60 b
	TriCor 4F	4.75	FL OZ/A	PRE					
	Classic	1.28	OZ WT/A	PRE					
3	Valor EZ	2.14	FL OZ/A	PRE	97 ab	80 a	98 A	92 a	77 a
	TriCor 4F	4.75	FL OZ/A	PRE					
	Classic	1.28	OZ WT/A	PRE					
	Enlist Duo	75	FL OZ/A	V3 GLYMA					
4	Valor EZ	2.14	FL OZ/A	PRE	97 ab	88 a	98 A	97 a	78 a
	TriCor 4F	4.75	FL OZ/A	PRE					
	Classic	1.28	OZ WT/A	PRE					
	Enlist One	32	FL OZ/A	V3 GLYMA					
	Liberty 280 SL	29	FL OZ/A	V3 GLYMA					
5	Valor EZ	2.14	FL OZ/A	PRE	98 a	75 a	98 A	90 a	67 b
	TriCor 4F	4.75	FL OZ/A	PRE					
	Classic	1.28	OZ WT/A	PRE					
	Liberty 280 SL	29	FL OZ/A	V3 GLYMA					
6	Valor EZ	2.14	FL OZ/A	PRE	97 ab	85 a	98 a	97 a	67 b
	TriCor 4F	4.75	FL OZ/A	PRE					
	Classic	1.28	OZ WT/A	PRE					
	Enlist Duo	75	FL OZ/A	V3 GLYMA					
	EverpreX	1	PT/A	V3 GLYMA					
7	Valor EZ	2.14	FL OZ/A	PRE	96 b	83 a	98 a	97 a	79 a
	TriCor 4F	4.75	FL OZ/A	PRE					
	Classic	1.28	OZ WT/A	PRE					
	Liberty 280 SL	29	FL OZ/A	V3 GLYMA					
	EverpreX	1	PT/A	V3 GLYMA					
	Enlist One	32	FL OZ/A	V3 GLYMA					
8	Valor EZ	2.14	FL OZ/A	PRE	98 a	91 a	98 a	96 a	78 a
	TriCor 4F	4.75	FL OZ/A	PRE					
	Classic	1.28	OZ WT/A	PRE					
	Enlist One	32	FL OZ/A	V3 GLYMA					
	Liberty 280 SL	29	FL OZ/A	V3 GLYMA					
	Prefix	2	PT/A	V3 GLYMA					

Mixtures of Valor EZ plus TriCor 4F plus Classic represent Trivence.

Means followed by same letter or symbol do not significantly differ (P=.05, Duncan's New MRT).

Another study compared Palmer amaranth control with different PRE and POST herbicide applications including Engenia, Enlist One, and Liberty 280 SL. Engenia and Enlist One both exhibit some level of residual weed control, and evidence of this is the preplant interval requirements for dicamba and 2,4-D prior to soybean planting. However, at 4 wk after PRE application, Palmer amaranth control with Engenia and Enlist One was <40% (Table 2). Engenia PRO and Engenia plus TriCor controlled Palmer amaranth 90% at the same evaluation. Treatments containing Outlook controlled Palmer amaranth < 70% 4 wk after treatment. The lower Palmer amaranth control with Outlook-based treatment demonstrates that utilizing only a Group 15 herbicide as a PRE treatment does not provide adequate control of Palmer amaranth. This practice should be avoided.

By 1 wk after POST application, no PRE treatment controlled Palmer amaranth >65% (Table 2). At the same evaluation, treatments with Liberty 280 SL controlled more Palmer amaranth than Engenia or Enlist One. Engenia and Liberty 280 SL plus Reflex provided similar control 3 wk after treatment. Problematically, no treatment controlled Palmer amaranth >75%. However, this study was conducted with no crop and only single herbicide applications. Utilized in crop as components of a comprehensive herbicide program, control would have likely been much better.

Table 2. Palmer amaranth control with Engenia, Enlist One, and Liberty 280 SL at different timings at Stoneville, MS, in 2019.

					Palmer amaranth control (%)		
					4 wk after PRE	1 wk after POST	3 wk after POST
	Treatment	Rate	Rate Unit	Timing			
1	Nontreated				0 e	0 h	0 e
2	Engenia	12.8	FL OZ/A	PRE	39 d	13 fg	6 d
3	Enlist One	32	FL OZ/A	PRE	38 d	6 gh	6 d
4	Engenia PRO	16	FL OZ/A	PRE	90 a	63 c	10 d
5	Engenia	12.8	FL OZ/A	6-IN AMAPA	-	54 c	74 a
	Activator 90	4.8	FL OZ/A	6-IN AMAPA			
6	Enlist One	32	FL OZ/A	6-IN AMAPA	-	55 c	66 bc
	Activator 90	3	PT/A	6-IN AMAPA			
7	Liberty 280 SL	32	FL OZ/A	6-IN AMAPA	-	75 b	64 c
	Class Act NG	3	PT/A	6-IN AMAPA			
8	Liberty 280 SL	32	FL OZ/A	6-IN AMAPA	-	85 a	70 ab
	Reflex	16	FL OZ/A	6-IN AMAPA			
	Class Act NG	3	PT/A	6-IN AMAPA			
9	Engenia PRO	16	FL OZ/A	PRE	90 a	60 c	8 d
	TriCor 4F	12	FL OZ/A	PRE			
10	Outlook	12.8	FL OZ/A	PRE	53 c	15 ef	5 de
11	Engenia	12.8	FL OZ/A	PRE	69 b	25 d	5 de
	Outlook	12.8	FL OZ/A	PRE			
12	Enlist One	32	FL OZ/A	PRE	69 b	21 de	5 de
	Outlook	12.8	FL OZ/A	PRE			

Means followed by same letter or symbol do not significantly differ (P=.05, Duncan's New MRT).

Objective 2 – 2019

One study evaluated the effects of row configuration on soybean growth and development. The experimental design was a split-plot design with four replications. Whole plots were soybean row configuration and included single-, twin-, and triple-row configurations. Narrow rows for this study were characterized by 8-inch spaced twin row and triple-row configurations, as well as a single-row control planted on a 40-inch raised bed. Sub-plots were seeding rates and included 80,000 and 150,000 seed/A, and a 130,000 seed/ single row commercial standard. All plots were treated with Command plus Boundary the day of planting.

Canopy width was greater for soybean in triple-row configuration seeded at 150,000 seed/A compared with the commercial standard single-row configuration seeded at 130,000 seed/A (Table 3). No differences were detected among other treatments for canopy width at growth stage R3. Although no differences in soybean yield were detected, soybean in the twin-row configuration seeded at 150,000 seed/A produced the greatest numerical yield (59.6 bushels/A).

A second study was conducted in Stoneville, MS, in 2019 to determine the influence of duration of competition from Palmer amaranth with soybean planted in different row configurations. The experimental design was a split-plot and four replications. Whole plots were soybean row configuration and included single- and triple-row configurations. Sub-plots were application timings for POST herbicide treatments and included PRE, 7, 14, 21, 28, 35, and 42 d after emergence (DAE). The PRE application was Boundary at 1.5 pt/A and the POST applications consisted of Xtendimax with VaporGrip at 22 fl oz/A plus Roundup PowerMax at 28.4 fl oz/A plus Warrant at 3 pt/A. Each initial POST herbicide application was followed by a sequential application 10 to 14 d after the initial application. Sequential applications did not include Warrant. All plots were sprayed on 10- to 14-d intervals after both prescribed POST applications were made until those individual plots reached ≥ 95% control of Palmer amaranth.

Table 3. Canopy width at R3 and yield in soybean grown with different row configurations and seeding rates at Stoneville, MS, in 2019. .

Row Configuration	Seeding rate	Canopy width	Yield
	Seed/A	cm	Bu/A
Single	80,000	21.25 ab	54.9
Single	130,000	13.10 b	51.8
Single	150,000	7.95 ab	53.5
Twin	80,000	13.50 ab	56.3
Twin	150,000	9.75 ab	59.6
Triple	80,000	10.55 ab	44.1
Triple	150,000	1.60 a	46.5

Means within a column followed by a different letter are different at $p \leq 0.05$.

No differences in Palmer amaranth control were observed between row configurations for each initial herbicide application timing (Table 4). However, Palmer amaranth control was different for the initial application timings within row configuration. Palmer amaranth control was lower when the initial herbicide application was delayed until 28 DAE for both row configurations compared with other timings.

Soybean yield differences were detected among the weed free, 7, 14, and 21 DAE application timings and the nontreated for both single and triple row configurations (Table 4). Yield in the single-row configuration was not affected until the 28 DAE application timing. However, no differences in soybean yield were observed in the triple-row configuration.

Table 4. Palmer amaranth control and yield in soybean grown in different row configurations and treated initially at different intervals following planting at Stoneville, MS, in 2019.

Row configuration	Initial application timing	Palmer amaranth control	Yield
		%	Bu/A
Single row	Nontreated	-	52 cd
Single row	Weed Free	95 a	75 a
Single row	7 DAE	95 a	74 a
Single row	14 DAE	95 a	70 a
Single row	21 DAE	94 a	65 ab
Single row	28 DAE	85 b	55 bc
Triple row	Nontreated	-	41 d
Triple row	Weed Free	95 a	65 abc
Triple row	7 DAE	95 a	62 abc
Triple row	14 DAE	95 a	65 abc
Triple row	21 DAE	94 a	54 abc
Triple row	28 DAE	84 b	53 bcd

Means within a column followed by a different letter are different at $p \leq 0.05$.
Abbreviations: DAE= days after emergence.

Data from the first year of this research suggests that soybean canopy width could potentially be increased with narrow-row configurations compared with a single-row configuration. This could potentially help the furrow to be shaded more rapidly, which could aid in mid- to late-season weed control. However, no benefits were detected with Palmer amaranth control and yield comparing narrow-row soybean to commercial standard single row soybean. Further research is needed to evaluate if there could potentially be a benefit to narrow row soybean production for Palmer amaranth control and soybean yield.

Objective 3 – 2019

Two studies were conducted at the Delta Research and Extension Center in 2019 to evaluate barnyardgrass control with mixtures of glyphosate, dicamba, 2,4-D, and foliar fertilizers, and to determine effect of sub-lethal concentrations (simulating tank contamination) of dicamba on barnyardgrass control with Roundup PowerMax and Select Max. In the first study, foliar fertilizers included a 4-0-10 and 25-0-0. Herbicides utilized were Roundup PowerMax, Engenia, and Enlist One.

A negative interaction for barnyardgrass control was observed when foliar fertilizers, Engenia, or Enlist One were mixed with glyphosate (Table 5). The greatest reduction in barnyardgrass control (23 to 25%) was observed when Engenia was added to Roundup PowerMax. The addition of foliar fertilizers to mixtures with Roundup PowerMax resulted in a 10 to 12% reduction in control of barnyardgrass.

Table 5. Barnyardgrass control 21 days after application of Roundup PowerMax alone and mixed with Engenia, Enlist One, and/or foliar fertilizers at Stoneville, MS, in 2019.

Treatment	Rate	Timing	Barnyardgrass control	
	FL OZ/A		%	
4-0-10	64	6-8 in ECHCG	0	d
25-0-0	128	6-8 in ECHCG	0	d
Roundup PowerMax	32	6-8 in ECHCG	91	a
Roundup PowerMax 4-0-10	32 64	6-8 in ECHCG 6-8 in ECHCG	81	b
Roundup PowerMax 25-0-0	32 128	6-8 in ECHCG	79	b
Roundup PowerMax Engenia	32 12.8	6-8 in ECHCG	68	c
Roundup PowerMax Engenia 4-0-10	32 12.8 64	6-8 in ECHCG	63	c
Roundup PowerMax Engenia 25-0-0	32 12.8 128	6-8 in ECHCG	64	c
Roundup PowerMax Enlist One	32 32	6-8 in ECHCG	71	c
Roundup PowerMax Enlist One 4-0-10	32 32 64	6-8 in ECHCG	66	c
Roundup PowerMax Enlist One 25-0-0	32 32 128	6-8 in ECHCG	66	c

Means within a column followed by the same letter are not different at $p \leq 0.05$.

Abbreviations: ECHCG, barnyardgrass.

Select Max alone controlled barnyardgrass 31 to 46% (Table 6). Sublethal rates of dicamba, which can commonly occur in a tank contamination situation did not result in the same negative interaction as a full rate of dicamba mixed with Roundup PowerMax.

Table 6. Barnyardgrass control with Roundup PowerMax and/or Select Max mixed with sub-lethal concentrations of dicamba at Stoneville, MS, in 2010.

Treatment	Rate	Timing	Barnyardgrass control
	FL OZ/A		%
Roundup PowerMax	32	6-8 in ECHCG	86 a
Select Max	16	6-8 in ECHCG	46 b
Roundup PowerMax Select Max	32 16	6-8 in ECHCG 6-8 in ECHCG	86 a
Engenia	0.1	6-8 in ECHCG	0 d
Roundup PowerMax Engenia	32 0.1	6-8 in ECHCG	85 a
Select Max Engenia	16 0.1	6-8 in ECHCG	31 c
Roundup PowerMax Select Max Engenia	32 16 0.1	6-8 in ECHCG	86 a
Engenia	0.025	6-8 in ECHCG	0 d
Roundup PowerMax Engenia	32 0.025	6-8 in ECHCG	84 a
Select Max Engenia	16 12.8	6-8 in ECHCG	34 c
Roundup PowerMax Select Max Engenia	32 16 0.025	6-8 in ECHCG	85 a

Means within a column followed by the same letter are not different at $p \leq 0.05$.

Abbreviations: ECHCG, barnyardgrass.

Two other studies were conducted at the Delta Research and Extension Center in 2019 to evaluate the negative interaction of glyphosate mixed with dicamba for barnyardgrass control. The first study evaluated different formulations of glyphosate (Roundup PowerMax, Makaze, Envy Six Max, Cornerstone 5 Plus, and Honcho K6) in combination with dicamba (Engenia). The different formulations of glyphosate were chosen to (1) represent products commonly sold by retailers in Mississippi and (2) represent the different salt bases used in glyphosate. The second study evaluated different formulations of dicamba (Engenia, Xtendimax with VaporGrip, and FeXapan plus VaporGrip) as well as 2,4-D (Enlist One) in combination with Roundup PowerMax.

Glyphosate formulation had no effect on the level of barnyardgrass control with and without Engenia (Table 7). However, barnyardgrass control with all glyphosate formulations was reduced 8 to 10% when Engenia was added.

Dicamba formulation had no effect on control of barnyardgrass with Roundup PowerMax (Table 8). However, all formulations of dicamba and Enlist One reduced barnyardgrass 17 to 19% when mixed with Roundup PowerMax.

Table 7. Barnyardgrass control 21 days after application of different glyphosate formulations with and without Engenia at Stoneville, MS, in 2019.

Treatment	Rate	Timing	Barnyardgrass	
	FL OZ/A		%	
Roundup PowerMax	32	6-8 in ECHCG	91	a
Makaze	32	6-8 in ECHCG	90	a
Envy Six Max	22	6-8 in ECHCG	89	a
Cornerstone 5 Plus	23.3	6-8 in ECHCG	91	a
Honcho K6	23.3	6-8 in ECHCG	90	a
Engenia	12.8	6-8 in ECHCG	0	c
Roundup PowerMax Engenia	32 12.8	6-8 in ECHCG	83	b
Makaze Engenia	32 12.8	6-8 in ECHCG	81	b
Envy Six Max Engenia	22 12.8	6-8 in ECHCG	80	b
Cornerstone 5 Plus Engenia	23.3 12.8	6-8 in ECHCG	80	b
Honcho K6 Engenia	23.3 12.8	6-8 in ECHCG	81	b

Means within a column followed by the same letter are not different at $p \leq 0.05$.

Abbreviations: ECHCG, barnyardgrass.

Table 8. Barnyardgrass control 21 days after application of Roundup PowerMax and different formulations of dicamba or 2,4-D in Stoneville, MS, in 2019.

Treatment	Rate	Timing	Barnyardgrass	
	FL OZ/A		%	
Enlist One	32	6-8 in ECHCG	0	c
Engenia	12.8	6-8 in ECHCG	0	c
Xtendimax plus VaporGrip	22	6-8 in ECHCG	0	c
FeXapan plus VaporGrip	22	6-8 in ECHCG	0	c
Roundup PowerMax	32	6-8 in ECHCG	90	a
Enlist One Roundup PowerMax	32 32	6-8 in ECHCG	73	b
Engenia Roundup PowerMax	12.8 32	6-8 in ECHCG	71	b
Xtendimax plus VaporGrip Roundup PowerMax	22 32	6-8 in ECHCG	73	b
FeXapan plus VaporGrip Roundup PowerMax	22 32	6-8 in ECHCG	73	b

Means within a column followed by the same letter are not different at $p \leq 0.05$.

Abbreviations: ECHCG, barnyardgrass.

Finally, a study was conducted at the Delta Research and Extension Center in 2019 to evaluate barnyardgrass control with Roundup PowerMax, Engenia, and/or Select Max applied with different nozzle types. Nozzles included flatfan (XR), AIRMIX (AM), and Turbo Teejet Induction (TTI) chosen to provide a range of droplet sizes from fine to very coarse.

Barnyardgrass control was greatest with Roundup PowerMax applied using XR (95%) and AM (96%) nozzles or with Roundup PowerMax Max plus Select Max applied with an XR (89%) nozzle (Table 9). Increased droplet size associated with TTI nozzles as well as the combination of Roundup PowerMax plus Select Max plus Engenia reduced control of barnyardgrass to 64%.

Table 9. Barnyardgrass control 21 days after application of Roundup PowerMax alone and in combination with Select Max and/or Engenia applied with different nozzles at Stoneville, MS in 2019.

Treatment	Rate	Nozzle	Timing	Control	
	FL OZ/A			%	
Roundup PowerMax	32	XR	6-8 in ECHCG	95	a
Roundup PowerMax	32	AM	6-8 in ECHCG	96	a
Roundup PowerMax	32	TTI	6-8 in ECHCG	85	bc
Select Max	16	XR	6-8 in ECHCG	30	f
Select Max	16	AM	6-8 in ECHCG	29	f
Select Max	16	TTI	6-8 in ECHCG	25	f
Roundup PowerMax Select Max	32 16	XR	6-8 in ECHCG	89	ab
Roundup PowerMax Select Max	32 16	AM	6-8 in ECHCG	84	bc
Roundup PowerMax Select Max	32 16	TTI	6-8 in ECHCG	78	cd
Roundup PowerMax Engenia	32 12.8	XR	6-8 in ECHCG	73	de
Roundup PowerMax Engenia	32 12.8	AM	6-8 in ECHCG	75	cde
Roundup PowerMax Engenia	32 12.8	TTI	6-8 in ECHCG	70	de
Roundup PowerMax Select Max Engenia	32 16 12.8	XR	6-8 in ECHCG	75	cde
Roundup PowerMax Select Max Engenia	32 16 12.8	AM	6-8 in ECHCG	75	cde
Roundup PowerMax Select Max Engenia	32 16 12.8	TTI	6-8 in ECHCG	64	e

Means within a column followed by the same letter are not different at $p \leq 0.05$.

Abbreviations: ECHCG, barnyardgrass; XR, flatfan; AM, AIRMIX; TTI Turbo Teejet Induction.

Mixing dicamba and glyphosate results in a negative interaction, leading to poor control of barnyardgrass. The negative interaction cannot be overcome by pairing different formulations of glyphosate and dicamba together. Barnyardgrass control from applications of Roundup PowerMax and Engenia did not differ with nozzle type used. However, sublethal concentrations of dicamba with a full rate of Roundup PowerMax did not result in reduced barnyardgrass control. From preliminary data, it appears that glyphosate and dicamba may need to be applied in separate applications or another application of glyphosate approximately 10 days following may be needed for control of barnyardgrass.

Impacts and Benefits to Mississippi Soybean Producers:

Mississippi has averaged 1.98 million acres of soybean over the past five years, and a majority of soybean-producing counties contain at least one GR weed species. The data generated from this research will allow producers to implement effective control options for GR weeds, become aware of developing resistance problems, receive information on prevention and control tactics for resistant weeds, and allow Mississippi soybean producers to remain competitive regionally while improving economic returns.

Publications:

1. Bararpour, T., J. A. Bond, G. Singh, R. R. Hale, H. M. Edwards, and B. H. Lawrence. 2020. Glyphosate-resistant *Lolium perenne* control and seed suppression in Mississippi. Agron. (*In Press*).
2. Franca, L. X., D. M. Dodds, T. R. Butts, G. R. Kruger, D. B. Reynolds, J. A. Mills, J. A. Bond, A. L. Catchot, and D. G. Peterson. 2020. Droplet size impact on lactofen and acifluorfen efficacy for Palmer amaranth (*Amaranthus palmeri*) control. Weed Technol. (*In Press*)
3. Lawrence, B. H., J. A. Bond, T. W. Eubank III, B. R. Golden, D. R. Cook, and J. P. Mangialardi. Evaluation of 2,4-D-based herbicide mixtures for control of glyphosate-resistant Palmer amaranth. Weed Technol. Weed Technol. Weed Technol. 33:263-271
4. Nandula, V. K., D. A. Giacomini, W. T. Molin, and J. A. Bond. Resistance to clethodim in Italian ryegrass (*Lolium perenne* ssp. *multiflorum*) from Mississippi and North Carolina. Pest Manage Sci [Online]. Available at https://wileyonlinelibrary.com doi: 10.1002/ps.5650.
5. 2019 Weed Control Guidelines for Mississippi. 2019. Mississippi State University Extension Service Publication P-1532.
6. Maples, W., B. Mills, D.M. Dodds, J.A. Bond, A.L. Catchot, D. Cook, W. Crow, B.R. Golden, J. Gore, L. Oldham, and H.C. Pringle. 2019. Cotton 2020 Planning Budgets. Mississippi State University Extension Service Publication P-3168.
7. Maples, W., B. Mills, B.R. Golden, T.W. Allen, J.A. Bond, D. Gholson, J. Gore, and H.C. Pringle. 2019. Rice 2020 Planning Budgets. Mississippi State University Extension Service Publication P-3167.
8. Maples, W., B. Mills, J.T. Irby, T.W. Allen, J.A. Bond, A.L. Catchot, D. Cook, W. Crow, D. Gholson, B.R. Golden, J. Gore, B. H. Lawrence, and H.C. Pringle. 2019. Soybeans 2020 Planning Budgets. Mississippi State University Extension Service Publication P-3166.

9. Maples, W., B. Mills, E. Larson, J.A. Bond, A.L. Catchot, D. Cook, W. Crow, D. Gholson, B.R. Golden, J. Gore, L. Oldham, and H.C. Pringle. 2019. Corn, Grain Sorghum, and Wheat 2020 Planning Budgets. Mississippi State University Extension Service Publication P-3169.
10. Bond, J. A. and B. H. Lawrence. 2019. New paraquat handling and use regulations. [Online] Available at https://www.mississippi-crops.com/2019/12/04/new-paraquat-handling-and-use-regulations/ (12/04/2019)
11. Bararpour, T., R. R. Hale, J. A. Bond, J. W. Seale, and B. R. Golden. 2019. Weed management programs for Mississippi corn. Proc. South. Weed Sci. Soc. 72:216-217.
12. Bond, J. A., K. Bradley, N. G. Corban, K. L. Gage, M. Loux, E. J. Miller, J. K. Norsworthy, D. B. Reynolds, L. E. Steckel, and B. G. Young. 2019. The effect of multiple dicamba exposures on soybean growth and yield. Weed Science Society of America Annual Meeting. 11-13 Feb. 2019. New Orleans, LA. [Online]. Available at http://wssaabstracts.com/public/59/proceedings.html.
13. Corban, N. G., B. H. Lawrence, H. M. Edwards, J. D. Peeples, T. L. Sanders, D. B. Reynolds, and J. A. Bond. 2019. Soybean performance following exposure to dicamba at multiple growth stages. Proc. South. Weed Sci. Soc. 72:148-149.
14. Lazaro, L. M., J. Evans, J. K. Norsworthy, S. B. Mirsky, A. S. Davis, K. Bradley, L. E. Steckel, M. V. Bagavathiannan, J. A. Bond, L. Lindquist, N. R. Jordan, M. L. Flessner, M. J. VanGessel, W. Everman, W. S. Curran, and N. E. Korres. 2019. Weed seed rain phenology: an areawide approach. Weed Science Society of America Annual Meeting. 11-13 Feb. 2019. New Orleans, LA. [Online]. Available at http://wssaabstracts.com/public/59/proceedings.html.
15. Mirsky, S. B., J. K. Norsworthy, A. S. Davis, M. V. Bagavathiannan, S. C. Bream, J. A. Bond, K. Bradley, W. S. Curran, J. Evans, W. Everman, M. L. Flessner, G. Frisvold, N. R. Jordan, L. M. Lazarro, J. Lindquist, L. S. Shergill, L. E. Steckel, and M. J. VanGessel. 2019. Eliminating weed seeds at soybean harvest: lessons learned from the area-wide IWM team. Weed Science Society of America Annual Meeting. 11-13 Feb. 2019. New Orleans, LA. [Online]. Available at http://wssaabstracts.com/public/59/proceedings.html.
16. Mirsky, S. B., J. K. Norsworthy, A. S. Davis, M. V. Bagavathiannan, J. A. Bond, K. Bradley, W. W. Curran, J. Evans, W. Everman, M. L. Flessner, G. Frisvold, N. R. Jordan, L. M. Lazaro, J. Lindquist, L. S. Shergill, L. E. Steckel, and M. J. VanGessel. 2019. A national assessment of cover crops in an IWM program. Weed Science Society of America Annual Meeting. 11-13 Feb. 2019. New Orleans, LA. [Online]. Available at http://wssaabstracts.com/public/59/proceedings.html.
17. Nandula, V. K., D. Giacomini, B. H. Lawrence, W. Molin, and J. A. Bond. 2019. Resistance to clethodim in Italian ryegrass from Mississippi and North Carolina. Weed Science Society of America Annual Meeting. 11-13 Feb. 2019. New Orleans, LA. [Online]. Available at http://wssaabstracts.com/public/59/proceedings.html.
18. Nandula, V. K., G. B. Montgomery, A. Vennapusa, M. Jugulam, D. Giacomini, J. Ray, J. A. Bond, and P. Tranel. 2019. Glyphosate-resistant Echinochloa colona from Mississippi and Tennessee: magnitude and resistance mechanisms. Weed Science Society of America Annual Meeting. 11-13 Feb. 2019. New Orleans, LA. [Online]. Available at http://wssaabstracts.com/public/59/proceedings.html.

19. Peeples, J. D., B. H. Lawrence, H M. Edwards, and T. L. Sanders. 2019. Glyphosate-resistant Italian ryegrass control with residual herbicides and cover crops. Proc. South. Weed Sci. Soc. 72:61-62.

Wesley, Jr., M. T., J. A. Bond, E. J. Larson, D. B. Reynolds, J. C. Ferguson. 2019. Italian ryegrass timing of removal effects on corn in Mississippi. Weed Science Society of America Annual Meeting. 11-13 Feb. 2019. New Orleans, LA. [Online]. Available at http://wssaabstracts.com/public/59/proceedings.html.

20. Wesley, Jr., M. T., Z. R. Treadway, J. A. Bond, D. B. Reynolds, E. J. Larson, J. C. Ferguson. 2019. Droplet size effects on preemergence herbicide efficacy for Italian ryegrass. Weed Science Society of America Annual Meeting. 11-13 Feb. 2019. New Orleans, LA. [Online]. Available at http://wssaabstracts.com/public/59/proceedings.html.

Presentations:

1. Mississippi State University Northeast Research and Extension Center Field Day – Mississippi weed control update; Verona, MS (August 27, 2019)
2. Mississippi Row Crop Short Course – Herbicide programs in Mississippi row crops; Starkville, MS (December 2, 2019)
3. Backwater Flood Meeting– Thoughts on weed management following the flood; Rolling Fork, MS (October 22, 2019)
4. Tunica County Grower Meeting – Weed management in Mississippi row crops; Tunica, MS (February 21, 2019)
5. Coahoma County Grower Meeting – Weed management in Mississippi row crops; Clarksdale, MS (February 21, 2019)
6. Humphreys County Grower Meeting – Weed management in Mississippi row crops; Belzoni, MS (February 19, 2019)
7. Yazoo County Grower Meeting – Weed management in Mississippi row crops; Yazoo City, MS (February 19, 2019)
8. Calhoun County Grower Meeting – Weed management in Mississippi row crops; Pittsboro, MS (January 28, 2019)
9. Pontotoc County Grower Meeting – Weed management in Mississippi row crops; Pontotoc, MS (January 28, 2019)
10. Washington County Grower Meeting – Weed management in Mississippi row crops; Hollandale, MS (January 15, 2019)
11. Madison County Grower Meeting – Weed management in Mississippi row crops; Canton, MS (January 14, 2019)
12. Hinds County Grower Meeting – Weed management in Mississippi row crops; Raymond, MS (January 14, 2019)
13. Tri State Soybean Forum – Targeting Palmer amaranth with residual herbicides; Stoneville, MS (January 4, 2019)
14. Mississippi State Extension Statewide Program – Weed control in Mississippi row crops; Stoneville, MS (November 19, 2019)

15. Montana State University Palmer Amaranth Workshop – Palmer amaranth: evolution of a driver weed; Sidney, MT (November 6, 2019)
16. Mississippi Agricultural Consultants’ Association Research Exchange – Mississippi weed control update; Stoneville, MS (September 27, 2019)
17. Mississippi Agriculture Industries Council Certified Crop Advisor Training – Weed control issues in Mississippi row crops; Orange Beach, AL (July 23, 2019)
18. Mississippi State University Extension Service Scout School – Weed identification in Mississippi crops; Raymond, MS (June 4, 2019)
19. Mississippi State University Extension Service Scout School – Weed identification in Mississippi crops; Clarksdale, MS (May 30, 2019)
20. Mississippi State University Extension Dicamba Applicator Training – Auxin applicator training; Cleveland, MS (March 6, 2019
21. Mississippi State University Extension Dicamba Applicator Training – Auxin applicator training; Clarksdale, MS (March 6, 2019
22. Mississippi State University Extension Dicamba Applicator Training – Auxin applicator training; Clarksdale, MS (March 6, 2019
23. Mississippi State University Extension Dicamba Applicator Training – Auxin applicator training; Tunica, MS (March 6, 2019
24. Mississippi State University Extension Dicamba Applicator Training – Auxin applicator training; Raymond, MS (March 5, 2019
25. Mississippi State University Extension Dicamba Applicator Training – Auxin applicator training; Greenwood, MS (March 4, 2019
26. Mississippi State University Extension Dicamba Applicator Training – Auxin applicator training; Yazoo City, MS (March 4, 2019
27. Mississippi State University Extension Dicamba Applicator Training – Auxin applicator training; Stoneville, MS (March 4, 2019
28. National Conservations Systems Cotton and Rice Conference – Weed management in Mississippi soybean; Baton Rouge, LA (February 1, 2019)
29. National Conservations Systems Cotton and Rice Conference – Weed management in Mississippi soybean; Baton Rouge, LA (January 31, 2019)
30. BASF Herbicide Meeting – Weed control for row crops in the midsouthern U.S.; Tampa, FL (January 23, 2019)