Influence of Lactofen and 2,4-DB Combinations on Peanut Injury and Yield

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ABSTRACT

Lactofen plus crop oil adjuvants are increasingly being used to combat acetolactate synthase-resistant weeds in peanut production. To control a broader spectrum of weeds, it is desirable to mix 2,4-DB with lactofen. However, lactofen can be highly injurious to peanuts. It is unknown if the addition of 2,4-DB will exacerbate or prolong the injury observed by lactofen. Experiments were conducted in Citra and Jay, FL in 2011 and 2012 to examine the impact of lactofen, 2,4-DB and lactofen + 2,4-DB applied at 15, 30, and 45 days after planting (DAP) on peanut injury and yield. It was observed that 2,4-DB did not increase foliar injury or stunting (as measured by canopy width) compared to lactofen alone. Additionally, yield was not impacted by any herbicide combination or application timing. From these data, lactofen plus 2,4-DB combinations, applied with crop oil adjuvants, can be used with little concern for exacerbating effects on peanut growth or yield relative to lactofen applied alone.

Key Words: Peanut yield, canopy width, herbicide injury, herbicide combinations.

Palmer amaranth (*Amaranthus palmeri* S. Watson) continues to spread across the peanut production region of the southeast. Further complicating the spread of this weed is that many of these populations are resistant to acetolactate synthase (ALS) inhibiting herbicides as well as other herbicides with alternative mechanisms of action (Heap, 2012; Wise *et al*., 2009). This is troublesome because imazapic is one of the few herbicides that has been shown to consistently provide effective control of Palmer amaranth (Grichar, 1997; 2007). Without imazapic, growers must rely on soil-applied herbicides, paraquat, and postemergence protoporphyrinogen-oxidase (PPO) inhibitors to control Palmer amaranth. While soil-applied herbicides can be effective in controlling Palmer amaranth, adequate rainfall or irrigation is required for activation, making control erratic and dependent on weather patterns (Dobrow *et al*., 2011). To avoid this complication, the only alternatives are postemergence PPO-inhibitors which are limited to acifluorfen or lactofen for control. Though these herbicides can be highly effective, Palmer amaranth size must be 10 cm in height, or less, for these herbicides to provide consistent control (Morichetti *et al*., 2012). Considering the rapid growth-rate, developing approaches to enhance herbicide performance are needed. Additionally, the application of lactofen to peanuts has shown mixed results. Boyer *et al*. (2011) reported that lactofen applied at 45 DAP did not result in yield loss while Dotray *et al*. (2012) did observe yield loss at 45 DAP. Therefore, relying on lactofen for Palmer amaranth control can potentially be a risky strategy.

In an attempt to manage Palmer amaranth that exceeds 10 cm in height, and possibly delay the development of PPO-resistance, 2,4-DB can be applied with lactofen. However, because lactofen is typically combined with crop oil adjuvants, this causes 2,4-DB to be applied with these products as well. While it has been shown that applications of 2,4-DB (at various schedules) in combination with crop oil does not significantly reduce peanut yield (Dotray *et al*., 2004), no research has investigated the combinations of 2,4-DB and crop oil with other herbicides.

In the plant, 2,4-DB is a non-active precursor molecule that must be converted into 2,4-D by a β-oxidation reaction (McComb and McComb, 1978). These reactions in legumes proceed slowly and high levels of active 2,4-D rarely occur (Wain and Wightman, 1954). However, lactofen plus crop oil adjuvants have been shown to cause as much as 48% injury and delay canopy closure by as much as 10 days (Boyer *et al*., 2011). Moreover, crop oil adjuvants have commonly been reported to increase herbicide uptake (Wanamarta and Penner, 1989). With the significant amount of peanut injury caused by lactofen, and the possible loading of more 2,4-DB into the plant, it is questioned if the inclusion of 2,4-DB with lactofen would intensify peanut injury or prolong recovery that would negatively impact yield.

Therefore, the objective of this study was to determine if 2,4-DB plus lactofen combinations, applied with crop oil adjuvants, would adversely impact peanut yield. Secondly, it was questioned if these applications would delay peanut canopy development.

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Table 1. Peanut response to lactofen and 2,4-DB applied with crop oil concentrate at 15, 30, or 45 days after planting in Citra, FL.

Herbicide	Rate	Timing	Injury[a] 7 DAT		Injury[a] 14 DAT		Canopy width[b]		Yield[c]	
	g/ha	DAP[d]	%				% of non-treated			
Lactofen	220	15	29	ab	2	b	81	d	99	a
2,4-DB	270	15	6	c	2	b	97	ab	105	a
Lactofen plus 2,4-DB	220 + 270	15	36	a	2	b	84	cd	105	a
Lactofen	220	30	22	b	7	a	87	c	103	a
2,4-DB	270	30	7	c	0	b	100	a	97	a
Lactofen plus 2,4-DB	220 + 270	30	23	b	8	a	87	c	105	a
Lactofen	220	45	28	b	7	a	99	ab	99	a
2,4-DB	270	45	7	c	3	b	98	ab	100	a
Lactofen plus 2,4-DB	220 + 270	45	28	b	9	a	94	b	99	a

[a]Values are the mean of 8 replications. Means within a column followed by different letters are significantly different at the $p \leq 0.05$ level.
[b]Canopy width was measured 7 days after the respective herbicide application.
[c]Peanut yield in the non-treated was 4200 and 4600 kg/ha in 2011 and 2012, respectively.
[d]DAP – Days after planting.

Materials and Methods

Experiments were conducted at the Plant Science Research and Education Unit in Citra, FL, as well as the West Florida Research and Education Center in Jay, FL. The soil type at Citra was an Arredondo fine sand (loamy, siliceous, semiactive, hyperthermic grossarenic paleudult) with 0.5% organic matter while the Jay location was an Orangeberg sandy loam (fine-loamy, kaolinitic, thermic typic kandiudults) with 1.5% organic matter. The cultivar Georgia-O6G (Branch, 2007) was planted between April 27 and May 17 at both locations in 2011 and 2012, respectively. These dates are all within the recommended planting window for their respective regions. The entire field was treated with pendimethalin (380 g/ha) and diclosulam (25 g/ha) prior to planting and hand-weeding was used when necessary to maintain the experiment weed-free. All fertility and pest management was provided in accordance to local management practices.

All experimental herbicide treatments were applied using a CO_2-pressurized sprayer calibrated to deliver 187 L/ha. These included lactofen (200 g/ha), 2,4-dichlorophenoxy butric acid (2,4-DB) (275 g/ha) and lactofen (200 g/ha) + 2,4-DB (275 g/ha). All applications included a crop oil adjuvant at 1% v/v (Agridex; Helena Chemical Company. 225 Schilling Blvd., Suite 300. Collierville, TN 38017). These herbicide treatments were applied 15, 30, or 45 days after planting (DAP).

Visual estimates of percent peanut foliar burn were recorded 7, 14, and 21 days after treatment (DAT) using a scale of 0 to 100% where 0 = no herbicide activity and 100 = peanut death. Additionally, peanut canopy width was measured at 7 DAT at 5 random locations in each plot and averaged. Optimal crop maturity was determined by the hull scrape method (Williams and Drexler, 1981) and plots were harvested by inverting the center two rows of each plot using a conventional digger-shaker-inverter. Peanut was allowed to field dry for approximately 3 days and commercial harvesting equipment was used. Peanuts were dried to 9% moisture and yield was determined and adjusted to a kg/ha basis. Yield and peanut injury data were collected at the Citra location while only yield was collected at the Jay location. For ease of interpretation, canopy width and yield data where converted to percentage of the non-treated control.

The experimental design was a randomized complete block with a factorial arrangement of treatments with herbicide and timing as the two factors. Data were analyzed using ANOVA to detect the presence of main effects and interactions. Means were separated using Fisher's Protected LSD (P=0.05).

Results and Discussion

The main effect of year, and all by year interactions, were not significant at either location. Therefore, data were combined across years. However, the herbicide by timing interaction was significant and all data are shown in Table 1.

Peanut foliar injury ranged between 6 and 36% at 7 DAT (Table 1). As expected, lactofen and lactofen plus 2,4-DB combinations were most injurious ranging from 22 to 36% while injury from 2,4-DB alone was 6 to 7%. By 14 DAT, peanut recovered no treatment caused more than 9% injury. By 21 DAT, there was no observable

Table 2. Peanut yield response to lactofen and 2,4-DB applied with crop oil concentrate at 15, 30, or 45 days after planting in Jay, FL.

Herbicide	Rate	Timing	Yield[a]	
	g/ha	DAP[b]	% of non-treated	
Lactofen	220	15	101	a
2,4-DB	270	15	95	a
Lactofen plus 2,4-DB	220+270	15	96	a
Lactofen	220	30	95	a
2,4-DB	270	30	97	a
Lactofen plus 2,4-DB	220+270	30	101	a
Lactofen	220	45	101	a
2,4-DB	270	45	102	a
Lactofen plus 2,4-DB	220+270	45	100	a

[a]Peanut yield in the non-treated was 4500 kg/ha and 4850 kg/ha in 2011 and 2012, respectively. Values are the mean of 8 replications. Means within a column followed by different letters are significantly different at the $p \leq 0.05$ level.

[b]DAP – Days after planting.

peanut injury in any plots (data not shown). The level of injury from lactofen plus crop oil was expected. Boyer *et al.* (2011) observed lactofen and acifluorfen plus crop oil injured peanuts at levels ranging from 20 to 48%. Additionally, the overall low injury level of less than 10% from 2,4-DB was also expected. Numerous researchers have examined the injury potential of 2,4-DB and rarely have they reported any significant peanut injury (Grichar *et al.*, 1997; Baughman *et al.*, 2002; Dotray *et al.*, 2004; Faircloth and Prostko, 2010). This indicates that 2,4-DB injury on peanut is commonly insignificant, even in the presence of crop oil adjuvants (Dotray *et al.*, 2004), but the current question was to determine if the addition of 2,4-DB would increase or prolong the injury observed from lactofen alone. In these experiments, 2,4-DB did not increase injury over lactofen alone. At 7, 14, and 21 DAT, no significant differences were observed between lactofen and lactofen + 2,4-DB within an application timing (Table 1).

Peanut stunting, measured as canopy width 7 DAT, was also determined. There was evidence that both lactofen and lactofen plus 2,4-DB applied at 15 DAP resulted in some initial stunting effects, with 19 and 16% reduction in canopy width, respectively. Conversely, 2,4-DB applied alone resulted in only 3% reduction in canopy width and was not statistically different from the non-treated. This same trend was observed at the 30 DAP application timing with lactofen treatments resulting in 13% reduction in canopy width, while no reductions were observed with 2,4-DB alone. By 45 DAT, no reductions were noted for any application. The impact of lactofen on peanut canopy width was similar to that observed by Boyer *et al.*, (2011) in that they reported that lactofen at 30 DAP resulted in greater canopy stunting when applied at 45 DAP. Regardless, the impact of herbicide application on peanut canopy width appears to be driven by lactofen and the addition of 2,4-DB does not impact this effect.

There were no yield reductions at either the Citra and Jay locations in either year for any herbicide or application timing (Table 1 and 2). Even with potential crop injury associated with lactofen application, other research has shown that applications of lactofen at 30 or 45 DAP was not detrimental to yield (Boyer *et al.*, 2011). This is contrary to Dotray *et al.*, (2012) where lactofen applied at 45 DAP did result in significant yield loss. The lack of impact on yield for 2,4-DB application rate and timing is also in agreement with previous results (Grichar *et al.*, 1997; Baughman *et al.*, 2002; Dotray *et al.*, 2004). What is unique about the current research is the examination of the impact on yield by the combination of lactofen with 2,4-DB at different timings. The lack of yield loss with this herbicide combination indicates that this strategy can be effectively used for Palmer amaranth control without detrimental impacts on peanut production.

Postemergence applications of lactofen are required for many peanut producers to control ALS-resistant Palmer amaranth. Since lactofen has been previously shown to cause significant foliar burn and peanut stunting when applied with crop oil, it was questioned if the addition of 2,4-DB would increase this injury. These results suggest that lactofen plus 2,4-DB combinations did not increase peanut injury over lactofen alone. Additionally, applications made between 15 and 45 DAP did not compromise yield. Therefore, peanut producers should have little concern about peanut safety if lactofen plus 2,4-DB (applied with crop oil adjuvants) combinations are required to address specific weed problems.

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