Application Timing of Lactofen for Broadleaf Weed Control in Peanut (*Arachis hypogaea*)

David L. Jordan, John W. Wilcut*, and Charles W. Swann[1]

ABSTRACT

Field experiments compared single and sequential applications of lactofen {+-2-ethoxy-1-methyl-2-oxoethyl 5-[2-chloro-4-(trifluoromethyl)phenoxy]-2-nitrobenzoate} to the standard herbicide programs of alachlor [2-chloro-*N*-2,6-diethylphenyl)-*N*-(methoxymethyl)-acetamide] + paraquat (1,1'-dimethyl-4,4'-bipyridinium ion) and acifluorfen {5-[2-chloro-4-(trifluromethyl)phenoxy]-2-nitrobenzoic acid} + bentazon {3-(1-methylethyl)-1*H*-2,1,3-benzothiadiazon-4(3*H*) 2,2-dioxide} for broadleaf weed control. A single late postemergence (LPOST) application of lactofen controlled morningglory species (*Ipomoea spp.*) and prickly sida (*Sida spinosa* L.) as well as lactofen applied early POST (EPOST) and LPOST. Lactofen applied sequentially at groundcracking (GC) and EPOST provided greater and/or more consistent control of common lambsquarters (*Chenopodium album* L.) and prickly sida than alachlor+paraquat applied GC or acifluorfen+bentazon applied LPOST. *Ipomoea spp.* control was less with a single LPOST application of lactofen than with acifluorfen+bentazon applied LPOST in 1988. Eclipta (*Eclipta prostrata* L.) was controlled with single or sequential lactofen applications and with acifluorfen+bentazon applied LPOST. Peanut yield was greater when lactofen was applied at GC followed by an EPOST application compared with a single application of lactofen applied LPOST, acifluorfen+ bentazon applied LPOST, or alachlor+paraquat applied GC.

Key Words: *Chenopodium album, Eclipta prostrata, Ipomoea spp., Sida spinosa.*

Common lambsquarters, *Ipomoea* morningglory species, and prickly sida are among the most troublesome weeds to control in peanut production in the Virginia and North Carolina area (3). Eclipta, another annual broadleaf weed, is becoming more common and troublesome (authors personal observations). Although dinitroanilines applied preplant incorporated (PPI) control a variety of annual grasses and common lambsquarters, growers are reluctant to apply these herbicides in Virginia because of potential injury to peanut (8). As a result, the chloroacetamide herbicides, alachlor and metolachlor (2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl)acetamide), often are used for annual grass control (8). Unfortunately chloroacetamide herbicides do not adequately control common lambsquarters (3, 4, 8). Consequently, postemergence (POST) herbicide applications are required to control common lambsquarters (3, 4, 5). Additionally, growers must rely on POST herbicides to control prickly sida and *Ipomoea spp.* (3, 4, 5, 6).

At the time this research was initiated, herbicides registered for POST application in peanut did not provide residual control of common lambsquarters, *Ipomoea spp.*, and prickly sida. Bentazon controls small prickly sida and also provides some common lambsquarters control (3). Acifluorfen effectively controls common lambsquarters and *Ipomoea spp.* when applied to small weeds (9). However, common lambsquarters emerge early and continue to emerge throughout the early portion of the growing season (7, 8). Thus, sequential applications of acifluorfen and/or bentazon were often needed for season-long control.

Earlier work (8) demonstrated common lambsquarters control with lactofen+alachlor applied at ground cracking (GC) followed by a POST application of lactofen. Control from this lactofen system exceeded the standard POST program of acifluorfen+bentazon. The initial lactofen+alachlor application at GC was necessary to control common lambsquarters (8).

Existing data indicate lactofen can be used for control of common lambsquarters, common ragweed, and *Ipomoea spp.* in peanut (8). At the time this research was initiated, no data was available on the effectiveness of lactofen for eclipta and prickly sida control in peanut. The objectives of this research were to evaluate broadleaf weed control, and peanut tolerance and yield with lactofen as influenced by application timing.

Materials and Methods

The experiments were conducted in grower's fields near Capron, VA in 1988 and 1989 on a Nansemond fine loamy sand (Aquic Hapludults) with 1.1% organic matter and pH 6.0. Florigiant peanut was planted May 3, 1988 and NC7 peanut was planted May 23, 1989 at a rate of 112 kg ha^{-1}, 5 cm deep in a well prepared flat seedbed using conventional equipment. Individual plots were four rows, spaced 91 cm apart and 6.1 m long.

All treatments except weedy and weed-free controls received metolachlor applied preemergence (PRE) at 2.2 kg ha^{-1}. Postemergence herbicide treatments were alachlor+paraquat applied at GC, lactofen at GC followed by (fb) lactofen applied two wks after GC (EPOST), lactofen applied EPOST fb lactofen at three to four wks after GC (LPOST), alachlor+lactofen applied at EPOST fb lactofen applied LPOST, lactofen applied LPOST, and the commercial prepackage mixture of acifluorfen+bentazon[2] applied LPOST. Alachlor, lactofen, and paraquat were applied at 2.20, 0.22, and 0.14 kg ai ha^{-1}, respectively; while the acifluorfen+ bentazon tank mixture was applied at 0.28 + 0.56 kg ai ha^{-1}. A nonionic surfactant[3] at 0.25% v/v was applied with alachlor+paraquat. Acifluorfen+bentazon and lactofen were applied with a crop oil concentrate[4] at 1.25% and 0.32% v/v, respectively.

Weed densities ranged from 40 to 50 plants of each species per m^2. Weeds were in the cotyledon to two-leaves growth stage for the GC application in both years. When EPOST treatments were applied, weeds were cotyledon to four leaves in 1988 and two to four leaves in 1989. Weeds were in the one- to six-leaves growth stage when LPOST treatment were applied in both years.

Visual estimates of percent weed control using a scale of 0% to 100% (where 0% = no control and 100% = complete control) were recorded in early September 1988, and in early August 1989. A similar scale of 0% = no crop phytotoxic response and 100% = complete death of the crop was used to assess peanut tolerance to herbicide application. Foliar chlorosis,

[1]Post-doctoral Res. Assoc., Dep. Crop and Soil Sci., Univ. Georgia, Coastal Plain Exp. Stn., P. O. Box 748, Tifton, GA 31793; Former Assist. Prof., and Prof., Tidewater Agric. Exp. Stn., Va. Polytech. Inst. & State Univ., Suffolk, VA 23437. Current address of J. W. Wilcut: Dep. Crop and Soil Sci., Univ. Georgia, Coastal Plain Exp. Stn., Tifton, GA 31793.

[2]Storm. BASF Corp. 100 Cherry Hill Rd., Parsippany, NJ 07054.

[3]X-77 Spreader (mixture of alkylarylpolyoxyethylene glycols, free fatty acids, isopropanol). Valent USA Corp., North California Blvd., Walnut Creek, CA 94596.

[4]Agri-dex, a paraffin base petroleum oil 83%; surfactant blend 17%. Helena Chemical Co., 5100 Poplar Ave., Memphis, TN 38137.

*Corresponding author.

stunting, and reduction in plant population were the parameters used in making the visual estimates of weed control and crop injury. Peanuts were harvested at maturity using conventional harvesting equipment.

Data for weed control and peanut yield were subjected to analysis of variance. Means are separated by Fisher's Protected LSD test at $P \leq 0.05$.

Results and Discussion

Weed Control. The interaction of treatment by location was significant for control of all weeds and for peanut yield. Therefore, data will be discussed for individual years. Metolachlor alone appeared to control *Ipomoea spp.* 43% and 33% in 1988 and 1989, respectively (Table 1). This apparent control, however, was actually the result of uncontrolled common lambsquarters suppressing the *Ipomoea spp.* population. Common lambsquarters is one of the earliest weeds germinating and fastest growing weeds in Virginia- North Carolina peanut fields (7, 8). All systems with GC, EPOST, and LPOST treatments consistently controlled *Ipomoea spp.* better than metolachlor alone. Metolachlor primarily controls annual grasses and yellow nutsedge (*Cyperus esculentus* L.) in peanut (3). The greatest control of *Ipomoea spp.* was obtained with systems that used two applications of lactofen either with or without alachlor, or with a single LPOST application of either acifluorfen+bentazon or lactofen. However, in 1988, acifluorfen+bentazon LPOST controlled the *Ipomoea spp.* better than one application of lactofen POST. Acifluorfen is considered to be a better postemergence-applied herbicide for *Ipomoea spp.* control than lactofen (1).

Prickly sida control was consistently negligible with metolachlor alone (Table 1). Control improved with alachlor+paraquat applied GC but remained less than the other postemergence systems. Paraquat has not been reported to provide adequate prickly sida control (3, 4). Lactofen LPOST controlled prickly sida 97% and 88% in 1988 and 1989, respectively, while acifluorfen+bentazon applied LPOST controlled less at 81% and 56%, respectively. Acifluorfen generally does not control prickly sida (3, 5) while bentazon at rates used in this study will control small prickly sida (three true leaves or less) (5, 6). In agreement with these results, Wesley and Shaw (2) reported greater prickly sida control with lactofen than with acifluorfen in soybean (*Glycine max* L.). Other research in Virginia (4) has reported excellent prickly sida control with lactofen in peanut.

Common lambsquarters control with metolachlor alone was less than 15% both years (Table 1), which is in agreement with previous research with alachlor and metolachlor (4, 8). Alachlor+paraquat improved common lambsquarters control both years but generally was not equivalent to lactofen or acifluorfen+bentazon systems. In 1988 maximum ($\geq$ 85%) control was provided by any lactofen-containing system. In 1989, two applications of lactofen (GC+EPOST) was the single most effective treatment (i.e. 100% control). There was no benefit to using alachlor with lactofen for common lambsquarters control. Paraquat does not adequately control common lambsquarters (4). Lactofen controls common lambsquarters postemergence only up to two-leaves growth stage, thus the GC application is critical (8). Older plants become more tolerant to lactofen as evidenced by the 33% control from a single LPOST application of lactofen in 1989. Common lambsquarters in 1988 was cotyledon to two leaves stage and in 1989 three- to four-leaves growth stage.

Eclipta control with metolachlor alone was 59%, and was greater than metolachlor followed by alachlor+paraquat applied at GC (37%). This apparent discrepancy was due to alachlor+paraquat controlling more common lambsquarters than metolachlor alone. Eclipta germinates relatively late (Wilcut personal observations), and uncontrolled common lambsquarters in the metolachlor alone treatment suppressed later germinating eclipta. All other POST systems, with a minimum of one application of lactofen or acifluorfen+bentazon provided essentially complete ($\geq$99%) eclipta control. Previous research also reported excellent eclipta control with acifluorfen+bentazon (6).

Peanut response. Early season injury ranged from 20 to 35% with all herbicide-containing treatments with no individual treatment differences being evident (data not

Table 1. Broadleaf weed control with herbicide programs containing lactofen[ab].

Herbicide and application timing			*Ipomoea spp.*[c]		Prickly sida		Common lambsquarters		Eclipta
GC	EPOST	LPOST	1988	1989	1988	1989	1988	1989	1989
			%						
None	None	None	43	33	15	0	0	14	59
Ala+para	None	None	57	49	47	20	71	52	37
Lactofen	Lactofen	None	89	92	100	88	85	100	100
None	Lactofen	Lactofen	90	90	99	94	93	66	100
None	Ala+ lactofen	Lactofen	89	93	100	96	88	74	100
None	None	Lactofen	80	84	97	88	85	33	100
None	None	Aci+bent	92	92	81	56	93	50	99
LSD (0.05)			11	15	4	18	13	12	14

[a]Aci = Acifluorfen at 0.28 kg ha^{-1}; Ala = alachlor at 2.20 kg ha^{-1}; bent = bentazon at 0.56 kg ha^{-1}; lactofen at 0.22 kg ha^{-1}; and para = paraquat at 0.14 kg ha^{-1}.

[b]Metolachlor was applied to all plots PRE at 2.20 kg ha^{-1}.

[c]*Ipomoea spp.* consisted of a complex of entireleaf, ivyleaf, and pitted morningglory.

Table 2. Peanut yield with herbicide programs containing lactofen[a,b].

Herbicide and application timing			Yield	
GC	EPOST	LPOST	1988	1989
			kg ha^{-1}	
None	None	None	1490	1720
Ala+para	None	None	2620	1430
Lactofen	Lactofen	None	3190	2400
None	Lactofen	Lactofen	2110	1650
None	Ala+ lactofen	Lactofen	2470	1860
None	None	Lactofen	2440	1570
None	None	Aci+bent	2930	1340
Weed free control			3840	2620
Weedy control			1110	1280
LSD (0.05)			920	1030

[a]Aci = Acifluorfen at 0.28 kg ha^{-1}; Ala = alachlor at 2.20 kgha^{-1}; bent = bentazon at 0.56 kg ha^{-1}; lactofen at 0.22 kg ha^{-1}; and para = paraquat at 0.14 kg ha^{-1}.

[b]Metolachlor was applied to all plots PRE at 2.20 kg ha^{-1} except the controls.

shown). By mid-July, peanut had completely recovered from the herbicide-induced injury. Previous research indicated good peanut tolerance to paraquat, lactofen, and acifluorfen+bentazon in virginia peanut (4, 5, 6, 7, 8).

All herbicide-containing systems except metolachlor alone yielded greater than the weedy control in 1988 (Table 2). Only lactofen GC fb lactofen EPOST provided peanut yield equivalent to the weed-free check in 1988. Yields that were statistically equivalent to this lactofen system, though numerically less were obtained with 1) alachlor+ paraquat GC, 2) alachlor+lactofen EPOST fb lactofen LPOST, 3) lactofen LPOST, and 4) acifluorfen+bentazon LPOST.

In 1989, maximum yield from a herbicide-containing system was obtained with lactofen applied GC+EPOST. This treatment yielded equivalent to the weed-free check, 2,400 versus 2,620 kg ha^{-1}, respectively. The weedy check yielded 1,280 kg ha^{-1} while all remaining systems were intermediate to these extremes.

Summary

These data indicated that a system with sequential applications of lactofen at GC fb EPOST provided greater broadleaf weed control than either lactofen applied sequentially EPOST fb LPOST or a single LPOST application of either lactofen or acifluorfen+bentazon. Better control was generally reflected in higher peanut yields. Overall, the sequential application of lactofen at GC fb EPOST was the most effective herbicide system. This system provided superior control of prickly sida and common lambsquarters than the standard of acifluorfen+bentazon. This system was the only system to yield as high as the weed-free checks in both years.

Acknowledgment

The authors wish to thank David N. Horton and Leslie D. Fortner for technical assistance. Appreciation is also extended to the Virginia Peanut Growers Association and Valent USA for partial funding support of this research.

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Accepted September 10, 1993