

**TWO-PASS WEED CONTROL**  
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**Introduction**

Improved corn (*Zea mays*) and soybeans (*Glycine max*) varieties have strong seedling vigor and, under favorable environmental conditions, exhibit satisfactory tolerance to many herbicides. Adequate weed management in non-transgenic corn or soybeans generally can be accomplished with a pre-emergence followed by a post emergence herbicide treatment. Thus tillage for the purpose of herbicide incorporation is often not required in these crops, and cultivation may not be utilized. However, conventional weed management in cotton (*Gossypium hirsutum*) generally requires at least three separate herbicide applications. Moreover the first herbicide treatment is usually incorporated in the soil before planting. In addition, two to three cultivations are commonly used in conventional cotton. Therefore, weed control in conventional cotton costs more than that in corn or soybeans, in large part because of the number of field trips that are required. Not only are more herbicides used, but in general, more tillage is necessary, and the use of cultivation is more common. It is possible to accomplish adequate weed management in corn or soybeans with one or two tillage operations and two herbicide treatments. In contrast, cotton weed management generally requires three tillage operations, three separate herbicide applications, and multiple cultivations.

With transgenic, herbicide resistant varieties, two post emergence applications of Roundup Ultra® herbicide (glyphosate) usually provide excellent weed control in Roundup Ready® soybeans. However, due to cotton's slow early-season growth, Roundup Ready® cotton still may require three or more, carefully-timed weed management treatments to achieve adequate weed control. An additional limitation is that, Roundup Ultra herbicide may not be used over-the-top of Roundup Ready cotton beyond the 4- leaf stage. Consequently most cotton weed management programs still need four or more field passes to achieve adequate weed control. While Roundup Ultra alone generally does not achieve acceptable weed control with two passes, combining Roundup Ultra with other herbicides, particularly herbicides with soil-residual activity might create workable, two-pass weed control programs. The objective of this research is to develop herbicide programs that would achieve adequate weed control in cotton using only two field passes. Thus reducing the number of field operations and consequent equipment and labor costs to levels similar to those needed for weed control in corn and soybeans.

**Experimental Approach**

Treatments were designed to provide full-season control of a broad spectrum of weed species with only a minimum number of applications. Three treatment strategies were used: 1) Current, commonly used standards which require more than two passes; 2) The use of a long-residual, broad spectrum layby herbicide, after a single, early Roundup application and 3) Programs evaluating residual tank mix partners with Roundup. Exact treatments are listed in Tables 1 and 2.

Several registered and experimental herbicides from corn and soybeans were evaluated for their potential as long-residual, broad spectrum post-directed, layby herbicides in cotton. These were: Reflex® (fomesafen),

Callisto® (mesotrione), FirstRate® (chloransulam), and Valor® (flumioxazin). Herbicides were applied with MSMA.

Within the residual tank mix programs a factorial arrangement of four tank mixtures and three application schemes were used. The tank mixtures 1) Roundup® alone, 2) Roundup plus Milopro® (propazine) 3) Roundup plus Dual II Magnum® (s-metolachlor) and 4) Roundup plus Milopro plus Dual II Magnum. Application schemes were 1) Prowl® (pendimethalin) plus Cotoran® preemergence followed by Roundup tank mixtures at the 4-leaf stage of cotton; 2) Roundup tank mixtures at the cotyledon stage of cotton followed by Reflex (fomesafen) plus MSMA at layby; and 3) Roundup tank mixtures at the four-leaf stage of cotton followed by Reflex plus MSMA at layby. Milopro and Dual II magnum were chosen as residual tank mix partners because preliminary research showed these herbicides to be promising for this use.

Field experiments were done using standard weed science, small-plot methods, at Portageville and Clarkton, Missouri on Tiptonville fine sandy loam and Boskett sandy loam soils respectively. Control of crabgrass (*Digitaria spp.*), goosegrass (*Eleusine indica*), Palmer amaranth (*Amaranthus palmeri*), common cocklebur (*Xanthium strumarium*), ivy' and entireleaf morningglory (*Ipomea herderacea* and *lacunosa*) and puncturevine (*Tribulus terrestris*) was evaluated. A hail storm at the Portageville location and sand damage at the Clarkton location severely damaged cotton and yield was not collected.

**Results**

Three-way tank mixtures of Roundup + MiloPro + Dual followed with Reflex + MSMA usually provided 90% or greater weed control, whether applied following Prowl and Cotoran, or applied over-the-top with no prior treatment, (Tables 1 and 2). However, cotyledon-stage applications of the same mixtures followed by Reflex + MSMA were an exception at the Clarkton location, where weed control was less than 90% (Table 2). The two-pass programs outlined above provided equivalent or better weed control than did a three-pass program comprised of Cotoran followed by two Roundup applications or a traditional program of Prowl + Cotoran followed by Cotoran + MSMA, early post-directed followed by Reflex + MSMA, late post-directed. Callisto, FirstRate or Valor, post directed following an early application of Roundup, provided less than 80% control of crabgrass, goosegrass, ivyleaf and entireleaf morningglory and Palmer amaranth in some instances.

**Summary**

The best two-pass treatments provided equivalent or better weed control than that from current three-pass standards (Prowl + Cotoran followed by Cotoran + MSMA or Staple followed by Reflex + MSMA), two Roundup applications alone or Cotoran followed by Roundup. The two pass programs cost less than the three-pass standards, but were more expensive than two Roundup applications or Cotoran followed by Roundup (Tables 1 and 2). Experimental layby herbicides were generally weak on goosegrass and Palmer amaranth. Palmer amaranth remains as a key, difficult-to-control weed species.

Table 1. Weed control and costs from two-pass and standard cotton weed control programs at Portageville, Missouri, 2000.

Treatment			Final Weed Control				Approximate Cost <sup>2</sup>
Herbicide	Rate	Timing <sup>1</sup>	Goosegrass	Palmer Amaranth	Common Cocklebur	Ivyleaf & Entireleaf Morningglory	
lb ai/A			-----(-%)-----				\$/A
Prowl	1	PRE					
Cotoran	1.25	PRE					
Roundup	0.75	4-LF	95	75	88	90	31
Prowl	1	PRE					
Cotoran	1.25	PRE					
Roundup	0.75	4-LF					
MiloPro	1	4-LF	95	93	95	95	36
Prowl	1	PRE					
Cotoran	1.25	PRE					
Roundup	0.75	4-LF					
Dual M.	1	4-LF	100	95	83	78	42
Prowl	1	PRE					
Cotoran	1.25	PRE					
Roundup	0.75	4-LF					
MiloPro	1	4-LF					
Dual M.	1	4-LF	98	96	100	95	47
Roundup	0.75	COTYL					
Reflex	0.375	LAYBY					
MSMA	2	LAYBY	63	78	90	85	39
Roundup	0.75	COTYL					
MiloPro	1	COTYL					
Reflex	0.375	LAYBY					
MSMA	2	LAYBY	63	80	88	80	44
Roundup	0.75	COTYL					
Dual M.	1	COTYL					
Reflex	0.375	LAYBY					
MSMA	2	LAYBY	95	98	90	88	49
Roundup	0.75	COTYL					
MiloPro	1	COTYL					
Dual M.	1	COTYL					
Reflex	0.375	LAYBY					
MSMA	2	LAYBY	95	96	96	93	55
Roundup	0.75	4-LF					
Reflex	0.375	LAYBY					
MSMA	2	LAYBY	68	85	93	88	39
Roundup	0.75	4-LF					
MiloPro	1	4-LF					
Reflex	0.375	LAYBY					
MSMA	2	LAYBY	83	96	90	90	44
Roundup	0.75	4-LF					
Dual M.	1	4-LF					
Reflex	0.375	LAYBY					
MSMA	2	LAYBY	95	95	88	88	49
Roundup	0.75	4-LF					
MiloPro	1	4-LF					
Dual M.	1	4-LF					
Reflex	0.375	LAYBY					
MSMA	2	LAYBY	98	100	100	95	55
Prowl	1	PRE					
Cotoran	1.25	PRE					
Cotoran	1	DIR@4-LF					
MSMA	2	DIR@4-LF					
Reflex	0.375	LAYBY					
MSMA	2	LAYBY	95	88	98	98	60

Table 1, continued

Treatment			Final Weed Control				Approximate Cost <sup>2</sup>
Herbicide	Rate	Timing <sup>1</sup>	Goosegrass	Palmer Amaranth	Common Cocklebur	Ivyleaf & Entireleaf Morningglory	
lb ai/A			------(%)-----				\$/A
Prowl	1	PRE					
Cotoran	1.25	PRE					
Staple	0.0625	4-LF					
Reflex	0.375	LAYBY					
MSMA	2	LAYBY	78	65	85	88	70
Roundup	0.75	4-LF					
Roundup	0.75	LAYBY	70	80	85	75	28
Cotoran	1.25	PRE					
Roundup	0.75	4-LF					
Roundup	0.75	LAYBY	95	98	98	93	38
Roundup	0.75	4-LF					
Callisto <sup>3</sup>	0.094	LAYBY					
MSMA	2	LAYBY	60	80	90	78	NA <sup>3</sup>
Roundup	0.75	4-LF					
FistRate	0.016	LAYBY					
MSMA	2	LAYBY	65	68	80	80	32
Roundup	0.75	4-LF					
Valor <sup>3</sup>	0.0625	LAYBY					
MSMA	2	LAYBY	60	85	95	88	NA <sup>3</sup>
Untreated			0	0	0	0	0
LSD (5%)			10	13	13	14	

<sup>1</sup>Timing abbreviations: PRE, preemergence, just after planting; 4-LF, cotton with 4 true leaves and approximately 3" tall; COTYL, cotton in cotyledon stage; LAYBY, postemergence directed application when cotton is 8 to 12" tall; DIR @ 4-leaf, postemergence directed application when cotton is approximately 3" tall.

<sup>2</sup>Costs estimated based upon herbicide prices from 2000 Mississippi State Weed Control Guidelines and a \$4/A application cost. Application costs were not added for preemergence applications as they are usually applied from planter-mounted sprayers.

<sup>3</sup>Callisto and Valor are not commercially available and prices have not been announced at this time.

Table 2. Weed control and costs from two-pass and standard cotton weed control programs at Clarkton, Missouri, 2000.

Treatment			Final Weed Control			
Herbicide	Rate lb ai/A	Timing <sup>1</sup>	Goosegrass	Palmer	Puncturevine	Approximate Cost <sup>2</sup> \$/A
				Amaranth		
Prowl	1	PRE				
Cotoran	1.25	PRE				
Roundup	0.75	4-LF	88	75	88	31
Prowl	1	PRE				
Cotoran	1.25	PRE				
Roundup	0.75	4-LF	93			
MiloPro	1	4-LF		94	90	36
Prowl	1	PRE				
Cotoran	1.25	PRE				
Roundup	0.75	4-LF				
Dual M.	1	4-LF	100	100	80	42
Prowl	1	PRE				
Cotoran	1.25	PRE				
Roundup	0.75	4-LF				
MiloPro	1	4-LF				
Dual M.	1	4-LF	100	98	95	47
Roundup	0.75	COTYL				
Reflex	0.375	LAYBY				
MSMA	2	LAYBY	83	63	83	39
Roundup	0.75	COTYL				
MiloPro	1	COTYL				
Reflex	0.375	LAYBY				
MSMA	2	LAYBY	80	93	93	44
Roundup	0.75	COTYL				
Dual M.	1	COTYL				
Reflex	0.375	LAYBY				
MSMA	2	LAYBY	95	70	88	49
Roundup	0.75	COTYL				
MiloPro	1	COTYL				
Dual M.	1	COTYL				
Reflex	0.375	LAYBY				
MSMA	2	LAYBY	88	85	80	55
Roundup	0.75	4-LF				
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Reflex	0.375	LAYBY				
MSMA	2	LAYBY	88	90	95	44
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MiloPro	1	4-LF				
Dual M.	1	4-LF				
Reflex	0.375	LAYBY				
MSMA	2	LAYBY	98	95	100	55
Prowl	1	PRE				
Cotoran	1.25	PRE				
Cotoran	1	DIR@4-LF				
MSMA	2	DIR@4-LF				
Reflex	0.375	LAYBY				
MSMA	2	LAYBY	100	90	100	60

Table 2, continued

Treatment			Final Weed Control			
Herbicide	Rate lb ai/A	Timing <sup>1</sup>	Goosegrass	Palmer Amaranth	Puncturevine	Approximate Cost <sup>2</sup>
			------(%)-----			\$/A
Prowl	1	PRE				
Cotoran	1.25	PRE				
Staple	0.0625	4-LF				
Reflex	0.375	LAYBY				
MSMA	2	LAYBY	95	95	98	70
Roundup	0.75	4-LF				
Roundup	0.75	LAYBY	93	93	98	28
Cotoran	1.25	PRE				
Roundup	0.75	4-LF				
Roundup	0.75	LAYBY	94	91	94	38
Roundup	0.75	4-LF				
Callisto <sup>3</sup>	0.094	LAYBY				
MSMA	2	LAYBY	68	90	93	NA <sup>3</sup>
Roundup	0.75	4-LF				
FisrRate	0.016	LAYBY				
MSMA	2	LAYBY	93	88	98	32
Roundup	0.75	4-LF				
Valor <sup>3</sup>	0.0625	LAYBY				
MSMA	2	LAYBY	85	93	95	NA <sup>3</sup>
Untreated			0	0	0	0
LSD (5%)			15	14	12	

<sup>1</sup>Timing abbreviations: PRE, preemergence, just after planting; 4-LF, cotton with 4 true leaves and approximately 3" tall; COTYL, cotton in cotyledon stage; LAYBY, postemergence directed application when cotton is 8 to 12" tall; DIR @ 4-leaf, postemergence directed application when cotton is approximately 3" tall.

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