

**THE EFFECT OF LATE SEASON
APPLICATION OF GLYPHOSATE ON COTTON
PLANTS AND WEEDS**

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Abstract

Glyphosate (Roundup, 0.36 kg ae/L) applied over the top of cotton plants at 20% open bolls improved boll ripening, defoliation, prevented vegetative regrowth, improved lint quality and controlled weeds. In addition to increase the farmer income it also reduces the number of the remaining bolls and thus reduced the survival rate of the Pink Boll Worm.

Introduction

Vegetative and reproductive crop growth at late season, are strong sinks and may compete on assimilates with the developing fruits (bolls). This late growth may result in lower yield and poor fiber quality. Late emerging weeds do not effectively compete with the crop, but may interfere with the mechanical harvest, reduce lint quality and enrich the seed bank in the soil. In cotton, glyphosate is usually applied at the early stages of seedbed preparation for a non-selective control of existing annual and perennial weeds. At a later stages, roundup is also applied as directed spray or as a 'lay by' treatment to control emerging weeds. Due to its mobility in the plant phloem, the herbicide moves rapidly in the plant and accumulates in sinks such as growing points, meristems and storage organs. In the present study we report on a series of 5 years of experiments, in which we examined the herbicide ('Roundup') for its activity as a preharvest growth regulator for cotton and for selective control of late germinating weeds.

Material and Methods

Field trials were conducted during 5 consecutive years from 1995 through 1999 (Table 1). Some of the field were grown as "skip row" where (2 rows, 1 skip), whereas the the other experiments were conducted in "normally" grown cotton (rows 0.96m appart). 'Roundup' was applied on cotton grown

in commercial drip irrigated fields at different stages of fruit development, from 0 to 40% boll opening. The herbicide was applied at a level of 0 to 6.6% (v/v) of the spray volume using either aerial (30 L/ha) or ground application (100L/ha). Weeds infesting the fields were at different growth stages and some of them were in early seed set. Experiments were designed in random blocks with 3 to 4 replicates. When air application was practiced, plots were large enough to make at least one module per plot (ca. 1.8 ha/plot). When ground application was used, plots were smaller (0.36 ha/plot). Similar experiments were conducted annually in several regions throughout the country.

Table 1. Details of the field experiments with roundup applied at late growth stage of cotton, 1995-1999

Year	Cotton type	Boll opening (%)	Roundup rate (L/ha)	Spray volume (L/ha)	Number of site
1995	Acala	20	1.0	30	3
1996	Acala	20	1.0	30	4
1996	Acala	20	3.3	100	4
1997	Acala	0/10/40	3.3/6.6	100	2
1997	Acala	20	1.0	30	6
1998	Acala	20	3.3	100	2
1998	Acala	20	1.0	30	2
1998	Pima	15	2.0/4.0/6.0	100	1
1999	Acala	20	3.3	100	1
1999	Pima	20/40	8.0	200	1

Parameters Checked

Cotton growth and reproduction were monitored from the late application of roundup until the harvest. Seed cotton was harvested mechanically and the following fiber quality parameters: grade, length, strength, micronaire, as well as stickiness, trash content and neps were determined. Both, weeds and crop seeds were collected and their viability was measured following germination in pots. Bolls remaining after the harvest were counted and the rate of pink boll worm infested bolls was determined.

Results

The first experiments conducted in 1995 in 3 sites indicated that air applied roundup at the 20% boll opening stage did not cause any damage to the crop or yield. On the contrary, although not statistically significant, most quality parameters were improved as compared to the untreated control. Weeds such developed johnsongrass (*Sorghum halepense*), black nightshade (*Solanum nigrum*) and palmer amaranth (*Amaranthus palmeri*) were completely controlled.

Further experiments have shown that early application of roundup (0 boll opening) affected the germination rate of cotton seeds and more so of *Euphorbia geniculata* seeds (Table 2). Furthermore, this early treatment inhibited the emergence of cotton seeds at a rate-dependent pattern whereas the emergence of *E. geniculata* seeds was completely ceased. Later roundup application (10% and 40% boll opening) did not affect cotton seed germination and slightly

inhibited their emergence. *E. geniculata* seed's germination and emergence were both inhibited at this application and only half of them were viable. These data indicate that glyphosate was taken up by both, cotton and weed plants and it was translocated to their sinks (the seeds) resulting in significant damage to the seeds. However, when roundup was applied at 40% boll opening, many of the cotton seeds were fully developed and their vigor was less affected (Table 2).

Table 2. Germination and emergence of seeds harvested from cotton and weeds treated with roundup at different rates and stages of boll opening (ground application).

Roundup (L/ha)	Boll opening	Cotton		<i>Euphorbia</i>	
		Germin.	Emerg.	Germin.	Emerg.
0	0	100	100*	100*	100*
3.3	0	97	75	65	0
6.6	0	87*	30	60	0
3.3	10	97	73	50	45
6.6	10	97	71	50	40
3.3	40	100	81	50	50
6.6	40	100	69	50	40

*Significant difference

During the summer of 1996, roundup was applied either from the air (4 experiments) or the ground (4 experiment) when cotton plants were at the 20% boll opening. In spite of the fact that roundup rate (L/ha) was more than 3 folds higher when ground application was used (3.3 L/ha) as compared to air application (1.0 L/ha), no differences in cotton response were observed. These data indicated the importance of the roundup concentration in the spray volume rather than the rate applied. On the other hand, when the efficacy of the herbicide was examined in 'skip row' as compared to 'normal' cotton, significant differences were found (Table 3).

Table 3. Effect of air-applied roundup (1.0 L/ha) on 'Acala' cotton grown as 'skip row' or 'normal' stand. Results are combined from 4 different locations tested in 1996.

Cotton	Roundup	Yield parameters*			
		Lint (mt/ha)	Lint (%)	Grade	Value (\$/ha)
'Skip row'	+	1.80a	33.2a	51.8a	334a
	-	1.62b	31.8a	55.3b	295b
'Normal'	+	1.94a	33.1a	53.7a	353a
	-	1.99a	33.9a	53.8a	350a

*Means followed by the same letter within each pair are not significantly different (p=0.05).

Along the 5 years of experiments, no significant differences were found in fiber quality parameter (Table 3 and Table 4). Roundup applied at all stages tested improved cotton leaves defoliation as it is evident from the data in Table 4. Similarly, in Acala and Pima type cotton these treatments with roundup reduced significantly the number of unripe bolls that remained on the plant after picking (Fig. 1). Hence, there was less chance for the Pink Boll Worm to survive and damage the following crop.

Table 4. Effect of time of ground application and rate of roundup on Acala cotton foliage, yield and quality parameters.

Roundup (L/ha)	Boll				
	Opening (%)	Leaves (%)	Yield (mt/ha)	Grade	Neps
0.0	-	100*	5.77	50.7	47
3.3	0	62	5.94	45.9	37
6.6	0	67	5.70	50.5	25
3.3	10	54	5.66	45.6	36
6.6	10	63	5.87	50.6	24
3.3	40	58	5.83	50.7	24
6.6	40	28	5.72	45.6	29

*Significant difference

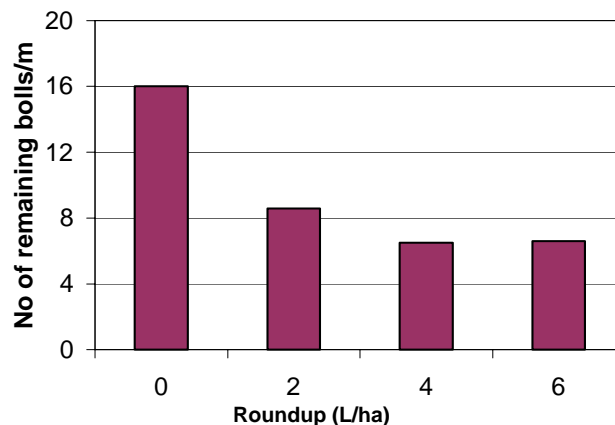


Figure 1. Effect of roundup rates applied at 15% boll opening of Pima cotton on the number of bolls remaining on the plant after picking.

Summary and Conclusions

- P Air and ground applied roundup at the 0 to 40% boll opening did not cause any visible damage to the crop or yield.
- P Although more than 3 folds more roundup was applied by ground application (3.3 L/ha) as compared to air application (1.0 L/ha), no differences in cotton response were observed, indicating the importance of roundup concentration in the spray volume rather than the rate applied.
- P Roundup was more efficacious in 'skip row' as compared to 'normal' cotton stand (40 inches).
- P Most lint quality parameters were improved (or not affected) as compared to the untreated control.
- P Weeds present at the time of application were controlled and the vigor of their seed severely reduced.

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