

Value of Roundup Ready Technology in Strip-Tilled Soybeans

*D. L. Wright, P. J. Wiatrak, B. Kidd, W. Koziara,
T. Piechota, J. Pudelko, and D. Zimet

ABSTRACT

Research was conducted during 1995 and 1996 on a Dothan sandy loam to evaluate: 1) Roundup Ready (RR) soybean (*Glycine max* in a Roundup only herbicide program as compared to a conventional herbicide program using strip tillage, and 2) the economic comparisons based on yield and costs. In 1995, most Roundup treatments controlled weeds better than preemergence Prowl and postemergence Classic, except when morningglory (*Ipomoea* spp.) was present. Applications of Roundup (especially repeat applications) significantly increased plant height. Yields of soybean in 1995 varied from 38 bu/a to 20.4 bu/a with best yields from treatments where Roundup was applied three times. In 1996, two applications of Roundup Ultra provided good nutsedge (*Cyperus* spp.) control (at least 70%) except the lower rate of Roundup Ultra, 1.5 pt/a followed by 1.5 pt/a. Yields were higher after most Roundup treatments as compared to conventional treatments or the control. Cost of the conventional herbicide program in 1995 was about \$17/a as compared to almost \$34/a for the three applications of Roundup plus Prowl. However, yield was 9.6 bu/a more in the RR system resulting in about \$30/a more profit when including the technology fee and extra seed cost. Cost in 1996 was about \$21/a for the conventional herbicide program as compared to \$9/a for Roundup with a 9.6 bu/a yield advantage, resulting in about a \$67/a advantage to RR technology. Both of these trials were conducted using strip tillage which would have additional savings over conventional tillage, probably resulting in an even greater economic advantage.

INTRODUCTION

Roundup Ready (RR) technology in soybean (*Glycine max* [L.] Merr.) was approved recently and has gained high grower interest and acceptance. Weed control and planting method in soybean will experience

radical changes as varieties adapted to the region become available to growers. Research across the United States has consistently shown that RR systems will control weeds in a cost-effective manner (Woodruff, 1997). Preliminary studies have indicated that one application of Roundup in narrow rows may be adequate to control weeds season long, while two applications may be necessary for season long control on wide row soybean (Murphy, 1997). Roundup Ready technology has not been shown to cause yield reduction. However, many of the current varieties on the market are not adapted to Southern conditions because they mature too early. Therefore, improvements in yield can be expected as better adapted varieties become available. Due in part to RR technology, more strip till or no-till and use of conservation tillage and narrow rows will be used since weeds can be controlled more efficiently than in the past. The objectives were to evaluate: 1) RR soybean in a Roundup only herbicide program as compared to a conventional herbicide program using strip tillage, and 2) the economic comparisons based on yield and costs.

MATERIALS AND METHODS

In 1995, Roundup at 1 qt/a + Induce 0.5% v/v was applied on 25 May and on 6 June, 500 lb/a of 3-9-18 fertilizer was applied over the entire study. On 9 June, soybean was planted strip tillage with a Brown Rotill implement and KMC planters in four row by 20-ft-long plots. Two middle rows of each plot were planted with a transgenic cultivar (Asgrow) at a seeding rate of 3.6 seeds/1 ft of row. Two outside rows were planted with the soybean cultivar 'NK4884'. Preemergence herbicides were applied on the day of planting. Biocot @ 2 pt/a + Dimilin 2L @ 4 oz/a + Crop oil @ 1 qt/a were applied on 14 August to control insects. Postemergence herbicides were sprayed on 28 June (Classic and Roundup), 11 July (Roundup), 26 July (Roundup), and 25 August (Roundup). The influence of treatments on soybean plant height was evaluated two wk after the first application of Roundup and 140 d after planting.

Estimation of weed control was performed on a percent basis, where 100% = highest weed control and 0% = no weed control. Weed control was estimated 40 and 80 d after planting. Number of weeds per plot were counted two wk after planting and after every postemergence treatment application. Because the leaves had not dropped and were still green, soybean was

¹D.L. Wright, ¹P.J. Wiatrak, ¹B. Kidd, ²W. Koziara, ²T. Piechota, ²J. Pudelko, and ²D. Zimet. ¹University of Florida, North REC, Quincy, FL. and ²Agric. Univ. of Poznan, Plant and Soil Cultivation Dept., Mazowiecka, Poznan, Poland. Manuscript received 21 April 1997.

*Corresponding author.

defoliated with Harvade @ 8 oz/a + Dropp @ 1/8 pt/a + Crop oil @ 1 pt/a and harvested on 1 Dec.

In 1996, Roundup Ultra at 1 pt/a was applied to the study area on 13 June (2 d before planting). The entire study was planted with 'HARTZ 7550' Roundup Ready soybean cultivar using a Brown Ro-till implement and KMC planters in strip tillage at 10 seeds/ft and in 3 ft wide rows on 15 June. Plot size was 4 rows x 25 ft long.

Preemergence herbicides were applied on the day of planting and postemergence herbicides were applied on 10 July and 18 July. Ambush at 6 oz/a + PennCap M at 0.5 pt/a + Dimilin 2F at 4 oz/a were applied to control insects on 5 September.

Soybean growth (plant height) was evaluated two wk after Roundup application and 140 d after planting in 1995, and 30 days after herbicide applications in 1996. Soybean was harvested on 4 December. Both tests were arranged in a Randomized Complete Block design with four replications. Data were analyzed by analysis of a variance and means were separated using Fisher's LSD test at the 5% probability level.

RESULTS AND DISCUSSION

In 1995, all plots treated with residual herbicides, except where Roundup was used in the combination, had three times more weeds (mainly nutsedge [*Cyperus* spp.] and grasses) growing in the second half of the vegetative period. Main weed species in the control plots were: crabgrass (*Digitaria* sp.) (1.5/sq.ft.), junglerice (*Echinochloa colonum* [L.] Link) (1.2/sq. ft.), bahiagrass (*Paspalum notatum* Flugge) (0.3/sq. ft.), nutsedge (5.4/sq. ft.), morningglory (*Ipomoea* sp.) (0.7/sq. ft.) and pigweed (*Amaranthus* sp.) (1.0/sq.ft.). Most treatments with Roundup controlled weeds better than preemergence Prowl and postemergence Classic, especially at 80 DAP evaluation (Table 1a and 1b). The exception was morningglory control where an application of Prowl + Classic gave best results.

Applications of Roundup significantly increased height of soybean plants when compared to the control (Table 2). This effect was visible throughout the season. Soybean was shortest in control plots due to competition from weeds. Plant number was not influenced by any herbicide treatments. Grain yield of soybean varied from 3.8 bu/a to 20.4 bu/a (Table 2). The highest yields were obtained from treatments where Roundup was applied three times. Low yields of soybean were due to use of the Asgrow variety not adapted to Florida conditions.

In 1996, both yellow (*Cyperus esculentus*) and purple (*Cyperus rotundus*) nutsedge species were

present, and none of the preemergence herbicides controlled nutsedge. Two applications of Roundup Ultra provided good control (at least 70%) of nutsedge (Table 3). Only Roundup Ultra at 1.5 pt/a followed by 1.5 pts./a gave less than 70% control of nutsedge. Roundup Ultra applied once provided lower control of nutsedge when compared to two applications of Roundup Ultra. Application of Roundup Ultra at 3 pts./a controlled only 64% of nutsedge. One application of Roundup at 1.5 pt/a gave less than 20% control of nutsedge.

There were no differences in plant height of soybean among treatments with the applications of Roundup. Good stands and fast growing soybean developed a closure which covered weeds. Nutsedge was not present before harvest. Differences in height of soybean were observed soon after application of postemergence herbicides (Table 4). Plants treated with Prowl + Canopy and Fusilade DX + Classic + Agridex were shorter than untreated ones. Soybean was taller in the plots treated with Squadron than in the control plots. Later, during the vegetation season, herbicide treatments did not affect the height of soybean. The yields of soybean were higher after applications of Roundup Ultra as compared to other treatments (Table 4).

The conventional herbicide program in 1995 cost about \$17/a as compared to the Prowl + Roundup system which cost about \$34/a. If the technology fee and extra seed cost were added to this an extra \$11 would need to be added to the \$34 for a total cost of \$45/a. However, an extra 9.6 bu/a of soybeans were produced at a value of \$67.20, making the Roundup system about \$39/a more profitable.

In 1996, the conventional program of Prowl + Canopy cost about \$21/a while the best Roundup treatment cost \$9/a. At the same time yield was 9.6 bu/a better for the Roundup system making the Roundup system about \$67/a more profitable after the seed price and technology fee are taken into account. These figures are for strip till soybean and do not make a comparison with conventional soybean which would require more tillage, labor, fuel, and have more soil erosion over the long run. This new genetic technology is exciting since it can cut weed control costs, aid in transformation to conservation tillage and perhaps result in higher yields.

LITERATURE CITED

- Murphy, T.R. 1997. Pre harvest weed control. Oilseed Reporter. 7(1):5.
Woodruff, J.M. 1997. RR soybean variety and drill planting. Oilseed Reporter. 7(1):8.

Table 1a. Weed control at 40 and 80 d after herbicide treatment of Roundup Ready soybean in 1995.

Treatment	Crabgrass (%)		Junglerice (%)		Bahlagrass (%)	
	40	80	40	80	40	80
Check						
Roundup 1.5pt/a*+Roundup 1pt/a*	89.8	78.2	77.8	71.5	72.0	74.2
Prowl 2.3 pt/a PRE Classic 0.5 oz/a 20 days later	83.0	56.2	71.2	55.8	75.5	70.5
Prowl 2.3 pt/a PRE Classic 0.5 oz/a 20 days later Roundup 1.5 pt/a*	75.0	80.0	76.5	80.5	87.0	83.5
Prowl 2.3 pt/a PRE Roundup 1.5pt/a*	84.5	67.5	74.8	58.0	83.8	70.0
Prowl 2.3 pt/a PRE Roundup 1 qt/a**	86.0	74.0	82.0	71.8	94.2	72.5
Prowl 2.3 pt/a PRE Roundup 1.5 pt/a* as needed (3x)	91.8	93.8	77.0	85.2	83.5	89.8
Roundup 1.5pt/a* +AMS 2%	88.0	71.8	91.5	65.0	84.5	65.8
Roundup 1 pt/a* +AMS 2% Roundup 1 pt/a* +AMS 2%	86.8	87.2	93.2	86.8	87.5	79.8
Prowl 2.3 pt/a PRE Roundup 1pt/a* +AMS 2%	84.2	70.8	77.5	63.0	86.2	68.0
Prowl 2.3 pt/a PRE Roundup 1 qt/a** +AMS 2%	92.0	79.2	84.5	80.5	88.2	76.8
Roundup 1.5 pt/a* +AMS 2% as needed (3x)	86.8	83.5	89.5	86.7	85.0	83.0
Mean	86.2	76.6	81.4	73.2	84.3	75.8
SD _(0.05)	13.6	10.6	n.s.	14.5	n.s.	9.3

PRE - preemergence, * - when weeds were 2-3 in. tall, ** - when weeds were 4-6 in. tall

Table 1b. Weed control at 40 and 80 d after herbicide treatment of Roundup Ready soybean in 1995.

Treatment	Pigweed (%)		Morningglory (%)		Purple Nutsedge (%)	
	40	80	40	80	40	80
Check						
Roundup 1.5pt/a*+Roundup 1 pt/a*	98.8	94.2	79.2	75.8	73.2	73.0
Prowl 2.3 pt/a PRE						
Classic 0.5 oz/a 20 days later	83.2	68.2	93.8	82.0	83.5	69.0
Prowl 2.3 pt/a PRE						
Classic 0.5 oz/a 20 days later	87.8	85.0	91.2	85.2	81.8	82.5
Roundup 1.5pt/a*						
Prowl 2.3 pt/a PRE	82.0	75.5	74.2	57.5	86.5	64.0
Roundup 1.5pt/a*						
Prowl 2.3 pt/a PRE	83.2	73.8	83.0	60.5	85.2	55.8
Roundup 1 qt/a**						
Prowl 2.3 pt/a PRE	84.2	86.2	79.2	77.5	86.5	78.5
Roundup 1.5pt/a* as needed (3x)						
Roundup 1.5 pt/a*+ AMS 2%	81.2	65.2	89.5	73.8	83.5	64.5
Roundup 1 pt/a* + AMS 2%						
Roundup 1pt/a* +AMS 2%	83.0	65.5	87.5	79.5	89.8	73.0
Prowl 2.3 pt/a PRE						
Roundup 1 pt/a* +AMS 2%	80.0	62.5	86.2	70.5	85.8	70.2
Prowl 2.3 pt/a PRE						
Roundup 1 qt/a** + AMS 2%	86.5	76.2	77.2	63.8	89.2	66.5
Roundup 1.5pt/a* +AMS 2%						
as needed (3x)	91.5	89.5	71.8	70.0	85.5	84.5
Mean	85.6	76.5	83.0	72.4	84.6	71.1
LSD_(0.05)	11.4	8.9	16.9	11.0	14.9	8.7

PRE - preemergence, * - when weeds were 2-3 in. tall, ** - when weeds were 4-6 in. tall.

Table 2. Influence of herbicide treatment on plant number per 1 ft of row, plant height, and grain yields of soybean in 1995.

Treatment	Plants per 1 ft of row	Plant height (in.)		Grain yield (bu/a)
		2 weeks after Roundup appl.	140 days after planting	
Check	2.4	11.8	15.8	3.8
Roundup 1.5 pt/a*+Roundup 1 pt/a*	2.4	12.7	20.8	15.2
Prowl 2.3 pt/a PRE Classic 0.5 oz/a 20 days later	2.4	15.2	25.2	8.6
Prowl 2.3 pt/a PRE Classic 0.5 oz/a 20 days later Roundup 1.5 pt/a*	2.2	13.6	22.8	12.7
Prowl 2.3 pt/a PRE Roundup 1.5 pt/a*	2.3	13.4	22.8	10.8
Prowl 2.3 pt/a PRE Roundup 1 qt/a**	2.3	13.5	23.2	12.2
Prowl 2.3 pt/a PRE Roundup 1.5 pt/a* as needed (3x)	2.2	12.9	21.5	19.1
Roundup 1.5 pt/a* +AMS 2%	2.5	12.6	22.7	13.1
Roundup 1 pt/a* + AMS 2% Roundup 1 pt/a* + AMS 2%	2.5	12.8	22.1	16.4
Prowl 2.3 pt/a PRE Roundup 1 pt/a* + AMS 2%	2.3	13.1	22.8	11.6
Prowl 2.3 pt/a PRE Roundup 1 qt/a** + AMS 2%	2.1	13.6	23.0	12.6
Roundup 1.5 pt/a* +AMS 2% as needed (3x)	2.4	12.4	21.0	20.4
Mean	2.3	13.1	22.0	13.0
LSD _(0.05)	0.26	0.96	1.23	3.63

PRE = preemergence, * - when weeds were 2 in. tall, ** - when weeds were 4-6 in. tall.

Table 3. Weed control after herbicide treatment of roundup ready soybean in 1996.

Treatment	Nutsedge 30 d after postemerg. appl. (%)	Morningglory (%)		
		30 d after first appl.	30 d after second appl.	Late season
Roundup Ultra 1.5pts./a POST.	12.50	75.50	69.5	62.50
Roundup Ultra 2.0pts./a POST.	15.0	92.50	70.0	62.50
Roundup Ultra 3.0 pts./a POST.	57.50	92.50	82.5	80.00
Roundup Ultra 1.5pts./a, 1 pt./a POST.	81.50	97.25	96.3	95.00
Roundup Ultra 1.5pts./a, 1.5pts./a POST.	61.25	97.25	94.5	92.50
Roundup Ultra 2.0pts./a, 1.0 pts./a POST.	72.50	95.50	97.0	92.50
Roundup Ultra 2.0pts./a, 1.5pts./a POST.	70.00	95.75	91.3	90.75
Roundup Ultra 2.0pts./a, 2.0pts./a POST.	81.25	99.00	98.5	97.00
Prowl 1.8pts./a+Canopy 8 oz/A PRE.	0.0	68.75	75.0	65.00
Squadron 3 pts./a PRE.	0.0	12.50	12.5	12.50
Fusilade DX 1pts./a + Classic 0.5 oz/a + Agridex 1% v.v. POST.	22.50	0.00	0.0	0.0
Check	0.0	0.00	0.0	0.0
Mean	39.5	68.9	65.6	62.52
LSD _(0.05)	9.34	9.0	10.9	10.6

PRE - preemergence, POST - postemergence, fb -following by, ae - acid equivalent.

Table 4. Height of plants and grain yields of roundup ready soybean as influenced by herbicide treatment in 1996.

Treatment	Plant height (in.)		Grain Yield (bu/a)
	30 d after planting	30 d after post- emergence herbicide appl.	
Roundup Ultra 1.5 pts./a POST.	14.15	37.50	42.9
Roundup Ultra 2.0 pts./a POST.	14.95	37.67	38.5
Roundup Ultra 3 pts./a POST.	15.0	37.72	40.3
Roundup Ultra 1.5 pts./a, 1.0 pt./a POST.	14.08	37.40	41.7
Roundup Ultra 1.5 pts./a, 1.5 pts./a POST.	14.33	35.97	40.3
Roundup Ultra 2.0 pts./a, 1.0 pt./a POST.	14.73	38.28	39.3
Roundup Ultra 2.0 pts./a, 1.0 pt./a POST.	14.33	38.45	41.7
Roundup Ultra 2.0 pts./a, 2.0 pts./a POST.	13.85	36.57	40.6
Prowl 1.8 pt/a + Canopy 8 oz/a PRE.	13.98	37.15	33.3
Squadron 3 pt/a PRE.	16.42	38.63	34.0
Fusilade DO 1 pt/a + Classic 0.5 oz/a + Agridex 1% v.v. POST.	12.98	36.20	35.9
Check	13.92	38.22	35.4
Mean	14.39	37.48	38.7
LSD _{0.05}	1.00	NS	5.17

PRE - preemergence, POST - postemergence, fb - following by, ae - acid equivalent.