

2º PAINEL – CULTURAS RESISTENTES AOS HERBICIDAS

WEED CONTROL STRATEGIES FOR ROUNDUP READY SOYBEANS

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Abstract

Roundup can be used effectively to control a wide range of weed species in Roundup Ready soybeans. Timing of the Roundup application was critical for optimum soybean yields and gross return. Soybean yields and economic return confirmed the presence of the critical period for weed control in soybeans. Two weed control strategies were identified: 1) In fields with high weed pressure use two applications of Roundup, the first applied preplant to the unifoliate stage of soybean growth followed by a second application at the 1-to-3 trifoliate stage of soybean growth. 2) In fields with low weed pressure, apply Roundup at the unifoliate stage of soybean growth and apply a second application at the 1-to-3 trifoliate stage only if late emerging weeds exceed threshold densities.

Roundup has played an important role in the successful adoption of conservation tillage systems by providing effective non-selective control of established weeds. Through gene transfer, resistance to Roundup has been conferred to several agronomically important crops including corn and soybeans. Roundup can now be applied postemergence for broad spectrum weed control in Roundup Ready soybeans in Ontario.

The effectiveness of Roundup for weed control will be influenced by the timing of weed seedling emergence relative to the growth stage of the soybeans. The critical period for weed control in soybeans occurs from the 1-to-2 trifoliate stage of crop growth, approximately twenty days after crop emergence. Roundup should be applied at this stage of crop growth to optimize soybean yields. In order to test this yield window field studies were conducted to evaluate the agronomic and economic performance of weed control strategies in Roundup Ready no-till soybeans. Treatments consisted of : single applications of Roundup at 1L/ac applied: 1) preplant (2-to-5 days before planting), 2) at the unifoliate stage, and 3) at the 1-to-3 trifoliate

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stage of soybean growth; Treatments with two sequential applications of 1L/ac of Roundup: 1) preplant and at the unifoliate stage, and 2) at the unifoliate and 1-to-3 trifoliate stages; Additional treatments included a preplant tank-mix or sequential treatment of Roundup plus 0.125 or 0.168 L/ac of Pursuit which provided residual weed control, and an untreated control. Trials were conducted for four years at the Woodstock Research Station (1995-1998) and at Ridgetown College in 1998. In all trials, no-till Roundup Ready soybeans were grown in 76 cm (30") rows using recommended production methods.

We compared the efficacy, yield, and the economic gross return and risk associated with these control strategies in Roundup Ready soybeans. It was not our intention to compare weed control practices in Roundup Ready versus conventional soybean production. An economic analysis was conducted to determine the adjusted gross returns for each treatment. Adjusted gross returns were calculated as gross revenue (crop yield x crop price) minus the unique costs for weed control (cost of herbicide application + cost of herbicides). In order to help farmers make informed weed management decisions for the 1999 growing season we have used anticipated herbicide costs and soybean price for the 1999 season. The costs used were: \$7/ac to spray herbicides each time, \$7.95/L for Roundup (356g/L), \$167.35/L for Pursuit (240g/L), and \$7.80/L for Agral 90. Soybean were priced at \$6.70/bu (on February 26, 1999) for the November 1999 crop. We did not include fixed production costs, such as costs for planting, harvesting, or additional seed costs of \$0.35/kg associated with growing Roundup Ready soybeans as these costs were common to all treatments.

Timing of the Roundup application was critical for successful weed management.

Roundup is a non-residual herbicide and controls emerged weeds only. Timing of Roundup relative to weed emergence was critical in determining the level of weed control (Fig 1). In these trials, lambs-quarters, common ragweed, redroot pigweed, yellow foxtail, and barnyard grass were the dominant weed species. Lambs-quarters and common ragweed emerged in early May whereas redroot pigweed, yellow foxtail and barnyard grass emerged in early June. At the time preplant applications of Roundup were made, only lambs-quarters and common ragweed populations were present and as a result, later emerging weed species such as redroot pigweed, barnyard grass or yellow foxtail, were not controlled (Table 1). With later applications of Roundup (1-to-3 trifoliate stage of soybean growth), control of all species was improved, particularly later emerging redroot pigweed, yellow foxtail, and barnyard grass. In addition, Roundup provided good control of dandelion, fleabane (Canada and annual) and

annual sowthistle but poor to fair control of ladys-thumb, wild buckwheat, and black medic.

The yield window for Roundup Ready soybeans was the unifoliate to 1-to-3 trifoliate stage of soybean growth

Results from these studies were consistent with previous research which had identified the 1-to-2 trifoliate stage of soybean growth as the critical period of weed control. In this study soybeans had up to 3 trifoliate leaves at the latest timing of herbicide application. Competition from weeds emerging after a single preplant application of Roundup, reduced yields by 20 bu/ac compared to plots where Roundup was applied twice. (Table 2). Competition from early emerging weeds that were not controlled up to the 1-to-3 trifoliate stage reduced soybean yields by 7 bu/ac. A combination of two Roundup applications were required to consistently prevent competition from early and late emerging weeds and optimize yields the first occurring as a preplant or at the unifoliate stage of soybean growth followed by a second application at the 1-to-3 trifoliate.

Two weed control strategies for Roundup Ready no-till soybeans were identified:

1) When weed competition was high, two applications of Roundup maximized average long-term yields and gross returns.

Highest average yields (41 to 42 bu/ac) and gross returns (\$249 to \$245) were obtained when Roundup was applied preplant or at the unifoliate stage followed by a second application at the 1-to-3 trifoliate stage of soybean growth (Table 2). The economic performance of the two Roundup application treatments was also more consistent across alternative soybean price scenarios. When the potential soybean price was varied by +/- 50% from the bench-mark price of \$6.70/bu, two applications of Roundup consistently outperformed all other treatments. Roundup in combination with Pursuit increased soybean yield compared to a single Roundup application, however, the cost of Pursuit was greater than the value of the additional crop yield obtained.

Under high weed pressure differences between the single and two Roundup application treatments were greatest. These conditions resulted in yields that were 7 to 12 bu/ac and gross returns \$32 to \$64/ac greater with the two applications of Roundup than with a single application at the unifoliate or 1-to-3 trifoliate stage (Table 2). **The most appropriate strategy for fields with high weed pressure is to apply Roundup twice. The first application should be made preplant to the unifoliate stage of**

soybean growth and second application at the 1-to-3 trifoliolate leaf stage.

2) When weed competition was low, use of weed thresholds provided opportunities to maximize economic gross return and reduce unnecessary applications of Roundup.

In 4 out of 5 trials a single application of Roundup at the unifoliolate stage of soybean growth gave similar gross return as treatments with two applications of Roundup (individual year data not shown). Using the principles of integrated weed management (IWM), the need for an additional Roundup application at the 1-to-3 trifoliolate stage can be determined using weed density and economic thresholds. If these options had been employed in these trials, a second application of Roundup at the 1-to-3 trifoliolate stage would have been required in only one trial. This IWM treatment would have produced an average yield of 39 bu/ac and gross return of \$239/ac, an agronomic and economic performance similar to that obtained with the use of two applications. This would have required a total of 6 Roundup applications over 5 trials compared to 10 using the two application strategy, a 40% reduction in herbicide use. **Therefore, the most appropriate strategy for fields with low weed pressure is to apply Roundup at the unifoliolate stage of soybean growth and apply a second application at the 1-to-3 trifoliolate stage only if late emerging weeds exceed threshold densities.**

In summary two weed control strategies for Roundup Ready soybeans were identified based on the critical period for weed control in soybeans. In fields with high weed pressure use two applications of Roundup, the first applied preplant to the unifoliolate stage of soybean growth followed by a second application at the 1-to-3 trifoliolate stage of soybean growth. 2) In fields with low weed pressure, apply Roundup at the unifoliolate stage of soybean growth and apply a second application at the 1-to-3 trifoliolate stage only if late emerging weeds exceed threshold densities.

Table 1. Weed control in no-till Roundup Ready soybeans: (average of 5 trials, Woodstock 1995-1998, Ridgetown 1998).

Treatment (Time of Roundup application)	----- Weed species -----				
	Common ragweed	Lambs- quarters	Redroot pigweed	Barnyard grass	Yellow foxtail
	----- % Control ^a -----				
Preplant (pp)	65	53	13	9	3
pp; 1 to 3 trifoliolate	100	99	98	96	88
Unifoliolate	92	83	55	51	81
Unifoliolate; 1 to 3 trifoliolate	99	99	97	90	98
1 to 3 trifoliolate	92	96	98	94	89
Roundup + Pursuit ^b	94	99	91	62	99

^a Mid-season control, average of 2 or more trials

^b Sequential (preplant plus postemergence) application in 1995-1997, preplant tank-mix in 1998.

Table 2. Economics of weed control in no-till Roundup Ready soybeans: Cost of weed control, yield and gross return (average of 5 trials, Woodstock 1995-1998, Ridgetown 1998).

Treatment (Time of Roundup application)	Cost of weed control ^a	Yield	Gross return ^b
	(\$/ac)	(bu/ac)	(\$/ac)
Weedy	0	14	95
Preplant (pp)	15	22	131
pp; 1 to 3 trifoliolate	30	42	249
Unifoliolate	15	36	226
Unifoliolate; 1 to 3 trifoliolate	30	41	245
1 to 3 trifoliolate	15	35	218
Roundup + Pursuit ^c	48	38	209

^a Variable costs only (TUA not included).

^b Soybean price = \$6.70/bu (26 Feb, 1999).

^c Sequential (preplant plus postemergence) application in 1995-1997, preplant tank-mix in 1998.