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Comparison of soybean varieties with different herbicide-resistant traits

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Introduction

- The 2009 growing season marked the introduction of soybean varieties with new herbicide-resistant traits, glufosinate-resistant (Liberty Link) and second generation glyphosate-resistant (Roundup Ready 2 Yield) soybean.
- There have been claims that some varieties containing these newer traits may provide increases in yield.
- Soybean seed technology costs tend to be higher for newer herbicide-resistant traits.
- Therefore, growers have questioned, "How do these newer soybean technologies compare based on weed control, yield, and economic returns with current systems?"

Objectives

- Compare weed management and yield of soybean varieties with different herbicide-resistant traits.
- Determine the economic returns for each soybean trait under different weed management systems.

Materials and Methods

- Four soybean varieties of each trait were planted in 38-cm rows at a population 432,250 seeds/ha at E. Lansing and Richville, MI in mid-May.
- Soybean varieties were selected based on similar maturities, highest yields from MSU's soybean performance trials, and availability, since isolines of the different traits were not available.
- Split-plot design (Table 1), four replications, two years (2009 & 2010)

Table 1. Soybean traits (main plot) and weed control systems (sub-plot)

Soybean traits ^a	Weed control systems
non-GMO (conventional)	Standard PRE
Liberty Link (glufosinate-resistant)	PRE fb. POST
Roundup Ready (glyphosate-resistant)	MPOS fb. LPOS
Roundup Ready 2 Yield (glyphosate-resist.)	Untreated

^a Four soybean varieties were evaluated for each trait, only one Roundup Ready 2 Yield variety was evaluated in 2009 due to availability.

- Herbicide treatments for the different soybean traits and weed control systems are listed in Table 2.

Table 2. Herbicides selected for the different weed control systems

Weed control systems ^a	non-GMO	Liberty Link	Roundup Ready Systems
Standard (PRE)	flumioxazin + fomesafen + pendimethalin		
PRE ^b fb. POST	flumi. ^c + chlor. fb. fomes. + cleth.	flumi. + chlor. fb. glufosinate	flumi. + chlor. fb. glyphosate
MPOS fb. LPOS	imazamox fb. fomes. + cleth.	glufosinate fb. glufosinate	glyphosate fb. glyphosate
Untreated	—	—	—

^a Application timings: PRE = preemergence applied after planting, POST = postemergence applied to 10-cm weeds after PRE; MPOS = mid-postemergence applied to 10-cm weeds; LPOS = late-postemergence applied to 10-cm weeds after MPOS.

^b Flumioxazin alone was applied at the Richville location

^c Abbreviations: flumi. = flumioxazin; chlor. = chlorimuron; fomes. = fomesafen; cleth. = clethodim

- Data collected:
 - Injury and weed control were assessed throughout the season
 - Soybean yield at 13% moisture
- Economic analysis:
 - Economic return = (yield x selling price) – (tech. fee + weed control + app. costs)
 - Cost assumptions: fall 2010 seed technology fees and herbicide costs, Dec. crop selling price and non-GMO soybean premium
- Statistical analysis:
 - Data was subjected to analysis of variance using PROC MIXED in SAS. Interactions and main effects were tested, means separated at $P \leq 0.05$.

Results and Discussion

- The two years of this research were quite different. In 2010, precipitation was limiting in July and August resulting in substantially lower soybean yields as compared with 2009.
- Overall the two herbicide systems, PRE fb. POST and MPOS fb. LPOS systems provided excellent weed control, regardless of soybean technology (data not shown).
- At Richville, yield did not differ among weed control systems, due to lower weed populations both years. In 2009 the highest yielding soybean traits were Liberty Link and both Roundup Ready traits. However, there were no differences in yield in 2010 (Figure 1).
- At East Lansing in 2009, there was an interaction between weed control system and soybean trait for yield. Across each weed control system, the Liberty Link and Roundup Ready 2 Yield varieties were always amongst the highest yielding (Table 3). However, they were not always better than the current Roundup Ready soybean varieties.
- At East Lansing in 2010, the main effect of soybean trait was not significant for yield (Figure 2a). However, the main effect of weed control system was significant with the PRE fb. POST and MPOS fb. LPOS systems yielding the highest (Figure 2b).

- At Richville in 2009, both Roundup Ready systems and the PRE fb. POST non-GMO program provided the highest economic returns (Table 4). In 2010, the non-GMO soybean systems provided the greatest economic returns.
- At East Lansing, the Liberty Link and Roundup Ready 2 Yield systems provided the greatest economic returns both years (Table 5). In 2010, the non-GMO soybean systems also were amongst the highest economic returns.

Table 3. Yield for the different soybean traits and weed control systems at East Lansing in 2009.

Weed control systems	non-GMO	Liberty Link	Roundup Ready	RR 2 Yield*
	kg/ha			
Standard (PRE)	4380 de	4785 bc	4770 bc	4985 abc
PRE fb. POST	4230 e	5095 a	4675 c	4950 abc
MPOS fb. LPOS	4570 cd	5190 a	5000 ab	5320 a
Untreated	2685 g	3405 f	2640 g	3135 f

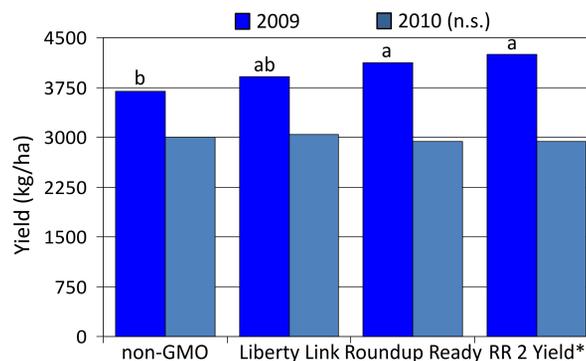


Figure 1. Yield for the different soybean traits averaged over weed control systems at Richville in 2009 and 2010. Weed control strategies (PRE, PRE fb. POST, MPOS fb. LPOS, untreated) were not significant.

Table 4. Economic return (\$/ha) of the various soybean traits and herbicide systems at Richville in 2009 and 2010. Herbicide system was not significant for 2010, so data were combined over system.

Soybean traits	2009	2010
	Combined systems	
non-GMO	\$1720 ab	\$1320 A
Liberty Link	\$1650 b	\$1255 B
Roundup Ready	\$1700 ab	\$1210 B
RR 2 Yield*	\$1835 a	\$1195 B

* Only one RR 2 Yield soybean variety was available in 2009.

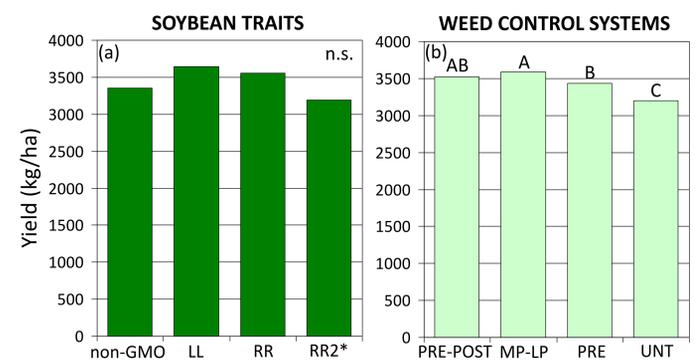


Figure 2. Yield for the different soybean traits (a) and weed control systems (b) for East Lansing in 2010. Interactions were not significant, so data is presented by main effects.

Table 5. Economic return (\$/ha) of the various soybean traits and herbicide systems at East Lansing in 2009 and 2010. Herbicide system was not significant for 2009 or 2010, so data were combined over system.

Soybean traits	2009	2010
	Combined systems	
non-GMO	\$2010 b	\$1600 A
Liberty Link	\$2180 a	\$1560 A
Roundup Ready	\$2070 b	\$1350 B
RR 2 Yield*	\$2190 a	\$1510 A

* Only one RR 2 Yield soybean variety was available in 2009.

Conclusions

- There are several options available for high soybean yields and effective weed management.
- The yield potential of the different soybean traits varied by different environmental conditions. Under higher yielding environments (2009), the newer traits Liberty Link and Roundup Ready 2 Yield were amongst the highest yielding, but they were not always better than the current Roundup Ready soybean varieties. There were no differences in yield for the different soybean traits under lower yielding environments (2010).
- Under the current economic conditions, several different soybean traits and weed control systems were amongst the highest economic returns. Growers should choose soybean trait and weed control systems that best fit into their production system.

Acknowledgments

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