Integrated Weed Management: Soybean Seeding Rate and Residual Herbicide

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Introduction:

Increased soybean seed cost in recent years has generated interest in reducing seeding rates to maintain consistent economic returns. However, low seeding rates result in reduced established plant stands with slower canopy development, and canopy development is touted as an important element of integrated weed management (IWM). IWM practices have become even more important to slow the development and spread of glyphosate resistant weeds. The need to control herbicide resistant weeds has also renewed grower interest in using preemergence (PRE) residual herbicides (another IWM tactic). Therefore the objective of this study was to determine the effect of soybean seeding rate and PRE residual herbicide use on:

- Weed control
- Soybean canopy development
- Yield

Research Design:

This study was conducted in 2012 and 2013 at the Arlington Agricultural Research Station. Five different seeding rates ranging from 60,000 to 190,000 seeds/a were planted in 15 inch rows in mid-May. A residual herbicide was applied PRE to half of the plots within one day of planting. Postemergence (POST) applications were made at the V4 soybean growth stage and consisted of one of two herbicide programs. Herbicide and rate information are provided in Table 1.

Results- Weed Control:

Weed density and height at the time of POST herbicide application were not affected by soybean seeding rate (Table 2). A PRE application of Prefix® reduced common lambsquarters, common ragweed, and annual grass densities by 94, 89, and 91%, respectively (Figure 1). Moreover, average heights of these weed species were 46, 62, and 28% shorter, respectively, when exposed to a PRE herbicide (Table 2).

Another critical component of herbicide resistance management is to reduce the number of seeds added to the soil seed bank, and an increase in seeding rate was not effective at accomplishing this goal (Table 3). However, the PRE and POST herbicide program combinations influenced end-of-season weed density and seed production (Table 3).

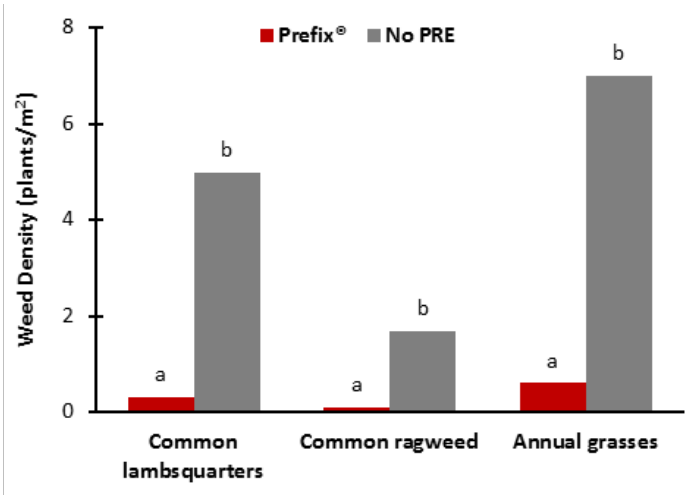

Figure 1. Effect of PRE herbicide application on weed density at the POST timing.

Table 1. Herbicides and rates used in a 2012 and 2013 field study.

Treatment	Herbicide	Rate
PRE residual	Prefix®	2 pt/a
Conventional Program	Raptor® +	5 fl oz/a
	FirstRate® fb	0.3 oz/a
	Fusilade DX®	12 fl oz/a
Glyphosate Program	Roundup PowerMax® +	22 fl oz/a
	Raptor® +	5 fl oz/a
	FirstRate®	0.3 oz/a

Table 2. Effect of soybean seeding rate and PRE herbicide application on weed density and height at the POST timing[1].

	Common lambsquarters	Common ragweed	Annual grasses
Treatment	**Density (plants/ft²)**		
Seeding rate			
190,000[2]	1.7 b	0.7 a	2.3 a
120,000	1.5 b	0.7 a	2.5 a
95,000[3]	0.9 a	0.5 a	2.2 a
60,000	1.5 b	0.5 a	2.2 a
PRE herbicide			
Prefix®	0.3 a	0.1 a	0.6 a
No PRE	5.0 b	1.7 b	7.0 b
Treatment	**Height (in)**		
Seeding rate			
190,000	2.3 a	3.3 a	4.2 a
120,000	2.3 a	3.4 a	3.9 a
95,000	2.4 a	3.8 a	3.7 a
60,000	2.1 a	3.8 a	3.7 a
PRE herbicide			
Prefix®	1.7 a	2.2 a	3.3 a
No PRE	3.0 b	5.7 b	4.6 b

[1]Means with the same letter are not significantly different (P < 0.05).
[2]Consists of high and high blend seeding rate. High blend was a mixture of 120,000 glyphosate-resistant and 70,000 glyphosate-susceptible soybean seeds.
[3]Mixture of 60,000 glyphosate-resistant and 35,000 glyphosate-susceptible soybean seeds.

Results- Soybean Canopy Development:

Canopy development is a critical element of crop competitiveness, and subsequently enhancing canopy development is an element of cultural weed control. To quantify the development of the soybean canopy, cumulative intercepted photosynthetically active radiation (CIPAR) values from the V1 to R1 soybean growth stage were calculated. An increase from 60,000 to 190,000 seeds/acre increased CIPAR during by 43 and 63% in 2012 and 2013, respectively (Table 4). CIPAR values also increased by 21 and 13% in 2012 and 2013, respectively, when a PRE herbicide was used (Table 4). This suggests that the use of a PRE herbicide can also promote quicker canopy development and thus contribute to cultural weed control.

Results- Soybean Yield:

In 2012 where Prefix® was applied, there was no difference in yield among the five seeding rates. However, in POST-only treatments, an increase from a moderate to a high (120,000 to 190,000 seeds/a) seeding rate improved yield by 6.3 bu/a (Figure 2). This interaction was not significant in 2013, possibly due to lack of competition for water early in the season as rainfall totals were well above normal prior to the POST applications in 2013.

Table 3. Influence of PRE and POST herbicide program combinations on end-of-season weed density and seed production during 2012 and 2013[1].

PRE herbicide	POST herbicide	Total weed density plants/ft²	Total weed seeds seeds/ft²
Prefix®	Glyphosate program	0 a	0 a
	Conventional program	0 a	0 a
No PRE	Glyphosate program	0.6 b	12 b
	Conventional program	2.5 c	344 c

[1]Means with the same letter are not significantly different (P < 0.05).

Table 4. Influence of soybean seeding rate and PRE herbicide application on CIPAR in 2012 and 2013[1].

	CIPAR[2]	
Treatment	**2012**	**2013**
	(MJ/ft²)	
Seeding rate		
190,000	20 a	14 a
120,000	17 b	10 b
60,000	11 c	5 c
PRE herbicide		
Prefix®	18 a	10 a
No PRE	14 b	9 b

[1]Means with the same letter are not significantly different (P < 0.05).
[2]Abbreviation: CIPAR, cumulative intercepted photosynthetically active radiation.

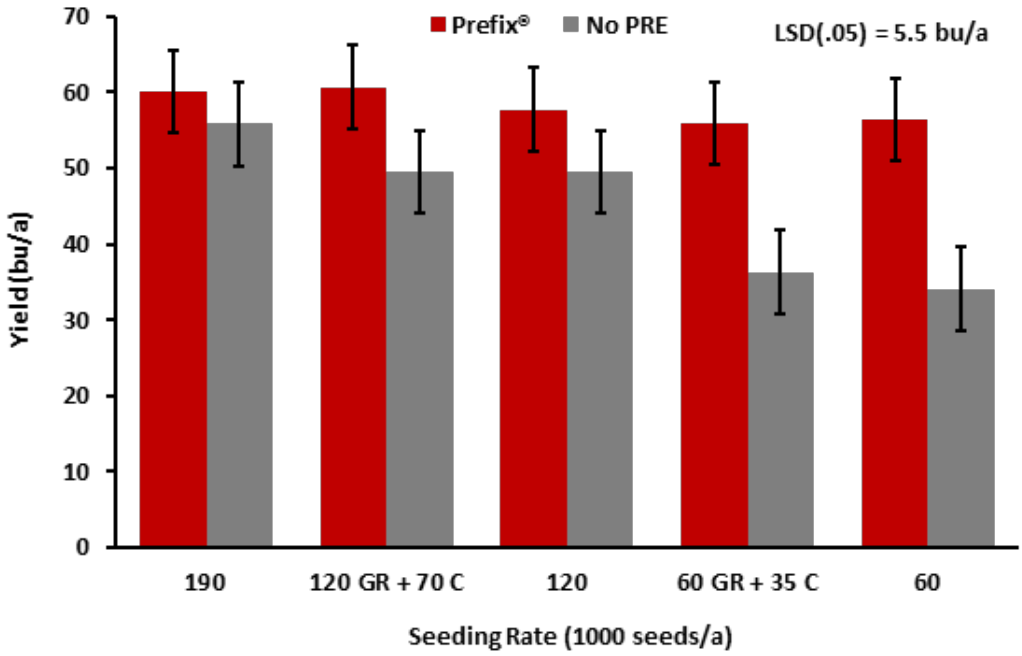

Figure 2. Effect of PRE herbicide application and soybean seeding rate on yield in 2012.

Conclusions and Recommendations:

An increase in soybean seeding rate within the current economical range of rates was not effective at reducing weed exposure to POST herbicide applications and therefore would not reduce selection pressure to POST herbicides as a HRM strategy.

Furthermore, increased seeding rate did not reduce end-of-season weed density or seed production, another component of HRM. While decreasing seeding rate did not adversely affect weed control in this experiment, with the integrated use of effective herbicides, these results may also support the notion that lower soybean populations could be at greater risk of yield loss, when needed resources like water are limited early in the season.

The use of an effective PRE herbicide, as demonstrated in this experiment, limits the early-season weed competition. This may reduce that risk of yield loss with low seeding rates by allowing the soybean plants to take full advantage of sunlight and close open space in the canopy.

Moreover, a very unique result in this experiment was the observation that residual herbicides increased the speed of canopy development by significantly increasing early-season CIPAR. Thus, utilizing PRE residual herbicides aids the culture control mechanism of crop competition.

This publication is available on the Wisconsin Crop Weed Science program website.
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