EFFECT OF SOYBEAN ROW SPACING ON WEED COMPETITION

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Introduction

Many research reports have documented greater weed control in narrow row soybeans as compared to wide row soybeans. For example, Young et al. (2001) reported greater giant foxtail, waterhemp, and velvetleaf control in many experiments where 7.5-, 15-, and 30-inch row spacings were compared (Table 1). In their experiments, they included several rates and two timings of glyphosate and two conventional herbic ide programs. The experiments were conducted for three years at two locations in Illinois and for two years at another location in Illinois.

For giant foxtail, control was greater in the 7.5-inch rows than 30-inch rows in four of the eight experiments (Table 1). In the other four experiments, control was similar between the 7.5- and 30-inch row spacings. Giant foxtail control was also greater in 15-inch rows than 30-inch rows for three of the eight experiments. Waterhemp was only present at five of the experiments. In each experiment, waterhemp control was greater in narrow rows than the 30-inch rows. The benefit of narrow rows was greater with waterhemp than giant foxtail. This may have occurred because of waterhemp's tendency to emerge later than foxtail. The effect of row spacing on velvetleaf control was similar to giant foxtail control in that control was greater with narrower rows in about half of the experiments.

Table 1. Weed control ratings averaged over 10 postemergence herbicide treatments in eight experiments where 7.5-, 15-, and 30-inch soybean row spacings were compared.

Soybean	Experiment							
row spacing	1	2	3	4	5	6	7	8
(inches)	Giant foxtail control (%)							
7.5	92	97*	98*	95	98*	99	91	98*
15	94	95	98*	93	95*	99	88	97*
30	95	94	96	93	94	99	90	95
	Waterhemp control (%)							
7.5	98*		98*		94*	90*		87*
15	98*		99*		91*	87*		84*
30	84		89		85	80		78
	Velvetleaf control (%)							
7.5	88	84	88*	93*	97*	89	89	99*
15	81	83	91*	88*	96*	89	84*	99*
30	84	82	73	80	92	82	90	97

* indicates that the average control in the 7.5- or 15-inch soybean row spacing differed from the 30-inch row spacing.

Greater weed control in narrow row soybeans is generally attributed to more rapid canopy closure with narrower row spacings. The University of Wisconsin soybean program conducted a study at Arlington in 1999 where the percentage of light that penetrated

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through the canopy of soybeans grown in different row spacings was measured (Figure 1). These results are the average of four soybean varieties-herbicide combinations and three seeding rates. These results show the faster canopy development with narrow row soybeans and thus greater shading of weeds that may be growing in or below the canopy. The end of season shading is similar among the three row spacings, but the differences early in the season support the theory that canopy development accounts for differences in weed control.

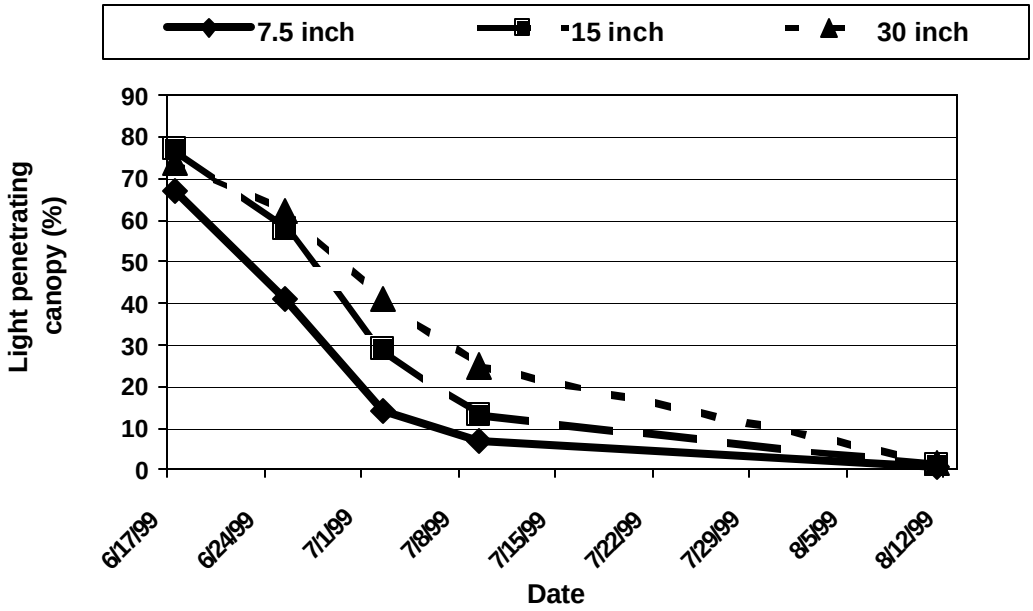

Figure 1. Percentage of sunlight that penetrated through the soybean canopy at three row spacings as measured at Arlington in 1999.

Importance of Quantifying the Row Spacing Effect

It is important to determine the effect that soybean row spacing has on weed growth to improve our predictions of weed competition and yield loss. We can use this information directly in the weed management software called WeedSOFT. WeedSOFT is a decision support system that predicts the economic returns for the herbicide treatments that are appropriate for a field's specific conditions. This prediction is based on a bioeconomic model where a herbicide treatment's economic return is calculated based on predicted yield loss from weed competition with and without control. An important part of this prediction is accurately predicting crop yield loss, which is a function of weed competition. Within the model, the total of the weeds' competition is called the total competitive load. (The competitive load is calculated by multiplying each weed's density by its competitive index. This product is summed for the different weed species present in the field to determine the total competitive load.) If weeds are less competitive in narrow row spacings, their competitive load needs to be modified and lessened so the model does not overestimate the soybean yield loss. Therefore, we were interested in determining if row spacing affected the competitive ability of weeds and the magnitude of the effect.

Materials and methods. In 2000 and 2001, several studies were established across the Midwest to validate the soybean yield loss estimates from WeedSOFT. A number of the studies in the Midwest included wide row (30-inch) and narrow row (7.5- or 15- inch) soybean row spacings that could be used to compare the effect of row spacing on the competitive ability of the weeds.

Sites that were included in this analysis were East Lansing, MI, two at Columbia, MO, one at Arlington, WI, and one at Lancaster, WI. Experiments were arranged in a randomized complete block, split plot design with four replications where the main plots were soybean row spacing. The experiments in Michigan and Wisconsin compared 7.5- and 30-inch row spacings, while the experiments in Missouri compared 15- and 30-inch row spacings. Herbicide treatments used in individual experiments were site specific and chosen from WeedSOFT yield loss predictions so that the treatments would provide a range of yield loss in each study. Weed free and nontreated controls were also included in each study. Pre-harvest weed biomass and soybean yield were measured in each study. To determine the direct effect of soybean row spacing on weed competitive abilities, the total pre-harvest weed biomass for treatments that were applied to both row spacings were compared. A ratio of narrow row (7.5- or 15-inch) weed biomass to wide row (30-inch) weed biomass was used to determine the extent that row spacing affected weed competitive abilities for each study. Comparing soybean yields as a percentage of the weed free yield tested the indirect effect of row spacing on weed competitive ability.

Direct effect of soybean row spacing: Weed biomass. The Arlington, WI and both Columbia , MO studies had less weed biomass in the narrow row spacing than in the wide row spacing when the weeds were treated with the same herbicide program (Figure 2). The ratio of mean weed biomass in narrow row soybean to wide row soybean was 0.78, 0.63, and 0.87 for Arlington, WI and Columbia, MO in 2000 and 2001, respectively. At Lancaster, WI, the weed biomass in 7.5-inch rows averaged 81% of the weed biomass in the 30-inch rows, but the difference was not statistically significant. The reason that these five experiments did not all have significant differences between narrow and wide rows is mainly due to the variability in weed distribution at the individual sites. The Lancaster, WI and East Lansing, MI sites had heavy, patchy weed distributions. Overall, weed biomass appears to be a good indicator of weed competitive ability.

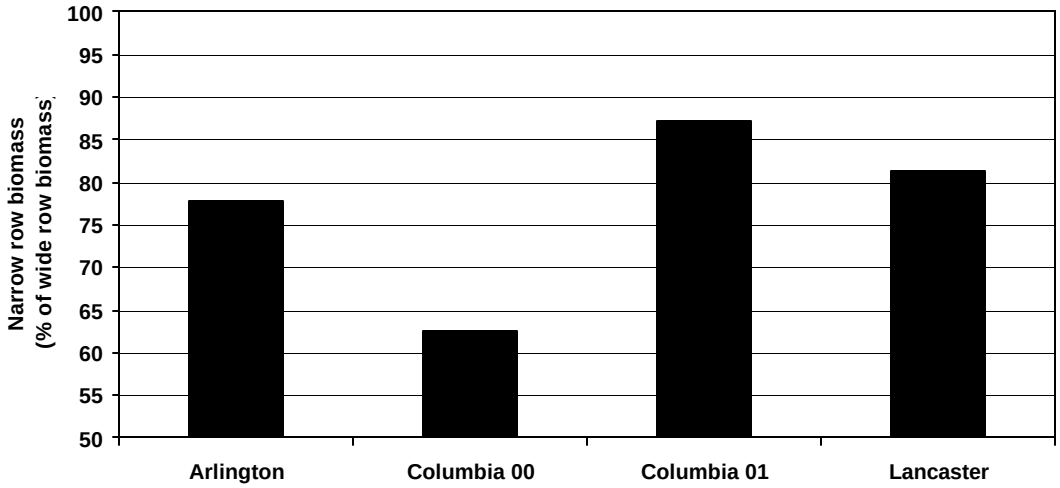

Figure 2. Biomass of weeds grown in narrow row soybean when expressed as a percentage of the biomass of weeds grown in wide rows. Results are averaged across five herbicide treatments at each site.

Indirect effect of soybean row spacing: Soybean yield. In four of the five studies (Arlington, Columbia 2001, East Lansing, Lancaster), narrow row soybean had 2.2 to 8.6 % less yield loss than wide row soybean when expressed as a percent of the weed free yield, but only the Columbia, MO study in 2001 had a statistically significant difference (Figure 3). Researchers in

Illinois reported similar results. Yield may not be as accurate of indicator of weed competitive ability due to the variability and relatively small difference that need to be measured.

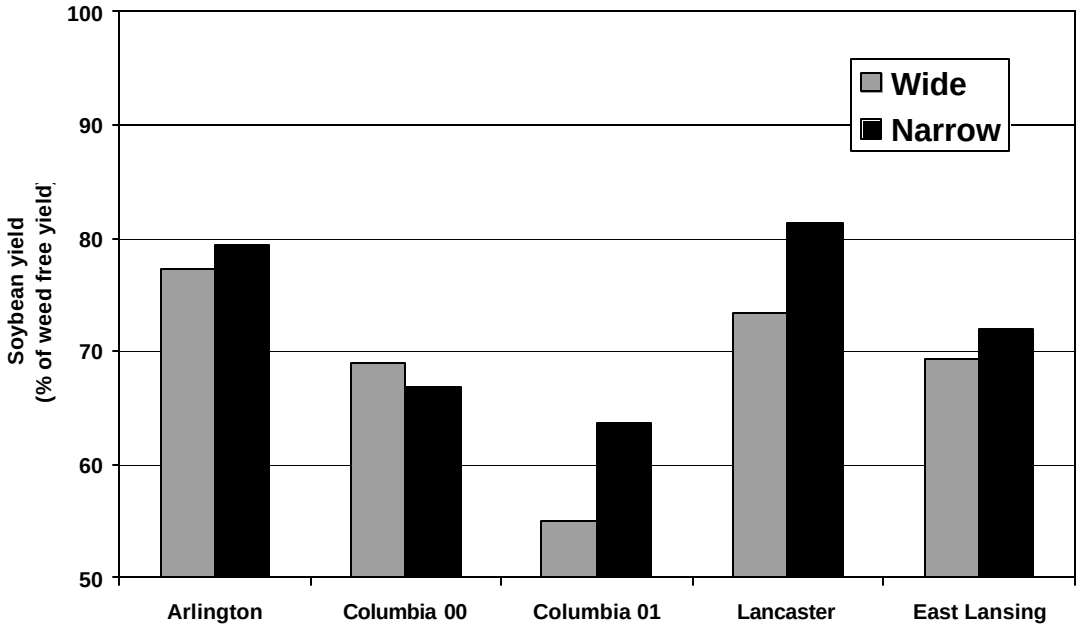

Figure 3. Effect of weed competition on soybean yield when weeds competed against narrow and wide row soybeans. Results are averaged across five herbicide treatments at each site.

Implications of the research. Soybean row spacing is a characteristic that is entered into WeedSOFT to more accurately predict yield loss. Each row spacing has a value or modifier that is multiplied by the competitive index of any weed species that is entered in the program. For row spacings less than 30 inches, this reduces the competitive effect of the weeds. Current soybean row spacing modifiers are 0.8, 0.85, 0.9, 0.95, and 1 for 7.5-, 10-, 15-, 20- and 30-inch soybean rows, respectively. This research suggests that the current modifiers are reasonable estimates of the row spacing effect. When testing the impact of different row spacing modifiers within WeedSOFT, it can be shown that row spacing will have little effect on the predicted economic returns for different herbicide options when weeds are present at higher densities. This occurs because the yield loss without control would be large with either row spacing. However, at low weed densities, the row spacing effect needs to be accounted for because it will affect the economic threshold or profitability of alternative herbicide treatments.

Literature Cited

Young, B. G., J. M. Young, L. C. Gonzini, S. E. Hart, L. M. Wax, and G. Kapusta. 2001. Weed management in narrow- and wide-row glyphosate resistant soybean (*Glycine max*). Weed Technol. 15:112-121.