TIME OF WEED EMERGENCE AND ECONOMIC IMPACT ON CROPS

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Late emerging weeds are a concern for corn and soybean growers and their consultants because of their potential impact on crop yield and harvest efficiency and their seed production if left uncontrolled. The challenge with late emerging weeds is determining if control is justified because the weed exceeds an economic threshold and will reduce yield or that the seed production justifies control. This paper will review several factors that need to be considered when trying to assess the impact of late emerging weeds. In general, we need to consider the time of weed emergence, their survival, how successfully they grow in competition with the crop, the effect of their competition on crop yield, and their seed production.

Weed Emergence

Weed species differ in the time of first emergence and the length of emergence. We often characterize certain weeds as being early emerging weeds such as giant ragweed and woolly cupgrass or late emerging weeds such as crabgrass and waterhemp. Even though some weed species generally emerge early, a small percentage of their seeds in the seedbank may germinate and emerge later in the season. This can lead to a large number of late emerging weeds if the weed seedbank is large. For example, the majority of woolly cupgrass emerges early in the season, but the small percentage that emerges later in the season leads to the perception that woolly cupgrass is a late emerging weed. For common weeds like giant foxtail and common lambsquarters, the majority of seedlings will emerge within six weeks after planting. In soybeans, we found that over 80% of giant foxtail and common lambsquarters emerged by six weeks in both years (Figure 1; Mulugeta and Boerboom 1999). Although most of these weeds had emerged when the postemergence herbicide application was applied, there were still weeds emerging after the application. Then, the important question is "What is the fate of these weeds?" Fortunately, we know that many weeds will not survive. When we recorded the survival of giant foxtail that emerged after corn and soybean planting in two different years, we found that 40 to 58% did not survive (Bussan and Boerboom 2000). Similar results were found with velvetleaf where 38 to 44% did not survive (Bussan and Boerboom 2001). It is probable that later emerging weeds would have an even lower survival rate because of greater shading from the crop. Although a majority of weeds will emerge prior to postemergence herbicide treatment or while there is still soil residual activity, late emerging weeds are still a concern. It is especially important to consider if weed species that are present in a field are either late emerging or have long durations of emergence.

Effect of Time of Weed Emergence on Weed Growth and Competition

Many studies have measured the effect of time of weed emergence on crop yield and have found late emerging weeds are much less competitive than weeds that emerge with the crop. Two recent examples include studies with woolly cupgrass and giant ragweed growing with corn. The growth of woolly cupgrass was reduced by more than 90% when it emerged at the V5 stage of growth as compared to woolly cupgrass that emerged with the corn (Figure 2; Mickelson and Harvey 1999). The growth of woolly cupgrass that emerged at the V2 corn stage was even reduced by more than 50%. The giant ragweed study only compared ragweed emerging with corn or ragweed that emerged 4 weeks after corn or at the V5 corn stage. The late emerging giant

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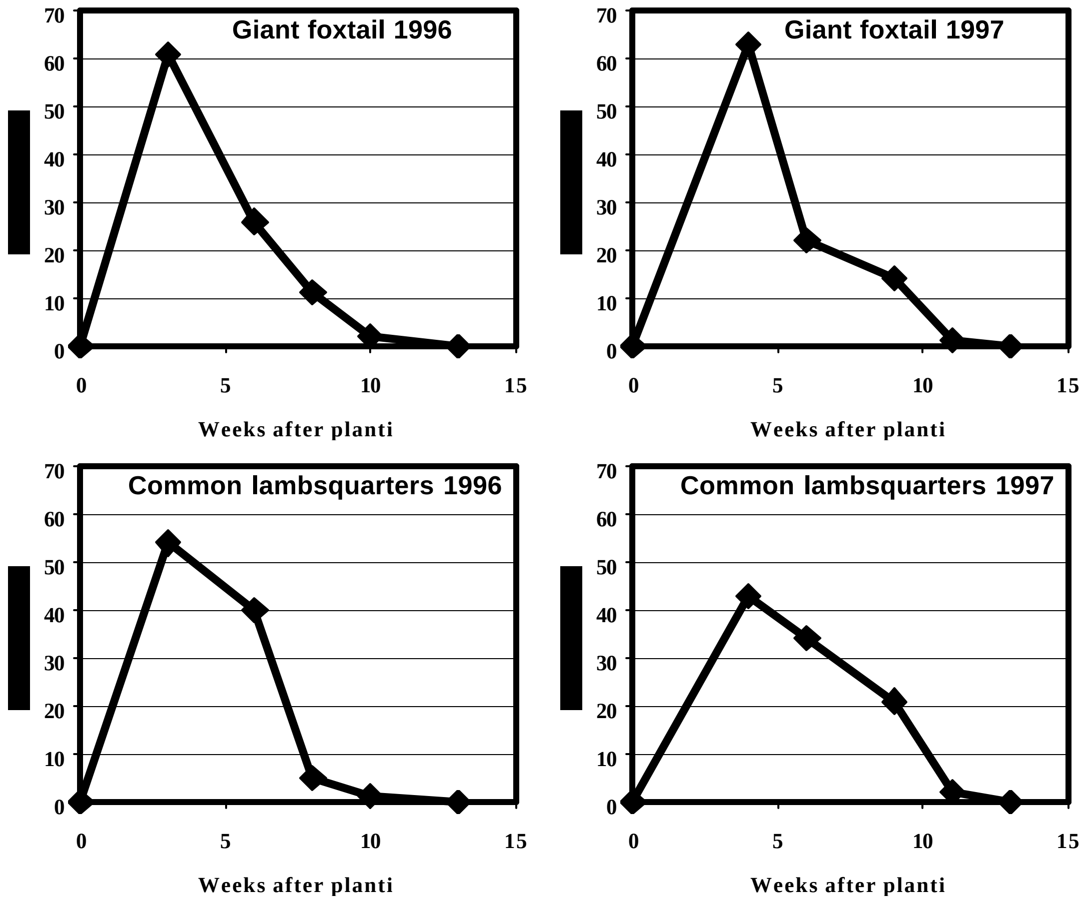

Figure 1. Giant foxtail and common lambsquarters emergence as a percentage of cumulative emergence when recorded during the 13 weeks following soybean planting at Arlington, WI.

ragweed's growth was 73 to 95% less than the early emerging ragweed across the densities and years of the study (Figure 3; Harrison et al. 2000). The reduced growth of late emerging weeds translates into less competition and less crop yield loss. For example, a 61% corn yield loss was measured with the highest giant ragweed density when the ragweed emerged with the corn, but the yield loss was four-fold less when the ragweed emerged 4 weeks later. The study's authors calculated that it would take ten times more late emerging giant ragweed to reach a treatment threshold than early emerging ragweed. Many other weeds are not as competitive as giant ragweed and late emerging plants may have less of an effect on crop yield loss although it would still depend on their density.

Effect of Time of Weed Emergence on Seed Production

Although late emerging weeds are less of a threat to yield, they will still produce seed. Fortunately, the same benefit that crop competition has against late emerging weed growth is also reflected in a corresponding reduction in seed production. Woolly cupgrass that emerged at the V5 stage of corn only produced about 40 seeds/plant as compared to 550 to 1760 seeds/plant for early emerging cupgrass (Figure 5). Similarly, giant ragweed seed production was 79 to 92% less when it emerged at the V5 corn growth stage than when it emerged with the corn (Harrison et al. 2001).

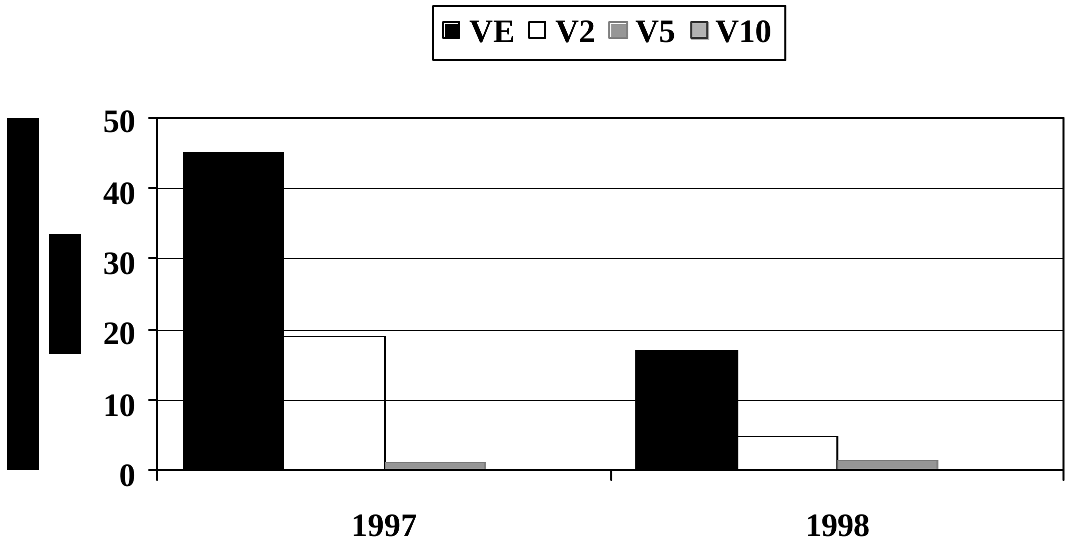

Figure 2. Woolly cupgrass biomass when emerging with corn (VE) or at the V2, V5, or V10 corn growth stages (Mickelson and Harvey 1999).

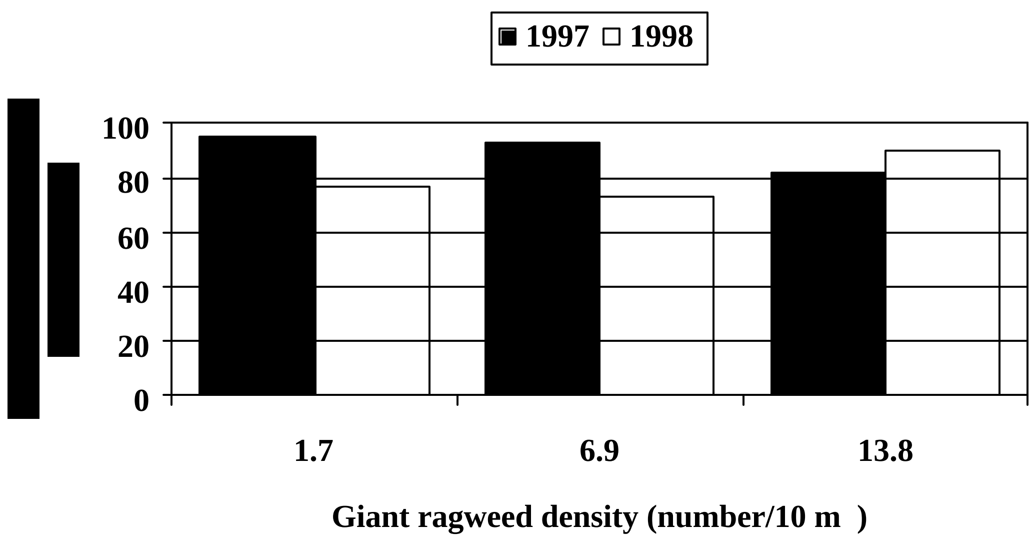

Figure 3. Reduction in giant ragweed biomass when emerging at 4 weeks after corn (V5 corn growth stage) as compared to giant ragweed emerging at the same time as corn (Harrison et al.2001).

Economic Simulations with Late Emerging Weeds

To assess the economic impact of late emerging weeds, we need to predict the crop yield loss, which is affected by the weed's density, the weed's competitive ability, and the weed's size relative to the crop. WeedSOFT provides yield and economic predictions based on these three factors. Simulations of different scenarios of giant foxtail and giant ragweed competing with corn and soybeans were conducted and the results are presented in tables 1 and 2. The densities of both weed species were set relatively low to simulate situations where a postemergence herbicide treatment may be needed. In the simulations, the weed size remains constant, but the size or stage of the crop increases. The small weed size with the larger crop simulates a late emerging weed scenario. The predicted yield loss from both giant foxtail and giant ragweed is

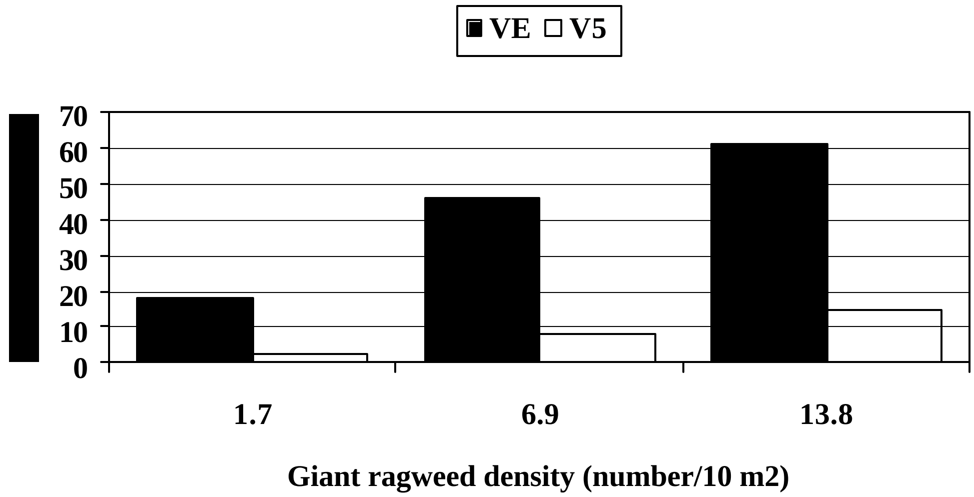

Figure 4. Corn yield loss from giant ragweed that emerged at the same time as corn or 4 weeks after corn (V5 corn growth stage) (Harrison et al. 2001).

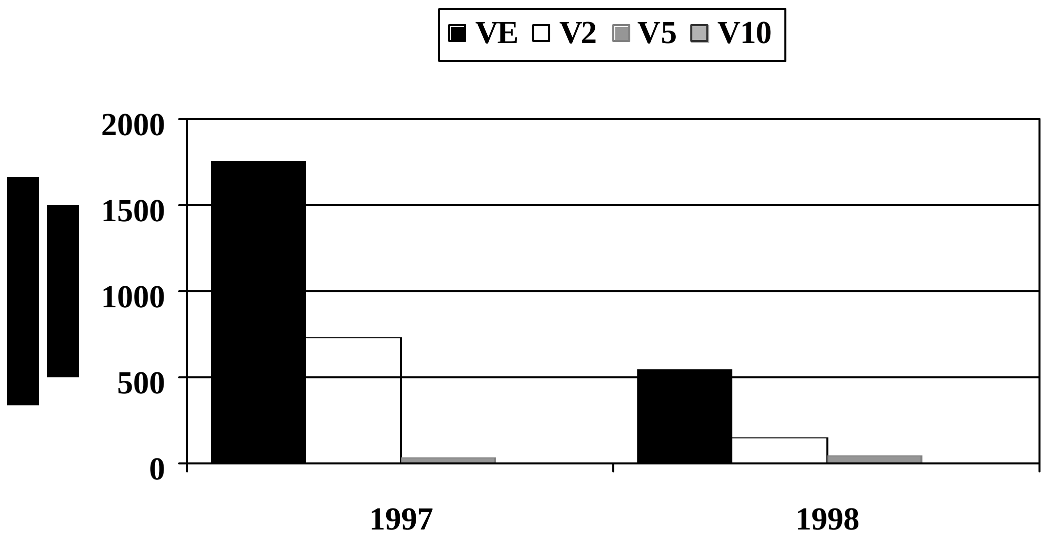

Figure 5. Woolly cupgrass seed production when emerging with corn (VE) or at the V2, V5, or V10 corn growth stages (Mickelson and Harvey 1999).

greater with the small soybeans than the small corn because both of these weeds would have a greater height advantage against soybeans than corn. In all of the situations with a small stage of crop growth, the yield loss justifies a herbicide treatment and predicted returns are substantial. Simulations of either foxtail or ragweed in corn greater than 24 inches tall predicted low levels of corn yield loss and negative returns with either herbicide treatment, which would also require a drop nozzle application. In soybeans, the prediction for the Roundup Ultra treatment for the 3-4 trifoliate soybean with giant foxtail had a breakeven return and it certainly would not pay to control the foxtail in larger soybeans. Because giant ragweed is more competitive than giant foxtail, it was predicted that it would be profitable to control giant ragweed at this density even in larger soybeans.

Table 1. Estimated corn yield loss and returns to Accent or Northstar treatments based on giant foxtail or giant ragweed competition.

	Giant foxtail			Return to	Giant ragweed			Return to
Corn size	Size	Density	Yield loss	Accent	Size	Density	Yield loss	Northstar
(inch)	(inch)	(no/100 ft^2)	(%)	($/a)	(inch)	(no/100 ft^2)	(%)	($/a)
0-5	2-4	100	22	54.23	2-4	30	25	74.14
6-12	2-4	100	16	29.73	2-4	30	18	48.14
12-24	2-4	100	8.5	3.23	2-4	30	9.9	18.64
> 24	2-4	100	3.9	-18.52	2-4	30	4.7	-0.49

Table 2. Estimated soybean yield loss and returns to Roundup Ultra or FirstRate treatments based on giant foxtail or giant ragweed competition.

Soybean	Giant foxtail			Return to	Giant ragweed			Return to
stage	Size	Density	Yield loss	Roundup	Size	Density	Yield loss	FirstRate
	(inch)	(no/100 ft^2)	(%)	($/a)	(inch)	(no/100 ft^2)	(%)	($/a)
0-unifol.	< 2	100	30	57.24	< 2	30	56	124.40
1-2 trifol.	< 2	100	18	22.24	< 2	30	46	98.40
3-4 trifol.	< 2	100	9	-0.26	< 2	30	29	56.40
bloom	< 2	100	3	-15.26	< 2	30	9.6	8.90

In reviewing research data and conducting economic predictions, several major points become apparent in regard to the impact of time of weed emergence. First, we need to focus on controlling the early emerging or first flush of weeds because these weeds account for the greatest density, they are the most competitive against the crop, and they will produce the most seed. Second, weeds of average competitive abilities that emerge later in the season, perhaps 6 weeks after planting, are likely to have minimal effect on crop yield and control will be hard to economically justify. Control of more competitive weeds like giant ragweed may be justified depending upon their density. However, there are often few herbicide options for late herbicide applications. Third, it is fortunate that crop competition greatly reduces the seed production of late emerging weeds. The reduction may be greater than 90% depending on the time of emergence. This should alleviate many concerns about seed production if the weed's density is relatively low. The challenge still remains when extreme weather conditions do not allow the crop canopy to develop as it normally should. This limits the crop's competition against the weed and we may need to lower our threshold for treatment accordingly.

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