ARE TWO-PASS HERBICIDE PROGRAMS VIABLE?

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Two-pass herbicide programs often refer to systems where a preemergence herbicide is applied near planting and is followed by a postemergence herbicide. In corn, the preemergence herbicide may target grass weeds or a mixture of grass and broadleaf weeds and the postemergence herbicide may be focused more on broadleaf weeds or perennial weeds. In soybean, it may be more beneficial to target broadleaf weeds with the preemergence herbicide because grass weeds are easily controlled postemergence with glyphosate. In general, the benefit of a two-pass program may be more frequent and of greater magnitude in corn than soybean, but two-pass programs in soybean still need to be considered.

Before asking if two-pass herbicide programs are viable, it's more important to consider why two-pass programs are even needed. Reasons why two-pass programs fit in corn and soybean weed management systems include (1) improving controlling of problem weeds; (2) reducing the risk of yield loss from late postemergence applications; and (3) increasing herbicide diversity to reduce the risks of herbicide resistant weeds.

Problematic Weeds

Wisconsin growers and agri-professionals are challenged to control several problematic weeds. The top five problematic weeds in soybean and corn were identified in 2005 by agri-professionals (Table 1). This list includes giant ragweed in both crops and waterhemp in soybean, which are weeds that are difficult to control for an entire season with a single herbicide application. Giant ragweed is a particular problem with postemergence programs because it grows so rapidly that it may become too large for effective control with postemergence herbicides or compete significantly with the crop before it is controlled. Unfortunately, highly effective preemergence herbicides are not available in corn or soybean to control giant ragweed. However, preemergence herbicides can suppress the giant ragweed so that postemergence herbicides are effective. Waterhemp differs from giant ragweed in that it creates more problems because of its mid and late season emergence and ALS herbicide resistance. This emergence pattern increases the value of postemergence herbicides when preemergence herbicides lose their residual activity.

Table 1. Most problematic weed species identified by agri-professionals in soybean and corn in 2005.

Species	Soybean	Species	Corn
C. lambsquarters	63%	Giant ragweed	19%
Giant ragweed	9%	Crabgrass spp.	15%
Ragweed spp.	4%	C. lambsquarters	14%
Dandelion	4%	Foxtail spp.	9%
Waterhemp	4%	Velvetleaf	7%

Common lambsquarters are also a major problem in Wisconsin. It is the main weed problem in soybean and in the top three weeds in corn according to agri-professionals (Table 1). Apart from some triazine resistant populations, common lambsquarters generally has been controlled successfully with preemergence or postemergence herbicides. However, lambsquarters control with glyphosate has been less consistent in recent years. Part of the reason for this

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problem may relate to the size of lambsquarters when they are sprayed. In a recent survey of agri-professionals, 69% of respondents commented that lambsquarters are sprayed when they are greater than 4 inches tall (Figure 1). It is likely that a preemergence broadleaf herbicide would reduce the size of these lambsquarters when they are sprayed postemergence with glyphosate.

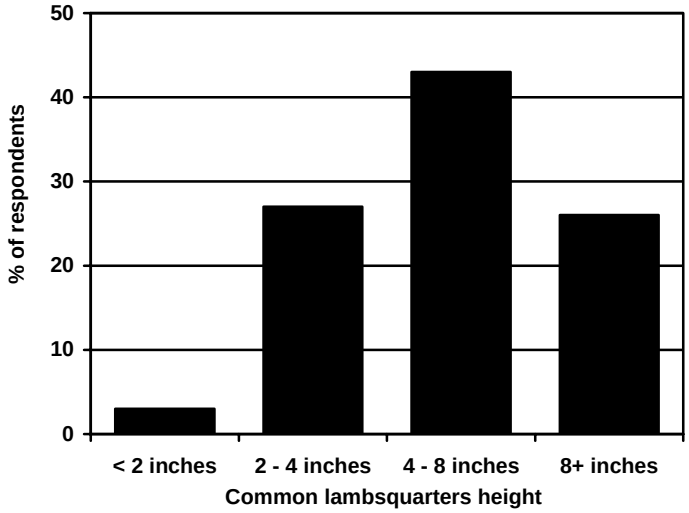

Figure 1. Height when lambsquarters are sprayed with glyphosate according to agri-professionals in Wisconsin (n = 302).

Early Season Weed Competition and Risk Management

While poor control of these weeds and their effect on yield is a problem, the economic effect of poorly timed weed management may be just as costly. Many research studies have demonstrated the effect of early season weed competition on crop yield. For example, we compared the effect of controlling weeds postemergence with glyphosate in corn when they reached a 4-inch height or at a 12-inch height as compared to being controlled preemergence in 2006. Although the 12-inch weed removal treatment had the least weed biomass in the fall, the average yield of the 12-inch removal treatment was 194 bu/a, which was 12 bu/a less than the 4-inch removal treatment and 15 bu/a less than the preemergence treatment (data not shown). We have also measured the value of preemergence herbicides in reducing the risk of yield loss from late applications of postemergence herbicides (Figure 2). In this 2-year study, half rates of common preemergence herbicides were applied alone or were followed with a standard glyphosate application. The half rate of these preemergence herbicides provided partial weed suppression, which substantially increased corn yield when followed with the postemergence glyphosate. The single application of glyphosate yielded 165 bu/a, whereas corn yielded 189 bu/a when averaged across the seven two-pass herbicide programs.

The effect of early season weed competition can be estimated easily with the WeedSOFT yield loss calculator located at http://weedsoft.unl.edu. Using a scenario with four common lambsquarters per ft^2 across a range of soybean growth stages, this web tool calculates potential yield losses as the lambsquarters are allowed to compete for increasing durations (Figure 3). With 8-inch tall lambsquarters and V4 soybean, slightly more than 3 bu/a might be lost from a 50 bu/a yield potential at a cost of $19/a. This represents the economic risk of a delayed herbicide application. Other scenarios in corn or soybean with single or multiple weeds can easily be simulated with this web tool.

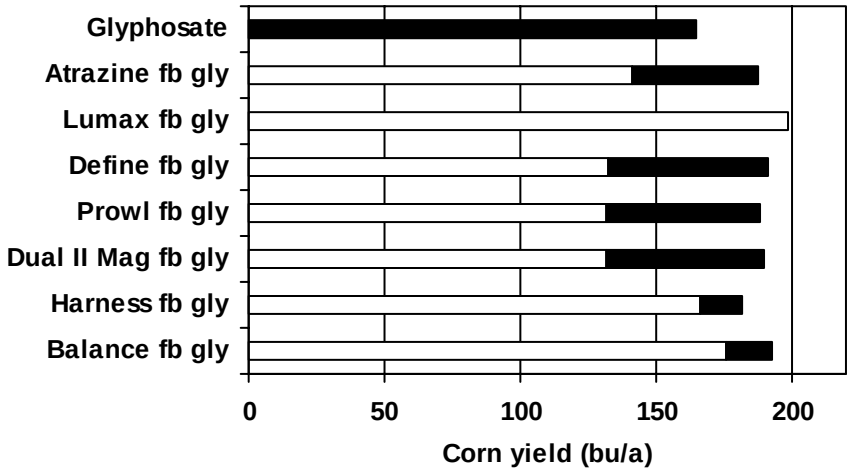

Figure 2. Average corn yield with half rates of preemergence herbicides alone (white bar) compared to the preemergence herbicide followed by (fb) glyphosate (white plus black bar). Experiments conducted at Arlington Ag Research Station in 2005 and 2006.

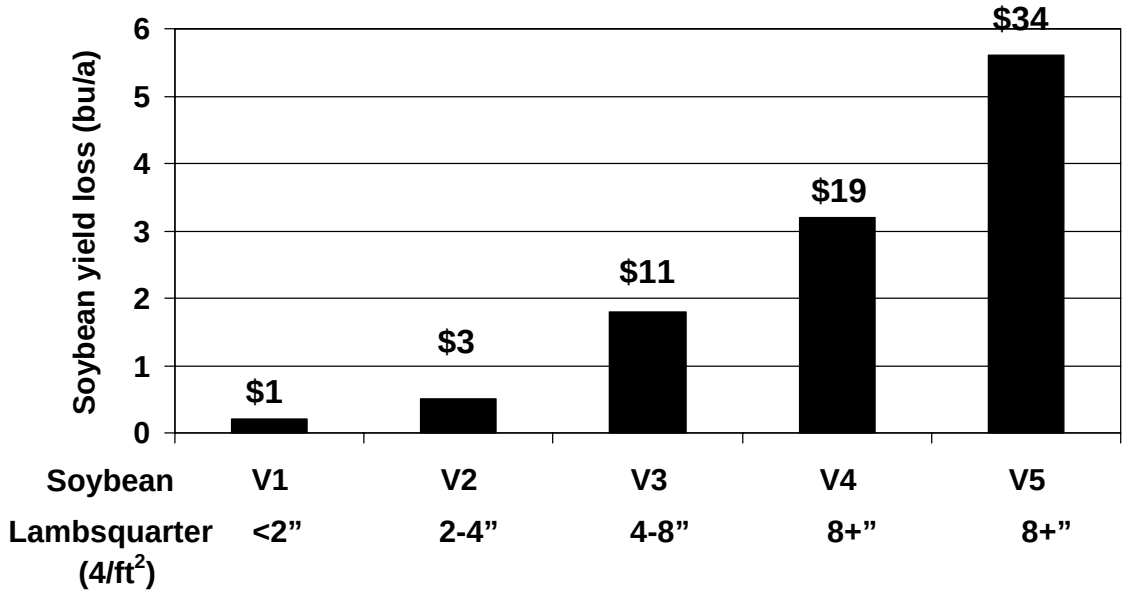

Figure 3. Estimated soybean yield and economic losses when common lambsquarters are controlled at increasing soybean growth stages and common lambsquarters heights.

Herbicide Resistance Management

Two pass herbicide programs may also contribute to herbicide resistance management strategies in addition to improving weed management or reducing risk. Of concern, the number of glyphosate-resistant weeds in the US is increasing (Figure 4) and includes several weeds that are common in Wisconsin (i.e., waterhemp, giant ragweed, horseweed, and common ragweed). Is there a reason for concern? Most agri-professionals (81%) reported that they believe glyphosate-resistant weeds will have some or frequent effects, especially with problem weeds in Wisconsin (data not shown). The contribution of two pass programs to resistance management can be to reduce the number of weeds that are treated with the same herbicide. Relative to glyphosate resistance, the use of a preemergence herbicide may control a majority of the weeds so that only a

small number of remaining weeds are exposed to glyphosate This likely reduces the selection pressure for resistance for many weeds. However, it may not be as effective on weeds like giant ragweed that are only suppressed by preemergence herbicides or on weeds like waterhemp that can emerge after the residual activity of preemergence herbicides dissipates. Still, it is better than relying solely on postemergence applications of glyphosate.

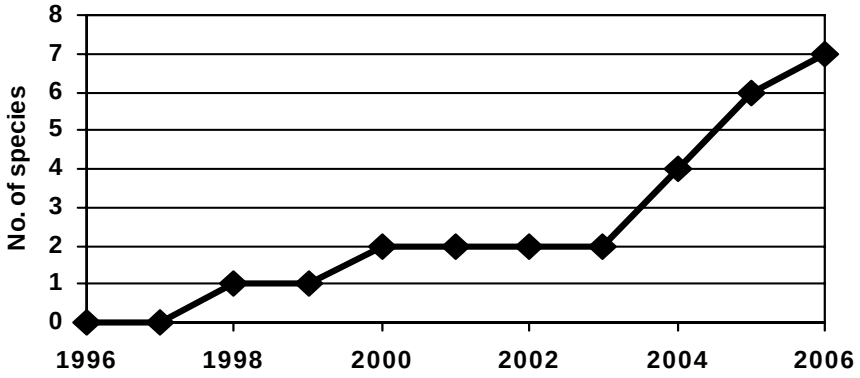

Figure 4. Number of glyphosate-resistant weed species reported in the United States since the introduction of glyphosate-resistant crops.

Conclusions

The focus of this paper is whether or not two-pass herbicide programs are viable. Three benefits of two-pass programs have been presented that include improved weed control, reduced economic risks, and increased herbicide diversity, which will reduce selection for herbicide resistance. However, two-pass herbicides programs may be more costly than single pass programs. A preemergence herbicide program has the cost of the herbicide(s) and the application. In a no-till system, the preemergence herbicide can be added to the burndown herbicide application so the added cost is only the cost of the herbicide. The cost of the preemergence herbicide may be low with herbicides like atrazine to more expensive premixtures. Many useful preemergence herbicides might cost $7 to 15/a and the cost-to-benefit ratio may be favorable in many situations, especially in corn. On farm tests are currently being conducted in soybean to determine the frequency of economic benefits with two-pass programs.

Are two-pass herbicide programs viable? The answer is yes. Are they always justified? It depends on the crop, the weed spectrum, the weather, the number of acres to be treated, and the resources available to spray the acres. These questions need to be assessed by farm managers to determine the right answers.