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Timing Post-Emergent Weed Control in Corn

As the season progresses, not only does your corn grow, the weeds grow as well, competing with the crop for light, water and nutrients. The longer the weeds compete with the corn the greater yield loss. The level of crop yield loss will depend on (a) environmental variables, (b) weed species composition within a given field, (c) weed density and (d) time of weed emergence relative to the crop growth stage.

In addition, to decide whether or not weed control is economically worthwhile, there is a need for understanding if a given weed infestation is likely to reduce yield if left uncontrolled. This establishes the rationale for introduction of the concept of **critical period of weed control (CPWC)**. The CPWC is a period in the crop growth cycle during which weeds must be controlled to prevent yield losses. Weeds that emerge before or after this period may not present a threat to crop yields. This information is essential in making decisions on the need for and timing of weed control and in achieving an efficient use of herbicides.

Research at the University of Nebraska has shown that each crop has a CPWC during which weeds must be controlled to maintain maximum yields. However, we also concluded that the length of such critical period is influenced by the cropping practices, for example by the nitrogen level in corn.

CPWC in dry-land corn as affected by nitrogen: Studies were conducted in 1999 and 2000 at Mead and Concord. Predominant weed species at both locations/years were velvetleaf, common waterhemp and green foxtail, with the densities ranging from 80-120 plants per square yard. Nitrogen was applied immediately prior to planting as 46-0-0 and incorporated within one hour after application.

CPWC in corn was affected by the level of nitrogen fertilizer. Generally, a reduction in nitrogen fertilizer resulted in a longer CPWC, thus corn was the less tolerant crop to weed presence. For example, at zero N level, CPWC ranged from approximately 1st to 11th leaf stage of corn, based on a 5% acceptable yield loss (Table 1). This suggests that when no N-fertilizer is applied, the timing of weed control measure should start early in the season (at the 1st leaf stage of corn) and needs to be maintained through the 11th leaf stage, approximately the time of crop canopy closure.

Table 1: Critical period of weed control in corn based on 5% yield loss expressed as crop leaf stage (eg.V1) and days after crop emergence as affected by the level of nitrogen fertilizer.

Nitrogen-Level	Time to Control Weeds	Time to Control Weeds
lbs / acre	Corn leaf stage	Approximated Days After Crop Emergence
N = 0	V1 - V11	8-45
N = 55	V3 - V10	10-42
N = 110	V4 - V9	15-39
N = 210	V6 - V9	20-39

This data implies that an increase in N fertilizer delayed the timing of weed control and increased the corn tolerance to weed presence. From a practical standpoint, an insufficient N can reduce corn tolerance to weeds and it can widen the window of a CPWC. Furthermore, from a nitrogen restriction-use and a regulatory perspective, anticipated restrictions on the level of N use in corn may require more intensive weed management programs.

Cost of delaying weed control in corn crop: A common question among producers is "how much is it going to cost me if I delay weed control". In order to answer such question we graphed the yield loss data against the crop growth stage at the time of weed removal (Figure 1). In a practical situation one may decide to select, for example, 2%, 5% or 10% yield loss to signify the beginning of the critical period (time of weed removal). This range will allow adjustment of CPWC depending on the risk one is willing to take. In our study, an arbitrary level of 5% yield loss was used to determine the beginning of CPWC in both crops (see the 5% yield-loss-line at the Figure 1).

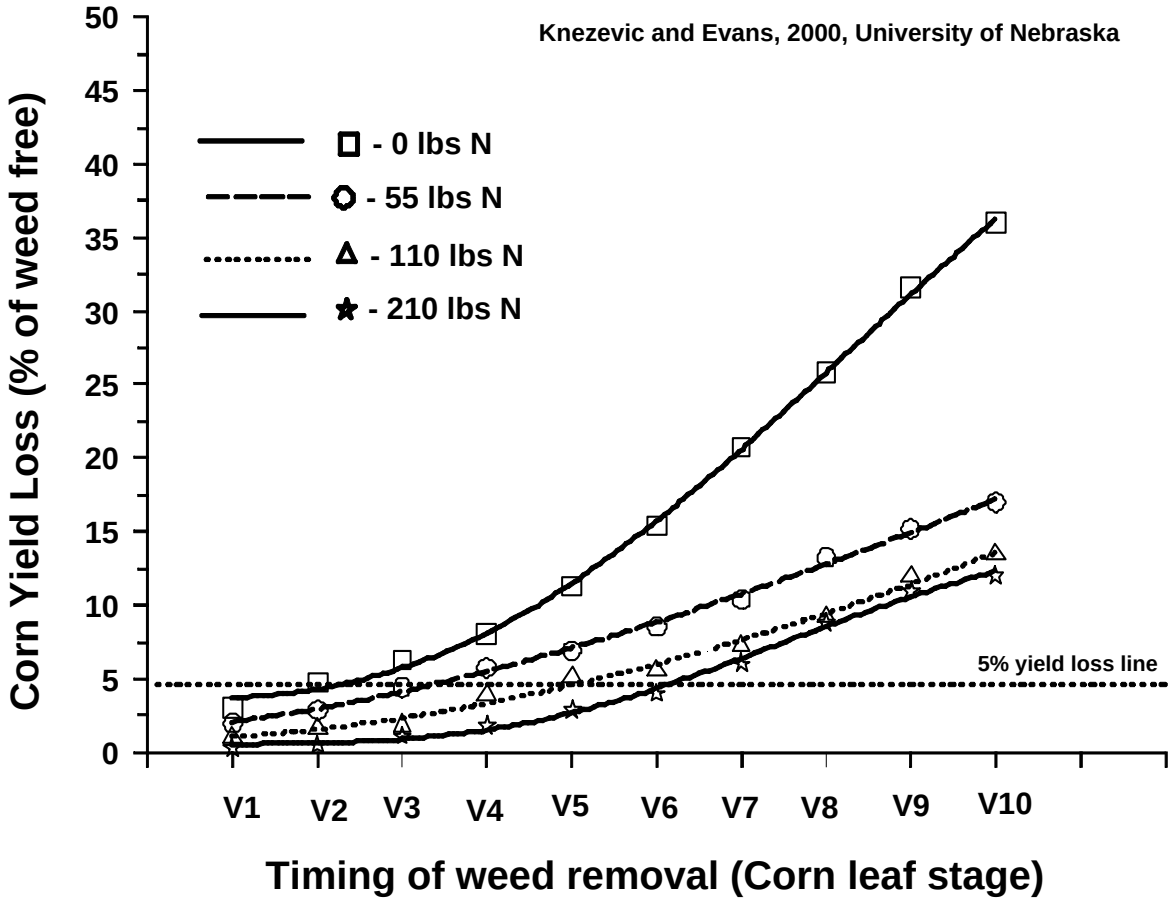
In order to determine the cost of delaying weed control, the curve above the arbitrarily selected point (the beginning of CPWC) should be used. For example, if an arbitrarily selected point of CPWC is 5%, the 5% yield loss will occur if the weeds are removed at the 2nd leaf stage in 0-N-level. Delaying weed control to the 3rd leaf stage will cause about 7% yield loss, in essence costing producer a 2% yield loss. A similar trend is observed for the later leaf stages at each of the four curves. Therefore, we conclude that delaying the time of weed removal, after the starting point of CPWC will cost a producer an average of 2% in yield loss per every leaf stage of delay. This recommendation is applicable up to canopy closure in corn (about 11 fully developed leaves).

To determine the actual economics of the cost of delayed control, the producer will have to convert the percentage yield loss of the actual target yield on his farm. For example, if a target yield for corn is 100 bushels per acre, delaying weed control for every leaf stage of crop will cost producers about 2 bushels per acre of yield (thus 2% of 100 bushels per acre). In terms of actual economic loss, it will be about $7 per acre for every crop leaf stage of delay, assuming a price of $3.50 bushel for corn.

WEED SIZE: Weed size at the time of weed control measure is another concern. In the corn study, the weeds were about the same size as the crop at the time of their removal except for the Mead site in 2000. If the weeds are taller than corn they will shade the crop so the control should be initiated 4-5 days (1-2 leaves) prior to the beginning of CPWC. If the weeds emerge 5-8 days after the crop they will not shade the crop that early in the season so the control can be initiated 5-10 days (2-3 leaves) after the beginning of critical period, as it is shown with the later start of the CPWC at Mead in 2000. The size of weed species will effect the herbicide use rates too, especially the rates of Roundup or various generic glyphosates in Roundup-Ready soybeans. It is well known that Roundup has much better activity on grassy than broad leaf species. Therefore the rates of 16 to 24 oz should provide control of most common annual grassy species (foxtails, barnyardgrass, field sandbur, woolly cupgrass, panicums) that are 3-8 inches tall. The same rates should control annual broadleaves (velvetleaf, lambsquarters, pigweeds, mustards) that are less than 6 inches tall. For taller grasses and broadleaf species a full rate (32 oz) will be required. Higher rates of Roundup (40 oz - 60 oz) will be needed to control species such as ivy-leaf morning-glory, sweet clover, field bindweed, Venice mellow and various smartweeds (lady's thumb, Pennsylvania smartweed, wild buckwheat, etc).

Practical use of the CPWC and timing of weed control in herbicide tolerant crops: A generally sound strategy, for example in Roundup-Ready corn will be to apply Roundup tank-mixed with a residual herbicide at the beginning of the critical period, which will provide adequate weed control the entire critical period. In order to select appropriate herbicide mixtures for the weed spectrum at your farm, we suggest to consult the herbicide efficacy tables from the Guide for Weed Management in Nebraska (Extension Publication, EC-130). (SK)

Figure 1: Corn yield loss and CPWC as influenced by the timing of weed removal and N rate



Control of problem weeds in Roundup-Ready soybean with soil applied herbicides

Many practitioners are reporting that glyphosate used alone does not work well today compared to 5-6 years ago, and it appears that Nebraska's fields are experiencing a slow shift in weed species. In the last three years, university weed extension specialists have been receiving phone calls and complaints on glyphosate failing to control certain weed species, including some "new weeds". The list of such species includes: marestail (horseweed), morning-glory (common and ivyleaf), wild buckwheat, Pennsylvania smartweed, lady's thumb, venice mallow, yellow sweetclover, field bindweed, waterhemp, kochia, Russian thistle, primrose species and volunteer Roundup-Ready corn. If these weeds are not controlled, their seeds will be a major problem in the future, especially in no-till systems, due to lack of tillage as a tool for weed control. Such shifts in weed populations to more tolerant weeds is already resulting in an increased weed control costs due to additional herbicide applications or increased glyphosate rates. This article summarizes data from our studies conducted at Concord and North Platte in 2004 with the

objective to test six soil applied herbicides for control of the above weed species. The six broadleaf herbicides were: Authority 75DG (5 oz/acre), Sencor 75DF (8 oz/acre), Canopy XL 56DG (6.5 oz/acre), Commit 3ME (1.5 pt/acre), Pursuit Plus 2.9EC (2.5 pt/acre), Scepter 70DG (2.8 oz/acre) and Steel 2.6 EC (3 pt/acre). These herbicides were applied to the soil after planting weed seeds.

The level of weed control at 40 days after planting varied by the weed species and herbicide. For example, Sencor provided excellent control (100%) of kochia, velvetleaf and Venice mallow compared to a lower control level (37%) of ivy leaf morningglory (Table 2). For control levels for each weed species and herbicides see Table 2.

The results indicate a potential to effectively control most of those weed species with various pre-emergence type herbicides applied to the soil after soybean planting. Soil applied herbicides would also provide additional mode of action for weed control, thus reducing a chance for weed resistance. Soil applied herbicides would also provide a longer "comfort zone" for weed control early in the season by delaying the critical time for weed removal and reducing the need for multiple glyphosate applications later on in the season.

Using various weed control tools is not a new thing, we only "forgot" about it since the introduction of Roundup-Ready crops. Changing modes of actions in your herbicide program is also one of the basic ideas in an Integrated Weed Management (IWM) program (eg. integrating several tools for weed control), especially to combat weed resistance/tolerance issues. I believe that Roundup-Ready technology has a fit under the umbrella of an IWM system, and the value of this technology can be preserved only by proper management, and reduced overuse.
In essence, the development of an IWM program is based on a few general rules that can be used on any farm, which includes: (1) use of agronomic practices that limit the introduction and spread of weeds (preventing weed problems before they start), (2) help the crop compete with weeds, and (3) use practices that do not allow weeds to adapt. Combining agronomic practices based on the above rules will allow agronomists to design an IWM program for any field. The bottom line is that an IWM program is not a 'recipe'. Rather, it needs to be changed and tailored to a particular farming operation. The goal is to manage weeds, since their eradication is not possible. For more details on IWM see Guide for Weed Management in Nebraska. The concepts of IWM become even more important when other Roundup-Ready crops become more common (eg. Roundup-Ready corn, Roundup-Ready alfalfa). It is easy to fall into a trap of overusing glyphosate when one glyphosate-tolerant crop is grown after another. Therefore, proper use of this technology, as a component of IWM program, is the key to preserving the long-term benefits of this technology while avoiding many of the concerns about their use, or misuse (eg. overuse). (SK)

Table 2. Weed species and their control (%) with various PRE-EMERGENCE type herbicides at 40 days after application at Concord in 2004 (preliminary data).

Weed species	Authority 5 oz/acre	Sencor 75DF 8 oz/acre	Canopy XL 6.5 oz/acre	Commit 1.5 pt/acre	Pursuit Plus 2.5 pt/a	Scepter 2.8 oz/a	Steel 3 pts/acre
Field bindweed	77	63	100	73	98	98	97
Ivyleaf morningglory	88	37	90	40	72	83	85
Kochia	100	100	100	100	100	98	100
Russian thistle	100	95	100	37	95	98	98
Yellow sweetclover	67	98	93	98	81	90	86
Velvetleaf	98	100	95	100	100	90	97
Venice mallow	92	100	100	100	97	98	97
Common waterhemp	100	100	100	96	100	95	100
Wild buckwheat	100	100	100	100	100	100	100
Lambsquarter	100	100	100	100	100	100	100
RoundupReady-corn	12	27	71	33	55	96	95

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