Science Societies

Critical time of palmer amaranth removal in soybean affected by residual herbicides

By Matt Ernst

January 11, 2022



Photo courtesy of Wikimedia Commons/Chafer Machinery.

New research in *Agronomy Journal* (**https://doi.org/10.1002/agj2.20615**) underscores the importance of residual herbicides in controlling Palmer amaranth in soybeans. The study documented that residuals delayed the critical time of Palmer amaranth removal during seasons that were both wetter and drier than usual. This showed pre-emergence soil-applied residuals can buy producers significant time before post-emergence products may be needed to control weed populations, potentially yielding long-term benefits for herbicide resistance management.

Soybean producers and CCAs alike have found pre-emergence residual herbicides to be an essential part of managing herbicide-resistant weeds. Research from the University of Nebraska–Lincoln (UNL) recently published in *Agronomy Journal* (**https://doi.org/10.1002/agj2.20615**), underscores the importance of residual herbicides in controlling Palmer amaranth in soybeans.

The study documented that residuals delayed the critical time of Palmer amaranth removal during seasons that were both wetter and drier than usual. This showed pre-emergence soil-applied residuals can buy producers significant time before post-emergence products may be needed to control weed populations, potentially yielding long-term benefits for herbicide resistance management.

Research Reinforcing the Fundamentals

The main research plot, studied in 2018 and 2019 at Carleton, NE, compared three treatments: no pre-emergence herbicides; pre-emergence flumioxazin, applied as Valor SX; and a pre-emergence premix of flumioxazin/metribuzin/pyroxasulfone, applied as Fierce MTZ.

The critical time of Palmer amaranth removal (CTPAR) was defined as the point of removal needed before a 5% soybean yield loss. Subplots had Palmer amaranth removed at the V1, V3, V6, R2, and R5 soybean growth stage.

The takeaway is familiar to CCAs in soybean country. “Both herbicides provided relatively good control of Palmer amaranth early in the season,” says Amit Jhala, UNL Associate Professor/Extension Weed Management Specialist and a co-author of the *Agronomy Journal* article.



Early-season competition of Palmer amaranth with soybean if not controlled by a residual herbicide at planting. Photo courtesy of Amit Jhala.

The pre-emergence residuals increased the CTPAR—even during an unusually dry 2018 season. In 2018, the CTPAR was 33 days after emergence (DAE) for Valor SX and 24 DAE for Fierce MTZ. The CTPAR was even longer in 2019, an unusually wet year: the CTPAR was 42 and 45 DAE for Valor SX and Fierce MTZ, respectively. “It is important to have irrigation or rain of about half an inch within 12 days of applying residual herbicides,” Jhala says.

The Nebraska research, like other studies, also showed pre-emergence herbicides delay the Celsius growing degree days where 50% response between lower and upper limits occurs, or ED_{50}. When ED_{50} is delayed, soybean plants produce more pods that usually have higher seed counts per pod. Higher numbers of pods and seeds mean higher soybean yields; the Nebraska researchers found higher yields in plots treated with residuals. This study reinforced other research, in Nebraska and elsewhere, showing pre-emergence herbicides can contribute to better yields by controlling Palmer amaranth.

Differences in Weed Biomass

The UNL researchers also documented the differences in Palmer amaranth biomass among all three treatments. Palmer amaranth biomass was about three to five times higher, depending on the season, in plots without pre-emergence residuals. During the 2019 season, the researchers found some differences between the single-site and multiple-site-of-action residuals. That year, Palmer amaranth biomass per acre was lower in the plots where flumioxazin was applied alone pre-emergence. The authors attributed this to a higher rate of flumioxazin, when it was applied alone, than in the premix.

But that single-season result should not deter using multiple-site-of-action residual herbicides. A different Nebraska study found a flumioxazin/pyroxasulfone premix reduced Palmer amaranth biomass by 86%, and a 2017 Tennessee study found pre-emergence residuals decreased PPO-inhibitor-resistant Palmer amaranth by 98%.

The evidence underscores the importance of pre-emergence residuals—for both current and future season weed control. “A soil-applied herbicide with multiple modes of action will also reduce number of weeds exposed to post-emergence herbicide and eventually reduce the weed seed production and weed seedbank,” Jhala says.

Multiple Sites of Action vs. Single Site

The Nebraska research built on other Nebraska studies demonstrating the efficacy of using pre-emergence residuals with multiple sites of action to manage herbicide resistance in both Palmer amaranth and waterhemp. Those results are repeated in research trials in other regions, says Travis Legleiter, University of Kentucky Extension Specialist in Weed Science.

“We usually buy ourselves two to three weeks of time (until post applications) just by having a single or multiple-site-of-action residual versus none at all,” he says. That lines up with the Nebraska research, which indicated around 10 days longer for post-applications for residuals compared with no residuals.

In some cases, the time until post-emergence applications may be even longer. “On one of our research sites, in far western Kentucky in 2019, by the time we got ready to spray our first post-emergent application on a site that had received a multi-site-of-action residual, we were already on our second post treatment for those sites that had received no residual at all. We bought ourselves four weeks there,” Legleiter says.

Legleiter acknowledges that the product cost of multi-site-of-action residuals, as compared with a single-site residual, may be an initial deterrent for some producers. “The financial payoff in using a multi-site of action is in the yield. But unfortunately, you may not see that every year,” he notes. “Producers might be looking at a single-site cost of around $15 per acre and the multi-site of action maybe adding another $10 or more, depending on the exact product and rate,” he says.

Legleiter advises presenting producers with the long-term impacts of reducing Palmer amaranth populations. The more residuals extend the time until a post-emergent application is needed, the better the long-term outlook for the efficacy of post-emergent herbicides on resistant weeds. “So we encourage producers to value the

multi-site-of-action product for the long-term weed control, reducing those resistant weed populations and the weed seedbank," Legleiter says.

Multi-Site Moving Forward

In Nebraska, Amit Jhala agrees with the wisdom of taking the long view and continuing the use of multiple-site-of-action residuals. "This is particularly important in soybean as effective post-emergence herbicides are limited, particularly for management of glyphosate and PPO-inhibiting herbicide-resistant waterhemp and Palmer amaranth," he says.

In short, selecting the right combination of pre-emergence and post-emergence herbicides can minimize new weed biotypes. "Selection of a pre-emergence herbicide based on known weed composition of the field may increase pre-emergence herbicide efficacy and further delay the critical timing of weed removal," concluded Jhala and his co-authors, in the *Agronomy Journal* article.

Dig deeper

View the original *Agronomy Journal* article, "Residual Herbicides Affect Critical Time of Palmer Amaranth Removal in Soybean," at **https://doi.org/10.1002/agj2.20615**.

More integrated pest management

Back to issue

Back to home

Text ©

. The authors. CC BY-NC-ND 4.0. Except where otherwise noted, images aresubject to copyright. Any reuse without express permission from the copyright owner isprohibited.