Evaluating Herbicide Incorporation Via Water Quality and Timing Under Different Tillage Strategies

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Situation Statement: Glyphosate-resistant weeds have caught the attention of most soybean producers in Eastern North Dakota, and in some cases, people were caught off-guard. As the resistant weeds move further north and west throughout the state, there are new challenges for producers as well as shared challenges state-wide. Some of the more notable differences for producers further west will be an increased tendency for minimum or no-till and lower annual precipitation.

The most important piece to combatting glyphosate-resistant weeds in soybeans is an effective pre-emergent (PRE) herbicide program. Predicting when an activating rainfall will occur is as difficult as ever even though we know that the amount of rain will impact the success of PRE herbicides. The question then becomes, “how will the herbicide be affected if we don’t get enough rain to activate the product?” Herbicide labels will sometimes mention that tillage is an option for activating herbicides when rain does not occur. A field trial was established in 2016 to evaluate weed control using three soybean herbicides affected by delayed rain and if rotary hoeing can substitute for rain activation. These treatments were tested in both tilled and no-till (direct seeded) situations.

Goal: The goal of this study is to evaluate common pre-emergent herbicide options (that would be used in cases of glyphosate resistance) when water activation is delayed. Three herbicides would be compared under tilled and no-till situations, and each of those combinations would be compared with getting no rain and incorporation, getting no rain with tillage for incorporation (harrow/rotary hoe), and getting 0.5” of rain either 1 or 5-7 days after herbicide application.

Description of the research conducted:

The three herbicides chosen, Spartan (sulfentrazone), Fierce (flumioxazin + pyroxasulfone), and metribuzin, represent the chemistries of a large portion of the rain activated PRE herbicides for soybeans. Metribuzin is a generic product sold under many names but was formerly sold as Sencor. Each herbicide was compared in corn stubble that was either tilled or left not-tilled. A center pivot irrigation system was used to simulate rainfall (0.5” of water) for herbicide activation treatments. The herbicides were activated within 1 day of application, 7 days after application, rotary hoed 7 days after application, or received no activation treatment. The first natural activating rainfall occurred 16 days after treatment so the non-activated treatment was actually activated a little over 2 weeks following herbicide applications. The weeds in the study area were common lambsquarters and redroot pigweed. All existing weeds received glyphosate treatment immediately after planting so that only the pre-emerge component of the herbicides was evaluated. There was no new weed emergence subsequent to each irrigation event, only a single emergence date several weeks following the last irrigation treatment.

The study was conducted as a split-split plot arrangement of a randomized complete block design. The study had 4 replicates total of each treatment. Total treatments (sub sub-plots) was 24. Data were analyzed via SAS and subjected to ANOVA. LSD values were calculated for mean separation. A weighted t statistic was generated to make comparisons across all treatment combinations.

Findings:

The best way to start with the results will be to look at each main component of the trial. In general, no-till plots had less weed control than tilled plots (~10% less overall). The most likely cause for the difference is that the tilled treatments created more soil to herbicide contact while more herbicide may have gotten bound to residue in the no-till treatments. This was largely related to performance of a single product (metribuzin) as it tested much worse in no-till than with tilled treatments (Table 1). Spartan and Fierce were largely the same across tillage strategies, though Spartan under tillage actually performed worse than no-till on common lambsquarters when there was no activation. It is not immediately clear why this occurred.

Fierce was the most resilient product of the three. There was never a decline in performance across the tillage and activation strategies. Spartan was also resilient except for the one instance under tilled conditions where receiving no activation reduced control by nearly 20%. Metribuzin was affected the most by tillage and activation (see below). For individual species; metribuzin was better on lambsquarters than pigweed (~10% difference). Fierce was better on pigweed under tillage but provided equal control to both under no-till. Spartan provided statistically similar control to both species, though it often trended toward higher control of lambsquarters than pigweed.

A one week delay in rain activation only caused reduced control with metribuzin. With metribuzin the control dropped off dramatically under no-till when no activating rain occurred. Rotary hoeing did not increase control in no-till and actually reduced weed control under tilled conditions. In this case the rotary hoeing may have planted more seeds than it terminated, while not activating the product. Rotary hoeing did increase the weed control from Spartan under tilled conditions. Rotary hoeing had no effect on no-till Spartan nor either tillage strategy with Fierce but control was already very high with those treatments. Based on these results, rotary hoeing would not be recommended with metribuzin.

It was surprising to see Fierce so stable across treatments. One of its components, pyroxasulfone (sold alone as Zidua), needs multiple rainfall events totaling at least 0.5” or more for activation. Yet, there was no apparent negative response due to activation strategy. In 2016 the activating rain came 16 days after the herbicides were applied. That is still a relatively short period of time. Spartan and Fierce would likely see a dramatic drop in efficacy between 21 and 28 days after application if not activated properly, though it is not clear which one would drop first. This study will continue in 2017 at the CREC.

 