Evaluating the Effects of Intense Precipitation on the Efficacy of Weed Management in Soybeans

Project Update, 8/26/21

Our proposed work included three research objectives investigating how extreme precipitation affects weeds and weed management efficacy. Weed management tactics included both a residual herbicide (S-metolachor) and cover crop mulch (with or without a cover cro mulch). S-metolachlor is a commonly used pre-emergent herbicide used to control weeds in both corn and soybean, as well as a number of other crops. S-metolachlor also has a relatively high-water solubility (530 mg L-1) and low sorption to soil particles, making it an ideal candidate for a precipitation study.

The experiment occurred PSU's R.E. Larson Research Center in Rock Springs, PA and was established as a split-split plot randomized complete block design with four replications. The split plots (2 m X 2 m) will consist of a full-factorial combination of the residual herbicide (two levels: no herbicide ('NoHerbicide') and with S-metolachlor ('s-metolachlor')) and cover crop (with a cereal rye cover crop ('Rye) and without ('NoRye'). As a split plot we applied four levels of precipitation treatments (0, 1, 2, and 3 inches of simulated rainfall in a single day event).

In Fall 2020, cereal rye (130 kg seed ha-1) was and then terminated in late Spring 2021 with glyphosate. Prior to cereal rye termination, above-ground biomass was collected from two 0.50 m2 quadrats per plot, sorted into cereal rye and weeds, then oven-dried, and weighed. The no cover crop plots were maintained weed-free until soybean planting with broad-spectrum herbicides as needed. Prior to soybean planting, all plots received a burndown herbicide to kill any existing vegetation. Soybean (420,000 seeds ha-1) were planted in 30 in. rows, and standard fertility (NPK) was applied based on soil tests. At time of soybean planting, a ZRX roller-crimper system was used to flatten cereal rye in both cover crop treatments. At this time, the residual herbicide will be applied (S-metolachlor at 1.75 kg ai ha-1) in the designated treatment

To evaluate the effect that varying precipitation has on the efficacy of weed control tactics (S-metolachlor or cover crops) alone or in combination, we planted two weed species that are generally effectively controlled with S- metolachlor (smooth pigweed and giant foxtail). Prior to S-metolachlor application, 500 viable seeds of each weed species were sown into a 0.5 m^2 quadrat in the center of the subplot.

Approximately one week after S-metolochlor application, the precipitation treatments were imposed using 16 rainfall simulators which applied either 1, 2, or 3 in. of additional precipitation in a single day event. This precipitation was in addition to ambient rainfall.
To do this, we used a low-intensity sprinkler, which consists of a PVC pipe frame and in the center an inverted cone spray tip, and sprayer nozzle mounted on a PVC sprinkler arm with a water pressure control mechanism (ball and throttling valve, and pressure gauge.
Weed Control Efficacy: After S-metolachlor application, emerged seedlings of all four weed species were counted and carefully pulled weekly. Weed emergence counts continued until soybean canopy closure.

Status Update:
We successfully constructed 16 rainfall simulators to imposed the precipitation treatments (see Figure 1).

Figure 1. Picture of one of the 16 rainfall simulators constructed to impose precipitation treatments.

We are still in the process of analyzing the data. However, so far our data suggests that s-metolachlor successfully suppressed emergence of giant foxtail (Figure 2) and smooth pigweed (Figure 3) compared to the no herbicide treatments, even under the most extreme precipitation scenario (3 inches). Interestingly, without the cereal rye cover crop, we see greater weed suppression with s-metolachlor at 1 and 2 inches of additional precipitation compared to both the 0 and 3 inches of rain. The loss of efficacy with the 3 inch precipitation event suggests that higher levels of rainfall we likely will see a loss of s-metolachlor efficacy.

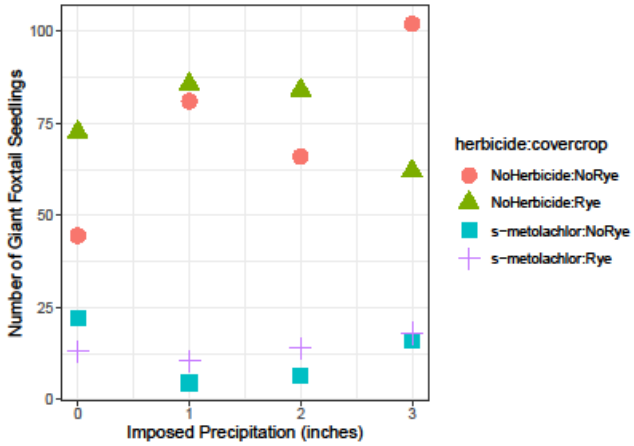

Figure 2. Number of giant foxtail seedlings emerged in treatments including with (Rye and without (NoRye) a cereal rye cover crop, and with and without a s-metolachlor. Precipitation treatments include 0, 1, 2, and 3 inches of precipitation imposed in a single day event.

Across all levels of simulated precipitation, we found the most consistent suppression of pigweed emergence when both s-metolachlor and a cereal rye cover crop were present.
The cereal rye cover crop suppressed emergence of smooth pigweed when no additional precipitation was added. Interestingly, without the cereal rye cover crop (in both treatments with and without the s-metolachlor), we found that the imposed precipitation treatments decreased the emergence of smooth pigweed seedlings.

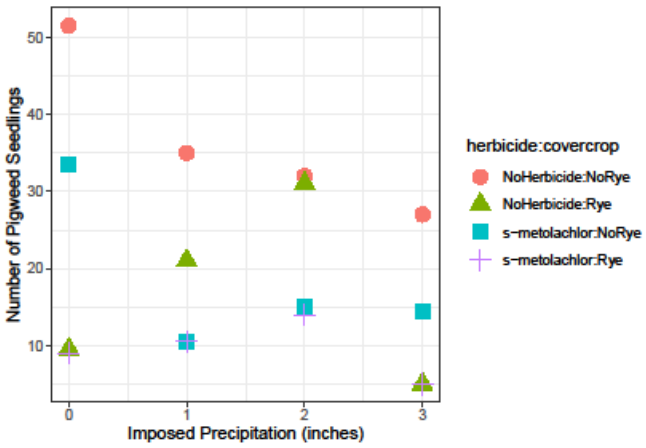

Figure 3. Number of smooth pigweed seedlings emerged in treatments including with (Rye and without (NoRye) a cereal rye cover crop, and with and without a s-metolachlor. Precipitation treatments include 0, 1, 2, and 3 inches of precipitation imposed in a single day event.