Field experiments were established in soybean fields in Gilbert, IA and Dayton, IA in fall of 2022. The first objective of this study (Objective 1) was to evaluate the efficacy of the Redekop Seed Destructor (**Figure 1**) in destroying waterhemp seeds at the time of soybean harvest. The Redekop seed destructor unit (currently priced at $75,000) was installed at the rear of a John Deer S680 combine.

The success of the harvest weed seed control methods relies on the propensity of some weed species like waterhemp and Palmer amaranth to retain a majority of seeds by the time the soybean crop is harvested. 75-80% of waterhemp seeds were still retained by the plants at the time of soybean harvest after accounting for shattering losses to the ground (September through the date of harvest). Out of those seeds that were retained by the plants at harvest, approximately 30% were lost as the combine head passed through those plants in the field (header loss; **Figure 2)**. Additionally, 10% of the waterhemp seeds entering the combine can be lost at the grain tank (grain tank contamination) or escape through the combine thresher (chopper) during the harvest operation.

To determine the seed kill efficacy of the Redekop seed destructor, waterhemp seed samples exiting the combine were collected in 1 m^2 trays placed on the ground with the seed destructor unit turned on vs. off (treatments). Those samples were cleaned and weed seeds were counted. More than 90% of pigweed seeds exiting the seed destructor unit had a moderate to severe physical damage when viewed under a digital microscope (**Figure 3**). Those seeds failed to germinate and were considered non-viable. These results from the first run of this study indicated that the Redekop seed destructor was effective in reducing viable weed seed returns to the soil by more than 90% compared to a conventional harvest operation.

Future efforts need to be focused on minimizing the weed seed inputs to the soil because of the combine header loss (reel contacting the waterhemp plants) to more effectively utilize this harvest weed seed control technology in soybean. Early harvest dates of soybean would also be beneficial to minimize natural shattering of waterhemp seeds with an objective to capture a majority of weed seeds and destroy them with the seed destructor.

Waterhemp seed bank decline: To quantify a decline in viable weed seed bank (Objective 2), four permanent 0.5 m^2 quadrats will be established in each plot (with or without HWSC) in the spring of 2023. Waterhemp (and other weed species present at the test sites) emerging in each quadrat will be marked separately to establish three different emergence cohorts in 2023. Fields will be planted to corn or soybean in 2023. Data on pigweed emergence period (beginning and end dates), emergence counts, and plant height will be monitored from 0.5 m^2 quadrats at biweekly intervals and a final assessment of pigweed density in August. Waterhemp biomass and seed production

(by cohort) will also be determined in the four 0.5 m2 quadrats in each plot. Weed biomass will be quantified by clipping weeds at the soil surface; those samples will be oven dried and weighed. Weed seed production (no. m^{-2}) will be estimated to determine the impact of this harvest weed seed control technology in reducing weed seed banks in soybean-based production systems of Iowa.

Figure 1. Redekop seed destructor (high-impact mill) attached to a John Deer S680 combine in a soybean field at harvest in Dayton, Iowa, 2022.

Figure 2. Measuring header, grain tank, and thresher losses of waterhemp seeds at harvest in a soybean field in Iowa, 2022.

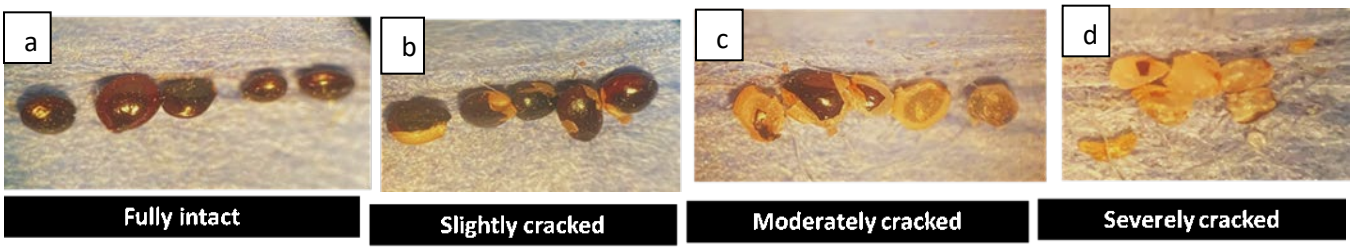

Figure 3. Different levels of physical damage of pigweed seeds after passing through the Redekop seed destructor (high-impact mill) compared to conventional harvest (a).