Assessing the Influence of Base Germination Temperature and Chemical Desiccants on the Recruitment Biology of Cleavers (*Galium* species)

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Cleavers are problematic weed species in canola that can reduce crop yield, impair harvest operations, and reduce crop processing efficiency. A two-year field study was conducted to better understand the biology and impact of pre-harvest herbicides on cleavers populations. The study identified that cleavers have a base temperature of 2° C and can germinate at very low temperatures from April to November. These temperatures are lower than expected and can extended well into the fall. Therefore, producers should scout fields late into the fall and early in the spring to ensure identification of early emerging or overwintering cleavers populations. The study also showed that the viability and the amount of contamination from cleavers at harvest can be reduced by using pre-harvest herbicides.

Cleavers, including *Galium aparine* (cleavers or catchweed bedstraw) and *Galium spurium* (false cleavers) are problematic weed species in canola that can reduce crop yield, impair harvest operations, and reduce crop processing efficiency. The development of herbicide resistance in these species, as well as the potential for evolved glyphosate resistance, means that knowledge of their biology and the development of alternative management strategies is critical.

Researchers at the University of Saskatchewan conducted a two-year study to better understand the recruitment biology of cleavers, as well as the impact of pre-harvest herbicides on successive cleavers populations. The objectives of this study were: to determine the differences in base germination temperatures of *Galium spp*. populations from different locations in western Canada, and to investigate options for reducing cleavers seed return in canola crops. Seedbank management, which includes managing seed returns to the seedbank, is a critical component of managing herbicide resistant weeds.

In the first experiment eight *Galium spurium* populations and one *Galium aparine* population from different locations on the Canadian Prairies were assessed in germination studies. The study used a thermogradient plate and included a range of temperatures (1-10° C) set at 1°C increments. Because the range of germination temperatures is quite wide for Galium, this experiment focused on identifying the lowest threshold temperature for germination in these populations. Germination times were recorded daily for 21 days to determine the lowest temperature at which seeds germinated.

For the second experiment, a two-year field study was conducted in 2016 and 2017 at two sites, including Saskatoon and Scott. In this experiment, researchers evaluated the effect of pre-harvest herbicides on cleavers contamination in canola crops, as well as mature cleavers seed viability and vigour. Seed vigour was evaluated using an electrolyte leakage test. At each location, cleavers were seeded just prior to canola to achieve a target density of 50 plants/m^2 (350 seeds/m^2). In the study, several herbicides were evaluated included saflufenacil, diquat, glufosinate, saflufenacil plus glyphosate, diquat plus glyphosate, and glufosinate plus glyphosate. Both canola and cleavers were harvested from the entire plot using a small plot combine. Cleavers seed were separated manually from canola seed to calculate cleavers seed contamination and canola seed yield.

The results of the thermogradient plate experiment showed that the base temperature for germination was a consistent 2° C for all *Galium spurium* populations and 4° C for the *Galium aparine* population. This suggests that all *G. spurium* populations, regardless of population, have developed the potential to germinate very early in the spring and well into the autumn months. This may also help to explain the ability of cleavers to act as a facultative winter annual (can germinate in autumn and in spring) as opposed to an obligate winter annual (germinate only in autumn).

The results of the two-year field study showed that the percentage of cleavers found in the harvested sample for all treatments was < 2.0%. The glufosinate + glyphosate and saflufenacil + glyphosate application resulted in significantly lower cleavers contamination than most other treatments. All other treatments did not show a significant difference when compared to the untreated check. It is important to note that no sample had greater than 2.0% cleavers contamination, which means all of these samples can be expected to grade a #2 canola or better. However, some treatments resulted in a cleavers contamination that would downgrade the sample from a #1 to a #2 canola. The study also showed that a number of the herbicides reduced seed viability and increased electrolyte leakage in cleavers seeds, indicating potentially lower seed vigour.

Overall, the study showed that all the western Canadian accessions of *G. spurium* have a base temperature of 2° C and can germinate at very low temperatures from April to November. This is the first time the base temperature of *G. spurium* has been identified and considering this is the major species in cropped fields in western Canada, the implications of these findings are important. Producers should scout fields late into the fall and early in the spring after the snow has melted to ensure identification of early emerging or overwintering cleavers populations.

The study also showed that pre-harvest herbicides have the potential to manage cleavers seed production and reduce competition with canola by increasing seed mortality, and by reducing seed viability and vigour. With the increasing incidence of cleavers across the prairies coupled with the increasing acres of glyphosate and glufosinate-resistant canola, an opportunity exists to improve cleavers management by targeting the seedbank. Producers are reminded that seedbank management, which includes managing seed returns to the seedbank, is a critical component of managing herbicide resistant weeds.