**Winter Oilseed Grower Bulletin #6: Timing Pennycress Harvest with Physiological Maturity**

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As land stewards and business owners, growers look for innovative ways to sustainably increase production on their farms. The period between crop harvest and planting the following year (late fall to early spring) is a potential resource for additional crop production. Despite the availability of arable land, it can be difficult to temporally occupy this space due to the short growing season in the Upper Midwest. This conundrum has spurred research on crops that are able to germinate and establish during the fall, survive cold winter temperatures, and yield a marketable product in the spring. One winter annual that fits these characteristics is pennycress (*Thlaspi arvense* L.), a versatile species that can serve as a cover crop and a cash crop, benefitting growers both environmentally and economically. However, pennycress retains weedy characteristics, such as silicle shatter (Figure 1), that are unfavorable for agricultural production. Silicle shatter occurs in many species related to pennycress, including canola (*Brassica napus* L.) and camelina (*Camelina sativa* L.), and is a significant cause of seed loss when these species are not harvested near physiological maturity[1,2]. Physiological maturity corresponds to the growth stage when a crop has reached maximum dry matter. Measurable parameters such as seed moisture, 1000-seed weight, seed yield, oil content, and oil fatty acid composition can be used to determine whether physiological maturity has occurred. The objective of this research was to determine when pennycress physiological maturity occurred in terms of maximizing seed oil content and yield.

Figure 1. Germinated pennycress seed from silicle shatter one week after physiological maturity, June 22, 2018 (Rosemount, MN). Photo by Julija A. Cubins.

This research was conducted over the 2016-2017 growing season in Morris and Rosemount, MN. Pennycress was hand sampled at varying growth stages throughout the month of June to determine the timing of physiological maturity, and, thus, the appropriate time to harvest and reduce potential seed loss due to silicle shatter. Oil content and seed yield maximization served as the key indicators of physiological maturity. To determine these parameters, plants were hand harvested at each sampling interval and dried in an oven; seed was then mechanically separated from the vegetation using a thresher. Seed oil content was measured using near magnetic resonance and seed yield was determined by weighing the harvested and threshed seed sample and extrapolating to kg $ha^{-1}$.

Oil content followed similar trends at both study locations. Pennycress seed produced very little oil at the earliest harvest interval and rapidly increased before plateauing at maximum oil content midway through the experiment (Figure 2). In both locations, oil content maximized around 310 g $kg^{-1}$, or 31% oil. The pattern of seed yield at the Morris site shows the dramatic effect of silicle shatter on yield loss (Figure 3). Seed yield was low at early harvest intervals due to seed immaturity, maximized mid-trial, and decreased dramatically with late harvest intervals as silicles were prone to shatter. Based on the yield pattern and oil content data (Figures 2 and 3), physiological maturity occurred once oil content stabilized despite yield beginning to maximize earlier in the experiment. This corresponded to when 60% of seed on the plants were ripened, meaning that the seeds were dry, black, and could be seen through the dry silicle[4]. Delaying harvest by eleven days after physiological maturity yielded 70% less seed than the maximum yield, further indicating the importance of harvest timing. Seed yield at the Rosemount site was consistent across harvest intervals and was not a strong indicator of physiological maturity due to a lack of statistical change (Figure 3). One potential reason for this is that the Rosemount site had one less sampling interval than the Morris site. Plants may not have been as dry and prone to silicle shatter by the final harvest date and therefore did not experience the same seed loss. In this case, oil maximization was the main consideration and harvest should be delayed until oil content maximized (Figure 2). Based on this information, physiological maturity occurred at the Rosemount site when 40% of seed on the plants were ripened[4].

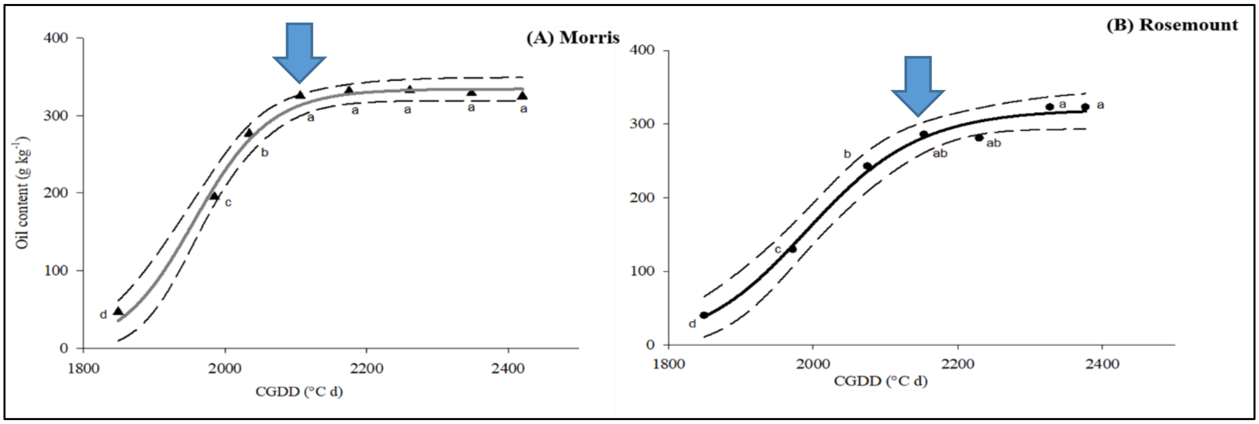


Figure 2. Changes in pennycress oil content (g $kg^{-1}$) with respect to cumulative growing degree days, Morris and Rosemount, MN[3]. Proposed timing of physiological maturity based on oil content stabilization indicated with blue arrow.

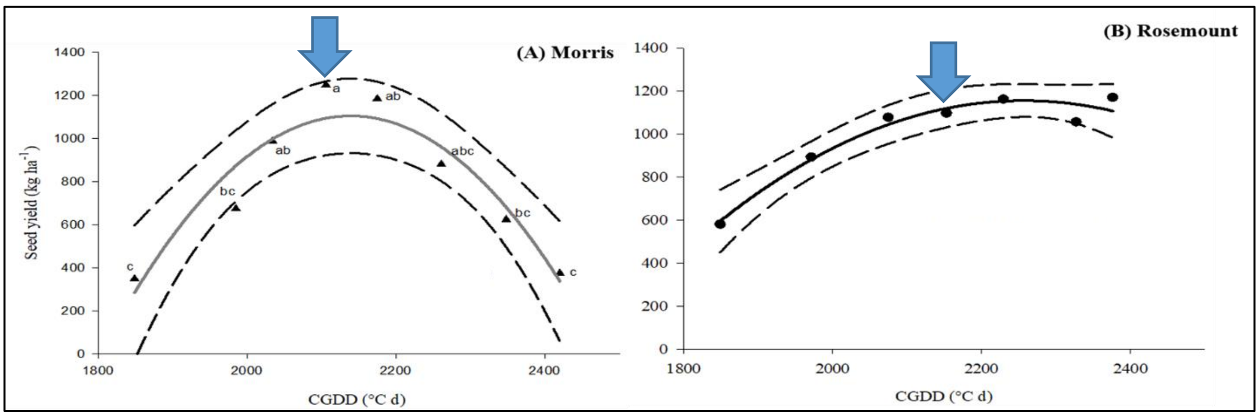


Figure 3. Changes in pennycress seed yield (kg $ha^{-1}$) with respect to cumulative growing degree days, Morris and Rosemount, MN[3]. Proposed timing of physiological maturity based on seed yield maximization and oil content stabilization indicated with blue arrow.

Overall, physiological maturity occurred when about half of the seeds on the plants were ripe, indicating that harvest should occur prior to harvest maturity, when all the silicles and seeds on a plant were ripe, to maximize pennycress seed yield and oil content. However, a formative barrier to harvest is seed moisture at physiological maturity. At both locations, seed had 66% moisture content at physiological maturity. This makes it difficult to facilitate mechanical crop harvest, which is most feasible when a crop is between 12% and 14% moisture. In order to successfully harvest pennycress in the future, seed and crop moisture must be reduced for harvest. Research has been initiated to test the efficacy of harvest aids to decrease plant moisture after physiological maturity and will be the topic of a future research report.

**References**


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