Winter Oilseed Grower Bulletin #3: Influence of Growing Degrees on Winter Camelina Seed Yield and Quality

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Winter camelina is a winter-annual oilseed crop that offers the potential for producing a second crop in the Upper Midwest. It is estimated that 27 million ha used for corn and soybean production in the Upper Midwest can be temporally intensified by inclusion of winter cover crops that can provide additional income to growers as well as ecologic and environmental services to the community (Sindelar et al., 2017). Winter camelina is of interest as it has a short growing season, requires low nutrient inputs, tolerant to drought, and can survive the harsh Upper Midwestern winters. Earlier research has demonstrated that winter camelina can provide a suite of environmental benefits including nitrogen sequestration, pollinator habitat and forage. The Forever Green Initiative team has shown that winter camelina is economically viable as it can yield up to 1700 lbs/ac and contains about 38-42% oil by weight. The oil extracted from winter camelina seed is rich in omega-3 fatty acids and vitamin E. Camelina oil can be used to produce both food (cooking oil) and industrial (aviation fuel) grade oil.

Although winter camelina shows great promise as a winter annual crop, it still has some agronomic challenges that need to be addressed. For instance, research had showed that camelina grain yield is reduced by 24% when seed pods were harvested at 90% maturity as opposed to 50% maturity Sintim et al. (2015), which may be caused by low moisture content. This indicates that physiological maturity (i.e. when about 60-70% of the siliques ripe) in camelina occurs prior to full plant ripening and thus, waiting until the plant has fully matured can impact overall yield negatively, likely due to seed pod shatter and/or avian predation (field observations). In addition, not much has been known about best time to harvest camelina to optimize the seed yield and quality. Therefore, the research was conducted at two locations Morris and Rosemount, Minnesota, to determine the optimum number of growing degree days needed to maximize 1) Seed oil content, 2) Seed yield and quality, and 3) Quantify the seed moisture content at physiological maturity.

Results showed that seed yield of winter camelina reached maximum seed yield levels of 1094 and 1927 kg/ha when cumulative growing degree days (CGDD, calculated using 4°C as a base temperature) was 1324 and 1310°C d at Morris and Rosemount, respectively (Fig. 1; Walia et al., 2018). Overall, seed yields were greater at Rosemount as compared to Morris, which may have resulted from warmer air temperatures during autumn and spring coupled with higher precipitation, especially at flowering and seed-setting at Rosemount.

The increase in seed oil content mirrored that of seed yield, reaching maximum levels of 38.3 and 39.7 % at Morris and Rosemount at 1281 and 1291°C d CGDD, respectively (Fig. 2). This indicates that seed oil content maximizes little earlier than seed yield by about 43 and 19°C d at Morris and Rosemount, respectively which might be resulted from difference in air temperatures at both locations. In the present study, oil content at full maturity did not differ across environments.

An estimated seed moisture content at physiological maturity was 41.0 % at both locations, which occurred during last week of June (Walia et al., 2018). However, the optimum moisture content of camelina seed at harvest is about 8% (Enjalbert and Johnson, 2011). The high moisture contents prevent mechanical harvest (i.e. plot combine), thus supporting the need for harvest aid (e.g., desiccant or swathing). Results suggests that desiccants or swathing could be used to tighten camelina harvest window without sacrificing seed yield and quality. The application of harvest aids offers the potential saving of one to two weeks of direct seed drying to reach harvest maturity. Moreover, harvesting camelina earlier allows earlier seeding of a second crop in a double-cropping system to improve overall production, economics and provide ecosystem services in a double-cropping system in the Upper Midwest.

References

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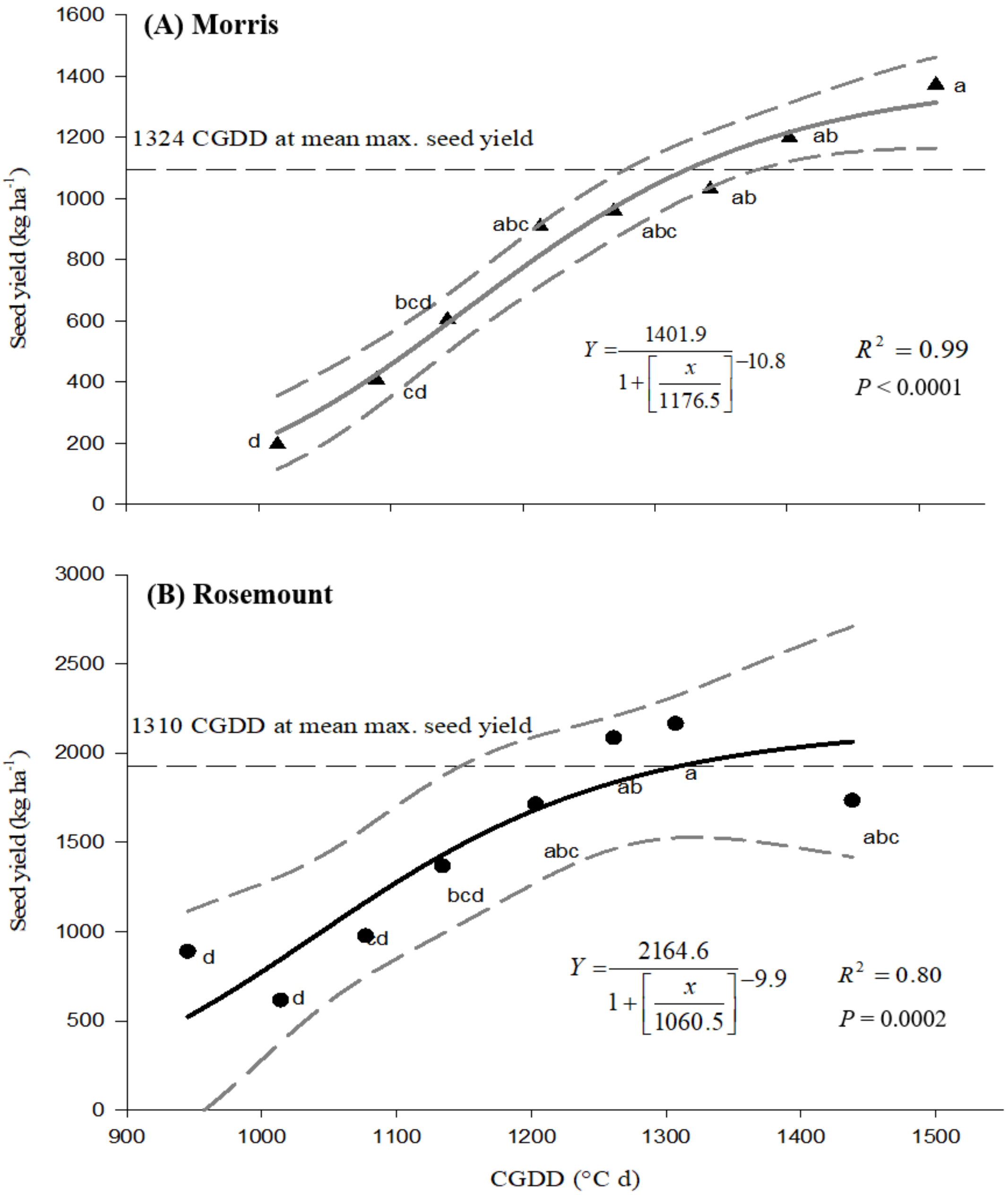

Figure 1. Relationship of seed yield as a function of CGDD at (A) Morris and (B) Rosemount, MN. Individual values are means, $n = 4$. Values followed by the same letter at each location are not significantly different using Tukey's HSD at the $P \leq 0.05$ level. The horizontal reference line denotes maximum seed yield at each location, dashed lines mark the 95% confidence interval and the estimated CGDD at maximum yield is given for each location. (Adapted from Walia et al., 2018)

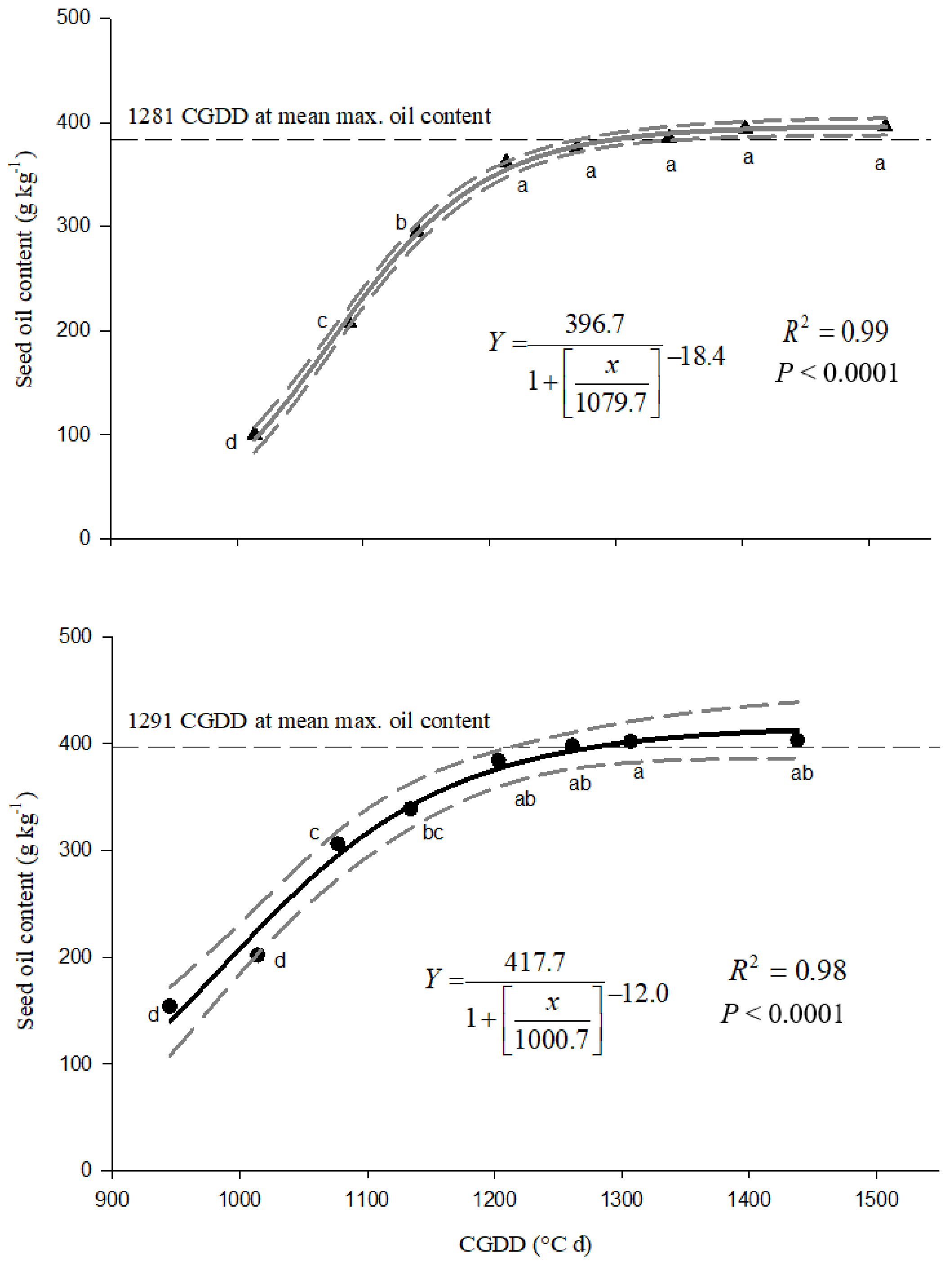

Figure 2. Relationship of seed oil content as a function of CGDD at (A) Morris and (B) Rosemount, MN. Individual values are means, $n = 4$. Values followed by the same letter at each location are not significantly different using Tukey's HSD at the $P \leq 0.05$ level. The horizontal reference line denotes maximum oil content at each location, dashed lines mark the 95% confidence interval and the estimated CGDD at maximum oil is given for each location. (Adapted from Walia et al., 2018)