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Characterization of pathogens and foliar disease interactions impacting sugar beet storage

In the US, sugar beet (*Beta vulgaris*) production has a market value of over $5 billion. In Michigan, sugar beets are stored for up to 200 days post-harvest while awaiting processing. Beets are stored primarily in covered or uncovered outdoor piles, although there is one indoor piling facility in Sebewaing, MI. During this storage period there are several factors that cause the beets to rot, reducing the sugar content and overall profit. In addition to root degradation, fungal mycelium, bacterial lipopolysaccharides, and pectinase byproducts clog filters and slow the extraction process. Michigan Sugar estimates that delaying onset of storage rot one month could save the industry $1 million per year. Proper identification and characterization of the pathogens affecting stored beets will allow for better targeting of disease management. In addition to organisms that directly colonize the beet root, there has been conflicting reports on how foliar disease in the field will affect the storability of the beet.

Cercospora leaf spot (CLS) is the most damaging and widespread foliar disease of sugar beet. To investigate the impact CLS has on pathogens colonizing the beet root, post-harvest trials will evaluate symptom development after inoculation with *Fusarium graminearum, Botrytis cinerea, Penicillium vulpinum*, and *Phoma betae* in beets with high or low in-season CLS severity. Beet root rot will be rated monthly between harvest and 150 days into storage. Preliminary research in North Dakota suggests that CLS does not affect the physiological storage qualities of the beet (Fugate et al., 2021). In contrast, Smith and Ruppel (1971) reported CLS could lead to increased storage rot, although no specific information was given about pathogens involved. This study will also examine varietal effect on rate of rot using CLS resistant and susceptible varieties. In addition to root rot, respiration rate will be also be monitored in beets with high and low CLS levels.

During storage in 2019 and 2020, *Penicillium* spp. (55%), *Botrytis cinerea* (12%), and *Fusarium* spp. (11%). were most frequently isolated from Michigan piling grounds. Other fungal pathogens isolated from both indoor and outdoor storage piles included *Geotrichum* spp., *Alternaria alternata,* and *Aspergillis niger*. The *Fusarium* spp. will be characterized to the species level by a combination of genotyping and morphology. *Geotrichum* spp. were isolated from the field in fall of 2019 and was found in storage in 2020. *Geotrichum* spp. has not previously been reported on beet in Michigan. *Geotrichum candidum* was recently reported on sugar beet in North Dakota and Minnesota (Khan et al. 2020); this fungus causes rubbery or sour rot on potato and is often characterized by a sour odor. The field isolate from 2019 is being used in the storage trials this year. Future goals include determining the virulence, and epidemiology of these storage pathogens to make management recommendations help reduce infection.

Two storage trials were conducted during winter of 2020 that looked at factors impacting the susceptibility of sugarbeet to postharvest disease. Trial 1 examined the impact of CLS infection in the field, and trial 2 evaluated the impact of variety in addition to CLS infection. Trial 1 used C-G333NT, and trial 2 used sugarbeet varieties C-G333NT and F1042 (Campbell, 2015) as CLS-susceptible materials and HIL-9865 and EL50/2 (McGrath, 2012) as CLS-resistant materials. Results from the storage trial 1 showed no significant differences between storage rot susceptibility in beets with high or low CLS levels in the field ($P > 0.05$). Both length and depth of lesions caused by *P. vulpinum* and *B. cinerea* were similar, *F. graminearum* caused slightly less severe symptoms, and *Geotrichum* sp. did not cause symptoms

statistically different from the control. In trial 2, however, our results suggest that the interaction between CLS level, pathogen, and variety may affect sugarbeet rot depth ($P < 0.05$). There will be another timepoint at the end of the storage season, as well as a minimum of one mid-winter sample. Future trials will continue to examine the effect of CLS, as well as the varietal effect on rate of rot symptom development.

To measure the effect of CLS on respiration rate, roots of C-G333NT and HIL-9865 with high and low CLS ratings from trial 2 were stored in vented respirometry chambers at 42°F. Samples are taken periodically throughout the storage season to measure the beet respiration rate/kg. These beets are not inoculated with any storage pathogens. There was no significant difference in respiration rate of beets with high or low CLS levels following timepoint 1 and 2, 60- and 80- days post-harvest ($P > 0.05$). Additional rate measurements will be collected 100- and 120-days post-harvest. There does appear to be a difference in respiration rate among varieties. In addition to further evaluation of varietal effect on respiration, the impact of storage pathogens on respiration rate will be evaluated in the future.

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