Project Title: Impact of Cercospora leaf spot disease severity on sugarbeet root storage

Project Number/Description: New; expected duration, 3 years

Project Leaders:
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Other Personnel Involved: USDA and NDSU laboratory technicians; summer interns

Project Location: Field work will be done near Foxhome, MN; storage and laboratory work will be done at USDA facilities in Fargo, ND.

Justification for Research:

Cercospora leaf spot (CLS), caused by the fungus *Cercospora beticola* (Crous et al., 2001), is one of the most damaging foliar diseases of sugarbeet and is rated by North Dakota and Minnesota grower representatives as the major production problem in 2017. Fungicide applications are an important component of an integrated pest management program for controlling CLS. *C. beticola*, however, has developed tolerance to several fungicides that are used against this disease, increasing the likelihood that disease symptoms will develop during production and that roots harvested from CLS-diseased plants will be incorporated into storage piles. In Minnesota and North Dakota, sugarbeet roots are stored in ventilated or frozen piles for up to eight months. Although it is suspected that roots harvested from CLS-diseased plants do not store as well as healthy roots, the effects of CLS on root storage properties such as storage respiration rate, sucrose loss in storage, losses in recoverable sugar, and the accumulation of invert sugars and other impurities that increase sucrose loss to molasses have not been determined. A three-year research study is proposed to quantify the effect of CLS on short-term and long-term storage properties using roots from plants with varying levels of CLS disease severity. Data from this research will assist growers in decision-making processes regarding the necessity of fungicides for CLS control and assist cooperatives in determining best practices for the storage of roots from Cercospora-infected plants.

Summary of Literature Review:

Cercospora leaf spot is the most economically damaging foliar disease of sugarbeet in North Dakota and Minnesota (Khan and Hakk, 2016). At harvest, CLS causes significant reductions in root yield and sucrose concentration and increases the concentrations of non-sucrose impurities that cause sucrose loss during processing (Smith and Ruppel, 1973; Smith and Martin, 1978). While other production diseases such as Aphanomyces root rot, Fusarium yellows, rhizomania, and rhizoctonia root and crown rot, are known to have a negative impact on storage (Campbell and Klotz, 2006; Campbell and Klotz, 2008; Klotz and Campbell, 2009; Campbell et al., 2011; Campbell et al., 2014), the effects of CLS on sugarbeet root storage properties are largely unknown. Presently, no information is available regarding the effect of CLS disease severity on root respiration rate, sucrose loss in storage, and the postharvest accumulation of invert sugars and other impurities. Increased storage rot susceptibility, however, has been reported for *Cercospora*-infected sugarbeets with low genetic resistance to CLS (Smith and Ruppel, 1971). It is unknown whether this increased susceptibility to rot is due to genetic differences in CLS susceptibility or increased severity of disease symptoms.

Objective:

Determine the impact of different levels of disease severity caused by *Cercospora beticola* on sugarbeet root storage properties including respiration rate, sucrose loss in storage, invert sugar accumulation, loss to molasses, and recoverable sugar per ton during short-term and long-term storage.

Materials and Methods:

Plants with varying severities of CLS will be produced in a field trial near Foxhome, MN. Six-row plots (11 ft wide by 30 ft long) will be planted with an approved variety with a lower CLS rating. Plants will be produced using recommended practices. Just prior to row closure, all rows will be inoculated with 5 lb/ac of dried *C. beticola*-infected leaves. Treatments will include a non-treated check, and 1 to 5 fungicide application treatments to get different levels of disease severity. Fungicides will be applied at 10 to 14 day intervals using mixtures of fungicides at their full rates and in a rotation program. Fungicides will be applied to the middle four rows of each plot using a four-nozzle boom sprayer calibrated to 690 KPa pressure. The experiment will be set-up as a randomized complete block design with four replicates. Disease severity will be recorded during the growing season. The middle two rows of each plot will be harvested, weighed, and washed. A 10-root sample from each plot will be ground to brei after harvest and used to determine sucrose content, loss to molasses, invert sugar concentrations, impurity concentrations, and recoverable sugar per ton prior to storage. The remaining roots from each plot will be divided into 10-root samples and stored at 5°C and 95% humidity. Respiration rates of 10-root samples will be determined after 30, 90, and 120 days in storage using a Licor infrared CO_2 analyzer (Campbell et al., 2011). Following respiration rate determinations, samples will be ground into brei. Brei samples will be used to determine sucrose content, loss to molasses, invert sugar concentrations, impurity concentrations, and recoverable sugar per ton after 30, 90, and 120 days in storage.

Time Line of Anticipated Accomplishments:

Apr 2018	Field plots planted
Oct 2018	Roots harvested; yield data collected; storage studies initiated
Jan 2019	All storage study samples collected
Apr 2019	Data analysis complete and presented at 2020 reporting session.

References:

Campbell, L.G., Fugate, K.K., Niehaus, W.S. (2011). Fusarium yellows affects postharvest respiration rate and sucrose concentration in sugarbeet. J. Sugar Beet Res. 48:17-39.

Campbell, L.G., Klotz, K.L. (2006). Postharvest storage losses associated with *Aphanomyces* root rot in sugarbeet. J. Sugar Beet Res. 43:113-127.

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Crous, P.W., Kang, J.-C., Braun, U. (2001). A phylogenetic redefinition of anamorph genera in *Mycosphaerella* based on ITS rDNA sequence and morphology. Mycologia 93:1081-1101.

Khan, M.F.R., Hakk, P.C. (2016). Efficacy of fungicides for controlling Cercospora leaf spot on sugarbeet. 2015 Sugarbeet Res. Ext. Rep., Coop. Ext. Serv., North Dakota State Univ., 46:118-121.

Klotz, K.L., Campbell, L.G. (2009). Effects of Aphanomyces root rot on carbohydrate impurities and sucrose extractability in postharvest sugar beet. Plant Dis. 93:94-99.

Smith, G.A., Martin, S.S. (1978). Differential response of sugarbeet cultivars to Cercospora leaf spot disease. Crop Sci. 18: 39-42.

Smith, G.A., Ruppel, E.G. (1971). Cercospora leaf spot as a predisposing factor in storage rot of sugar beet roots. Phytopathology 61:1485-1487.

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Budget:

Labor (salary & fringe benefits)	10,000.00
Equipment (over $250.00)	0.00
Supplies	2000.00
Travel	0.00
Leases	0.00
Other	0.00
Total	**$12,000.00**

TOTAL FUNDING REQUEST: $12,000.00