Cercospora beticola risk model and in-field validation for Cercospora leaf spot on sugar beets, 2021-22

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Methods: Aerial spores were collected in sugarbeet fields using a Burkard spore trap in Michigan from 2019, 2020, 2021 and 2022 and from Ontario, Canada 2019, 2020, and 2021 early in the season (May to July). Environmental factors were monitored using on-site or local MSU Enviroweather stations and evaluated for correlations to spore abundance. Stepwise regression analyses were conducted to assess the accuracy of the model variables separately and together.

A preliminary model was created in 2021 to predict elevated spore numbers with a threshold of 35 spores. Correlated weather predictors were identified, and logistic modeling was used to predict elevated spore counts ($R^2 = 0.18$, $P < 0.0001$). The model predicted whether daily spore abundance was 35 or more spores (Spore35) based on number of hours with leaf wetness greater than or equal to 25% from 11AM to 10AM (DurLW), average daily air temperature in Celsius from 11AM to 10AM (AvgTemp), and maximum daily wind speed in km/h (MaxWS). The following model equation was used to predict risk for elevated aerial spores.

Spore35 = 0.1132*DurLW + 0.1285*AvgTemp + 0.0369*MaxWS - 5.0814

A validation study was conducted in 2022 to test the ability of this model to assist in fungicide application timing and improved management. The field treatments were in a randomized complete block design with three treatments applied to both CLS susceptible and resistant sugarbeet variety.

Location: Frankenmuth (Saginaw Valley Research and Extension Center)	**Treatment Timings:** see table
Planting Dates: April 29, 2022 (Harvest September 23)	**Pesticides:** see table
Soil Type: Loam	**O.M.:** 5.0 **pH:** 7.5
Replicates: 4	**Variety:** C-G021 and C-G932NT

Table 1. Model validation treatment programs tested in 2022. After initiation, subsequent spray timings followed a 14-day interval for the susceptible (C-G932NT) and 28-day interval for the resistant variety (C-G021).

Trt	Variety	Program	Initiation Criteria [a]	Actual Initiation Date	No. App.	App. Interval	AUDPC [b]		Yield (T/A)
1	C-G021	Non-treated control	-	-	-	-	31.6	c	17.5
2	C-G021	Grower standard [c]	55 DSV	7/12/22	3	28-day	14.0	c	17.3
3	C-G021	Model Spore35	70% + DSV 3 or 4	7/8/22	3	28-day	27.6	c	20.0
4	C-G932NT	Non-treated control	-	-	-	-	264.1	a	15.3
5	C-G932NT	Grower standard	50 DSV	7/8/22	5	14-day	135.5	b	15.7
6	C-G932NT	Model Spore35	70% + DSV 3 or 4	7/8/22	5	14-day	102.5	b	14.1
				P-value			< 0.001		NS

[a] Model Spore35 was implemented to trigger at a 70% likelihood threshold for the presence of 35 or more *C. beticola* spores paired with a BEETcast DSV value of 3 or 4 on the same day.
[b] Grower standard program as follows for the susceptible variety: Manzate Max (1.6 qt) ACDFG; Inspire XT (7 fl oz) CF; Super Tin (8 fl oz) D; and resistant variety: Manzate Max (1.6 qt) ADG and BEH; Inspire XT (7 fl oz) DE; Super Tin (8 fl oz) GH. Application letters code for the following dates: A=8 Jul, B=12 Jul, C=19 July, D=2 Aug, E=9 Aug, F=16 Aug, G=30 Aug, and H=6 Sept.
[c] Area under the disease progress curve was calculated using disease severity scores (0-10 scale) collected Jul 26 through Aug 15.
[d] Column values followed by the same letter were not significantly different based on Fisher's Protected LSD (α=0.05).

Summary: The treatments in this study did not result in significant differences in yield. The model prediction spray timings triggered at the same time as the susceptible standard control treatment. Therefore, no significant differences in AUDPC were observed between the model-based spray timing and the grower standard control for the susceptible variety. Both the model-based, and the grower standard fungicide treatments resulted in significantly lower CLS pressure than the non-treated control. No significant difference in AUDPC was detected between treatments on the resistant variety. The addition of a resistant cultivar may not be necessary to test early-season risk models in future experiments.

Aerial spores were collected mid-May through mid-July of 2022 at SVREC in Frankenmuth, Michigan. The current model predicted correctly 73% of days where *C. beticola*-like conidia observed surpassed the 35-spore threshold on a small subset of 15 days monitored (final analyses in progress). Spore observations from 2022 and alternative modeling techniques will be used to further refine the risk models of interest, and final models will be validated in 2023.

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