**Validation of a spore-based *Cercospora beticola* risk model for improved application timing and management of Cercospora leaf spot on sugar beets, 2025**

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**Methods:** A preliminary model was created in 2021 to predict elevated *C. beticola* spore numbers using a threshold of 35 spores (Hernandez et al. 2025). The model was created using daily numbers of aerial spores collected in sugar beet fields using Burkard spore traps in Michigan from 2019-2022 and in Ontario, Canada from 2019-2021 early in the season (May to July). Environmental factors were evaluated for their impact of spore number. Stepwise regression analyses were conducted to assess potential models.

Weather variables highly correlated to spore counts were identified and logistic modeling was used to predict elevated spore levels ($R^2 = 0.18$, $P < 0.0001$). The model predicted the chance that daily spore abundance was ≥35 (Spore35) based on number of hours with leaf wetness (≥ 25%) from 11AM to 10AM (DurLW), average daily air temperature (°C) from 11AM to 10AM (AvgTemp), and maximum daily wind speed (km/h) (MaxWS). The following equation was used to predict risk for elevated aerial spores:

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

A validation field study was conducted to test the ability of this model to assist in fungicide application timing and improved management (details below). Treatments were designed to: a) compare a model-based initiation timing to standard initiation corresponding with cumulative BEETcast daily disease severity values of 45 DSV for a CLS-susceptible variety, and b) to assess efficacy of model-based timings when varying the first fungicide product applied (Table 1). The treatments were arranged in a randomized complete block design with six treatments applied in 2025. Regardless of initiation date, a total of six applications were applied in each program at application intervals of 10-14 days.

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|---|---|
| **Location:** Frankenmuth, MI (SVREC) | **Treatment Timings:** see table |
| **Planting Dates:** May 11, 2025 (Harvest: September 11) | **Pesticides:** see table |
| **Soil Type:** Loam | **O.M.:** 5.0 **pH:** 7.5 |
| **Replicates:** 4 | **Variety:** HIL-2332NT |

**Table 1.** Model validation treatment programs tested in 2025. All model programs were based on the Spore35 model initiation criteria. After initiation, all subsequent spray timings followed a 14-day interval.

| Trt | Program [a] | Initiation Criteria [b] | Actual Initiation Date | # App. | App. Interval | 1st Application Active Ingredients (FRAC Groups) |
|---|---|---|---|---|---|---|
| **1** | Non-treated control | - | - | - | - | - |
| **2** | **Dithane F45 (1.6 qt) ABCDE**<br>+ Proline 480 SC (5.7 fl oz) B<br>+ Super Tin (8 fl oz) C<br>+ Domark 230 ME (6.9 fl oz) D<br>+ Badge (2 pt) F | 45 DSV | 7/1/25 | 6 | 14-day | mancozeb (M3) |
| **3** | **Dithane F45 (1.6 qt) GHIJK**<br>+ Proline 480 SC (5.7 fl oz) H<br>+ Super Tin (8 fl oz) I<br>+ Domark 230 ME (6.9 fl oz) J<br>+ Badge (2 pt) L | Model 50% | 6/24/25 | 6 | 14-day | mancozeb (M3) |

| | | | | | | |
|---|---|---|---|---|---|---|
| **4** | **Inspire XT (7 fl oz) G**<br>+ Dithane F45 (1.6 qt) GHIJK<br>+ Proline 480 SC (5.7 fl oz) H<br>+ Super Tin (8 fl oz) I<br>+ Domark 230 ME (6.9 fl oz) J<br>+ Badge (2 pt) L | Model 50% | 6/24/25 | 6 | 14-day | difenoconazole (3) + propiconazole (3) |
| **5** | **Lucento (5.5 fl oz) G**<br>+ Dithane F45 (1.6 qt) GHIJK<br>+ Proline 480 SC (5.7 fl oz) H<br>+ Super Tin (8 fl oz) I<br>+ Domark 230 ME (6.9 fl oz) J<br>+ Badge (2 pt) L | Model 50% | 6/24/25 | 6 | 14-day | flutriafol (3) + bixafen (7) |
| **6** | **Veltyma (10 fl oz) G**<br>+ Dithane F45 (1.6 qt) GHIJK<br>+ Proline 480 SC (5.7 fl oz) H<br>+ Super Tin (8 fl oz) I<br>+ Domark 230 ME (6.9 fl oz) J<br>+ Badge (2 pt) L | Model 50% | 6/24/25 | 6 | 14-day | mefentrifluconazole (3) + pyraclostrobin (11) |

[a] Application letters code for the following dates: A=Jul 1, B=Jul 15, C=Jul 29, D=Aug 14, E=Aug 26, F=Sep 9; for model-based dates: G=Jun 24, H=Jul 8, I=Jul 22, J=Aug 5, K=Aug 20, L=Sep 2. MasterLock 0.25% V/V was added to all treatments.

[b] Model programs (Trt 3-6) were initiated based on the Spore35 model threshold of 50% likelihood of 35 or more *C. beticola* spores paired with a BEETcast DSV value of 3 or 4 on the same day. The first elevated risk incidence occurred Jun 19, however, rain and soil conditions delayed initiation of model-based programs until Jun 24.

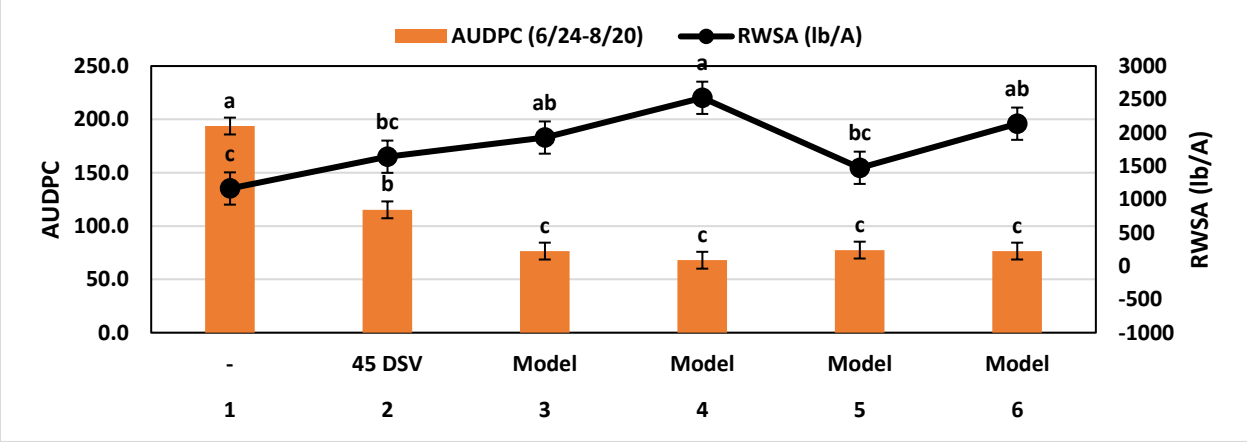


**Figure 1.** Area under the disease progress curve was calculated using disease severity scores (0-10 scale) collected Jun 24 to Aug 20. Significant differences indicated by different letters based on Fisher's Protected LSD (α=0.05).

**Summary:** The treatments in this study resulted in significant differences in area under the disease progress curve (AUDPC, $P < 0.0001$), yield ($P < 0.01$), and pounds of recoverable white sugar per acre (RWSA, $P < 0.01$) (Table 2). While all treatments resulted in significantly reduced AUDPC compared to the non-treatment control, model-based treatments resulted in significantly lower AUDPC compared to the grower standard program initiated at a cumulative BEETcast threshold of 45 DSV (Figure 1).

Of the tested fungicides applied first in these programs, only model-based spray programs started with products containing mancozeb, difenoconazole, or mefentrifluconazole+pyraclostrobin resulted in significantly greater yield and RWSA than the non-treated control. These observations indicate that CLS control was improved using model-based initiation thresholds, however, improvement in sugar yield further depended on the fungicides used at initiation timings. Further model validation is in progress.

**Table 1.** Model validation treatment programs tested in 2025. All model programs were based on the Spore35 model initiation criteria. After initiation, all subsequent spray timings followed a 14-day interval.

| Trt | Program [a] | Initiation Criteria | Final CLS (0-10) (Aug 20) | Final AUDPC (Jun 24-Aug 20) [b, c] | Yield (T/A) | RWSA (lb/A) |
|---|---|---|---|---|---|---|
| **1** | Non-treated control | - | 9.8 | 193.8 a | 5.4 c | 1163 c |
| **2** | **Dithane F45 (1.6 qt) ABCDE**<br>+ Proline 480 SC (5.7 fl oz) B<br>+ Super Tin (8 fl oz) C<br>+ Domark 230 ME (6.9 fl oz) D<br>+ Badge (2 pt) F | 45 DSV | 6.4 | 115.2 b | 7.7 bc | 1640 bc |
| **3** | **Dithane F45 (1.6 qt) GHIJK**<br>+ Proline 480 SC (5.7 fl oz) H<br>+ Super Tin (8 fl oz) I<br>+ Domark 230 ME (6.9 fl oz) J<br>+ Badge (2 pt) L | Model 50% | 5.0 | 76.5 c | 8.8 b | 1927 ab |
| **4** | **Inspire XT (7 fl oz) G**<br>+ Dithane F45 (1.6 qt) GHIJK<br>+ Proline 480 SC (5.7 fl oz) H<br>+ Super Tin (8 fl oz) I<br>+ Domark 230 ME (6.9 fl oz) J<br>+ Badge (2 pt) L | Model 50% | 4.6 | 67.9 c | 11.8 a | 2523 a |
| **5** | **Lucento (5.5 fl oz) G**<br>+ Dithane F45 (1.6 qt) GHIJK<br>+ Proline 480 SC (5.7 fl oz) H<br>+ Super Tin (8 fl oz) I<br>+ Domark 230 ME (6.9 fl oz) J<br>+ Badge (2 pt) L | Model 50% | 5.4 | 77.4 c | 7.2 bc | 1474 bc |
| **6** | **Veltyma (10 fl oz) G**<br>+ Dithane F45 (1.6 qt) GHIJK<br>+ Proline 480 SC (5.7 fl oz) H<br>+ Super Tin (8 fl oz) I<br>+ Domark 230 ME (6.9 fl oz) J<br>+ Badge (2 pt) L | Model 50% | 5.0 | 76.5 c | 9.7 ab | 2135 ab |
| | **Standard error** | | 0.2 | 7.9 | 1.0 | 242 |
| | **P-value** | | - | <0.0001 | 0.0032 | 0.0091 |
| | **Fisher's LSD** | | - | 19.1 | 2.7 | 681 |

[a] Application letters code for the following dates: A=Jul 1, B=Jul 15, C=Jul 29, D=Aug 14, E=Aug 26, F=Sep 9; for model-based dates: G=Jun 24, H=Jul 8, I=Jul 22, J=Aug 5, K=Aug 20, L=Sep 2. MasterLock 0.25% V/V was added to all treatments.

[b] Area under the disease progress curve based on disease severities collected Jun 24, Jul 29, Aug 13, and Aug 20. Disease severity based on a 0-10 scale: 1=0.1% (1-5 spots/leaf), 2=0.35% (6-12 spots/leaf), 3=0.75% (13-25 spots/leaf), 4=1.5% (26-50 spots/leaf), 5=2.5% (51-75 spots/leaf), 6=3%, 7=6%, 8=12% 9=25%, 10=50%.

[c] Column values followed by the same letter not significantly different based on Fisher's Protected LSD (α=0.05).

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