NYWGF RESEARCH -FINAL REPORT TEMPLATE for 2022-2023

Project Title: Sustainable Disease Management for 21st Century New York Viticulture

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New Research ☒

Amount Funded: $32,926 for the period 1 April 2021 to 31 March 2022

Project Summary Impact Statement:

The goal of this project was to advance industry knowledge of sustainable applied disease management through establishing a new moderately disease resistant vineyard at Cornell AgriTech, evaluate novel disease control products for powdery mildew, downy mildew, black rot, and botrytis, and evaluate high resolution satellite imagery as a tool for disease monitoring in NY viticulture. We began the establishment process for a 1ac Traminette vineyard at Cornell AgriTech Crittenden Farm. We conducted three sub-studies within our annual fungicide efficacy trials to determine how newly released biopesticides control powdery mildew, black rot, and botrytis. While disease pressure was high, we found that some new biopesticides were able to provide comparable control to commercial standards. We completed the second year of study to determine how well Orondis Ultra can control grapevine downy mildew which found that this product was highly effective when used alone, in rotation, and at only the most critical times of year. We made 14 convergent captures of high resolution satellite imagery and side canopy imagery with the autonomous vineyard robot, the PhytoPatholoBot which are currently being studied by new graduate student Kathleen Kanaley. Overall, our NYWGF project successfully launched multiple initiatives to advance sustainable disease management for NY grape growers.

Objectives:

1) Establish a new MDRV pathology vineyard at Cornell AgriTech for fungicide efficacy studies.
2) Conduct fungicide efficacy trials in pathology vineyards for powdery mildew (Chardonnay), downy mildew (Chardonnay/Chancellor), botrytis bunch rot (Vignoles), and black rot (Niagara) disease control.
3) Monitor Cornell pathology vineyards weekly with high resolution satellite imagery and an autonomous ground robot throughout the growing season to develop remote and proximal sensing-based disease surveillance.

Materials & Methods:

Objective 1: Approximately one acre was prepared for vineyard establishment in the 2021 growing season for a spring 2022 planting at Crittenden Farm at Cornell AgriTech in Geneva, NY. All field prep is being conducted by the Cornell AgriTech Field Research Unit including ground preparation, trellis installation and vine planting with supervision and guidance by David Combs. Traminette vines were sourced from Double A Vineyards and will be planted to a mid-wire cordon with vertical shoot-positioned trellis. Rows will be approximately 10 panels with each panel consisting of 3 vines. A radish/pea mixture was seeded in this plot in August 2021 to prepare the soil for the late spring 2022 planting. We anticipate planting to begin after the risk of frost abates. After vines are in the ground, a trellis will be established with 9 foot rows and 6 foot vine spacing. Bamboo poles will be used to support the young vines until they are strong enough to support themselves. Commercial standard pest and disease control measures will be used as needed to protect these vines until they can withstand the pressure of disease testing. Row middles will be established with orchard/vineyard seed mix to reduce erosion from equipment.

Objective 2: We conducted sub-studies within our annual efficacy studies for powdery mildew, downy mildew, black rot, and botrytis to compare novel disease control strategies. Specific combinations for each disease are outlined in the subsequent results section. The general methods for our studies are as follows: treatments were applied to 4-vine plots in a randomized complete block design with four replicates. Sprays are applied with a hooded boom sprayer operating at 100psi and deliver 50gpa volume pre-bloom and 100gpa post-bloom. Initial applications are conducted when vines are approximately at 3" to 5" shoot growth stage (later for botrytis) and continue every 10-14 days until mid/late August when most commercial applications cease. Harvest evaluations are collected visually by visually inspecting fruit and foliage on the vine and estimating percent area infested in early September at the approximate time of commercial harvest. Destructive fruit samples are taken and inspected for disease incidence and severity at the end of the season.

Objective 3: In field season 2021, we operated an autonomous rover (RTK-GPS navigation algorithm on ROS system) with RGB sensing capacity within the pathology vineyards (the PhytoPatholoBot [PPB]) and made weekly convergent collections with high resolution satellite imagery from Planet Labs (SkySat) from June through September. A total of 14 datasets were collected from June 24 to Sep 23, 2021. Each PPB dataset contains stereo color images, RTK-GPS, and camera IMU information that can be used for grape disease detection and quantification. In total 10TB of data was generated on the ground to validate our various remote sensing imagery. One side canopy image was collected per 50cm satellite pixel, approximately two acquisitions per grapevine in one acre of Chardonnay grapes in the Cornell Pathology Vineyards. Sub-weekly, 6- & 8-band multispectral satellite imagery of the vineyard was acquired at 3-m resolution throughout the growing season from Planet Labs as well. To validate the imagery collected by the robot, human scouts were also deployed in the pathology vineyard weekly to rate for powdery mildew, downy mildew, black rot, and other miscellaneous damage. The satellite images were georectified following established best practices from Planet Labs and vine pixels were separated from the soil/grass background.

Results/Outcomes/Next Steps:

Objective 1: Our new MDRV research vineyard will likely be of appropriate age and size to initiate fungicide testing in year 3. Until the vines are healthy and large enough to provide sufficient data for efficacy, they will be maintained to commercial standards for New York vineyards. This will include proper fertilizer, weed control, pesticide applications for both insects and disease, as well as maintenance pruning. Once our vines are sufficiently grown, we look forward to using this vineyard to mirror with modification treatments in our powdery mildew and downy mildew fungicide efficacy trials so that growers can get a solid understanding of how management differs between *vinifera* and MDRV varieties with fungicide products of interest. For example, if we are applying Vivando at 10-14d intervals throughout the season on our Chardonnay vines, we will apply Vivando at ~21-24 day intervals in the Traminette.

Objective 2: Powdery Mildew

		% Powdery Mildew [%control][y]							
Material and Rate/A	Timing[z]	Leaf Infection		Leaf Area		Cluster Infection		Cluster Area	
UTC		100 a		89.6 a		100 a		96.3 a	
Conventional Standard									
Gatten EC 6.4 oz[x]	1 thru 7	100 a	[0]	44.2 c-h	[50.7]	82.5 a-i	[17.5]	39.9 c-h	[58.6]
Biopesticide 1 with and without standard									
Howler 5.0 lb[u]	1 thru 7	98.8 ab	[1.3]	56.3 b-f	[37.2]	96.3 a-c	[3.8]	37.8 c-g	[60.7]
Howler 5.0 lb[u]	1,3,5,7								
Gatten EC 6.4 oz[u]	2,4,6	97.5 a-c	[2.5]	40.2 c-i	[55.2]	75.0 a-j	[25.0]	36.4 c-i	[62.2]
Biopesticide 2 with and without standard									
Lifegard WG 4.5 oz[x]	1 thru 7	93.8 a-e	[6.3]	33.1 c-j	[63.0]	45.0 j-n	[55.0]	3.9 j-l	[96.0]
Lifegard WG 4.5 oz[x]	1,3,5,7								
Gatten EC 6.4 oz[u]	2,4,6	97.5 a-c	[2.5]	48.4 b-g	[46.0]	85.0 a-i	[15.0]	26.9 c-k	[72.1]
Lifegard WG 4.5 oz + Gatten EC 6.4 oz[x]	1 thru 7	100 a	[0]	57.5 a-f	[35.9]	93.8 a-d	[6.3]	46.9 c-e	[51.3]
Biopesticide 3 with and without standard									
Romeo 4.0 oz[t]	1 thru 7	93.8 a-e	[6.3]	42.1 c-I	[53.0]	67.5 c-k	[32.5]	40.3 c-h	[58.2]
Romeo 4.0 oz[t]	1,3,5,7								
Gatten EC 6.4 oz[u]	2,4,6	97.5 a-c	[2.5]	42.6 c-h	[52.4]	91.3 a-h	[8.8]	38.8 c-g	[59.7]

[z] Spray timings: Spray timings: 1 = 24 May; 2 = 7 Jun; 3 = 21 Jun; 4 = 6 Jul; 5 = 19 Jul; 6 = 2 Aug; 7= 16 Aug

[y] Values represent the means from four replicate plots per treatment, 20 clusters per plot. Means not followed by a common letter are significantly different according to Student's t-test (*P*0.05) performed on arcsin-transformed data; non-transformed values are shown. Percent control values presented for severity data are relative to the untreated check.

[x] "Induce" surfactant included in spray solution at 0.125% (v/v) concentration.

[w] "Nu-FilmP" surfactant included in spray solution at 0.25% (v/v) concentration.
[V] "Cohere" surfactant included in spray concentration at 0.03% (v/v) concentration.
[U] "Dyne-Amic" surfactant included in spray concentration at 0.03% (v/v) concentration.
[t] "WE-1181-1" surfactant included in spray solution at 16.0 oz/A.
Means not followed by a common letter are significantly different according to Student's t-test (*P*0.05) performed on arcsin-transformed data; non-transformed values are shown. Percent control values presented for severity data are relative to the untreated check.

Field season 2021 was a record year for powdery mildew. Anecdotally, Gold Lab field manager Dave Combs noted that the trials had the most powdery mildew that he has ever seen in his almost decade of managing the trials. We conducted a sub-study within our 40-treatment powdery mildew efficacy study to compare the disease control performance of 3 labeled biopesticides (Lifegard, Howler, and Romeo) alone, in rotation, and in combination with a commercial standard (Gatten). Generally, it is understood that biopesticides perform best in moderate pressure years, however we do still find these results to be of interest, as we are unfortunately unable to make a request to mother nature about the sort of disease pressure year we will receive in any given season. Selected biopesticides did not control leaf powdery mildew infection statistically any different than the untreated control. However, the area of leaf surface infected was reduced from that of the UTC, anywhere between 33 to 57%. Cluster infection of powdery mildew was only reduced by the full season programs of Lifegard and Romeo. Additions of Gatten to these biopesticides did not increase cluster infection control efficacy, however Gatten alone did not perform particularly well in this extraordinarily high pressure year. The area of the cluster infection was significantly reduced in all treatments from damage observed in the UTC. Notably, Lifegard alone provided the best leaf severity, cluster incidence, and cluster severity control of any treatment in our sub-study, even more so than Lifegard in rotation or combination with Gatten. Lifegard is a defense-activating biofungicide that has performed very well over 7 years of study in Cornell Grape Pathology for control of powdery mildew, downy mildew, black rot, botrytis.

Downy Mildew

		CHANCELLOR		CHARDONNAY	
		% Downy Mildew [%control][y]			
Material and Rate/A	Timing[z]	Cluster Infection	Cluster Area	Leaf Infection	Leaf Area
UTC	99 a	63 a	100 a	68 a	
Comparison Group A					
Revus 8.0 oz [x]	1 thru 7	56 b [43]	6 b [90]	30 b [70]	2 c [98]
Zampro 4.4SC 14.0 oz [w]	1 thru 7	37 b [63]	6 b [90]	30 b [70]	6 bc [91]
Orondis Ultra 6.75 oz[x]	1 thru 7	40 b [60]	3 b [95]	30 b [70]	3 bc [96]
Comparison Group B					
Lifegard WG 2.25 oz [x]	1,2,5,6,7				
Orondis Ultra 6.75 oz[x]	3,4	51 b [49]	6 b [90]	55 b [45]	10 b [86]
Lifegard WG 2.25 oz [x]	1,2,5,6,7				
Ridomil Gold MZ 2.5 lb[x]	3,4	36 b [64]	2 b [97]	56 b [45]	6 bc [92]
Comparison Group C					
Orondis Ultra 6.75 oz[x]	1,3,5,7				
Ranman 2.75 oz [x]	2,4,6	48 b [52]	7 b [90]	42 b [58]	4 bc [94]
Revus Top 7.0 oz [x]	1,3,5,7				
Ranman 2.75 oz[x]	2,4,6	37 b [63]	4 b [94]	55 b [46]	7 bc [90]
Zampro 4.4SC 14.0 oz [w]	1,3,5,7				
Ranman 2.75 oz[x]	2,4,6	46 b [54]	6 b [90]	46 b [55]	4 bc [94]

[z] Spray timings: 1 = 24 May; 2 = 7 Jun; 3 = 21 Jun; 4 = 6 Jul; 5 = 19 Jul; 6 = 2 Aug; 7= 16 Aug
[y] Values represent the means from four replicate plots per treatment, 20 clusters per plot. Means not followed by a common letter are significantly different according to Student's t-test (*P*0.05) performed on arcsin-transformed data; non-transformed values are shown. Percent control values presented for severity data are relative to the untreated check.
[x] "Induce" surfactant included in spray solution at 0.125% (v/v) concentration.
[w] "Silwett L-77" surfactant included in spray solution at 0.03% (v/v) concentration.

2021 was the second and final year of an Orondis Ultra sub-study designed to support an IR-4 application to get the product labeled for Eastern grape production. The below assessment summarizes the two years of performance. Overall, our results show that Orondis Ultra has high efficacy against grape downy mildew comparable to existing products when applied alone, in rotation, and when used only at the most critical times of season. Unfortunately, Syngenta let us know in Fall 2021 that they are no longer interested in supporting our IR-4 application to get Orondis Ultra approved for eastern grapevine due to reports of FRAC40 resistance in NY. They are unwilling to consider labeling any other Orondis combination product for DM in NY. This news was very disheartening, however, we are excited to test a novel DM AI from BASF this upcoming season that is a sister to Orondis.

Comparison Group A: To determine how well Orondis Ultra controlled downy mildew compared to tried-and-true downy products, Revus Top (mandipropamid + difenoconazole), and Zampro (ametoctradin + dimethomorph). Because all three of these products contain a FRAC-40 component (either mandipropamid or dimethomorph), we can compare the added benefit provided by the three other active ingredients in these products (oxathiapiprolin, difenoconazole, and dimethomorph). Across two years of study, we found that Orondis Ultra performed equivalently to both Revus Top and Zampro. All three of these products provided good incidence and excellent severity control. Though not statistically significant, both Orondis Ultra and Zampro provided slightly better cluster incidence control. This tracks with our previous knowledge that the active ingredients oxathiapiprolin and ametoctradin provide better DM control than difenoconazole, a DMI product, which has no activity against oomycetes.

Comparison Group B: Next, we wanted to see how Orondis Ultra compared to the gold standard of oomycete control, Ridomil Gold, when sprayed only at the two most important growth stages for DM control: immediate pre-bloom and immediate post-bloom. We bounded these applications with Lifegard WG in both the early and late season. In this comparison, Orondis Ultra and Ridomil Gold provided equivalent excellent cluster and leaf severity control. The two products varied in their cluster incidence control, though it should be noted these differences were not statistically significant. Ridomil Gold provided better cluster incidence control, and was also equal to Orondis Ultra for foliar incidence control.

Comparison Group C: Our final comparison looked at Orondis Ultra, Revus Top, and Zampro performance when used in rotation with the protectant Ranman. In this comparison, all three rotations provided excellent severity control and good incidence control for both cluster and foliage. While there were no statistical differences among these three programs, Revus Top in rotation with Ranman provided slightly better cluster incidence control, and slightly less foliar incidence control than the other two rotations. Once again, this tracks with our previous knowledge that the actives oxathiapiprolin and ametoctradin provide better DM control than difenoconazole, the “top” in Revus Top

Black Rot

		% Black Rot [%control]						
Material and Rate/A	Timing[z]	Cluster Infection		Cluster Area		Leaf Infection		Leaf Area
UTC		100 a		93.9 a		38.8 ab		2.1 ab
Commercial Standards								
SDHI: Aprovia 0.83EC 10.5 oz [x]	1thru 4	87.5 ab	[12.5]	41.4 cd	[55.9]	16.3 de	[58.1]	0.7cd [69.0]
DMI: Mettle 125 ME 5.0 oz [x]	1thru 4	90 ab	[10.0]	53.6 a-d	[42.9]	18.8 b-e	[51.7]	1.7a-d[18.5]
QoI: Flint Extra 3.5 oz [x]	1thru 4	90 ab	[10.0]	51.8 a-d	[44.8]	15.0 c-e	[61.3]	0.6b-[73.8]
Biopesticides								
Howler 5.0 lb [v]	1thru 4	93.8 ab	[6.3]	53.4 a-d	[43.2]	11.3 e	[71.0]	0.3d [85.7]
Lifegard WG 4.5 oz [x]	1thru 4	98.8 ab	[1.3]	50.6 b-d	[46.2]	16.3 de	[58.1]	0.7cd [67.3]
Oso 5SC 6.5 oz [x]	1thru 4	100 a	[0.0]	78.9 a-c	[15.9]	21.3 a-e	[45.2]	1.2a-d[41.1]
Romeo 4.0 oz [w]	1thru 4	93.8 ab	[6.3]	69.4 a-c	[26.1]	32.5 a-d	[16.3]	1.8a-c[13.1]
Regalia 4.0 qt+ Stargus 4.0 qt [u]	1thru 4	91.3 ab	[8.8]	32.6 cd	[65.3]	12.5 e	[67.8]	0.6cd [70.2]

[z] Spray timings: 1 = 18 May; 2 = 2 Jun; 3 = 15 Jun; 4 = 28 Jun

[y] Values represent the means from four replicate plots per treatment, 20 clusters per plot. Means not followed by a common letter are significantly different according to Student’s t-test (*P*0.05) performed on arcsin-transformed data; non-transformed values are shown. Percent control values presented for severity data are relative to the untreated check.

[x] “Induce” surfactant included in spray solution at 0.125% (v/v) concentration.

[w] “WE-1181-1” surfactant included in spray solution at 16.0 oz/A.

[v] “Dyne-Amic” surfactant included in spray solution at 0.3% (v/v) concentration.

[u] “NuFilmP” surfactant included in spray solution at 32.0 oz/A.

The 2021 season marked our first year of our Black Rot fungicide efficacy study. Poor control of black rot by OMRI labeled fungicides is a major barrier to organic juice grape production in NY. Overall, our study found that black rot is a formidable pathogen. Neither commercial standards, nor any of the biopesticides controlled cluster infection (incidence) to satisfactory levels, however, cluster area (severity) was reduced from the materials; Aprovia 0.83EC, Lifegard WG and the combination program of Regalia and Stargus. We were pleased to see that select biopesticides offered comparable control to conventional materials. Leaf infection was not as severe as damage observed on the clusters. All of the commercial standards gave acceptable leaf infection control, as well as several of the biopesticides. However, season programs of Oso 5SC and Romeo were statistically similar to the damage found in the UTC. The area of damage on leaves was also less than observed in previous seasons, but statistical differences were still recorded. Biopesticides Howler, Lifegard WG and the combination program of Regalia and Stargus gave comparable levels of control to the commercial standard Aprovia. Unfortunately Dr. Holland of UW-Madison was unable to mirror our study due to covid-related issues. We look forward to finding other ways to work with her in the future.

Bunch Rots:

		Botrytis				Sour Rot			
		Cluster infection [% control] [y]				Cluster infection [% control] [y]			
Material and Rate/A	Timing[z]	%Incidence		% Severity		% Incidence		% Severity	
UTC		2.5 a		0.2 a		83.8 a-d		29.3 b-e	
Commercial Standard									
Luna Experience 6.0 oz[x]	1,2								
Luna Experience 8.6 oz[x]	6,7	0.0 a	[100]	0.0 a	[100]	75.0 b-d	[10.4]	16.4 de	[43.8]
Biopesticide straight programs									
ProBlad Verde 28.0 oz[x]	1,2,6,7	1.3 a	[50]	0.1 a	[66.8]	88.8 ab	[-6.0]	41.6 ab	[-42.3]
Lifegard WG 4.5 oz [x]	1,2,6,7	0.0 a	[100]	0.0 a	[100]	85.0 a-c	[-1.5]	36.7 a-d	[-25.4]
Biopesticides combined with standard									
Luna Experience 6.0 oz[x]	1,2								
ProBlad Verde 28.0 oz[x]	6,7	2.5 a	[0]	0.4 a	[-132.7]	91.3 a	[-9.0]	48.8 a	[-67.0]
Luna Experience 6.0 oz[x]	1,2								
Lifegard WG 4.5 oz[x]	6,7	1.3 a	[50]	0.1 a	[33.5]	80.0 a-d	[4.5]	27.8 b-e	[5.1]
Lifegard WG 4.5 oz [x]	1,2								
Luna Experience 6.0 oz[x]	6,7	0.0 a	[100]	0.0 a	[100]	73.8 b-d	[11.9]	19.7 c-e	[32.8]

[z] Spray timings: 1 = 18 Jun; 2 = 29 Jun; 3 = 12 Jul; 4 = 26 Jul; 5 = 4 Aug; 6 = 11 Aug; 7 = 20 Aug; 8 = 3 Sep

[y] Values represent the means from four replicate plots per treatment, 20 clusters per plot. Means not followed by a common letter are significantly different according to Student's t-test (*P*0.05) performed on arcsin-transformed data; non-transformed values are shown. Percent control values presented for severity data are relative to the untreated check.

[x] "Induce" surfactant included in spray solution at 0.125% (v/v) concentration.

[w] "JMS Stylet Oil" included in spray concentration at 1.5% (v/v) concentration.

[v] "Dyne-Amic" included in spray concentration at 0.38% (v/v) concentration.

[u] "Kinetic" included in spray concentration at 0.05% (v/v) concentration.

The 2021 growing season was conducive to bunch rots, and in fact was a record year for sour rot in our trials. Sour rot appeared ~August 10th, about two weeks earlier than 2020. However as harvest evaluations indicate, we saw that this early appearance of sour rot outcompeted botrytis, as they occupy the same niche in the clusters. We saw significantly less botrytis infection than in past seasons. With such a low infection rate, it is difficult to assume efficacy against botrytis with these materials. Although sour rot was not the target of this study, the presence of this disorder was universal throughout the vineyard and provided an opportunity for data collection. However, these materials are not recognized as having efficacy against sour rot and therefore there were not any significant differences among the treatments. Interestingly, Luna Experience did seem to provide some cluster severity control against sour rot, however this was not statistically significant.

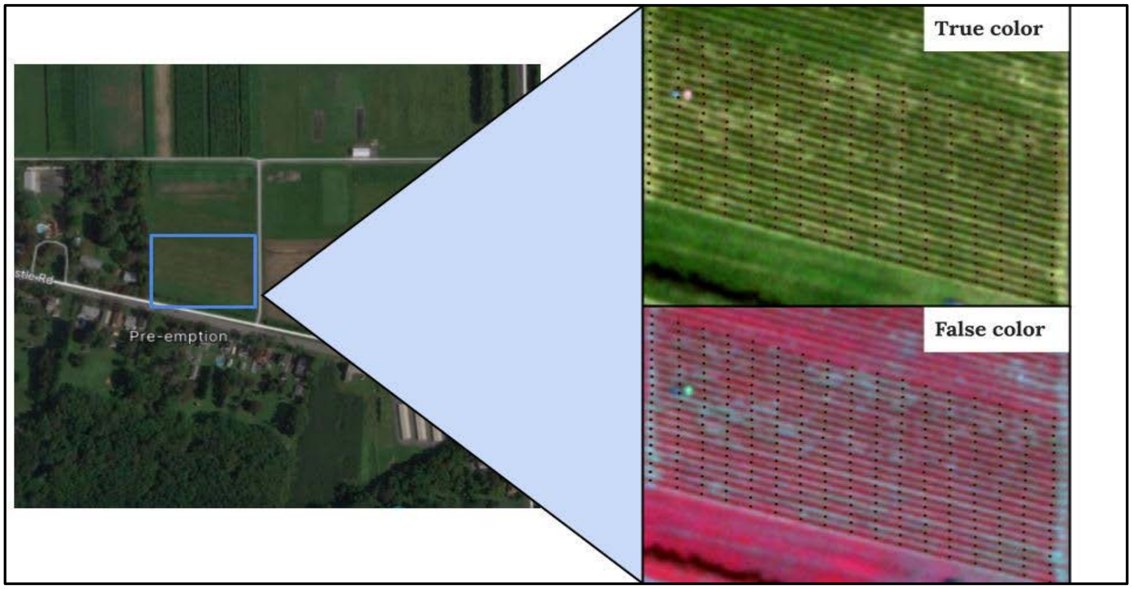
Objective 3:

Graduate student Kathleen Kanaley joined the Gold Lab in August 2021 to lead the project in objective 3. The satellite images acquired in 2021 and 2020 are being processed to extract surface reflectance data in the visible-to-near infrared range for diseased vines. The reflectance spectra of vines in different treatment blocks will be compared, and a time series analysis will evaluate changes in vine reflectance over the course of the growing season. Vegetation indices, including NDVI and EVI, will be calculated for each treatment to assess changes in vine health. The spectral data will be compared to ground-truthed disease severity collected by field scouts (2020 and 2021) and the PhytoPatholoBot (2021) measurements to assess the correlation between vine reflectance and plant health status. The result will be an evaluation of the utility of multispectral satellite imagery for remote disease detection at the vineyard scale. Examples of what some of this data looks like in analysis mode can be found at the end of the report.

In collaboration with the Jiang Lab, we have been working to continuously improve our computer vision model for disease detection with semantic segmentation models. Before operating the original PPB in field season 2022, we plan to compare the near real-time segmentation models targeting on efficiency and offline state of the art Hierarchical Multi-Scale Attention network targeting on accuracy in our partially labeled dataset. More information on the current computer vision model can be found in Liu et al. (2021, ASABE). A Vivid X-Vision, 5-band multispectral camera will be added to the original PPB for data collections in field season 2022.

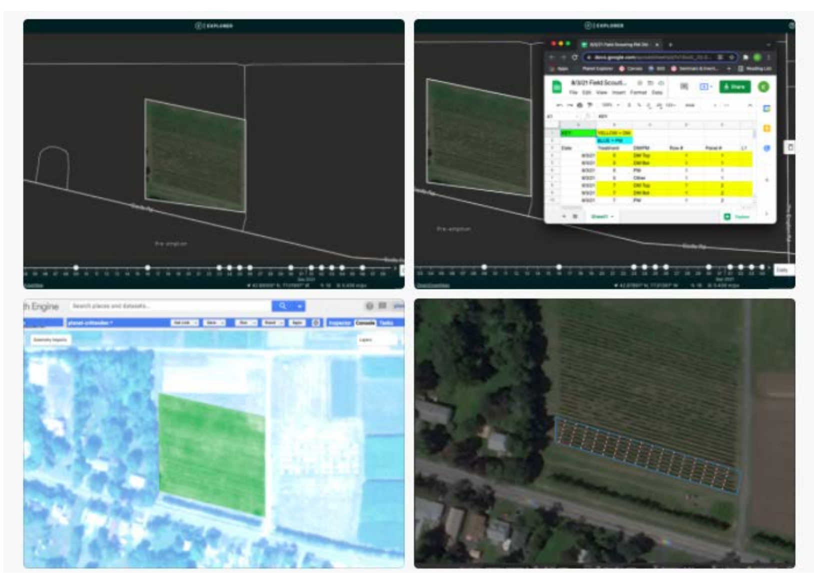
Technology Transfer Plan:
Results from this research are being communicated to NY grape growers through well-established channels, working closely with our Cornell Cooperative Extension colleagues. Gold holds the primary extension responsibilities for pathology and for the grape community of New York. Thus far, Gold has presented some of the results at the 2022 Lake Erie Winter Grape Meeting held in March 2022. She will present these results at the 2022 BEVNY Conference (March 2022), Penn State's Pre-Season Grapevine Disease Management Review Webinar (April 2022), BioIntensive Management Webinar (April 2022), and FLRGP Spring IPM Event (April 2022). Some of the results have been written up as a Grapes 101 article for *Appellation Cornell* entitled "Digging into the data: biopesticides for grape disease control," to be published late March 2022. Further results will be published in Gold's Annual Grape Disease Control Update (April 2022). Some of the results were presented by K. Kanaley at the 2021 CRAVE (Cornell Recent Advances in Viticulture) held virtually in the fall of 2021. Results have been incorporated into revisions of the *New York and Pennsylvania Pest Management Guidelines for Grapes*.

Attachments: relevant charts and graphs, photos etc.

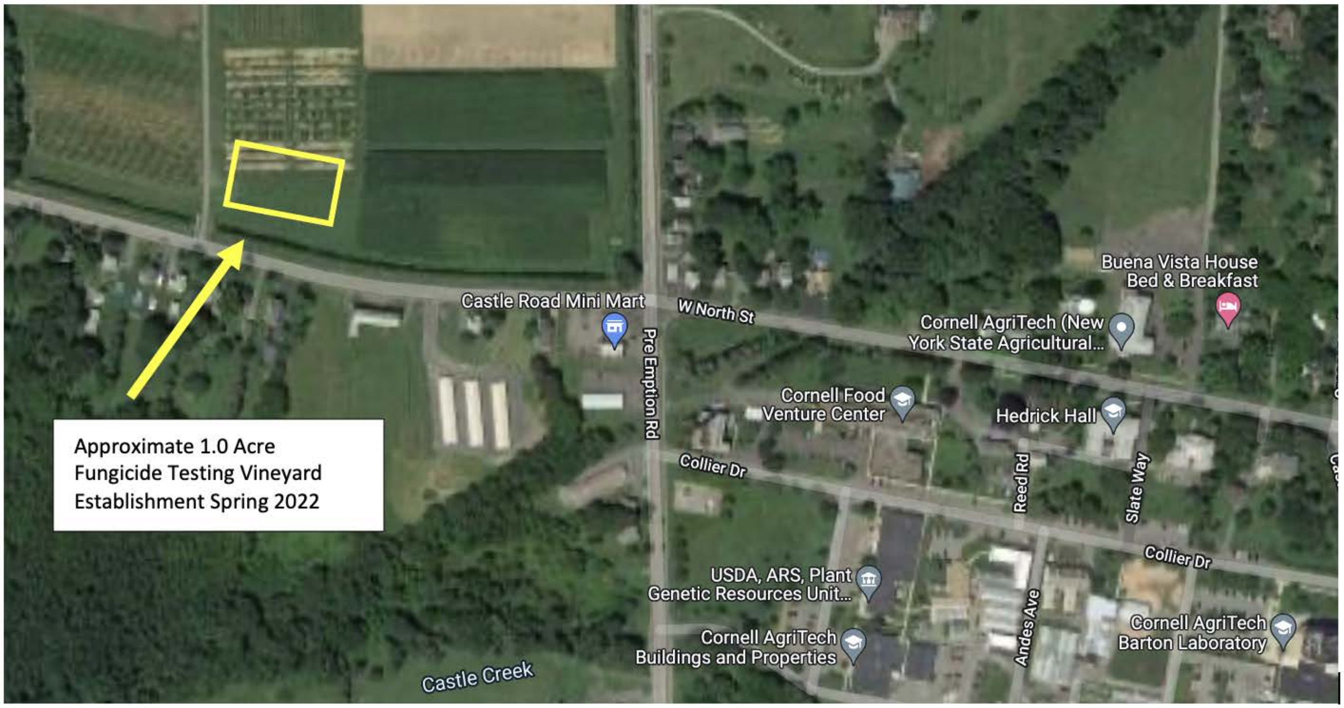


Satellite image of the Cornell Pathology vineyard located in Geneva, NY.

The vineyard is highlighted in blue on the left. On the right are expanded views of the twenty rows of Chardonnay vines included in the trials. The bottom right image labeled ‘False Color’, shows vegetation in red, and non-vegetated areas in blue. Trellis posts are indicated by dark circles. The image was acquired on August 16, 2021 by Planet Labs SSC18 satellite. Polygons marking the vine pixels in separate panels. Dark circles between panels are trellis posts.



Example of what imagery looks like during analysis.



Aerial photograph showing the area that will be established into the Traminette research vineyard. (google.maps.com)

New Traminette vineyard being prepped, spring 2021.

Kathleen Kanaley (left) spent her summers on her family's Seneca Lake vineyard and is excited to be returning to the NY grape industry as the lead graduate student on our downy mildew detection project. Kathleen will use the PhytoPatholoBot, below pictured with Katie, Yu, and Leo Liu, to validate her remote sensing work.

Project PI Katie Gold with Leora Gold (born July 4, 2021) scouting the powdery mildew efficacy study.