Part (A) of 2020 Report on Disease Efficacy Trials at HVRL: Apple Scab, Apple Rust, Fire Blight

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1. REPORT ON 2020 APPLE RUST AND FIRE BLIGHT EFFICACY TRIAL IN HIGHLAND NY

The trial objective. Observe several apple spray schedules for application at Tight Cluster through Petal Fall for activity against fire blight and cedar apple rust.

Rust inoculum. Galls of *Gymnosporangium juniperi-virginianae* and *Gymnosporangium clavipes* on infected branches of cedar trees interplanted with apple trees, carrying telial horns with teliospores that would give rise to basidiospores infecting apple leaves and fruit.

Fire blight inoculation. We inoculated flowers on 5 May 2020 by misting entire apple trees with water suspension of 5×10^6 CFU/ml of *E. amylovora* (Ea273), at 80% king bloom (GroundWork® rolling cart sprayer, 30 PSI, 3 Gal). We used slightly higher amount of inoculum than usual due to low average daily temperature of 49.1ºF (Max. 58.5ºF, min 41.3ºF; AccuWeather: Max. 62ºF, Min 37ºF). Inoculation started at 1:29 pm and completed at 4:10 pm. The first fire blight symptoms in this trial developed on 31 May: 1. First Fire Blight Symptoms Visible in Highland at HVRL Trial; 2. Fire Blight Infections 3-6 June If Any Flowers Still Open, blog published on June 2, 2020. We rated blossom and shoot blight incidence on 10 June. Going around the crown, we randomly chose 100 flower clusters per tree and counted the number of diseased and healthy clusters. Flower infections migrated into the shoots. We randomly chose 100 shoots per tree and counted infected and healthy shoots. Blossom and shoot blight were calculated as blossom and shoot blight percent on a per tree basis. Mean percent of blossom and shoot blight incidences were calculated for each treatment from 3-single tree replicates.

Apple varieties, experiment design, disease rating. Trial was conducted on mature 21-yr-old trees on MM.111 rootstock with M.9 interstem planted in discrete three-cultivar replicated plots at 25 ft between rows, 10 ft between trees within rows, and 20 feet between plots within rows. Each replicate plot consisted of one 'Golden Delicious' tree and another tree with the lower part of the crown with 'McIntosh' and the upper grafted part of crown with 'Ginger Gold'. Between each replicate plot, 10-12 ft tall cedar trees were planted to provide high level of rust inoculum and prevent inter-plot drift. A cedar hedge of a similar tree height surrounded the apple orchard. Treatments were replicated four times using a completely randomized design (CRD). Each replicate plot consisted of all three cultivars listed above. The percent incidence infection of rust on spur leaves was calculated from the number of leaves with rust lesions versus the leaves without the lesions on 20 randomly selected spur-leaf clusters per tree. The percent incidence of rust infection on fruit was calculated from the number of fruit with rust lesions versus the fruit without lesions on 20 to 25 randomly selected fruit clusters per tree, for a total of up to 50 fruit per tree replicate. The percent incidence infection of rust on shoot leaves was calculated from the number of leaves with rust lesions versus the leaves without lesions on 10 randomly selected shoots per tree. Disease incidences on leaves and fruit were subjected to LSD or Tukey's tests, respectively (α=0.05 or 0.1), for a completely randomized design.

Equipment. Treatments were sprayed dilute (300 gal/A) to drip using a tractor-carried handgun sprayer (Rear's Pak-Tank 100-gal sprayer, 250 PSI) to secure good coverage with the spray solution.

Maintenance sprays. Various insecticides according to entomologist Peter Jentsch's recommendations for 2020 season: https://blogs.cornell.edu/jentsch/. Standard herbicides and fertilizers applied.

Spray dates. Dates of the treatments according to the apple growth stages:

4/14/2019 – TC (BBCH 55)
4/23/2019 – TC (BBCH 55) Extended Spray
4/28/2019 – PK (BBCH 57)
5/4/2019 – Full bloom (BBCH 65)
5/16/2019 – PF i.e. fruit set (BBCH 69)

Fire blight rating: 10 June 2020
Spur Leaf Rust Rating: 12 – 15 June 2020
Fruit Rust Rating: 15 – 18 June 2020
Shoot Rust Rating: 14 – 30 June 2020

Spray Program Lineup: rates expressed in per acre (Vacciplant plant defense stimulant, active ingredient: laminarin 3.51%; Procure, active ingredient: triflumizole 42.14%; Ziram XCEL, active ingredient: ziram 76%):

1- Vacciplant 14 fl oz + Procure 16 fl oz (TC)
Vacciplant 14 fl oz + Procure 16 fl oz (TC) - Extended Spray
Nothing (PK)
Harbour 1.5 lbs (Full Bloom)
Procure 16 fl oz (PF)

2 - Vacciplant 14 fl oz (TC)
Vacciplant 14 fl oz (TC) - Extended Spray
Procure16 fl oz (PK)
Vacciplant 14 fl oz + Harbour 1.5 lbs (Full Bloom)
Ziram XCEL 6 lbs (PF)

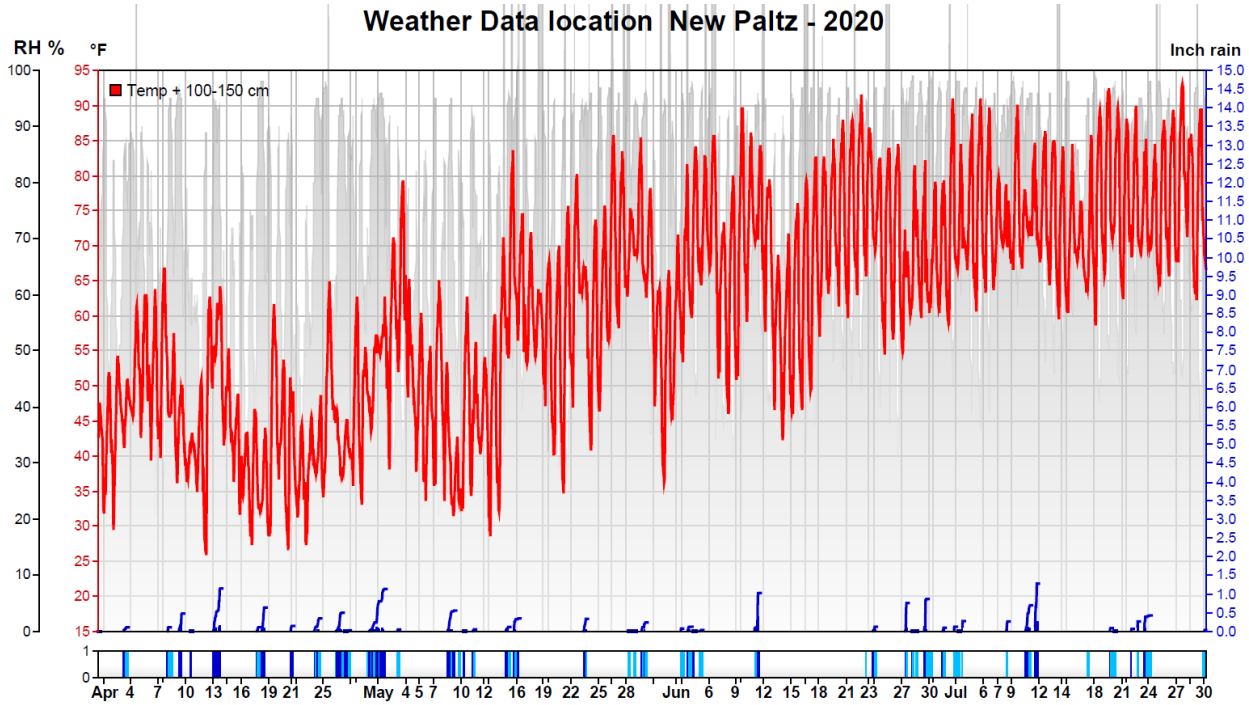
3 - Vacciplant 14 fl oz (TC)
Vacciplant 14 fl oz (TC) - Extended Spray
Ziram XCEL 6 lbs (PK)
Vacciplant 14 fl oz + Harbour 1.5 lbs (Full Bloom)
Procure 16 fl oz (PF)

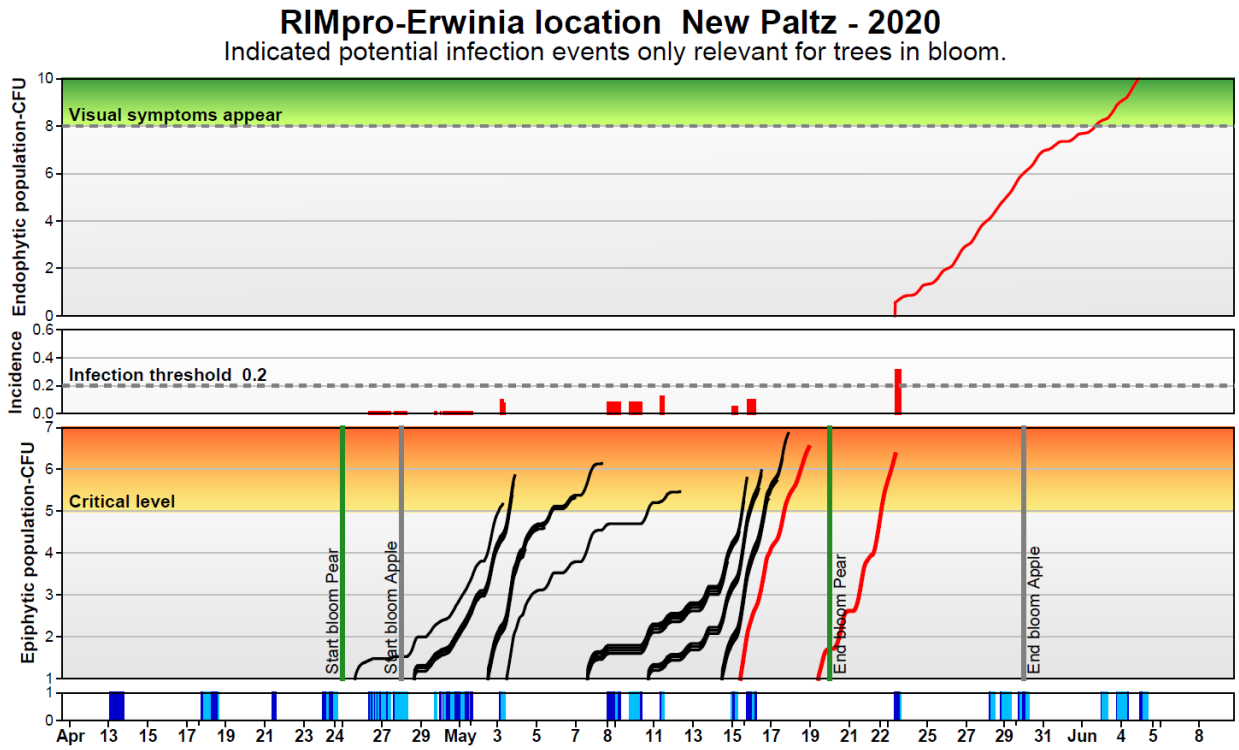
4 - Vacciplant 14 fl oz + Ziram XCEL 6 lbs (TC)
Vacciplant 14 fl oz + Ziram XCEL 6 lbs (TC) - Extended Spray
Nothing (PK)
Harbour 1.5 lbs (Full Bloom)
Ziram XCEL 6 lbs (PF)

5 - Vacciplant 14 fl oz + Procure 16 fl oz (TC)
Vacciplant 14 fl oz + Procure 16 fl oz (TC) - Extended Spray
Vacciplant 14 fl oz (PK)
Vacciplant 14 fl oz + Kasumin 2L 64 fl oz (FB)
Procure 16 fl oz (PF)

6 - UTC, Untreated Check

Summary of weather conditions in 2020 and natural disease infection periods, respectively:





Note: Graphs above used by permission from RIMpro B.V., Netherlands. Both graphs are formatted by RIMpro Cloud Service, an interactive Decision Support System for pest and disease prediction and management in fruit and grape production: https://www.rimpro.eu/

NEWA Apple Disease Models

Select a disease: Fire Blight

State: New York

Weather station: New Paltz (WG Minard)

Date of Interest: 05/14/2020

Calculate

Map | Results | More info

Fire Blight Risk Predictions for New Paltz (WG Minard)

Orchard Blight History: Fire blight occurred in your neighborhood last year.

Select the fire blight history in your orchard block of interest and the tool will calculate risk. Toggle orchard blight history to recalculate risk.

First blossom open date: 4/13/2020 Click if bloom has not occurred

The first blossom open date above is estimated based on degree day accumulations. Enter the actual first blossom open date for your orchard block of interest and the tool will calculate the protection period during bloom more accurately.

Accumulated degree days (base 43°F) through 5/14/2020: 408 (0 days missing)

	Past	Past	Current	Ensuing 5 Days				
Date	5/12	5/13	5/14	5/15	5/16	5/17	5/18	5/19
Cougarblight 4-Day DH	Low 3	Low 3	Low 45	Caution 293	High 427	High 498	High 469	Caution 266
Infection Potential EIP value	Low 0	Low 0	Moderate 0	High 69	Infection 101	Infection 116	Moderate 77	Moderate 37
Wetness Events								
Rain Amount	0.00	0.00	0.00	0.39	0.07	0.00	0.00	0.00
Dew	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Leaf Wetness (hours)	0	0	0	11	8	0	0	0
Hours >90% RH	0	0	3	13	11	1	11	3
RH max/min	70/25	87/24	255/30	255/47	255/40	255/48	255/67	93/30
Temp avg F	47	44	51	68	64	62	58	57

NA - data not available View Cougarblight Charts Download Time: 5/20/2020 23:00

Select a disease: Fire Blight

State: New York

Weather station: New Paltz (WG Minard)

Date of Interest: 05/23/2020

Calculate

Map | Results | More info

Fire Blight Risk Predictions for New Paltz (WG Minard)

Orchard Blight History: Fire blight occurred in your neighborhood last year.

Select the fire blight history in your orchard block of interest and the tool will calculate risk. Toggle orchard blight history to recalculate risk.

First blossom open date: 4/13/2020 Click if bloom has not occurred

The first blossom open date above is estimated based on degree day accumulations. Enter the actual first blossom open date for your orchard block of interest and the tool will calculate the protection period during bloom more accurately.

Accumulated degree days (base 43°F) through 5/23/2020: 570 (0 days missing)

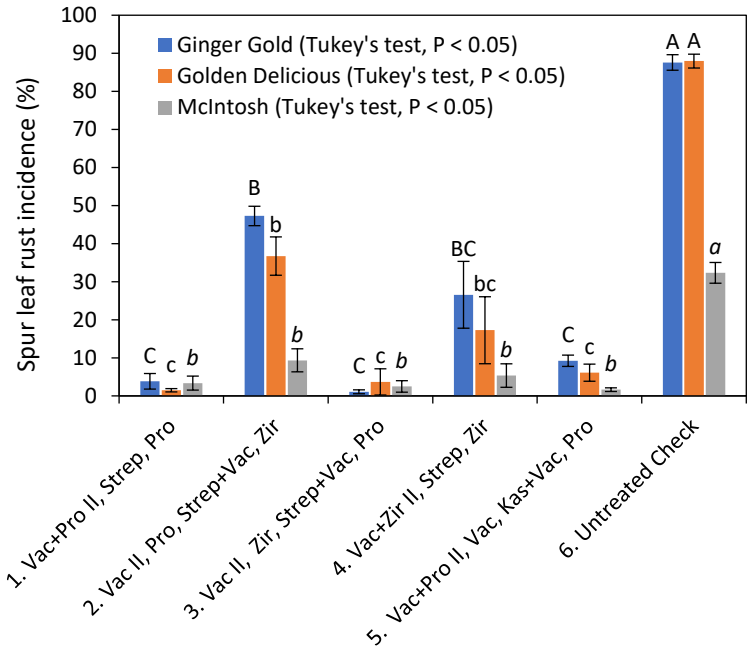
	Past	Past	Current	Ensuing 5 Days				Current	Ensuing 5 Days				
Date	5/21	5/22	5/23	5/24	5/25	5/26	5/27	5/28	5/29	5/30	5/31	6/1	6/2
Cougarblight 4-Day DH	Caution 227	High 434	High 459	Extreme 509	Extreme 516	Extreme 607	Extreme 843	Extreme 975	Extreme 1215	Extreme 1132	Extreme 845	Extreme 639	High 335
Infection Potential EIP value	Moderate 56	Infection 106	Infection 112	High 131	Infection 152	Infection 161	Infection 241	Infection 242	Infection 251	Infection 217	High 106	Moderate 36	Moderate 49
Wetness Events													
Rain Amount	0.00	0.00	0.34	0.00	0.00	0.00	0.00	0.02					
Dew	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes					
Leaf Wetness (hours)	0	0	8	0	0	0	0	7					
Hours >90% RH	5	4	14	7	10	14	8	11					
RH max/min	195/27	168/49	95/66	137/43	97/62	255/53	180/50	255/78					
Temp avg F	55	63	60	57	61	70	70	69					

NA - data not available View Cougarblight Charts Download Time: 5/29/2020 23:00

Note: Graphs above used from free EIP fire blight model showing the three major fire blight infection periods in 2020: 16-17 May, 22-23 May & 25-30 May: **http://newa.cornell.edu/index.php?page=apple-diseases**

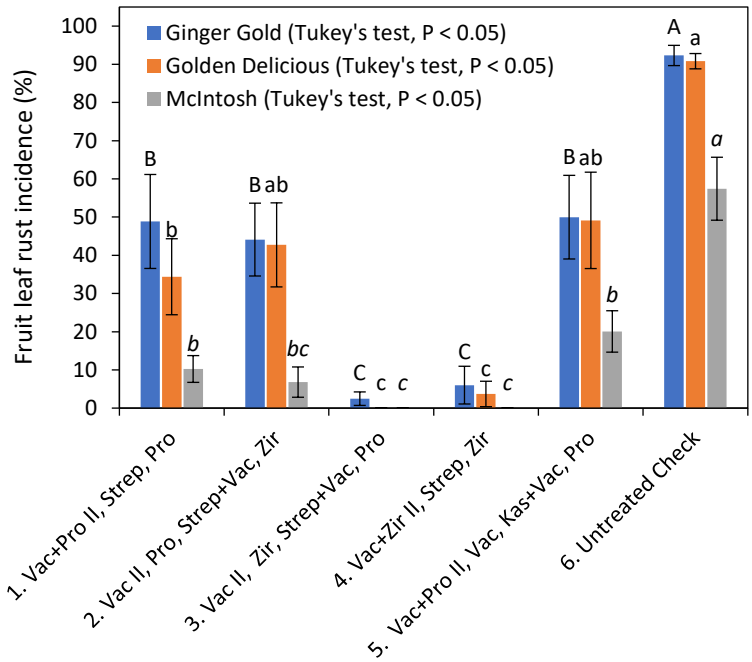
Results.

A) Spur leaf rust incidence (Cedar apple rust - *Gymnosporangium juniperi-virginianae*)



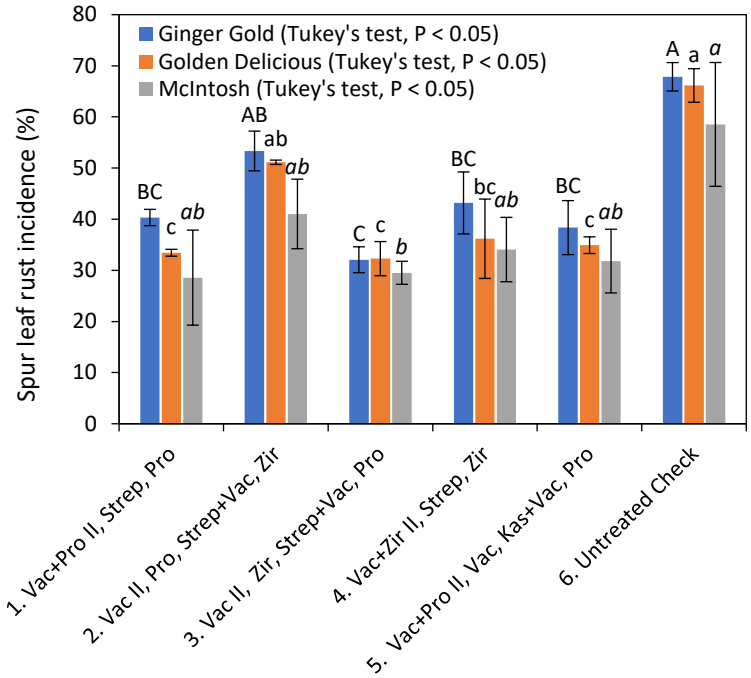
Note: Incidence means followed by different type of letters within the same cultivar i.e. bar color are significantly different (*p* < 0.05). Error bars represent standard error of the mean (SEM). Each mean consists of 4 replicate trees.

B) Fruit rust incidence (Quince rust - *Gymnosporangium clavipes*)



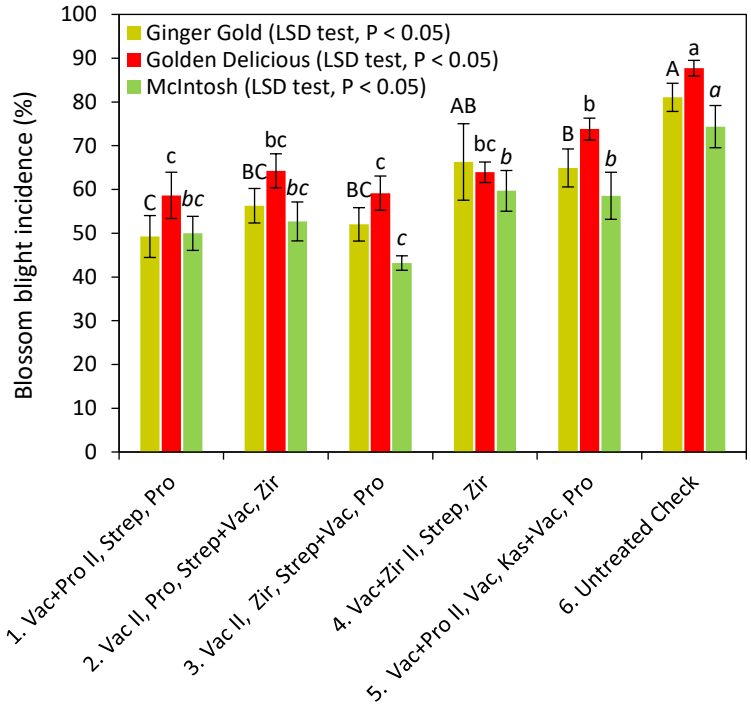
Note: Incidence means followed by different type of letters within the same cultivar i.e. bar color are significantly different (*p* < 0.05). Error bars represent standard error of the mean (SEM). Each mean consists of 4 replicate trees.

C) Shoot leaf rust incidence (Cedar apple rust - *Gymnosporangium juniperi-virginianae*)



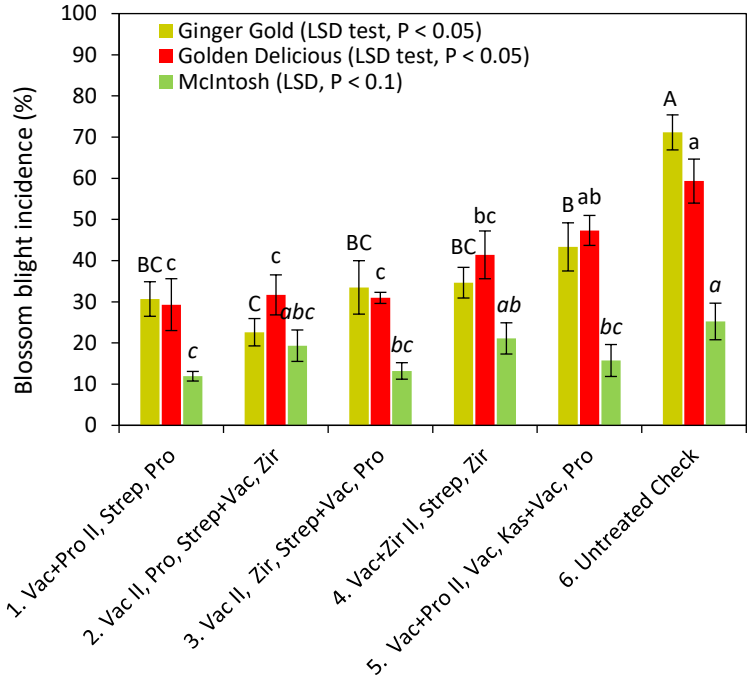
Note: Incidence means followed by different type of letters within the same cultivar i.e. bar color are significantly different (*p* < 0.05). Error bars represent standard error of the mean (SEM). Each mean consists of 4 replicate trees.

D) Blossom blight incidence (*Erwinia amylovora*)



Note: Incidence means followed by different type of letters within the same cultivar i.e. bar color are significantly different (*p* < 0.05). Error bars represent standard error of the mean (SEM). Each mean consists of 4 replicate trees.

E) Shoot blight incidence (*Erwinia amylovora*)



Note: Incidence means followed by different type of letters within the same cultivar i.e. bar color are significantly different (*p* < 0.05). Error bars represent standard error of the mean (SEM). Each mean consists of 4 replicate trees.

Commentary and interpretations – Apple rusts. The early part of the growing season was characterized by multiple frost events in April which extended almost up to mid-May. The growth stages of apple were unusually slowed by these low temperatures, and from Green Tip in this trial plot, which was around 25 March, it took slightly more than 1 month to pass to the Pink Bud growth stage on 28 April. Rain events were very frequent up until early June and with the rise of temperatures from mid-May onward these conditions extremely favored infections by *Gymnosporangium juniperi-virginianae* and *G. clavipes*, with the former being predominantly present on infected apple leaves and the latter being widely and dominantly present on infected apple fruit. The first symptoms of rust were visible around 20 May: **First Cedar-Apple Rust and Powdery Mildew Symptoms Visible at HVRL, Highland NY**. Under these conditions, the most effective spray schedules on early developing leaves on spurs were the 1, 3 and 5 and the reason why is probably the well timed use of the DMI imidazole fungicide Procure at Petal Fall, which coincided with the second, longer wave of temperature increases from 16 May onward, which favored the first severe rust infections that worked in conjunction with the intensive spur leaf development led by these temperatures. Treatments 1 and 5 had a second application of Procure, tank mixed with Vacciplant and applied within 9 days after the first application, referred to as Tight Cluster - Extended Spray, and was effective on protecting developing leaves on spurs. On apple fruit, the most effective spray schedules were 3 and 4, where 4 was likely very effective due to the predominant use of Ziram XCEL, twice at Tight Cluster and the third time at Petal Fall, with the potential longer-lasting synergistic effects of Vacciplant + Ziram XCEL combination at Tight Cluster and a longer-lasting and/or re-distributing residues of Ziram XCEL contributing to this effect. The spray schedule 3 was the most effective probably because of the better timing sequence in application of Ziram XCEL at Pink Bud, Vacciplant at Bloom and Procure at Petal Fall, in comparison to the program 2. Please see the heat map below with the specific colors assigned to each of the tested products. The key reason why shoot leaf infections were well established in almost all spray programs is the lack of continued fungicide coverage at First Cover (10 days after Petal Fall) and Second Cover. With some variation depending on cultivar,

the programs 1, 3, 4 and 5 provided significant effect likely due to Procure used at Petal Fall, with program 4 likely providing this effect due to similar Ziram effect mentioned for fruit above.

1- **Vacciplant 14 fl oz** + **Procure 16 fl oz (TC)**
Vacciplant 14 fl oz + **Procure 16 fl oz (TC)**
Nothing (PK)
Harbour 1.5 lbs (Full Bloom)
Procure 16 fl oz (PF)

2 - **Vacciplant 14 fl oz** (TC)
Vacciplant 14 fl oz (TC)
Procure16 fl oz (PK)
Vacciplant 14 fl oz + Harbour 1.5 lbs (Full Bloom)
Ziram XCEL 6 lbs (PF)

3 - **Vacciplant 14 fl oz** (TC)
Vacciplant 14 fl oz (TC)
Ziram XCEL 6 lbs (PK)
Vacciplant 14 fl oz + Harbour 1.5 lbs (Full Bloom)
Procure 16 fl oz (PF)

4 - **Vacciplant 14 fl oz** + **Ziram XCEL 6 lbs (TC)**
Vacciplant 14 fl oz + **Ziram XCEL 6 lbs (TC)**
Nothing (PK)
Harbour 1.5 lbs (Full Bloom)
Ziram XCEL 6 lbs (PF)

5 - **Vacciplant 14 fl oz** + **Procure 16 fl oz (TC)**
Vacciplant 14 fl oz + **Procure 16 fl oz (TC)**
Vacciplant 14 fl oz (PK)
Vacciplant 14 fl oz + **Kasumin 2L 64 fl oz (FB)**
Procure 16 fl oz (PF)

6 - UTC, Untreated Check

Commentary and interpretations – Fire blight. Blossom blight established very well in all the spray schedules indicating on the high infection pressure that preventive spray schedules were exposed to, when even expected efficacy of antibiotics was not excellent as shown in the variability between the spray schedules 1 and 4. However, the concentration of inoculum used on 5 May, just one day after antibiotic spray application on 4 May, could have been lower but was selected primarily due to the expected cold weather conditions with frosts from 5 – 14 May that could have reduced the inoculum levels (see weather conditions graph on pg. 4). In case the lower inoculum concentration was used it might have led to the overall lower incidence of the disease onset. Under these specific weather conditions and inoculum pressure, while varying somewhat depending on cultivar, spray schedules 1, 2 and 3 performed the best, but still allowed 43 to 64.3% infection on flowers. Shoot blight incidence was overall lower in comparison to the blossom blight, and the results largely confirmed that spray schedules 1, 2 and 3 performed the best, but still allowed 13 to 33% of infection on shoots. A greater consistency was observed among the spray schedules 2 and 3 that contained Vacciplant applications at Tight Cluster and Vacciplant + Streptomycin at Full Bloom than the spray schedules 1 and 4 that contained Vacciplant applications at Tight Cluster and only Streptomycin at Full Bloom.

2. REPORT ON 2020 APPLE SCAB EFFICACY TRIAL IN HIGHLAND NY

Apple scab inoculum. *V. inaequalis* ascospores in leaf litter from natural infections in 2019 season. Apple scab fungus ascospore release detected in Highland NY on March 20, 2020 with vacuum spore tower, online: First Mature Apple Scab Ascospores Detected in Highland NY 3/20/2020, 6:30 pm.

Apple varieties, experiment design, disease rating. Jersey Mac, Cortland 'RedCort', Golden Delicious 'Smoothee' as mature 25-yr-old trees on M.9 rootstock planted in discrete three-cultivar replicated plots at 25 ft. between rows, 10 ft. between trees within rows, and 20 feet between plots within rows. Treatments were replicated three times using a complete randomized design (CRD). Each replicate plot consisted of all three cultivars listed above. The percent scab infection incidence on spur leaves was calculated from the number of leaves with scab lesions versus the leaves without lesions on 20 randomly selected spur leaf clusters per tree. The percent incidence on fruit was calculated from the number of fruit with scab lesions versus the fruit without lesions on 25 randomly selected fruit clusters per tree, for a total of up to 50 fruits per tree replicate. The percent incidence infection of rust on shoot leaves was calculated from the number of leaves with rust lesions versus the leaves without lesions on 10 randomly selected shoots per tree. Disease incidences on leaves and fruit were subjected to LSD or Tukey's tests, respectively (α=0.05), for a completely randomized design.

Equipment. Treatments were sprayed dilute (300 gal/A) to drip using a tractor-carried handgun sprayer (Rear's Pak-Tank 100-gal sprayer, 250 PSI) to secure good coverage with the spray solution.

Maintenance sprays. Various insecticides according to entomologist Peter Jentsch recommendations for 2020 season: https://blogs.cornell.edu/jentsch/. Standard herbicides and fertilizers. ***The first*** streptomycin application was on 5/16/2020 to all treatments to control the predicted fire blight infection on 5/17/2020. ***The second*** streptomycin + Regulaid application for fire blight control was on 5/25/2020.

Spray dates. On 3/17/2020 the trees were at less than 5% GT. Dates of the treatments according to the protocol from the several pesticide companies with BBCH growths stage chart (BBCH scale and the spray dates below were based primarily on the cultivar 'Jersey Mac' and 'Golden Delicious' for PK stage):

1. 3/22/2020 – GT (BBCH 53) - NuFilmP did not arrive and so was not included in 7, 9, 10 at GT. Subfreezing temperatures the following night was another reason to not apply the surfactant.
2. 4/6/2020 – HIG (BBCH 54)
3. 4/14/2020 – TC (BBCH 55)
4. 4/23/2020 – TC2 (BBCH 55) **Extended spray**
5. 4/29/2020 – PK stage in Golden Delicious (BBCH 57) – spraying at PK because of a forecasted severe scab infection on May 1.
6. 5/4/2020 – MB - mid bloom (BBCH 64)
7. 5/16/2020 – PF (BBCH 69)
8. 5/26/2020 – 1C (BBCH 71) - Manzate used instead of Captan in treatments 2, 3, 4, 5, 6, 11 due to a streptomycin + Regulaid spray on 5/25/2020 for fire blight control.
9. 6/13/2020 – 2C (BBCH 72)
10. 7/7/2020 – 3C (BBCH 72)

Spur leaf scab rating: July 10 – 14, 2020.
Fruit scab rating: July 14 – 15, 2020.
Shoot leaf scab rating: July 17 – August 4, 2020.

Spray programs lineup: (Note: Stargus - containing 1 × 10^9 CFU/ml of *Bacillus amyloliquefaciens* strain F727 cells and spent fermentation media, FRAC BM02; Miravis A19649[B] - adepidyn aka pydiflumetofen, FRAC 7; Excalia – indiflin, FRAC 7; Cevya - mefentrifluconazole, FRAC 3, DMI - demethylation inhibitor):

1 - UTC - untreated control Regular

2 - Manzate Pro-stick 75 WG @ 3lb/A (HIG)
Manzate Pro-stick 75 WG @ 3lb/A (TC)
Manzate Pro-stick 75 WG @ 3lb/A (TC2) **Extended spray**
Cevya 4 fl oz + Manzate Pro-stick @ 3lb/A (PK, MB, PF)
Manzate Pro-stick 75 WG @ 3lb/A (1C)
Captan 80 WDG @ 3 lb/A (2-3C)

3 - Manzate Pro-stick 75 WG @ 3lb/A (HIG)
Manzate Pro-stick 75 WG @ 3lb/A (TC)
Manzate Pro-stick 75 WG @ 3lb/A (TC2) **Extended spray**
Cevya 5 fl oz + Manzate Pro-stick @ 2.5 lb (PK, MB, PF)
Manzate Pro-stick 75 WG @ 3lb/A (1C)
Captan 80 WDG @ 3 lb/A (2-3C)

4 - Manzate Pro-stick 75 WG @ 3lb/A (HIG)
Manzate Pro-stick 75 WG @ 3lb/A (TC)
Manzate Pro-stick 75 WG @ 3lb/A (TC2) **Extended spray**
Inspire Super @ 12 fl oz + Manzate Pro-stick 75 WG @ 3lb/A (PK, MB, PF)
Manzate Pro-stick 75 WG @ 3lb/A (1C)
Captan 80 WDG @ 3 lb/A (2-3C)

5 - Manzate Pro-stick 75 WG @ 3lb/A (GT)
Nothing (HIG)
Manzate Pro-stick 75 WG @ 3lb/A (TC)
Manzate Pro-stick 75 WG @ 3lb/A (TC2) **Extended spray**
Excalia @ 4 fl oz/A (PK)
Inspire Super @ 12 fl oz (MB)
Excalia @ 4 fl oz/A (PF)
Manzate Pro-stick 75 WG @ 3lb/A (1C)
Captan 80 WDG @ 3 lb/A (2-3C)

6 - Manzate Pro-stick 75 WG @ 3lb/A (GT)
Nothing (HIG)
Manzate Pro-stick 75 WG @ 3lb/A (TC)
Manzate Pro-stick 75 WG @ 3lb/A (TC2), **Extended spray**
Miravis @ 3.42 fl oz (PK)
Inspire Super @ 12 fl oz (MB)
Miravis @ 3.42 fl oz (PF)
Manzate Pro-stick 75 WG @ 3lb/A (1C)
Captan 80 WDG 3 lb/A (2-3C)

7 – Stargus @ 3 qts + Microthiol Disperss 20 lbs (GT)
Nothing (HIG)

Stargus @ 3 qts + Microthiol Disperss 20 lbs + NuFilmP @ 32 fl oz/100 gal (TC)
Stargus @ 3 qts + Microthiol Disperss 20 lbs + NuFilmP @32 fl oz/100 gal (TC2), Extended spray
Stargus @ 3 qts + Microthiol Disperss 20 lbs + NuFilmP @ 32 fl oz/100 gal (PK)
Stargus @ 3 qts + Microthiol Disperss 20 lbs + NuFilmP @ 32 fl oz/100 gal (MB)
Stargus @ 3 qts + Microthiol Disperss 20 lbs + NuFilmP @ 32 fl oz/100 gal (PF)
Stargus @ 3 qts + Microthiol Disperss 20 lbs + NuFilmP @ 32 fl oz/100 gal (1C)

8 – Stargus @ 2 qts + Manzate Pro-stick 75 WG @ 3lb/A (HIG)
Stargus @ 2 qts + Manzate Pro-stick 75 WG @ 3lb/A (TC)
Stargus @ 2 qts + Manzate Pro-stick 75 WG @ 3lb/A (TC2), **Extended spray**
Nothing (PK)
Nothing (MB)
Stargus @ 2 qts + Manzate Pro-stick 75 WG @ 3lb/A (PF)
Stargus @ 2 qts + Manzate Pro-stick 75 WG @ 3lb/A (1C)

9 - **Stargus @ 3 qts (GT)**
Nothing (HIG)
Stargus @ 3 qts + NuFilmP @ 32 fl oz/100 gal (TC)
Stargus @ 3 qts + NuFilmP @ 32 fl oz/100 gal (TC2), Extended spray
Stargus @ 3 qts + NuFilmP @ 32 fl oz/100 gal (PK)
Stargus @ 3 qts + NuFilmP @ 32 fl oz/100 gal (MB)
Stargus @ 3 qts + NuFilmP @ 32 fl oz/100 gal (PF)
Stargus @ 3 qts + NuFilmP @ 32 fl oz/100 gal (1C)

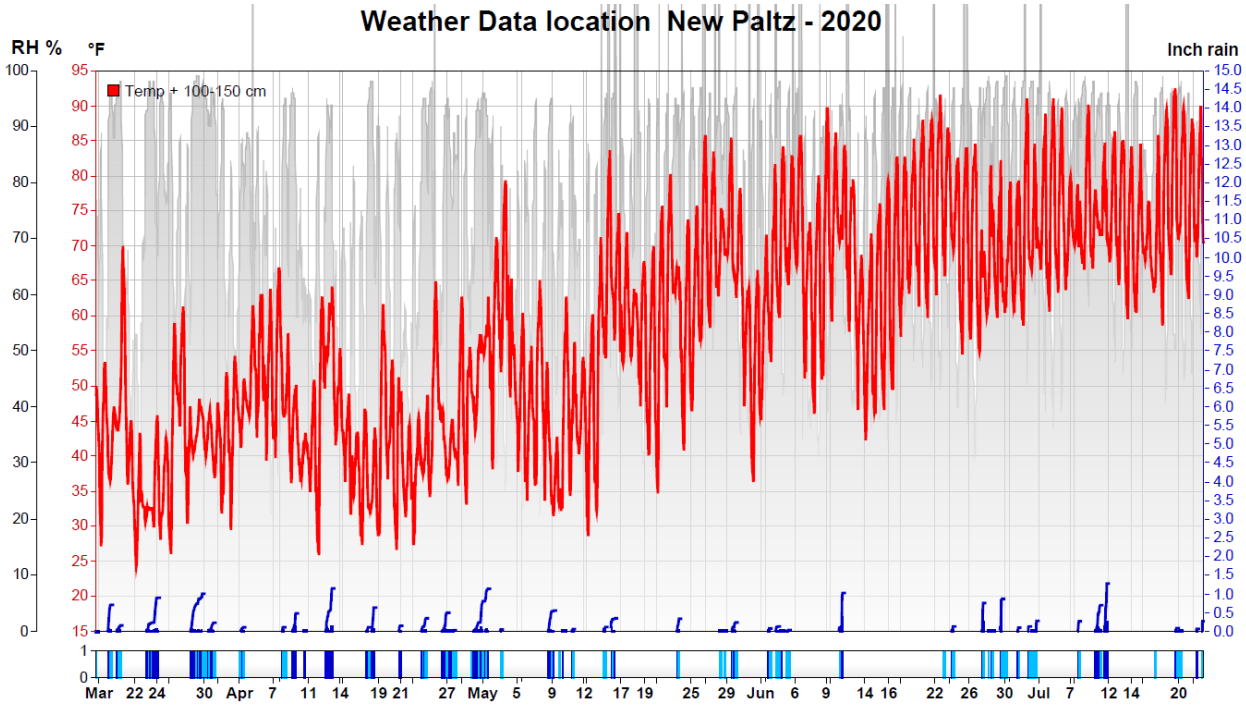
10 - Microthiol Disperss @ 20 lbs (GT)
Nothing (HIG)
Microthiol Disperss @ 20 lbs + NuFilmP @ 32 fl oz/100 gal (TC)
Microthiol Disperss @ 20 lbs + NuFilmP @ 32 fl oz/100 gal (TC2), **Extended spray**
Microthiol Disperss @ 20 lbs + NuFilmP @ 32 fl oz/100 gal (PK)
Microthiol Disperss @ 20 lbs + NuFilmP @ 32 fl oz/100 gal (MB)
Microthiol Disperss @ 20 lbs + NuFilmP @ 32 fl oz/100 gal (PF)
Microthiol Disperss @ 20 lbs + NuFilmP @ 32 fl oz/100 gal (1C)

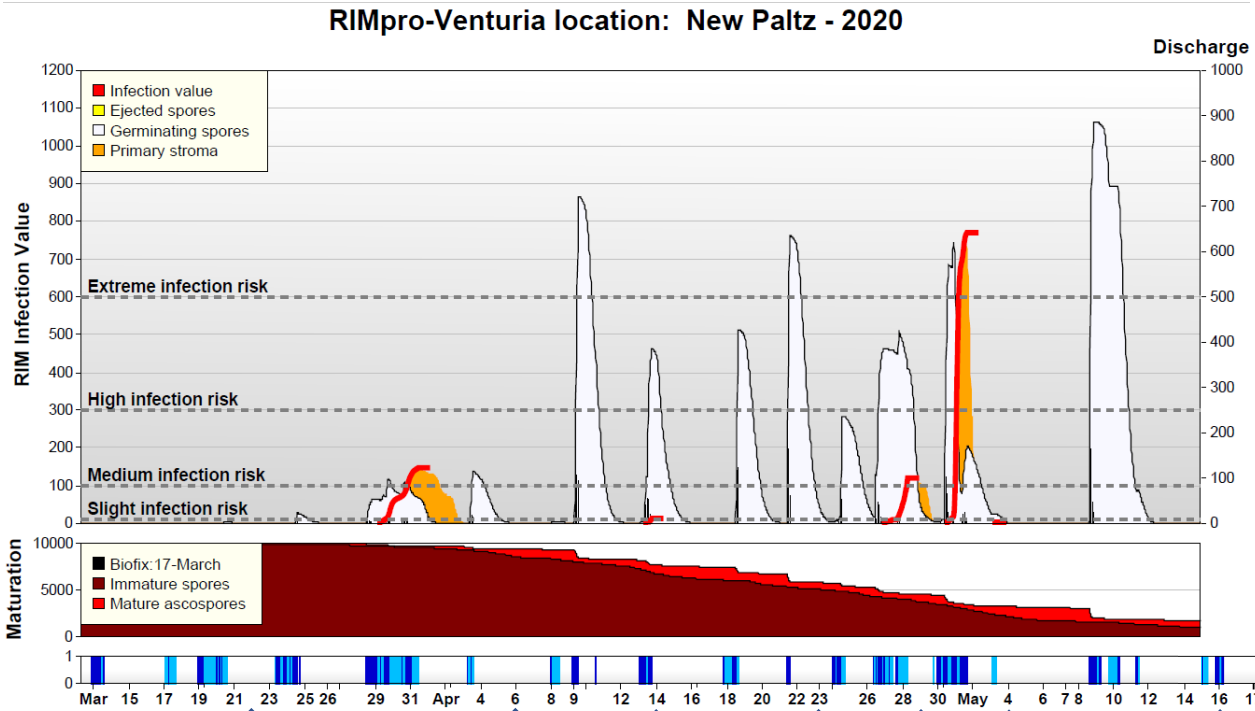
11 – **Indar @ 8 fl oz + Manzate Pro-stick 75 WG @ 3lb (TC)**
Indar @ 8 fl oz + Manzate Pro-stick 75 WG @ 3lb (TC2), Extended spray
Rally @ 8 oz + Manzate Pro-stick 75 WG @ 3lb (PK)
Luna Sensation 4.17 SC @ 5 fl oz/A + Manzate Pro-stick 75 WG @ 3lb (MB)
Luna Sensation 4.17 SC @ 5 fl oz/A + Manzate Pro-stick 75 WG @ 3lb (PF)
Manzate Pro-stick 75 WG @ 3lb/A (1C)
Captan 80 WDG 2.5 lb/A (2-3C)

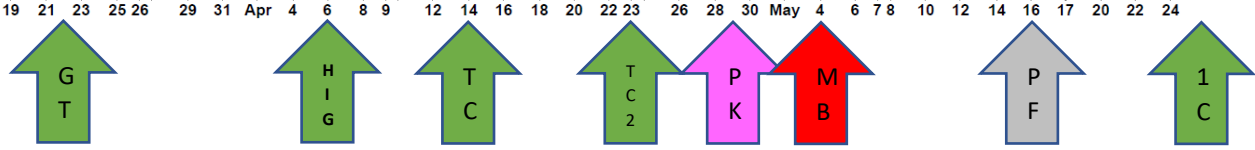
12 – Vacciplant @ 14 fl oz (TC)
Vacciplant @ 14 fl oz (TC2), Extended spray
Vacciplant @ 14 fl oz (PK)
Vacciplant @ 14 fl oz (MB)
Vacciplant @ 14 fl oz (PF)
Vacciplant @ 14 fl oz (1C)

13 – UTC – untreated control High, never received fungicides in the current year or in the past

Summary of weather conditions in 2020 and *V. inaequalis* infection periods, respectively:

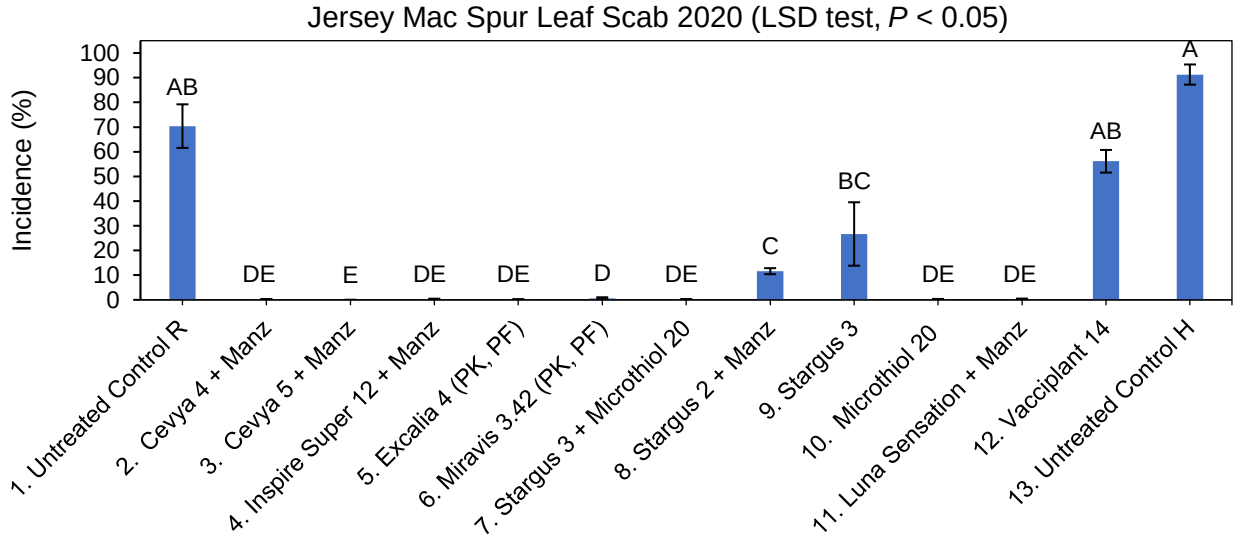


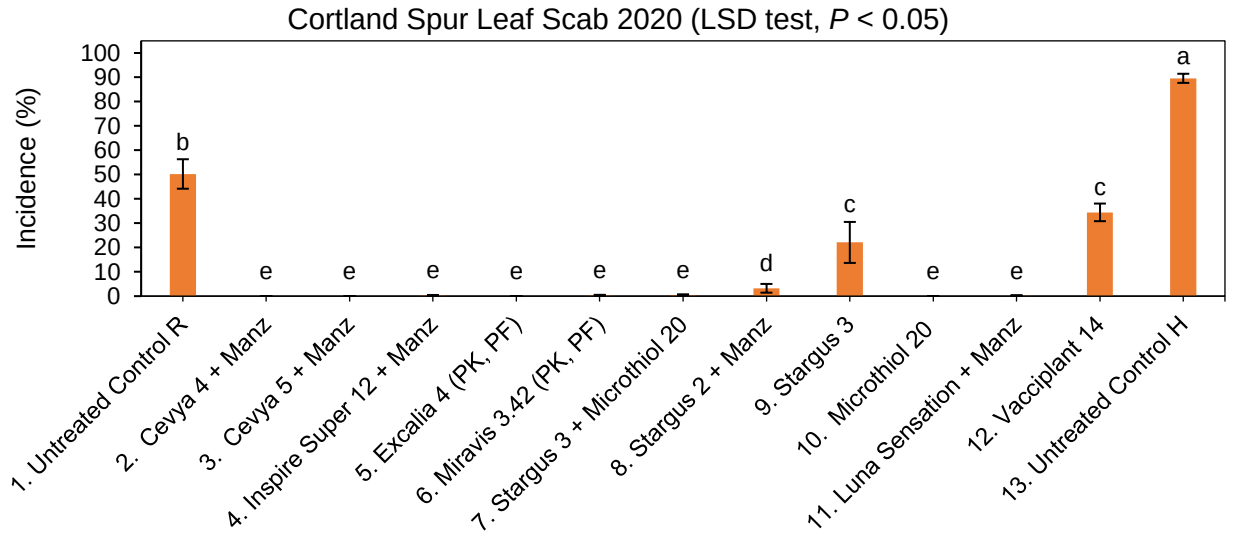


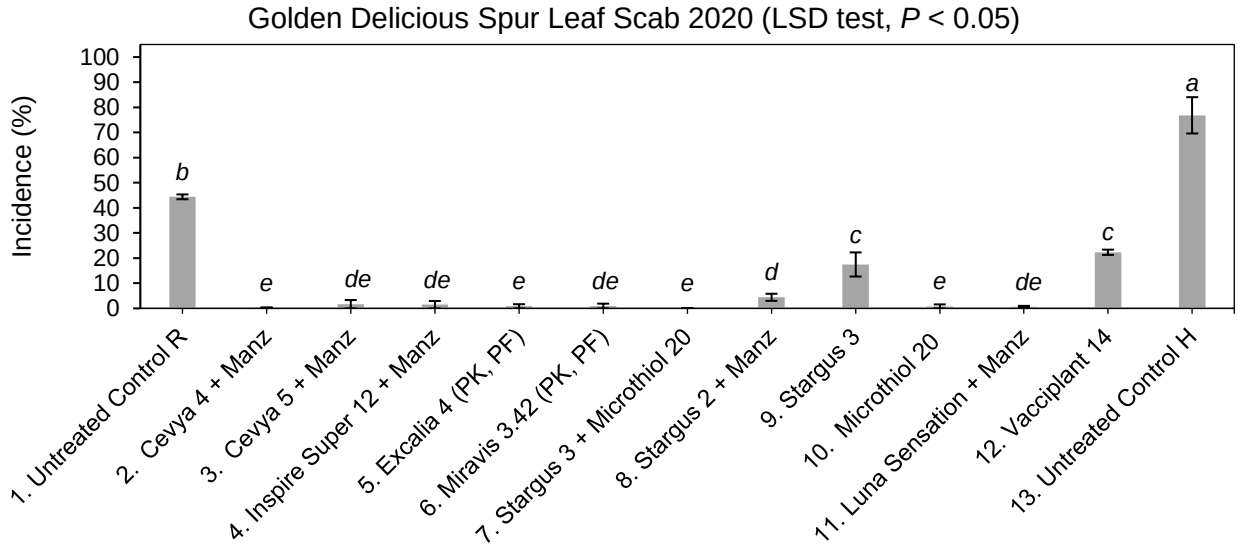


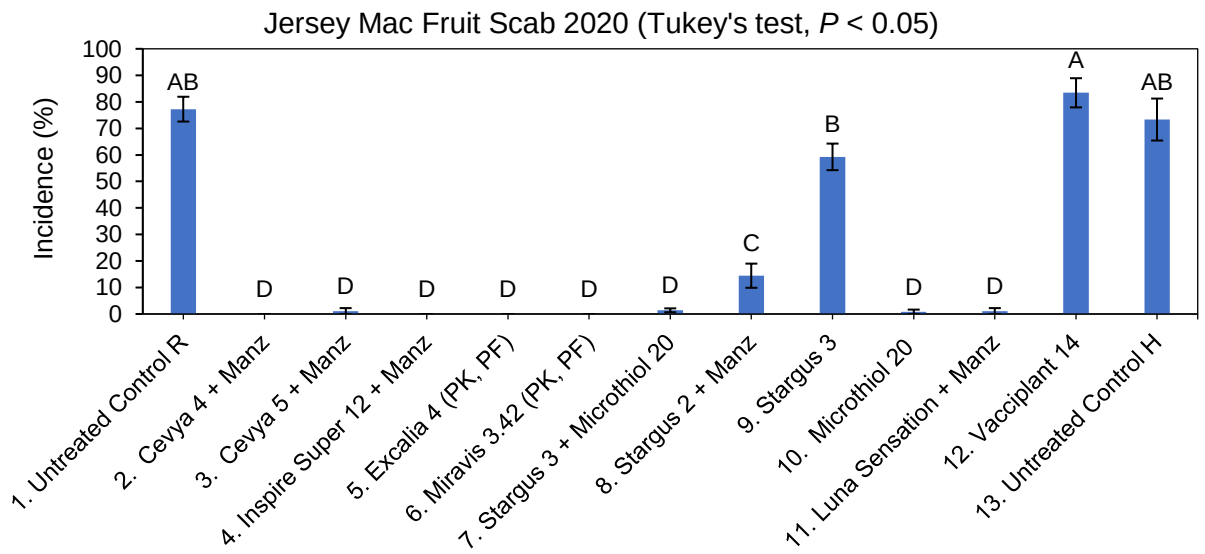
Note: Graphs above used by permission from RIMpro B.V., Netherlands. Both graphs are formatted by RIMpro Cloud Service, an interactive Decision Support System for pest and disease prediction and management in fruit and grape production: https://www.rimpro.eu/

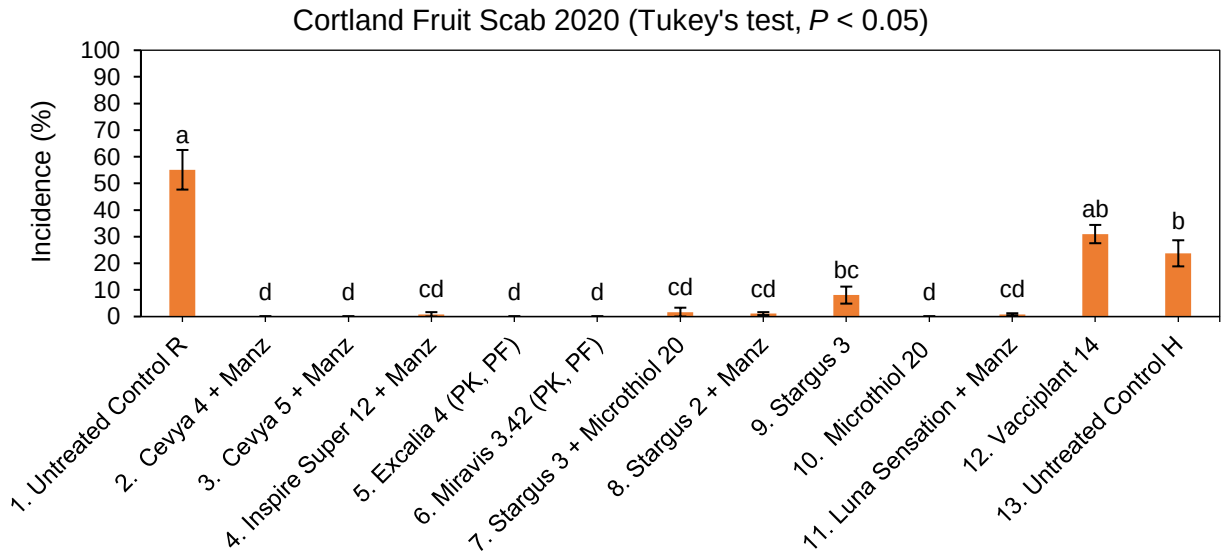
Results. For all graphs, incidence means followed by different letters are significantly different ($P < 0.05$). Error bars are standard error of the mean. Each mean consists of three replicate trees.

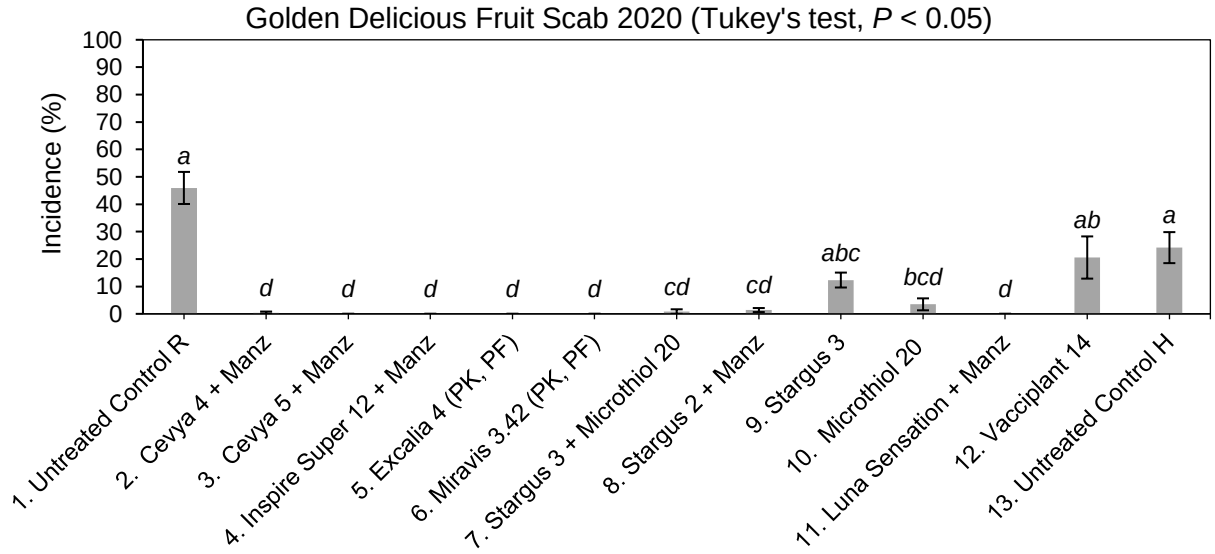


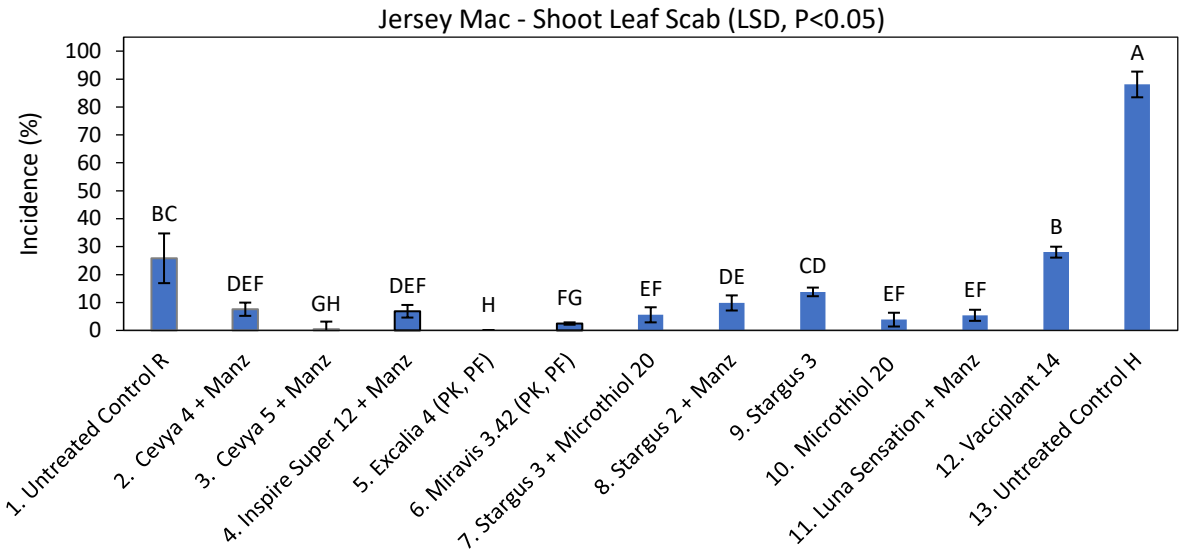


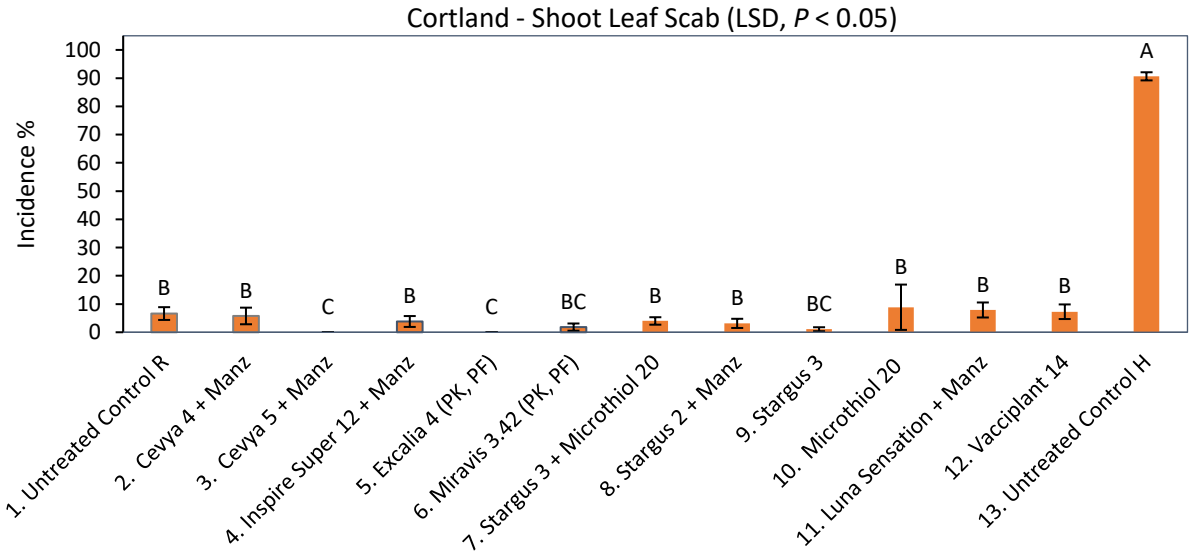


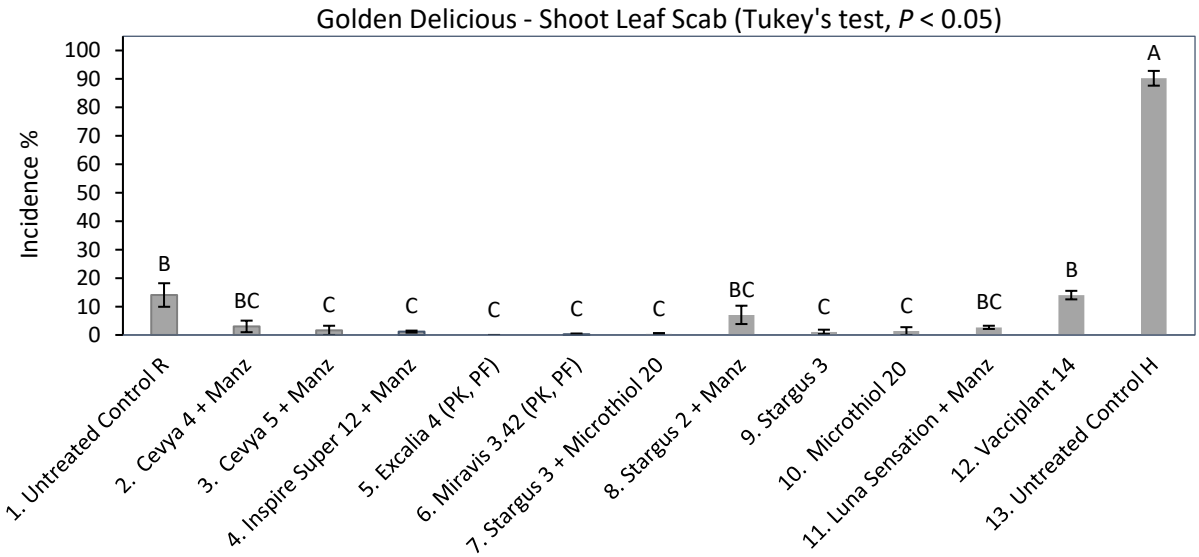

Jersey Mac Fruit Scab 2020 (Tukey's test, P < 0.05)
Incidence (%)
100
90
80
70
60
50
40
30
20
10
0
AB
D
D
D
D
D
D
C
B
D
D
A
AB
1. Untreated Control R
2. Cevya 4 + Manz
3. Cevya 5 + Manz
4. Inspire Super 12 + Manz
5. Excalia 4 (PK, PF)
6. Miravis 3.42 (PK, PF)
7. Stargus 3 + Microthiol 20
8. Stargus 2 + Manz
9. Stargus 3
10. Microthiol 20
11. Luna Sensation + Manz
12. Vacciplant 14
13. Untreated Control H


Cortland Fruit Scab 2020 (Tukey's test, P < 0.05)
Incidence (%)
100
90
80
70
60
50
40
30
20
10
0
a
d
d
cd
d
d
cd
cd
bc
d
cd
ab
b
1. Untreated Control R
2. Cevya 4 + Manz
3. Cevya 5 + Manz
4. Inspire Super 12 + Manz
5. Excalia 4 (PK, PF)
6. Miravis 3.42 (PK, PF)
7. Stargus 3 + Microthiol 20
8. Stargus 2 + Manz
9. Stargus 3
10. Microthiol 20
11. Luna Sensation + Manz
12. Vacciplant 14
13. Untreated Control H


Golden Delicious Fruit Scab 2020 (Tukey's test, P < 0.05)
Incidence (%)
100
90
80
70
60
50
40
30
20
10
0
a
d
d
d
d
d
cd
cd
abc
bcd
d
ab
a
1. Untreated Control R
2. Cevya 4 + Manz
3. Cevya 5 + Manz
4. Inspire Super 12 + Manz
5. Excalia 4 (PK, PF)
6. Miravis 3.42 (PK, PF)
7. Stargus 3 + Microthiol 20
8. Stargus 2 + Manz
9. Stargus 3
10. Microthiol 20
11. Luna Sensation + Manz
12. Vacciplant 14
13. Untreated Control H


Jersey Mac - Shoot Leaf Scab (LSD, P<0.05)
Incidence (%)
100
90
80
70
60
50
40
30
20
10
0
BC
DEF
GH
DEF
H
FG
EF
DE
CD
EF
EF
B
A
1. Untreated Control R
2. Cevya 4 + Manz
3. Cevya 5 + Manz
4. Inspire Super 12 + Manz
5. Excalia 4 (PK, PF)
6. Miravis 3.42 (PK, PF)
7. Stargus 3 + Microthiol 20
8. Stargus 2 + Manz
9. Stargus 3
10. Microthiol 20
11. Luna Sensation + Manz
12. Vacciplant 14
13. Untreated Control H


Cortland - Shoot Leaf Scab (LSD, P < 0.05)
Incidence %
100
90
80
70
60
50
40
30
20
10
0
B
B
C
B
C
BC
B
B
BC
B
B
B
A
1. Untreated Control R
2. Cevya 4 + Manz
3. Cevya 5 + Manz
4. Inspire Super 12 + Manz
5. Excalia 4 (PK, PF)
6. Miravis 3.42 (PK, PF)
7. Stargus 3 + Microthiol 20
8. Stargus 2 + Manz
9. Stargus 3
10. Microthiol 20
11. Luna Sensation + Manz
12. Vacciplant 14
13. Untreated Control H


Golden Delicious - Shoot Leaf Scab (Tukey's test, P < 0.05)
Incidence %
100
90
80
70
60
50
40
30
20
10
0
B
BC
C
C
C
C
C
BC
C
C
BC
B
A
1. Untreated Control R
2. Cevya 4 + Manz
3. Cevya 5 + Manz
4. Inspire Super 12 + Manz
5. Excalia 4 (PK, PF)
6. Miravis 3.42 (PK, PF)
7. Stargus 3 + Microthiol 20
8. Stargus 2 + Manz
9. Stargus 3
10. Microthiol 20
11. Luna Sensation + Manz
12. Vacciplant 14
13. Untreated Control H

Commentary and interpretations – Apple scab. The first symptoms of scab were visible on spurs leaves on 11 May: First Apple Leaf Scab Lesions Visible in Highland NY (HVRL) on 11 May 2020. The most effective spray programs on spur leaves and fruit were the treatments 2, 3, 4, 5, 6, 7, 10 and 11, with treatment 8 being very close in efficacy. On shoot leaves, control of scab followed largely similar patterns except for 2, 4, 6, 7 and 10, 11 where slight, more scab developed than expected. However, the UTC-R indicated that relatively drier weather conditions from May 3 to June 27 did not favor scab infections on shoot leaves, indicating that scab infection pressure from conidia on the established lesions on spurs and fruit for shoot infections was very low, while the primary scab infections were predominantly thwarted by the unfavorable weather conditions from 4 May onward. Treatment 9, i.e. Stargus at 3 qts/A performed relatively well on 'Cortland' and 'Golden Delicious' spur leaves of cultivars that bear some genetic resistance to scab, and that effect did persist consistently in fruit scab control, except on 'Jersey mac'. The comparison of treatments 7, 9 and 10 in control of spur leaf scab and fruit scab clearly indicates that sulfur (Microthiol Disperss) at the highest labelled rate is to be credited for the lion share in control of scab on these organs. Vacciplant at 14 fl oz performed relatively well only on spur and shoot leaves of the more resistant 'Cortland' and 'Golden Delicious', showing statistical reduction of the disease to 34 and 22% incidence on spurs, and 7 and 14% incidence on shoots.

Report compiled by Dr. Srdjan G. Acimovic, plant pathologist at Cornell University's Hudson Valley Research Laboratory, from: 6/10 2020 – 9/2/2020. Detailed weather data records for Highland NY during 2020 can be accessed at http://newa.cornell.edu/index.php?page=all-weather-data. This report will be available from September 2020 on this link: http://blogs.cornell.edu/acimoviclab/pesticide-efficacy-trials/.