California Melon Research Board
2011-12 Progress Reports

LYNN EPSTEIN

Fungicide Resistance and Diversity of Isolates that Cause Powdery Mildew of Melons

The goal of this research is to identify races of powdery mildew from the various melon producing regions and to offer guidance on what fungicides may develop problems with pathogen resistance. Consequently, we have been collecting isolates, testing them for fungicide resistance, and attempting to maintain the isolates, which is a challenge with an obligate pathogen. We have also been isolating DNA from the isolates in preparation for sequencing of the ribosomal DNA ITS region. All isolates were microscopically confirmed as *Podosphaera xanthii.* Our fungicide test utilizes a range of concentrations of compounds with different modes of action and fungicide resistance groups: Azoxystrobin (Quadris, a QoI in resistance group 11, which is considered to have a high chance of development of resistance); Pyraclostrobin (Pristine, also a QoI in resistance group 11); Trifloxystrobin (Flint, also a QoI in resistance group 11); Thiophanate-methyl (Topsin; a β-tubulin inhibitor in resistance group 1, which is also considered to have a high chance of development of resistance); Myclobutanil (Rally, a DMI in resistance group 3, which is considered to have a medium chance of development of resistance); Triflumazole (Procure, also a DMI in resistance group 3); a sulfur (Thiosperse; which has multi-site contact activity and is in resistance group M2, which is considered to have a low chance of development of resistance); and a mock-treated control. All experiments are in progress. Azoxystrobin and trifloxystrobin have the most variable efficacy between isolates; results are consistent with fungicide resistance in some isolates.

DOUG GUBLER

The Combination of Particle Film Applications and Insecticide-Based Aphid Management for Mosaic Virus Incidence and Potentially-Associated "Brown Blotch" Symptoms Reduction

Objectives *(and preliminary results)*

1. Evaluate the ability of the combination of particle film applications and systemic insecticide applications to decrease overall aphid density and to alter the species composition of alate aphids settling on melon plants. ***Higher (relative to that experienced in previous years) virus incidence was sought this year in order to detect apparent treatment differences. Therefore, two late season study sites, one furrow-irrigated field and one dryland / subirrigated field, were selected. At present, these fields have yet to be harvested and are still being monitored. Overall aphid density has been low to moderate. As in previous years' work, there appears to be an effect of particle films on aphid species composition trapped above plants: treated plots tend to harbor a larger percentage of melon aphid, Aphis gossypii, and untreated plots tend to harbor higher percentages of migrating, non-colonizing species. So far, nine species have been caught, including three migrants never encountered in previous years. Neonicotinoid insecticides, imidacloprid (Admire Pro) and acetamiprid***

(Assail), have been used on half of the acreage to control colonizing aphids. Aphid density and species composition is still being compiled.

2. Evaluate the ability of this treatment combination to reduce observed virus incidence as compared to no treatment at all.

A group sampling approach, consisting of 100 leaves (from ten groups) from each treatment plot, has been initiated at both research sites. Virus presence and identification will be carried out within the Falk Laboratory and used to calculate virus incidence per group. Visual scouting indicated presence of mosaic viruses at both sites.

3. Establish the existence or nonexistence of an association between specific mosaic virus infection and the occurrence of 'brown blotch' symptoms.

Plots, of four different crop ages: 15, 25, 35, and 45 days after sowing, were mechanically inoculated with either WMV2 or PRSV-W on September 2. Fruit will be harvested and subjected to cold storage at maturity, beginning with the most mature group during the week of October 3. Symptomatic fruit will be examined for virus presence and the effects of specific inoculation on fruit symptom incidence will be determined.

DONNA HENDERSON/MIKE STANGHELLINI

Evaluation of Fungicides Quadris and Cannonball for Late-Season Management of Root-Infecting Fungi in Cantaloupe

Objective: To evaluate the efficacy of Quadris (Azoxystrobin) and Cannonball (Fludioxonil) in a late-season application regime against *Monosporascus cannonballus* and other root-infecting fungi.

Materials and Methods: The cantaloupe crop (Sol Real) was planted on April 14, 2011 and harvested on July 6, 2011. There were seven treatments (Control, Quadris 55 DAP {Days After Planting}, Quadris70 DAP, Quadris 55 + 70 DAP, Cannonball 55 DAP, Cannonball 70 DAP, Cannonball 55 + 75 DAP). Each treatment consisted of one 80-inch bed, 75 feet long. Treated beds were replicated five times, with each bed being only a single treatment applied through the drip line, totaling 35 beds. Additionally, Quadris was applied (55, 70, and 55+70 DAP) as a side dress on furrow irrigated rows. There were three replication of each treatment (randomized block design).

Chemical treatments in the drip irrigated plot were applied, over a 60 min. time period at label rates, three hours after the start of a 6 hr long irrigation regime. In the furrow irrigated plot, the chemicals were applied immediately prior to the onset of the irrigation regime.

Disease incidence and severity were assessed as follows: the root system of 5 plants per treatment replication were excavated from soil 21 days after planting and at crop termination (July 6) and assessed for the following: % roots infected and/ or the severity of root rot. The rating system was as follows: 1 = 1-20, 2 = 21-40, 3 = 41-

60, 4= 61-80, and 5 = 81-100% of the system with lesions. Randomly selected roots from each treatment were cultured to confirm presence or absence of the root infecting fungi.

Additionally, the number of fruit per treatment replication was enumerated at harvest.
Appropriate tests will be used to analyze the data means.

Results:

Data are currently being analyzed but preliminary assessment indicates that none of the treatments provided significant disease control and that disease incidence in the furrow irrigated plot was more severe than in the drip irrigated plot.

TOM LANINI

Melon Tolerance and Weed Control with New Herbicides

Summary
Weed control in melons is expensive and difficult due to the limited availability of registered herbicides. Potential herbicides for use in melons include metolachlor (Dual Magnum), flumioxazin (Chateau), sulfentrazone (Zeus), pendimethalin (Prowl H_2O), fomesafen (Reflex) and linuron (Lorox). A honeydew, two cantaloupe and a watermelon variety were tested for tolerance and weed control with these new herbicides. The melon varieties were: Cantaloupe - Oro Rico, and Esteem; honeydew melon – Saturno; and watermelon - Paradise. Applications were made immediately after planting and mechanically incorporated to move the herbicides into the soil. The melons in the Lorox treated plots were almost completely killed. The rates were doubled this year to help improve weed control, but the higher rates proved lethal to cantaloupe and honeydew melons. Cerano treatments also reduced early season melon vigor, while other treatments appeared to be safe on melons. Weed control was fair to poor with many of the herbicides this year, with the exception of the Lorox, which controlled most weeds (and the melons). Grass weeds were particularly tough to control, with Dual magnum, Prowl H2O, and Cerano providing the best grass control. Grasses in the research plot included barnyardgrass and stinkgrass (*Eragrostis* sp.). Broadleaf weed control was also less than in previous years, possibly due to the method of incorporation. Melons have been harvested and data is currently being analyzed.

ERIC NATWICK

Biological Control of Soil Dewlling Insect Pests of Melon Crops

EXPERIMENT I
Purpose: Evaluate potential soil treatments with entomopathogenic fungi for mortality against field collected *Blapstinus* spp. beetles.

Treatments: To match those provide to UC for field application, Summer 2011.
1. Control
2. *Metarhizium anisopilae* (Ma) Clay granules
3. *Metarhizium anisopilae* Diatomaceous Earth (DE) Granules
4. *Isaria fumosoroseus* (Ifr) Mats
5. Mycotrol O, commercial *Beauveria bassiana*.

Methods:

1. One ounce shot cups with lids were weighed (90 cups per treatment) (July 6)
2. Greenhouse potting soil (~4 g) was added to each cup and weighted (July 7)
3. Fungal treatments numbers 2, 3, and 4 were added to cups for a 4 d fungal germination period (July 8)
    a. #2 = 0.0301 g/cup
    b. #3 = 0.0302 g/cup
    c. #4 = 3 hole punched disks from filter paper, 0.0258 g
4. Apply Mycotrol O to Treatment #5 cups at 1.06 x 10^8 conidia per cup in 0.25 ml water (July 11)
5. Add one live beetle to each cup (July 11)
6. Evaluate beetles for mortality July 18, 21, and 25
7. Record final weight for each cup July 25, then refrigerate
8. Evaluate treatments #2, #3, and #5 for conidia concentrations (July 26 – Aug 2)
    a. Add 10 ml water with 0.04% Tween 20 to each cup
    b. Vortex to mix
    c. Count spores using a hemacytometer
9. Evaluate selected cups from treatments #2, #3, and #5 for colony forming units (CFUs)
    a. Randomly select 10 cups from each treatment (after step 8 above)
    b. Serial dilute samples 10,000 and plate on selective agar to determine CFUs

Results:

Three treatments provided significant mortality of beetles after 10 days exposure to treated soil (Figure 1). Ma DE and Ma Clay granules caused the highest beetle mortality, followed by the commercial Mycotrol treatment. Only the Ifr Mat treatment (#4) did not cause significant mortality. Beetle mortality in the control treatment reached 43% by 14 days after being placed in the cups. Fungal mycosis was obvious for most dead beetles in Ma Clay, Ma DE, and Mycotrol treatments, but not for dead beetles in the Ifr Mat or Control treatments.

Spore counts and CFUs showed that the Ma DE granules produced more conidia than did the Ma Clay granules in this test. We expected the Ma granules to produce about 3.5 x 10^9 conidia per gram of granules and counts indicate that the Ma DE and Ma Clay granules produced 3.91 x 10^9 and 2.30 x 10^9 conidia per gram of granules, respectively. CFUs supported the conidia counts in that Ma DE granules averaged 2.43 x 10^9 CFU per gram of granules and Ma Clay granules were slightly less with 1.65 x 10^9 CFU per gram of granules. As a result, Ma DE and Ma Clay treatments averaged 1.16 x 10^8 conidia per cup and 7.08 x 10^7 conidia per cup, respectively. Mycotrol was added to the soil to provide 1.06 x 10^8 conidia per cup and conidia counts averaged near this expected amount with 1.19 x 10^8 conidia per cup. However, plated sample indicated a much lower CFU count at 1.17 x 10^6 CFU per cup and may explain the lower beetle mortality. Preliminary counts from ten control cups and ten Ifr Mat treatment #4 cups did not provide identifiable conidia and thus were considered to be zero.

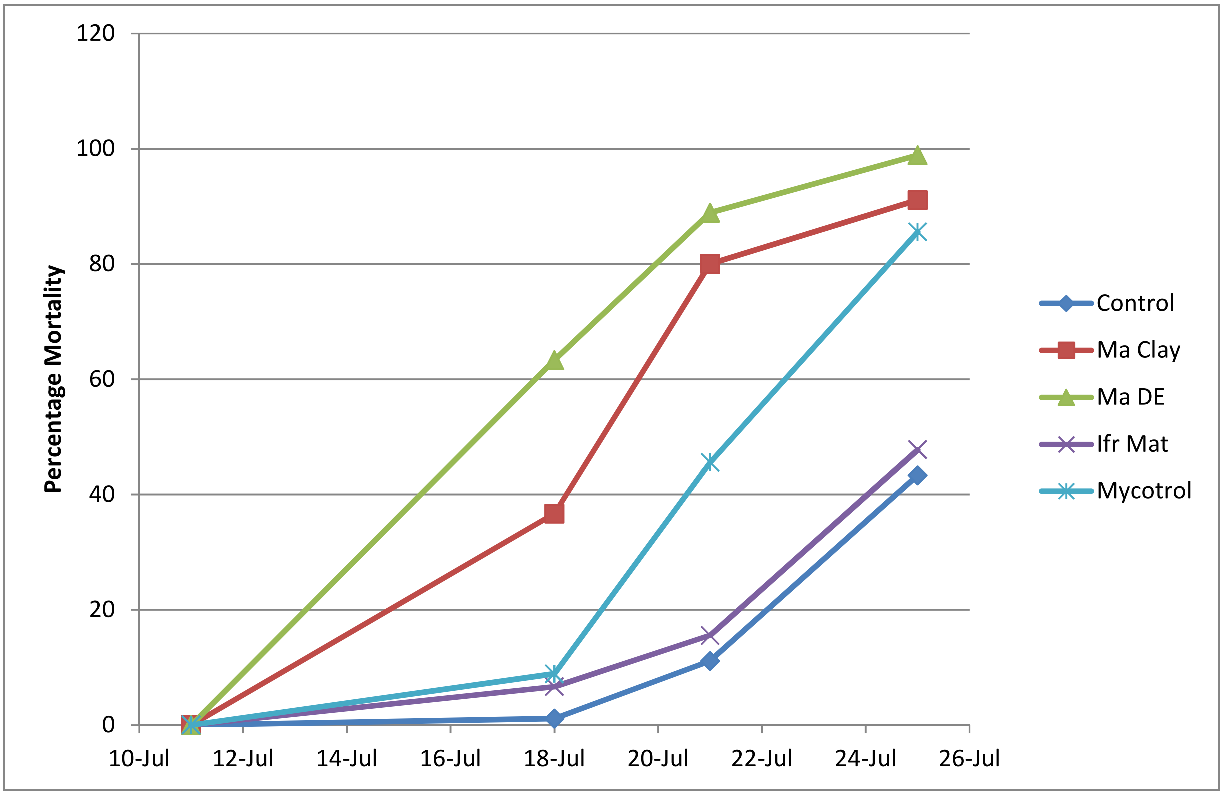

Figure 1. Percentage Mortality of *Blapstinus* spp. beetles exposed to fungal treated potting soil.

EXPERIMENTS II

Purpose: Evaluate potential soil treatments with entomopathogenic fungi for mortality on *Blapstinus* spp. beetles in field planted melons at UC Desert Research & Extension Center (DREC).

Treatments are listed in Table 1 below:

Table 1. Treatment List for Darkling Ground Beetle in Cantaloupe Melons, Holtville, CA, 2011.

Treatment	Amt/acre	Amt/plot or amt/3 gal	Appl. date	Plot #'s
1. Sevin Bran bait 5%	20 lb/acre	138.8 gm/plot dry	13 June	3, 12, 24, 26
2. Ambush Bait 0.05%	20 lb/acre	138.8 gm/plot dry	13 June	2, 11, 19, 29
3. Botanigard ES	16.0 fl oz	40.6 ml/3 gal	13 June	4, 13, 17, 27
4. Ma Diatomaceous (DE) Granules	2860 g/acre	46.4 gm/plot dry	13 June	7, 15, 22, 32
5. Ma Clay Granules	2860 g/acre	46.4 gm/plot dry	13 June	6, 9, 23, 28
6. *Isaria fumosoroseus* (Ifr) Spray	14.5 L/acre	1244.5 ml/3 gal	13 June	8, 10, 21, 25
7. Ifr Mat	327mats/acre	20 mats/plot	13 June	5, 16, 20, 30
8. Check		------------------	13 June	1, 14, 18, 31

Methods:
Plot size: 50' X 13.33' (2 beds/plot on 80" centers); one buffer bed between plots & 10' buffers between blocks. The experimental design was Randomized Complete Block with 4 Replicates.

Granule applications were spread evenly over the plots using a hand-held fertilizer spreader. Foliar sprays were applied using a tractor mounted spray boom with three TJ-60 11003VS nozzle/bed delivering 35 gpa @ 50 psi. Ifr Mat treatments were applied by placing the treated matts under 20 melons per plot marked with blue flags and 20 Matts with no Ifr were also placed under another 20 melons per plot marked with green flags. All treatments of granules spray and Mats were applied on 13 June, 2011.

In each plot, on 20 & 27 June 2011, 20-melon fruit, still attached to the vine, were examined by looking at the fruit and beneath the fruit on the ground spot and numbers of *Blapstinus spp.* beetles were recorded. On 5 July 20 melons per plot were examined in each plot for chewing damage from *Blapstinus* spp. beetles. In treatment #7, 20 melons with MA Mat treatments and Mat treatments without Ma were examined for beetle damage.

Results:
There were too few *Blapstinus spp.* beetles present in the field plots to give very meaningful results, but data were collected and are summarized in Tables 2 & 3 below:

Table 2. Number of Darkling Ground Beetle in 20 Melons, Holtville, CA, June 20, 2011.

Treatments	Atm/acre	Avg. No. of Beetles/20 melons		% Good Melons
		20 Jun	27 Jun	
1. Sevin Bran bait 5%	20 Lb/acre	0.25	0.25	98.75 [a]
2. Ambush Bait 0.05%	20 Lb/acre	0.00	1.00	100 [a]
3. Botanigard ES	16.0 fl oz	0.75	0.75	100 [a]
4. Ma DE Granules	2861 g/acre	0.75	3.00	100 [a]
5. Ma Clay Granules	2861 g/acre	0.75	0.25	100 [a]
6. Ifr Spray	14.5 Lb/acre	0.50	1.75	100 [a]
7. Ifr Mat	327mats/acre	1.00	1.25	88.75 [b]
8. Check	----------------	0.25	1.50	95 [a]
		P=0.71	P=0.1854	LSD=2.08 P=0.0054

[abcd] Mean separations within columns by t $test_{0.05}$

Table 3. *Blapstinus spp.* Beetle per 20 Melons and Percentages of good Melons, Holtville, CA, 2011.

Treatments	Atm/acre	Avg. No. of Beetles/20 melons		% Good Melons
		20 Jun	27 Jun	
Mat with Ifr	327mats/acre	0.050	0.075	88.75
Mat without Ifr	327mats/acre	0.0625	0.05	82.50
		T=-0.2425 P=0.8164	T=0.3612 p=0.7304	T=0.6702 P=0.5277

JOHN PALUMBO

New Insecticide Alternatives for Insect Management in Melons

Research projects have been successful in generating new and useful information on insect management during 2011. We continue to evaluate the efficacy of new insecticide alternatives against silverleaf whitefly adults and CYSDV in spring and fall melons, as well as evaluate new insecticide alternatives for seed corn maggot, leafminers and cabbage looper larvae.

In the early spring, two trials were conducted to examine insecticide seed treatments and in-furrow spray applications for control of seed corn maggot (SCM) on cantaloupes. Maggot pressure was moderate in trials and results showed again that a number of in-furrow spray treatments including Radiant, Entrust, and Cyazypyr provided protection from SCM comparable to the standards Capture. Seed treatments coated with experimental active ingredients were not as efficacious as either spinosad treated seed or the Capture in-furrow standard. Several spring whitefly trials were conducted to identify alternatives to endosulfan for suppression of adults and CYSDV. Melons were planted in early May to increase the chance of fall-like whitefly numbers and subsequent CYSDV infection. CYSDV incidence was moderate this spring and differences in infection rates were measured among the foliar spray treatments. Whitefly numbers were abundant and useful data was collected. Similar to last year, comparison of soil applied insecticides showed that Venom and BYI 2960 continue to provide the best activity against both adults and nymphs. Foliar trials confirmed that several new insecticide A.I.s provided good knockdown (3-5 days) including Pyrifluquinazon (NNI-0101), Sivanto (BYI 2960), Sulfoxaflor (XDE-208) and Cyazypyr (HGW86). All of these compounds significantly delayed the onset of CYSDV comparable to the industry standard (Thionex+Capture). Fall trials are currently underway and are further evaluating whitefly efficacy and CYSDV management. In addition, trials are being conducted to evaluate the cross-spectrum efficacy of several newly registered insecticide products that not only have worm control but have previously shown activity against leafminers and whiteflies (Coragen, Voliam Xpress, Voliam Flexi, Cyazypyr and Vetica). We are focusing on determining how well these compounds perform against known standards (Radiant and Movento).

ANTOON PLOEG

Evaluating the Efficacy of Novel Nematicides to Prevent Root-Knot Nematode Damage in Melons

Progress Report for California Melon Research Board. – September 30, 2011.

A field trial was initiated on a root-knot nematode (*Meloidogyne javanica*) site at the Kearney Research and Extension Center, Parlier, CA. The trial was designed according to a randomized block design with 5 replicates and 10 treatments. Seven nematicide treatments were compared to a standard Oxamyl, a Basamid treatment and a non-treated control. The seven nematicide treatments were: Sesamin, Nema-Q, Ecozin, Melocon (2 formulations), SoilBuilder, and Sincosin. Basamid was applied as a pre-plant treatment, all other treatments were applied at plant, and sometimes followed by one or more postplant applications.

Individual plots were 20 ft sections of 60-inch-wide beds. On 7/6/2011 Melon var. Durango was hand-seeded in the center of the plots. Twenty times three seeds were seeded at 1 ft intervals, and after emergence seedlings were thinned to 1 seedling per 1 foot. At seeding, soil samples were collected to determine initial root-knot nematode populations. Plots were indexed for vigor twice before final harvest. Melons were grown to maturity and were harvested on 9/19/2011. At this time all fruits were harvested per plot, and weighed individually. The number of plants were counted per plot, and five plants per plot were dug. Root systems of these plants were indexed for severity of root galling, and soil samples were collected from each plot to determine nematode population levels at harvest.

Data on nematode population levels, plot vigor, root-galling, and melon yields will be analyzed statistically using ANOVA procedures. The significance of differences between treatments will be determined at the 95% confidence level.

BILL WINTERMANTEL, BOB GILBERTSON & JIM McCREIGHT

Comparative Evaluation of New Resistance Sources and Development of Field-Based Serolgical Detection of CYSDV

1. Evaluate exotic melon germplasm from India for potential new sources of resistance to CYSDV . (McCreight, Wintermantel)
    a. Two putative resistant plants in two of the Indian plant introductions evaluated in Fall 2010 were self-pollinated in a greenhouse.
    b. 100 accessions previously untested Indian plant introductions were planted in a replicated test at DREC on August 18, 2011.
    Note: Many plants were damaged by ground squirrels at emergence and subsequent hail on September 13. The test was not replanted, and the survivors of the September 13 storm appear to have also survived heavy rain and hail on October 2.
2. Characterize host plant resistance to CYSDV in PI 313970 and TGR-1551, and select and introgress resistance to western U.S. shipping type background adapted to the desert southwest U.S. (McCreight, Wintermantel).

    Sixty-one progenies from selfs and crosses of CYSDV-resistant or susceptible selections were planted along with resistant and susceptible controls at DREC on August 18, 2011.
    Note: The test was replanted on September 21 following ground squirrel damage at emergence and subsequent hail damage on September 13. Plants from the August 18 and September 21 plantings survived flood and more hail on

October 2. The primary goal of the trial is not yield, but rather virus resistance, which should not be significantly affected by these events.

3. Evaluate virus content in PI 313970, TGR-1551 and lines derived from these sources to determine ability of lines to suppress CYSDV accumulation (McCreight, Wintermantel).

   This will be done using plants in the Fall 2011 field test.

4. Develop antiserum for field diagnosis of CYSDV using an immunostrip format (Gilbertson).

An antibody was developed previously through this project against the bacterially expressed capsid protein (CP) of CYSDV. This antibody was shown to be highly specific for detection of CYSDV in western blot and enzyme-linked immunosorbent assay (ELISA) analyses of the bacterially expressed protein and extracts prepared from CYSDV-infected plants as described in the 2010 annual report. Further field testing of the ELISA method will be performed during evaluation of the fall 2011 melon trial (Objectives 1-3). Studies are evaluating the antibody in a number of ELISA formats, including indirect, direct and double antibody sandwich. A series of antibody dilutions also are being tested to determine the sensitivity of the antisera.

We have an agreement with a private company for development of a lateral flow device (immunostrip) for the antibodies we developed against CYSDV. This collaboration could lead to the development and commercial availability of an immunostrip test for CYSDV.

Additional Accomplishments:

The Gilbertson Lab recently established new method for RT-PCR tests of stored tissue extracts of RNA viruses from different plant samples. Initial experiments detecting Potyvirus, Tospovirus and Torradovirus were successful, and samples from various locations successfully tested positive for CYSDV in melons as well. Now we are working on optimization of these tests to eliminate possible false negative results.

The Wintermantel Lab is evaluating previously identified common weed and crop hosts for their significance as reservoirs for CYSDV. Research has identified bean and buffalo gourd as high concentration reservoir hosts. Lettuce also accumulates high levels of CYSDV relative to most weeds and non-cucurbit hosts. This is reflected in the relatively efficient transmission of CYSDV from these hosts to melon. London rocket and Shepherd's purse accumulate very low levels of CYSDV, and transmission of virus from these latter hosts to melon is much less prevalent based on preliminary and ongoing studies. Evaluation of additional hosts is in progress.

Both laboratories have been involved with diagnosis of multiple sets of San Joaquin Valley melon samples exhibiting virus infection this year. Recently, several samples have tested positive for the aphid-transmitted viruses, Watermelon mosaic virus (WMV) and Cucumber mosaic virus (CMV), sometimes occurring together and associated with potentially significant yield loss. A tombusvirus, Lettuce necrotic stunt virus (LNSV), was identified in some plants as well, co-infecting with WMV and CMV, although the relationship between this soil-borne virus best known for causing lettuce dieback and disease symptoms on melon is still being determined.