Long Island Vegetable Pathology Program
2010 Annual Research Report

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EVALUATION OF REDUCED TILLAGE PRODUCTION SYSTEM FOR PUMPKIN

Investigators: M. McGrath, S. Menasha, and L. Hunsberger
Location: Long Island Horticultural Research and Extension Center

The primary goals of this multi-year experiment are to investigate changes in soil health and compare crop growth during the first years of implementing reduced tillage practices. A replicated experiment was conducted to compare pumpkin grown under a reduced tillage system with pumpkin grown using conventional tillage in a research field that has only been used to study reduced tillage since 2004. This experiment was conducted in the south half of the field with another experiment on sweet corn conducted in the north half. The cover crop in this field was fall-seeded rye. The conventional-till plots were established by mowing the cover crop on May 21, removing extra straw, then rototilling and disking to prepare the soil for planting. In the reduced-till plots the cover crop was rolled with a coulter packer on May 27 then sprayed with the herbicide Round-up, next a 2-row Unverferth zone builder was used to establish the rows on June 8. On July 2 pumpkin (cv Field Trip) was direct-seeded into all rows with 800 lb/A 11-11-12 controlled release fertilizer applied in a band by the seeder. Weed control in the pumpkins during the season was accomplished by using a hand-operated rototiller in the conventional-till plots and a hand-operated sickle-bar mower in the reduced-till plots in late July. Plots were three approximately 150-ft-long rows at 68-in spacing. Plant height and biomass measurements were taken during the season, and yield was measured at maturity. Soil health measurements including infiltration and penetration were taken.

After six years of producing crops with reduced tillage over a seven-year period (field was rested in cover crop in 2009), substantial differences exist in soil health of these plots compared to the adjacent conventional-till strip plots. For example, the average steady state water infiltration rate determined in early May 2010 was 0.37 cm/min for the reduced-till plots while only 0.16 cm/min for the conventional-till plots.

Plant growth was visibly better in the reduced-till plots than the conventional-till plots. Rye was visibly taller in the spring. The pumpkin canopy closed first in the reduced-till plots documenting better crop growth, and above-ground crop biomass of reduced-till pumpkins was 43% greater than conventionally-produced plants when assessed on July 26. All yield parameters were numerically higher for the reduced-till plots; weight of marketable fruit was 25% higher. Number of unmarketable fruit was lower. There were no significant differences between tillage systems in number of leaves per plant or number of plants per plot when assessed on 26 July.

EVALUATION OF REDUCED TILLAGE PRODUCTION SYSTEM FOR FALL BRASSICAS

Investigators: M. McGrath and L. Hunsberger
Location: Long Island Horticultural Research and Extension Center

The primary goals of this multi-year experiment are to investigate changes in soil health and compare crop growth during the first years of implementing reduced tillage practices. Before 2010 the field was plowed and conventionally tilled every year. A spring cover crop of triticale was seeded in late April after disking in 10-20-10 fertilizer at 500 lb/A. Limited growth occurred under the hot, dry summer weather. The cover crop was mowed in mid-August. The conventional-till plots were rototilled and disked to prepare the soil for planting. A 2-row Unverferth zone builder was used to prepare the rows in the reduced-till plots. A vacuum seeder was used to apply 700 lb/A of controlled release fertilizer in a band right next to the transplant row in all plots, and then a waterwheel transplanter was used to plant the rows. Each plot consisted of four rows each planted to a different cruciferous crop type at 18-in plant spacing and 34-in row spacing. Soil health measurements including infiltration and penetration were

taken. Soil moisture was monitored at 4, 8 and 12 inch depths. Plants were sampled in October (5 plants/rep), November (4 plants/rep) and December (3 plants/rep) to determine plant growth.

Differences in aboveground growth were detected only at the first sampling, with the conventional-till treatment having 38% higher weight than the reduced-till treatment. There were no differences in root weights between treatments.

ORGANIC HEIRLOOM TOMATO VARIETY EVALUATION

Investigators: M. McGrath, S. Menasha, and L. Hunsberger

Location: Long Island Horticultural Research and Extension Center

Heirloom tomatoes have become a staple on many organic farms and with over a hundred different varieties to choose from, information on crop performance, quality, and pest resistance is essential in helping growers make informed decisions on which varieties would perform best for their particular production system and market outlet. Therefore, this experiment was conducted to evaluate yield, crop quality, and pest resistance of 20 different varieties of heirloom tomatoes.

Tomato seed was sown in an organic potting mix on 22 April. Rye cover crop was flail chopped on 10 April, extra straw was removed for mulch, then the field was disked on 21 April. Fertilizer was spread and incorporated prior to laying plastic and drip tape on 22 April with a second layer of plastic applied on 27 May to manage nutsedge. The fertilizer used was a mix of Pro-Grow 5-3-4 organic fertilizer at 1000 lb/A and 8-1-2 peanut meal at 625 lb/A. Seedlings were transplanted on 1-2 June. Fish emulsion (Neptune's Harvest) was poured into the transplant hole before setting the seedlings. Plants were staked and trellised as they grew. Plants were inspected for diseases three times from 1 through 23 September. Incidence and severity of symptoms were recorded.

Septoria leaf spot was the main disease observed. It is the most common disease observed in organically-produced tomatoes on LI. No variety exhibited more severe symptoms than another. Brandywine had the highest values; it was among the most affected varieties in a similar experiment in 2009. Powdery mildew, while appearing later in the season, did vary in severity between varieties by the 23 Sep rating, with VFNT Cherry, Aker's West Virginia, Beauty, Marglobe and Prue exhibiting the highest incidence.

Flowers were first observed on 18 June. First fruit were observed on 24 June. Marketable yield varied greatly among the varieties evaluated mostly due to the fact there were many different types of tomatoes from cherry tomatoes, to plum, to beefsteak types. However, the largest fruit was produced from Cherokee Purple yielding fruit weighing 0.86 lbs per fruit. The smallest fruits were the cherry types (Ponderosa, Sponzillo and VFNT Cherry), producing fruit at 0.02-0.04 lbs each.

Fruit quality characteristics also varied greatly among the varieties evaluated. Overall, Aker's West Virginia, Cherokee Purple, Prue and Sponzillo were rated an 8-8.5 on a 1-9 scale for overall satisfaction with 1=no satisfaction and 9=great satisfaction. None of the other varieties were rated below a 6. In terms of taste, the variety Tainan was rated as being very acidic while many of the varieties were rated as being slightly sweet, neutral, or slightly acidic. External defects were common in many of the varieties ranging from green shoulder to radial cracking but there were four varieties which stood out as having no recorded external defects and included Beauty, Howard German, Peron and Ponderosa. Other varieties evaluated and not yet mentioned were Amish Paste, Burbank, Jaune Flammee, Ludmilla's Red Plum, Opalka, Orange Strawberry, Oxheart, and White Queen.

Project funded by the Friends of Long Island Horticulture Grant Program.

LATE BLIGHT RESISTANT TOMATO VARIETY EVALUATION

Investigators: M. McGrath, S. Menasha, and L. Hunsberger
Location: Long Island Horticultural Research and Extension Center

The objective of this experiment was to evaluate new tomato varieties and Cornell experimental varieties with resistance to late blight in terms of yield and susceptibility to diseases. They were compared to Mountain Fresh, a variety commonly grown on LI. Fertilizer (N-P-K 10-10-10) at 1000 lb/A was broadcast and incorporated on 10 May. Black plastic mulch and drip tape were laid on 11-13 May. Seeds were sown on 30 April in the greenhouse. Seedlings were transplanted by hand on 15 June following a waterwheel transplanter that applied liquid starter fertilizer. Plots consisted of 10 plants in a single row with 24-in plant spacing. A yellow cherry-type variety (Sun Gold) was planted between plots in the row for a visible plot separator. Plants were staked and trellised following standard procedure for fresh-market tomato production. Warrior (3 fl oz/A) was applied regularly to control worm pests. Leaves were examined routinely for symptoms of late blight and other diseases. Proportion of leaflets with disease symptoms were recorded starting 16 Sep. Yield data was taken on 26 Aug, 3, 9, and 21 Sept.

Powdery mildew was the first disease observed in this experiment. Incidence was very low in most plots at the first assessment on 16 Sep, which was late in the production season for disease development in the region. There were no significant differences in powdery mildew incidence between varieties; however, one of the Cornell experimental varieties had substantially more symptoms than the others. No symptoms of Septoria leaf spot were found in the plots reflecting the fact this experiment was located in a field where tomatoes had not been grown, thus the pathogen was not present in the soil, and the planting had sorghum wind breaks which might have interfered with any pathogen dispersal from other tomato plantings. Symptoms of late blight were not observed in any experiments at LIHREC in 2010. Yield variation was observed through the prolific cherry-type variety (Mountain Magic), with no differences between other varieties until September 21 when Cornell #2, Cornell #5 and Plum Regal produced the highest amounts of total fruit (including green at 12.6, 12.5 and 14.1 lbs/plant, respectively) and Cornell #2 and Cornell #3 had the highest recorded weights of marketable fruit (2.1 and 1.7 lb/plant, respectively). Mountain Fresh and Mountain Magic were given the highest rating for 'Overall Satisfaction', receiving a 7 and 8 respectively on a scale of 1-9 while the aforementioned plus Cornell #2 and Cornell #5 all received a 'Yes, I Would Buy it' rating; whereas Defiant PhR received the lowest rating (4).

Project funded by the Friends of Long Island Horticulture Grant Program.

IDENTIFICATION OF RACES OF THE CUCURBIT POWDERY MILDEW PATHOGEN OCCURRING ON LONG ISLAND

Investigators: M. McGrath and L. Hunsberger
Location: Long Island Horticultural Research and Extension Center

Races of the powdery mildew pathogen affecting cucurbit crops are defined based on their ability to infect melon varieties and experimentals with different genes for resistance. These melons are considered to be differentials. It is important to know what races are occurring in order to know what resistance genes are needed to effectively suppress powdery mildew in melons.

Eleven melon differentials plus two watermelon differentials were grown next to the resistant variety evaluations. Seedlings were transplanted into beds covered by black plastic mulch with drip irrigation. Cultural practices were the same and done at the same time as the near-by experiment with melon described in the following report. Powdery mildew severity was evaluated on both leaf surfaces on 2 and 22 Sept.

Races 1, 2, and 3 of the cucurbit powdery mildew fungus (*Podosphaera xanthii*) were present in 2010 with race 1 the dominant race based on severity of powdery mildew on the differentials Hale's Best Jumbo, PMR-45, PMR-5, and MR-1. Race 3 was detected on LI in 2008, but at a much lower frequency than the other races.

EVALUATION OF POWDERY MILDEW RESISTANT CANTALOUPE VARIETIES

Investigators: M. McGrath, S. Menasha, and L. Hunsberger
Location: Long Island Horticultural Research and Extension Center

The objective of this study was to evaluate varieties of cantaloupe with resistance to just race 1 of the powdery mildew fungus (Eclipse) or to races 1 and 2 (all other varieties tested). Fertilizer (N-P-K 10-10-10) at 1000 lb/A was broadcast and incorporated on 10 May. Black plastic mulch and drip tape were laid on 11-13 May. Seeds were sown on 17 June in the greenhouse. Seedlings were transplanted by hand into single rows in the mulch-covered beds on 2 July, one day after a waterwheel transplanter was used to open the holes and apply starter fertilizer plus insecticide. Additional fertilizer (N-P-K 46-0-0) at 30 lb/A was injected through the drip irrigation system twice. Plots were 10-ft long with three adjacent rows each with four plants spaced 24 in. apart. Rows were spaced 68 in. apart. Two plants of Multipik, a susceptible summer squash variety, were planted between each plot in each row to separate plots and provide a source of inoculum. A randomized complete block design with four replications was used. No fungicides with activity for powdery mildew were applied. Upper and lower leaf surfaces were assessed for powdery mildew on 19 Aug. Ripe fruit were harvested, weighed, and measured on 24 and 30 Aug. Many fruit were unmarketable at each harvest date because they had over-ripened; therefore, total yield for each plot was estimated using total fruit count and average fruit weight of marketable fruit. Characteristics of marketable fruit were also evaluated. Overall appearance and flavor were rated on a scale of 1 to 9 with 1= poor and 9 = best. Fruit sucrose levels were measured using a refractometer.

The resistant varieties evaluated were moderately effective providing 69-89% suppression of powdery mildew on upper leaf surfaces and 70-95% control on lower. Diva is not advertised as having resistance; however, results from this experiment and an experiment conducted in 2009 suggest that it does have resistance. Severity of powdery mildew on all these varieties in 2010 was substantially greater than in 2009 and 2008 when similar experiments were conducted with many of the same varieties. On 25 Aug 09, which was 1 week after the first harvest, very few symptoms of powdery mildew were found on the resistant varieties with none found on leaves of Eclipse or Strike, and severity well below 1% on the others, while severity was 20% and 16% on upper and lower leaf surfaces, respectively, of Superstar. On 15 Aug 08, severity was well below 1% for varieties with resistance to race 1 and 2, 5% and 34% on upper and lower leaf surfaces, respectively, for Eclipse, and 40% and 50% for Superstar. Whereas on 19 Aug 10, severity on upper and lower leaf surfaces was 10% and 3%, respectively, for Eclipse, 9-27% and 3-16% for varieties with resistance to race 1 and 2, and 88% and 54% for Superstar. Results from the 2008-2010 experiments suggest that a new race was present on Long Island in 2010. The planting of melon differentials described in the previous report also revealed a change in race occurrence on LI. There were reports of resistant varieties in commercial fields in NY becoming more severely affected by powdery mildew in 2010 than previous years.

The highest yielding varieties, based on total fruit weight, were Wrangler and Grand Slam. The variety with the best taste rating (7 of 9) and the highest sucrose concentration (9%) was Athena. Other varieties evaluated and not yet mentioned were Goddess and Rockstar.

Project funded by the Friends of Long Island Horticulture Grant Program.

EVALUATION OF POWDERY MILDEW RESISTANT MELON VARIETIES WITH PERSONAL-SIZED FRUIT

Investigators: M. McGrath, S. Menasha, and L. Hunsberger
Location: Long Island Horticultural Research and Extension Center

The objective of this study was to evaluate melon varieties that were released recently with resistance to powdery mildew. Only varieties bred to produce small fruit were examined since these are in demand by organic growers because standard-sized fruit add too much weight to boxes for CSA (community supported agriculture) customers and can damage other produce when they roll. They were compared to Passport, a variety lacking genetic resistance. Fruit type for most of the varieties tested is cantaloupe; Arava is a galia and Sivan is a charentais.

Cultural practices and assessments were the same and done at the same time as for another, adjacent experiment with melon described in the previous report, with the exceptions that seeds were sown on 4 June, seedlings were transplanted on 23 June, and yield assessments were done on 9, 16, 24 and 30 Aug.

Most of the resistant melon varieties did not effectively suppress powdery mildew. While all resistant varieties had numerically less severe powdery mildew than Passport, powdery mildew was significantly less severe than the susceptible variety on upper leaf surfaces only for Lil' Loupe (53% control) and on lower surfaces only for Arava (75%). Severity of powdery mildew on all resistant varieties in 2010 was substantially greater than in a similar experiments conducted in 2009 with many of the same varieties. Results from these experiments, as well as results in the previous reports, suggest that a new race was present on LI in 2010. The highest yielding varieties based on total fruit weight were Lil' Loupe and Head Start, though three other varieties had statistically similar yields. The best tasting variety was HSR 4370 (rating of 7). The variety with the numerically highest sucrose concentration was Pixie (11.8%). Other varieties evaluated and not yet mentioned were HSR 4307, HSR 4402, and Sugar Cube.

Project funded by the Friends of Long Island Horticulture Grant Program.

POWDERY MILDEW RESISTANT YELLOW SUMMER SQUASH VARIETY EVALUATION

Investigators: M. McGrath, S. Menasha, and L. Hunsberger
Location: Long Island Horticultural Research and Extension Center

The main goal of this experiment was to determine whether summer squash varieties with homozygous resistance to powdery mildew (i.e. two copies of the powdery mildew resistance gene; PMRR) are more resistant to powdery mildew than varieties with heterozygous resistance (PMR). The ability of these varieties to resist powdery mildew as well as their yields were determined relative to Gentry, a commercial standard variety lacking powdery mildew resistance.

Cultural practices and assessments were the same and done at the same time as for adjacent experiments with melon described in the previous reports, with the following exceptions. Seeds were sown on 3 June and seedlings were transplanted 22 June. Plots were four adjacent rows each with three plants spaced 24 in. apart. Rows were spaced 68 in. apart. A single plant of Multipik, a susceptible summer squash variety, was planted between each plot in each row to separate plots and provide a source of inoculum. A randomized complete block design with four replications was used. Upper and lower leaf surfaces were assessed for powdery mildew on 27 and 30 July, and on 5 and 13 Aug. Squash fruit were harvested and weighed on 16, 19, 23, 27 and 29 July; and on 3, 6 and 9 Aug. Fruit were separated into

marketable and unmarketable grades based on length, then weighed. There were no unmarketable fruit with blemishes due to disease or insect feeding.

Symptoms of powdery mildew were first observed on 27 July in all but 2 plots of Sunray and on 19% of the older leaves examined. Severity remained low through 5 Aug, when symptoms were observed to be covering on average less than 5% of both upper and lower leaf surfaces of the susceptible varieties (Gentry and Fortune). Two susceptible varieties were included in this experiment to investigate whether they could exhibit detectable differences in powdery mildew severity, which would be important considering the susceptible variety is used to estimate suppression achieved with resistant varieties. No differences were detected. Severity increased greatly by the next assessment 8 days later. Degree of suppression was 73-78% on upper leaf surfaces and 70-74% on lower leaf surfaces based on AUDPC values for the resistant varieties compared to those for Gentry. This suppression was not evident at the first two assessments (27 and 30 July) when disease severity was very low. No significant differences were detected between varieties with homozygous (PMRR) resistance (Sunray and PM Success) and heterozygous (PMR) resistance (Cheetah). All varieties had marketable fruit at the first harvest on 16 Jul. Sunray and Fortune produced the greatest number of fruit; PM Success produced the least. These varieties did not differ significantly from all other varieties. All varieties produced fruit with acceptable characteristics, which were rated at least 7 out of 9. Cheetah was previously known as HMX 5712.

Project funded by the Friends of Long Island Horticulture Grant Program

POWDERY MILDEW RESISTANT ZUCCHINI SQUASH VARIETY EVALUATION

Investigators: M. McGrath, S. Menasha, and L. Hunsberger
Location: Long Island Horticultural Research and Extension Center

The objective of this experiment was to evaluate varieties with powdery mildew resistance that are being marketed in the USA. Cultural practices and assessments were also the same as the previous report and done at the same time.

The abilities of the varieties evaluated in 2010 to resist powdery mildew as well as their yielding ability were determined relative to Spineless Beauty, a standard variety lacking powdery mildew resistance. Symptoms of powdery mildew were first observed on the third harvest date, 27 July, in the four plots with the susceptible variety and in 3 of the 28 plots planted to resistant varieties. Based on severity on 13 Aug, only Amatista and Reward suppressed powdery mildew on both upper and lower leaf surfaces in comparison with Spineless Beauty. They provided 52-67% control on upper surfaces and 59-61% control on lower surfaces. Soleil was the only variety that did not differ significantly in powdery mildew severity from Spineless Beauty at any assessment. The remaining four powdery mildew resistant varieties (Payroll, Dunja, Envy, and Golden Glory) exhibited 54-63% control of powdery mildew on lower leaf surfaces. There were few significant differences among the resistant varieties in disease severity. Total number of fruit produced was greatest for Golden Glory (6.3 lb/plant) and least for Dunja (3.9 lb/plant).

Project funded by the Friends of Long Island Horticulture Grant Program.

POWDERY MILDEW-RESISTANT ACORN-TYPE WINTER SQUASH VARIETY EVALUATION

Investigators: M. McGrath, S. Menasha, and L. Hunsberger
Location: Long Island Horticultural Research and Extension Center

The objective of this study was the same as for an adjacent experiment with summer squash described in a previous report. Cultural practices and assessments were the same and done at the same time as described in this previous report with the following exceptions. Powdery mildew was assessed on 20 and 28 July, and on 4, 11 and 18 Aug. Fruit were harvested and weighed on 14 Sept. Three representative fruit per plot were selected for measuring fruit width, fruit length, and cavity width and for assessing sugar content, which was done with a hand-held refractometer using fruit samples that were frozen and then thawed. Flesh color, cavity size and other fruit characteristics were also evaluated and overall appearance was rated on a scale of 1 to 5 with 1= poor and 5 = best.

Symptoms of powdery mildew were first observed on 20 July in 10 of 16 plots on 3% of the older leaves examined. Severity remained low, even on the susceptible variety, until the last assessment on 18 Aug. The resistant varieties were significantly less severely affected by powdery mildew than the susceptible variety on 4 Aug and numerically less on both leaf surfaces on 11 Aug and 18 Aug. Honey Bear was not significantly less severely affected by powdery mildew than the susceptible variety. Based on severity on lower surfaces on 18 Aug, Sweet REBA and Tay Belle PM provided 59-68% control of powdery mildew. Heterozygous resistance was as effective as homozygous resistance in this experiment, but not in a similar experiment conducted with these varieties in 2009. Honey Bear was effective in that experiment while Tay Belle PM was ineffective.

No significant differences were detected in number or weight per plant of marketable or estimated total yield. There were differences, however, in the individual weight per fruit, reflecting the fact Honey Bear was developed to produce small, personal-sized fruit. BRIX levels ranged from 5.96 in Tay Belle PM to 8.88 in Honey Bear but were not significantly different from each other.

Project funded by the Friends of Long Island Horticulture Grant Program.

POWDERY MILDEW-RESISTANT BUTTERNUT-TYPE WINTER SQUASH VARIETY EVALUATION

Investigators: M. McGrath, S. Menasha, and L. Hunsberger
Location: Long Island Horticultural Research and Extension Center

The objective of this study was to determine whether hybrids with homozygous resistance to powdery mildew (i.e. two copies of the powdery mildew resistance gene; PMRR), provide better suppression of powdery mildew than hybrids with heterozygous resistance (PMR). PMRR experimental hybrids were obtained from two plant breeders.

Cultural practices and assessments were the same and done at the same time as for another, adjacent experiment with melon described in the previous report, with the following exceptions. Seeds were sown on 28 May and seedlings were transplanted on 15 June. Powdery mildew was assessed on 4, 11 and 18 Aug. Fruit were harvested and weighed on 15 Sept. Three representative fruit per plot were selected for measuring fruit width, fruit length, and cavity width and for assessing sugar content, which was done with a hand-held refractometer using fruit samples that were frozen and then thawed. Flesh color, cavity size and other fruit characteristics were also evaluated and overall appearance was rated on a scale of 1 to 5 with 1= poor and 5 = best.

Symptoms of powdery mildew were first observed on 4 Aug on 1 to 6 of the 30 older leaves examined in all plots. Severity remained low through 11 Aug, when symptoms were observed to be covering on average less than 1% of both upper and lower leaf surfaces of even the susceptible variety. The 2010 summer season was unusually hot and dry, which may have affected development of powdery mildew through 11 Aug. Severity increased greatly by the next assessment 7 days later, exceeding 15% on upper leaf surfaces and 26% on lower for all varieties. Significant differences in powdery mildew severity were only detected among varieties on the last assessment date. And only Bugle, a PMRR variety, was significantly less (60%) severely affected by powdery mildew than Waltham, the susceptible variety.

No significant differences were detected in number or weight per plant of marketable yield, but differences were seen in the individual weight per fruit. Honey Nut was selected to produce small, personal-sized fruit. Significant differences were measured in BRIX levels between varieties with the lowest seen in Honey Nut (7.32) and the highest in Geneva (10.53). A high percentage of fruit of Honey Nut rotted while stored for 2 months in a barn, while most fruit of the other varieties held well under the uncontrolled conditions.

Project funded by the Friends of Long Island Horticulture Grant Program.

POWDERY MILDEW RESISTANT PUMPKIN VARIETY EVALUATION

Investigators: M. McGrath, S. Menasha, and L. Hunsberger
Location: Long Island Horticultural Research and Extension Center

There are many pumpkin varieties now commercially available that are advertised as having resistance to powdery mildew. Previous experiments have demonstrated that the level of resistance can be highly variable among these varieties and can in fact be low resulting in limited suppression of powdery mildew. The goal of this experiment was to confirm these results and extend the study to include new varieties. Growers need to know the degree of expected control from genetic resistance in their management program, and there is concern that this pathogen could be adapting to the major resistance gene in use.

A vacuum seeder with the closing wheels removed was used to open a seed furrow and to apply fertilizer in a band about 2 in. away from the seed. A blend of controlled release fertilizers, consisting of 300 lb/A 15-18-12 and 100 lb/A ESN, was used. Seeds were placed in the furrows on 22 Jun by hand with two seed per plant at 36-in. plant spacing within rows. Seed were also planted for a plant of Multipik summer squash, a susceptible variety, between plots in each row at 24-in spacing from the adjacent pumpkins to separate plots and to serve as a source of inoculum. Furrows were raked to close. After seedlings were established, doubles were thinned to one plant. Plots contained a total of 12 plants in three rows spaced 68 in apart. A randomized complete block design with four replications was used. Plant vines were moved as needed to maintain plot separation. No fungicides with activity for powdery mildew were applied.

No significant differences in powdery mildew severity were detected among any of the varieties. The susceptible variety Sorcerer did have the numerically highest severity value for upper leaf surfaces on 20 Aug and one of the highest values for lower surfaces, but not at the next assessment on 1 Sept. These results contrast with those obtained in previous pumpkin variety evaluations conducted at this facility in which some suppression of powdery mildew has always been detected relative to Sorcerer. Some of the resistant varieties included in the 2010 experiment demonstrated suppression in previous years. These results suggest that the pathogen has evolved to overcome the major gene for resistance in pumpkin. Four private seed companies developed the varieties evaluated in 2010. Additionally, powdery mildew resistant melon varieties evaluated in 2010 at LIHREC also did not provide the level of suppression achieved in previous years. Significant differences were detected among the varieties in yield. Camaro PMR

produced the largest fruit (10.5 lb/fruit) and the greatest weight of marketable and total fruit weight per plant. Trophy produced the smallest fruit at 4 lb/fruit.

Project funded by the Friends of Long Island Horticulture Grant Program.

FUNGICIDES FOR MANAGING CUCURBIT POWDERY MILDEW EVALUATED IN PUMPKIN

Investigators: M. McGrath and L. Hunsberger
Location: Long Island Horticultural Research and Extension Center

The primary objective of this study was to evaluate the efficacy of several fungicides with single site mode of action for the control of cucurbit powdery mildew. These fungicides have mobility in plants and thus are inherently more effective than protectant fungicides like Bravo due to their ability to move to the underside of leaves where powdery mildew develops best. Unfortunately, fungicides with single site mode of action are at risk of resistance developing. In previous years strains of the pathogen have been detected on LI with resistance to FRAC code 1, 7, and 11 fungicides and moderate resistance to FRAC code 3 fungicides. Both new and currently registered products were tested. Pathogen sensitivity to fungicides was also investigated in 2010 (see next 2 reports).

Seeds were planted at approximately 24-in. plant spacing within rows with a vacuum seeder on 21 Jun. The planter applied fertilizer in a band about 2 in. away from the seed. A blend of controlled release fertilizers, consisting of 300 lb/A 15-18-12 and 100 lb/A ESN, was used. Water was applied with overhead irrigation. Plots were three 15-ft rows spaced 68 in apart. The plots were 18 ft apart initially until plants began to vine. Vines were moved as needed to maintain plot separation. A randomized complete block design with four replications was used. Plots were inspected for powdery mildew symptoms on upper and lower leaf surfaces weekly beginning on 2 Aug. Canopy condition including defoliation was assessed on 21 Sep. Fruit quality was evaluated in terms of handle (peduncle) condition for mature fruit without rot on 22 and 29 Sep; and 7, 14, and 20 Oct. Handles were considered good if they were green, solid, and not rotting. Treatments were started on 4 Aug when the IPM threshold of one affected leaf out of 50 old leaves was reached in most plots. Subsequent applications were made weekly using a tractor-mounted boom sprayer equipped with twinjet (TJ60-11004VS) nozzles spaced 17 in. apart that delivered 53.5 gal/A at 100 psi.

On 2 Aug, two days before treatments were started, powdery mildew was observed at a low severity being on only 5% of the leaves examined, which were in 78% of the plots. All treatments were suppressing powdery mildew on upper leaf surfaces early in disease development based on the assessment on 16 Aug when severity for non-treated leaves was 4%. Pristine at both the low and high label rates was ineffective for powdery mildew on upper leaf surfaces at the 26 Aug assessment. Pristine contains two active ingredients which are FRAC Code 7 and 11 fungicides. The low rate was also ineffective at that time for powdery mildew on lower leaf surfaces, as were several treatments with BAS experimentals. Several other treatments were no longer effective by the assessment on 1 Sep, including Procure (FRAC Code 3 fungicide) at the intermediate label rate (6 fl oz/A) and the new fungicide Fontelis (previously known as LEM17), which is in the same fungicide group as the main active ingredient in Pristine (FRAC Code 7). Both Pristine and Procure effectively controlled powdery mildew in a similar fungicide evaluation conducted at LIHREC in 2009. Quintec was the most effective treatment providing 95% control of powdery mildew on lower leaf surfaces based on AUDPC. Degree of control of powdery mildew was related to defoliation and fruit quality expressed as handle condition.

Evidence that fungicide resistance in the pathogen could account for ineffective control with Pristine was obtained through research conducted on fungicide sensitivity in the pathogen, which is covered in the following two reports.

Project partly funded by the IR-4 Program.

FUNGICIDE SENSITIVITY OF CUCURBIT POWDERY MILDEW PATHOGEN POPULATIONS ON LONG ISLAND IN 2010

Investigators: M. McGrath and L. Hunsberger
Location: Long Island Horticultural Research and Extension Center

Fungicide resistance can be a major constraint to effectively managing powdery mildew in cucurbit crops. The goal of this study was to obtain information needed to guide fungicide recommendations in 2010 by conducting a bioassay in spring squash plantings at the start of powdery mildew development on LI and additional bioassays in pumpkin crops. These bioassays indicate which fungicides are likely to be most effective and how different fungicide programs being used in commercial fields are affecting pathogen sensitivity to fungicides.

A seedling bioassay was used to determine the sensitivity to fungicides of populations of the cucurbit powdery mildew fungus. Pumpkin seedlings were produced in a growth chamber and then greenhouse, treated with various doses of different fungicides applied to coverage with a CO_2-pressurized backpack sprayer, the next day put in the field for at least 4 hours, then kept in a greenhouse at LIHREC for about 10 days until powdery mildew was visible and could be assessed. Amount of mildew on leaves of treated plants was compared with leaves on non-treated plants to estimate the proportion of the pathogen population able to tolerate each fungicide concentration. The bioassay was conducted on 6 Aug in spring-planted summer squash crops where powdery mildew starts to develop first in order to obtain a measure of pathogen sensitivity before fungicides were used (spring squash generally is not treated with fungicides specific for powdery mildew due to how late the disease develops in crop production). It was also conducted on 31 Aug and 21 Sept in pumpkin crops and research fields at LIHREC. The research fields were a resistant squash variety evaluation not treated with powdery mildew fungicides, the reduced-till pumpkin research field which was treated with a fungicide program (alternation of Pristine, Procure, and Quintec; all tank mixed with Bravo plus copper), and plots in the powdery mildew fungicide evaluation experiment that had been treated weekly with Pristine, Procure or Quintec. Fungicides used in the bioassays represent all of the major chemical classes at risk for resistance currently registered for managing powdery mildew: FRAC Code 1 (Topsin M), Code 11 (Flint), Code 3 (Nova, Procure, Inspire, Tebuzol), Code 13 (Quintec) and Code 7 (Pristine). Farm locations where the bioassays were conducted were designated using a numbering system established for previous projects.

Resistance to FRAC Code 1 and Code 11 fungicides were detected at a high level in all spring squash plantings where the bioassay was conducted (81-100% and 83-100%, respectively). Resistance to these chemistries is qualitative and cross resistance occurs amongst all fungicides in each group; thus a pathogen strain able to tolerate 50 ppm of any fungicide in each group is completely resistant and would not be controllable with any fungicide in the group. The bioassay results supported not recommending fungicides in these groups in 2010; similar results were obtained in 2009. Surprisingly, resistance to Code 1 fungicides was not detected on 31 Aug in pumpkin crops at 4 of the 7 farms examined and the proportion of the pathogen population that was resistant was substantially lower than in the spring squash crops (1-32%). Resistance to Code 11 fungicides was high in all crops examined at both assay times (40-100% on 31 Aug).

Strains of the cucurbit powdery mildew pathogen were detected able to tolerate 500 ppm boscalid (FRAC Code 7), the active ingredient in Endura and an ingredient in Pristine. They were detected in most crops. Strains able to tolerate this concentration would be fully resistance to this chemistry because this is in the range of the concentration that would be present when Pristine is applied at the highest label rate to cucurbit crops. Considering that resistance was also found to be high for FRAC Code 11 fungicides, which is the group that the other active ingredient in Pristine belongs to, the potential existed for efficacy of Pristine to be affected by resistance in 2010.

The cucurbit powdery mildew pathogen populations on Long Island exhibited some tolerance of FRAC Code 3 fungicides. Strains able to tolerate 120 ppm were detected at a high percentage in the spring crops assayed (1-95%). They were less common in pumpkin crops (0-7%). Based on these assay results, this pathogen exhibits some variation in sensitivity to Code 3 fungicides, and is most sensitive to difenconazole.

All of the cucurbit powdery mildew populations assayed on Long Island exhibited a very high level of sensitivity to quinoxyfen, the active ingredient in Quintec. There was an extremely low level of detection of strains able to tolerate 1 and 10 ppm. The frequency of the pathogen population able to 1 ppm increased from an average of 0.2% on 6 Aug to 6.2% on 21 Sept. Only 0.7% tolerated 10 ppm.

Sensitivity of the pathogen population at the end of the season was often related to fungicide use and fungicide efficacy. This was especially evident for the LIHREC research fields. Proportion of the population able to tolerate 500 ppm boscalid was 70% where Pristine was applied weekly at the lowest label rate and control was ineffective (see previous report) versus 19% in another experiment where no powdery mildew fungicides were applied, and for 1 ppm quinoxyfen the proportions were 75% where Quintec was applied weekly and 1% in the non-treated planting. These results document why it is important to alternate amongst fungicides at risk for resistance development. Shifts in the pathogen population to higher frequency of resistant strains in response to fungicide use were also detected in commercial fields and associated with efficacy of powdery mildew control. For example, proportion of the population tolerating 500 ppm boscalid was 0% on 31 Aug and 11% on 21 Sept in a pumpkin crop at Farm 6 where control was good, while these values in two fields where control was poor were 14% and 70% for Field 1 at Farm 9 and 11% and 52% for Farm 10.

Project funded by the Friends of Long Island Horticulture Grant Program
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FUNGICIDE SENSITIVITY OF CUCURBIT POWDERY MILDEW PATHOGEN ISOLATES ON LONG ISLAND IN 2010

Investigators: M. McGrath and L. Hunsberger
Location: Long Island Horticultural Research and Extension Center

The objective of this study was to determine fungicide sensitivity of pathogen isolates (i.e. individuals) by testing them in the laboratory on treated leaf disks. The study described in the previous report utilized a seedling bioassay that assesses a pathogen population rather than individuals. The isolates used in this study were obtained from some of those populations. They were collected on 13 and 20 Sept, then maintained on leaf tissue on agar media in Petri dishes until tested.

For the leaf disk bioassay, pumpkin seedlings at the cotyledon leaf stage (about seven-day-old) are sprayed with various fungicide doses in a laboratory fume hood, treated plants dry overnight, then disks are cut from the cotyledons and placed on water agar in sectioned Petri plates. Each plate has four sections thus there are three treatments per plate plus a nontreated control. There are six disks per treatment. Disks are inoculated by transferring spores to each disk center. Each disk in a plate is inoculated with the same isolate, then plates are incubated for at least 10 days at room temperature on a laboratory shelf under constant light supplied by aquarium bulbs, at which time the control treatment shows good growth of the pathogen, with sporulating mildew covering an average of about 50% of leaf disk area. The percent leaf disk area colonized by sporulating mildew is recorded for each disk and averaged for each treatment. An isolate is considered to be insensitive (resistant) to a particular fungicide concentration if it is able to grow and sporulate on at least half of the disks. Due to limitations in the number of isolates and fungicide doses that can be done in each bioassay, the procedure is conducted multiple times over many weeks.

The bioassays conducted to date have revealed that many cucurbit powdery mildew pathogen isolates collected on LI in 2010 are resistant to 500 ppm boscalid (36.5%), the primary active ingredient in Pristine. The proportion varies among locations partly reflecting Pristine usage, from 0% where this fungicide was not used to 67% where it was. 82% of these isolates are resistant to 2 ppm myclobutanil (active ingredient in Nova) and 28% are resistant to 1 ppm quinoxyfen (a.i. in Quintec). Higher doses of these fungicides will be tested next. The boscalid dose is the only fungicide dose tested so far that is in the range of what would be in a spray tank at labeled rates for Pristine, thus it is the only one that corresponds to practical (field) resistance in this pathogen.

EFFICACY OF A NEW EXPERIMENTAL FUNGICIDE DEVELOPED BY BASF CORPORATION FOR MANAGING POWDERY MILDEW IN CANTALOUPE

Investigators: M. McGrath and L. Hunsberger
Location: Long Island Horticultural Research and Extension Center

The objective of this study was to evaluate a new mobile fungicide for powdery mildew. Controlled release fertilizer, consisting of a blend of 300 lb/A 15-18-12 and 100 lb/A ESN, was broadcast and incorporated on 15 June. Black plastic mulch and drip tape were laid on 17 June. A waterwheel transplanter was used to open holes for planting in the mulch and to apply starter fertilizer plus insecticide on 21 June. The next day three seeds were placed by hand into each of the holes. After seedlings were established they were thinned to one plant per hole. Plots were three adjacent rows each with seven plants spaced 24 in. apart. Rows were spaced 68 in. apart. The plots were 18 ft apart within the row. A randomized complete block design with four replications was used. Treatment applications were made weekly using a tractor-mounted boom sprayer equipped with twinjet (TJ60-11004VS) nozzles spaced 17 in. apart that delivered 53.5 gal/A at 100 psi. Severity of powdery mildew was assessed on upper and lower leaf surfaces on 3, 17 and 26 Aug; and 1 and 8 Sep.

Powdery mildew was first detected on 3 Aug in half of the plots. Treatment applications were started the next day. BAS 560 effectively controlled powdery mildew on both upper and lower leaf surfaces, providing 99.8% and 97.6% control, respectively, based on AUDPC values. Efficacy was similar to Procure, a registered, commercial standard fungicide for this disease applied at its highest label rate, which provided 97% control on both surfaces. Powdery mildew became severe in the non-treated plots, especially on lower leaf surfaces, illustrating the importance of mobile fungicides for managing this disease. Leaves in two of these plots had died by the last assessment date.

Project funded by the IR-4 Program.

EVALUATION OF FUNGICIDES FOR PHYTOPHTHORA BLIGHT IN SNAP BEANS

Investigators: M. McGrath and L. Hunsberger
Location: Long Island Horticultural Research and Extension Center

The objective of this study was to evaluate conventional fungicides against Phytophthora blight in snap beans. This study was conducted in a field where experiments on Phytophthora blight have been conducted previously. There were two adjacent plantings to maximize the potential that pods would be present when conditions were favorable for disease development. Both plantings were treated with fungicides on the same preventive schedule. Beans were direct-seeded on July 29 and Aug 17 into double rows spaced 34-in apart with a single row of zucchini (Spineless Beauty) direct-seeded between the pairs of bean rows to separate plots and provide a source of inoculum. A late planting date was used to increase the likelihood of Phytophthora blight developing during the experiment as conditions in this area are more likely to be favorable during late summer and fall. Fertilizer was provided before planting as a broadcast, incorporated application of 10-10-10 (N-P-K) at 500 lb/A on 21 July and as a side-dress

application of 46-0-0 at 43.5 lb/A on 9 Sept. Each plot consisted of two 10-ft rows of beans with 7-ft of nontreated bean plants separating plots within the planted row. A randomized complete block design with four replications was used for each planting. The primary source of inoculum in this field is soil-borne with supplemental inoculum provided using cucumber fruit infected with an isolate of *Phytophthora capsici* obtained from a commercial planting of snap bean on Long Island in 2009. The procedure for providing supplemental inoculum was as follows: cucumber fruit were cleaned and dried. A cork borer was used to remove a core of cucumber flesh and skin, next a PDA agar plug with the isolate was placed in the hole and the core was replaced. The fruit were then incubated in closed plastic boxes with wet paper towel until symptoms developed (4 days) at which point they were placed on zucchini plants in the field. Infected fruit were placed in the field on 21 and 29 Sep. The field was overhead irrigated within 24 hours to spread spores. Symptoms developed on fruit and foliage of zucchini plants as a result of both natural infection and inoculation. Fungicides were applied weekly for 4 weeks beginning before symptoms were observed in plots using a backpack CO_2-pressurized sprayer and a hand-held boom equipped with a single-nozzle boom operated at 42 psi. A 4004EVS nozzle delivering 39 gal/A was used on 22 Sep, 28 Sep, 6 Oct, and 13 Oct. Beans were examined routinely for symptoms and evaluated on 13 and 19 Oct. Percent infected bean pods were determined throughout each plot.

Symptoms were first observed in early Oct though no differences were seen between treatments. By 19 Oct, control was evident with all 4 fungicides tested (Ranman + Silwet, Presidio, Revus, and Ridomil Gold/Copper). Symptoms were only observed on bean pods. Affected pods had the characteristic yeast-like growth of *Phytophthora capsici*. Spores from this tissue were examined microscopically to confirm the observed pod rot was caused by *P. capsici*. In the second planting, pods did not form before the end of the season and Phytophthora blight was not observed.

Project funded by the IR-4 Program.

EFFICACY OF BIOPESTICIDES FOR MANAGING DOWNY MILDEW IN ORGANICALLY PRODUCED CUCUMBER

Investigators: M. McGrath and L. Hunsberger
Location: Long Island Horticultural Research and Extension Center

The objective of this study was to evaluate biopesticides using a cucumber variety that has exhibited relatively low susceptibility to downy mildew compared to other varieties in cucumber evaluations conducted at North Carolina State University since 2005. This integrated approach was taken because downy mildew is considered a difficult disease to manage organically. K-Phite was the only biopesticide evaluated that is not approved for organic production. The biopesticides were compared to an organic standard treatment, the copper fungicide NuCop, and a conventional fungicide program of Manzate Pro-Stick during the vegetative period followed by Bravo during the harvest period. Only protectant fungicides were used for the conventional fungicide standard because the organic fungicides also lack targeted activity and mobility. Most biopesticides were tested alone. Organocide was tested at a low label rate tank-mixed with NuCop at a low label rate.

A transplanter with a waterwheel was used to prepare holes for seeding, plus apply fertilizer in the process. Neptune's Harvest hydrolyzed fish emulsion fertilizer was used at 2 oz/gal. Cucumber was direct-seeded by hand on 13 Aug. Three seed were placed in each hole and thinned to one plant once established. Each plot was a single, 27-ft row with 18 plants at 18-in. spacing. Plots within a row were spaced 9 ft apart. Rows were spaced 8.5 ft apart or 14.2 ft apart to accommodate driveways. A randomized complete block design with four replications was used. A preventive, 7-day schedule was used for all treatments. Fungicides were applied for 6 weeks beginning on 25 Aug using a CO_2-pressurized backpack sprayer equipped with a single-nozzle boom operated at 45 psi. An 8002E nozzle delivering 28 gal/A was used on 25 Aug, 1 Sep, and 8 Sep. An 8006E nozzle delivering 28 gal/A was

used on 17, 22, and 30 Sep and 7 Oct. Rates were applied lower than intended on the first three dates due to a calculation error. Yield data was not obtained due to the late onset of downy mildew and the greater impact on plant condition of aphids and storms with strong wind.

Downy mildew began to develop on cucumbers on Long Island, NY, later in 2010 than in previous recent years. Environmental conditions were less favorable for pathogen dispersal and infection in the region due to the unusual dry conditions. Cloudy conditions with rain or high humidity are needed for successful pathogen dispersal and infection. Symptoms of downy mildew were first detected on Long Island in the cucumber sentinel plots at LIHREC for the downy mildew forecasting system on 7 Sep 2010. Symptoms were not observed in the experimental plots until 17 Sep. None of the treatments evaluated suppressed downy mildew to a detectable level compared to the non-treated control in this experiment, including the conventional fungicide treatment. Suppression did not occur as expected with the one integrated treatment consisting of a biopesticide (Actinovate) applied preventively then combined with mobile conventional fungicides (Previcur Flex and Ranman) that have targeted activity for downy mildew and have been documented to be highly effective in other evaluations. Lack of treatment affect likely is at least partly due to the fact downy mildew remained at a low level in this experiment due to environmental conditions. At the last assessment, only 28% of leaves had symptoms of downy mildew in the non-treated control, and severity on these leaves averaged only 13%. At two assessments the non-treated control had the highest values for downy mildew suggesting that many of the treatments tested were providing some suppression. Additionally, plants were damaged by high winds during storms and aphids.

Project funded by the IR-4 Biopesticide Demonstration Grant Program.

EVALUATION OF BIOPESTICIDES FOR MANAGING DOWNY MILDEW IN BASIL

Investigators: M. McGrath and L. Hunsberger
Location: Long Island Horticultural Research and Extension Center

Downy mildew is a new disease of basil. It was first reported in south FL in October 2007 and in Europe in 2001. Both gardens and commercial plantings on LI were affected in 2008 and 2009. It appears to now be established in FL where it occurs year round. Due to the ease with which the pathogen's spores are dispersed by wind, it is anticipated that downy mildew will continue to occur every year in the northeast. It is also anticipated that fungicides will be an important management tool considering there is no tolerance for blemishes on leafy herbs. Few fungicides are presently labeled for this use. The objective of this experiment was to evaluate biofungicides under LI conditions. Obtaining data to support product registration for this disease is a priority of the IR-4 program.

Biopesticides were evaluated in a replicated experiment with field-grown plants of basil. To provide a source of natural inoculum within the experimental area, basil was transplanted into spreader rows about 4 weeks before plants were scheduled to be transplanted into the plots. These rows were adjacent to rows of sorghum-sudangrass planted earlier to provide a more favorable environment for downy mildew to become established by creating shade and blocking air movement thereby promoting a more humid area. These plants were not inoculated. Basil for the experiment was seeded on 5 July in trays in a greenhouse and transplanted on 10 Aug into black plastic mulch with drip irrigation. A late planting date was used to increase the likelihood of downy mildew developing during the experiment. The primary source of initial inoculum in this area is considered to be wind-dispersed spores from affected plants in another area, rather than infested seed. Each plot had 26 plants in two 10-ft rows on black plastic mulch with 9-in plant spacing and 9-in row spacing. The plots were 6 ft apart in the row. A randomized complete block design with four replications was used. Fungicides were applied weekly for 7 weeks beginning before symptoms were observed in plots using a CO_2-pressurized backpack sprayer. The number of plants affected and percentage of leaves affected on up to 10 plants was determined at

each assessment. Incidence and average severity on affected plants was used to calculate overall severity for the canopy of each plot. A destructive sampling was done at the end of the season on 13 Oct. Similar assessment of downy mildew incidence and severity was done with these plants, then they were held enclosed in a plastic bag at 60 F for 7 days before re-assessing them to determine residual control.

Symptoms of downy mildew were first observed in this experiment on 16 Aug on one leaf in a spreader row. Symptoms were not found in plots until 20 Sep, which was after the fourth application. Few significant differences were detected among treatments. The conventional fungicide, Revus, was not significantly better than most of the biopesticide treatments. It was not as effective as expected based on previous evaluations conducted in FL. Results may have been affected by the fact disease onset was late in the season and occurrence remained low. While there were few significant differences among treatments, the biopesticide that appeared to be the least effective (Oxidate) is one of the two products currently labeled for managing downy mildew in organically-produced crops. At the first assessment only one treatment, ProPhyt, had no symptoms in all four replicate plots. These two apparent results are in agreement with observations of substantial differences in control made by a NY grower who used Oxidate and a phosphorous acid fungicide in his organic and conventionally-managed, respectively, greenhouse-grown basil. The treatment with the lowest AUDPC value was a tank-mix of low label rates of Organocide and copper.

Project funded by the IR-4 Biopesticide Demonstration Grant Program.

EVALUATION OF BASF EXPERIMENTAL FUNGICIDES FOR POWDERY MILDEW IN TOMATO

Investigators: M. McGrath and L. Hunsberger
Location: Long Island Horticultural Research and Extension Center

The objective of this study was to determine the efficacy of experimental fungicides against powdery mildew in tomatoes. Fertilizer (N-P-K 10-10-10) at 1000 lb/A was broadcast and incorporated on 10 May. Black plastic mulch and drip tape were laid on 11-13 May. Seeds were sown on 6 May in the greenhouse. Seedlings were transplanted on 14 June using a waterwheel transplanter that applied liquid starter fertilizer. Plots consisted of 10 plants in a single row with 24-in plant spacing and 68-in row spacing. There was 8-ft spacing between plots in a row. The experiment was arranged in two blocks separated by a central driveway. Each block had two rows with plots separated by a separator/spreader row. Plants were staked and trellised following standard procedure for fresh-market tomato production. Examining impact of treatment on yield was not an experiment objective; therefore, fruit were periodically removed and discarded in an effort to delay senescence and promote leaf development. Treatment applications were made using a CO_2-pressurized backpack sprayer with a boom that has a single twin-jet 110-degree nozzle (TJ-60 11003) that delivered 38 gpa at 44 psi. Each side of the planted row was treated with the boom held sideways to obtain thorough coverage of foliage mimicking a drop nozzle on a tractor sprayer. A preventive 7-day application schedule was used. Applications were made on 31 Aug; and 7, 13, 22 and 28 Sep. Leaves were examined routinely for symptoms of powdery mildew and other diseases. Symptoms had not started to develop naturally in this experiment when found in other research and commercial plantings, therefore leaves with powdery mildew from commercial fields were placed in the canopy of the spreader plants several times beginning on 26 Sep.

Powdery mildew was first observed in this experiment on 22 Sep, which was late in the production season for the region. Symptoms were found in 3 non-treated control plots and only 1 treatment plot then. All treatments provided excellent control. On 7 Oct, powdery mildew was found at a moderately severe level (up to 85% of leaflets affected) in all non-treated plots while symptoms were only found in 3 treatment plots. No significant differences in incidence of Septoria leaf spot were detected amongst treatments; however, occurrence of this disease in non-treated plots may have been limited due to leaf tissue already being affected by powdery mildew.

OZONE CONCENTRATIONS IN RIVERHEAD IN 2010

Investigators: M. McGrath and L. Hunsberger
Location: Long Island Horticultural Research and Extension Center

Ozone reached sufficiently high levels to cause acute, visible injury to leaves of sensitive crops in 2010 on Long Island. Ozone also causes sensitive plants to senesce prematurely. During the growing season (1 May – 30 Sep) in 2010 ozone concentration was ≥80 ppb for at least 32 hours on 13 days: 1 May (5 hours), 4 Jun (2), 5 Jun (3), 24 Jun (4), 26 Jun (2), 28 Jun (3), 4 Jul (1), 5 Jul (2), 6 Jul (1), 17 Jul (2), 21 Jul (2), 5 Aug (3), and 17 Aug (2). Ozone was at least 50 ppb on 724 hours on 94 days and at least 60 ppb on 324 hours on 52 days. The highest concentration in 2010 (106 ppb) occurred for one hour on 5 Jul. This was the only date that ozone exceeded 100 ppb, in contrast with previous years. Ozone was at least 40 ppb for 88 of 120 hours and at least 70 ppb for 35 hours during the 5-day period of elevated ozone (3-7 July). The ozone monitor was not working for 8 days in 2010 (13-20 July) when ozone could have reached high levels. Data was used from a monitor at another site Long Island (Holtsville). Typically high concentrations occurred between 1200 and 2200, as in previous years. Ozone was ≥80 ppb for 60, 124, 121, 184, 77, at least 67, 94, 40, at least 10, 95, 65, 47, and 57 hrs in 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, and 2008 respectively.

ASSESSMENT OF AMBIENT OZONE IMPACT ON PLANT PRODUCTIVITY USING A SNAP BEAN BIOINDICATOR SYSTEM

Investigators: M. McGrath and L. Hunsberger
Location: Long Island Horticultural Research and Extension Center

Research on ozone-sensitive and ozone-resistant snap bean lines was continued in 2010 using field-grown plants. The lines, sensitive S156 and resistant (tolerant) R331, were developed at the USDA-ARS Air Quality Research Unit in Raleigh, NC, to be used to investigate the impact of ambient ozone (O_3) on plant productivity. These lines yield similarly under low ozone concentrations. There were 3 successive field plantings to be able to assess the impact of ambient ozone occurring throughout the growing season. Seed were inoculated with Rhizobia then sown by hand with 2 seeds placed every 9 inches, then thinned to 30 plants per plot in a row with 4 replications. Drip tape was laid next to each row for irrigation. Bean pods were harvested when immature for fresh-market consumption from half the plants repeatedly as they developed. Bean pods were harvested when seed were mature from the rest of the plants. Plants were examined routinely for ozone injury. Injury and defoliation due mainly to ozone injury were rated. Ozone concentration data were obtained from a monitor maintained at LIHREC by the NYS DEC Air Quality Division. The hourly values were used to calculate ozone exposure expressed as AOT40 (accumulated ozone exposure over the threshold of 40 ppb between 8 am and 8 pm). AOT40 is a commonly used measure of ozone exposure.

Findings contributed to the database of plant response to ambient ozone (O_3). An extensive set of data from multiple locations, environmental conditions, and ozone concentrations is needed in order to model ozone impact on plant productivity. As in previous years at the NY location, O_3 reached sufficiently high levels in 2010 to cause acute, visible injury to bean leaves and to affect yield substantially. From plant emergence (about 7 days after planting) until the last fresh-market pod harvest, bean plants in the three plantings were exposed to O_3 during daytime (0800-2000) that was at least 40 ppb for 529, 727, and 449 hours, respectively. During these growth periods of 59, 84, and 70 days, O_3 exposure expressed as AOT40 (Accumulated Ozone exposure over a Threshold of 40 ppb) was 7,692 ppb.h, 11,400 ppb.h, and 6,308 ppb.h, respectively. These values greatly exceed the long-term critical level of ozone exposure for crops of 3,000 ppb.h accumulated over three months.

The O_3-sensitive snap bean line S156 yielded numerically less than the tolerant line R331 when grown under ambient O_3 conditions on Long Island in 2010. However, yield was not always significantly less. Total weight and number of bean pods harvested for fresh-market consumption from planting 1 (26 May) plants was 14% and 5% lower (not significant), respectively, for S156 compared to R331 (pods were harvested from 15 July through 4 Aug). There was a 29% reduction in both yield variables for planting 2 (9 June) plants (harvested 9 Aug to 7 Sept), and a 32% and 51% reduction in these variables, respectively, for planting 3 (14 July) plants (harvested 13-28 Sept). Exposure to ozone had a greater impact on mature bean yield. Weight of pods was 40% and 42% lower for S156 compared to R331 in planting 1 and 2, respectively. Weight of seeds removed from the pods was 36% and 24% lower, respectively.

Exposure to ozone caused acute foliar injury in all three plantings. The visible symptom was bronzing. The sensitive line was more severely affected than the tolerant one. Severely affected leaves eventually died and dropped. At the time of the third fresh-market harvest, S156 plants exhibited more severe injury in planting 2 than in planting 1, which reflects the greater impact detected on yield and higher O_3 exposure. Severity of O_3 injury was 35% on planting 1 S156 plants for mature bean harvest, versus 1% for R331, on 26 July, while it was 86% and 27%, respectively, on 31 Aug for planting 2 plants. Defoliation at those times was 31% for S156 and 1% for R331 in planting 1 and 86% and 9%, respectively, for planting 2 plants. Planting 3 plants were the most severely affected by O_3. On 21 Sep, 1 day after the second harvest, O_3 injury severity was 96% for S156 and 11% for R331. This finding was in agreement with the impact on yield but not the O_3 exposure, which was lower than the other plantings.