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POWDERY MILDEW OF PUMPKIN: EVALUATION OF CURRENTLY REGISTERED FUNGICIDES AND NEW FUNGICIDES

Investigator: M. T. McGrath
Location: Long Island Horticultural Research and Extension Center

Application of fungicides continues to be the principal practice for managing powdery mildew in pumpkin. There are very few resistant varieties. It is the most common disease occurring every year throughout Long Island. The main goals of this study were 1. to evaluate the components of a currently recommended fungicide program and 2. to evaluate this standard program with alternative fungicides. The standard program was Quadris (15.4 fl oz/A) applied in alternation with Nova (5 oz/A) + Bravo Ultrex (2.7 lb/A) on a 7-day schedule. For goal 1, two treatments were Quadris applied weekly and Nova + Bravo applied weekly. Alternative programs included: Cabrio substituted for Quadris (these are both QoI or strobilurin fungicides), Procure substituted for Nova (these are both DMI fungicides), and the sulfur fungicide Microthiol Disperss substituted for Bravo. Microthiol Disperss was one of the best protectant fungicides, performing as well as Bravo, in previous experiments. Cabrio is the only one of these fungicides not registered for use in NY.

'Appalachian' pumpkin was direct-seeded on 20 June. As for previous experiments, treatments were initiated after the IPM threshold of one leaf with powdery mildew symptoms of 50 old leaves examined was reached in all 36 plots. Upper and lower (under) surfaces of 5 to 50 leaves in each plot were examined weekly for powdery mildew beginning on 1 Aug when fruit were starting to enlarge. Symptoms were found in 1 of the 36 plots on 1 Aug (on 1 of 1800 older leaves examined), in 18 plots on 8 Aug (33 of 1800 leaves), and in all plots on 15 Aug (295 of 432 leaves). Powdery mildew incidence increased substantially between 8 and 15 Aug, thus incidence on 15 Aug differed from the IPM threshold more than desired. This suggests scouting in commercial fields should be done more frequently than every 7 days. Fungicides were applied weekly (on 15, 21, and 27-28 August; and 6 and 13 September) with a tractor-mounted boom sprayer equipped with D5-45 hollow cone nozzles spaced 17 in. apart that delivered 100 gpa at 150 psi.

Only 4 treatments, those that included Quadris, were applied on the first date (15 Aug) due to applicator error. Not surprisingly, these treatments had the least powdery mildew on 23 and 26 Aug. The grower standard fungicide program is Quadris applied in alternation with Nova + Bravo. The two components of this program were evaluated separately to determine if control with either Quadris and Nova was below expectations suggesting occurrence of resistance. Quadris was effective initially, providing 80% control of powdery mildew on upper leaf surfaces and 89% control on lower (under) surfaces on 26 Aug following two applications. But control dropped to 0% (severity not significantly different from nontreated) and 42%, respectively, 8 days later. Nova + Bravo was more effective, providing 87% and 65% control at that time even though the first application time of this treatment was missed. Quadris applied in alternation with

Nova + Bravo provided 75% and 42% control. In sharp contrast, Quadris applied at 12 fl oz/A on a 14-day schedule was one of the most effective treatments in an experiment at this location in 1997, providing 93% and 66% control at the 25 September assessment. Five of 9 isolates tested were resistant to QoI fungicides (able to grow well on disks treated with up to 100 ppm trifloxystrobin) and exhibited reduced sensitivity to DMI fungicides (able to grow well on disks treated with 50 or 100 ppm triadimefon). Resistance is qualitative to QoIs and quantitative to DMIs. It is not known whether this degree of insensitivity to DMIs is enough to affect efficacy of Nova. Two isolates were sensitive to both chemical classes. Interestingly, only two isolates exhibited a mixed response being sensitive to QoIs but tolerant to DMIs.

The most effective treatments were Quadris alt. Procure + Bravo and Quadris alt. Nova + Microthiol Disperss (sulfur). These were significantly better than the grower standard for powdery mildew on lower leaf surfaces based on 3 and 9 September severities and also AUDPC values. Cabrio at 16 oz/A alt. Nova + Bravo was as effective as the grower standard even though the Cabrio treatments were started a week after the Quadris ones. Efficacy of Cabrio likely was affected by resistance to QoI fungicides because of cross resistance within this chemical class. The two treatments providing the best control of powdery mildew had the least defoliation on all assessment dates and the most fruit with good solid handles, an important measure of pumpkin fruit quality. Nova + Bravo was the third best treatment based on all of these parameters. There was a trend toward more fruit in plots with best control, but differences were not significant. Quadris alt. Nova + Bravo had significantly less defoliation than nontreated on 5 and 12 September, but not on 17 September.

Impacts of Research Findings. Managing powdery mildew in NY will be greatly affected by development of resistance to QoI fungicides. These fungicides (Quadris and Flint) should be used in less than half of the applications in 2003. For 2003, a protectant fungicide is recommended every week in addition to systemic fungicides to control powdery mildew and manage resistance (previous recommendation was protectant every 14 day with systemics weekly). Sulfur is a good choice because it is one of the most effective protectants available and the least expensive (see next report). Microthiol Disperss and Procure were shown to be effective alternatives for Bravo and Nova, respectively.

POWDERY MILDEW OF PUMPKIN: EVALUATION OF PROTECTANT FUNGICIDES

Investigator: M. T. McGrath
Location: Long Island Horticultural Research and Extension Center

Application of fungicides continues to be the principal practice for managing powdery mildew in pumpkin as there are very few resistant varieties. It is the most common disease occurring every year throughout Long Island. The primary objective of this experiment was to evaluate protectant fungicides and a health-promoting fertilizer for their suitability as replacements for chlorothalonil formulated as Bravo. All materials tested are approved for use in NY. Several are approved for organic production; the rest are considered biocompatible.

Products tested and rate/A used were Serenade 6 lb, Kaligreen 5 lb, Nutrol 20 lb, Prudent Plus 2.5 qt, Kocide 2000 2 lb, JMS Stylet-oil 1.5%, Microthiol Disperss 4 lb, and Bravo Ultrex 2.7 lb. In addition to evaluating these products individually, Nutrol was tank-mixed with Prudent Plus (rates reduced to 10 lb and 2 qt) and Serenade (at 4 lb) was applied with Kocide and Microthiol Disperss. Serenade reportedly works by directly affecting pathogens and by stimulating the natural defense mechanisms of plants so that they become more resistant to diseases, which is called systemic acquired resistance or SAR.

'Appalachian' pumpkin was direct-seeded on 20 June. Fungicides were applied weekly (19 and 25 July; 1, 8, 15, 21, and 27-28 August; and 6 and 13 September) with a tractor-mounted boom sprayer equipped with D5-45 hollow cone nozzles spaced 17 in. apart that delivered 100 gpa at 150 psi. Three treatments with Nutrol (monopotassium bicarbonate) and/or Prudent Plus (health-promoting fertilizer, 3-19-13) were started 4 wks after planting on 19 Jul. All other treatments were initiated on 21 Aug after the IPM threshold of one leaf with powdery mildew symptoms of 50 old leaves examined was reached in all plots. Upper and lower surfaces of 5 to 50 leaves in each plot were examined weekly for powdery mildew beginning on 17 July and continued through 17 September.

Symptoms were observed in 8 of the 56 plots on 1 August (on 8 of 2800 older leaves examined), in 27 plots on 9 August (47 of 2800 leaves), and in all plots on 16 August (512 out of 560 old leaves; average severity of 10% and 5% on upper and lower surfaces of old leaves, respectively). Powdery mildew incidence increased substantially between 9 and 16 Aug, thus incidence on 16 August differed from the IPM threshold more than desired. This suggests scouting in commercial fields should be done more frequently than every 7 days. Treatments on an IPM schedule were started on 21 August, which was not as soon after threshold was reached as planned due to applicator error.

All treatments provided some control of powdery mildew although applications were started later than desired. Severity on upper leaf surfaces was significantly lower than nontreated for all treatments on 26 August, which was 5 days after the first application for the IPM scheduled treatments. While the overall level of control was not as high as in 2001, relative performance was similar. Serenade used alone was the least effective treatment; it was the only one to not differ from the nontreated on 3 September. Only 4 treatments (Microthiol Disperss, Bravo, Serenade + Microthiol Disperss, and Kocide) were providing control on 9 September after 3 applications. Microthiol Disperss and Bravo also worked well in 2001. These 2 fungicides were more effective than the standard program for powdery mildew (Quadris alt. Bravo + Nova) based on severity on upper leaf surfaces on 3 September and on AUDPC values, which is the severity summation for the season (78% versus 45% control, respectively). The standard did not work as well as in previous years, providing only 18% control on lower leaf surfaces, most likely due to resistance to Quadris, which was documented in an adjacent experiment (see previous report).

Preventive applications for the three treatments with Nutrol and/or the health-promoting fertilizer Prudent Plus provided some disease suppression. Comparison of

these 3 treatments to all others combined revealed a significant reduction in powdery mildew severity on upper surfaces on 16 August; however, standard comparison of individual treatments did not reveal an effect. Powdery mildew severity was numerically smallest for the Nutrol + Prudent Plus treatment on lower leaf surfaces on 22 and 26 Aug and this treatment was among the six best treatments until the last assessment on 17 September. Nutrol and Nutrol + Prudent Plus were the only treatments other than the standard program (Quadris alt. Bravo + Nova) that provided control on lower leaf surfaces.

Treatments providing the best control of powdery mildew had the least defoliation, which was due mainly to powdery mildew, and they exhibited a trend of more fruit with good solid handles, an important measure of pumpkin fruit quality. Compared to the nontreated control, Bravo and Quadris alt. Bravo + Nova were the only treatments with significantly less defoliation on all assessment dates, more new foliar growth on 5 September, and more leaves that were upright on 5 September. Pumpkins treated with Nutrol + Prudent Plus had significantly less defoliation than nontreated on 5 and 12 September and more canopy with upright leaves on 5 September. There were no significant differences among treatments in proportion of fruit with good solid handles on 24 September or 8 October. The five treatments with the highest number on both dates were Quadris alt. Bravo + Nova, Bravo, Serenade + Microthiol Disperss, Nutrol, and Prudent Plus or Nutrol + Prudent Plus. There were no significant differences in number of fruit, average fruit weight, or percentage of large fruit among the eight treatments compared for yield effects. However, nontreated had the fewest fruit and the second lowest average fruit weight.

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POWDERY MILDEW OF ACORN SQUASH: EFFICACY OF GENETIC CONTROL, USED ALONE AND COMBINED WITH FUNGICIDES

Investigator: M. T. McGrath
Location: Long Island Horticultural Research and Extension Center

The objectives of this study were to evaluate powdery mildew resistant (PMR) cultivars of acorn squash and to determine if there is a benefit to integrating chemical control with host-plant resistance by applying fungicides to these resistant cultivars. The resistant cultivars were evaluated by comparing them to nontreated and fungicide-treated susceptible cultivars. Taybelle PM is heterozygous for the incompletely dominant resistance gene, which means it has one allele for resistance from one parent. It is horticulturally similar to Taybelle. Autumn Delight is homozygous for resistance to PM, thus it has an allele from both parents, and compares to Table Ace. Seed of these four cultivars were obtained from Seminis Vegetable Seeds, Inc. Siegers and Stokes Seeds carry all 4 varieties. The other 2 PMR cultivars evaluated were obtained from the Cornell Plant Breeding program. The fungicide program (Quadris applied in alternation with Nova + Bravo) was applied on a 7-day schedule to susceptible cultivars and on a 14-day schedule to resistant cultivars. Harlequin is a multicolored acorn; the others evaluated are dark green acorns. Seed of Harlequin is available from Rupp Seed Co, Territorial Seed

Co and SeedWay. Turtle Tree Seeds plans to produce organic seed of Cornell PMR Acorn.

Transplants were seeded in the greenhouse on 28 May and planted into bare ground on 19 June. Upper and lower (under) surfaces of 5 to 50 leaves in each plot were examined approximately weekly for powdery mildew. Symptoms were first observed on the susceptible varieties on 12 August and on the resistant varieties on 20 August. Fungicide applications were started 1-2 days later. Application dates were: 1=15 August, 2=21 August, 3=27 August, 4=6 September, and 5=13 September. Taybelle and Table Ace were treated with Quadris at dates 1, 3,and 5 and Bravo + Nova at dates 2 and 4. Taybelle PM and Autumn Delight were treated with Quadris at date 2 and Bravo + Nova at date 4. Applications were made with a tractor-mounted boom sprayer equipped with D5-45 hollow cone nozzles spaced 17 in. apart that delivered 100 gpa at 150 psi. Defoliation was assessed during September. Ripe fruit were counted and weighed during the last week of September. Percentage of sucrose was determined using a hand refractometer for two fruit per plot.

Host plant resistance provided good control of powdery mildew without the addition of fungicide treatment. Taybelle PM provided control of powdery mildew on lower leaf surfaces statistically equivalent to that achieved with fungicides applied weekly to the susceptible variety Taybelle (80% vs 67% control, respectively); however, chemical control was more effective for powdery mildew on upper surfaces (28% vs 92% control for non-treated Taybelle PM and fungicide-treated Taybelle, respectively. Compared to fungicide-treated Table Ace, Autumn Delight provided better control on lower leaf surfaces (52% vs 98%, respectively) and equivalent control on upper surfaces (96% vs 81%). Chemical control, however, may have been compromised by resistance to Quadris. Autumn Delight, which has homozygous resistance, was less severely infected than Taybelle PM, which has heterozygous resistance, at all assessments. Powdery mildew severity on Cornell PMR Acorn and Harlequin did not differ significantly from the other two PMR varieties until 12 September when Autumn Delight was less severely infected on upper leaf surfaces. Control of powdery mildew provided by genetic resistance was not improved by applying fungicides twice based on powdery mildew severity; however, defoliation was significantly less in fungicide-treated plots of Taybelle PM. Additionally, a reduced fungicide program could function to delay selection of a new pathogenic race able to overcome this resistance. Fungicide treatment delayed senescence in addition to suppressing powdery mildew in Taybelle and Table Ace. Powdery mildew was the only foliar disease observed. Cornell PMR Acorn and Harlequin had the least defoliation when assessed in September (15% vs 79% for non-treated Table Ace on 12 September). Sucrose content was highest for Harlequin (13.2% Brix) and lowest for Autumn Delight (6.7% for non-treated); it was 8% for non-treated Taybelle PM and 9% for Cornell PMR Acorn. Applying fungicides to Taybelle improved sucrose content (8.5% vs 10.2%); values were higher, but not significantly, for Taybelle PM and Autumn Delight treated with fungicides (9.6% and 7.6%). Fungicide treatment did not affect fruit size for any variety. Fruit of Table Ace, Cornell PMR, and Harlequin were smaller than others.

In conclusion, growing varieties with resistance to powdery mildew is an effective and economic means to manage powdery mildew. Although neither control of powdery mildew nor yield were improved significantly by applying fungicides to Taybelle PM or Autumn Delight, there was a trend toward improvement plus an integrated program with two applications on a 14-day schedule would reduce selection pressure for new races of the pathogen able to overcome the resistant variety and pathogen strains resistant to the fungicides. Although seed of Taybelle PM and Autumn Delight is priced slightly higher than seed of Taybelle and Table Ace, overall production costs are lower because of the cost difference between a 7- and 14-day fungicide program. It will cost about $76 less to grow an acre of Autumn Delight sprayed twice compared to Table Ace sprayed five times and $99 less for Taybelle PM compared to Taybelle.

Project funded by the Cornell IPM Grant Program

POWDERY MILDEW OF BUTTERNUT SQUASH: EFFICACY OF GENETIC CONTROL, USED ALONE AND COMBINED WITH FUNGICIDES

Investigator: M. T. McGrath
Location: Long Island Horticultural Research and Extension Center

The objectives of this study were to compare Bugle, a new cultivar of butternut squash that has homozygous resistance for powdery mildew (e.g. an allele of the resistance gene from each parent), to a susceptible standard cultivar, Waltham Butternut, and to determine if there is a benefit to integrating chemical control with host-plant resistance by applying fungicides to the resistant cultivar. Bugle was developed by the Cornell Plant Breeding program. Seed is available from Rupp Seed Co and SeedWay. In addition to a nontreated control, each cultivar received a grower standard fungicide program (Quadris applied in alternation with Nova + Bravo on a 7-day schedule) and a reduced fungicide program (standard program applied on a 14-day schedule).

Methods were the same as for the parallel study with acorn squash. Standard program for Waltham was Quadris (week 1,3,5) and Bravo + Nova (2,4) and for Bugle it was Quadris (week 2,4) and Bravo + Nova (3,5). Reduced program was Quadris (week 2) and Bravo + Nova (4) for both Waltham and Bugle.

Compared to non-fungicide-treated Waltham, the resistant variety provided control of powdery mildew on upper leaf surfaces that was equivalent to that achieved with fungicides applied weekly to susceptible Waltham (86% and 92% control, respectively). Genetic control (non-treated Bugle) was superior to chemical control (fungicide-treated Waltham) for powdery mildew on lower leaf surfaces, providing 98% control versus 68%. Chemical control, however, may have been compromised by resistance to Quadris. Control of powdery mildew provided by genetic resistance with Bugle was not improved by applying fungicides. However, a reduced fungicide program could function to delay selection of a new pathogenic race able to overcome this resistance. Powdery mildew in the susceptible variety was not controlled on upper leaf surfaces with fungicides applied on a 14-day schedule (reduced fungicide program) as effectively as with a 7-day schedule (standard fungicide program)(45% vs 93% control).

Powdery mildew causes leaves to senesce prematurely; thus, as a consequence of better suppression with genetic than chemical control, Bugle not treated with fungicides had significantly less defoliation on all assessment dates in September than Waltham receiving the standard fungicide program (1% vs 22% on 5 September). Fungicide treatment did not affect size, quantity, or sucrose content of fruit produced for either variety. Non-fungicide-treated Bugle produced smaller fruit than fungicide-treated Waltham (2.5 vs 4 lb) but more fruit (5.9 vs 4.6); however, this was not quite enough to compensate for the smaller fruit size (15 versus 18 lb mature fruit/plant). Sucrose content, a measure of fruit quality, was slightly higher for Bugle than Waltham, but this difference was not significant. There were no significant differences among treatments in the quantity of immature fruit present at harvest. A few fruit had long splits that extended into the flesh. There was a trend toward fewer fruit having splits with increasing fungicide input for both varieties. Bugle was judged to have slightly better flavor after cooking than Waltham.

In conclusion, growing varieties with resistance to powdery mildew is an effective means to manage powdery mildew. Although neither control of powdery mildew nor yield were improved significantly by applying fungicides to Bugle, an integrated program with two applications on a 14-day schedule is recommended to reduce selection pressure for new races of the pathogen able to overcome the resistant variety and strains of the pathogen that are resistant to the fungicides. The greater cost of seed of Bugle, $48.50/lb versus $15.15/lb for Waltham, is almost offset by the additional fungicide applications needed to affectively control powdery mildew in Waltham. It will cost about $17 more to grow an acre of Bugle sprayed twice than an acre of Waltham sprayed five times.

Project funded by the Cornell IPM Grant Program

IN VITRO TESTS TO DETERMINE SENSITIVITY OF CUCURBIT POWDERY MILDEW TO FLINT FUNGICIDE IN 2000 AND 2002

Investigators: **N. Shishkoff and M. McGrath**
Location: Long Island Horticultural Research and Extension Center

Around the US in 2002, there have been reports that Flint fungicide has not been effective in controlling powdery mildew on cucurbits. The purpose of this study was to to determine the sensitivity to Flint fungicide of cucurbit powdery mildew isolates from Georgia, Long Island, and North Carolina in 2002 and compare these results to those of our initial baseline sensitivity test performed in 2000. Georgia plots had been sprayed with Bayleton, Flint, or nothing. Long Island isolates were from infested pumpkin plots that had not shown good control after spraying with Flint North Carolina isolates were collected from acorn squash in a plot sprayed with Quadris, another axoystrobin fungicide. A few California isolates were collected from cantaloupe with powdery mildew that had not been controlled with Flint Two-week old squash seedlings ('Seneca Prolific') were sprayed with Flint (50% ai) dissolved in water at 0, 0.5, 5.0 , 50 and 100 ppm, or with Bayleton (50%ai,) at 5, 50, and 100 ppm. Five leaf disks of each treatment were placed on water agar in petri plates (four treatments per plate) and inoculated. Plates were incubated for approximately 2 weeks at 24 C, at which time the

control treatment showed good growth, with sporulating mildew covering an average of 20-30% of leaf disk area.

Race was determined by inoculating each isolate onto leaf disks from muskmelon (*Cucumis melo*) cultivars used as race differentials ('Topmark', 'Del-1', 'Hale's Best', 'PMR-45', 'PMR-6'). In the original baseline sensitivity test, 37 powdery mildew isolates from 8 states showed little variation in sensitivity to Flint. When grown on cotyledon disks treated with Flint , 17 isolates tested were only able to grow at 0.3 ppm; 15 grew at 0.3 ppm in one replicate and at 3 ppm in another, 5 isolates consistently grew at 3.0 ppm, and none grew at 30 ppm. There was no noticeable correlation between sensitivity and geographic location or sensitivity and host. Races 1 and 2 were present. The 2002 isolates showed greater tolerance of Flint than the 2000 isolates, with 46/ 78 isolates (of both race 1 and 2) able to grow at 100 ppm. Resistance was clearly observed in populations of isolates from Georgia, Long Island, and North Carolina (too few isolates were tested from California to make any conclusions). It was evident that resistant isolates were commoner in plots that had been sprayed with Flint than in control plots, indicating that selection for resistance had occurred over the growing season. Growth of the mildew on sprayed disks showed the "all or nothing" behavior characteristic of single gene resistance to the fungicide. There was a noticeable correlation between resistance to Bayleton and resistance to Flint, although the two pesticides fall into different chemical classes.

Impact statement: Flint has only recently been registered for use on cucurbit powdery mildew. It was intended to be used in conjunction with other control methods to insure that resistance did not develop. Now, however, it may be of limited use in controlling powdery mildews, especially since so many isolates resistant to Flint are also resistant to Bayleton and thus have reduced sensitivity to the related fungicide Nova.

PHYTOPHTHORA BLIGHT OF CUCURBITS: IMPLEMENTING A MANAGEMENT PROGRAM

Investigator: M. T. McGrath, C. MacNeil, A. Erb, and T. Blomgren
Location: Capital District, Lake Plains Region, and Ontario, Wayne, Yates and Steuben Counties

Phytophthora blight is a very devastating disease that sometimes results in total crop loss. It has been increasing in importance and thus is a high priority for the IPM program. The goal of this project was to continue to work with growers in upstate New York to implement management practices identified through research conducted on Long Island. Current recommendations center around preventing the pathogen from being moved into a new field and managing soil moisture to avoid saturated conditions which favor disease onset. Fourteen fields were selected for the study on commercial farms where blight has been a problem. Management practices implemented include: selecting fields with no history of blight (13 fields), selecting fields that were not planted to a susceptible crop in 2000 or 2001 (11 fields), deep ripping between rows to improve soil drainage (8 fields), no-till production into rye+hairy vetch+clover to obtain a straw mulch barrier (1 field), and applying compost to improve drainage and increase microbial

activity (1 field). Weather conditions were very dry during the summer of 2002 and thus not favorable for Phytophthora blight, which was fortunate for the growers but unfortunate for studying management practices. Blight only developed in 1 of the 14 fields. Symptoms had not been observed in this field previously, but it was next to a field where blight had occurred in 1999, pickling cucumbers were grown in the field in 2001, and deep ripping was not used to improve drainage. Symptoms were observed near the irrigation reel where soil was wetter than the rest of the field. This further documents the importance of wet soils for blight development. An additional component of this project was to further extent information to growers about Phytophthora blight and its management. This was done through newsletters, one-on-one visits, field meetings, the Capital District Vegetable Seminar, and regional conferences including the 2002 NYS Vegetable Conference.

Project funded by the Cornell IPM Grant Program

OZONE CONCENTRATIONS IN RIVERHEAD IN 2002

Investigator: M. T. McGrath
Location: Long Island Horticultural Research and Extension Center

Ozone once again reached levels on Long Island that could cause acute, visible injury to leaves of sensitive crops. Ozone also causes sensitive plants to senesce prematurely. Concentration was ≥80 ppb for 94 hrs on 24 days in 2002: 24 May; 1,11-12, 23-24, and 26-27 June; 1-4, 8-9, 15, and 18-19 July; and 2-3, 5, and 10-13 Aug. Ozone was ≥80 ppb for 60, 124, 121, 184, 77, and at least 67 hrs in 1996, 1997, 1998, 1999, 2000, and 2001, respectively. The highest concentration (129 ppb) was reached on 18 July. Ozone exceeded 120 ppb on 2 and 18 July and 13 August. Typically high concentrations occurred between 1200 and 2200, as in previous years.

DEVELOPMENT AND OZONE SENSITIVITY OF BUTTERFLY BUSH VARIETIES GROWN UNDER NATURALLY HIGH OZONE ON LI

Investigator: M. T. McGrath and S. Clark
Location: Long Island Horticultural Research and Extension Center

Butterfly bush (*Buddleia*) was recently shown to be sensitive to ozone and to exhibit varietal differences in ozone sensitive through research using controlled exposures to ozone conducted in AL. The goal of this multi-year study is to examine development of 7 varieties on Long Island where ambient ozone is naturally high every summer. The varieties are Bonnie, Black Knight, Harlequin, Pink Delight, Potter's Purple, Royal Red, and Summer Beauty.

Plants are being grown in a pot-in-pot system and irrigated daily with spray stakes (Roberts Irrigation). Rooted cuttings were transplanted into 3-gallon pots on 20-21 July 2000. Pots were arranged in a randomized block design with 9 replications and 2 plants per replication. Several plants died over the 2001/02 winter. The fewest plants of Potter's Purple and Summer Beauty died (2 each), while 7 Royal Red and 10 Bonnie

plants died. Plant height, length of inflorescences, ozone injury, and number of inflorescences with dead flowers, open flowers, and unopened flowers were determined.

Black Knight was the first variety to have open flowers, as in 2001. Five of 13 plants had flowers on 2 July. Potter's Purple had significantly more open flowers than all other varieties on all assessment dates in August and October. Total flower count (which included dead and unopened) was also highest, but not significantly different from Black Knight on 6 August. Summer Beauty and Bonnie had the longest inflorescences; Black Knight, Harlequin and Royal Red had the shortest. Plants of Potter's Purple were significantly taller than others, next were Royal Red and Black Knight; Summer Beauty plants were the shortest. Summer Beauty had a significantly higher percentage of leaves with brown spots suspected of being ozone injury than the others when assessed on 8 October. Bonnie, Royal Red, and Pink Delight had the fewest. Summer Beauty and Pink Delight performed similarly in 2001. Pink Delight, Bonnie, and Potter's Purple had a higher percentage of yellowing foliage on 8 October.