Evaluation and Demonstration of Integrated Disease Management Options for Organic Tomato and Cucumber Production

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Abstract

Late blight (*Phytophthora infestans*) and downy mildew (*Pseudopernospora cubensis*) have the potential to significantly reduce tomato and cucumber yields in New York State, especially for organic growers. We evaluated four organic spray programs and resistant varieties for their ability to control disease and improve yield. Sprays provided protection, but no differences were detected between them. In both crops, the resistant variety had significantly less disease than the susceptible. Iron Lady yielded twice as much as Polbig. DMR 264 was slower to mature, therefore yields were significantly less than Marketmore 76.

Research Objectives:

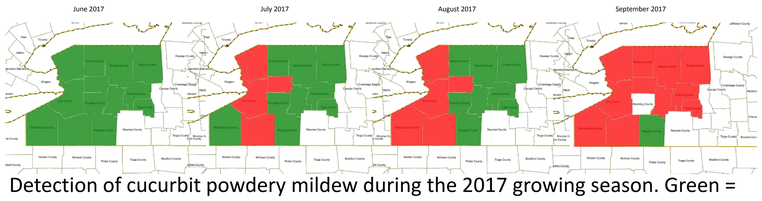
Diseases such as late blight and downy mildew can pose serious challenges to growers and sharply reduce yield. Our objectives in these trials were:

1. Demonstrate the importance of using disease-resistant cultivars.
2. Evaluate new biopesticides for organic tomato and cucumber production.

Growers benefit from knowing which organic sprays best protect their crops. Disease-resistant varieties, if successful, can reduce the need for sprays and reduce crop losses. We sought the most effective methods for organic control of major crop fungal diseases.

Contribution to IPM:

Integrated Pest Management (IPM) seeks to combine techniques that promote sustainable agricultural practices. These include using resistant varieties, biological controls, habitat modification, modification of cultural practices, chemical programs based on scouting and pest thresholds, and weather prediction models. By evaluating and demonstrating the importance of host resistance and evaluating new biopesticide fungicide programs for efficacy we aim to identify new tools that will be effective, and potentially reduce the number of copper sprays needed and slow the development of fungicide resistance. This will save growers time and money. Additionally, these trials allow us to monitor and detect the movement of these diseases into New York to enable real time pest monitoring and map generation using the iPiPE tools. See example below.



Detection of cucurbit powdery mildew during the 2017 growing season. Green = negative and red = positive report for that county.

Experimental Design and Treatments

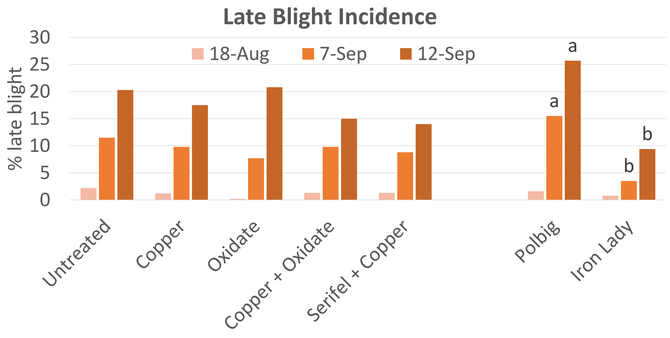
Organic fungicide programs and two cultivars each of tomato and cucumber were evaluated at the Cornell Lake Erie Research and Extension Laboratory (CLEREL), Portland, NY on a Chenagno gravelly loam soil. A split-plot design was used with three replications and treatments arranged in a randomized complete block design. Organic fungicide programs were the main plot and consisted of one 20-ft long raised black plastic mulched bed subdivided into 5-ft subplots for each of the two cultivars. Calendar sprays of each program were applied on 29 Jun, 13 Jul, 20 Jul, 2 Aug, 16 Aug, and 25 Aug and included 1) Untreated, 2) Standard copper spray (Badge X2 @ 1 lb/A), 3) Oxidate 2.0 (1.0%), 4) Standard copper spray (Badge X2 @ 1 lb/A) + Oxidate 2.0 (0.5%), 5) Serifel (4 oz/A) in-furrow on 7 June; foliar spray on 29 Jun, 20 July, 16 Aug; alternated with Copper (Badge X2 @ 1 lb/A) spray on 13 July, 2 Aug, 25 Aug. Tomato cultivars included Polbig (susceptible to late blight) and Iron Lady (resistant to late blight). Cucumber cultivars included Marketmore 76 (susceptible to downy mildew) and DMR 264 (resistant to downy mildew).

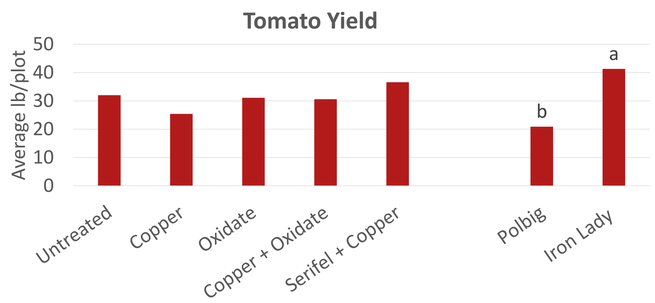
Late Blight: (from left) late blight symptoms on tomato, water-soaked gray lesions on tomato leaves, and 10x view of sporulation on underside of leaf.

Downy Mildew: (from left) downy mildew symptoms on cucumber leaves, interveinal chlorosis and necrosis on top of leaf, underside of leaf with dark sporulation, and 10x view of sporulation on underside of leaf.

Materials & Methods:

Seed for both cucumbers (Marketmore 76, DMR 264) and tomato (Polbig and Iron Lady) were planted in greenhouse for transplant production on 12 Apr, and on 7 Jun transplants were planted. For cucumber two transplants were planted at a 12-in. spacing in each subplot of five hills. Drip irrigation was applied as needed. A few of the plots had to be replanted due to early season cucumber beetle feeding. An organic insecticide (Surround at 30 lb/100 gal) was applied on a 3-5 day schedule to protect the cucumber seedlings from further insect damage. For tomatoes, five transplants were planted in each subplot at 18-in. spacing. Incidence of downy mildew and late blight were rated, approximately once per week after each disease was first detected. Cucurbit downy mildew was first detected on 2 Aug, while late blight was first detected on 12 Aug. Fruit was harvested and weighed approximately once per week after first fruit-set reached maturity. Data analyzed using SAS Version 9.4. No significant interactions between fungicide program and cultivar were detected. Means followed by the same letter(s) within a group are not significantly different according to Fisher's Protected LSD (*P*=0.05).



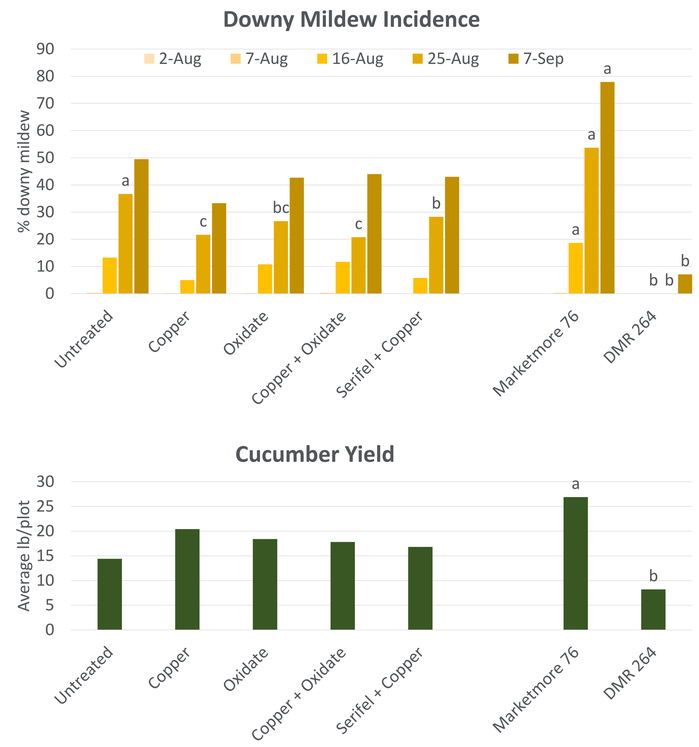


Late Blight in untreated tomato demonstration plots Polbig (left) with 80% incidence and Iron Lady (right) with only 1% incidence.

Results:

There were no significant interactions between fungicide programs and cultivars in both tomato and cucumber trials, therefore data were pooled across the main effects.

In tomato, all programs reduced disease compared to untreated, no significant differences between the fungicide programs were detected, and there were no significant differences in yield between programs. Iron Lady exhibited season-long resistance to late blight and had twice the yield of Polbig. In cucumbers, no significant differences were detected between fungicide programs on all dates, except 25 Aug, where Copper and Copper + Oxidate provided the best protection from downy mildew. Both the Serifel + Copper and Oxidate also significantly reduced downy mildew over the untreated. DMR 264 showed season-long resistance to downy mildew. Although Marketmore 76 had a significant amount of disease, it had the highest yield overall as it was an earlier maturing variety compared to DMR 264.



Downy mildew in untreated cucumber plots DMR 264 (left) with 0% incidence and Marketmore 76 (right) with 53% incidence on 25 August.

Conclusions

These trials demonstrated the importance of utilizing disease resistance, when available, in organic tomato and cucumber production. Host resistance is the best defense option against these two diseases for organic production. The organic fungicide programs helped to protect the crops, but overall were not as effective as resistance in Iron Lady tomato and DMR 264 cucumber cultivars.

Directions for Future Research

Priority should be given to continued identification of disease-resistant cultivars that not only help reduce loss, but have favorable horticultural characteristics such as flavor, fruit color, shape and quality.