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Update on Bacterial Leaf Spot Populations and Copper Resistance in Tomato and Pepper Crops in New Jersey

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Bacterial leaf spot (BLS) in Pepper and Tomato

- Very common in both pepper and tomato plantings.
- Caused by same Genus (Xanthomonas spp.)
- Overwinters in infected debris in soil.
- Once established in field/farm its going to be a yearly problem...
- Good, long crop rotations are needed.





Bacterial leaf spot on tomato transplants







Bacterial leaf spot – the pathogens

- Four species of *Xanthomonas* involved in BLS...
 - X. euvesicatoria (T1)
 - X. vesicatoria (T2)
 - X. gardneri (T3)

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- X. perforans (T4)
- Four races of BLS found in tomato (T1-T4) where each corresponds to specific spp. of *Xanthomonas*....
- Eleven BLS races found in pepper (0-10)
- Differential testing over past 15 years in bell pepper confirmed presence of all 10 races (in pepper) in NJ...
- What species are present depends on where you are in the world...
- Now collecting info on *Xanthomonas* spp. involved in tomato and pepper in New Jersey...

Bacterial leaf spot (BLS) in pepper

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- Many bell pepper cultivars have resistance to one or more races of the pathogen.
 - Some of the newest cvs. have race 1 10 resistance (X10R) (FL CVS.)
- The easiest way to control BLS is to plant resistant cultivars...
- Some cultivars lack resistance altogether such as Paladin...
- Some cultivars such as 1819 have resistance to races 1-5.
- cv. Turnpike -> 1-5,7-9; also has Pc tolerance.
- Check in Pepper Section of 2022/2023 Commercial Recommendations Guide for current list!
- There are a few non-bell types that carry limited BLS resistance packages and no resistance in tomato.
- It is important for you to know which races of BLS are present on your farm and if copper R is present!

Copper resistance detected in New Jersey

- Copper applications for the control of bacterial diseases in many crops used extensively...
- We have suspected the possibility of copper R developing in pepper and tomato for many years
 - Because of its broad-scale use and lack of efficacy on some farms
 - Resistance known on eastern shore of Virginia for many years now...

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Objectives

- Initiated the first survey of BLS and copper resistance in NJ in 2019. Just sampled a few farms in 2019 to work out lab protocols...
- 2020 objectives: begin to identify Xanthomonas species causing BLS on vegetable crops and assess the prevalence of copper resistance
- 2021 objectives: <u>expand</u> the sample size and conduct more robust genetic analysis of both the copper resistance genes and *Xanthomonas* species present

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Sampling locations

 Samples from pepper and tomato fields with BLS symptoms were collected and sent to Rutgers campus for isolation and testing...



2020 sampling

2021 sampling

Do Xanthomonas species have preferential host ranges?

• In NJ, Xanthomonas euvesicatoria and Xanthomonas perforans are both found on pepper and tomato at varying rates

	BLS on Pepper	BLS on tomato
X. euvesicatoria	60%	20%
X. perforans	40%	80%

- In Florida, BLS on pepper is mostly caused by X. euvesicatoria and BLS on tomato is mostly caused by X. perforans
- Conclusion: The host range is mixed...

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Can X. euvesicatoria and X. perforans both exist on the same farm?

- In 2020, only one *bacterial species was found per farm*
 - X. perforans or X. euvesicatoria

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- In 2021, all farms except one followed this trend
 - In this exception, X. euvesicatoria was found on one variety of pepper and X. perforans was found on another variety pepper
- Conclusion: It is possible to have both bacterial species causing disease on peppers in the same farm.



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How prevalent is copper resistance in NJ?

- In 2020, Xanthomonas isolates from commercial farms were found to be copper resistant in laboratory assays
- In 2021, about 54% of commercial farms sampled were found to have copper resistant Xanthomonas
- Conclusion: copper resistance is prevalent in NJ
- Remember, copper resistance and Xanthomonas populations may vary farm to farm and field to field!

Sampling locations

- More locations sampled in 2021
- Tomatoes & peppers sampled in 2021
- More locations, more samples, more diverse varieties of peppers especially

Not copper resistant





2020 sampling

2021 sampling

Conclusions

- Trends we see in FL are not the same for NJ
- It is possible to have both *X. euvesicatoria* and *X. perforans* in the same farm...
- Not all commercial farms have copper resistant bacteria, although 54% of those sampled in 2021 did...
- Copper resistance plasmids that BLS carries are probably not based on geographical location, bacterial species, or host
- Copper resistant bacteria may be able to survive in a field for multiple growing seasons

RUTGERS BLS vs Phytophthora-resistance

	BLS race	Phytophthora
Cultivar	resistance	resistance
Paladin	none	R*
Aristotle	1,2,3	Т
Declaration	1,2,3, 5	Т
Revolution	1,2,3, 5	Т
Archimedes	1-3, 7,8	Т
1819	1,2,3,4,5	Т
Intruder	1,2,3	Т
Turnpike	1-5, 7-9	Т
Playmaker	0-10	Ŧ

* We are starting to see Paladin break down in parts of NJ. Also has no BLS resistance

Bacterial disease control

- With bell peppers, start with those varieties that carry resistance to multiple races of pathogen...
 - First studies in NJ looking at bell pepper varieties with X10R resistance seem to show a yield drag.
 This is improving. See trial reports in Rutgers Plant & Pest Advisory!
- Clorox or Hot Water Seed treat tomato and pepper seed...
 - Especially important if you grow heirloom tomatoes!
- Prior to transplanting, apply Agri-Mycin 17 (FRAC code 25, streptomycin) sprays when first true leaves appear and continue every 45 days until transplanting (1.0 lb/100 gal, 1.25 tsp/gal, REI 12 h).
- Streptomycin cannot be applied after transplanting.
- Space out fields...especially if growing non-BLS resistant peppers; or tomatoes and peppers...
- Working fields while foliage is wet should be avoided as much as possible...
 - Tying and harvesting...<u>Under heavy infection stop tying</u>...
 - Workers can easily spread bacteria up and down rows...
 - Work in most affected blocks last...you want to avoid bringing in bacterial problems into otherwise healthy fields.

Bacterial leaf spot control in 2022

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- Apply fixed copper + mancozeb on a regular basis to help suppress spread...
 - Need to understand if copper is still effective in your own operation!
- Use of Actigard, disinfestants. If copper R present...drop copper apps
- Disinfestants. Remember, these products only work on what they come into direct contact with...
- Losses may be reduced by maintaining a high level of fertility, which will stimulate additional leaf formation and help replace leaves lost due to BLS.
 - However, sufficient restraint with fertilization must be done to ensure that plants do not become overly vegetative, or fruit set may be severely reduced.
- Gramoxone any blocks you are done with ASAP during season...
- Disk fields as soon as possible after the growing season is finished. This will
 hasten breakdown of the crop debris that is harboring the bacteria and
 minimize overwintering of the bacteria in the field

Bacterial leaf spot control in 2022

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- BLS control is becoming more and more difficult
- Understanding what bacterial populations you have on your farm extremely important...not just in tomato and pepper crops...
- If you think you have copper resistance, please reach out to us...
- Copper + mancozeb. Continue to use if copper resistance is not present...
- Actigard applications...studies show that it is somewhat irregular in efficacy...
- Double Nickel, Regalia, and K-Phite seem to help mitigate...
- If you are a bell pepper producer...begin to look at X10R varieties.

2022-2023

Mid-Atlantic Commercial Vegetable Production Guide (green cover)

• New for 2022-2023 growing seasons!

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- Forty-four Extension personnel from 6 states....
- Updates across the board on varieties, control recommendations, etc.
- Updated Tables for control options in greenhouse...
- Edamame section...new this year
- 464 pages, ~30 pages more than 2020-2021 guide...
- Check with your local Extension office or grower association for hardcopy of new guide...
- Is available for FREE online at Rutgers Plant & Pest Advisory!

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