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Disease management updates in vegetable crops

Special focus on Phytophthora blight and bacterial leaf spot in tomato and pepper

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Phytophthora blight (*Phytophthora capsici*)

Phytophthora blight

- Anytime water pools in or floods out a field after a rain, there is a good chance for Phytophthora blight development…
- Especially, if you have had a history of Phytophthora blight in the past!
- Unfortunately, the inability for long crop rotations….
  - U pick and road side operations

Phytophthora blight control in 2022…

- In fields with a long history of Ridomil (mefenoxam) resistance and phytophthora blight:
  - Use Ranman at 2.75 fl oz in 50 gal/A in transplant water
  - Apply Presidio at 3.0 to 4.0 fl oz/A via drip after transplanting, then come back with additional Ranman or Presidio application via drip 14 to 30 days later…
  - Do not use Ridomil at transplanting!
  - Foliar/fruit applications:
  - Orondis Ultra (OXTP + mandipropamid, 49 + 40) at 5.5 to 8.0 fl oz/A
  - Orondis Opti (OXTP + chlorothalonil, 49 + M5) at 1.75 to 2.5 pt/A

Phytophthora blight control in 2022…

- In fields with no history of Ridomil (mefenoxam) resistance and phytophthora blight:
  - Use Ranman at 2.75 fl oz in 50 gal/A in transplant water, in addition, apply:
  - Orondis Gold (OXTP + mefenoxam, 49 + 4) at 28.0 to 55 fl oz/A (1.75 to 3.43 pt/A) via drip after transplanting and 30 days later, then at ~14 days between apply Presidio at 3.0 to 4.0 fl oz/A or Ranman at 2.75 fl oz/A via drip
  - Foliar:
  - NO Orondis Ultra or Orondis Opti as foliar applications…use other materials

Phytophthora blight control in 2022…

- Foliar/fruit rot phase:
- Orondis Ultra [(OTXP + mandipropamid (Revus)] at 5.5 to 8.0 fl oz/A
- Orondis Opti [OXTP + chlorothalonil] at 1.75 to 2.5 pt/A
- Presidio (fluopicolide, 43) at 3.0 to 4.0 fl oz
- Ranman (cyzofamid, 21) at 2.75 fl oz/A
- Forum (dimethomorph, 40) at 6.0 fl oz/A
- Tanos (famoxadone + cymoxamil, 11 + 27) at 8.0 to 10.o oz 50DF/A
- Zampro (ametoctradin + dimethomorph, 45 + 40) at 14.0 fl oz/A

- You need to plan a strategy ahead of time in how you are going to combat the crown rot and foliar phase of phytophthora blight!

Phytophthora blight control in 2022…

- Mefenoxam-insensitivity (R)
- At transplanting:
  - Ranman (21) or Presidio (43)
- 14 days later
  - Presidio (43) or Ranman (21)
- 30 days after transplanting
  - Orondis Gold (49 + 4)
  - Ranman (21)
  - Presidio (43)
- Foliar control
  - Zampro (45 + 40)
  - Revus/Forum (40)
  - Copper (M1)
  - Limited use of Presidio (43) or Ranman (21)

- Mefenoxam-sensitive (S)
- At transplanting:
  - Orondis Gold (49 + 4)
- 14 days later
  - Presidio (43)
  - Ranman (21)
- 30 days after transplanting
  - Orondis Gold (49 + 4)
  - Ridomil Gold (4)
- Foliar control
  - Zampro (45 + 40)
  - Revus/Forum (40)
  - Ranman (21)
  - Presidio (43)
  - Ridomil Gold Copper (4 + M1)

If you apply Orondis Gold via drip you can't use Orondis products as foliars!

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.

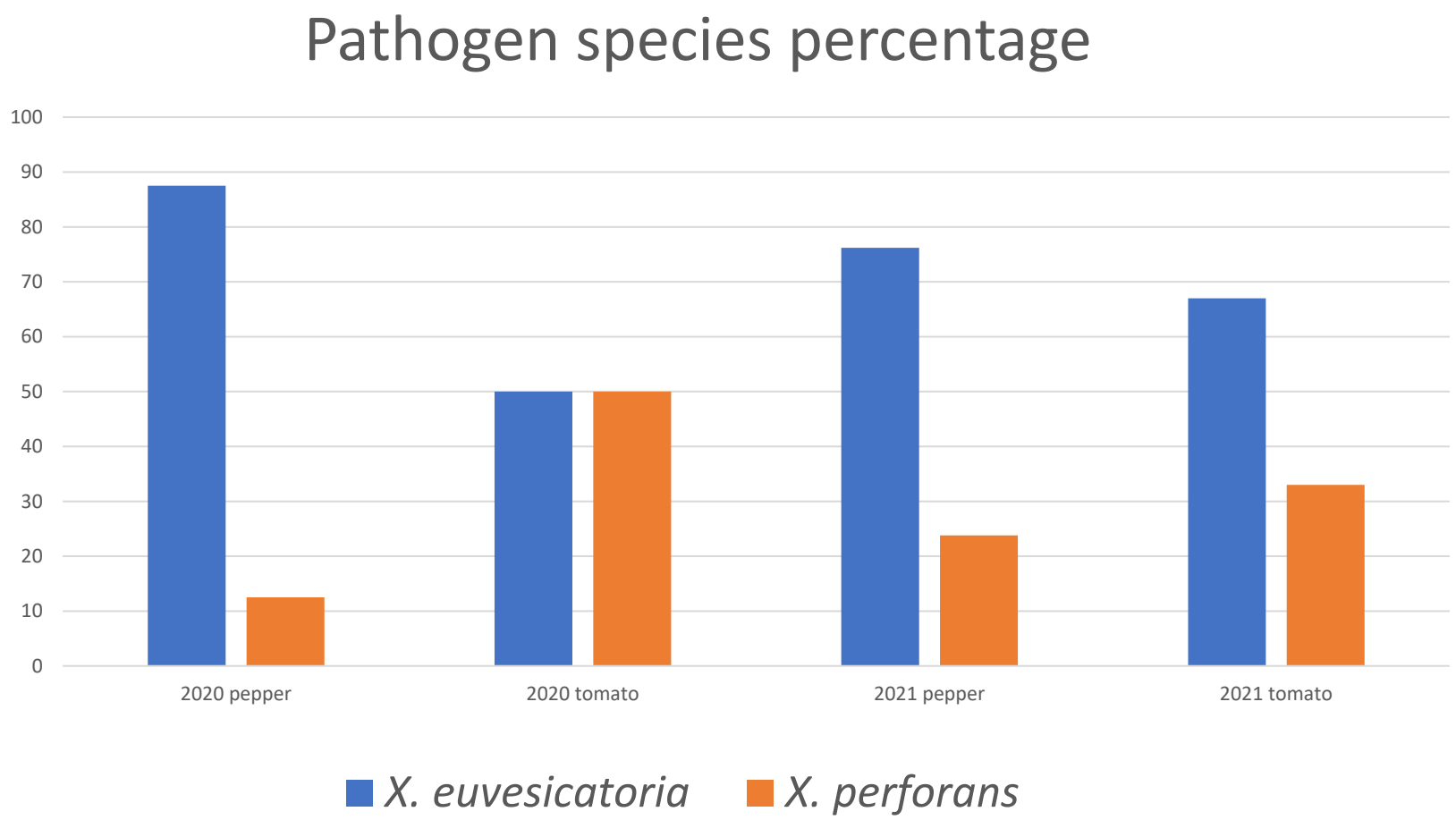
Bacterial leaf spot on tomato transplants

Bacterial leaf spot – the pathogens

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

- Initiated a small surveys in from 2019-2021 on select farms in NJ.
- Identify what species present and if copper R could be detected.
- *X. euvesicatoria* confirmed in both tomato and pepper
  - *X. euvesicatoria* can infected both tomato and pepper!
- Also detected some other interesting ones…
- *P. syringae* pv. *coriandricola* is a bacterial disease of carrot, parsley, and parsnip…found in tomato and pak choi in NJ
- *P. viridiflava* is a bacterial disease to tomato, melon, eggplant and many others…Found in parsley in NJ.
- *X. arboricola* pv. *pruni* causes bacterial leaf spot in peaches…found in tomato in NJ.


Pathogen species percentage
100
90
80
70
60
50
40
30
20
10
0
2020 pepper
2020 tomato
2021 pepper
2021 tomato
X. euvesicatoria
X. perforans

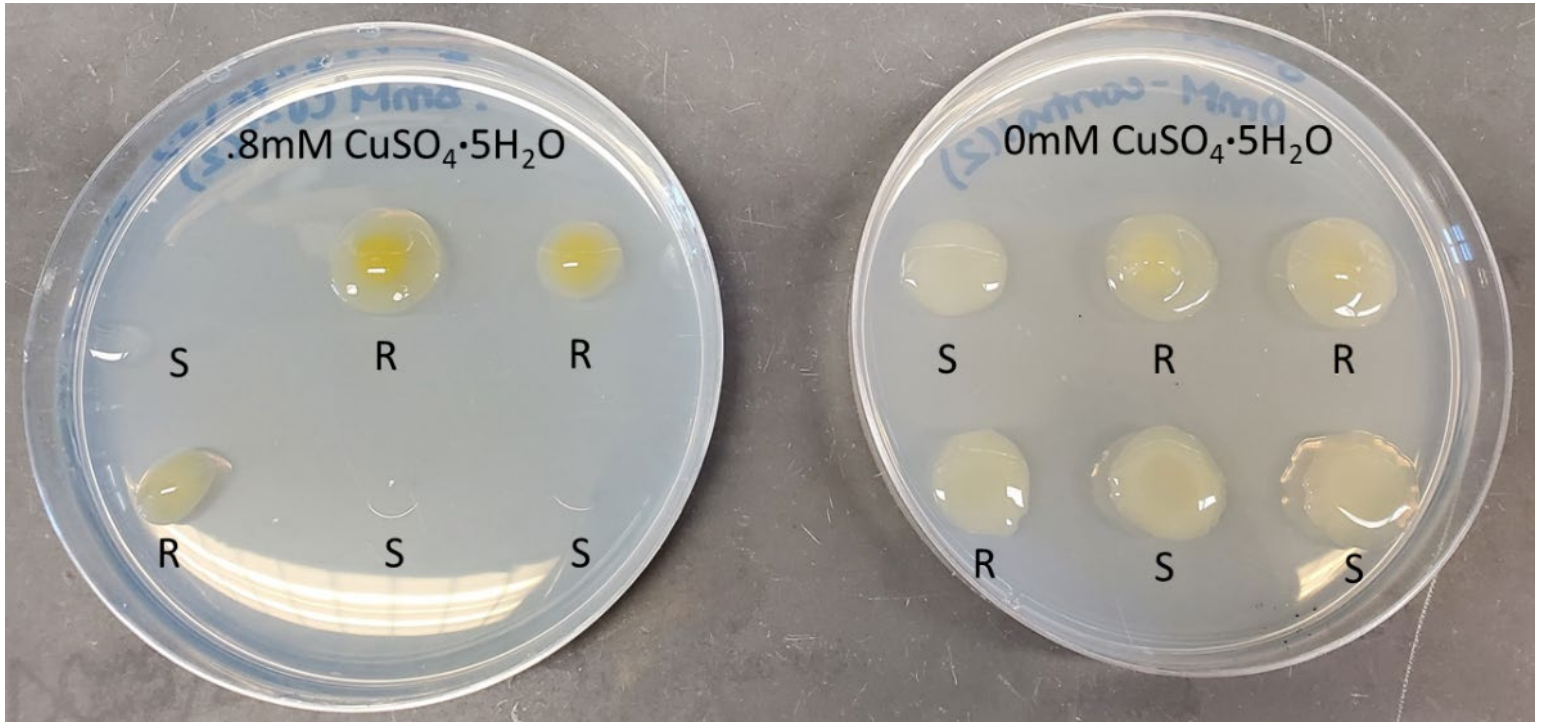
Bacterial leaf spot - pathogens

- Diverse *Xanthomonas* population in New Jersey, as I would expect, as well as in other regions of mid-Atlantic region
- Broad implications for understanding what species of bacterial leaf spot are present…
  - Potential for being seed-borne = more seed treatments being done
    - Growers in northern and central NJ use the hot water seed treatment each year
  - Some have multiple hosts = affect crop rotations!
  - Some may cross over between different types of commodities
    - *X. arboricola* pv. *pruni* in peach (stone fruits) and tomato….
    - We need further understanding on this…
  - Potential for copper resistance development and its subsequent impacts on production systems
  - Choosing resistant cultivars…
    - Bell pepper growers in southern New Jersey will need to adopt X10R varieties in the coming years, if not already!

Copper resistance detected in New Jersey

- Copper applications for the control of bacterial diseases in many crops used extensively…
- We have suspected the development of copper R 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…
- Copper R development known in other regions…
- In 2019, along with bacterial spp. determination we started to look for copper R in NJ in pepper/tomato and other crops…
- We did find copper R in bell pepper and tomato in NJ…
  - This varied by farm…50% of samples tested + for copper R!
- Our plans are to continue to survey over next couple of summers…Reach out to your County Agent or me and we will collect samples this summer!
  - This is not a quick test…

Copper Sensitivity Testing



Copper resistance among *Xanthomonas* species, as detected by growth on agar medium supplemented with copper sulfate. Left, copper added to agar medium -- 3 of 6 isolates showing growth; Right, no copper added -- all six isolates showing growth on medium. S = sensitive; R = resistant to copper.

Bacterial leaf spot (BLS) in pepper

- 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!**

BLS vs Phytophthora-resistance

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

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

Bacterial disease control

- Clorox or Hot Water Seed treat tomato and pepper seed…
  - Especially important if you grow heirloom tomatoes!
- 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!
  - Working fields while foliage is wet should be avoided as much as possible…
  - Tying and harvesting…Under heavy infection stop tying…
  - 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.
- Apply fixed copper on a regular basis to help suppress spread…
  - Need to understand if copper is still effective in your own operation!
  - Some of you may rely on disinfestants. Remember, these products only work on what they come into direct contact with…
  - Use of Actigard, disinfestants…if copper R present

General comments on cucurbit downy mildew

- Always comes up from south each year (so we think)
  - Naturally, with the weather…
  - In last 18 years, CDM it has shown up 1st on:
  - 6/25/04 -> 6/15/05 -> 7/12/06 -> 8/15/07 -> 7/9/08 -> 7/13/09 -> 8/11/10 -> 6/29/11 -> 5/30/12 -> 8/6/13 -> 7/22/14 -> 7/9/15 -> 7/11/16 -> 6/28/17 -> 7/2/18 -> 7/4/19 -> 7/2/20 -> 6/16/21
  - **(6% in May; 28% in June; 50% in July; 16% in Aug) = ~78% of time from June 15 – July 15.**
  - **All 1st on cucumber during last 12 yrs!**
  - Assumption is that it does not overwinter in northern regions because it needs a living host to survive…
  - In Europe, pathogen has been shown to produce oospores which would allow it to overwinter, but their role and presence in US is still not understood…
- Two mating types in US (A1 and A2)
  - A1 [lineage (clade) II] found on cucumber -> northern states (including NJ, NY,OH)
  - A2 [lineage (clade) I] mostly found on squash, watermelon and pumpkin
  - A1 and A2 mating types found in southern States (FL, GA, AL, SC, NC, TX)
  - Current population of cucurbit downy mildew across the US appears to be uniform with each lineage. Oospore production occurred in laboratory tests (Thomas, 2016).

General comments on cucurbit downy mildew

- New research shows that fungicide efficacy may differ depending on what CDM clade(s) are present (NCSU)
  - A1 [lineage (clade) II] mostly found on cucumber and melon
  - A2 [lineage (clade) I] mostly found on squash, watermelon, and pumpkin
- Some early research suggests that isolates in Clade II (cucumber) can quickly become resistant to specific fungicides (NCSU).
- Research out of NCSU also suggests that Clade II working itself sooner and further up East Coast than Clade I during the growing season…
  - Could be reason why we see more CDM in cucumber than other cucurbit crops in our region….
  - Clade I only detected in the late fall in NC.
  - Clade I not found in early summer in NC…
- Need to keep up to date with CDM reports each year!
  - Also follow and signup for CDM reports on CDMpipe website online…

Cucurbit downy mildew control in 2022

- Everyone needs to continue to diversify their spray programs…
- By that… use as many different FRAC groups as possible during the production season…
  - Switching to chemistries you haven't used before!
- Presidio – have been issues with lack of control in recent years.
- "newer" fungicides to include: Elumin 4SC (ethaboxam, 22); Orondis Ultra and Orondis Opti; Omega 500F (fluazinam, 29)
- Older fungicides: Ranman (21), Zampro (40 + 45), Previcur Flex (28) and others still working…
- Always tank-mix with protectant and rotate!
- Pay close attention to reports that come out via Extension so you know what cucurbit crops are being affected in your area!

Pepper anthracnose fungicide trial, RAREC

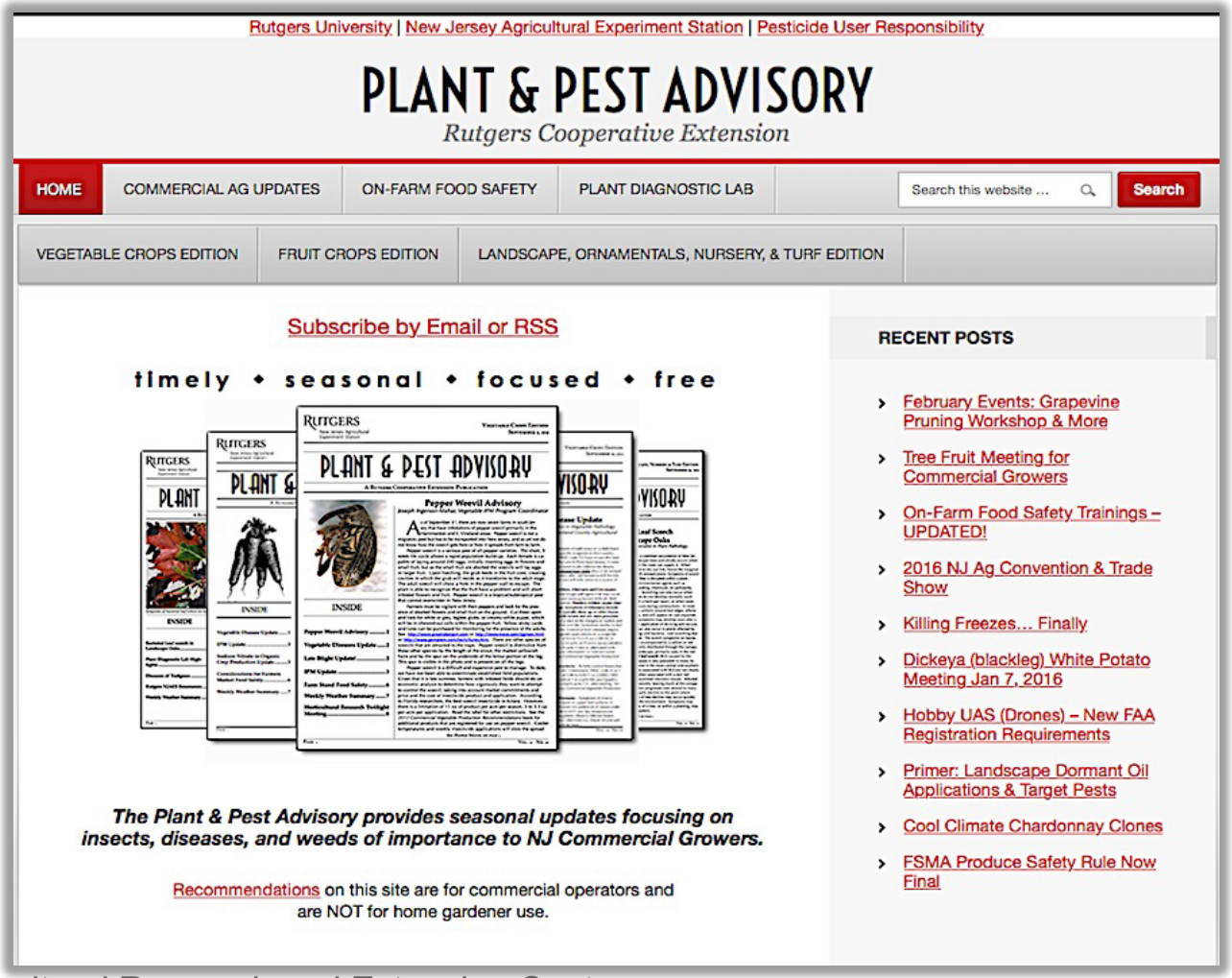
Fungicide program (application)	Healthy Fruit		Anthracnose-infected		Total fruit number	Total fruit weight (lb)	% Anthracnose infected fruit
	No.	Wt (lb)	No.	Wt (lb)			
UTC	16 b	5.95 b	67 a	18.60 a	83	24.55 b	80 a
2 pt Bravo (1,3,5,7) alt 1.5 lb Manzate (2,4,6,8) - local standard	62 a	24.84 a	17 b	5.19 b	79	30.03 ab	22 b
2 pt Bravo (1,3,5,7) alt. 13.5 fl oz Aprovia Top (2,4,6,8)	64 a	24.61 a	16 b	5.33 b	81	29.94 ab	21 b
2 pt Bravo (1,3,5,7) alt. 14.0 fl oz Quadris Top (2,4,6,8)	66 a	25.59 a	12 b	4.81 b	78	30.40 ab	18 bc
2 pt Bravo (1,3,5,7) alt. 11.4 fl oz Mirivas Prime (2,4,6,8)	87 a	32.71 a	18 b	5.63 b	105	38.34 ab	17 bc
2 pt Bravo (1,3,5,7) alt. 4 oz Cannonball (2,4,6,8)	85 a	32.90 a	18 b	6.53 b	103	39.43 ab	17 bc
2 pt Bravo (1-8) - local standard	85 a	33.88 a	15 b	4.78 b	100	38.65 ab	16 bc
2 pt Bravo (1,3,5,7) alt. 5.8 fl oz Mirivas Prime (2,4,6,8)	93 a	35.10 a	14 b	4.23 b	107	39.33 ab	16 bc
2 pt Bravo (1,3,5,7) alt. 12 oz Cabrio (2,4,6,8) - local standard	82 a	31.76 a	9 b	3.31 b	91	35.08 ab	12 bc
2 pt Bravo (1,3,5,7) alt. 15.5 fl oz Quadris (2,4,6,8) - local standard	98 a	38.43 a	8 b	2.59 b	105	41.01 a	8 c

Aprovia Top (FRAC code 3+7) = difenoconazole + cyprodinil
Quadris Top (3+11) = difenoconazole + azoxystrobin
Miravis Prime (7+12) = pydiflumetofen + fludioxonil
Cannonball (12) = fludioxonil
Cabrio (11) = pyraclostrobin
Quadris (11) = azoxystrobin

2022-2023
Mid-Atlantic Commercial Vegetable Production Guide

- New for 2022-2023 growing seasons!
- Forty-five Extension personnel from 6 states help update it
- Updates across the board on varieties, control recommendations, etc.
- Updated Tables for control options in greenhouse…
- Edamame section…new this year
- 466 pages, 30 pages more than 2020-2021 guide…
- Sent to printer yesterday, should be available to growers in next few weeks…Check with your local Extension office or grower association…
- Will be on-line in mid-February…

plant-pest-advisory.rutgers.edu



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