Tomato and Pepper

Tuesday morning 9:00 am

Where: Grand Gallery (lower level) Room A-B

Recertification credits: 1 (1B, PRIV OR COMM CORE)
CCA Credits: PM(0.5) CM(0.5) PD(1.0)

Moderator: Ron Goldy, District Vegetable Educator, MSU Extension

9:00 a.m. Phytophthora Research and Control in Peppers

- Mary Hausbeck, Plant Pathology Dept., MSU
- Jennifer Foster, Plant Pathology Dept., MSU

9:30 a.m. Early Tomato Yield Without High Tunnels

- Stephen Reiners, Horticultural Science Dept., Cornell Univ.

10:00 a.m. Safe Handling of Peppers and Tomatoes

- Les Bourquin, Food Science Dept., MSU

10:30 a.m. Current Issues in Work Authorization and Enforcement Actions

- Kimberly Clarke, Varnum, Riddering, Schmidt & Howlett, LLP, Grand Rapids, MI

Phytophthora Research and Control in Peppers

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Michigan has over 82,000 acres of vegetables that are susceptible to the soilborne oomycete pathogen *Phytophthora capsici*. The pathogen may overwinter in the soil and persist for many years (>10 years). The roots, crowns, stems, leaves and fruits of peppers can all be infected by *P. capsici*. This pathogen is favored by rain and warm temperatures and spreads readily via water. *P. capsici* has been found in irrigation ponds and surface water sources. Integrated management strategies are required to control Phytophthora crown, root and fruit rot of pepper. The most effective control measures are to avoid planting susceptible crops in infested soil and to limit the spread of the pathogen to clean fields. Crop rotation has limited benefits due to the long term survival of *P. capsici* in the soil. Cultural control methods, such as properly constructed raised plant beds, can be helpful by reducing saturated soil conditions. Foliar applications of fungicides directed at the base of the pepper plant applied prior to disease development can be helpful. Several resistant or tolerant bell pepper cultivars are available to Michigan producers. A combination of host resistance, effective fungicides, and cultural control strategies may be used to reduce significant yield losses from *P. capsici*.

Fungicide Trial

Currently registered fungicides were evaluated for control of Phytophthora crown, root and fruit rot of bell pepper (Table 1). The trial was conducted at the Michigan State University Muck Soils Research Farm in Laingsburg, MI on clay loam soil previously planted to pickling cucumber. According to the seed producers, the bell peppers 'Red Knight' (Seminis, Inc., St. Louis, MO) and 'Paladin' (Syngenta Seeds Inc., Boise, ID) are susceptible and intermediately resistant to *P. capsici*, respectively. On 9 Jun, 6-week-old pepper plants were transplanted by hand into raised beds 6-inches-high and covered in black plastic mulch with a single drip irrigation tape under the plastic. In each bed, peppers were planted into double staggered rows; one row of 'Red Knight' and the other of 'Paladin.' The spacing between rows was 12 inches. Drenches were applied to pepper seedlings in transplant trays just prior to planting. Applications of foliar fungicides were initiated at planting, and continued on a 7-day schedule. The plants were inoculated with a virulent isolate of *P. capsici* from Michigan that is insensitive to the fungicide mefenoxam, trade name Ridomil (Syngenta, Greensboro, NC). Plants exhibiting symptoms of Phytophthora crown and root rot, including wilting and death, were counted weekly. The pepper fruits were harvested four times, sorted by cultivar, and graded by size and incidence of Phytophthora fruit rot.

Table 1. Products tested.

Product	Active ingredient	Labeled	
		Peppers	*P. capsici*
Revus 2.08SC	mandipropamid	yes	yes
Presidio 4SC	fluopicolide	yes	yes
Prophyt 4.2EC	potassium phosphite	yes	yes
Tanos 50WG	famoxadone + cymoxanil	yes	yes, foliar and fruit phase only
Reason 500SC	fenamidone	yes	yes, foliar and fruit phase only
Acrobat 50WP	dimethomorph	yes	yes
Forum 4.18SC	dimethomorph	yes	yes
Kocide 2000 54DF	copper hydroxide	yes	no

Disease pressure was high at the test site with 96.3% of the susceptible 'Red Knight' and 30.6% of the tolerant 'Paladin' peppers showing Phytophthora root and crown rot symptoms by 9 Sep (Table 2). Although plants treated with the drench/spray program of a Prophyt 4.2EC drench, followed by Presidio 4FL alternated with Acrobat 50WP alternated with Prophyt 4.2EC significantly limited death of 'Red Knight' plants and had significantly higher yields than the untreated inoculated control, over 83% of treated plants died. 'Paladin' plants treated with Revus 2.08SC and Presidio had significantly less plant death (< 10%) than the untreated inoculated control (30.6%). No statistical differences in yield were observed among treatments applied to 'Paladin.'

Table 2. Evaluation of fungicides for management of Phytophthora crown and root rot of pepper.

Treatment and rate/A	Plant death (%)		Yield (lb/40 ft row)	
	'Red Knight'	'Paladin'	'Red Knight'	'Paladin'
Untreated inoculated	96.3 c*	30.6 d	3.4 cd	109.2
Untreated uninoculated	1.9a	0.6a	78.7 a	76.2
Prophyt 4.2EC 4 pt drench application, Presidio 4SC 4 fl oz *-alternate-* Acrobat 50WP 6.4 oz *-alternate-* Prophyt 4.2EC 6 pt	83.1 b	10.6 bcd	19.1 b	62.5
Revus 2.08SC 8 fl oz	90.6 bc	5.0ab	10.4 bc	113.5
Prophyt 4.2EC 4 pt drench application, Prophyt 4.2EC 6 pt**	90.6 bc	13.1 bcd	5.9 cd	88.2
Presidio 4FL 3 fl oz	91.9 bc	5.6abc	8.3 bcd	121.1
Tanos 50WG 10 oz	94.4 c	26.3 d	5.1 cd	107.2
Reason 500SC 8.2 fl oz	96.3 c	21.9 cd	7.0 cd	104.4
Acrobat 50WP 6.4 oz	96.9 c	15.6 cd	6.0 cd	108.4
Forum 4.18SC 6 fl oz	98.1 c	12.5 bcd	2.2 d	106.7
Kocide 2000 54DF 2 lb	99.4 c	15.0 cd	2.2 d	119.8

*Column means with a letter in common or with no letter are not significantly different (Fisher's Method, P=0.05)
**Foliar application began 14 days after transplanting

Variety Trial

Pepper cultivars and breeding lines were evaluated in the greenhouse for tolerance to Phytophthora root and crown rot. Twenty-seven breeding lines and cultivars with three to four true leaves were transplanted into individual pots. Pots were inoculated using millet seed inoculum with one of four *P. capsici* isolates from Michigan; 12889, OP97, SP98 and SFF3. Eight plants of each breeding line or cultivar were used per isolate. Eight plants per cultivar or breeding line were not inoculated. The plants were evaluated for wilting and plant death every two days. The fruits were harvested from the remaining plants at the end of the trial. The experiment was replicated twice.

Pepper plants exhibited symptoms of infection seven days after inoculation. Infected plants appeared wilted, and in some cases, had a dark brown stem lesion girdling the base of the plant. A week after initial disease symptoms, signs of infection appeared, including mycelia and pathogen sporulation within the stem lesions. The uninoculated control pepper plants never presented symptoms in either of the experiments (data not shown).

Differences in virulence among *P. capsici* isolates were observed across all cultivars and breeding lines screened (Table 3). Inoculation with isolate 12889 resulted in a significantly higher plant death than the other isolates. OP97 was less virulent than 12889, but significantly more virulent than SFF3 and SP98. Differences in cultivar susceptibility to crown and root rot were observed. 'Paladin' had the lowest average plant death (%) among all cultivars across all isolates. The bell pepper PRO3-15x16R-5 and the Poblano pepper XPP2548 had the lowest average plant death (%) among all breeding lines screened across all isolates. All cultivars and breeding lines in the trial were tolerant to the isolates SP98 and SFF3, including those cultivars considered susceptible.

Cultivar selection plays an important role in disease management. Different pepper cultivars will not provide an equal level of tolerance to local isolates of *P. capsici*. Growers should evaluate several pepper cultivars on-site, selecting those which provide the greatest level of tolerance to the isolates at their location.

Table 3. Plant death (%) among bell pepper lines inoculated with four isolates of *P. capsici*.

Pepper lines	Plant death (%) per isolate			
	12889	OP97	SP98	SFF3
Cultivars				
Alliance	100	94	19	6
Aristotle (non-pelleted seed)	100	44	6	6
Aristotle (pelleted seed)	100	31	0	13
Brigadier	100	94	25	13
Camelot	100	94	13	19
Declaration	100	25	19	0
Paladin	63	6	0	0
Plato	100	81	13	6
Red Knight	100	94	13	25
Revelation	100	88	13	0
Revolution	100	25	0	13
Snapper	100	100	19	25
Breeding lines				
9925776	100	63	13	6
9931126	81	25	0	13
9941819	100	69	0	0
9943084	100	44	13	0
9943095	100	94	19	0
PRO3-13x14R-4	69	0	6	6
PRO3-15x16R-5	38	6	0	13
PRO4T-11x12	100	19	6	6
PRO5-C71x72	100	0	0	0
PRO5-81x82	81	0	0	6
PRO5-C85x86	100	6	6	6
PRO5-C87x88	100	0	0	13
Prophet	94	50	0	6
PX9942595	100	63	0	0
XPP2548	25	13	13	0