MAPPING YOUR ROUTE TO THE FUTURE

Great Lakes Fruit, Vegetable & Farm Market EXPO
DeVos Place Convention Center
Grand Rapids, MI
December 7-9, 2004

Phytophthora

Wednesday morning 9:00 am

Where: Grand Gallery Room E-F (lower level)

Recertification credits: 1 (Private, 1B, 1C)

CCA Credits: IPM(2)

Moderator: Bruce MacKellar, St. Joseph Co. MSU Extension

9:00 a.m. Wisconsin Experience with Phytophthora Fruit Rot of Cucumbers

- Walter R. Stevenson, Plant Pathology Dept., Univ. of

9:15 a.m. Are all Susceptible Crops Equally Susceptible to Phytophthora Blight?

- Gerald J. Holmes, Plant Pathology Dept., NC State Univ.

10:15 a.m. Planning Your Strategy: New Tips

- Mary Hausbeck, Plant Pathology Dept., MSU

Phytophthora – Planning Your Strategy: New Tips

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Michigan has over 79,000 acres of vegetables that are vulnerable to root, crown, and fruit rot caused by the soilborne fungus, *Phytophthora capsici*. *Phytophthora capsici* has two mating types that allow the production of long term survival spores (oospores) and development of genetic adaptations that foster fungicide resistance. The oospores can survive in soil up to ten years without a susceptible crop, and both mating types needed for oospore production have been found in every sampled field in Michigan. *Phytophthora* is favored by rain and warm temperatures that occur during the Michigan growing season and has recently been found in irrigations ponds and other surface water sources. The most effective control measure that growers have available is to avoid planting in infested soil and limit the spread of the disease to clean fields. Crop rotation is difficult as infested acreage and urban pressure is increasing across the major growing areas of the state. Properly constructed raised beds can be helpful as they keep vulnerable plants from saturated soil conditions. Foliar applications of preventive fungicides can be effective if proper coverage and timing of applications can be achieved. A combined approach of all available control techniques is more effective than using just one control measure.

Fungicide Trials

Research conducted at Michigan State University has identified fungicides that can be used to limit fruit infection of pickling cucumbers. At one time, the standard systemic fungicide mefenoxam (Ridomil, Ultra Flourish) was very effective in protecting the fruit from infection. However, the repeated use of this fungicide and the genetic adaptation capability of *Phytophthora capsici* resulted in resistant populations of the pathogen in many of Michigan vegetable fields. In these cases, using Ridomil Gold or Ultra Flourish does not offer any control and alternative fungicides should be used (Table 1). Recent registrations of Acrobat (dimethomorph), Gavel (mancozeb + zoxamide), and Tanos 50DF (famoxadone + cymoxanil) give growers alternatives to Ridomil Gold or Ultra Flourish and are helpful as rotational products for growers interested in using Ridomil Gold or Ultra Flourish.

Table 1. Products used in 2004 pickle trials.

Product	Active ingredient	Company	Crops on label
Acrobat 50WP	dimethomorph	BASF	cucurbits
Forum 4.16SC	dimethomorph	BASF	no
Gavel 75DF	mancozeb + zoxamide	Dow	cucumber, melon, summer squash
Kocide 2000 54DF	copper hydroxide	Griffin	cucurbits
Maestro 80DF	captan	Arvesta	no
ManKocide 61DF	mancozeb + copper hydroxide	Griffin	cucumber, melon, summer squash
Manzate 75DF	mancozeb	Griffin	cucumber, melon, summer squash
Ridomil Gold MZ	mefenoxam + mancozeb	Syngenta	cucumber, melon, summer/winter squash
Tanos 50DF	famoxadone + cymoxanil	duPont	cucurbits

A study was conducted at a grower cooperator's farm in Van Buren County, MI on a sandy loam soil with a history of *Phytophthora*, and previously planted to cucumber. Plots were 600 ft long with 9 rows per plot, 30 in between rows and 3 in between plants. Treatments were replicated twice in a random order. Fungicide treatments were applied with a conventional boom sprayer with XR8003 nozzles spaced 20 in. apart, operating at 60 psi and delivering 30 gal/A. Sprays were applied when the oldest fruits on the vine were 1, 3, and 5 in. in size. Numbers of infected fruit that came across the transfer belt of the harvester were recorded for a pass of 3 rows by 600 ft (4,500 ft^2). Samples of fruit were taken on 30 August from each treatment strip and stored five days under ambient conditions, and evaluated for *Phytophthora* infection on 3 September.

Rainy conditions (5 in. total) occurred during the 12 days between the first and final applications. The soil remained wet throughout the trial and disease developed uniformly across all untreated plots. All treatments significantly reduced the amount of infected pickles at the time of harvest (Table 2).

Table 2. Efficacy of fungicides for Phytophthora crown, root, and fruit rot of pickles, trial 1.

Treatment and rate/A (fruit size when treated)	Infected fruit	
	At harvest (number)	After 5 days storage (%)
Untreated	1,092.5 b*	33.0
Forum 4.16SC 6.2 fl oz + Kocide 2000 54DF 1.5 lb (1", 3", 5")	6.5 a	11.5
Forum 4.16SC 6.2 fl oz + Kocide 2000 54DF 1.5 lb + Manzate 75DF 2 lb (1", 3", 5")	12.5 a	11.5
Gavel 75DF 2 lb + Kocide 2000 54DF 1.5 lb (1") Acrobat 50WP 6.4 oz + Kocide 2000 54DF 1.5 lb (3", 5")	10.5 a	24.0
Gavel 75DF 2 lb + Kocide 2000 54DF 1.5 lb (1", 3") Acrobat 50WP 6.4 oz + Kocide 2000 54DF 1.5 lb (5")	11.5 a	17.0
Tanos 50DF 8 oz + Kocide 2000 54DF 1.5 lb + Manzate 75DF 2 lb (1") Gavel 75DF 2 lb + Kocide 2000 54DF 1.5 lb (3") Acrobat 50WP 6.4 oz + Kocide 2000 54DF 1.5 lb (5")	1.0 a	10.0
Tanos 50DF 10 oz + Kocide 2000 54DF 1.5 lb + Manzate 75DF 2 lb (1") Gavel 75DF 2 lb + Kocide 2000 54DF 1.5 lb (3") Acrobat 50WP 6.4 oz + Kocide 2000 54DF 1.5 lb (5")	66.0 a	36.0
Tanos 50DF 12 oz + Kocide 2000 54DF 1.5 lb + Manzate 75DF 2 lb (1") Gavel 75DF 2 lb + Kocide 2000 54DF 1.5 lb (3") Acrobat 50WP 6.4 oz (5")	2.0 a	3.5
Tanos 50DF 10 oz + ManKocide 61DF 2 lb (1") Gavel 75DF 2 lb + Kocide 2000 54DF 1.5 lb (3") Acrobat 50WP 6.4 oz + Kocide 2000 54DF 1.5 lb (5")	10.0 a	7.5
Ridomil Gold MZ 2.5 lb + Kocide 2000 54DF 1.5 lb (1", 3", 5")	10.0 a	31.0
Maestro 80DF 6 lb + Kocide 2000 54DF 1.5 lb (1", 3", 5")	37.0 a	5.5

*Column means with a letter in common or no letter are not significantly different (Student-Newman-Keuls; P=0.05).

A study was conducted at a grower cooperator's farm in Van Buren County, MI on a sandy loam soil with a history of *Phytophthora*, and previously planted to cucumber. Plots were 600 ft long with 9 rows per plot, 30 in between rows and 3 in between plants. Treatments were replicated twice in a random order. Fungicide treatments were applied with a conventional boom sprayer with XR8003 nozzles spaced 20 in apart, operating at 60 psi and delivering 30 gal/A. Sprays were applied four different times, when the oldest fruits on the vine were 1, 3, and 5 in. (12, 16, and 20 September) in size and again on 23 September. Numbers of infected fruit that came across the transfer belt of the harvester were recorded for a pass of 3 rows by 600 ft (4,500 ft^2). Samples of fruit were taken on 25 September from each treatment strip and stored five days under ambient conditions, and evaluated for *Phytophthora* infection on 30 September.

A driving rainstorm between the second and third applications provided 1 in. of rain in a 15 minute period. This event left substantial amounts of soil on the fruit that remained until harvest. No other precipitation occurred during the trial. All treatments significantly reduced the amount of infected pickles at the time of harvest (Table 3). All treatments of Maestro 80DF (both rates) + Kocide 2000 54DF applied either alone or in rotation with Acrobat 50WP + Kocide 2000 54DF were very effective in limiting *P. capsici* infection to under 16 fruit per harvest pass. There were no significant differences among the treatments for amount of infected pickles evaluated after five days of storage.

Table 3. Efficacy of fungicides for Phytophthora crown, root, and fruit rot of pickles, trial 2.

Treatment and rate/A (fruit size when treated)	Infected fruit	
	At harvest (number)	After 5 days storage (%)
Untreated	83.3 b*	4.4
Acrobat 50WP 6.4 oz + Kocide 2000 54DF 1.5 lb (1", 3", 5") . .	29.3 a	0.2
Maestro 80DF 4 lb + Kocide 2000 54DF 1.5 lb (1", 3", 5")	15.7 a	0.8
Maestro 80DF 6 lb + Kocide 2000 54DF 1.5 lb (1", 3", 5")	5.0 a	0.0
Tanos 50DF 12 oz + Kocide 2000 54DF 1.5 lb (1", 3", 5")	30.3 a	2.3
Gavel 75DF 2 lb + Kocide 2000 54DF 1.5 lb (1", 3", 5")	20.0 a	0.2
Gavel 75DF 2 lb + Kocide 2000 54DF 1.5 lb (1") Tanos 50DF 12 oz + Kocide 2000 54DF 1.5 lb (3") Acrobat 50WP 6.4 oz + Kocide 2000 54DF 1.5 lb (5")	28.0 a	0.0
Maestro 80DF 6 lb + Kocide 2000 54DF 1.5 lb (1", 5") Acrobat 50WP 6.4 oz + Kocide 2000 54DF 1.5 lb (3")	7.7 a	0.0

*Column means with a letter in common or no letter are not significantly different (Student-Newman-Keuls; P=0.05).

Fumigation Trials

Studies conducted on vegetable crops (tomato, eggplant, pepper, zucchini, winters squash, melon, and watermelon) in 2003 and 2004 compared the efficacy of currently registered fumigants for the control of *Phytophthora capsici* and their possible use as a replacement product for Methyl bromide. Each year, trials were conducted on grower cooperator farms in fields with severe *Phytophthora* disease pressure. Treatments of Methyl bromide/chloropicrin, chloropicrin alone (100 %), and Telone C-35™ (1,3-dichloropropene/chloropicrin) were applied using standard gas-injection knives 10-12 in. below the soil and then covered with plastic mulch. Applications of Vapam™ (metam sodium) and K-Pam™ (metam potassium) were made via drip tapes installed under the plastic mulch. In 2003, each product was applied alone at the upper rates used by growers. For 2004, K-Pam™ was tested alone and in combination with chloropicrin at both the upper and lower labeled rates. Each crop was planted after the appropriate period of off-gassing had expired for each treatment.

Plots were rated for amount of plants killed by *P. capsici* each year and the plantings of melon and watermelon were especially vulnerable to disease (Table 4). Data from the 2004 trial shows that applications of both rates of K-Pam™ applied either alone or in combination with chloropicrin were very effective in controlling *P. capsici* in both the melon and watermelon plantings. Applications of Methyl bromide/chloropicrin and chloropicrin alone also significantly limited disease in the highly susceptible crops in 2004.

Table 4. Evaluations of fumigants for Phytophthora crown and fruit rot of cucurbit crops.

Treatment	Rate/acre	Application method[z]	Plant death (%)[y]	
			Melon	Watermelon
Untreated	–	–	97.8 b[x]	37.7 b
Methyl bromide/Chloropicrin (67/33)	350 lb	Shank	22.2 a	11.1 ab
Telone C35	35 gal	Shank	66.7 b	36.7 b
Chloropicrin K-Pam	25 gal 30 gal	Shank Drip	0.0 a	0.0 a
Chloropicrin K-Pam	25 gal 60 gal	Shank Drip	0.0 a	0.0 a
Chloropicrin	25 gal	Shank	20.0 a	33.3 b
K-Pam	60 gal	Drip	3.3 a	8.8 a
K-Pam	30 gal	Drip	8.8 a	0.0 a

[z]Materials were applied either at time of bed formation using swept back knives or pre-plant through drip tape.
[y]Percentage of plants killed by disease out of nine original plants.
[x]Column means with no letter or a letter in common are not significantly different, SNK, P=0.05.

Combining the percentage of plants killed by *P. capsici* for all crops resulted in significant disease control for all treatments applied in 2003 (Fig. 1). In 2004, both rates of K-Pam™ applied alone or in combination with chloropicrin were very effective in limiting *P. capsici* in all crops (Fig. 2). Applications of Methyl bromide/chloropicrin and chloropicrin alone were also significantly better than the untreated control. The treatment of Telone C-35™ was not as effective in 2004 as it was in the 2003 study.