COMPARING FUMIGANTS FOR THE CONTROL OF *PHYTOPHTHORA CAPSICI* IN VEGETABLE CROPS

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The soil-borne pathogen *Phytophthora capsici* affects the production of cucumbers, eggplant, peppers, both summer and winter squash, melons, watermelons, and tomatoes. In Michigan, *P. capsici* is a limiting factor in the production of over 80,000 acres of vegetable crops. *Phytophthora capsici* has two mating types that allows for production of long term survival spores (oospores) and development of genetic adaptations that foster fungicide resistance. Both mating types needed for oospore production have been found in every sampled field in Michigan. The oospores can survive in soil for at least ten years without the presence of a susceptible crop.

Phytophthora is favored by rain and warm temperatures that occur during the Michigan growing season and has 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. Crop rotation to clean fields is becoming more difficult as infested acreage and urban pressure is increasing across the major growing areas of the state. The scarcity of uninfested fields has led Michigan=s fresh market vegetable growers to utilize raised plant beds combined with methyl bromide-based fumigants. The use of methyl bromide is favored due to the short-plant back interval and its effectiveness under a wide range of application conditions. Combining raised beds, black plastic, and methyl bromide has allowed the production of *P. capsici*-susceptible crops on infested soil.

Research conducted at Michigan State University has focused on finding new products or combinations of products that are as effective as methyl bromide in controlling *P. capsici*. During the summer of 2003 and again in 2004 large scale replicated plots were established on a grower=s farm on a parcel infested with Phytophthora. Products were applied pre-plant either by shank injection or through drip tape. All treatments were applied to raised beds covered with LDPE film commonly used by Michigan growers. Treatment plots consisted of one plastic mulch covered bed (140-ft). Two drip tubes were installed 1 in. under the plastic during bed formation and mulch laying and divided the bed into thirds. Treatments were placed in a randomized complete block design with four replicates.

Each treatment row was divided into seven 20-ft sections and planted with seven different vegetable crops in this order: tomato, eggplant, pepper, zucchini, winter squash, muskmelon, and watermelon. Stand counts and vigor ratings were taken for each crop several times over the course of the study. Yields were collected by harvesting fruit from entire 20 ft of row.

After planting in 2003, warm dry conditions prevailed until the first week of Aug when several heavy rains saturated the soil. Disease developed quickly and uniformly across the replicates with significant differences in plant death for muskmelon and watermelon (Table 1). There was only limited plant death for the tomato, eggplant, pepper, and squash plots for any of the rating dates. Applications of Telone C35, Vapam HL, methyl bromide/chloropicrin, and Multigard Protect (56 gal) + Vapam HL (30 gal) had the lowest plant death ratings for both melon crops. Multigard Protect (37 gal) + Vapam HL (20 gal) and Multigard FFA (70 gal) also had significantly less plant death for watermelon compared to the untreated control.

Significant plant death in the watermelon plots did produce yield differences. Applications of Telone C35, methyl bromide/chloropicrin, Vapam HL, and Multigard Protect (56 gal) + Vapam HL (30 gal) provided the highest yields among the treatments tested.

Additional studies were conducted in 2004 that incorporated information from 2003 to further enhance applications of new products. To improve performance of drip-applied treatments, applications were made using tape with an 8 in. emitter spacing instead of the 12 in. industry standard. This change allowed for more uniform distribution of water and product across the bed. A higher rate of Midas/chloropicrin (33/67) was used in 2004 as the rate used in 2003 was not effective in controlling *P. capsici* on both melon and watermelon. Multigard treatments were not included in 2004 and were replaced by sodium azide. There was significant early phytotoxicity symptoms recorded for the sodium azide treatments. Most of the crops recovered from this injury after 5 to 6 weeks after planting.

Table 1. Plant death from Phytophthora corn and root rot when melon and watermelon were planted in plots treated with various fumigants.

Treatment	Rate/acre	Application method[z]	Plant death [y]	
			Melon	W. Melon
Untreated			10.0 d	10.0 f
Multigard™ Protect Multigard™ Protect	46.6gal 5.8 gal	Drip Pre Drip Post	10.0 d	10.0 f
Multigard™ Protect Multigard™ Protect	70.0 gal 5.8 gal	Drip Pre Drip Post	9.5 d	7.5 def
Multigard FFA Multigard™ Protect	46.9 gal 5.8 gal	Drip Pre Drip Post	10.0 d	7.8 def
Multigard FFA Multigard™ Protect	70.4 gal 5.8 gal	Drip Pre Drip Post	8.8 cd	6.0 cde
Multigard™ Protect +Vapam HL Multigard™ Protect	37 gal 20 gal 5.8 gal	Drip Pre Drip Post	7.5 bcd	4.8 bcde
Multigard™ Protect +Vapam HL Multigard™ Protect	56 gal 30 gal 5.8 gal	Drip Pre Drip Post	5.0 abc	3.8 bc
Vapam HL	75 gal	Drip Pre	3.8 ab	2.3 ab
Propylene oxide	45 gal	Shank Pre	10.0 d	10.0 f
Methyl Bromide/chloropicrin (67/33)	350 lb	Shank Pre	1.3 a	1.8 ab
Telone C35	35 gal	Shank Pre	2.5 a	0.0 a
Midas/chloropicrin (50/50)	250 lb	Shank Pre	9.3 d	9.0 ef
Midas/chloropicrin (33/67)	200 lb	Shank Pre	9.0 d	10.0 f

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