Soil fumigation controls sudden wilt of melon

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Fumigants control Pythium fungus infections and appreciably increase melon yields

Sudden wilt affects melons within a few weeks of fruit maturity. Healthy-appearing vines suddenly collapse, usually after the last irrigation: the leaves wither, and the nearly ripe, exposed melons sunburn and dry in the sun. The disease is reported to be a fungal infection of the roots caused by *Pythium* spp. We conducted a series of experiments on control of this disease by soil fumigation.

Preliminary field and laboratory tests were performed during January-June 1982 at the U.S. Department of Agriculture Field Station, Brawley, California, to evaluate fumigation with methyl bromide at 250 and 400 pounds per acre. The top foot of soil in the field was a silty clay loam; the subsoil was a silt loam down to 5 feet. Although virus infections in the field made the evaluation difficult, we were able to obtain enough data from these tests to conclude that a relatively high rate — probably more than 400 pounds per acre — would be necessary to fumigate such fine-textured soils adequately.

We conducted the second experiment at the UC Imperial Valley Field Station, El Centro, during July-December 1982. Initial growth of White Crenshaw melons in soil treated with methyl bromide at 400 pounds per acre was exceptional. Unfortunately, virus infections became so severe that it was impossible to evaluate the treatments accurately, although we obtained some information before the viruses became prevalent.

Primary roots from plants in untreated soil appeared to be white and unscathed. However, microscopic examination showed abundant fungal structures (pythiaceous hyphae) in the cortex of the primary roots, as well as on the surface near scars where lateral roots had once been, and no root hairs were observed. Other fungus structures typical of *Pythium* spp. were also visible. In roots from the methyl bromide 400-pound-per-acre plot, however, there were many root hairs, and lateral roots were intact. *Pythium*-like fungal structures were found on the roots, but less commonly than on roots from untreated soil.

The results of this experiment indicated that methyl bromide at 400 pounds per acre was an effective, albeit probably not completely successful, treatment for the control of sudden wilt.

The third experiment, in January-July 1983, was conducted in a 265- by 200-foot field at the UC Imperial Valley Field Station that had a history of sudden wilt. The sandy clay-loam soil was prepared and leveled, but not furrowed. The moisture content of soil samples taken from four sites diagonally across the field indicated that the soil could be successfully fumigated.

We used nine treatments, but will report here only on the following: methyl bromide at 420, 560, and 630 pounds per acre; a mixture of 80 percent methyl bromide and 20 percent chloropicrin at a rate of 525 pounds per acre; and an untreated control. A commercial applicator rig with chisels set 12 inches apart and 10 inches deep fumigated an 11- by 265-foot area. On the first traverse, both edges of the 1-mil-thick polyethylene tarp were buried; on the second traverse, one edge was glued to the first strip, and the outside edge buried. An 11-foot-wide strip across each end of the field at right angles to the other treated areas was fumigated with methyl bromide at approximately 400 pounds per acre in an attempt to prevent subsequent contamination problems.

Because of heavy rainfall, the tarps were not removed for 20 days. At that time (late February), beds were prepared and seeded with *Pythium*-free Top Mark melon seed. We used Top Mark, because it is more resistant than Crenshaw to viruses, although it is also less susceptible to sudden wilt.

A treatment plot consisted of three 265-foot-long rows 80 inches apart. The two outer rows and 20 feet at either end of the center row were machine-seeded; most of the center row (225 feet) was seeded by hand using 1,200 seeds. The field was furrow-irrigated after seeding, and plants were thinned to 1-foot intervals after emergence. Fertilization consisted of 180 pounds of phosphorus applied before planting and 80 pounds of nitrogen side-dressed when plants were six to seven weeks old.

We took data only on plants in the center 210 feet of the center row of each plot, although we also considered the general appearance of plants in the border rows.

Stand count and appearance

Five weeks after seeding, stand percentages in the four fumigant treatments were as follows: methyl bromide/chloropicrin, 68 percent; methyl bromide at 560 pounds per acre, 67 percent; methyl bromide at 630 pounds, 63 percent; and methyl bromide at 420 pounds, 62 percent. The untreated plot had a 47 percent stand. Plants in treated plots also looked healthier and larger than those in the untreated plot. Weeds were virtually absent from the treated plots but abundant in the untreated plot. No postemergence seedling damping-off in treated plots was observed in this experiment or in the previous two experiments.

The early differences in growth in treated plots continued during the season. About 10 weeks after planting, the plants in the methyl bromide/chloropicrin and the 560- and 420-pound-per-acre methyl bromide plots were clearly the most advanced, but those at one end of the 630-pound treatment were stunted and somewhat bronze with considerable browning of leaf margins. The cause may have been methyl bromide or bromine residues, but this was not confirmed.

Even 14 weeks after planting, the differences in growth in methyl-bromide-treated and untreated soil were pronounced. The vines completely covered the beds and furrows from row to row in treated plots but only about one-third of

Vines and leaves of nearly mature melons struck by sudden wilt collapse and wither, exposing the fruit to sunburn and drying.

Pea seedlings growing in soil taken from field plots and tested in a growth room

Previous soil treatment in field	Percentage of pea seedlings growing*		
	Date of field soil collection†		
	3/31/83	3/31/83	4/13/83
	Planting dates in growth room		
	4/1/83	4/7/83	4/19/83
	%	%	%
Control (untreated)	4.0	7.2	24.4
Methyl bromide:			
420 lb/acre	74	91.6	—
560 lb/acre	94	88.3	—
630 lb/acre	90.6	90.5	92.7
Methyl bromide/chloropricin:			
525 lb/acre	85	87	—
UC mix, autoclaved	98	96.6	96.6

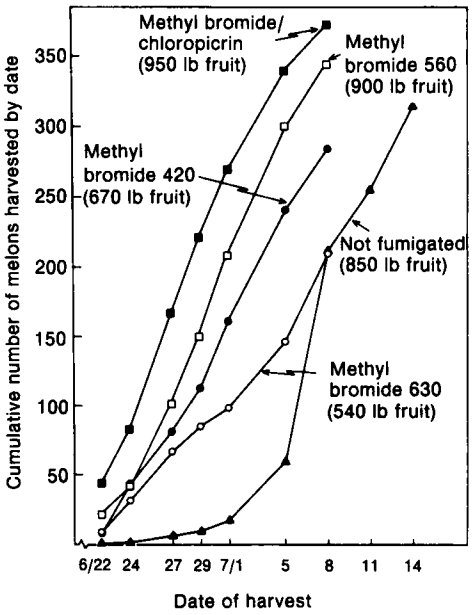
* Percentages of the means of duplicate treatments. Each treatment consisted of *Pythium*-free Little Marvel pea seeds surface-disinfested in sodium hypochlorite solution before planting, planted 10 in each of four pressed peat pots, 2.5 by 2.5 inches. Treatments randomized in growth room, held at 21°C night 23°C day temperatures with 12-hour light period.

† Soil taken from 2.5- to 6-inch layer from four places in each treatment plot, bulked, and mixed.

the beds in untreated plots. There were incipient virus symptoms in all of the plots, but they were not pronounced. Also, no wilted plants were seen in any of the plots, even though many plants in an adjacent Crenshaw planting showed early to advanced stages of sudden wilt.

Soil analysis

We tested the soil for *Pythium* spp. by using sterilized beet seed as "bait." Untreated soil was highly infested with *Pythium* spp., since 61 of 72 seeds became infected. Soil from some of the fumigation treatments was also infested: 10 of 24 seeds from methyl bromide/chloropicrin treatments and 2 of 24 seeds from methyl bromide 420-pound-per-acre plots were positive for *Pythium* spp. None of 24 seeds from methyl bromide 560- or 630-pound-per-acre plots was infested. The *Pythium* sp. isolated grew slowly and was not typical of most previous isolates. Possibly, it was not directly connected with sudden wilt; tests are underway to determine its role in the disease.



All melons from treated plots were harvested before any from untreated plots were picked.

We performed quantitative laboratory tests of the effectiveness of fumigation by growing *Pythium*-free Little Marvel peas as indicator plants in peat pots containing soil from treated and untreated field plots (see table). Emergence counts, taken up to 10 days after seeding, were nearly as large in fumigated soils as in autoclaved UC mix. Only a few plants emerged in untreated soils. *Pythium* spp. isolated from diseased peas were similar to those isolated previously from melon seedlings. Thus, fungi capable of causing damping-off of peas were significantly reduced (perhaps eliminated) in the 2.5- to 6-inch layer by fumigation with methyl bromide or methyl bromide/chloropicrin mixtures.

Yield

In field plots, marketable fruit were harvested from June 22 to July 14. Plants in untreated plots did not show much wilt, but they did not mature until those in treated plots had set fruit and had begun to wither naturally. A day before the last melon picking in the fumigated plots, we found about 20 wilting areas in the untreated plot, as compared with 3, 2, and 11 wilting areas in plots treated with 630, 560, and 420 pounds methyl bromide per acre, respectively. Wilt was not severe in any of the areas.

Melon yield in the methyl bromide/chloropicrin and methyl bromide 560-pound-per-acre plots was much higher than in the untreated plot (see graph). A higher incidence of wilt may have caused the low yield in the methyl bromide 420-pound-per-acre plot. The low yield in the 630-pound-per-acre plot is probably an indication of methyl bromide injury to the plants.

The most striking result is that almost all of the melons were harvested from the methyl bromide 560-pound-per-acre and methyl bromide/chloropicrin plots before any melons were picked in the untreated plot.

Conclusions

These experiments in the Imperial Valley indicate that it is feasible to use methyl bromide or a mixture of methyl bromide and chloropicrin to control sudden wilt. The high concentrations needed (above 420 pounds per acre, but less than 560 pounds per acre) make the treatment expensive, however. Our results suggest that fumigation may have advantages in addition to disease control: it appears that perhaps up to 50 percent less seed may be needed (an important factor if hybrid seed is planted); weeds may be controlled; thinning may be reduced, if not eliminated; and the plants mature earlier.

We are continuing work on identification of the species of *Pythium* involved and their role in producing the disease, effect of the fumigation treatments on a second melon planting or other crops, and use of other chemical measures for controlling the disease.

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