Table 4. Effect of off-season management and soil treatments on nutseige emergence in mulched beds 26 days after fumigation.

<table>
<thead>
<tr>
<th>Season</th>
<th>Fumigant</th>
<th>Nutseige plants/bed ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Solarized</td>
</tr>
<tr>
<td>Fall 1985</td>
<td>Control*</td>
<td>7.1 b</td>
</tr>
<tr>
<td></td>
<td>V-201</td>
<td>1.1 a</td>
</tr>
<tr>
<td></td>
<td>MBC</td>
<td>0.0 a</td>
</tr>
</tbody>
</table>

*Eight weeks solarization under 4 mil clear polyethylene film (10 July-9 Sept.) vs Sesbania macrocarpa cover crop in summer 1985.

Control = no fumigant; V-201 = methyl isothiocyanate 17%, 1,3-dichloropropene 34%, chloropicrin 15% at 35 gal/acre; MBC = methyl bromide 98%, chloropicrin 2% at 300 lb./acre.

Mean separation by DMRT (P = .05).

Fusarium and Verticillium wilt in the cover crop block were not affected by pH: MBC reduced disease incidence regardless of pH and V-201 was effective at pH 7.5. Yields in the fall crop by solarization and Fusarium in the non-solarized area by the high pH, that the fumigants displayed Fusarium control at the low pH in the cover crop block. Verticillium wilt in the cover crop block was not affected by pH: MBC reduced disease incidence regardless of pH and V-201 was effective at pH 7.5. Yields in the fall crop on solarized plots did not benefit from fall fumigation; however, best production in the double crop was obtained from previously fumigated plots (Table 1). Previous work (13) indicated that the benefit of fall applications of MBC may carry through a fall/spring double-crop management. Yields in fumigated plots, regardless of off-season management, were higher with the low pH in the fall crop and with the high pH in the spring.

Conclusions

Although Florida summer conditions are not ideal for soil solarization (rainfall and high water tables mitigate against maintaining the high soil temperatures developed in some other agricultural areas) the pest management procedure has potential as an alternative method for controlling nematodes, weeds, and soil-borne diseases of tomato.


CONTROL OF EARLY BLIGHT OF TOMATO WITH FOLIAR SPRAY MIXTURES AND HIGH FERTILIZER RATES

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Additional index words. mancozeb, chlorothalonil, tribasic copper sulfate, cupric hydroxide, Lycopersicon esculentum, Alternaria solani.

Abstract. Once-weekly sprays of mancozeb + tribasic copper sulfate applied to cherry tomatoes (Lycopersicon esculentum

Mill. cv. BHN 12) provided better early blight (Alternaria solani) control than either material alone. Mancozeb cupric hydroxide sprays resulted in control better than mancozeb alone and equal to cupric hydroxide alone. Chlorothalonil + Cu sprays gave better control than any other spray mixture or any component material alone. All mancozeb + Cu and chlorothalonil + Cu mixtures appeared to be compatible. The severity of early blight on 'Walter' tomatoes was greatly inhibited by 748, 1,122, or 1,496 pounds per acre rates of an 18-0-20.75-1.2 N-P-K-Mg fertilizer compared to 167 or 374 pounds per acre rates. In general, disease severity increased with decreasing fertilizer rate.

Early blight, caused by the fungus Alternaria solani (Ell. & Mart.) Jones and Grout, is one of the most common

foliage blights of tomato worldwide. In Florida, however, the disease occurs sporadically and generally is of little economic importance on the commonly grown large-fruited, fresh-market cultivars. On occasion, the disease develops on the stems (collar rot phase) of container plants while in the greenhouse or plant production house. When, and if, these infected plants are transplanted to the field, the disease often is very difficult to control and may be extremely destructive. In addition, some of the cherry tomato cultivars seem to be quite susceptible and require frequent fungicide applications to prevent substantial loss of foliage and fruit. The apparent difficulty of growers to control early blight when it occurs, has prompted many to question the efficacy of the maneb/mancozeb Cu mixtures used primarily for control of bacterial spot (Xanthomonas campestris pv. vesicatoria) and, incidentally, for the control of early blight. Therefore, a field experiment was carried out during the spring season of 1986 to compare the effectiveness of maneb + Cu mixtures to that of chlorothalonil + Cu mixtures for control of early blight.

_Altvernaria solani_ is considered to be a weak pathogen (1, 4) and to be strongly influenced by climatic and cultural conditions. Factors that reduce plant vigor supposedly predispose the host to disease, whereas high soil fertility supposedly protects the host from disease (1, 4). However, actual experimental data supporting these observations and suppositions are lacking. Therefore, an experiment was carried out in the fall season of 1974 to determine the effect of fertilizer rates on early blight development in the field.

**Materials and Methods**

_Fertility experiment_. Increasing rates of an 18-0-20.75-1.2 (N-P-K-Mg) fertilizer, prepared from potassium nitrate, ammonium nitrate, and magnesium sulfate, were applied in 2 bands (1 band on each bed shoulder) to the surface of raised beds (20 inches wide x 10 inches high) of EauGallie fine sand. The rates were 187, 374, 748, 1122, 1496 lbs./acre (0.58, 1.16, 2.32, 3.49 lb./30 linear feet). The beds were shaped and pressed, the appropriate fertilizer amounts applied, and ethylene dibromide (24 gal/acre, 20% EDB) injected. The beds then were covered with 1.5 mil. black polyethylene mulch. ‘Walter’ tomato plants (20 plants/plot) were set in the beds 14 Oct. on a 1.5 foot spacing. A Latin square design was used with 5 blocks of 5 treatments. No fungicides or bactericides were used. Commercial insecticides were used for insect control. Early blight severity was estimated 18 Nov., 9 Dec., and 23 Dec. by counting the number of lesions on 12 terminal leaflets per plot. Additionally, the percentages of plants more than 10% defoliated by early blight were determined on 9 Dec. Fruit were harvested mature green 30 Dec., 7 Jan., and 14 Jan. For statistical analyses, all leaf spot numbers and percentages were transformed to logs and arcsins, respectively. Least significant deviations (LSD) were calculated to compare means.

_Fungicide-bactericide spray experiment_. Cherry tomato (BHN 12) transplants, obtained from the Whisenant Farms of Parrish, Florida, were set in the field 25 Mar. A split plot experiment involving 3 fungicide treatments (main plots) and 3 bactericide treatments (subplots) was carried out on EauGallie fine sand utilizing a randomized complete block design with 4 replications. Each subplot consisted of 10 cherry tomato plants set 1 foot apart within rows. Sprays were applied once weekly from 2 Apr. Through 10 June using a hand-held boom pressured with CO2 at 40 psi. Commercial insecticides were used for the control of lepidopterous larvae. No other insecticides were used or needed. The 3 main plot fungicide treatments and rates per 100 gal were: mancozeb, 1.5 lb. (Dithane M-45); chlorothalonil, 1.5 qt. (Bravo 500); and control (no fungicide). The 3 subplot bactericide treatments and rates per 100 gal were: tribasic copper sulfate, 4.0 lb. (Cities Service TBCS), cupric hydroxide, 2.0 lb. (Kocide 101); and control (no bactericide). The number of early blight lesions were counted from 10 terminal leaflets per plot on 28 May and from 6 terminal leaflets per plot on 6 June. In addition, the percentage defoliation of each plant was estimated 6 June and 10 June. Fruit were not harvested for yield records. However, on 10 June, 100 fruit per plot were picked and examined for early blight symptoms. The percentages of diseased fruit were recorded. For statistical analyses, all leaf spot numbers and percentages were transformed to logs and arcsins, respectively. Least significant deviations (LSD) were calculated to compare means.

**Results and Discussion**

_Fertility experiment_. Slight deficiency symptoms were observed 18 Nov. on plants in 2 of the five 374 lb./acre plots and in all of the 187 lb./acre plots. By 9 Dec., severe deficiency symptoms were apparent on all plants receiving 374 lb./acre, and very slight symptoms had developed on a few plants in the 748 lb./acre plots. On 23 Dec. only plants which received 1,496 or 1,122 lb./acre of the 18-0-20.75-1.2 fertilizer were free of deficiency symptoms, although the plants receiving 748 lb./acre were only slightly affected. Highest marketable yields were obtained from the 1,496 and 1,122 lb./acre plots and the least from the 187 lb./acre plots (Table 1). On 9 Dec., disease severity decreased with increasing fertilizer rates (Table 1). Disease severity gradually worsened and by 23 Dec., many plants were partially defoliated and defoliation was most severe where the plants received the low amounts of fertilizer (Table 1).

These data support the general observations made over the years (1, 4) that early blight was a disease of stressed or senescent plants and that high soil fertility inhibited disease development. Although some early blight developed on all plants, regardless of fertilizer rate (Table 1),

<table>
<thead>
<tr>
<th>Fertilizer rates</th>
<th>18 Nov.</th>
<th>9 Dec.</th>
<th>23 Dec.</th>
<th>Percent defoliation</th>
<th>Marketable fruit yields</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tons/acre</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1496</td>
<td>12 ab</td>
<td>11 a</td>
<td>172 ab</td>
<td>42 a</td>
<td>16.9 bc</td>
</tr>
<tr>
<td>1122</td>
<td>14 b</td>
<td>15 a</td>
<td>144 a</td>
<td>35 a</td>
<td>17.2 c</td>
</tr>
<tr>
<td>748</td>
<td>5 a</td>
<td>24 a</td>
<td>292 b</td>
<td>53 a</td>
<td>14.1 b</td>
</tr>
<tr>
<td>374</td>
<td>40 c</td>
<td>48 b</td>
<td>645 c</td>
<td>97 b</td>
<td>14.5 b</td>
</tr>
<tr>
<td>187</td>
<td>53 c</td>
<td>91 b</td>
<td>591 c</td>
<td>98 b</td>
<td>11.2 a</td>
</tr>
</tbody>
</table>

Table 1. Effect of fertilizer rates on development of early blight (_Altntaria solani_) and marketable yields of _Walter_ tomatoes.

*18-0-20.75-1.2 N-P-K-Mg fertilizer.
*2Per cent plants more than 10% defoliated, all percentages transformed to arcsin for analysis.
*3Mean no. leafspots from 12 terminal leaflets, means followed by same letter statistically equal. All numbers changed to Log for statistical analysis.
the disease was far more severe on “hungry” plants than those receiving 1,122 to 1,496 lb./acre of an 18-0-20.75-1.2 fertilizer. It would appear that commercially standard rates of fertilizer can greatly retard development of early blight. Also, the leaving of plants in the field for long periods of time postharvest when the fertilizer supply has been exhausted could result in severe early blight development and provide an inoculum source for later crops.

**Fungicide-bactericide spray experiment.** Early blight did not occur until late in the season (around harvesting time), but was uniformly distributed and very severe, causing up to 93% defoliation of nonsprayed plants.

On 18 May, chlorothalonil and cupric hydroxide gave the best control of early blight (Table 2). Mancozeb and TBCS gave excellent control, but not as good as that provided by chlorothalonil or cupric hydroxide. The combination of mancozeb + TBCS gave better control than either material alone, and mancozeb + cupric hydroxide gave better control than mancozeb alone (Table 2). By 6 June, the disease was more severe throughout the plots (Table 2). Again, chlorothalonil and cupric hydroxide resulted in the best disease control. The combination of mancozeb + TBCS gave better disease control than either material alone. The mancozeb + cupric hydroxide mixture was better than mancozeb alone and equal to cupric hydroxide. The chlorothalonil + Cu combinations resulted in better control than any material alone or any other combination. These same relationships held constant throughout the season, regardless of disease severity or method of evaluation used. The nonsprayed plants were 66% defoliated at this time, whereas the chlorothalonil + Cu sprayed plants were only 0.5% defoliated (Table 3). The mancozeb and TBCS plants were 11 and 14% defoliated, respectively. Chlorothalonil and cupric hydroxide sprayed plants were only around 5% defoliated. The combination of mancozeb + TBCS gave much better control (1.8% defoliation) than either material alone. On 10 June, the nonsprayed plants were over 93% defoliated (Table 3). Plants sprayed with mancozeb were nearly 70% defoliated, whereas those sprayed with chlorothalonil were only 16% defoliated. Cupric hydroxide gave better control than TBCS (25% vs 63% defoliation). All combinations seemed to be compatible and resulted in control equal to or better than that of any of the individual components.

Early blight lesions developed on the calyx end of nearly 32% of the nonsprayed fruit harvested 10 June (Table 4). All materials alone and all combinations resulted in excellent fruit disease control.

It is apparent that the mancozeb + TBCS or mancozeb + cupric hydroxide combinations were compatible, as were the chlorothalonil + TBCS or chlorothalonil + cupric hydroxide mixtures. All combinations resulted in early blight control, with the exception of mancozeb + Cu alone, which gave less control than the other materials alone or any other combination.
control equal to or better than their individual components. The lack of early blight control in the plant production house or in the field probably can not be blamed onto the use of manebl/mancozeb + Cu mixtures. However, mancozeb alone applied only once weekly did not adequately control early blight when disease pressure was high. Workers in Michigan (2) and South Carolina (3) have found that the manebl/mancozeb + Cu combinations gave excellent control of early blight.


**CHOANEPHORA WET ROT OF PEPPER**

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Additional index words. Botrytis rot, bud rot, Phytophthora defoliation.

Abstract. *Choanephora cucurbitarum* (Berk. & Rav.) Thaxter, the causal agent of a wet rot of pepper (*Capsicum annuum* L.), has been commonly observed only in the fall on commercial pepper fields of southwest Florida from 1966 to 1986. Grower and agribusiness representative reports have indicated a similar pattern of occurrence during the last 20 yr. The fungus attacks young plant tissue including buds, leaves, petioles, stems, flowers, and very young fruit. It also infects young tissue of cultivated hibiscus (*Hibiscus rosa-sinensis* L.) and appears endemic on swamp hibiscus (*Hibiscus coccineus* Walt.). During the summer months of 1973, 1974, and 1975, the fungus was observed first on swamp hibiscus then on pepper plants in early September. Growth and sporulation on both hosts ceased soon after the ambient temperature dropped below 14.4°C (58°F). The spring pepper crop escapes *C. cucurbitarum* infection because the plants are nearly mature, with very little young tissue, by the time temperature rises above 14.4°C and high levels of inoculum develop in mid-May.

Peppers have been cultivated on a commercial scale, producing a spring (February-June) and a fall (August-November) crop, in various parts of Florida since 1950 (1).

Fall pepper plants are field seeded in early August or transplanted to fields in the first week of September. Growers attempting to obtain an early harvest by planting earlier than normal have encountered severe damage incited by *Choanephora cucurbitarum* at all stages of plant growth but more evident after plants reached an average height of 20 cm (8 inch). Damage and plant loss have been observed in the fall but not in the spring since disease occurrence records were initiated in June 1966.

Fungicide applications in the field did not control wet rot (C. H. Blazquez, unpublished reports); however, no severe losses occurred. In large scale fungicide field trials, disease occurrence has been slight (8).

Severe symptoms of wet rot resemble a blight caused by *Phytophthora capsici* Leonian (12) recently observed on the east coast of Florida (4). Choanephora wet rot was reported as *Botrytis* blight (2) because occasionally *Botrytis cinerea* Pers. ex Fries occurs in late November and early December when some pepper fields still have active lesions caused by *C. cucurbitarum*. The simultaneous occurrence of 2 similar diseases and the confusing literature reports (4, 6, 15) which considered *C. cucurbitarum* a blossom disease first and a foliage disease second, led growers and researchers to suspect other pathogens. Reports of *Botrytis* induced growers to apply weekly spray applications of fungicides against the disease until nearly harvest time. Appearance of Choanephora wet rot in early September in Florida was known to experienced growers for many years and recorded since 1966 (C. H. Blazquez, unpublished reports) but its occurrence was not quantified on an area-wide basis until 1973 (2). Periodic reports from agribusiness representatives, growers, and field scientists indicate that the pattern of disease occurrence from 1966 to 1986 has not changed, as the disease sporadically becomes severe in one or more specific areas when favorable weather occurs during the months of September, October, and November.

In Bihar, India, the appearance of Choanephora wet rot and damage on chilli (*Capsicum annuum* L.) during September was reported but disease severity was not estimated (7). Damage was also reported but not measured on *Chenopodium ambrosioides* L. in Rajasthan (13), eggplant (*Solanum melongena* L.) in Meerut (9), or guar (*Cyamopsis tetragonoloba* L. Taub.) in Jodhpur (14). None of these reports mentioned the timing of fungicide applications in the field, nor did they consider a report from India (7) of inactivation of Choanephora wet rot by a temperature drop in November.

In Georgia, Higgins in 1923 (11) chose the name “bud rot” without seeing the disease. In Florida, Dougherty (8) suggested that “bud rot” should be used as the common name for the disease but was unsuccessful in selecting a suitable fungicide because of low disease incidence.

The experiments and observations reported herein were to determine the susceptibility of pepper tissue to *C.