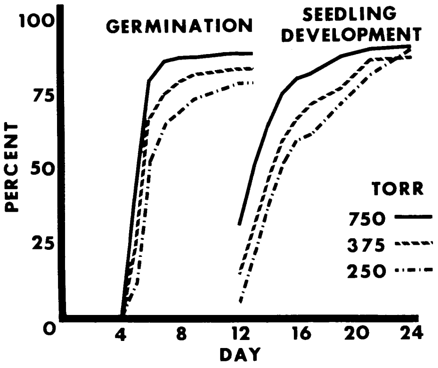

Fig. 2. Germination and seedling development percentages of 'C-28' tomato seeds at three pressures.

have inhibited germination and slowed the rate of germination. In general, results agree with those presented in previous literature (3,11) and show that the effects are duplicated when the low $O_2$ partial pressures are achieved by pressure instead of gas composition modifications at atmospheric pressure.

Seedling development percentages varied directly with pressure through day 21, but by day 24 no consistent trend was evident (Fig. 2). Seed development at day 24 varied directly with pressure (Table 1). Less evident was the trend of decreasing developmental rate minus germination rate as pressure was increased (Table 1), although the differences approximated that of germination rates. While final developmental percentages of seeds germinated do not seem to be affected by pressure, the delay at reduced pressures is evident. Since tomato is a $C_3$ dicot, results agree with published literature on the development of seeds germinated *in vacuo* (7) or at atmospheric pressure in reduced $O_2$ partial pressures (3,4,5,6,7, 9,11). The effect of inverse variation between pressure and developmental rates needs further investigation to determine if seedling size at germination in atmospheric pressure is different than seedling size at germination in lower pressures. Low pressure had an inhibitory effect on developmental percentage from seed, showing that if low pressure were used at some time during seedling production, the application of low pressure should begin at least after germination to obtain higher germination percentages (10).

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# Effect of Soil Fumigation and Alternate-year Seeding on Weed Control, Bacterial Spot Incidence, and Yield of Pepper Transplants[1]

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*Additional index words. Capsicum annuum, Xanthomonas vesicatoria*

*Abstract.* **In field tests conducted near Tifton, Georgia, soil fumigation with either a methyl bromide-chloropicrin mixture (67-33%, 480 kg/ha) or metham (748 liters/ha) decreased weed infestation and increased growth and marketable yields of pepper (*Capsicum annuum* L.) transplants, compared with pepper planted consecutively without fumigation. Alternate-year rotation of pepper with rye also reduced weed infestation and increased yield. Weed control accounted for 81% of marketable transplant yield. *Xanthomonas vesicatoria* (Doidge) Dows. overwintered in pepper debris incorporated fresh or dried. Bacterial spot occurred too erratically to permit any conclusions except that the methyl bromide-chloropicrin fumigation failed to provide any control.**

About 200 million field-grown pepper transplants are shipped each spring from southern Georgia to production areas of the eastern and midwestern United States and southern Canada. These transplants are produced under certification regulations of the Georgia Department of Agriculture (1). To be certified in Georgia, pepper transplants must be produced on land that has not been used for production of pepper transplants (except certified transplants) during the previous 3 years (1). Generally, fields used for pepper-transplant production are not fumigated, and weeds and soil-borne plant pathogens sometimes cause major losses. Although diphenamid (*N,N*-dimethyl-2,2-diphenylacetamide) is generally used, weed control is difficult because pepper seed germinate slowly (9).

Bacterial spot incited by *Xanthomonas vesicatoria* is one of the most serious diseases on pepper transplants. Primary inoculum for seedling infection may originate from contaminated seed (4) but apparently also may be present on overwintering plant residue (8, 11). Preventive applications of copper, streptomycin, or copper-streptomycin combinations may be hindered by adverse weather conditions and by the presence of antibiotic-resistant strains of *X. vesicatoria* (10).

In the spring of 1974, we observed (unpublished) a high incidence of bacterial spot on pepper transplants in part of a grower's field that had been fumigated with methyl bromide, where-

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Table 1. Effect of soil chemical treatment and incorporation of bacterial spot-diseased pepper residue on bacterial spot incidence, weed control, and growth and yield of pepper transplants in 1976.

| Treatment | Bacterial spot incidence[z] | Growth rating[y] | Weed control[x] (%) | Plant yield (1,000's/ha) Marketable | Cull | Total | Marketable yield (%) |
|---|---|---|---|---|---|---|---|
| Fresh residue 1975, no fumigant | 2.7[w] | 1.3a | 0a | 272a | 945b | 1,217a | 22a |
| Dry residue 1975, no fumigant | 1.7 | 1.3a | 0a | 227a | 1,316b | 1,543ab | 15a |
| Dry residue 1975, methyl bromide-chloropicrin 1976 | 3.0 | 4.7b | 67c | 1,490b | 598a | 2,088c | 71b |
| Dry residue 1975, metham 1976 | 1.0 | 4.0b | 40b | 1,534b | 323a | 1,857bc | 83b |

[z] Based on a 1 to 5 scale in which 1 = no plants infected, 2 = trace, and 5 = most plants infected.

[y] Based on a 1 to 5 scale in which 1 = small, chlorotic, nonvigorous plants and 5 = large, dark green, vigorous plants.

[x] Based on 0% control in the checks (nonfumigated).

[w] Mean separation in columns by Duncan's multiple range test, 5% level. No letters indicate values are not significantly different.

as only traces of the disease occurred in an untreated part of the same field. When bacterial spot appeared in one of our pepper-transplant nutrition tests in the spring of 1975, we decided to use the area to evaluate the effects of soil fumigation, pepper-residue incorporation, and alternate-year seeding on bacterial spot incidence, weed control, and growth and yield of pepper transplants. We intentionally spread the spot bacterium throughout the test area by frequent irrigation and transplant clipping (5).

The area, where tests were conducted in 1976 and 1977, was a Tifton sandy loam near Tifton, Georgia. Four (1976) or 6 (1977) treatments were arranged in a randomized complete block design with three replications, each 3.8 x 12 m and separated by 5.4-m rye strips. Treatments in 1976 included: i) fresh diseased-pepper residue incorporated into the soil; ii) dry diseased-pepper residue incorporated into the soil; iii) methyl bromide-chloropicrin (bromomethane-trichloronitromethane) mixture (67%-33%) at 480 kg/ha injected 15-18 cm deep on 23-cm centers into soil in which dried diseased-pepper residue was incorporated in 1975; and iv) metham (sodium methyldithiocarbamate), drenched at 748 liters/ha in 6,500 liters of water and sealed with 1.2 cm of water, in soil in which diseased-pepper residue was incorporated in 1975. These treatments were repeated during 1977 and the following 2 treatments were added: v) rye instead of pepper transplants grown in 1976 after incorporation of dry diseased-pepper residue in 1975; and vi) same as treatment v except that metham was applied before seeding pepper in 1977. The last 2 treatments will subsequently be referred to as alternate-year seeding. The fresh diseased-pepper residue was incorporated into the soil by disking. The dry residue was added to the soil by mowing the plants with a rotary mower, allowing the tissue to air-dry, and incorporating the residue with a disc harrow.

Each year 'Keystone Resistant Giant' pepper seeds treated with captan (*N*-[(trichloromethyl)thio]-4-cyclohexene-1,2-dicarboximide) were seeded in late March at 200 seed/m of row in 4 rows 0.35 m apart on each bed of 2-bed plots. The seed lot used was free of *X. vesicatoria* according to testing by the Georgia Department of Agriculture. Seeding was 16 days after soil fumigation. The seedbed was fertilized with 55, 47, and 44 kg/ha of N, P, and K, respectively, applied as complete fertilizer placed 2.5 cm under the seed in an 8-cm band. An additional 68 kg of N/ha was applied in 6 applications with the irrigation water. Diphenamid at 4.5 kg a.i./ha was used on all plots for weed control. The transplants were grown according to Georgia certification regulations (1). Soybeans were grown in the plot area as a summer cover crop.

As plants in the treated plots reached marketable size, they were rated visually for severity of bacterial spot, weed control, and for growth response. Bacterial spot severity was rated on a 1 to 5 scale: 1 = no plants infected, 2 = trace, and 5 = most plants infected. Weed control was estimated based on 0% control in the check. Growth response was rated on a 1 to 5 scale: 1 = small, chlorotic, nonvigorous plants and 5 = large, dark green, vigorous plants. Yield of marketable and cull transplants was determined by harvesting and evaluating plants in a representative 1.8-m length of row in each plot. Transplants were considered marketable if they were at least 15 cm tall with a stem diameter of at least 0.4 cm. Marketable transplants were weighed in 1977.

Bacterial spot was first observed in late May of each year. More bacterial spot occurred in 1976 than in 1977; however, it was rather erratic in both years (Tables 1 and 2). Although bacterial spot incidence was higher in methyl bromide-chloropicrin treated plots than in other plots, the disease occurred so erratically that the difference was not statistically significant either year (Tables 1 and 2).

Marked differences in weed control resulted from the chemical treatments and alternate-year seeding (Tables 1 and 2). Methyl bromide-chloropicrin gave the most weed control; it was followed by metham with alternate-year seeding, metham with consecutive-year seeding, and alternate-year seeding without fumigation. Weed infestation was very heavy in plots planted consecutively to peppers without fumigation. Weed control accounted for 81% of the variation in marketable transplant yield. The major weeds were redroot pigweed (*Amaranthus retroflexus* L.), carpetweed (*Mollugo verticillata* L.), cutleaf evening primrose (*Oenothera laciniata* Hill), yellow nutsedge (*Cyperus esculentus* L.), and Florida pusley (*Richardia scabra* L.). Low infestations of pigweed, carpetweed, evening primrose, and nutsedge occurred in plots treated with both diphenamid and the soil fumigants.

Treatment of the soil with methyl bromide-chloropicrin or metham and alternate-year seeding without fumigation significantly increased the marketable yield and usually the total yield of transplants compared with the nontreated plots planted consecutively to peppers (Tables 1 and 2). At least 71% of the transplants from the fumigated and alternate-year seeded treatments were marketable, whereas only 15 to 41% were marketable in nontreated plots planted to pepper each year. As indicated by the growth ratings taken in 1976 (Table 1) and weights of marketable plants taken in 1977 (Table 2), transplants grew largest under fumigation and alternate-year seeding.

Our results indicate the benefits of both soil fumigation and crop rotation in the production of pepper transplants in southern Georgia. These results also show the difficulty in controlling weeds, even with a recommended herbicide, when peppers are planted repeatedly on the same land. Soil fumigation with general-purpose fumigants such as those used in our test not only controlled

Table 2. Effect of soil chemical treatment, incorporation of bacterial spot-diseased pepper residue, and alternate-year planting on bacterial spot incidence, weed control, and yield of pepper transplants in 1977.

| Treatment | Bacterial spot incidence[z] | Weed control[y] (%) | Plant yield (1,000's/ha) Marketable | Cull | Total | Marketable yield (%) | Marketable plant weight (g) |
|---|---|---|---|---|---|---|---|
| Fresh residue 1975-76, no fumigant | 1.0[x] | 0a | 498a | 706b | 1,204a | 41b | 5.2ab |
| Dry residue 1975-76, no fumigant | 1.0 | 0a | 339a | 1,160c | 1,499ab | 23a | 4.4a |
| Dry residue 1975-76, methyl bromide-chloropicrin 1976-77 | 1.7 | 94d | 1,611c | 299a | 1,910bc | 84c | 13.2d |
| Dry residue 1975-76, metham 1976-77 | 1.3 | 72c | 1,850cd | 419ab | 2,269cd | 82c | 8.9c |
| Dry residue 1975, rye 1976, no fumigant | 1.0 | 38b | 1,316b | 446ab | 1,762b | 75c | 7.7bc |
| Dry residue 1975, rye 1976, metham 1977 | 1.0 | 87cd | 2,017d | 399ab | 2,416d | 83c | 10.1c |

[z] Based on a 1 to 5 scale in which 1 = none, 2 = trace, and 5 = most plants infected.
[y] Based on 0% control in the checks (nonfumigated).
[x] Mean separation in columns by Duncan's multiple range test, 5% level. No letters indicate values are not significantly different.

weeds but also reduced populations of soil-borne plant pathogenic fungi and nematodes below damaging levels (6). Fungi are killed more easily than some bacteria by soil fumigants (7). Although we were unable to show that fumigation with methyl bromide-chloropicrin increased the severity of bacterial spot, as was suggested by our earlier field observation (unpublished), our results indicate no control of bacterial spot with fumigation. Our results also confirm earlier findings (8, 11) that the spot organism can overwinter in association with host debris. Weather not conducive to disease development during 1976 and 1977 probably explains the low and erratic occurrence of bacterial spot in our tests.

There is considerable interest in the use of general-purpose soil fumigants in vegetable-transplant production in southern Georgia (6). In our tests the soil fumigants were applied in late winter, after most commercial peppers have been seeded. Since pepper transplants are seeded in late winter, fumigants that require a waiting period between application and seeding must be applied in late January or early February, when soil temperatures are too low for effective fumigation and chemical dissipation is slow, resulting in phytotoxicity. Additional research is needed to evaluate these fumigants when they are applied in late fall, before late winter and early spring seeding of vegetable transplants (6).

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# The Effect of Dusting Sulfur on Muskmelons[1]

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*Additional index words. Cucumis melo, Sphaerotheca fuligenea*

*Abstract.* **Thirty-one cultivars of muskmelon (*Cucumis melo* L.) were evaluated for their response to foliar dusting sulfur applications. Most cultivars were highly resistant to sulfur injury. Resistance was variable among cantaloupe types (Reticulatus group); all winter melon types (Inodorus group) were resistant.**

Sulfur dust has been widely used for over a century to protect plants against various diseases (7). It is especially effective in controlling powdery mildews, but some crops are sensitive and suffer foliage damage, particularly when applied during high temperatures. Among the cantaloupes (*Cucumis melo*, Reticulatus group), 'PMR 45', which is widely used in California and Arizona and various strains of this cultivar, are known to be very sensitive to sulfur (1). Two other important western cultivars. 'Topmark' and 'King Henry', are known to be resistant and are regularly treated with sulfur for powdery mildew control without damage to the plants. Sulfur is an ideal control for powdery mildew on cantaloupes because it is effective, inexpensive, leaves no harmful residue and has no adverse effect on the environment.

The effects of sulfur dust on muskmelons have not been very well documented in the literature, although there are several accounts of damage to the foliage. Jagger (5), describing the first serious outbreak of powdery mildew on Imperial Valley cantaloupes in 1925,

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