Efficacy of Methyl Bromide Alternatives in Tomato and Double-cropped Cucumber

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Previous research has demonstrated the efficacy of 1,3-D + chloropicrin when combined with pebulate as an alternative package for soil fumigation in tomato production. In most cases, this combination has resulted in tomato yields similar to those achieved with methyl bromide. Soil solarization has been proposed as an alternative to methyl bromide. Most research conducted to date has focused on the effects of alternatives on a first crop, mostly tomato, and little work has addressed the residual effects on a double-crop, such as cucumber. The purpose of this research was to compare standard methyl bromide soil fumigation to fumigation with the best chemical alternative, a mixture of 1,3-dichloroporopene (1,3-D) and chloropicrin used in combination with pebulate, and the best nonchemical alternative, soil solarization, for soilborne pest control and crop response in both fall tomatoes and spring double-cropped cucumbers.

The experiment was conducted at the Gulf Coast Research and Education Center in Bradenton, FL on an EauGallie fine sand soil during the fall of 1998 and the spring of 1999. Treatments were assigned to 3 bed plots 210 ft in length arranged in a randomized complete block design and replicated 6 times. Fall treatments consisted of a nontreated control, methyl bromide and chloropicrin (67/33 %, respectively) at 350 lbs./acre, 35 gal/acre of a mixture of 1,3-D and chloropicrin (83/17%, respectively) with pebulate herbicide (4 lb./acre) applied prior to fumigant application), and 8 weeks of soil solarization from 28 July to 15 Sept 1998. Pebulate was applied to the soil surface pre-bed and incorporated 6 to 8 inches deep in one pass with a s-tine harrow (field cultivator) on 3 Aug 1998. Beds were formed on the 5 Aug 1998 and methyl bromide and 1,3-D/chloropicrin were applied that day with 3 chisels per bed spaced 12 inches apart. Seven days preplant, all solarization and nontreated control plots were sprayed with paraquat (0.5 lb./acre) to dessicate existing weed cover (primarily yellow and purple nutsedge) so it would not interfere with early plant growth. Methyl bromide and 1,3-D treated plots were not sprayed because there was no nutsedge emerged. Six week-old Solamar tomato plants were transplanted 2 ft apart into the beds on 17 and 18 Sept 1998. Tomato plants and weeds were sprayed with paraquat after the last tomato harvest in the fall and a second application was made 2 weeks prior to planting the spring cucumbers on 18 Feb 1999.

Tomato plants were more vigorous in soil treated with methyl bromide and 1,3-D + chloropicrin + pebulate than in soil which received no chemical treatment. Fumigation with methyl bromide was superior to soil solarization at both evaluation dates. The combination of 1,3-D + chloropicrin + pebulate improved tomato plant vigor over what was observed with soil solarization at the second evaluation in November. Plants were no more vigorous with soil solarization than with no treatment. Prior to planting the tomatoes, nutsedge had begun to emerge and penetrate the mulch in all of the plots, but there were more plants in the nontreated and solarization plots than in the fumigant plots, necessitating an application of paraquat to

desicate the foliage. Both fumigants and soil solarization reduced nutsedge compared to the nontreated throughout the season and there was no statistically significant differences in the number of nutsedge plants between either fumigant or between the fumigants and soil solarization, due in large part to the early desication of nutsedge in solarization plots. Pigweed control was good with all treatments relative to the nontreated, but only the fumigant treatments reduced crabgrass. The soil in the test area had a low population of root knot nematodes at the beginning of the experiment. After the final tomato harvest, the most severe galling of roots was observed with soil solarization. The extent of galling was not severe in the test but was much higher with solarization than occurred with any other treatment, including the nontreated control. Methyl bromide resulted in no gall formation while galling on plants grown in soil treated with 1,3-D was intermediate. Soil fumigation with either methyl bromide or 1,3-D resulted in few tomato plants with symptoms of Fusarium wilt and both fumigants were superior to either soil solarization or the nontreated control in reduction of the incidence of Fusarium wilt of tomato. Soil solarization reduced the incidence compared with no treatment but the level of infestation was over 20% which would be unacceptable commercially.

The most extra large and total marketable fruit were produced with methyl bromide and 1,3-D + chloropicrin + pebulate in the first two harvests and for the season total. In the third harvest, more extra large fruit were produced with methyl bromide and 1,3-D than with solarization or the nontreated and more marketable fruit were produced compared to the nontreated plots.
Production of medium size fruit was less in the first harvest with the two fumigants, but it was greater in the second and third harvests and for the season as a total. There was no difference in the number of large fruit in the first harvest, but fumigation increased production in the second and third harvests and for the season total. Generally, soil fumigation increased cull production, indicating that overall fruit production was greater with methyl bromide and 1,3-D compared to no treatment or soil solarization. There was no difference in fruit production in any size category or marketable or cull yields between methyl bromide and 1,3-D + chloropicrin + pebulate.
Yields of all sizes and grades were highest with the fumigant treatments, intermediate with soil solarization and lowest where no soil treatment was applied.

Even though all of the nutsedge was desicated with paraquat after the final tomato harvest and again shortly before seeding cucumbers, by Apr., nutsedge was once again present in all plots but with no difference in numbers emerged through the plastic with either fumigant treatment or with solarization. Significantly more crabgrass was present in the beds of solarization plots than in fumigated plots, but there were no differences in populations of pigweed or eclipta.
The extent of root galling by rootknot nematodes was assessed visually after the last harvest and there was considerable galling on the cucumber roots. Methyl bromide was the only treatment to significantly reduce gall formation relative to the nontreated control treatment. The degree of galling with soil solarization was the same as that with no fumigant, whereas 1,3-D was intermediate between methyl bromide and solarization.
Cucumber yields following fall application of methyl bromide were greater than with solarization or no soil treatment. Cucumber production in solarized plots was equal to the nontreated . The production of slicer cucumbers in soil treated in the fall with 1,3-D + chloropicrin + pebulate was not significantly different from that observed with methyl bromide or solarization.