Conventional and organic alternatives to methyl bromide on California strawberries.

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Third year experimentation in replicated field plots with high rates of compost, broccoli mulch and a mycorrhizal inoculant was conducted during the 1997 growing season at our research farm on the California central coast. Past seasons (1995 and 1996) plant performance and yield data were reported at the San Diego and Orlando MBAO conferences, and initiation of field trials for the 1998 strawberry production season are currently underway. The results and status of these studies are presented chronologically as follows:

1. 1995 field studies. The site used for this study was previously farmed in strawberries for 9 years using methyl bromide/chloropicrin fumigation. Soil microbial biomass present at the initiation of the trial indicated very little biological activity from which to base a non chemical soil management program upon, as would be the case with most intensively managed areas of the California Central Coast where strawberries am produced. We used compost and broccoli mulch each at 25 tons per acre, alone and in combination with one another to amend the soil and establish a suppressive environment for strawberry root pathogens. In addition, Telone/chloropicrin, Basamid, and metham sodium were compared to a methyl bromide standard for plant Vigor, pathogen establishment and fruit yield. Organic soil amendments were not effective in this first year scenario to increase yields over untreated soil when planted into previously fumigated fields. Also, some degree of wood suppression occurred with Telone/chloropicrin, in addition to the MIT liberators, Basamid and metham sodium. These data are presented in a recent publication by these authors (Sances and Ingham, 1997).

2. 1996 field studies. In addition to the two the organic soil amendment treatments used in our 1995 studies, the 1996 trials were conducted on previously fallow land (3 years), and included organic soil amendments with aid without mycorrhizal (VAM) inoculation, as well as one treatment using strawberry plug plants. These plug plants were container produced daughter plants that were grown in artificial potting media without chemical fumigation, and substituted for commonly used bare root plants in one experimental treatment of our study. At the time of this writing, data are being summarized for publication. However, trends from the individual alternative soil treatments were as follows:

a) Organic soil amendments. As with the 1995 studies, with the Chandler cultivar, neither 25 tons/acre of compost, nor 25 tons fresh weight of broccoli mulch/acre were sufficient to suppress pathogen establishment and prevent reduction in fruit yields. Compared to untreated plots, the season totals for fruit were not significantly higher than plots receiving no pre plant soil amendments or chemical fumigation. The combination treatment of compost @ 25 T/A +broccoli @ 25 T/A + VAM inoculant, performed numerically better than either amendment alone.

b) Mycoorrhizal inoculation. Due to the poor naturally occurring VAM colonization observed in the 1995 studies, we inoculated all organic soil amendment plots with a commercial formulation of VAM. One experimental treatment of compost only was used as a control to determine baseline VAM activity from the compost and fallow soil alone. Soil microbial biomass analyses demonstrated that VAM colonization was not statistically improved by these treatments, although yields from inoculated plots were numerically higher (8.7%).

c) Alternative nursery plants. Beginning in 1996, we used disease free strawberry plants that were produced in soilless potting media (strawberry transplant "Mug plants"), and planted them into non fumigated soil for comparison with conventionally produced plants in non fumigated and conventionally fumigated soil. Compared to bare root plants, plug plants during this seasons trials were more vigorous and yielded 38.5% higher fruit yield in non fumigated soil. Further, fruit production from these plants was statistically the same and numerically higher (4.8%), than

conventionally produced bare root plants planted into methyl bromide fumigated field soil. These data are currently being summarized for publication by these authors.

3.1997 results. Results from field trials from the third year of central coast tests are summarized as follows:

a) Three methyl bromide alternative chemicals were tested on our field station in replicated blocks of commercially planted Camerosa. The site used had two consecutive broccoli crops planted on it and incorporated into the top 12" of mi. Overall, Camerosa was much more vigorous than the Chandler cultivar used in previous experiments. It is also better adapted to non fumigated soils. In the alternative chemical trials, experimental treatments used were 1. Basamid at 300 and 360 lbs. per acre in bed applications, 2. Telone/ chloropicrin at 30 gallons per acre in both shank applications and injection through the drip irrigation system under plastic mulch, 3. Vapam, also applied through the drip irrigation system at 75 gal. per acre, 4. Concentrated Clove oil at 2.25 gallons per acre applied through the drip irrigation system, and, 5. Methyl bromide/chloropicrin at 350 lbs. per acre for the standard soil treatment program. Untreated plots were used as the control. Following pre plant soil applications, these plots were grown to maturity and harvested once a week through the season to June 1 for fresh market, and to July 1, 1997 for processing. Fresh market harvest values showed only slight differences between the methyl bromide/chloropicrin standard and shank applied and drip injected Telone chloropicrin (3.2 and 5.1 % less fruit harvested respectively). By comparison, the untreated control lost 14.7% fresh market yield at this site. This value was small in comparison to previous years data (1995 and 1996) using soil sites without the broccoli cropping history. It is generally accepted that in a post methyl bromide system, growers would manage planting sites to include fields with a broccoli rotation history.

b) Organic treatments included high rate (25 T/ac.) compost usage, preplant broccoli mulch, plug (transplant daughters) plants, and a biological inoculant involving a commercial VAM formulation applied as a drench at planting. Overall, the plug plants obtained for these trials were not as healthy as 1996 material. They were grown using a fully organic potting mix that was inappropriate. These plants did not initiate growth and yield as early as the 1996 bare root plants produced from nurseries using methyl bromide/chloropicrin. These treatments are being repeated in current seasons experiments with plug plants using conventional but non fumigated potting soil.

Overall, 1996 data indicate that the biological Inoculant (VAM) improved plant performance with regard to overall yields of both bare root and plug plant plots. However, VAM colonization and soil microbiaI biomass data do not directly correlate enhanced biological activity with increased plant performance. These soil treatments have been replicated in current seasons trials with expanded sampling activities to elucidate further the relationship of inoculants with host plant symbiosis and overall yield. In addition, the broccoli mulch treatment did not show reduced pathogenicity or increased plant performance compared to untreated soil. These results agree with previous seasons work where disease suppression may occur early season, but is not long lasting enough to prevent yield reduction. Another aspect may be a phytotoxic effect of broccoli decomposition on strawberry plants which is an aspect of current seasons experimentation.

4. Our current season experiments include further development of chemical alternatives as well as applications of organic soil amendments incorporated into: a) preconditioned soil on our .. experiment station that has been continuously cover cropped and composted for two years Prior to planting strawberry, and, b) previously unplanted (native) soil. Both situations will test inoculants, broccoli, plug plants, and high rates of compost soil amendments to increase biological activity of these two candidate soils for use in development of a post methyl bromide, alternative production system for strawberries on the California Central Coast.