Chloropicrin Fumigation Followed by Bacterial Treatment Increases Strawberry Yield

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The objective of this research was to develop an integrated approach to increasing strawberry yields without the use of methyl bromide. The design of this study is a result of 5 years of research at Fresno, Parlier, and Salinas. Preliminary testing was done at Fresno and Parlier, and the most promising treatments were tested in advanced trials at Parlier and Salinas. Preliminary trials included screening of 130 PGPR strains (plant growth promoting rhizobacteria). Advanced trials in Salinas and Parlier tested for additional increase in yield when soil fumigation was followed by treatment with PGPR at planting. PGPR and chloropicrin (pic) fumigation were found to have an additive effect, therefore, this trial includes several PGPR strains in pic treated soil.

Plant Growth Promoting Rhizobacteria and Chloropicrin Interaction. PGPR are bacteria that live on the roots of plants, enhance growth, and sometimes induce disease resistance. The mechanisms by which they work can include antibiotic production, competition for nutrients and infection sites, and production of plant hormones that effect root growth. We applied the strains in a sodium alginate suspension, dipping the roots in the suspension at time of planting. In commercial practice, the bacteria would be applied in the drip system.

PGPR were applied to roots at planting. Bacteria were grown on Tryptic soy broth for 3 days to induce endospore formation. The cells were centrifuged and resuspended in 0.6% sodium alginate and stored in the refrigerator. Immediately before planting, the concentrated bacterial suspensions were further diluted with 0.6% alginate and plant roots were dipped into the suspension. Final concentration was approximately 10^7 cfu/ml. To avoid cross contamination, workers wore and changed gloves between treatments. Plants were carried in plastic boxes with liners. Liners were discarded and the boxes cleaned with 70% alcohol between treatments.

Testing began by screening strains in small plots at Parlier, CA. The top few strains were tested in larger plots in the advanced trial the following year. As small plot screening trials continued, the top strains from previous years were included as a high control. In all, 130 strains were screened. To determine if performance of the strains differed in fumigated soil, strains that did well in the advanced trials were included as subplot treatments in larger interaction trials with chemical fumigants as the main plots. Strains that consistently did well were included in trials in Salinas, CA and were used in combination with chloropicrin fumigation as well as MBr and methyl iodide fumigation, and in non-fumigated plots. PGPR were applied at planting, after the fumigant had dissipated.

Results. The results here are consistent with earlier results, and with the results of other researchers. Yield in plots with pic treatment alone is slightly less than MBr alone. Yield in non-treated plots is significantly lower. Surprisingly, yield in some of the pic plus PGPR plots is even higher than in MBr plots.

Discussion. This integrated approach is advantageous because it does not require a major change in the cropping system. PGPR lend themselves to application through the drip irrigation system, and chloropicrin is already in use in combination with MBr. Little or no additional equipment is needed since many growers already apply fertilizer through the irrigation system. Some chemical alternatives require a long waiting period between crops, resulting in loss of yield and revenue. Strawberry yields achieved with this combination of treatments are equal to or better than those achieved with methyl bromide.

These strains belong to Gustafson, Inc., producers of BioLogic and Kodiak, a biological widely used in cotton production. Estimated cost for use of a PGPR product in strawberry production is around $250 per acre. Gustafson considers some of these strains sutiable candidates for commercialization. Decisions about commercialization of biologicals depend on market demand for the product, how well the organism grows in laboratory and scale up cultures, shelf life and other factors.