MANAGEMENT OF PATHOGENS ASSOCIATED WITH BLACK ROOT ROT OF STRAWBERRY

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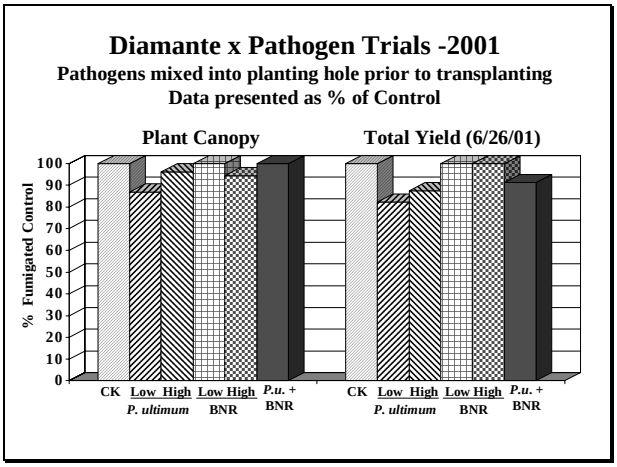
Black root rot of strawberry is caused by a complex of pathogens and when severe, can cause significant reductions in plant growth and yield. The two most commonly recovered pathogens from symptomatic plants were *Pythium* and binucleate *Rhizoctonia* spp. While commonly recovered from necrotic root tissue, the involvement of *Cylindrocarpon* spp. in the disease complex is uncertain at this time.

Evaluation of Pathogen Involvement in the Disease Complex

Greenhouse evaluations have been performed to confirm pathogenicity and virulence of *Pythium* spp. (*P. ultimum* is the most common species recovered) and binucleate *Rhizoctonia* spp. (AG-A, G, and –I) recovered from diseased field grown plants. Field evaluations to clarify the pathogen's contribution to reductions in plant growth and yield are in progress. The pathogens were added back to fumigated soil prior to transplanting the strawberry plants. The results from midseason indicate that at the inoculum levels used, *P. ultimum* can reduce plant growth and yield.

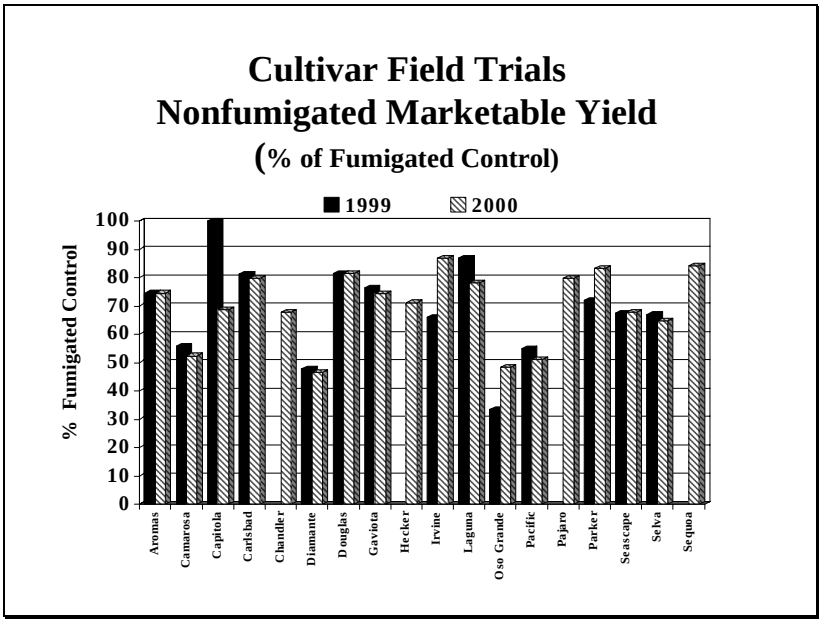


Host Tolerance to Black Root Rot Pathogens

One approach for mitigating the loss of methyl bromide soil fumigation for disease control would be to plant strawberry cultivars that are tolerant to black root rot root pathogens. Commercial cultivars have been evaluated in the greenhouse for their tolerance to *P. ultimum* and binucleate *Rhizoctonia* spp., with significant differences observed. For example,

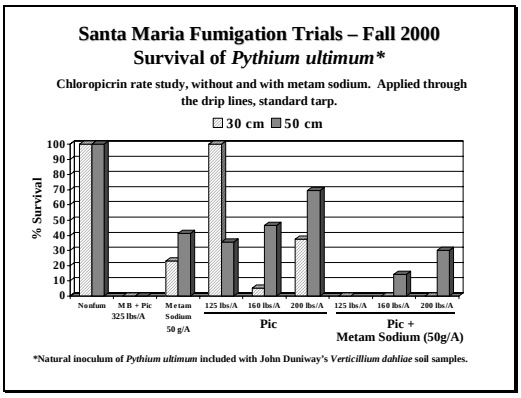
Selva, Aromas, Seascape, and Douglas were more tolerant to *P. ultimum* than Torrey, Pajaro, Camarosa, and Chandler.

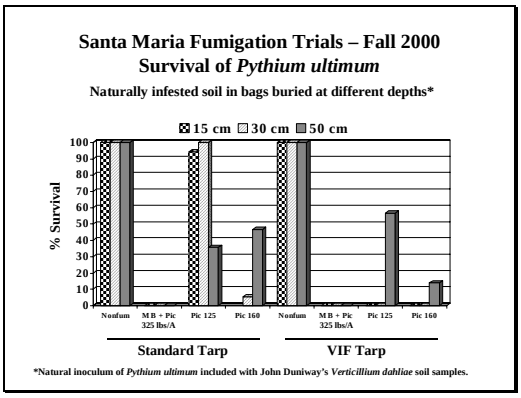
Field trials to evaluate cultivar performance in nonfumigated soil have been conducted in a test plot that has not been previously fumigated and is naturally infested with the pathogens associated with black root rot. Importantly, Verticillium wilt and Phytophthora root and crown rot have not been a problem at this test location, so trials evaluating the contribution of the general root pathogens associated with black root rot on plant growth and yield can be conducted independent of these lethal pathogens. Significant differences in yield in nonfumigated compared to fumigated soil have been observed among cultivars. With a few exceptions, the results were similar for each of the two years the trials were been conducted.

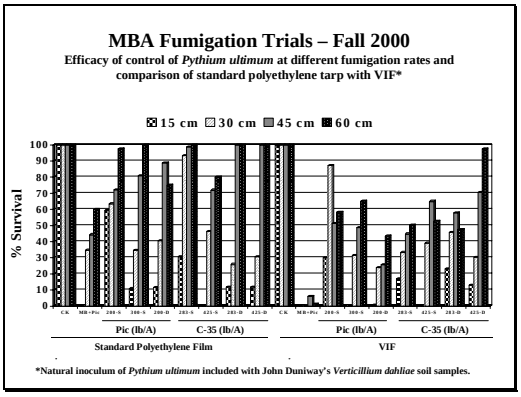


Evaluation of Microbial Inoculants for Strawberry Yield Enhancement
Microbial isolates recovered from the strawberry rhizosphere were evaluated in growth chamber for their effect on strawberry growth. Those isolates that stimulated root and shoot growth were then evaluated in the field for their ability to enhance yield when plants were grown in nonfumigated soil. For the first two years of trials the microbial inoculum was applied only at planting time and inconsistent results were obtained (there was a 34% increase in yield for the first year, but not effect the second year for one isolate). For the last trial additional supplemental applications of the inoculants were made through the drip system. With one isolate evaluated there was a 20% increase in yield over the nonfumigated control.

Evaluation of Alternative Fumigants for Control of *Pythium* spp.
Alternative fumigants, methods of application, and different plastic tarps have been evaluated for their ability to control *P. ultimum*. In trials in Santa Maria and at MBA conducted in collaboration with John Duniway, applications of metam sodium and the use of virtually impermeable film (VIF) rather than the standard polyethylene tarp increased the efficacy of the fumigation.



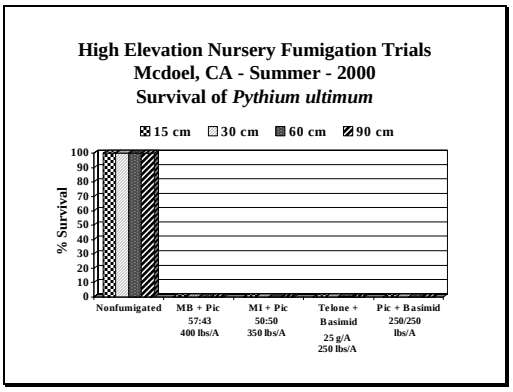


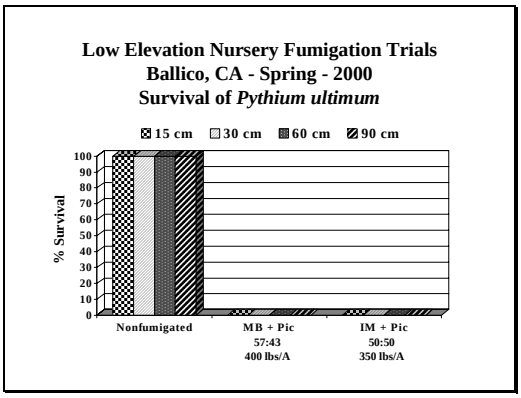


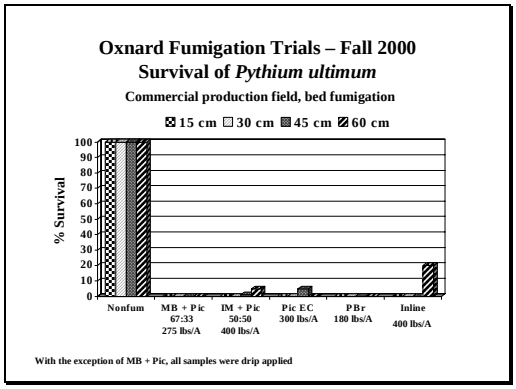
Nursery Fumigation Trials

Objective of this project is to evaluate efficacy of different fumigants for controlling soilborne pathogens in commercial strawberry nurseries and following plant productivity in commercial fruit production fields. Trails also were conducted in commercial fruit production fields to evaluate the efficacy of bed fumigation for pathogen control. It is a collaborative, multidisciplinary project involving a soil chemist (Husein Ajwa), plant pathologists (Greg Browne, Carolee Bull, John Duniway, and Frank Martin), a nematologist (Becky Westerdahl), a weed scientist (Steve Fennimore), a strawberry horticulturist (Christopher Winterbottom) and an agricultural economist (Rachel Goodhue). Natural inoculum of *Pythium ultimum* was produced in soil and included with John Duniway's *Verticillium dahliae* soil samples buried at different depths in the soil

profile. The bags were recovered after fumigation and the survival of *P. ultimum* determined by plating on a differential medium.







Summary of Fumigation Data

- Broadcast application of all fumigants that were evaluated were effective in controlling *P. ultimum* in nursery settings.
- Drip applied fumigants to the production beds were effective in pathogen control
- Enhanced efficacy of fumigant application for control of *Pythium ultimum* was observed with:
    - Use of VIF tarps
    - Application of metam sodium
- Some of the alternative fumigants were effective in controlling *Pythium ultimum* at the rates used.
    - Telone C-35
    - Iodomethane
    - Propargyl Bromide