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TITLE: Comparison of 1 vs. 2 annual applications of various trunk micro-injected materials to suppress Oak Root Fungus (*Armillaria mellea*) over a 2 year period on Blue Gum (*Eucalyptus globulus*)

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INTRODUCTION AND BACKGROUND

The genus *Armillaria* contains about 40 species of important wood rotting fungi which are widely distributed around the world. Some of these species are destructive root rotting pathogens of various trees and shrubs. They most often invade through the bark of major roots or root collars and progressively destroy living root tissues leading to serious decline and ultimate death of the host. *Armillaria mellea* is the most often cited species due to the fact that at one time all 40 species shared this name. True *A. mellea* is often found infecting broad leaved trees in ornamental parklands and landscapes, natural woodlands, and fruit orchards. This fungus is notable for several reasons; it has an extremely large host range, it has a very well developed survival strategy in soil, and it has no proven curative chemical control to date.

In California this fungus is one of the most destructive pests of landscape ornamentals, and control or suppression of this pathogen has been a very disappointing endeavor. The object of this study was to determine if injection of any of various systemic fungicides chosen for this study could accomplish the goal of fungal suppression/control on actively infected Blue Gum trees, and further to compare the difference, if any, between one or two annual applications. This study was undertaken in two stages; 25 trees were given a single treatment, or held as a control for a two year period, and a second random set of 10 trees were selected and treated a second time, with data recorded and analyzed on disease pressure and canopy density over the two years for all the trees in the plot.

METHODOLOGY

1. Study Location- The site is located on the Nipomo Mesa in Nipomo, CA. It was selected due to the widespread and active *Armillaria mellea* infection present. The site was a mature planted grove of *Eucalyptus globulus* that was being developed into a housing tract. The grove was selectively felled and these trees chipped on site, with the chips piled at the base of the remaining trees. This chipped material was allowed to cover the root collars to a depth of 3-5 feet and after a very heavy rain year became a 'wet blanket' that physically covered the root collars exacerbated the disease development. The remaining trees were heavily infected and dying from the disease at an alarming rate. At the time of treatment they seemed to be near the threshold of becoming non-treatable trees due to the level of infection. The wood chip barrier was removed using an air spade prior to the first treatment

2. Experimental Design – The following microinjection treatments were applied to 5 plots containing 5 randomly selected trees, 4 'treated' trees each and an untreated control. Additionally, for the second year treatment two randomly selected plots were re-treated using identical materials and protocol as the first year treatment, and these trees were tracked along with the single treatment trees for health and vigor

3. Laboratory Analyses- The presence of 'disease' (*Armillaria mellea*) was evaluated and confirmed using laboratory techniques and analyses provided by The Crop Doctor Laboratory, 2751 Ernest Place, Cambria California, 93428. Each subject tree was evaluated several times over the course of the trial for presence or absence *Armillaria mellea* by a Plant Pathologist.

Materials used are as follows:

#1= Bacillus subtillus @ 6 mLs per 2" dbh (or 3 mLs per 1"dbh)
#2= Tebuconizole 16% @ 6 mLs per 2" dbh (or 3 mL per 1" dbh)
#3= Arborfos @ 5 mLs per 2" dbh (or 2.5 mLs per 1" dbh)
#4= Arborfos @ 10 mLs per 2" dbh (or 5 mLs per 1" dbh)
#5= Untreated control

4. Trunk Injection Protocols – Microinjection procedures were performed according to guidelines of the J. J. Mauget Company of Arcadia. CA, using a battery-powered drill with 11/64 inch (4.3 mm) drill bit. Injection units were placed at the base of each tree on the trunk using diameter/2 to determine dosage in capsules. Injections were performed on all trees (excepting controls) on 12/8/05, and the second set of 10 'treatment trees' received their second annual treatment on 3/8/2007. The work was performed at the Centex Knollwood Property, Nipomo Mesa, CA by A&T Arborists.

5. Disease and Canopy Evaluation Ratings – A disease severity index rating ran from 1-5 with 1 as lowest and 5 as highest amount of disease present. The canopy is rated also from 1-5, with 5 as healthiest and 1 as lowest (weakest). Canopy densities were estimated based on a visual survey of individual trees over the course of the study. These ratings were made at the start of the trial

and on three month intervals following initial treatment. The change in disease rating and canopy health for each tree during this period was then calculated and tabulated.

6. Data Analysis – Disease and Canopy rating changes were placed on an Excel spread sheet and analyzed for significance using a Standardized Range test.

RESULTS

All of the injection treatments resulted in improvement in health condition ratings compared to the untreated control trees during the two year trial. In the evaluation of the single annual treatments the ArborFos treatments at both dosages (5ml & 10ml) performed very well, however the Bacillus and Tebuject treatments did not show much affect in either disease suppression or canopy density ratings at the one year point. The second year data began to show more separation in the treatments and the controls began to show more disease problems (Tables 1 & 2). The ArborFos treatment trees were the most significantly improved overall in both disease suppression and canopy density ratings at the end of the second year at both doses used in this study. The Bacillus and Tebuject 16 treatment trees also showed improvement over the single annual treatment, especially in the disease suppression catagory.

DISCUSSION

The results of these experiments indicate that the trunk-injected fungicides used in the study were able to significantly suppress development of *Armillaria mellea* in heavily infected Blue Gum trees. The data reflects that the ArborFos treatments were most effective, with the two dosages very similar in their efficacy against the fungus on these trees (Table 1) It was noted that both dosages of ArborFos treatments had an apparent 'therapeutic' effect on the trees in general and both the dosages led the group in canopy improvement (Table 2).

The Tebuject 16 treatment was also effective in disease suppression, but apparently needed the second treatment dosage or additional time to produce these results (Table 1). This was also apparently true for the Bacillus treatment. B. subtillus has been used successfully as a soil drench to obtain control of this fungus in grape vines, and there is data that supports its efficacy (1). It is possible that dosages could be adjusted to obtain better results with this material in the future.

In summary, all of the treatments showed suppressive effects against *Armillaria mellea*. The ArborFos treatments accomplished this effect more quickly, and additionally the trees treated with ArborFos showed significantly improved canopy appearance and increased vigor. The treatments with the trial materials were able to act as suppressive agents in the control of this fungus, and further testing is encouraged by this data.

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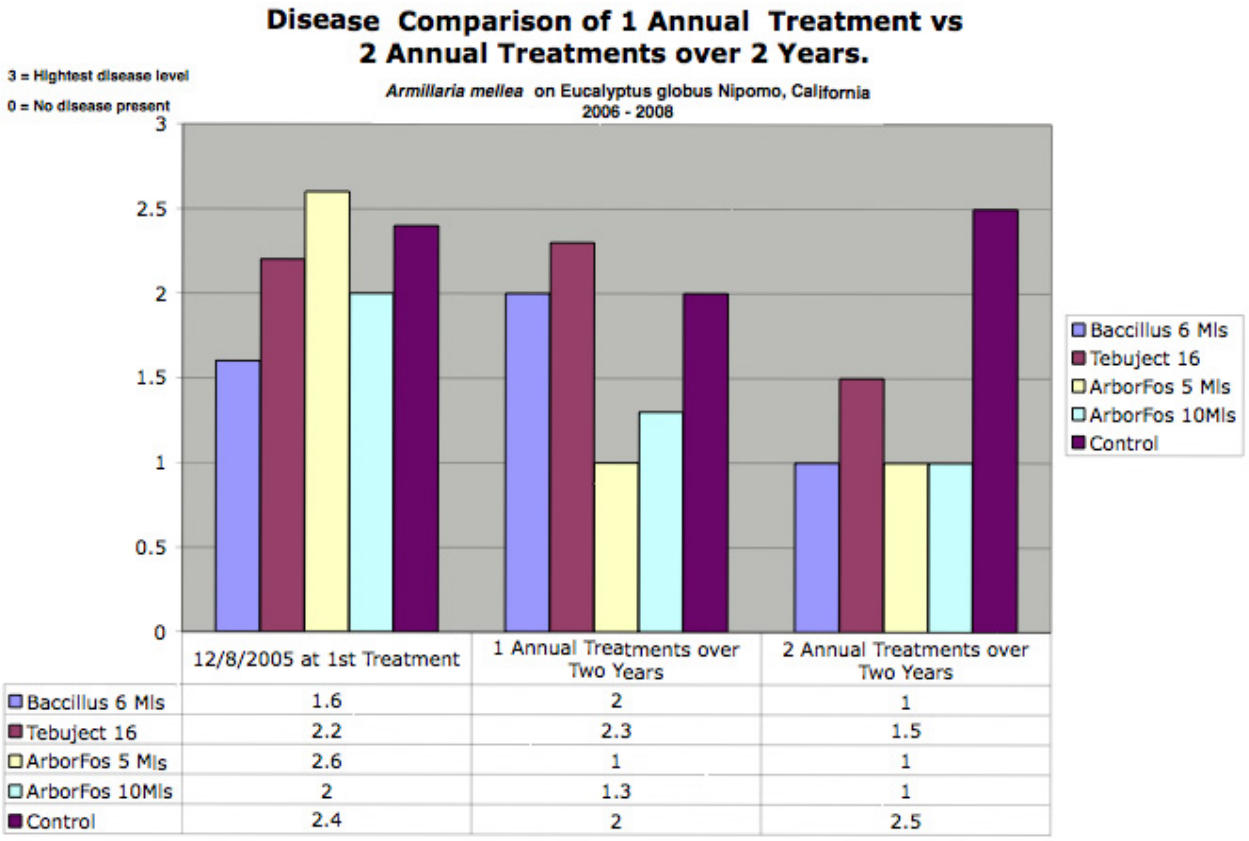
TABLE 1



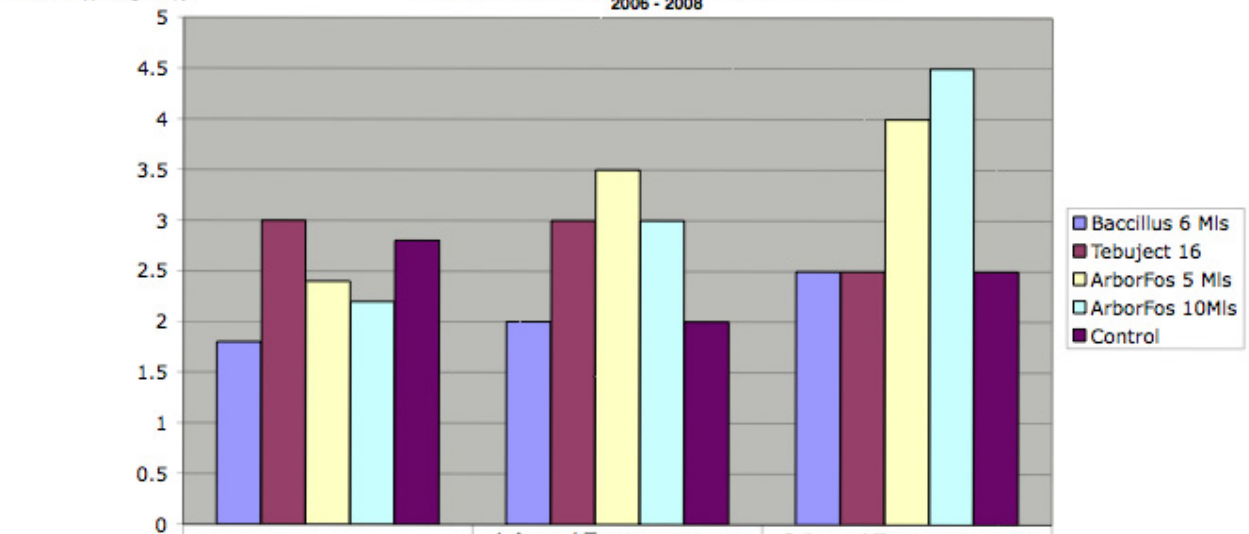
	12/8/2005 at 1st Treatment	1 Annual Treatments over Two Years	2 Annual Treatments over Two Years
Baccillus 6 Mls	1.6	2	1
Tebuject 16	2.2	2.3	1.5
ArborFos 5 Mls	2.6	1	1
ArborFos 10Mls	2	1.3	1
Control	2.4	2	2.5

TABLE 2

Canopy Comparison of 1 Annual Treatment vs 2 Annual Treatments over 2 Years.

5 = healthiest appearing canopy
0 = Worst appearing canopy

Armillaria mellea on Eucalyptus globus Nipomo, California
2006 - 2008



	12/8/2005 at 1st Treatment	1 Annual Treatments over Two Years	2 Annual Treatments over Two Years
Baccillus 6 Mls	1.8	2	2.5
Tebuject 16	3	3	2.5
ArborFos 5 Mls	2.4	3.5	4
ArborFos 10Mls	2.2	3	4.5
Control	2.8	2	2.5