Control of brown wood rot in lemons - 2017[1]

Glenn C. Wright
Department of Plant Sciences, U. of A., Yuma Agriculture Center, Yuma, AZ

Introduction

Coniophora eremophila, a wood rotting fungus, was first reported in lemons in 1992 (Matheron, Gilbertson & Matejka, 1992). Another species, Antrodia sinuosa was found to be infesting lemons, and was isolated in 1997. Further research (Bigelow, Matheron & Gilbertson, 1996; Bigelow, Gilbertson & Matheron, 1998) found that Coniophora has been found sporulating on desert plants, but not been found sporulating on lemon wood, while Antrodia has been found sporulating on decaying fallen wood within lemon groves. Furthermore, the optimum temperature range for growth of Antrodia and Coniophora is 30-35C (86-95F), and the rate of decay for Coniophora and Antrodia in Lisbon lemon is higher than that for orange, tangelo and grapefruit trees. Finally, wood decay experiments suggest that Antrodia is a greater threat to lemon trees than is Coniophora.

Yuma growers have noted that these fungi appear to be more aggressive than in the past. Specifically, the level of infection is increasing, and the age of trees that become infected is decreasing. Whereas in the past, 20-year-old trees and older were likely to become infested, today trees younger than 20 years old are increasingly likely to be infested with the wood rots. This is likely because the inoculum load in the orchard is increasing.

Hand pruning is the typical method that growers use to reduce incidence of the disease, yet is one of the most expensive costs that an Arizona lemon grower must bear. Diseased wood is removed with chain saws, but is not often removed from the orchard floor. Sometimes, branch cuts are painted with fungicides, or with Bordeaux to kill spores that remain alive. Growers also top and hedge trees regularly. In this case, prunings are allowed to fall on the orchard floor, then are chopped and disked into the soil.

Increasing inoculum load may be because of the large infested branches that remain on the floor, because the hedged prunings are infested, or because application of Bordeaux is not sufficient to reduce spores.

Previous work by Matheron and Porchas (2006) showed that applications of Azoxystrobin and Propiconazole significantly reduced growth of the brown wood rot fungi when applied to a fungus-infested dowel inserted into a lemon scaffold branch. As a result, some of the Arizona lemon growers apply azoxystrobins to the foliage of the trees to reduce spore load in the orchard.

The objective of this study is to compare normal grower practice versus enhanced use of fungicide and improved field sanitation in several commercial groves on the Yuma Mesa.

Materials and Methods

Two grower cooperators were identified for this experiment, Cooperator "A" and Cooperator "B". Each cooperator wished to apply treatments that best fit their management practices, so the treatments were slightly different for each. Cooperator A agreed to do the following:

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1. Standard Treatment (Treatment 1) - Cut out diseased wood, paint cut branches with copper, chop prunings from topping and hedging in field
2. (Treatment 2) - Cut out diseased wood, paint pruning cuts with copper, chop prunings from topping and hedging in field, spray field with azoxystrobin at 15 oz. per acre (100 gpa).
3. (Treatment 3) - Cut out diseased wood, paint pruning cuts with copper, remove prunings from topping and hedging from the field and burn them, spray field with azoxystrobin at 15 oz. per acre (100 gpa).
4. (Treatment 0) - We also included a block where there were no treatments applied, other than topping and hedging. This block had been infested with the disease for several years.

This cooperator provided a plot map on 7/27/16. Treatments 1, 2 and 3 were each assigned on one 2.5-acre block, while treatment 0 was assigned to a 10-acre block. There are two replications. Treatments 1 through 3 had diseased branches removed in early November 2016. No spraying nor cutting of diseased wood nor applications of copper was done in 2016. Treatment 0 was topped and hedged in early December 2016.

Azoxystrobin was applied to the field in March and September 2017. Treatments 1 through 3 had diseased branches removed in late December 2017.

Cooperator B agreed to do the following:

1. Control Block – Cut out diseased branches, chop prunings from topping and hedging in field.
2. Cut out diseased branches, paint cut branches with copper, chop prunings from topping and hedging in field. Remove large branches from the field and burn them, spray field with azoxystrobin at 15 oz. per acre (100 gpa) in the Fall and Spring.
3. Cut out diseased branches, paint cut branches with copper, chop prunings from topping and hedging in field. Remove large branches from the field and burn them.
4. Cut out diseased branches, chop prunings from topping and hedging in field. Remove large branches from the field and burn them.

This cooperator provided a plot map on 12/5/16. Each treatment was established on one 10-acre block, with no replications. No treatments (topping, hedging, spraying, etc.) were applied in 2016, and unfortunately, they were not completed in 2017.

Meanwhile, University of Arizona personnel began inspecting the sites for Cooperator A in June 2016. For each block, we inspected each tree as to whether there were signs of the Antrodia brown wood rot. If a tree had the disease it was noted. UA personnel inspected each site monthly through March, 2018, except in August and October 2016. About 200 to 600 trees were inspected at each site per month. For Cooperator B, inspections began in November 2016 and continued through December 2017.

Results and Discussion

Results for Cooperator A are found in Figure 1. For treatment 0 (No treatments made other than topping and hedging), infection rate increased from about 95% in June 2016, to 100% in November, then it continued at that level through March 2018.

For treatment 1, the standard practice infection started at 20% in June 2016, increasing to about 70% by September 2016. Following a removal of diseased branches, the level of infestation decreased to about 10% in June 2017 and then increased quickly again to about 70% by December 2017. Another branch removal operation in early January 2018 caused the infestation to drop again to levels less than 20%. Since no fungicides were applied or wood was removed from the orchards, these decreases in infection rate are due to the removal of diseased branches during the topping and hedging operations, plus the natural reduction in fungal growth rate that occurs as air temperatures cool in the fall (Matheron et.al., 2006).

For treatment 2, which included a topical treatment of copper upon the cut branches and a biannual treatment of Azoxystrobin to the orchard floor, infestation rates followed a similar pattern as with treatment 1, but the levels were as much as 50% less. For example, while treatment 1 annual infestation levels were the greatest in September 2016 and December 2017 at 69 and 66% respectively, for treatment 2, those levels were at 39 and 47% respectively. This represents a 44% decrease in infested trees under treatment 2 versus treatment 1 in 2016, and a 29% decrease in infested trees under treatment 2 versus treatment 1 in 2017. Compared with treatment 1, treatment 2 led to about a 50% reduction in infested trees through 2016, and at 30 to 50% reduction from January 2017 through March 2018.

For treatment 3, which included a topical treatment of copper upon the cut branches, removal of large branches from the field and the Azoxystrobin application, there was also a reduction in infested trees compared with treatment 1. For example, infested trees under treatment 3 were 48% and 13% less in September 2016 and December 2017, respectively, compared with treatment 1. By January 2018, the infestation rate for treatment 3 was 8%, compared with 37% in treatment 1.

Since data is limited for Cooperator B, no graph is shown. The control block was 100% infested in November and December, and the other blocks had infestations ranging from 70 to 100%. Topping, hedging, application of azoxystrobin and removal of diseased wood should reduce the disease incidence in 2017, but we were not certain that those operations had taken place.

Overall, it appears as if treatments 2 and 3 led to reduced infestation in the orchards, and treatment 2 was somewhat more effective (although there was no statistical significance between treatments 2 and 3.

Over the course of the experiment, we found several limitations to the experiment. The most important limitation is that given the size of the experiments, it was impossible to determine if each tree that had a symptom was infested. We noted whether there was dead foliage in the tree and assumed that the fungal diseases had caused the foliage to die. We did not actually look for the presence of the disease on the dead foliage, as that would have been logistically impossible. Next, we were not able to rate each tree as to the degree of infestation. Trees were marked as to if they had dead foliage or not. A tree with 50% collapse of the canopy was rated the same as a tree with one dead branch. Again, it was logistically impossible to rate every tree in the 25-acre experiment. Finally, we were not always able to see the top of the canopy and may have missed dead foliage there.

These limitations suggest that a better way should be found to assess the degree of fungal infestation in an orchard. We hope to continue this work and using spore traps to quantify the level of Antrodia in infested orchards.

Literature Cited

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