Experimental Report
Could *U. Oudemansi*i outcompete citrus brown rot (*M fructicol*a)

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Test site: North Waikato, in hamlet called Ohinewai

Background

The Botryzen product is a fungi, *Ulocladium oudemansii* that out competes *Botrytis cinerea* which cause botrytis rots in grapes, strawberries and other vegetables. The material has been explored against other rots. In the US trials were successful against brown rots in stone fruit.

As part of the manufacturing process the fungi is grown up on a sandy substrate. This substrate once spore extraction has presumably occurred is a waste product. However as would be expected the waste contains many active spores. And if this produce is spread over an area, the fungi will colonize the area, and remove brown rot from the area.

Photo of waste material. Fingernail for scale

Thus this product has potential for citrus brown rot control. Citrus brown rot is a problem in our orchard. It is likely that the brown rot organism was present in the citrus orchard, since it was 3 – 4 decades old. We purchased the property in 2011, and did not notice any brown rot until winter-spring of 2015. This year it caused massive defoliation in a section of the orchard that was on the south side of the shelter belt. Photos taken at this time are shown below.


Defoliated Sweet Navel Orange tree (left) and resultant leaf fall on the ground (right)

This was obviously a concern, so research was undertaken to determine the cause and appropriate solutions. It was determined that the fruit drop, which occurs in appropriately June with the onset of winter temperatures, and continues slowly though the season, sat on the ground and get colonized by *Monilinia fructicol*a. The spores then get splashed (or otherwise travel) up into the leaves, which causes leaf death and leaf drop. This also causes good fruit to get infected and also drop, or worse say on the tree, and become hard to pick up as rejects in the picking / grading process.

The defoliated regions of the tree, will also die back, although this is limited to the thin twigs on the branches and not the complete branch.

The rot is worse in late spring when the environment is still very wet, but temperatures have increased. This allows the rot to spread quickly, where as the wetter winter with lower temperatures, the temperature is below the optimal brown rot growth window.


Infected fruit (right) showing change in color associated with brown rot infection. The fungus produces white spores / spore bodies turning the fruit white (right) and these then infect other fruit / leaves.

Brown rot has appeared every year since 2015, infecting the original area, abit to a less extent as well as infecting other areas of the sweet navel orange trees. It always starts on the south sides of the trees.

Attempts of control has centred around removal of citrus fruit on the ground, and increasing airflow. One year the dropped citrus fruit were picked up on a weekly or bi-weekly cycle. Then transported to the other side of the 0.5Ha block and dumped. It was hoped here they would be far enough away that the infected rotting fruit wouldn't infect the citrus trees. However this work did not seem to impact the end result.

The other attempt was to prune the trees. They required pruning anyway as they were getting to large. The centre of the trees were removed, reducing the overall height, and also increasing sunlight and airflow to the south side of the trees. However it did not reduce infection.

Connection was made with Peter Foster at Botryzen and substrate obtained.

Product

Botryzen
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Supplied 'waste' material in 10x 25 litre sacks.

Application

With suggested application rate of half a sack per tree:

- Row 3, from water tank to fejioa hedge
- Row 3, five trees in from east end

Applied 2/3 on south side, since this is where brown rot starts, and 1/3 to northside. Also threw up into leaves on south side.

Then in a more adhoc way:

- 1-2 scoops per new citrus. These were located north side of row 2, and in ad hoc locations in row 4 and 5.
- More for limequat and cumquat 4-5 scoops
- Sprinkled around all nectarines, that row's peachs and early peaches. Also threw into the nectarine trees to somewhat attach to tree parts.

Noted that a lost of dust was generated, (wore a face mask which is essential) and this drifted through grass / trees.

The application rate when the ground was bare created an even coat of material. Whereas applying the maximum rate on the south side, the material got 'lost' into the longer grass / chop and drop.

Coverage over bare ground

Same application rate, but showing ‘less’

Observations:

- The fungi did not form a thick black mat as expected. This didn’t seem to occur anywhere on the property. It is assumed that the application rate was not heavy enough to form a solid mat.
- Early in fruit season, May-June. Any fruit drop very quickly decomposed, with different looking fungi than normal. Therefore fruit not sitting on ground for extended period of time
- July fruit that sits on ground, taking longer to rot, so some getting traces of brown rot? But then taken over by other fungi.
- At season end, there was no fruit on or off the trees that looked like it had been infected with citrus brown rot. Nor was there any distinctive aroma that accompanies the brown rot.
- Only three leaves were noticed on the ground and infected with brown rot. This was spring, and I through here comes the infection. Since they typically started with a few leaves dropping, then a short time later masses of leaves infected and dropping. However there was not mass infection at any time.
- The Mexican lime (*Citrus* × *aurantiifolia*) carried its crop through winter for the first time. We have one tree, and for the last few years it has lost all its crop and large number of leaves to the citrus brown rot.
- The Tahitian lime (*Citrus* × *latifolia*) did get minor infection. I can’t comment if this was more or less than in previous years since hadn’t been a major problem. So accurate comparisons cannot be made
- The produce was not sprinkled heavily around the trifoliate rootstock tree (*Citrus trifoliata*). Thus the large volume of fruit that this tree produced and dropped, got infected with citrus brown rot. This was to be expected. However the downside was that the citrus brown rot then jumped to the Meyers lemon (*Citrus* ×*meyeri*). This resulted in the meyer lemon loosing nearly all its crop as the disease worked its way up the tree. The disease stopped once temperatures warmed enough that its infection no longer continue. It should be noted that the lemon tree had a a large proportion of its crop low to the ground as it is young tree. A properly pruned commercial citrus tree would not carry such a large crop close to the ground. Other lemon trees nearby also lost a few low fruit to brown rot.
- The limequat was also not infected, showing no signs of leaf drop (it had very few fruit set this year). This was the first time in at least two years that this tree had not been significantly defoliated. There was also no infection on the Kumquat which typically also has significant leaf loss.

Climate and crop notes

- This year would have likely been a good year for brown rot infections. It was a ‘warm’ winter, (no data, just based upon gut). The warmer winter temperatures would suited infection and growth of brown rot. Being the Waikato is was also wet over winter, so a warm wet winter. But was not wetter than typical.
- Low fruit production. This year was an ‘off’ year. We still have a biannual bearing in the orchard. Therefore there would be less fruit drop of immature fruit in June. Thus there would be less infection sites compared to an ‘on’ year.
- Trees were pruned heavily on north side to increase air flow and sunlight into the south side of the trees in 2018. Thus for the 2019 season there was more sunlight and airflow to the south side of the trees.

Conclusion

This test can only be taken as indicative. That said, it seems to strongly indicate that *Ulocladium oudemansii* has potential as a citrus brown rot biological control agent. The sweet navel orange crop was not affected by citrus brown rot for the first time in four years. This control also extended to some other young citrus trees that typically were infected.

No infection occurred in rows 1, 2, 4 or 5 even though the produce was applied to high risk areas in row 3 and north sides of row 2 and ad hoc locations on 4 and 5. This is implies that either it was a year where other circumstances (low crop or pruning) eliminated the brown rot, or that in spreading the material, enough fungi spread around the orchard on the air currents (or moved biologically) that the benefit spread though the remaining rows. This would imply that the dose rate could be reduced and the outcome would remain the same.