The effect of HLB on pre-harvest development of Diplodia stem-end rot

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Diplodia Stem End Rot
Phomopsis Stem End Rot
Alternaria stem-end rot

Diplodia infects citrus fruit under the calyx
--- usually remains latent until after harvest
--- invades from the calyx abscission zone into fruit
The decay rate is greatly enhanced by exposure to ethylene

High incidence of Diplodia DNA was found in HLB-affected orange juice
DNA from a fungus consistently present in HLB-affected juice, but not in juice from healthy fruit.
By DNA sequencing, the fungus was identified—it was Diplodia
The finding was confirmed by Diplodia specific primers.

Studies conducted on citrus fruit harvested from trees
PCR detection for Diplodia and Clas
Fruit Detachment Force (FDF) measurement
Diplodia isolation
Electron Microscopy
Fruit ethylene production measurement
Fruit decay assay

AS and HLBs fruit were compared in the assays

Higher incidence of Diplodia was found in HLB-symptomatic than non-symptomatic fruit
Positive correlations between Diplodia and Clas titers for both cultivars
Significantly higher Diplodia titers in HLBs than in AS fruit (P<0.001)
After harvest, the fruits were treated at 27.8°C and 90%–95% relative humidity, with 10 ppm ethylene for 4 d (ethylene degreening treatment). Then fruits were transferred to air storage for up to another two weeks.

Decay incidence of orange fruit during ethylene treatment and subsequent air storage:

- After harvest, the fruits were treated at 27.8°C and 90%–95% relative humidity, with 10 ppm ethylene for 4 d (ethylene degreening treatment).
- Then fruits were transferred to air storage for up to another two weeks.

7 days after ethylene treatment:

- Untreated Control
- Ethylene Treated

Isolation and identification of Diplodia from HLBs fruit:

- Identity was verified by PCR
- Induce spore on autoclaved citrus twig

Correlation of Diplodia Ct value and ethylene production in HLB-symptomatic fruit:

- R = 0.838
- R = 0.855

Correlation of Diplodia Ct value and FDF in HLB-symptomatic fruit:

- Fruit Detachment Force (FDF) = the pulling force required for detaching fruit from the stem
Summary

- Diplodia post-abscession zone observed under an SEM
- Increased on-tree decay of fruit on the HLB-affected trees
- Many of the on-tree decay were caused by Diplodia

HLB leads the infected citrus under a great biotic stress

- Pre-harvest Diplodia SER is not unusual
- Pre-harvest fruit drop is exacerbated
- Post-harvest fruit decay is increased
- Contribute to HLB-related off-flavor of orange juice ??
  - Need study to know
- Diplodia management should be enhanced and applied pre-harvest

Consequences

- Diplodia pre-harvest invasion of HLB-affected fruit

Fungicide spray trial

- Five citrus cultivars:
  - Navel Orange
  - Early Gold Orange
  - Midsweet Orange
  - Murcott Tangor
  - Ruby Red Grapefruit

- 20 trees used for each cultivar
- Quadris Top Fungicide: four times (15.4 oz/35 gal of water)

The schedules:

- Dates applied fungicide
- Dates assessed for qPCR
- Dates measured FDF
- Dates evaluated fruit drop

- Early Gold Orange
- Navel Orange
- Midsweet Orange
- Murcott Tangor
- Ruby Red Grapefruit
Average (AVG) and Distribution of Fruit Detachment Force (FDF)

Cumulative fruit drop count and drop percentage during the maturation season

- Reduced fruit drop significantly for
  - 'Early Gold' (45%)
  - 'Midsweet' (30%)
  - 'Murcott' (46%)
during the maturation season

- No effect on fruit drop for
  - 'Navel' or
  - 'Ray Ruby'

Fungicide foliar application may be an effective strategy in control of HLB-related fruit drop for some citrus types and cultivars

More work needs to be done to confirm these results

Fungicide resistance and cost-benefit ratios need to be considered also