Pecan scab control and fungicide coverage from ground-based sprayers

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Overview of presentation

• Background, challenges to good fungicide coverage
• Describe results of some recent experiments
  • Scab distribution in the tree
  • Spray coverage results
• Summarize these in the context of options for control of scab
Background

- Mature pecan trees are tall (>50 ft)
- Major disease is scab (*Fusicladium effusum*)
- Various fungicides are used to control scab
- Much of the application is by ground-based air-blast sprayers
- Good scab control in the top of the tree is perceived to be challenging (especially if wet – 2013 is a case in point)
- Many factors affect spray coverage – tractor speed, application volume, weather conditions, tree architecture and tree height
- Objective: to characterize scab distribution and the impact of management on scab severity in the canopy of mature pecan trees
Pecan scab life cycle (*Fusicladium effusum*)

Overwinters as conidia and stroma.

Epidemics build up on fruit (conidia) in autumn.

Conidia from stroma infect young foliage in spring.

Epidemics build up on young leaves (conidia) in summer.

Fungus becomes dormant as ‘stroma’ and overwintering conidia in winter.

Overwinters as conidia and stroma in spring.
Experiment design and procedures

Vertical distribution of pecan scab in mature trees

- Trees received fungicide (propiconazole, TPTH) by air-blast sprayer (Aerofan D2/40 1000), Ground speed 2 mph, 100 gallons per acre) or were non-treated
- 4 replicates of each treatment. Fully randomized design
- Fruit were assessed for scab incidence and severity in early-Aug and early Oct
- Samples (10 fruit) taken at <15, 15-25, 25-35, 35-40 and >40 ft
- Data analyzed using a generalized linear mixed model with an analysis of simple effects and means separation
Weather and timing of fungicide sprays

2010

2011

- 54-y average 15 Mar-15 Oct is 29.09 ins (739 mm)
- 2010 was an average year with evenly distributed rainfall 30.16 ins (766 mm)
- 2011 was a relatively dry year 23.37 (591 mm)
Vertical distribution of scab in the pecan canopy

August

- On non-treated trees severity declined with tree height in all seasons
- Fungicide treatment has a significant effect reducing scab in the low-mid canopy (≤35 ft)
- Above 40 ft, there was no significant effect of fungicide on scab severity

Within each column of charts, bars with the different letters are significantly different (P=0.05). Whiskers are 95% confidence intervals.
Vertical distribution of scab in the pecan canopy

October

- On non-treated trees severity declined with tree height in all seasons
- Fungicide treatment most often had a significant effect reducing scab in the low-mid canopy (≤35 ft)
- At 25 ft and below, there was a consistent effect of fungicide on scab severity

Within each column of charts, bars with the different letters are significantly different (P=0.05). Whiskers are 95% confidence intervals.
Spray coverage in mature trees

- Used water sensitive cards (Syngenta) at different heights in the canopy to measure spray distribution
- Placed two cards at each of 5 heights in both the inner and outer canopy of three trees (at 15, 25, 35, 40 and 50 ft)
- Moneymaker trees up to ~80 ft
- Durand-Wayland m3210
- Replicated three times (3 trees)
- Analyzed using generalized linear mixed model

Water sensitive cards placed in trees

2012
Fungicide spray coverage in mature trees

- A decrease with spray coverage with height
- Up to 35 ft, spray coverage appears good
- Performed image analysis cards to measure area covered and the number of droplets
- Compared coverage to height in the tree

1. Card is photographed and digitized
2. Image analysis is used to separate spray area from background
3. The area covered by spray is measured
4. The number of spray droplets are counted
Fungicide spray coverage in mature trees

• Percent area coverage is significantly less at heights >35 ft
• But up to 35 ft, spray coverage appears comparable at all heights tested
• The height to which scab control was observed in trees described in earlier experiments

Data analyzed using a generalized linear model. Letters indicate significant differences using the slice option (P=0.05). 95% Confidence Intervals are indicated.
Fungicide spray coverage in mature trees

Least square means of droplets counted on spray cards at different heights

- Droplet number was significantly less at heights >35 ft
- But up to 35 ft, droplet numbers were comparable at all heights tested

Frequency of droplet size range counted on spray cards at different heights

- The frequency of droplet size varied with height
- Fewest droplets of all sizes (particularly droplets >0.1 mm²) were collected at heights 35 ft

Data analyzed using a generalized linear mixed model. Letters indicate significant differences using the slice option (P=0.05). 95% Confidence Intervals are indicated.
Wind speed achieved by an air-blast sprayer

Experiments to characterize the wind speed profile of an air-blast sprayer used in pecan orchards

• How does wind speed declines with distance from the fan?
• How does that relate to spray deposition?
• Use sonic anemometer to record wind speeds from air blast sprayer. Recorded data to 1/100th of a second
• Set anemometer at 5 heights (6, 15, 35, 40 and 50 ft) and three distances (6, 20 and 40 ft). Operated for 2-min intervals and record mean wind speed (mph)
• Background wind 2.3 mph (st dev 1.1)
Wind speed achieved by an air-blast sprayed

Experiments to characterize the wind speed profile of an air-blast sprayer

Sprayer set-up

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All nozzles were fit with a no. 25 swirl plate

- Durand-Wayland Millenium 3210
- Powered by a 350 hp turbo-diesel
- 26 nozzles operated per side (ceramic disc and swirl plates)
- Pump was operated at 150 psi and 100 gpm
- Drove at 2 mph
- Calibrated for 100 gal/acre
Characteristics of wind from an air-blast sprayer

Wind profile from an air-blast sprayer

- Wind speed velocity 6 ft from the fan is substantial (>45 mph)
- The wind impacts stationary air and consequently there is a rapid decline in wind speed
- By approx. 35 ft height wind speed is ≤6.5 mph, and by 40-50 ft, wind speeds approximates to ambient
Limitations of ground-based spray application

- Thus limitations of the spray equipment preclude efficacious scab control, particularly in seasons like 2013
- The data show that the quantity of spray getting to heights ≥40ft is significantly less compared to lower in the canopy
- Aerial application might help address this shortcoming
- But hedging may also help reduce scab...
Hedging - spin-off benefits in managing pecan scab?

How might hedging help?

Hedging alternate sides every 2 yr reduces tree height

More of the tree on the hedged side is exposed to spray

On the non-hedged side there is more spray obstruction reducing spray access to greater heights

A greater proportion of total fruit may be within the area of efficacious scab control, which could result in lower yield losses overall
Potential disadvantages of hedging for scab

How might hedging hinder?

Spray coverage is better, but...

...there is substantially more susceptible foliar material in the top of the tree throughout the season

The new growth is very susceptible at a time when there is plenty of inoculum available for infection - the result is scab despite intensive spraying
Hedging - what we are doing

• We are collaborating with three growers in the region monitoring scab at different heights in hedged and non-hedged trees

• The initial observations indicate hedged trees still have scab in the upper canopy

• Results should be available in 2014
Preliminary results

- Incidence of scab on leaflets - July (percent leaflets scabbed)

- There is a numeric reduction at >25 ft compared to non-hedged trees

- But this was early in the season and we are still collecting and analyzing data
Summary

• Scab distribution differed in non-treated and fungicide treated trees.
• In treated trees there was less disease in the lower canopy.
• Ground-based spray coverage is effective to at least 35 ft, which was the height to which disease was consistently reduced (≤35 ft).
• Wind speed declined rapidly with height and distance from the fan.
• Thus ground based spraying is likely inadequate for mature trees when/where scab is an issue (particularly if much taller than 35 ft).

Questions:

• How effectively does aerial application fill this gap?
• Can we adjust ground-based spray volume/speed for better coverage in tall trees?
• Where scab is an issue, can pruning or hedging keep tree height below that for which air blast sprayers are efficacious?
• Fungicide resistance....
Acknowledgements

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Thank you, and any questions?