

# Hop Powdery Mildew: Biology and Management

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Courtesy WFM

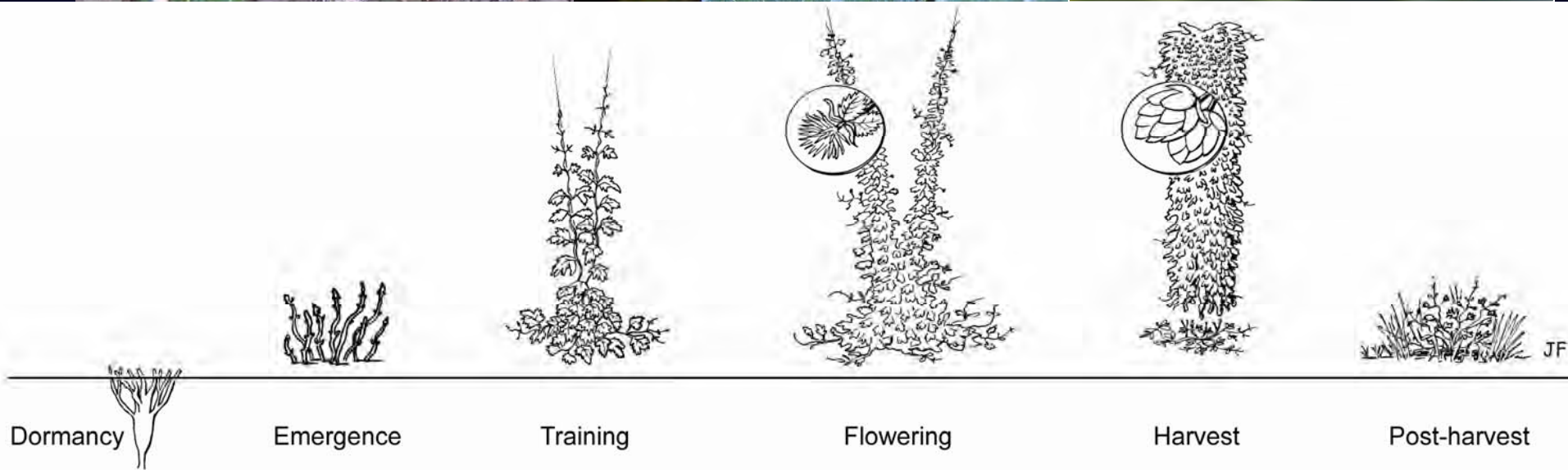














A

B

C





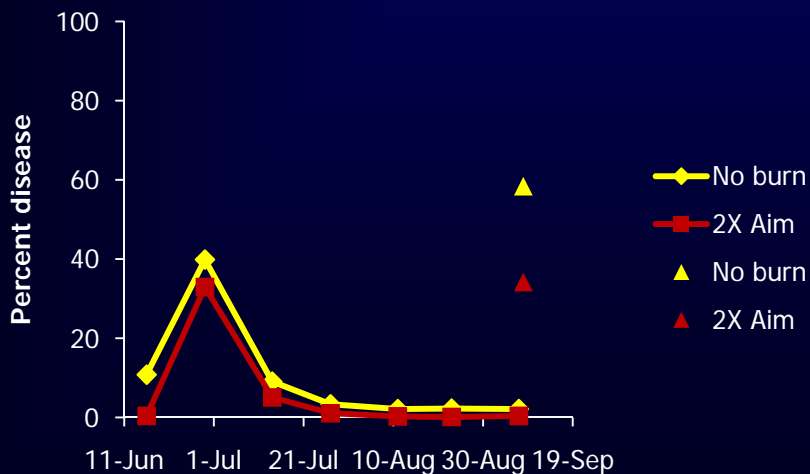
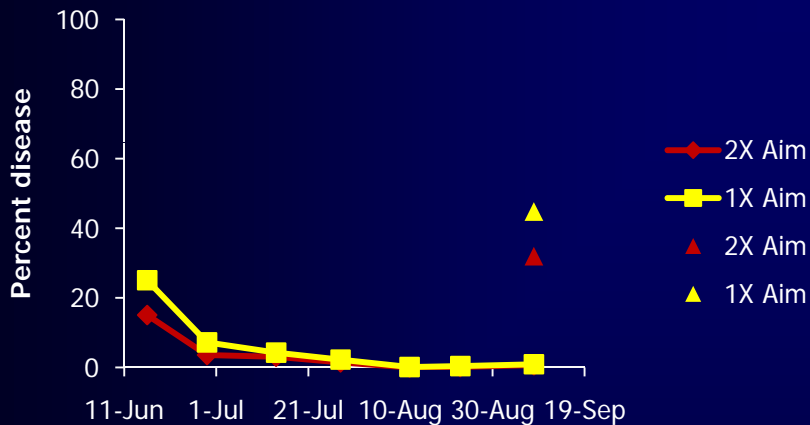
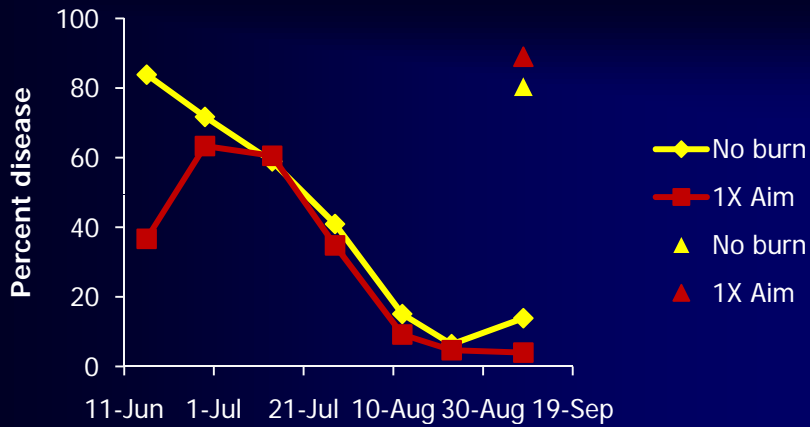
# Basal Foliage Management



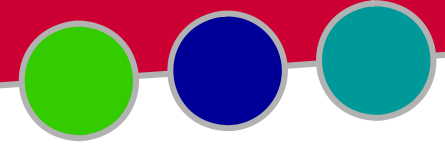


# Basal Foliage Management and Powdery Mildew on Cones

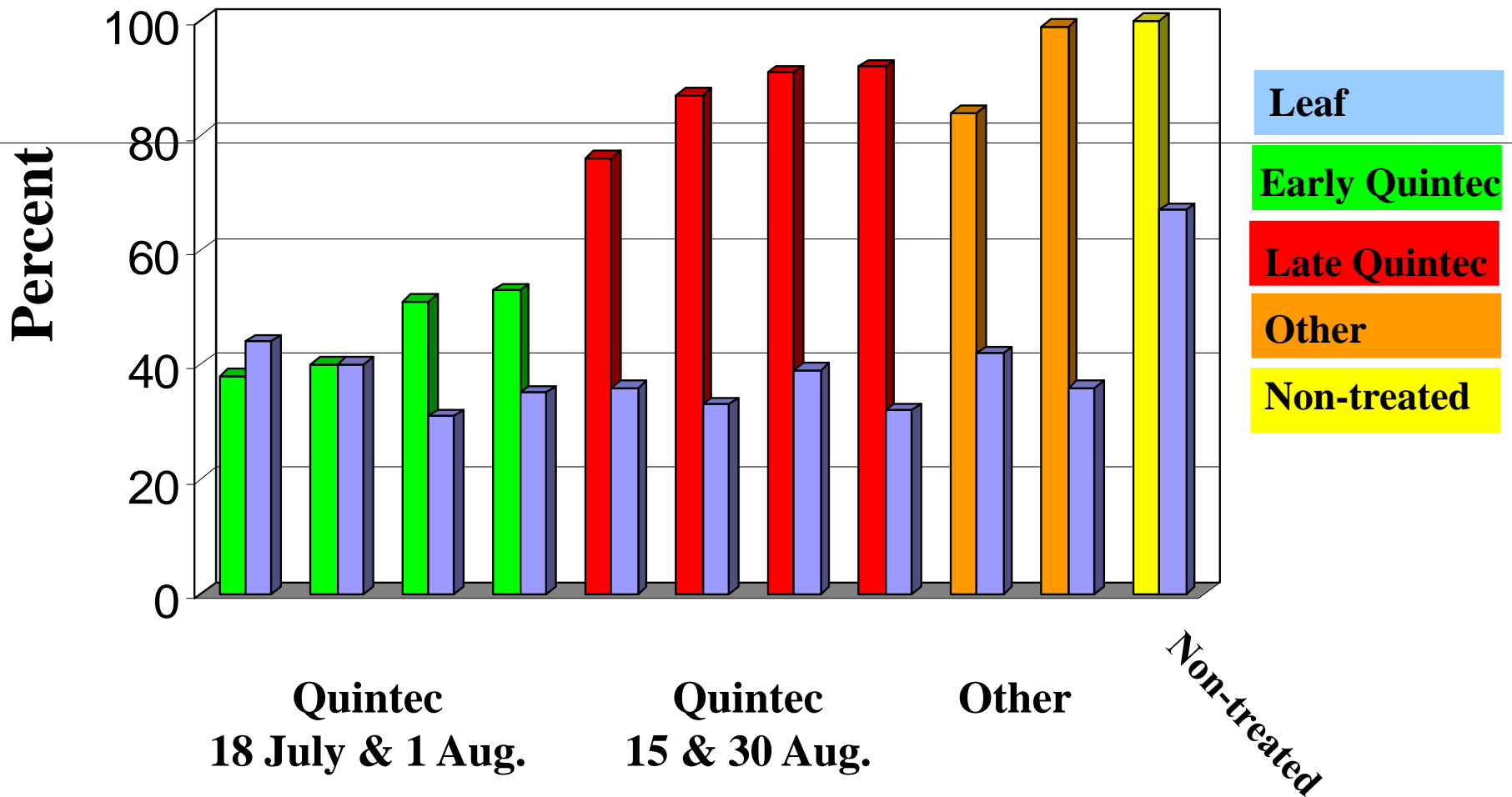
- Small sample size, but effect of:
  - Leaf disease levels ( $P=0.0001$ )
  - Basal foliage management ( $P=0.0204$ )
  - Interaction of leaf disease x basal foliage ( $P=0.0111$ )





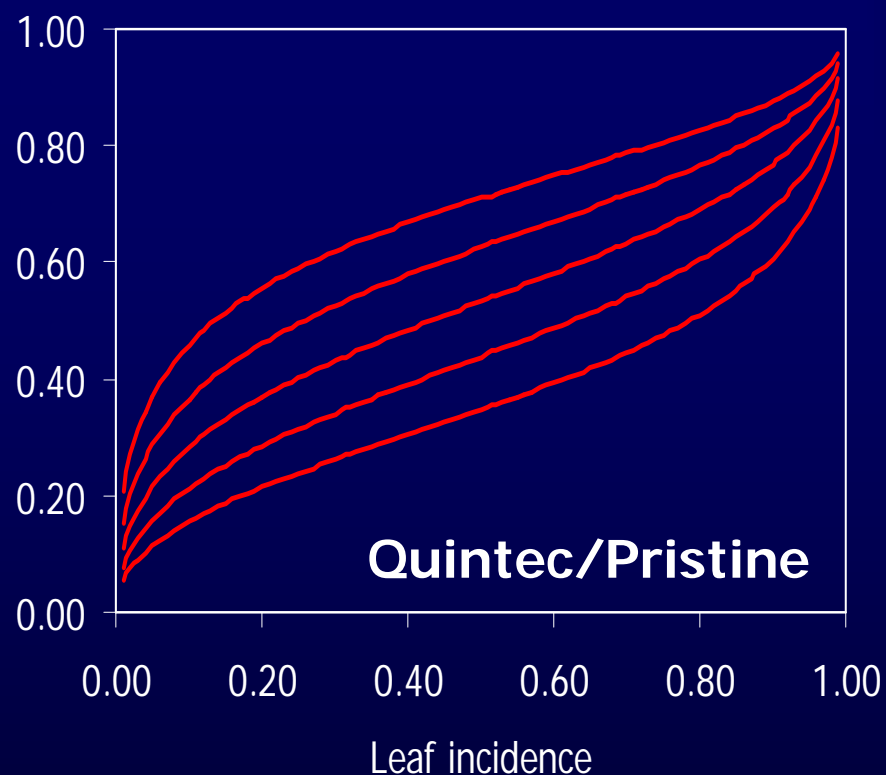
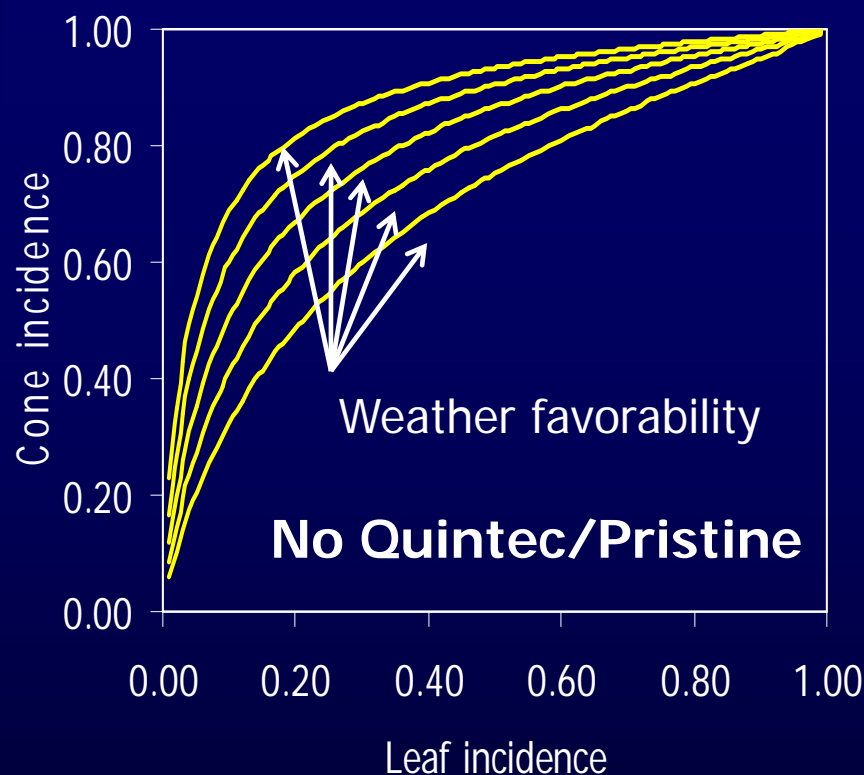


# Effect of fungicide timing on hop powdery mildew cv. Zeus – 2008





# Disease Model Predictions



- Model predicts significant disease reduction from highly effective fungicides during critical cone development stage







# Cone Tissues

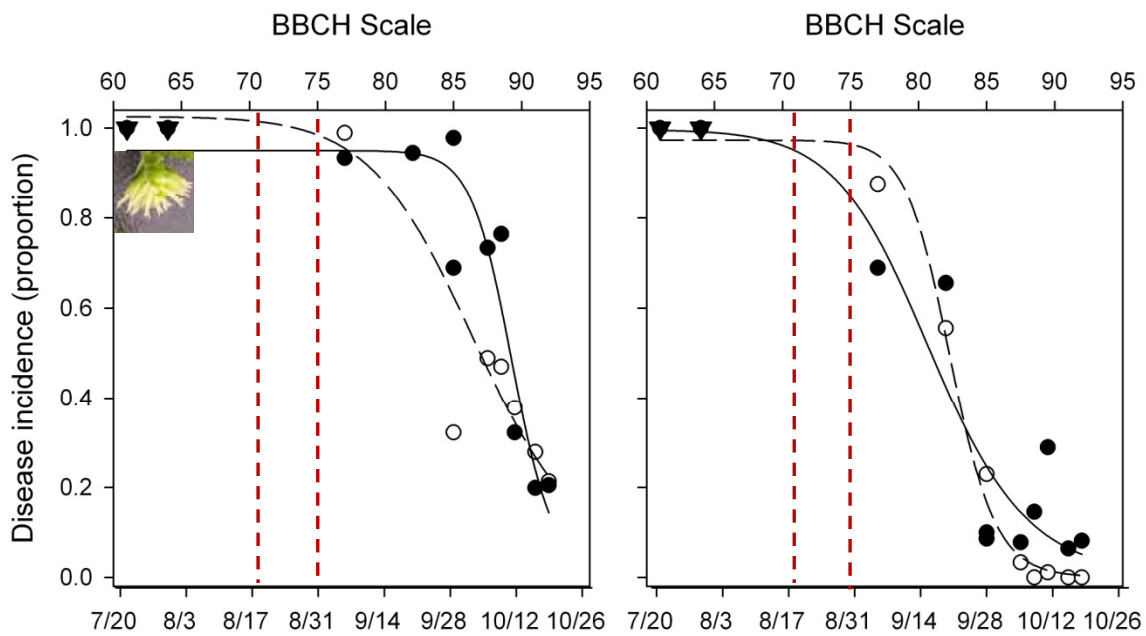
Bract



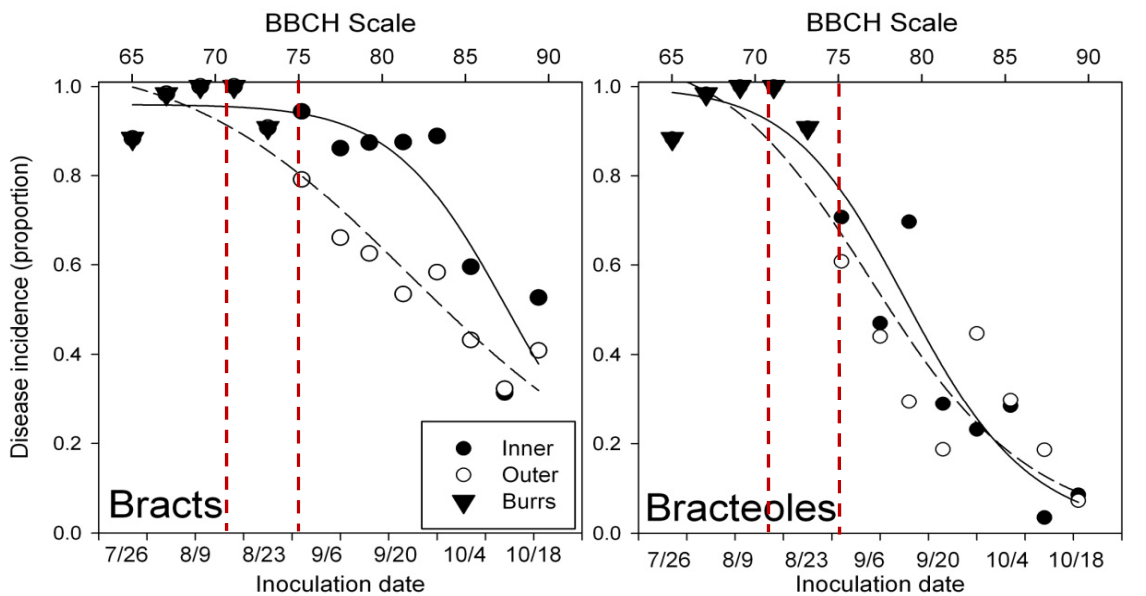
Bracteole (w/ seed)







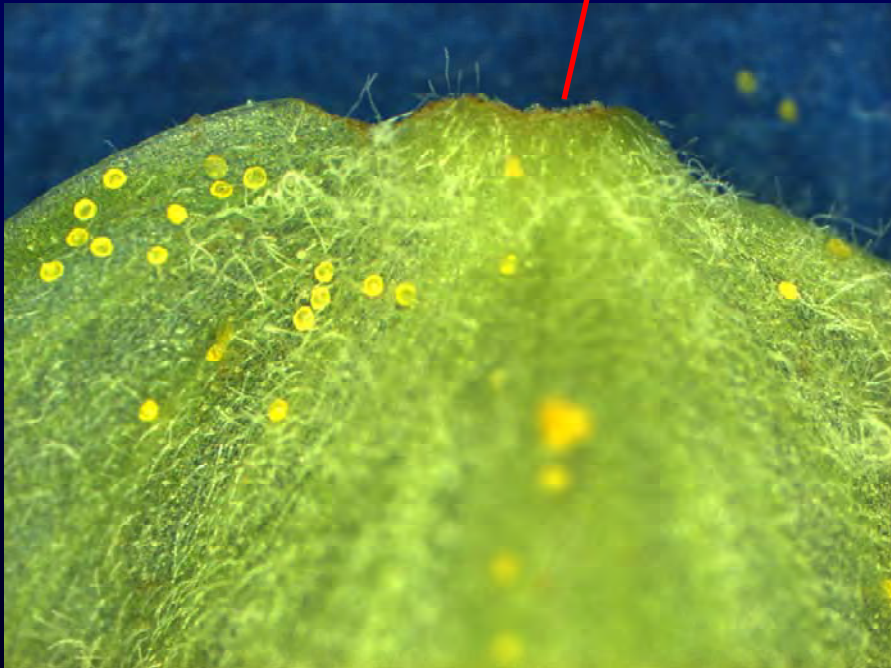
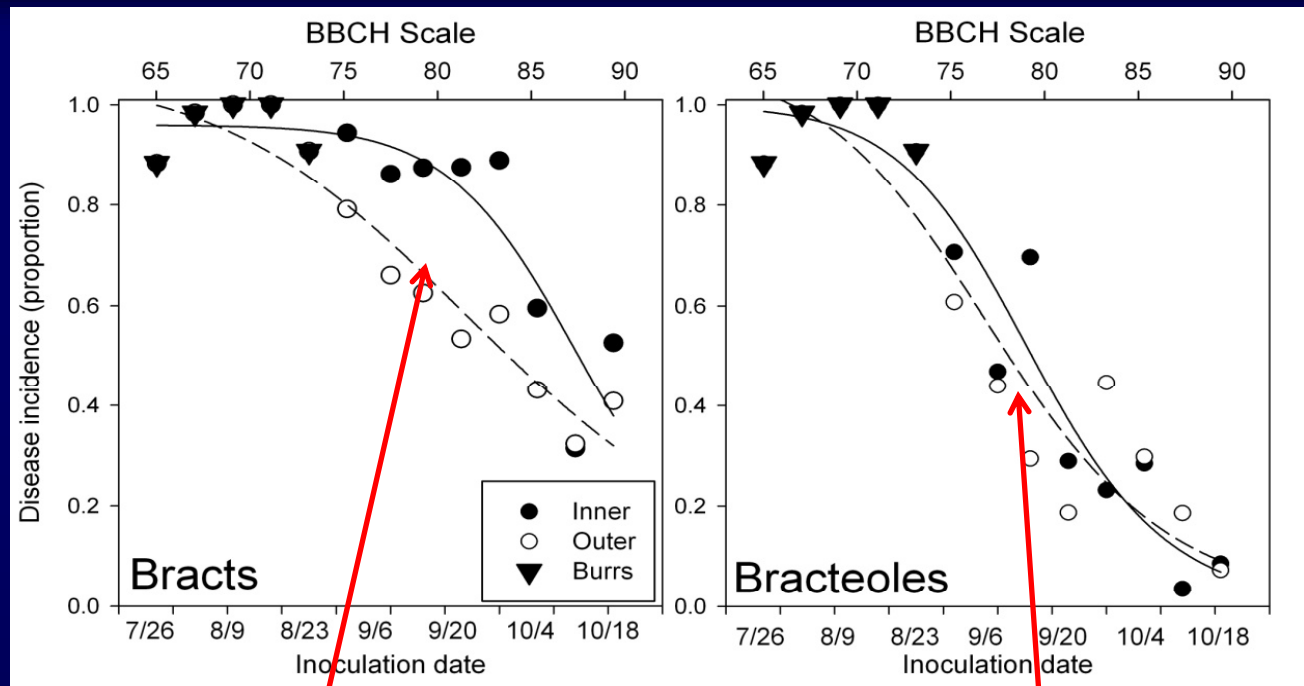
2009



2010





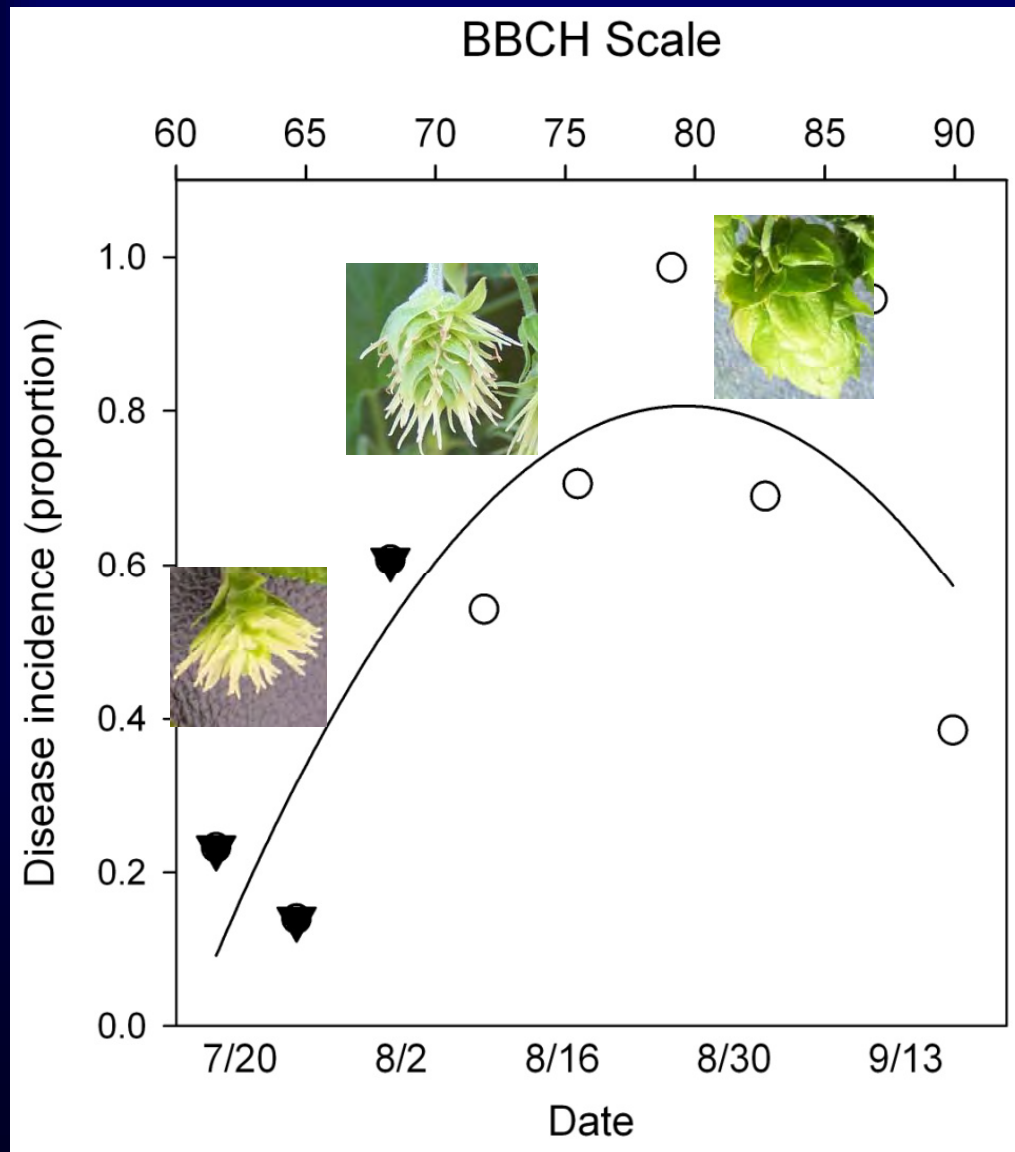








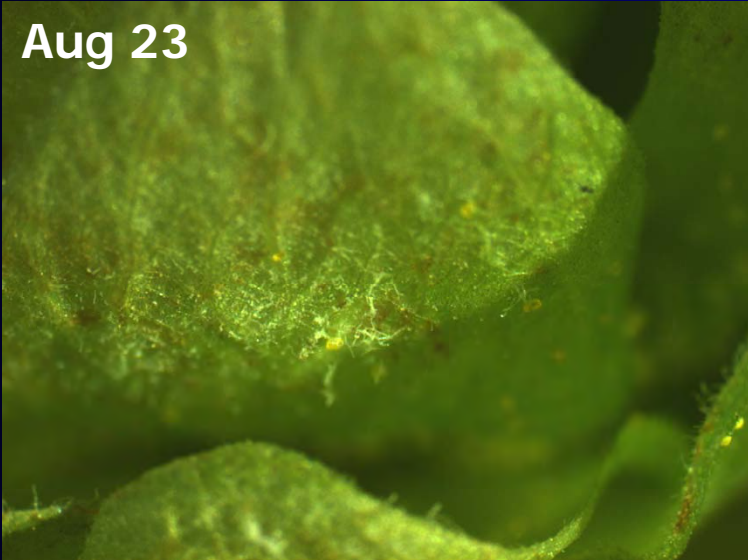
# Field-Produced Cones



- Willamette
  - Greatest susceptibility observed during transition from burr to cone
  - Susceptibility decreased near harvest and post-harvest period



Aug 23



Sept 7



# Field-Produced Cones

- Decreasing severity and incidence of disease, although browning more pronounced with later infections



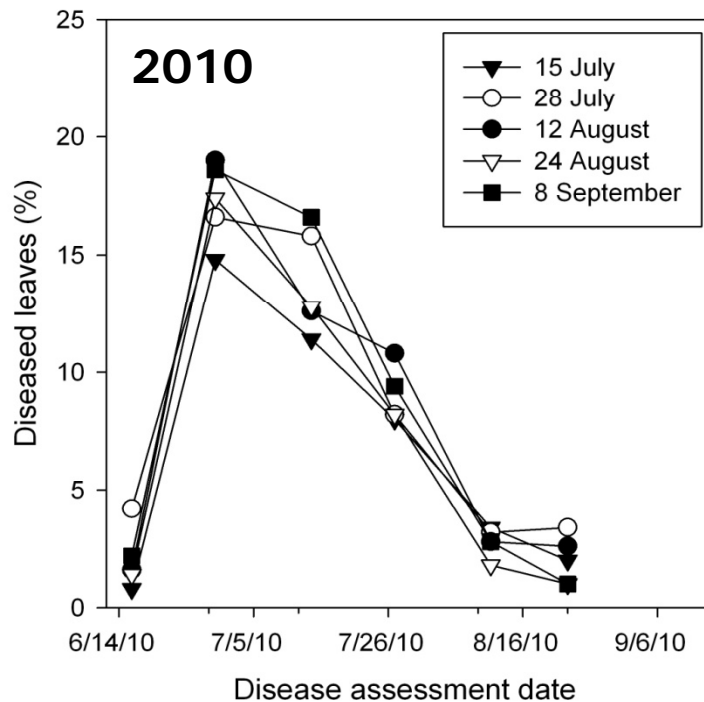
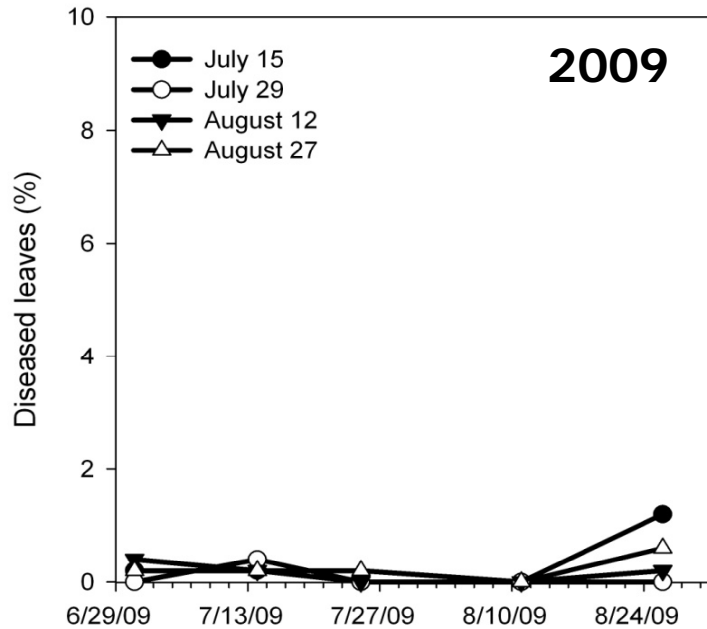
# Disease Management

- How long does powdery mildew need to be controlled on cones?
  - Last spray date?
  - Yield and quality impacts?



# Commercial Hop Yard (Zeus)

- Applications of Quintec, Pristine, or Folicur:
  - Mid July
  - Late July
  - Mid August
  - Late August
  - Early Sept (2010)

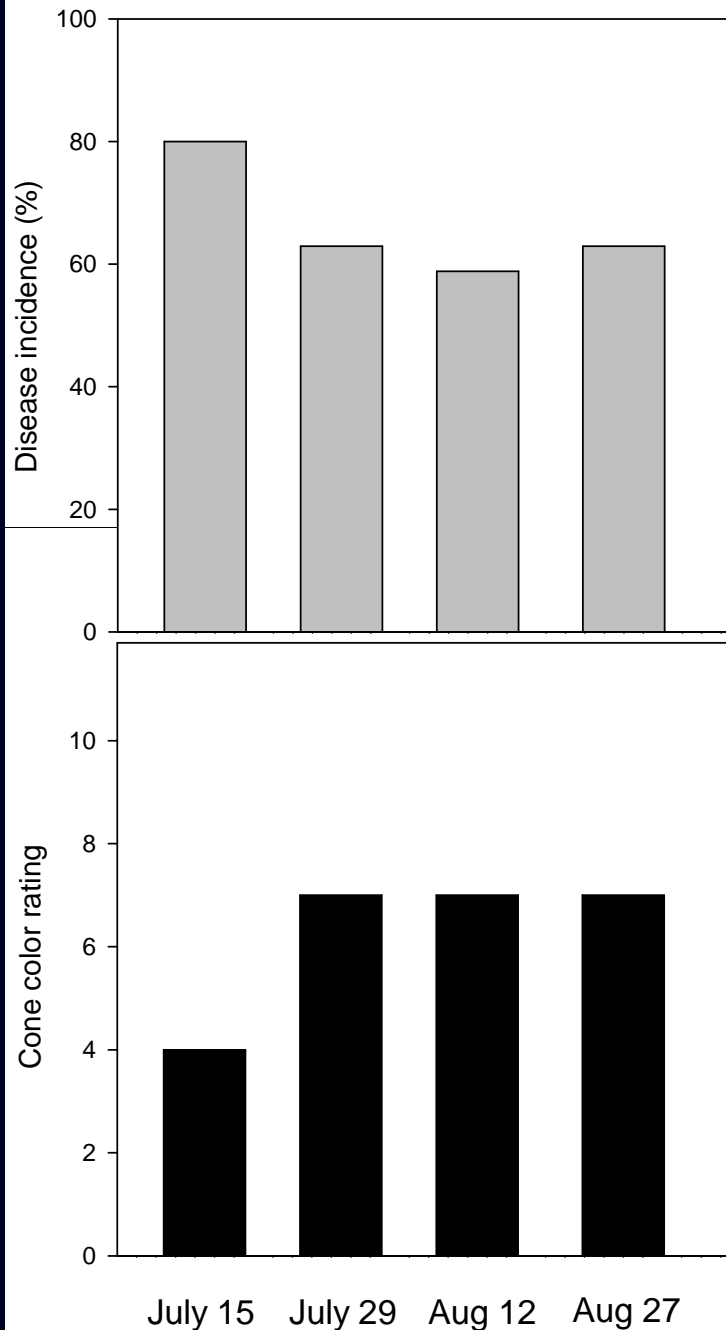




# 2009 Late Season Disease Control

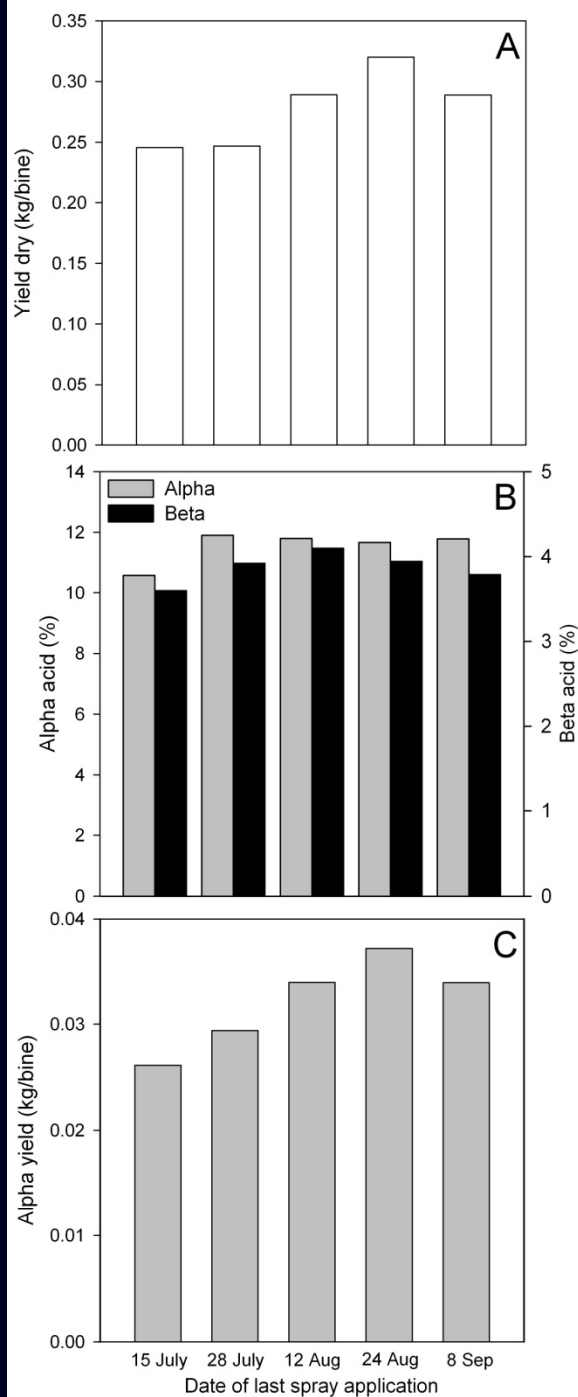
## Commercial yard

- Disease reduction from treatments through 29 July
  - Associated with improved cone color
- No effect on yield, aroma, bittering acids and storage index



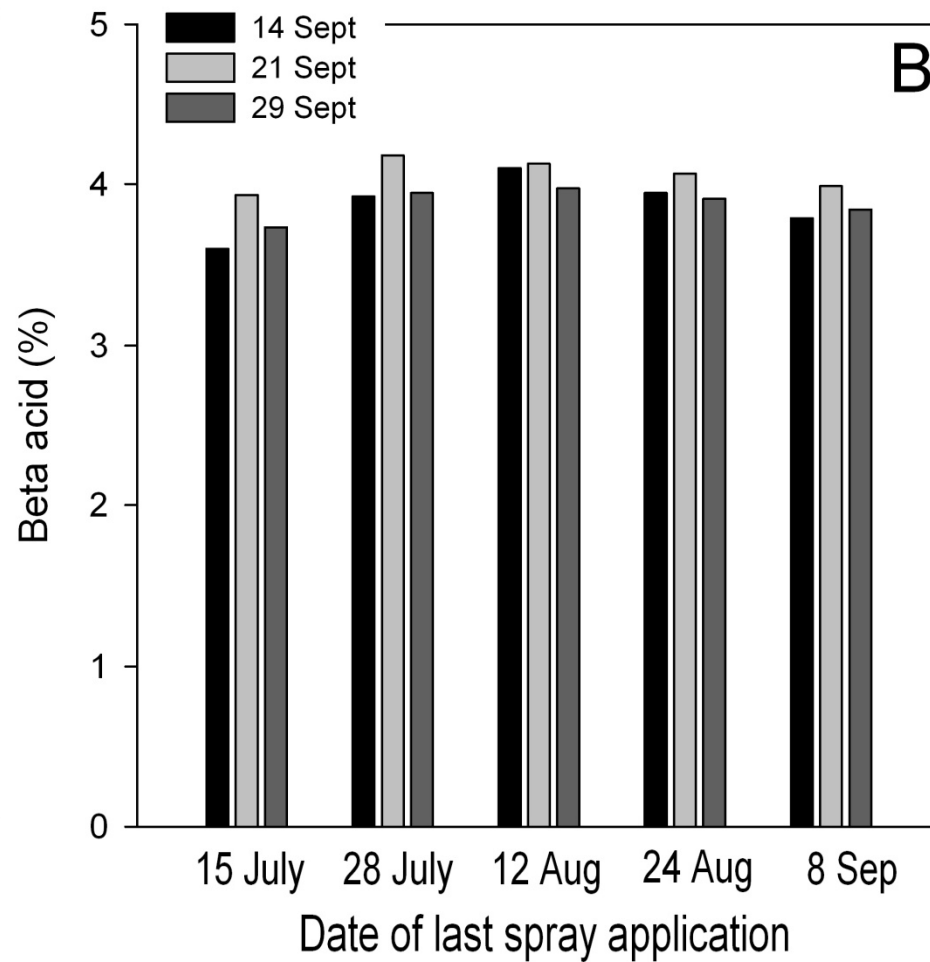
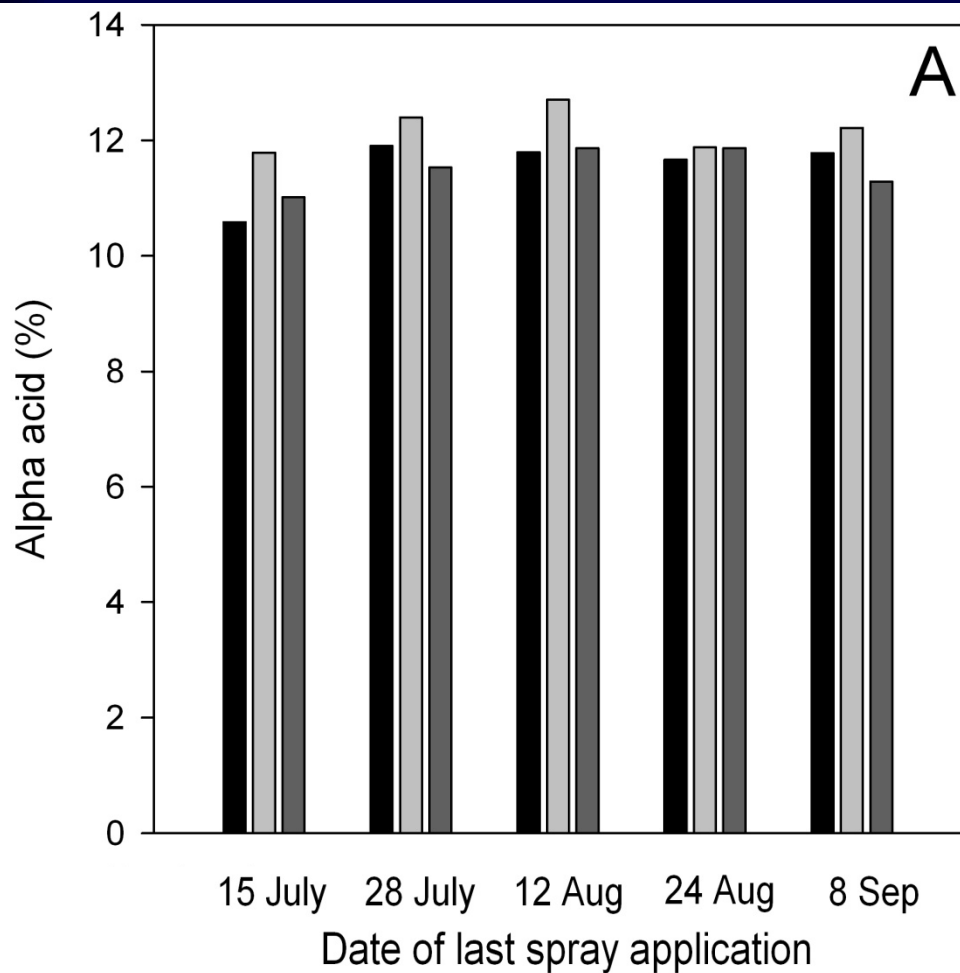


# 2010 Late Season Disease Control



- Powdery mildew:
  - 100% in every treatment (!)
- Yield:
  - 16 to 28% increase in cone yield due to fungicide treatments up to 12 August.
- Alpha and beta acids:
  - Greater than 1% increase in alpha acid and 0.5% beta acid in all treatments compared to last spray on 15 July
- Total alpha acid yield (yield x % alpha acid)
  - Increased 30% by treatments that continued through at least 12 August.





	Alpha	Beta	HSI
14 Sept	11.6	3.9	0.22
21 Sept	12.2	4.1	0.24
29 Sept	11.5	3.9	0.24

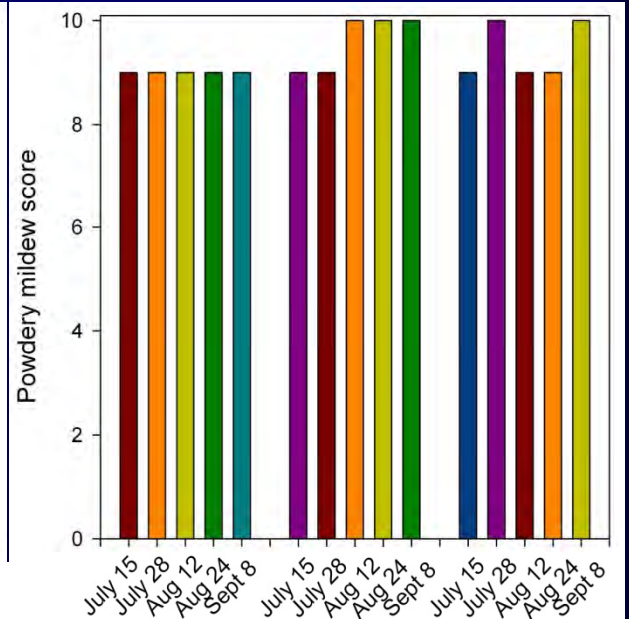
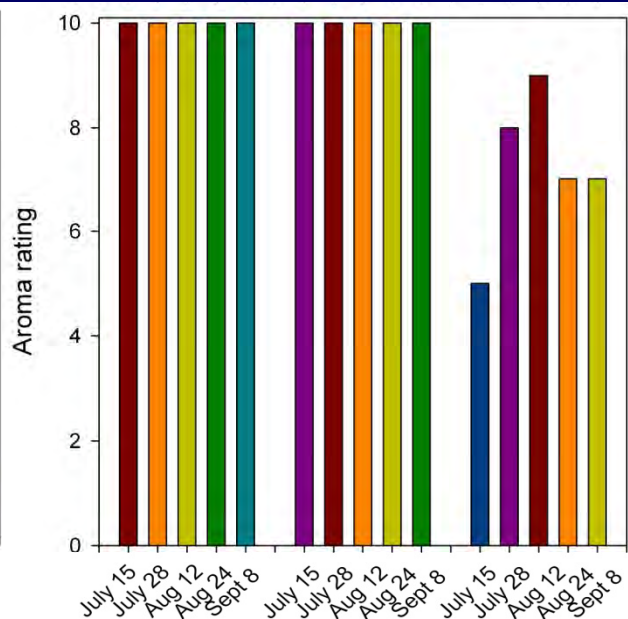
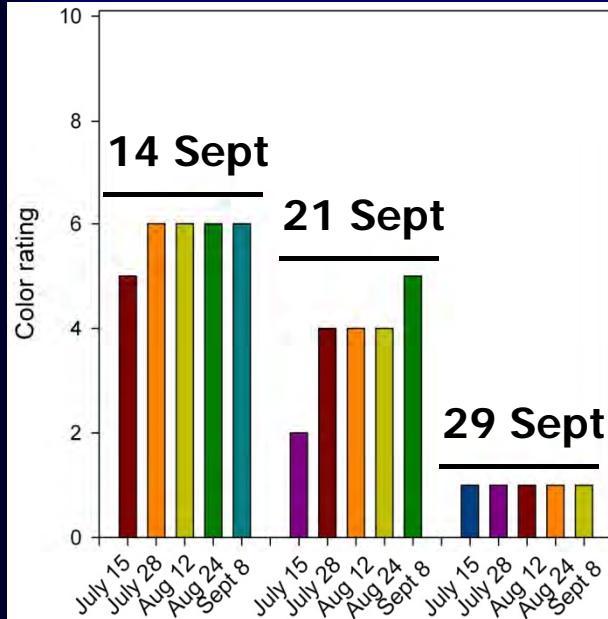


# Fungicide and Harvest Date Effects on Dry Matter

Last spray date (product)	Dry matter (%)		
	14 Sept	21 Sept	29 Sept
July 15 (Quintec)	26.4	28.0	32.8
July 28 (Quintec)	26.1	27.5	32.5
August 12 (Pristine)	25.1	26.8	31.8
August 24 (Pristine)	25.5	25.2	31.3
Sept 8 (Folicur)	25.0	26.5	32.6
<i>Average dry matter</i>	25.6A	26.8B	32.2C



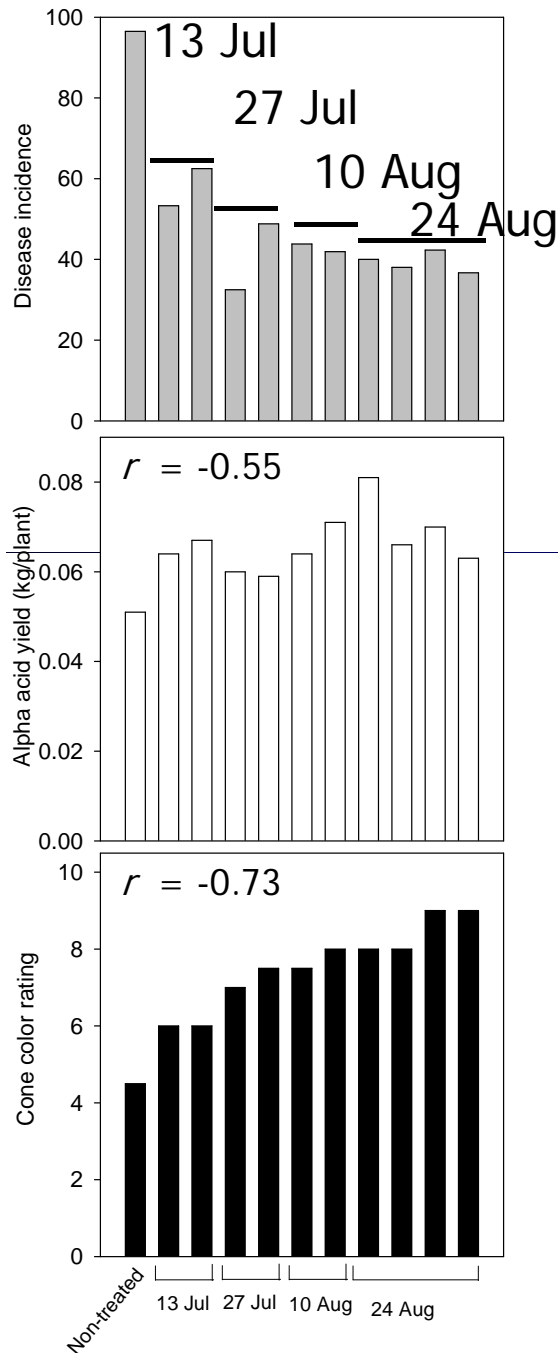
# Cone Quality Evaluations



# 2009 Late Season Disease Control

## Experimental plots

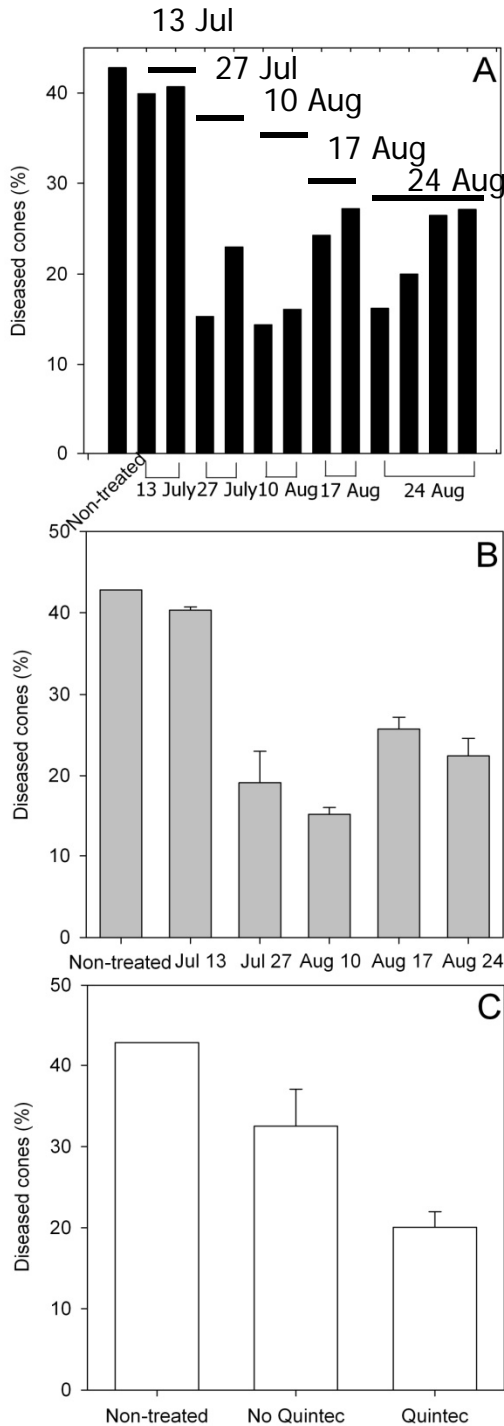
- Disease reduction from treatments through 27 July
  - Trend for higher yield with later treatments
  - Cone color improved with late treatments
  - No effect on bittering acids, storage index or aroma between fungicide treatments





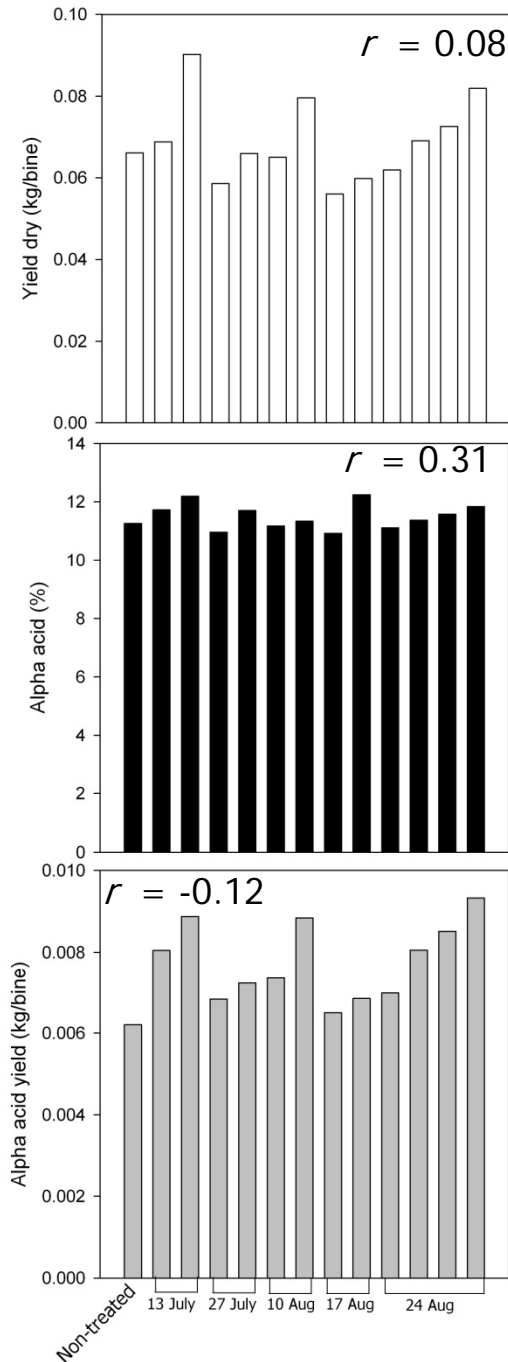
# 2010 Late Season Disease Control

- Treatments stopped 13 July similar to non-treated plots
- No apparent trend in disease control from sprays past 27 July
- Related to timing of Quintec



# 2010 Late Season Disease Control

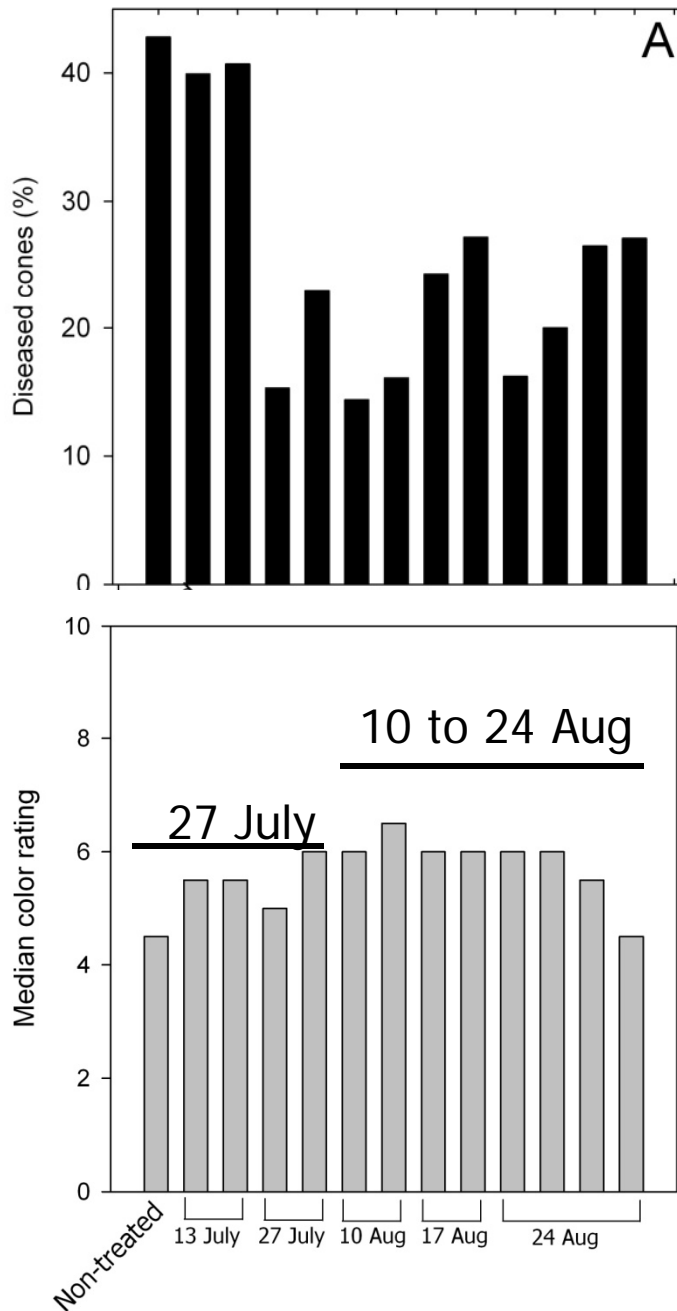
- No effect of powdery mildew levels on yield, alpha acid, or alpha acid yield





# Cone Color Improvements

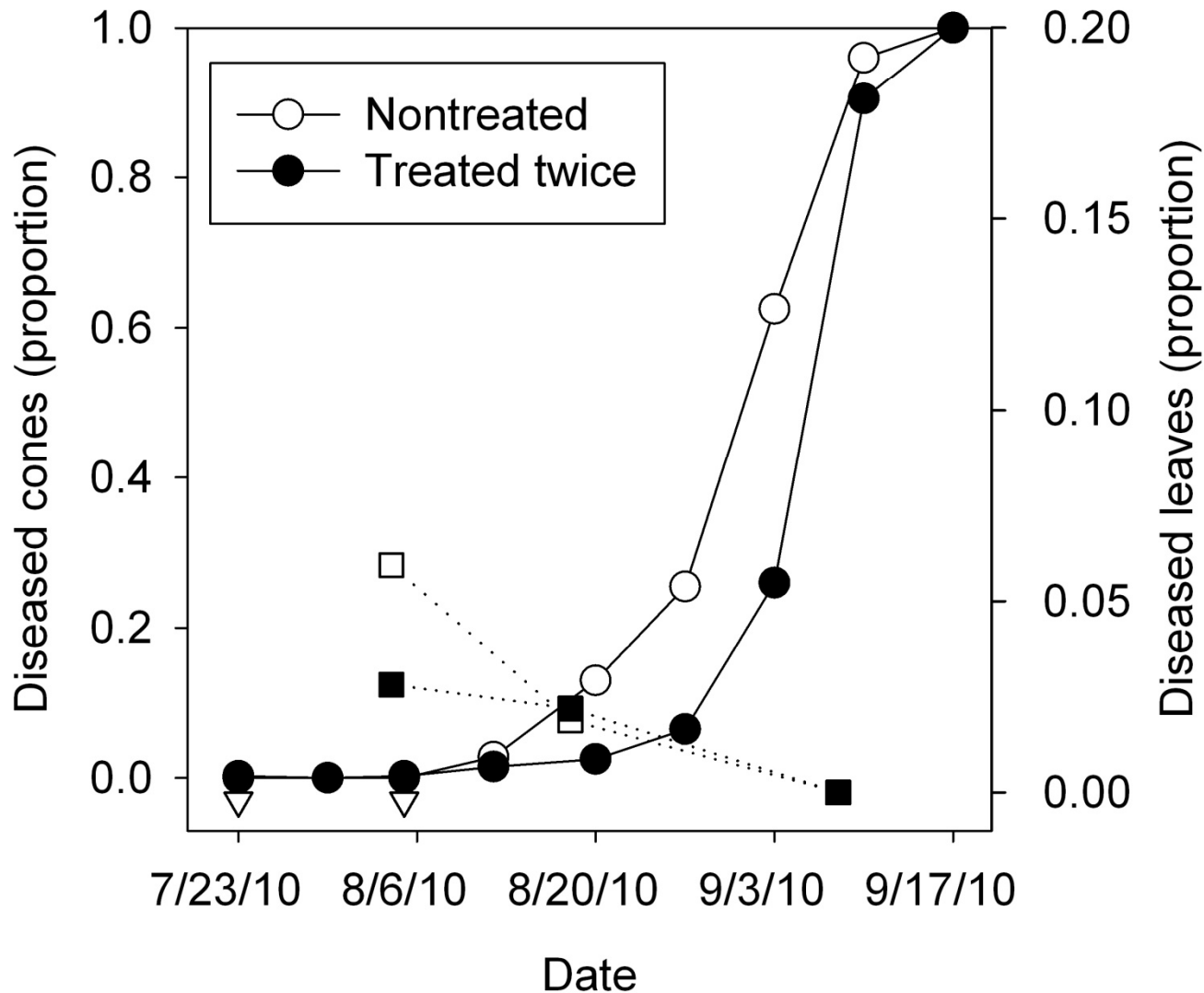
- Overall, relatively small affect of fungicides on color
- Fungicides up to 10 August associated with highest values of cone color







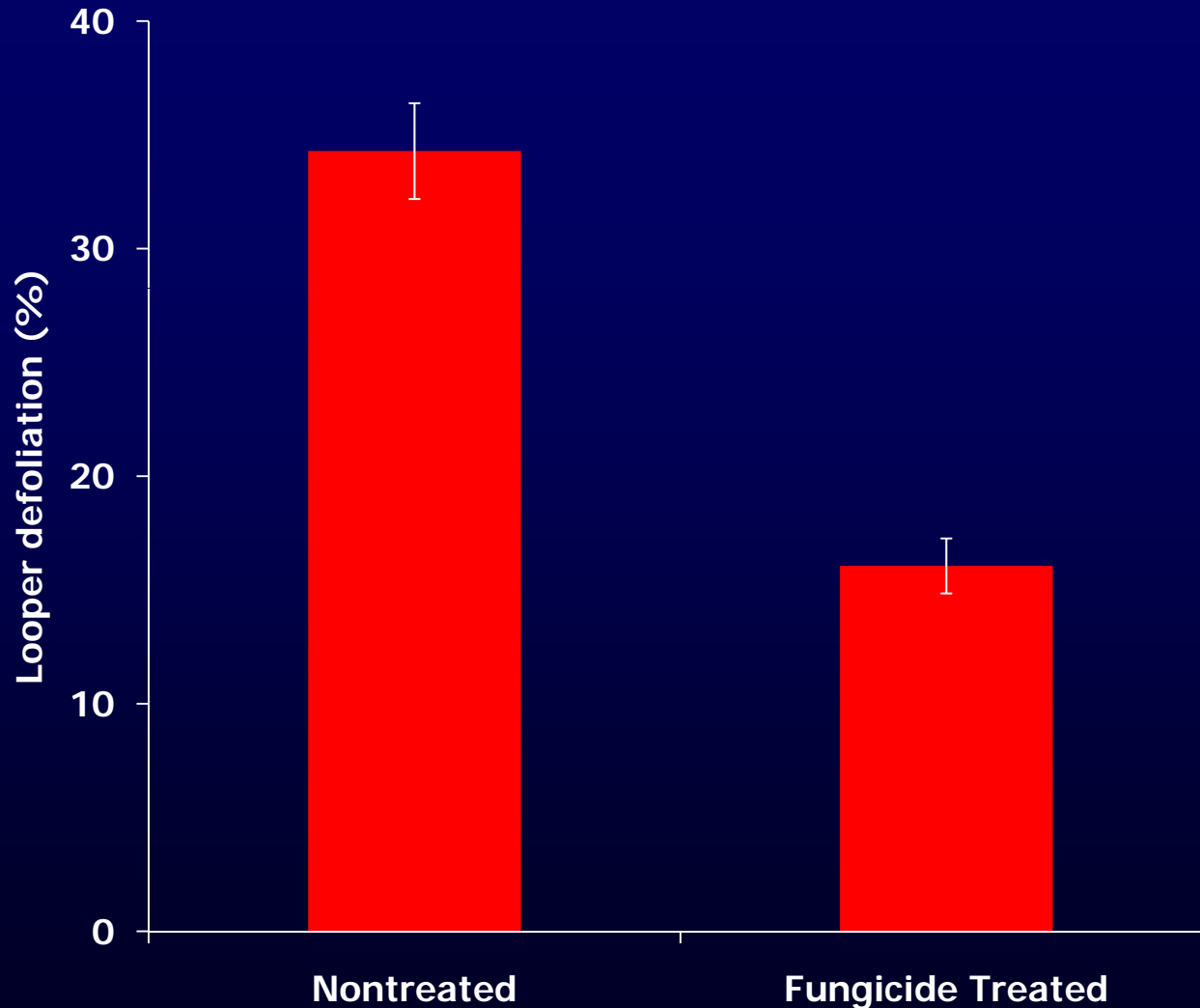
# Powdery Mildew Development on Cones



## Treated Plots

- Quintec  
July 23
- Pristine  
August 5

# Reduced Looper Damage on Fungicide Treated Plants



two sided *t*-test:  $P = 0.0003$



# Yield and Quality Summary

1. Fungicide applications required through at least late July to minimize powdery mildew and maximize cone color quality
  - Apply most effective fungicides during transition period from burr to cone development in late July and early August
2. Disease control through this period can be associated with higher alpha acid content and yield, and certainly cone color
3. Additional late season sprays may be of value under moderate or high disease pressure conditions or moderately late harvest situations
  - With moderate to high disease levels or later harvest, cone color and alpha acid yield have been maximized by fungicide treatments that continue until just before harvest
  - No fungicide treatment maintained cone color when harvested too late





**Hop Research Council  
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Grower cooperators**

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