

# **New Tools for an Old Foe: II. Powdery Mildew Management**

**Walt Mahaffee**

**USDA-Agriculture Research Service  
Horticulture Crops Research Laboratory  
Corvallis, Oregon**





# Managing Powdery Mildew

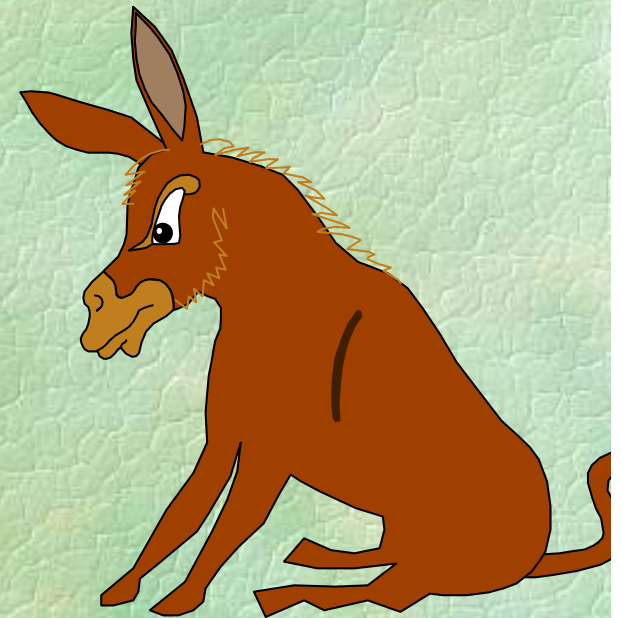
- It is not a question of whether or not you will have it.
- It is question of how much you want to live with and what you are willing to spend to achieve that goal.
- It is a numbers game, get behind and you loss





# How do we make disease management decisions?

- **We make assumptions**
  - Overwintering and other inoculum exists in vineyard
  - All acreage of the same genotype is equally at risk
  - Some assume conditions are always favorable
  - The fungicides and sprayers work as advertised



# What is in our Toolbox?





# What is in our Toolbox?

- Culture Practices
- A well calibrated sprayer
- Synthetic fungicides
- Sulfur
- Copper
- Oils
- Carbonates
- Phosphites
- Biological





# Cultural Practices

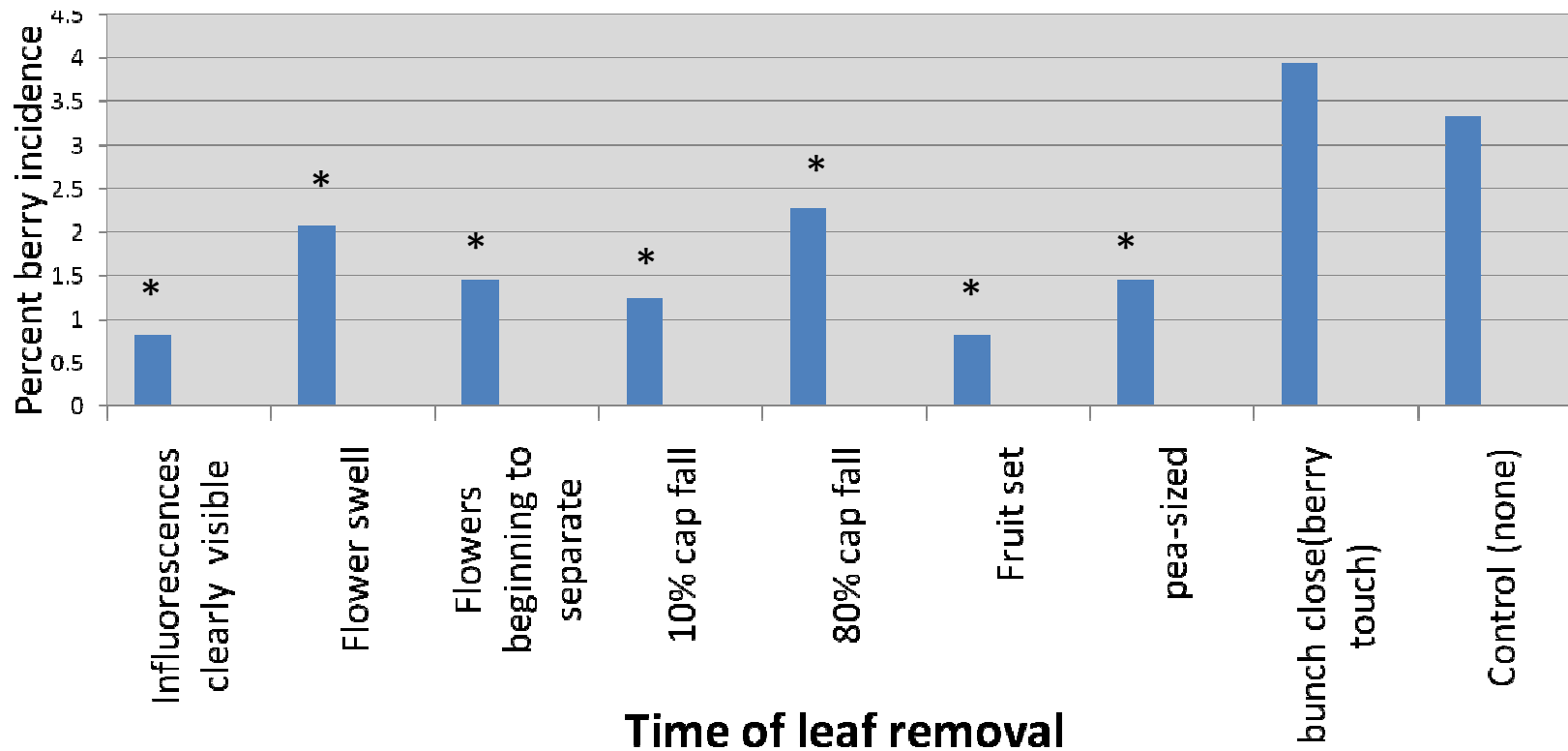
- **Reduce Vigor**
  - hedging doesn't count
- **Shoot positioning – keep it open**
  - Consider a sloppy VSP if high vigor
- **Early Leaf pulling**
  - Light and air exposure



# Pre-bloom Leaf Removal

Patty Skinkis and Walt Mahaffee

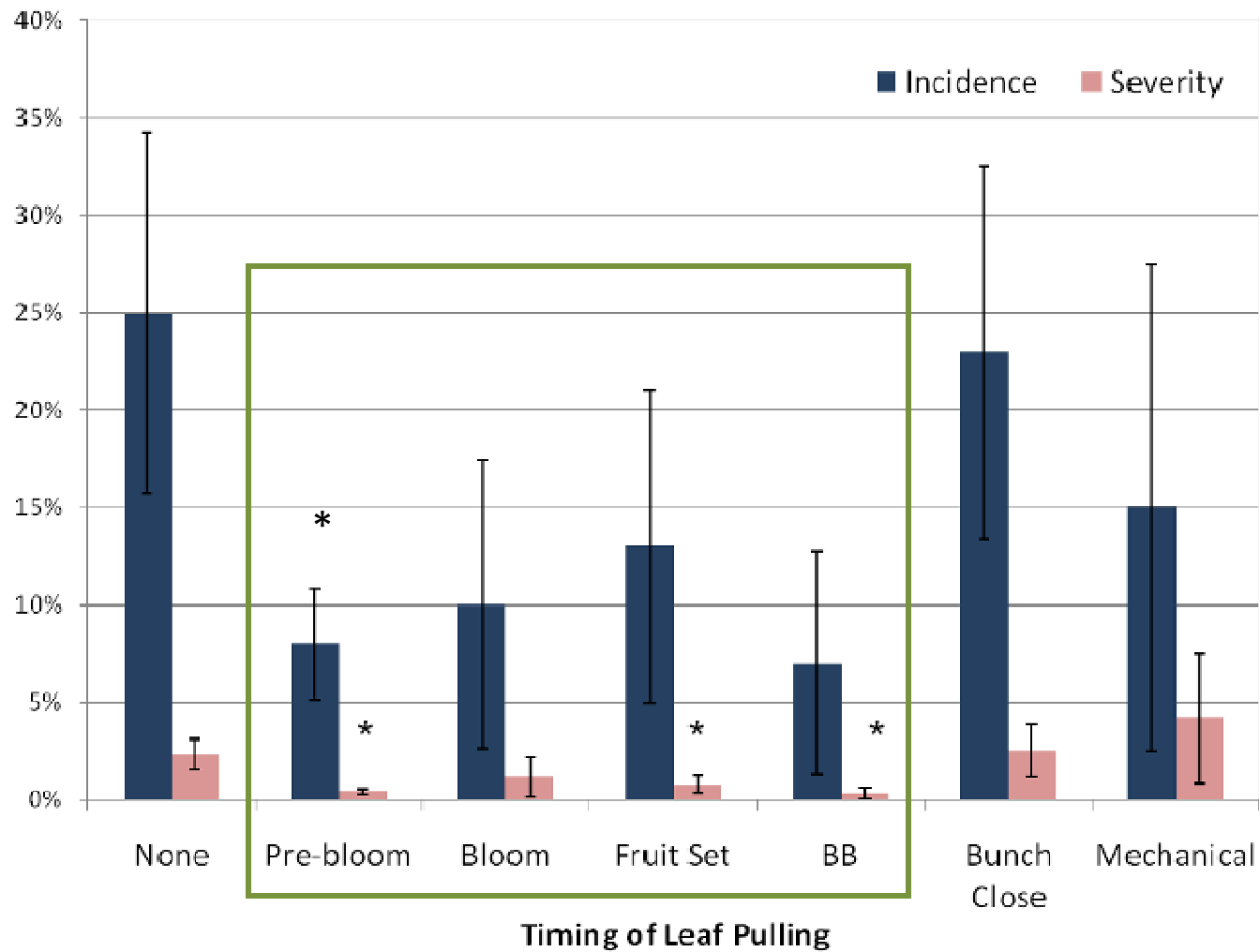
# Effect of Leaf Removal on Powdery Mildew Flower Infection - 2008



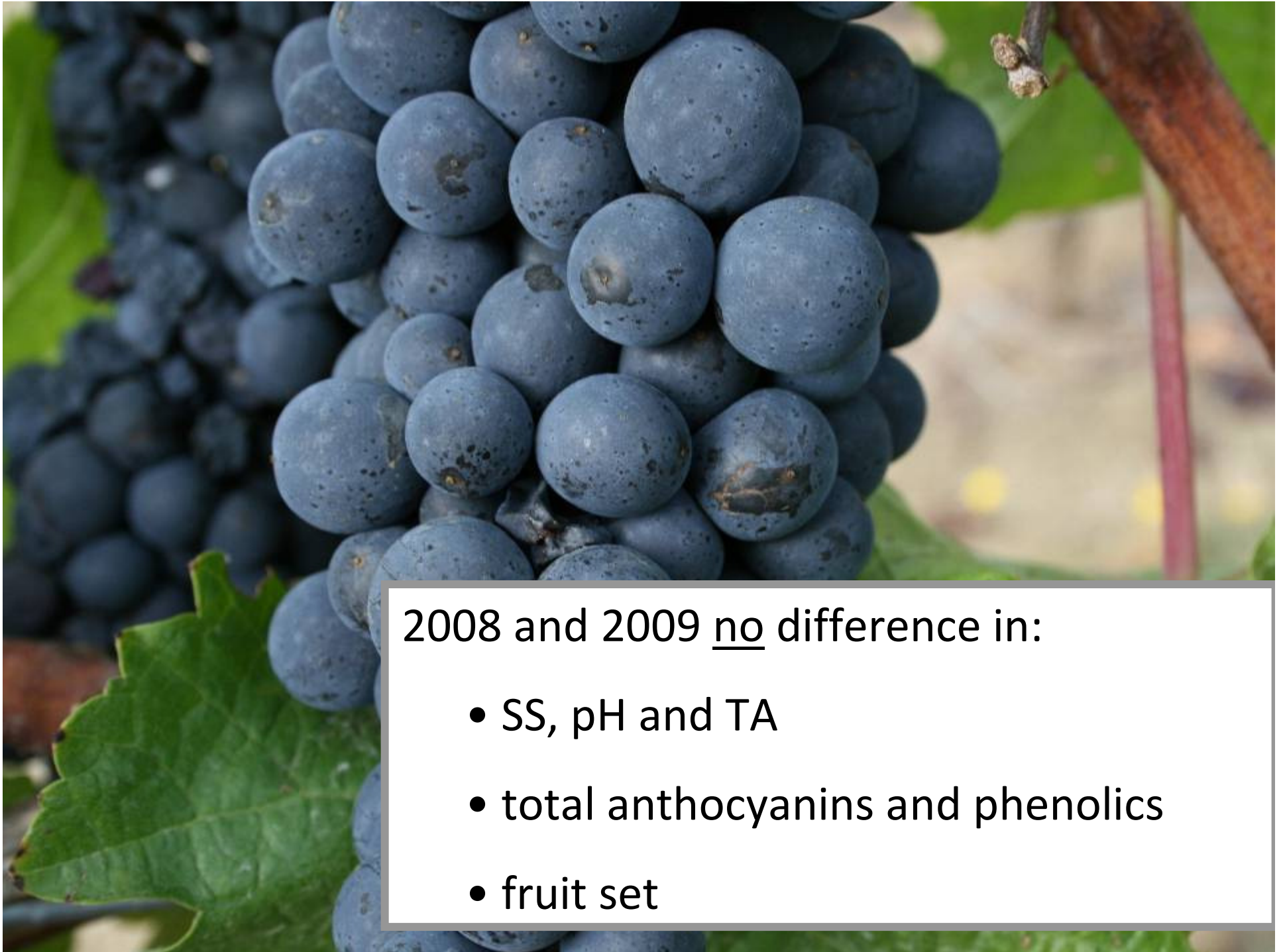
\* Statistically different from control at  $P=0.05$



## Powdery Mildew Fruit Infection 2009



\* Statistically different from control at  $P=0.05$



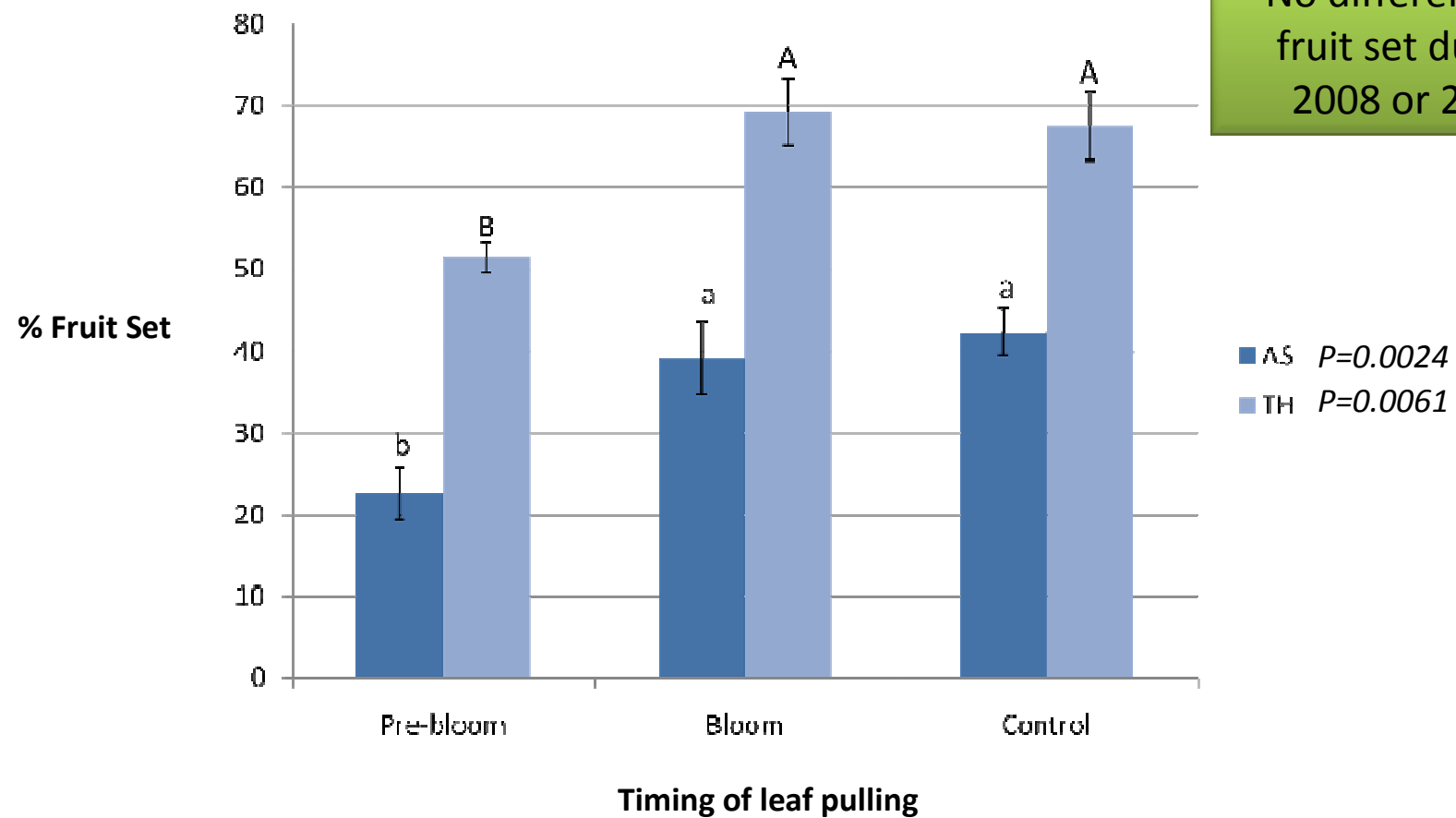
2008 and 2009 no difference in:

- SS, pH and TA
- total anthocyanins and phenolics
- fruit set





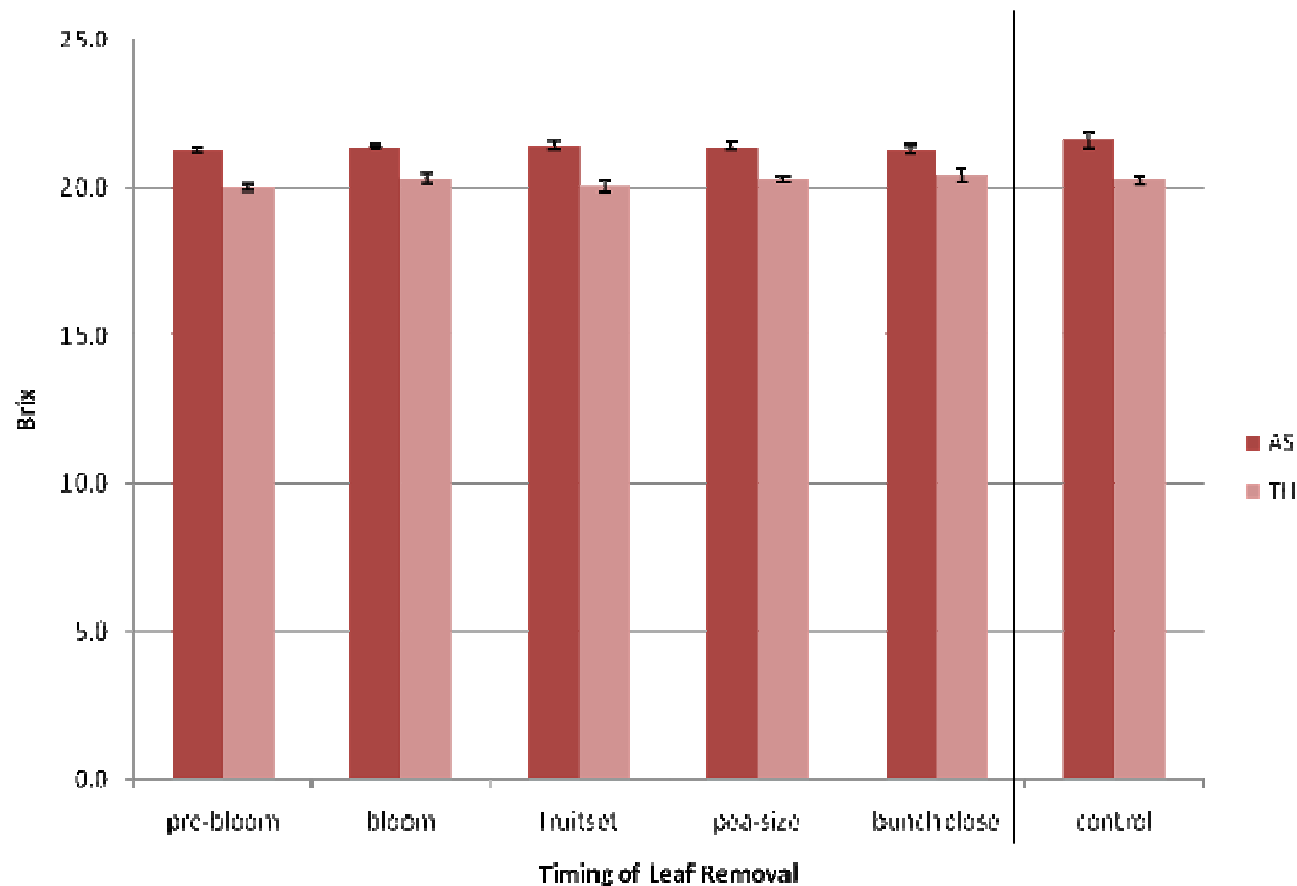
Influence of leaf pulling on fruit set 2010



No difference in  
fruit set during  
2008 or 2009

# No difference in fruit ripening 2008-2010

**Soluble Solids of Fruit from Various Leaf Pull  
Treatments - 2010**

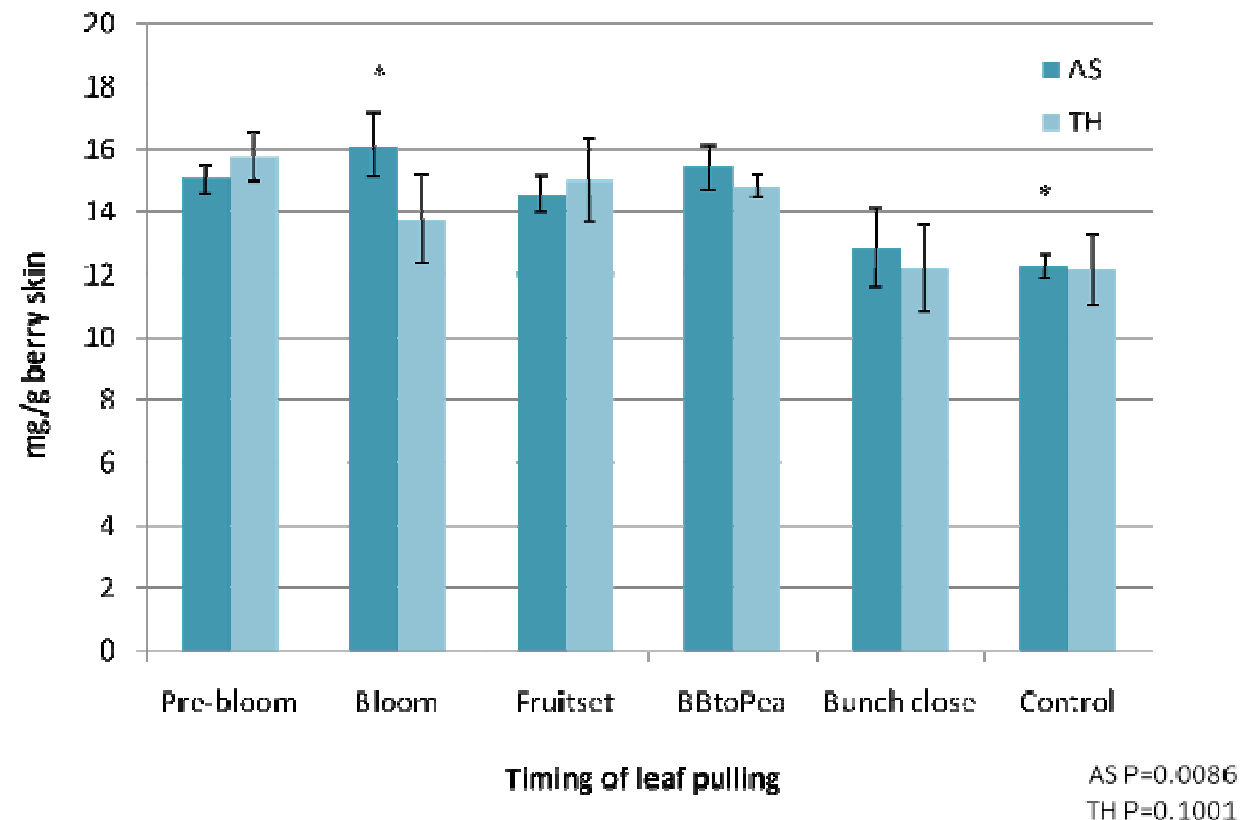




# Effect of exposure on berry anthocyanins and phenolics

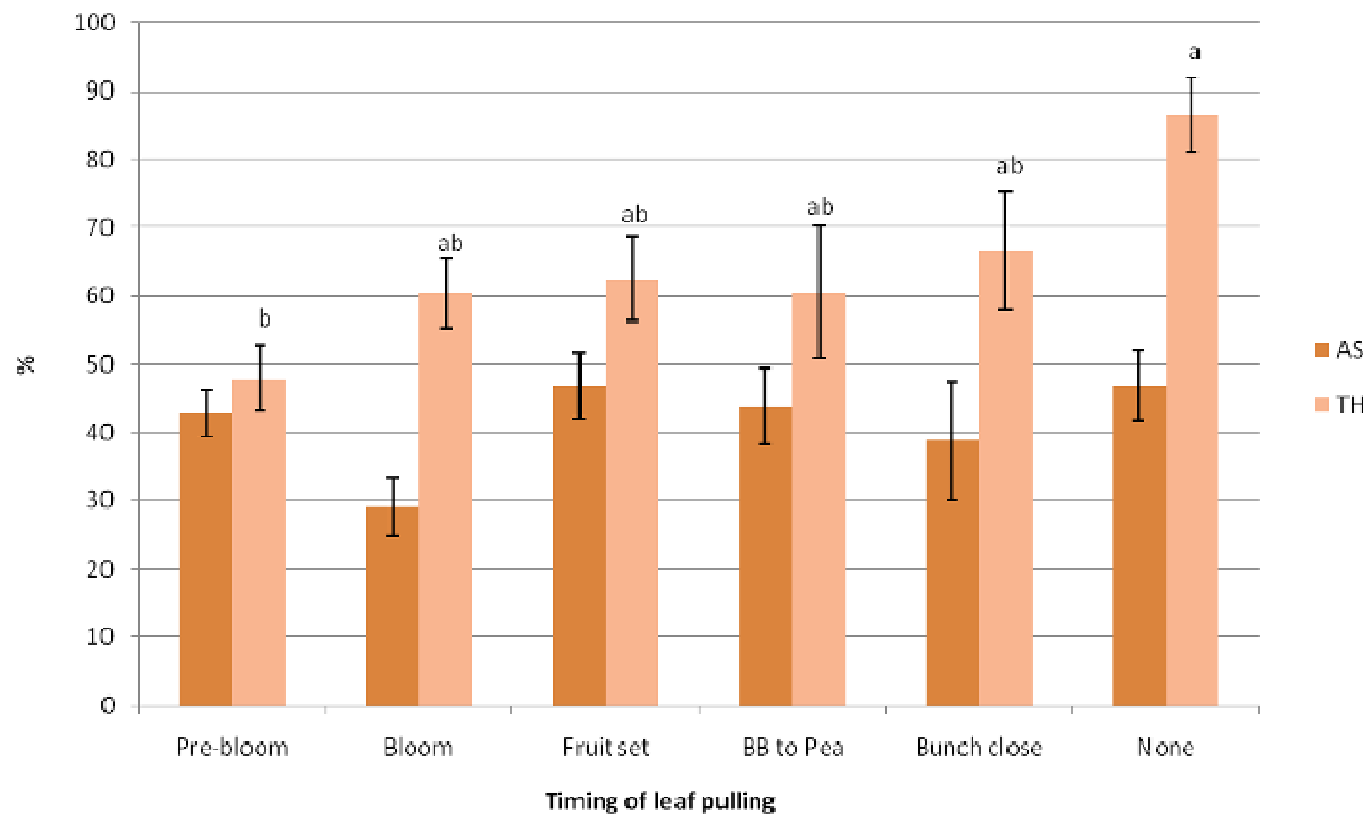
- No difference by treatment 2008-2009.
- Bloom > Control at one site

Effects of leaf removal on total skin phenolics 2010



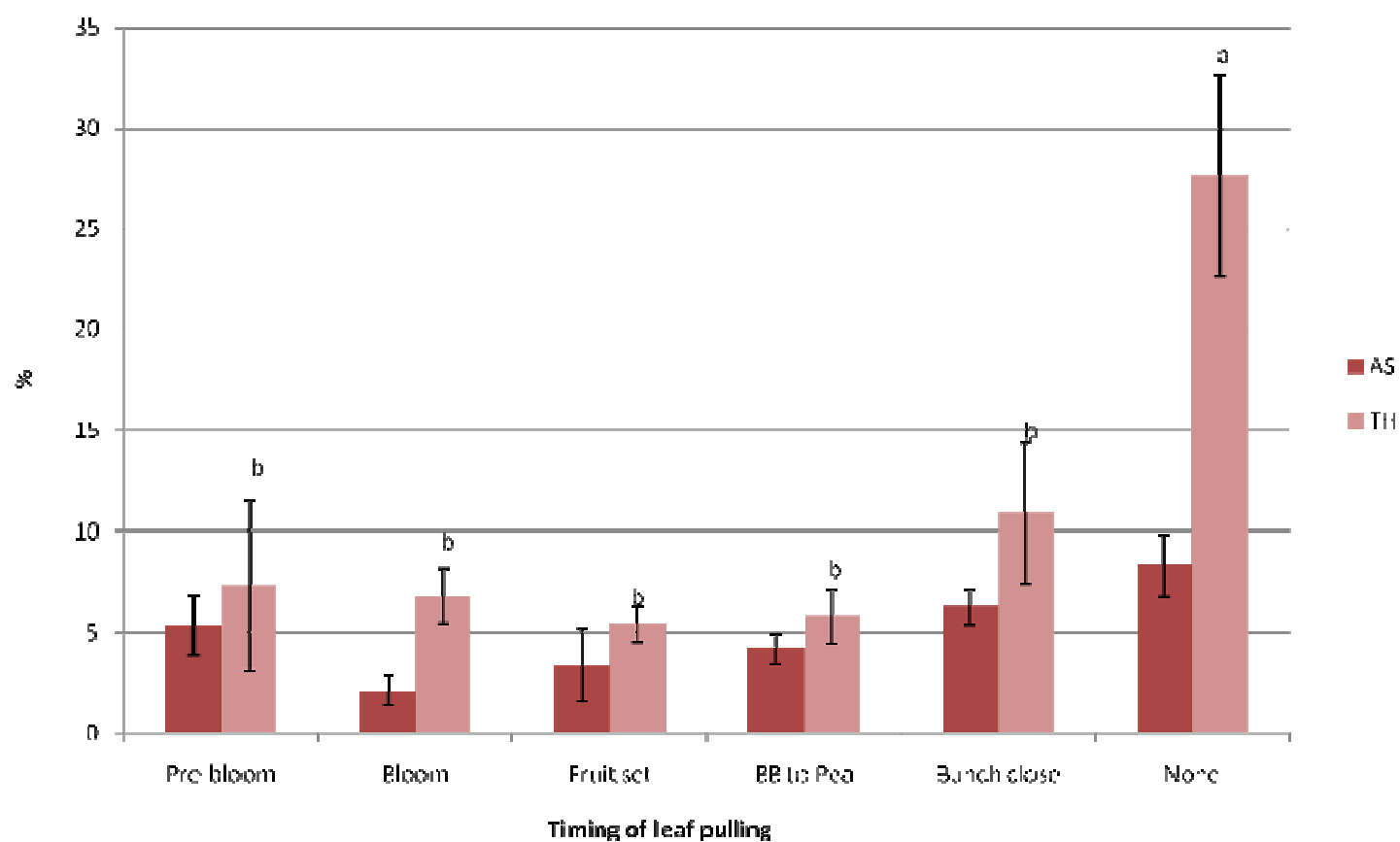
# 2010 Disease Data

Incidence of Botrytis Bunch Rot in Clusters at Harvest 2010





Severity of Botrytis Bunch Rot in Clusters at Harvest 2010





Reduced cluster compactness and exposure doesn't always ensure prevention of botrytis infection if weather is a major factor (2010).

# Conclusions

- There is a longer window of opportunity for leaf pulling.
- Severe leaf pulling even significantly before flowering does not negatively impact fruit quality
- There are significant benefits for disease management.



# Synthetic Fungicides

- **Strobilurins** (high probability of resistance development)
  - Flint (Trifloxystrobin)
  - Sovran (Kresoxim-methyl)
  - Abound (Azoxystrobin)
  - Pristine (mix of pyraclostrobin/boscalid)
- **Sterol inhibitors (SI or DMI)** (some resistance present)
  - Rally (Myclobutanil)
  - Rubigan (Fenarimol)
  - Elite (Tebuconazole)
  - Procure (triflumizole)
- **Anilide** (high probability of resistance development)
  - Endura (boscalid)
  - Pristine (mix of pyraclostrobin/boscalid)
- **Quinoline** (Resistance present but fitness cost)
  - Quintex (quinoxifen)



# Contact Fungicides

- **Oils**

- Petroleum based
- Plant extracts

- **Soaps**

- Potassium laurate

- **Carbonates**

- Potassium bicarbonate

- **Peroxides**

- Hydroperoxide

- Can strip waxes and make tissue more susceptible
- Resistance potential very low
- Use to augment program
- Short residual, little or no protection
- Phytotoxicity possible under certain conditions
- Can reduce beneficial insect populations



# Arimcarb Damage





# Other Protectant Fungicides

- **Sulfur** (unknown mechanism/no resistance in 100+ years)
  - Micronized
  - Dusting
  - Limesulfur (dormant applications only)
- **Copper** (increases cuticle thickness)
  - Copper Hydroxide
- **Phosphonates** (induced resistance)
  - Phosphorous acid
  - Mono and di-potassium phosphites



# Sulfur

- Check for phytotoxicity
- Use micronized product for longer residual
- Use when highs are  $>60^{\circ}\text{F}$  but do not apply when temperatures are  $>90^{\circ}\text{F}$ ???
- Heavy use will reduce beneficial insects
- Even leaf coverage not necessarily the best



# Biologicals/plant extracts

- **Seranade**

- Antibiotic produced by *Bacillus subtilis*
- Contact activity – little residual

- **Sonata**

- Antibiotic produced by *Bacillus pumulis*
- Contact activity – little residual

- **Plant Shield**

- *Trichoderma harianum*

**Surfactant can be the active ingredient**

Always check current label before using



# Other products? out there

- Surround (kaolin clay)
  - Barrier
- Elexa 4 plant defense booster (chitosan)
  - Elicits plant defense responses
- Cinnacure (cinnamaldehyde)
- Auxigro (glutamic and aminobutyric acid)
- Many others

**Surfactant can be the active ingredient**

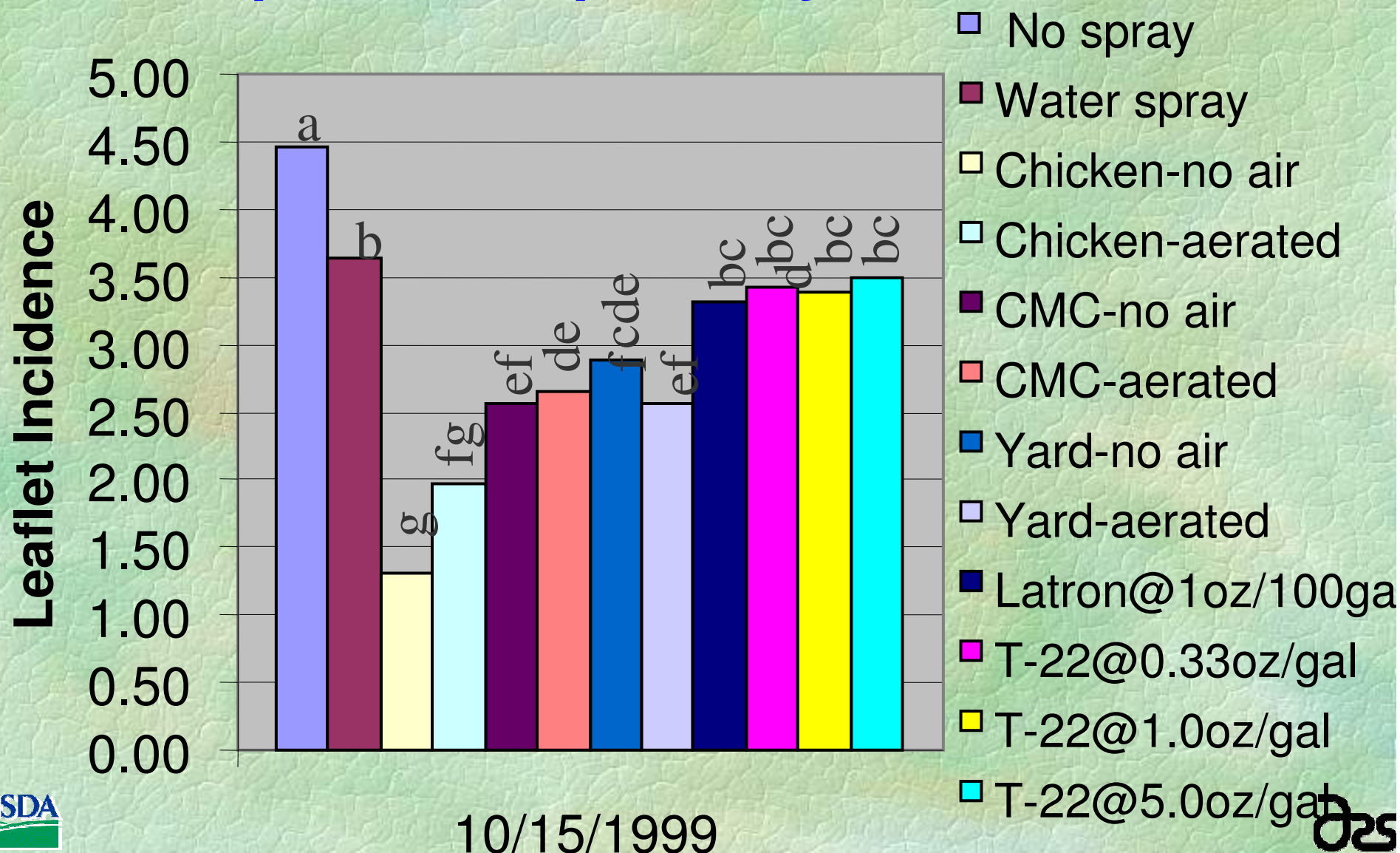


# What is in our Toolbox?



# What is the real Active ingredient?

## water helps control powdery mildew






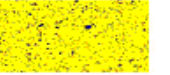






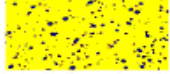

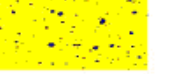




# How do we use them?

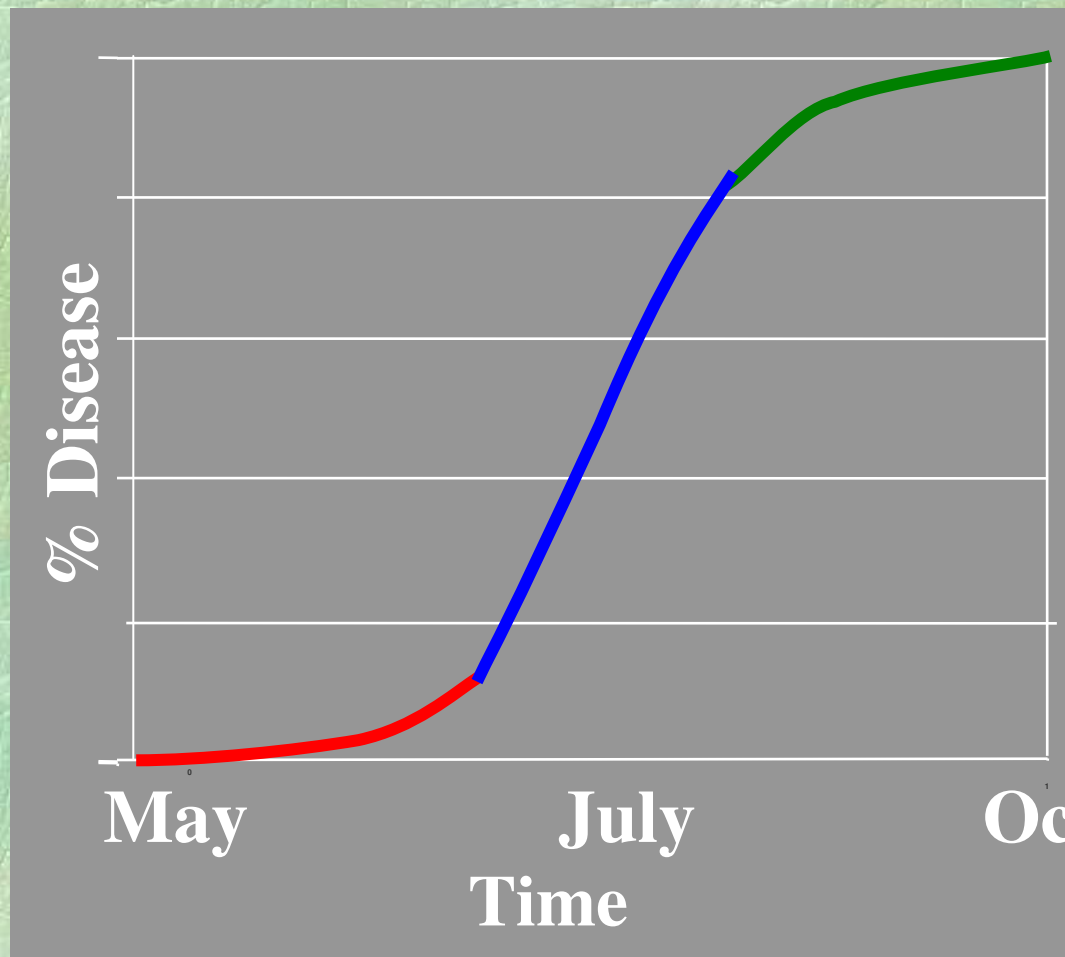
- Make sure sprayer is setup, correct nozzles, properly calibrated and targeted
- Check your coverage
- Timing



	125 L/ha	85 L/ha	45 L/ha
Fine			
Medium			
Coarse			
Very Coarse			
Extra Coarse			



# Polycyclic Disease



Primary Inoculum Limiting

Biology of Pathogen Limiting

Host Limiting

# Controlling a Powdery Mildew Epidemic Targeting Both Cleistothecia and Conidia

