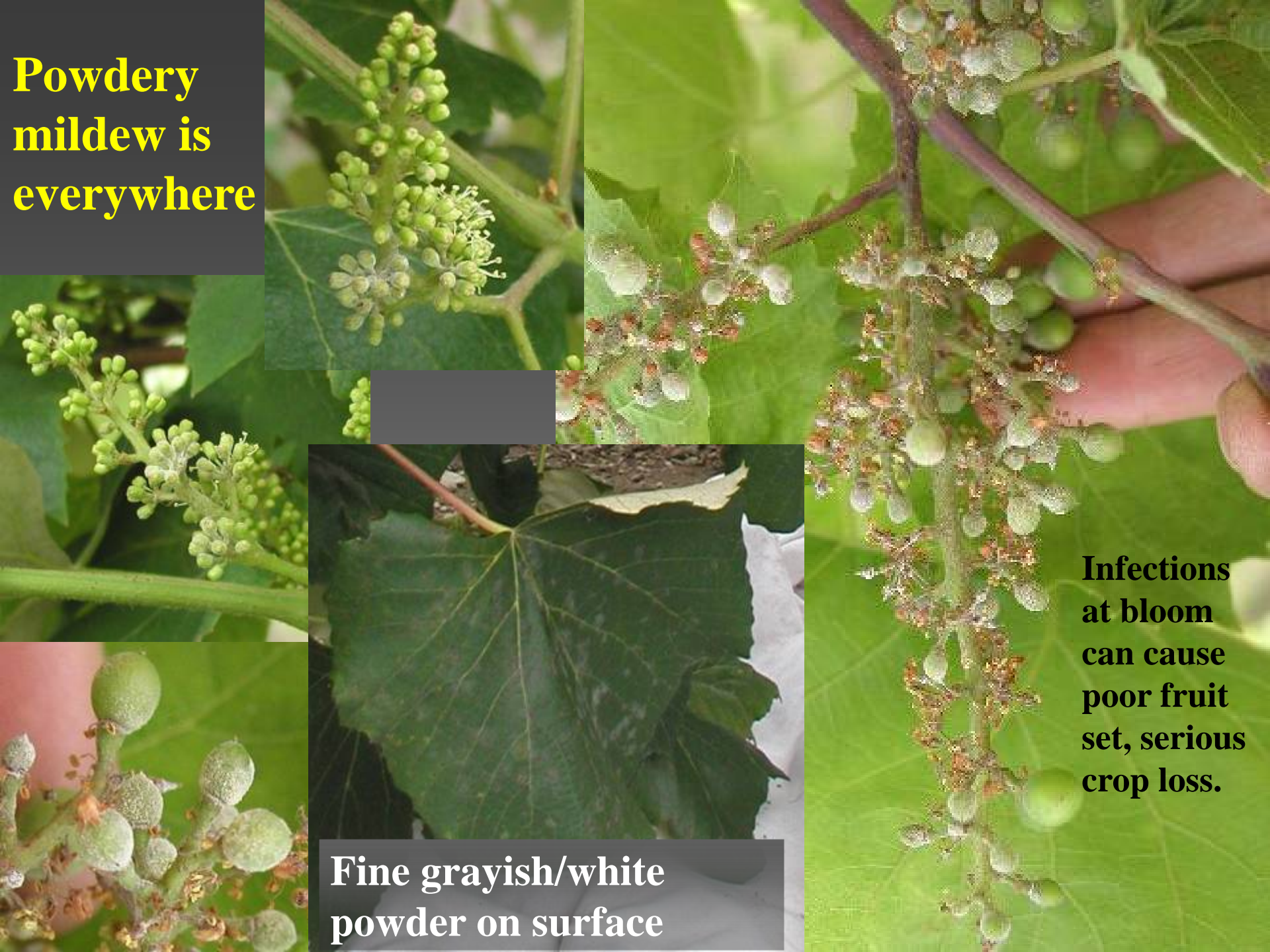




Grape Diseases And Their Control: Powdery mildew and Botrytis bunch rot

Henry Ngugi, Bryan Hed, and Noemi Halbrendt
Penn State University

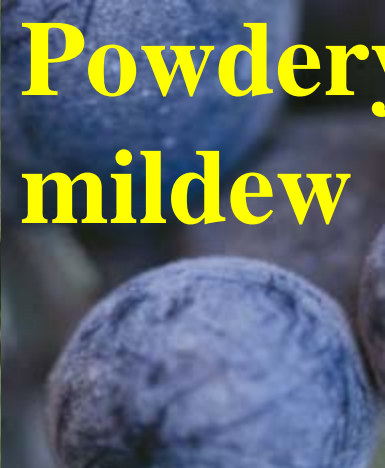
**Powdery
mildew is
everywhere**



**Fine grayish/white
powder on surface**

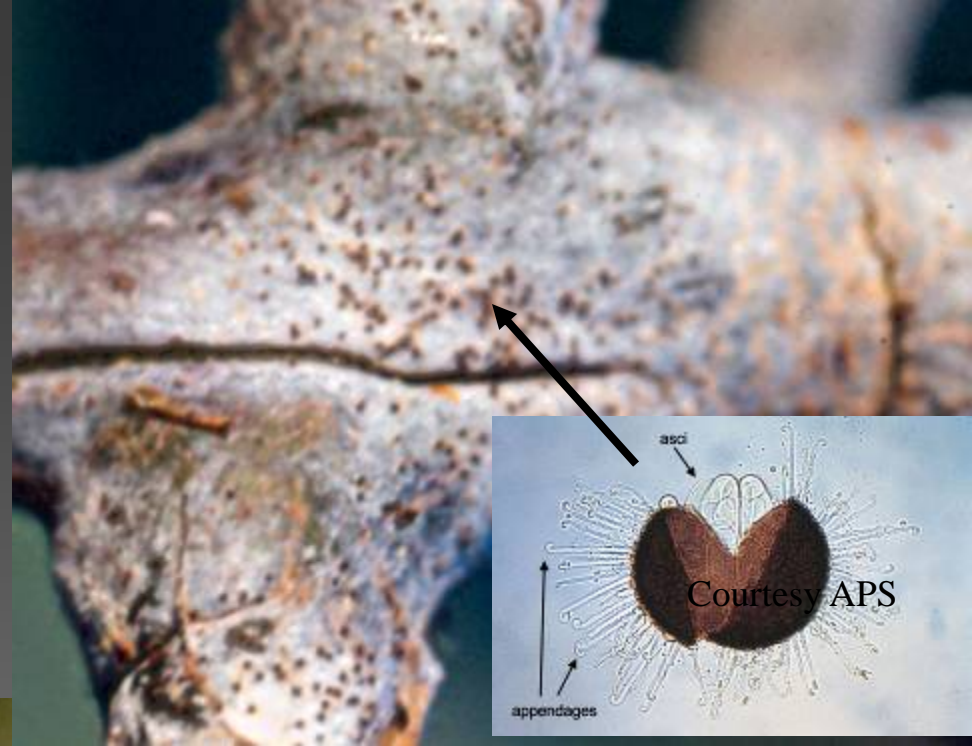
**Infections
at bloom
can cause
poor fruit
set, serious
crop loss.**

Powdery mildew



**Splitting of
berries as
they expand
leaves them
open to rot
complex
organisms**

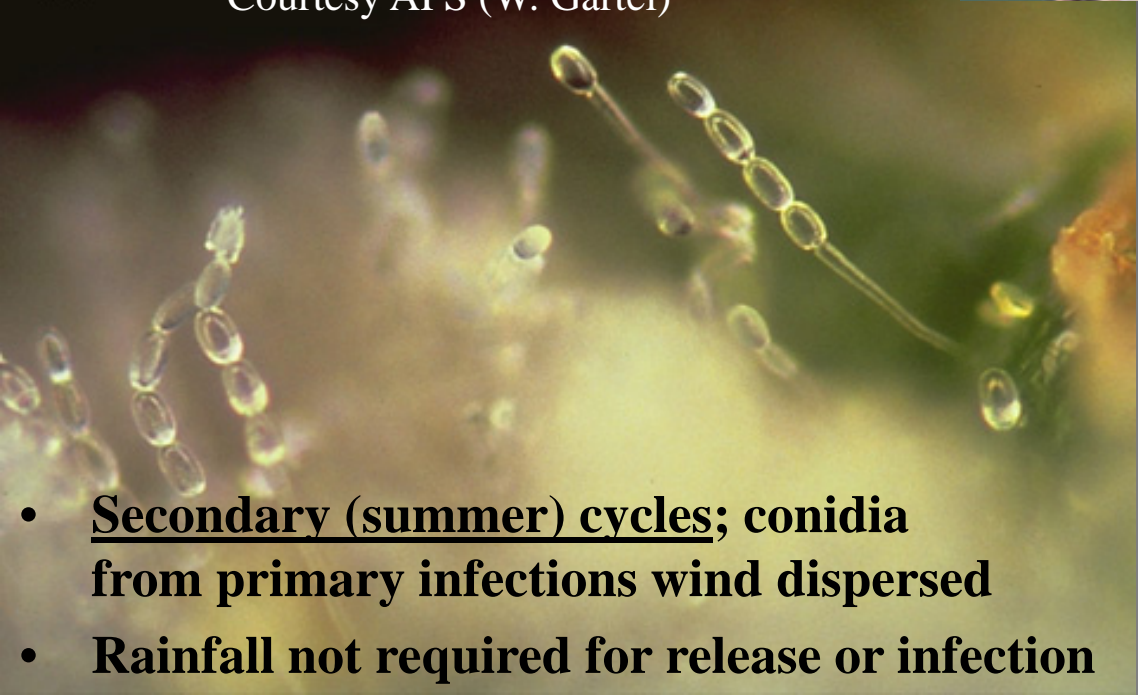
Powdery Mildew 101



- Primary infection cycle;
 - Cleistothecia swell, split open during spring rain
 - ascospores blown to new tissue (0.1" rain, budbreak to fruit set)
 - Infect wet or dry tissue at >50F.

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Courtesy APS (W. Gärtel)



- Secondary (summer) cycles; conidia from primary infections wind dispersed
- Rainfall not required for release or infection

Managing powdery mildew on Fruit

- Fruit susceptibility period is limited
 - critical bloom through fruit set
 - Concord, Niagara: capfall to 2-3 weeks post bloom
 - Sensitive hybrids/vinifera: capfall to 4 weeks post bloom
- Best materials, full rates, best coverage, tightest intervals
- Pre-bloom control of rachis and leaf infections limit spread to fruit



Powdery mildew management depends on...

- **Weather; spring rainfall, temperature**
- **Primary inoculum load**
- **Variety**
 - **susceptible hybrids/vinifera; spray 3-5" shoots-veraison?**
 - **Concord/Niagara; 2- 4 sprays; immediate pre-bloom to 2-3 weeks post-bloom**



Powdery Mildew; Chemical Control

- Strobilurins; Flint, Sovran, Abound, Pristine
 - very effective, broad spectrum, very rainfast
- Very prone to development of resistance (rotate, full rates, good coverage, limit number of sprays, don't use as last spray of season, tank mix with **sulfur**)
- **Resistance Alert: Study in VA** (Baudoin et al., Plant Health Progress; 2/2008)
 - no pm resistance to Endura, Quintec detected yet, but...
 - reduced pm sensitivity to SIs detected.
 - pm resistance to strobies in VA
 - Resistance to strobies already established in NY.

Powdery Mildew; Chemical Control

- **Sterol inhibitors: Rally (formerly Nova), Elite, Orius, Tebuzol, Rubigan, Procure**
- **Older chemistries not as effective as before**
 - efficacy has slipped due to resistance
 - still important in rotations
- **Newer Si chemistries may be more active.**
 - **Difenoconazole (Inspire super, Revus Top)**
 - **Tetraconazole (Mettle)**

Powdery Mildew; Chemical Control

- Quintec (Quinoxifen)
- New chemistry in PA in 2004.
- Controls only powdery mildew.
- Protective; no post-infection activity.
- Rain-fast after 1 hour (when applied alone).
- Good to excellent control of pm.
- Prone to development of resistance.



Powdery Mildew; Chemical Control

- **Adament 50WG** - trifloxystrobin (50 %) + tebuconazole (50 %)
- **Controls powdery mildew, black rot, Bot) .**
- **Rain-fast**
- **Prone to development of resistance.**
- **Endura (boscalid)**
 - **effective at powdery mildew rate (4.5 oz)**
 - **also controls Botrytis at 8 oz rate**
 - **high resistance risk**

Powdery Mildew; Chemical Control

- **Sulfur**

- **Effective at cool and warm temps.**
- **toxic to some varieties (Concord, red hybrids)**
- **inexpensive**
- **some formulations organic**
- **Subject to wash off by rain (sticker can help)**
- **some post infection activity**
- **Tank mix with strobilurins to manage resistance.**

Powdery Mildew; Chemical Control

- Copper and lime
 - moderate efficacy (best on downy mildew)
 - cannot be mixed with some pesticides
 - toxic to some grape varieties
 - inexpensive
 - some formulations organic



Powdery Mildew; Chemical Control *Alternatives*

- **Serenade**
 - formulation of soil bacterium (*Bacillus subtilis*)
 - fair/good control in rotations with Sis and strobies
 - organic
 - not reliable in solo programs.
- **JMS Stylet oil**
 - effective at 14 day intervals, 1.5-2% solution
 - Eradicant; good coverage critical
 - 2 or more applications around veraison lowers brix
 - organic formulation available

Powdery Mildew; Chemical Control

Alternatives

- **Nutrol (Monopotassium phosphate)**
 - Eradicant; little or no protective activity
 - more effective when applied weekly at half rates than biweekly at full rates
 - moderate efficacy
 - inexpensive
 - good coverage critical
 - apply with a surfactant
- **Kaligreen, Armicarb, Milstop (Potassium bicarbonate)**
 - control similar to Nutrol.
 - ...but more expensive
 - organic formulations



What's in the pipeline?

- **Potential releases in 2011**
 - **Vivando (metrafenone) – powdery mildew**
 - **Torino (cyflufenamid) – powdery mildew**

Powdery Mildew;

Site selection/preparation/Cultural control

- **Maximize air circulation and sun exposure:**
 - **site selection**
 - **trellis system**
 - **shoot thinning/positioning, leaf pulling**
- **Excellent weed control**
- **Nitrogen/water management to limit shoot growth**
- **Summer hedging to remove excess growth in late summer.**

Botrytis bunch rot

**During ripening;
- Berries turn brown
to reddish brown...**



gray sporulation on surface

Botrytis 101

- **Primarily a fruit disease**
- **Primary infection; starts at capfall**
 - most remain dormant (latent)
 - immature berries resistant to rot (unless conditions are very wet).
- **After veraison: latent infections may activate (injury?) and rot berries**
- **Berries increasingly more susceptible to direct invasion or through wounds**
- **Rot spreads rapidly within overcrowded, compact clusters**



Botrytis Management

Chemical Control

- Bloom; control latent infection if weather wet.
- Pre-close; last chance to reach inside of compact (predisposed) cluster.
- Veraison; protect from direct invasion of susceptible fruit from outside cluster.
- During ripening; controls spread until harvest, especially if wet.



Fungicides currently labeled for Botrytis

- **Strobilurins – Flint (Adament), Pristine**
 - **control around bloom when applied for other diseases**
 - **Flint effective at high 3 oz rate**
 - **Pristine good at higher (12.5 oz) rate.**
- **Elevate 50WDG (fenhexamid); effective, moderate resistance risk**
- **Endura 70WG (boscalid) effective at 8 oz (less effective at powdery mildew rate of 4.5 oz), high resistance risk.**

Fungicides currently labeled for Botrytis

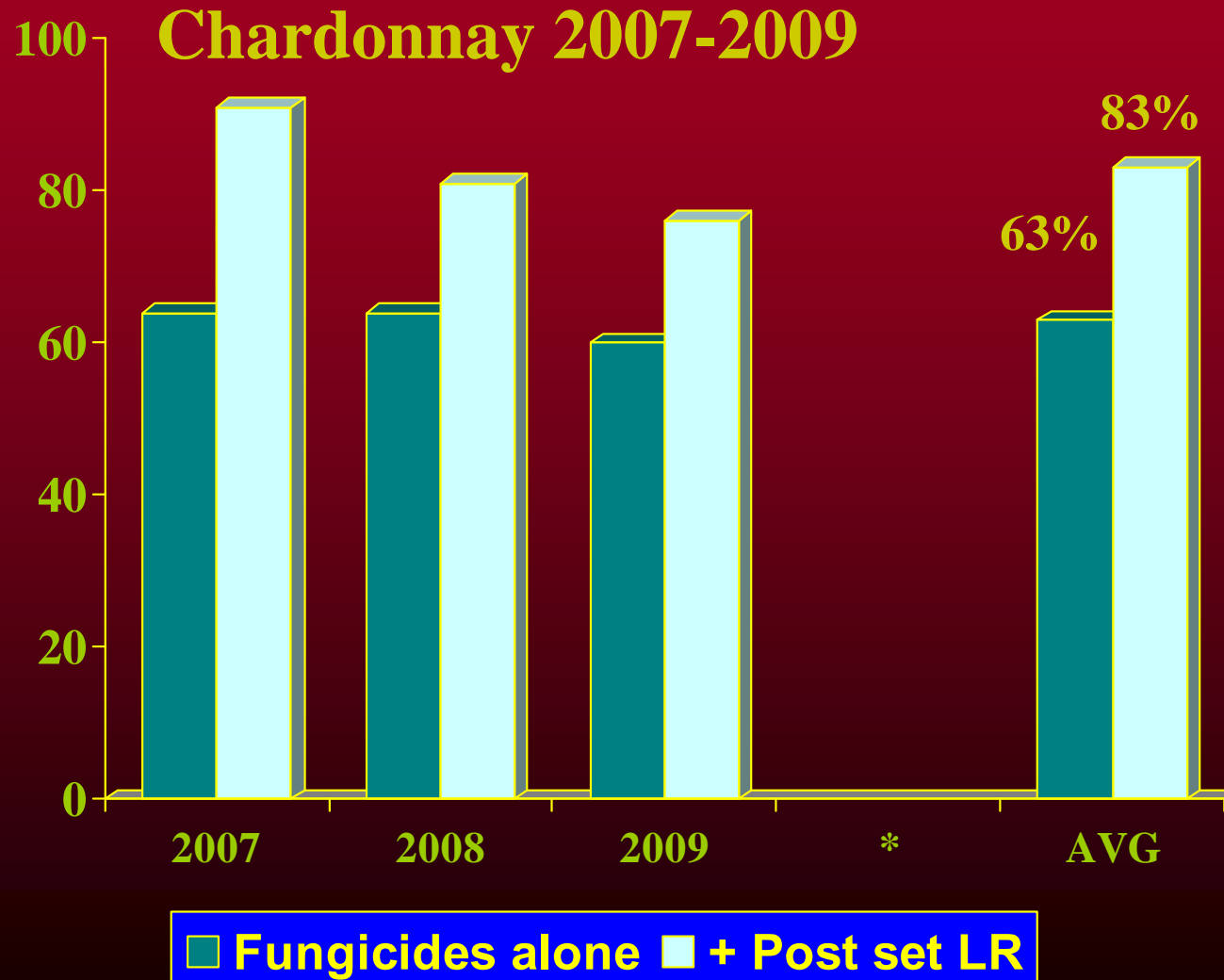
- **Rovral (iprodione); old standard, effective, efficacy improved with surfactant, high resistance risk, some post infection activity.**
- **Scala (pyrimethanil), Vanguard (cyprodinil; effective, high resistance risk, very rainfast, some post infection activity.**
- **Be aware of cross resistance when rotating**

Botrytis Management

Cultural Control

- **Avoid excessive nitrogen**
- **Wound management: control birds, insects, powdery mildew**
- **Improve aeration and light penetration around clusters: proper trellis, pruning, shoot thinning, shoot positioning, and...leaf removal.**

Cultural Control; how important is LR to Botrytis control?

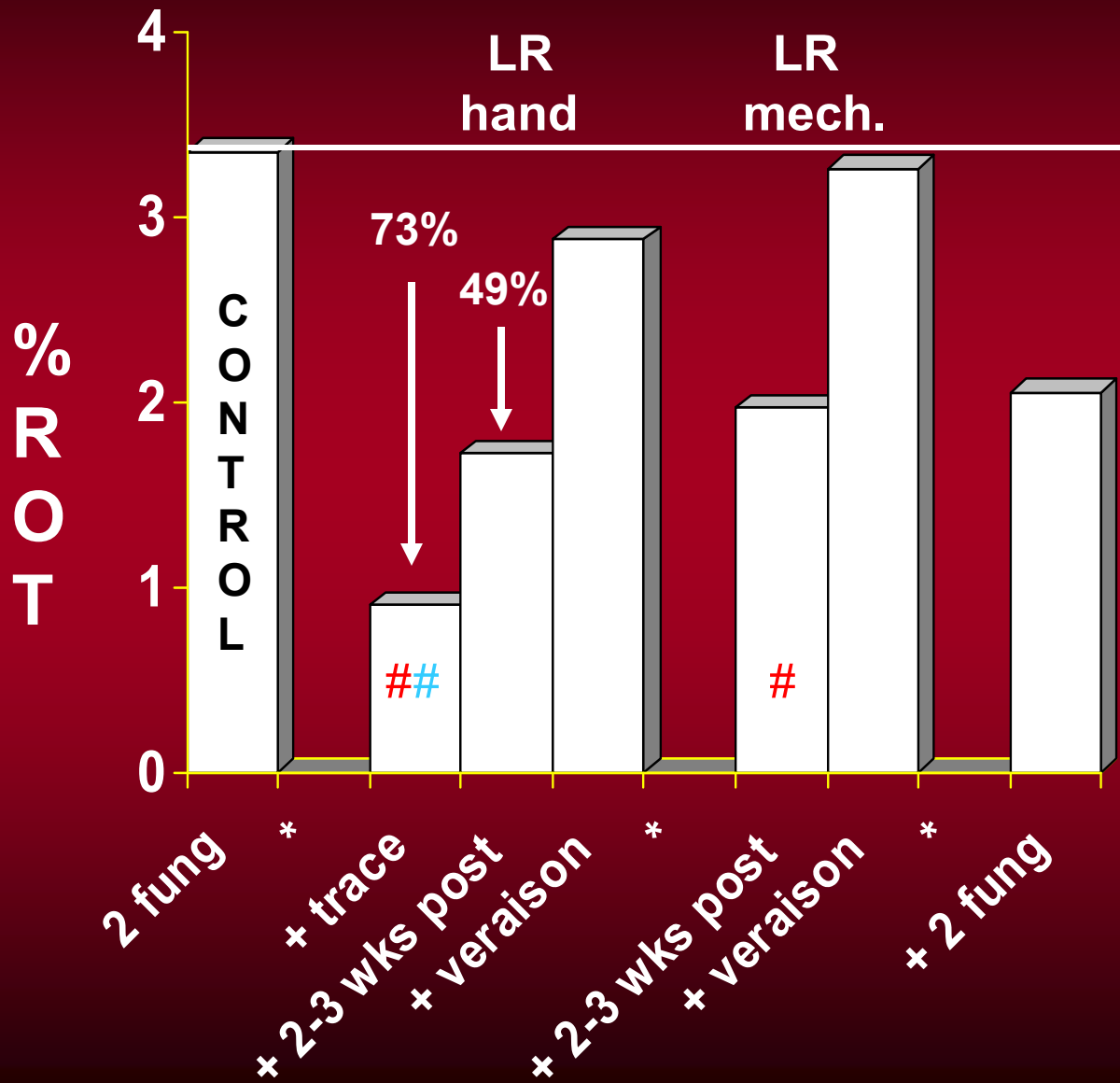


LERGREC; Leaf removal timing, method

- **Chardonnay**
- **Leaf Removal**
 - **trace bloom**
 - **2-3 wks post bloom**
 - **veraison**
- **Hand vs mechanical (Gallagher leaf blower)**



2007-09 Results: Chardonnay, *Botrytis*



• Fisher's Protected LSD ($P \leq 0.05$).

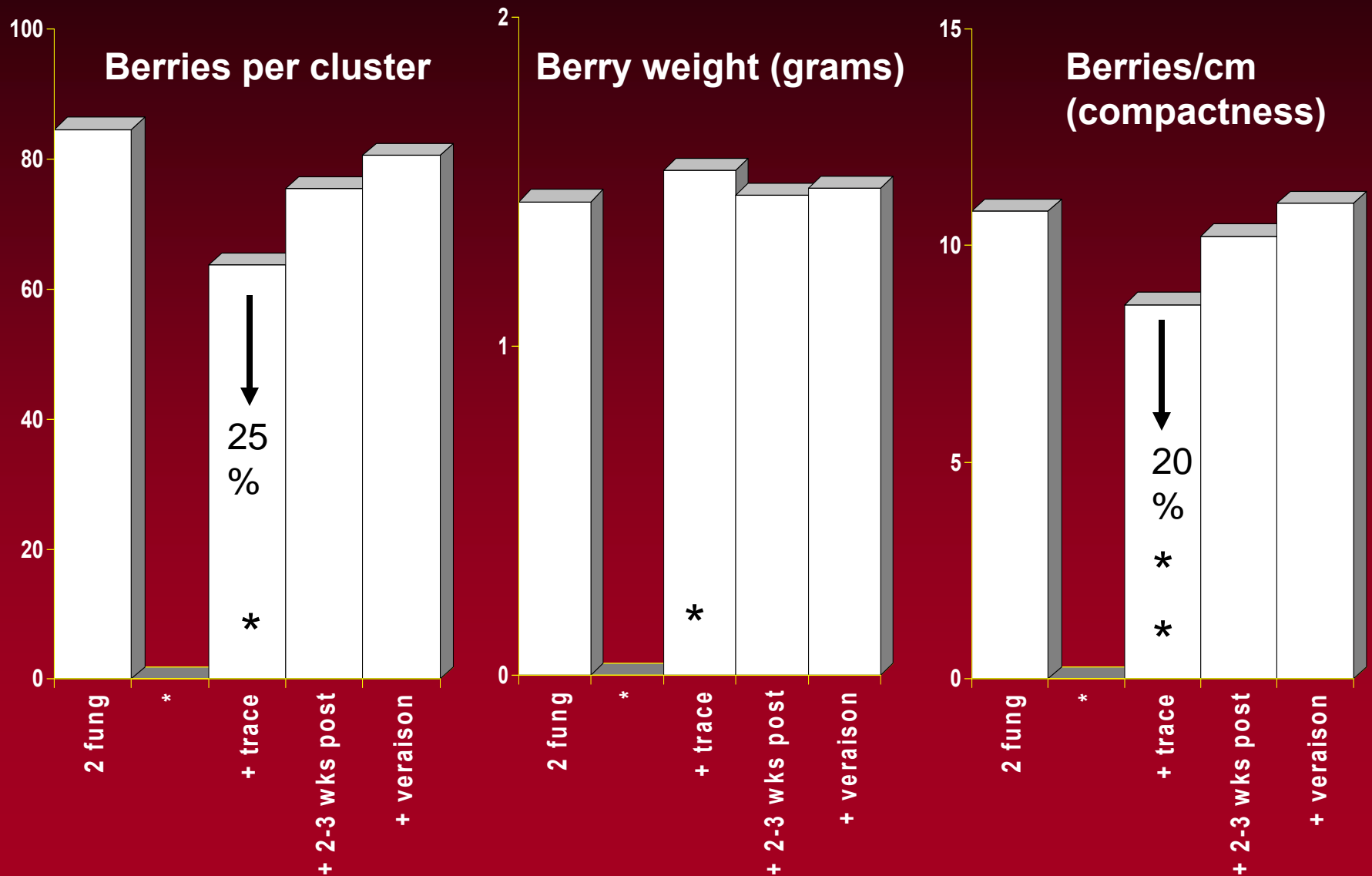
Sig. reduc. In 2008

Sig. reduc. In 2009

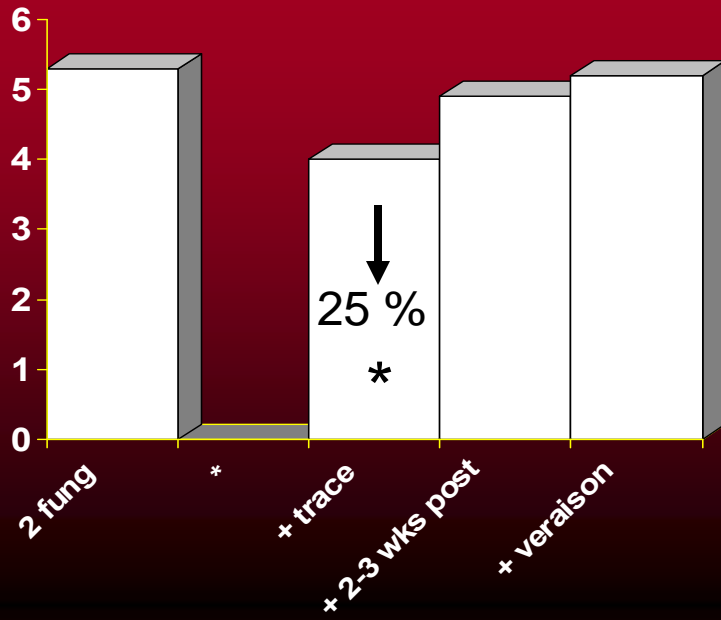
- Hand \approx machine
- Early LR more effective than late.



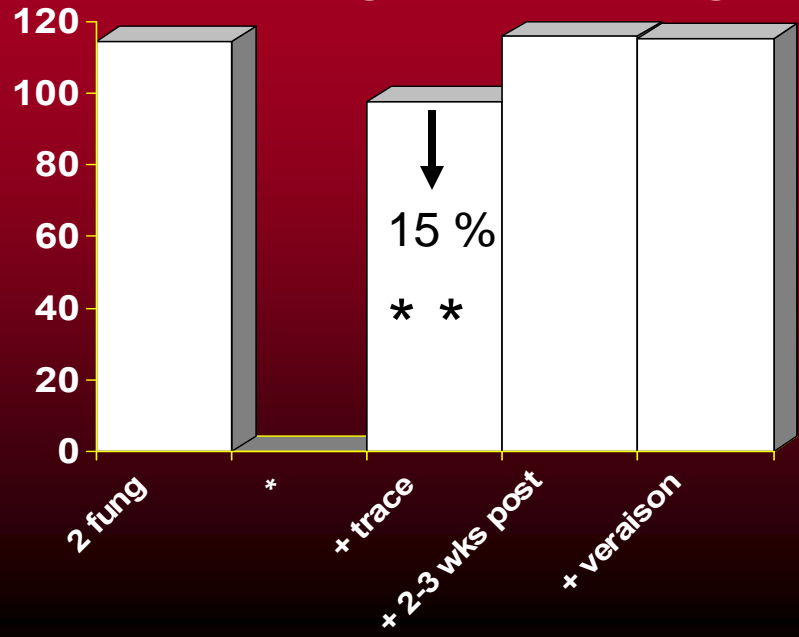
2007-2009 Cluster Effects



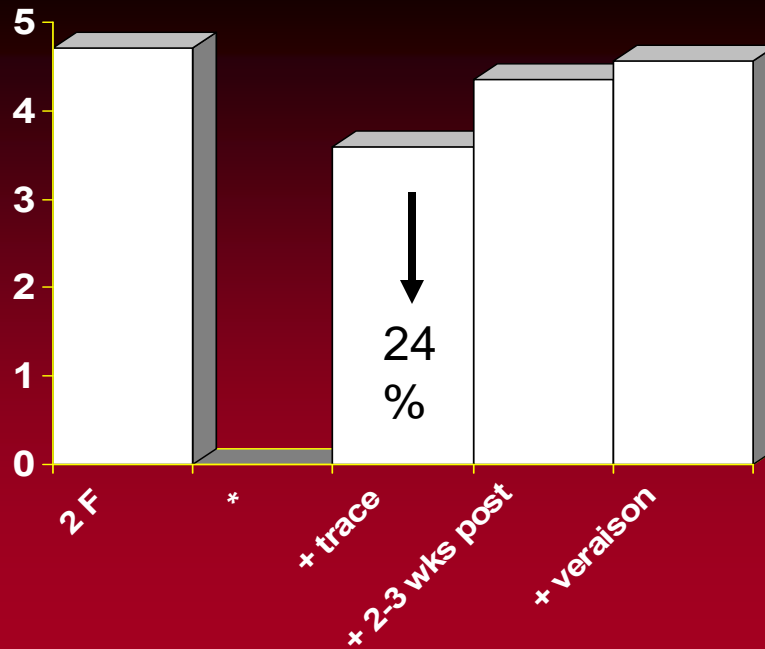
Yield (kg) per vine (08-09)



Cluster weight 2007-2009 (grams)



Yield Effects



Average yield (tons/A; 08-09)

Questions?



Botrytis Research: Management of cluster compactness and bunch rots with Trace Bloom Leaf Removal

- improves cluster exposure
- reduces compactness which...

- improves spray penetration
- reduces bunch rot

