Frost Protection & Recovery in Vineyards

2009 Review

Spring Frost

- What
  - Damage to vines vegetative growth
- When
- Where
- Why

Cold Damage to Vines

- Winter kill
  - 10°F (-12°C)
- Spring frost
  - 31°F – ½ hour
  - 26° - 28°F

Bud Damage Winter vs Spring

Budbreak and Frost

- March 15 – average
- May 1 – frost possibility until
- Prune late
- Double prune
- Variety & Site selection

General History of Spring Frost

2008	Statewide	Scattered outside of Lodi	
2007	Winter Injury		
2006	Minor Frost	(Just before Budbreak)	
2001	Frost	April 1-3	East SJ Co & North Delta
1999	Frost	April 10	East SJ Co
1997	Frost	April 5	Scattered East
1996	Minor Frost	March 26	Scattered
1991	Winter Kill		
1984	Minor Frost	(one night)	
1983	Slight Frost	South County	
1972	**Major Frost**		
1968	Frost		

Frost Damage

- What
- When
- Where
  - Inversions vs Arctic air mass
  - Low Areas
  - Obstruction of air flow
- Why

Contributing Factors Frost

- Soil texture
- Slope & Aspect (drainage)
- Stage of Vine Growth
- Carbohydrate Status
- Variety
- Relative Humidity & Dew Point
- Weather Pattern up to Frost

Topography and Drainage

Dew Point
&
Relative Humidity

Frost Damage

- Ice Nucleation
- Ice nucleating bacteria
- Ice Crystals
- Cell Rupture
- Cold Temperatures

Being Prepared –What to Do?

Active Frost Protection

versus

Passive

Control Strategies

- Passive
  - To reduce or prevent potential damage
  - Less costly
- Active
  - To prevent immediate damage
  - More Costly

Active Protection

- Sprinklers or Misters
- Wind Machines
- Orchard Tunnels
- Heat
- Bactericides – $CuSO_{4,}$, $Cu(OH)_2$, etc.
- Biological

Wind Machine

Semi-Portable Machines

Overhead Sprinkler Irrigation

Water Supply Needed

- Radiation Frost 50 to 55 gpm/acre
  - 0.11 to 0.15 acre inches per hour
- Advective Frost 100 + gpm/acre
  - 0.25 acre inches per hour
- Period of Protection ½ to 6 hours or more

Radiation vs. Advective Frost

- Relative humidity; dew point
- Wind, clouds or fog
- Soil texture
- Slope & aspect (drainage)
- Stage of vine growth
- Variety

Examples of Technology

- Sprinklers - $1500/acre – water supplies
- Wind Machines - $20,000/10 acres – radiation
- Orchard Tunnel - $10,000/10 acres – radiation
- Helicopters - $200/hr ? – Acres
- Other

Comparative per Acre Costs

- Wind Machines $2,000 $25.79
  10 acres; effective
- Sprinklers $1,500 $ 4.58
  limited application
- Helicopter $ $40.00/hr
  Effective but, expensive and limited

Alternative Controls

- Chemicals copper based; bactericides
  - No evidence of Effect
- Micro Mist/Foggers
  - No consistent evidence
- Biological
  - Yes, but not available
  - Not 100% effective

Passive Control Strategies

- Passive
  - Site selection
  - Soil & ground cover
  - Irrigation Pre-Frost
  - Delay growth

Pre-Frost Irrigation

Increased Protection

Limitation of Drip Irrigation

Soil & Ground Cover

- Soil's Capacity & Conductivity
- Dry & Cultivated
- Uncultivated & Bare
- Dry & Mowed
- Wet & Mowed

GROUND PREPARATION FOR FROST CONTROL

Warmest

WET, FIRM, BARE GROUND	+2 degrees F
DRY, FIRM, BARE GROUND	———
SHREADED COVER CROP	-0.5
FRESH DISCED	-2
LOW COVER CROP	-1 to 3
HIGH COVER CROP	-3 to 8

Coldest

Cover Crop Benefits vs Costs

Living Dangerously

Weather Records and Monitoring

- History of Site
- Area temperature and weather data
- Thermometer Stations placed
- Weather Stations or Data loggers (low cost)
- Frost alarms
- NOAA web site www.wrh.noaa.gov

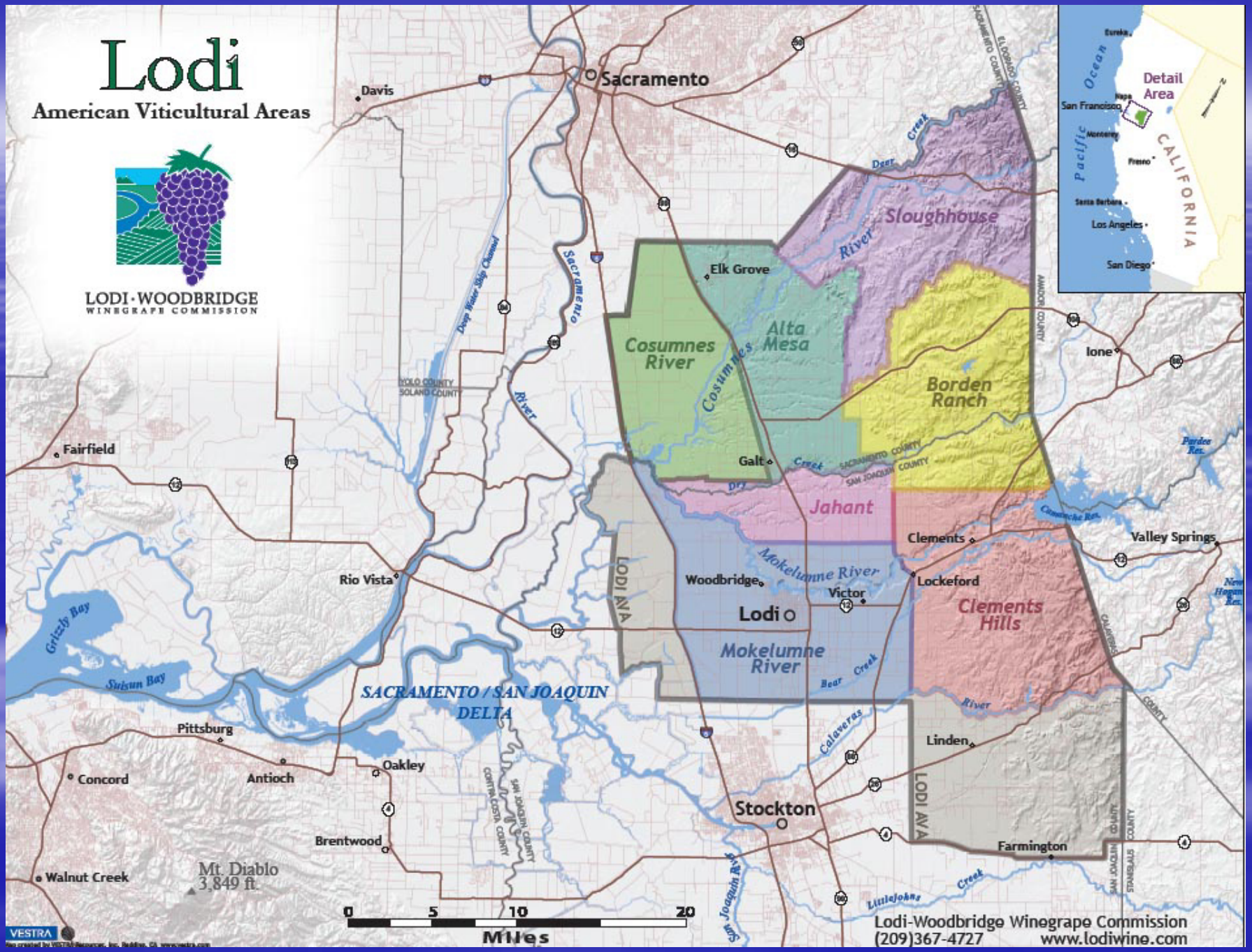
Frost Recovery Strategy

What to do after the damage is done.

2008 Surprise

Spring Frosts

- 1933 Late April
- 1961 April 19 and 20
- 1964 April 24
- 1972 March 26, 27, and 28
- 1983 April 13
- 1984 April 20
- 1997 April 5
- 1999 April 9
- 2001 April 8
- 2008 April 15, 20 and 24


Lodi
American Viticultural Areas
LODI·WOODBRIDGE
WINEGRAPE COMMISSION
Sacramento
Davis
Elk Grove
Galt
Ione
Clements
Valley Springs
Lockeford
Woodbridge
Victor
Lodi
Rio Vista
Fairfield
Pittsburg
Concord
Antioch
Oakley
Brentwood
Walnut Creek
Mt. Diablo
3,849 ft.
Stockton
Linden
Farmington
Sloughhouse
Cosumnes River
Alta Mesa
Borden Ranch
Jahant
Clements Hills
Mokelumne River
LODI AVA
SACRAMENTO / SAN JOAQUIN DELTA
Grizzly Bay
Suisun Bay
Deer Creek
Dry Creek
Bear Creek
Littlejohns Creek
Calaveras River
San Joaquin River
Sacramento River
Deep Water Ship Channel
Pardee Res.
Camanche Res.
New Hogan Res.
Detail Area
Pacific Ocean
CALIFORNIA
Eureka
San Francisco
Monterey
Fresno
Santa Barbara
Los Angeles
San Diego
0 5 10 20
Miles
VESTRA
Lodi-Woodbridge Winegrape Commission
(209)367-4727 www.lodiwine.com

Lodi District Weather Stations
2008

April	7	15	20	24
Lodi	32.7	36.9	34.0	30.2
Acampo	35.0	39.1	33.9	32.1
Lockeford	34.3	35.4	34.1	33.8
Live Oak	32.7	39.5	35.6	33.3
Woodbridge	32.8	37.9	34.0	33.0
Thornton	33.4	38.5	35.8	32.3
Lodi West	35.0	40.0	36.0	36.0
Walnut Grove	33.6	36.8	30.6	32.1
Clay Station	35.5	34.0	31.8	31.3
Sheldon	34.7	33.6	33.3	32.6

Avg April Minimum 48º F

Chardonnay

Sauvignon blanc

Chardonnay

Pinot gris

Grenache

Merlot

Frost Damage Mitigation

- Trimming Damaged Tissue
- Shoot Thinning
- Cluster Thinning
- Removing All Shoots or Repruning

  Benefits < Costs 1933, 1967,1972
- Adjust Management for Lower Crop

Doing Something vs Nothing

- Shoot Removal — Winkler, 1933
- Repruning vs Trimming — Antcliff, 1957
- Self Recovery — Lider, 1965
- Shoot Removal — Kasimatis & Kissler,1972

Kasimatis & Kissler Trials

- Tokay, Carignane, Zinfandel, Chenin blanc, and Grenache
- Seven Sites
- Shoot Removal of all shoots, damaged shoots only, and a control with no adjustment
- Shoot removal done 3 days after frost*

*1972 Frost March 26, 27, & 28

Harvest Yield

1972

	Yield lbs per vine				
Strategy	Total	Primary	Secondary	Basal	Latent
Remove All Shoots	32.8	4.6	0.9	13.9	0.8
Damaged Removed	37.5	13.0	1.6	7.2	1.6
Control	38.1	14.6	0.9	6.8	1.3

Brix	NSD	(0.2-0.6 ºBrix)
T.A.	NSD	(0.3-0.7 g/L)
pH	NSD	-

Canopy/Crop Load Strategies

- Cluster Thinning — No
- Shoot Thin Damaged shoots if half or more of shoots killed to clusters and beyond — Maybe
- Shoot Thin if only shoot tips damaged — No
- Remove all shoots and start again — No
- Cut back to long spurs if cane pruned — Maybe
- Do nothing, but irrigate* — Yes (9/10)

*and normal pest control

Summary

- Irrigation normal or slightly more initially
- No extra nitrogen; less depending on crop
- Continue Pest Management, especially powdery mildew
- No cluster thinning
- No shoot thinning for most varieties and sites
- Cane pruned vines may benefit from re-pruning
- Some fruit buds developing for 2009 may be damaged, but many factors determine ultimate fruitfulness for next year.

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