24th Annual Gulf Coast Grape Growers Field Day

Texas A&M AgriLife Extension

February 5, 2016
Cat Spring Agricultural Hall
13035 Hall Road
Cat Spring, Texas

Grape Growers Committee of Austin County

President

Doug Rowlette, PhD

Members

David Fleming

Scott Greene

Roy Hearnsberger

Sue Hearnsberger

James Kasparek

Jerry Watson

24TH ANNUAL GULF COAST GRAPE GROWERS FIELD DAY

FRIDAY, FEBRUARY 5

Cat Spring Agricultural Society Hall
Cat Spring, TX

8:30 – 9:00 am	**Registration**
9:00 – 9:10 am	**Introduction and Announcements** Fran Pontasch & Dr. Justin Scheiner, Texas A&M AgriLife Extension
9:10 – 9:40 am	**Vineyard Design: A Critical Step in Successful Production** Fritz Westover, Westover Vineyard Advising
9:40 – 10:10 am	**Developing a Productive Vineyard: Years 1 to 3** Fran Pontasch, Texas A&M AgriLife Extension
10:10 – 10:30am	**Break**
10:30 – 11:00am	**Vineyard Nutrition & Rootstock Trial Update** Andrew Labay, Texas A&M AgriLife Extension
11:00 – 11:30 am	**Winemaker's Perspective on Blanc Du Bois Harvest Chemistry** Marta Latowski, Haak Winery and Vineyard
11:30 – 11:45 am	**Real Texas Wine** Chris Brundrett, William Chris Vineyards
11:45 – 12:00 pm	**An Update from Rio Farms** Andy Scott, Rio Farms Inc.
12:00 – 1:00 pm	**Lunch**
1:00 – 1:10 pm	**Texas Wine & Grape Growers Association Update** Jon Bowden, Region 3 Vineyard Director
1:10 – 1:40 pm	**46 years of Viticulture: The Good, the Bad, the Ugly** Dr. George Ray McEachern, Texas A&M University
1:40 – 2:10 pm	**Vineyard Pest Management in the Gulf Coast** Jim Kamas, Texas A&M AgriLife Extension
2:10 – 2:30 pm	**Break**
2:30 – 3:00 pm	**Grapevine Trunk Diseases** Dr. David Appel & Albre Brown, Texas A&M AgriLife Extension
3:00 – 3:30 pm	**What We Learned from the 2015 Growing Season** Dr. Justin Scheiner, Texas A&M AgriLife Extension
3:30 pm	**Wine Reception**

WESTOVER vineyard advising

Grapevine Training Systems & Techniques for Training Young Vines

What is a Vine Training System?

The **system** or **form** in which a vine is cultivated

Training Systems Vary in:

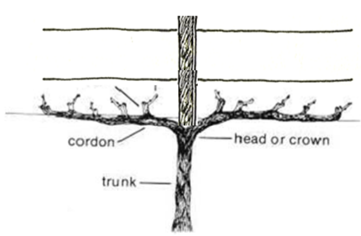
- **Yield & quality**
- **Labor**
  - Shoot positioning, leaf pulling, pruning, etc.
- **Suitability for varieties**
  - Upright or Procumbent shoot growth
- **Suitability for climates**
  - Wet, dry, cold, hot
- **Cost of establishment**

Some Common Training Systems

Vertical Shoot Positioned

VSP

Vertical Shoot Positioned
Spur Pruned



Bi-lateral cordon, vertical shoot positioned VSP

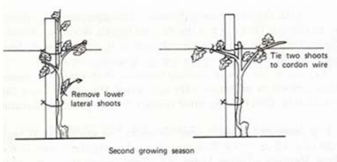
- An international standard
- Cordons at 38 to 42 inches above the ground
- One fruiting zone

WESTOVER vineyard advising

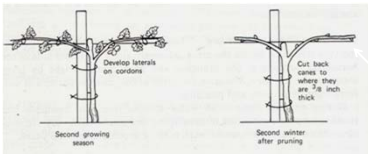
Young Vine Training (VSP)

First leaf training for single trunk, bi-lateral, spur pruned vines

Vertical **S**hoot **P**ositioned Training System



Steps in developing a cordon trained vine: may complete in 1st or 2nd growing season depending on vigor



When developing cordons leave maximum 6 to 7 buds per cordon extension per year

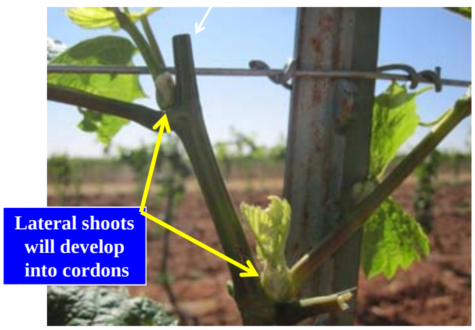
Train one strong shoot up to cordon wire (this will be the future trunk)

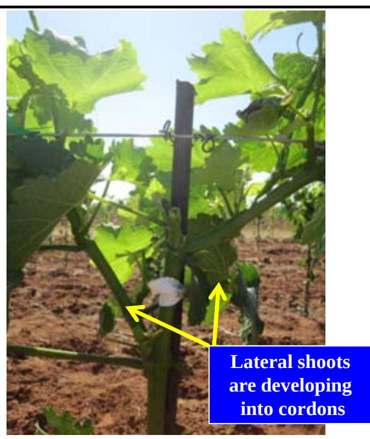
Allow shoot tip to grow well past cordon wire

Allow shoot tip to grow well past cordon wire then cut at cordon wire

The primary shoot (future trunk) will be about pencil size diameter or greater at intersect with cordon wire

Note sturdy pencil size diameter at tipping point at cordon wire





Laterals not being trained as cordons can be removed to reduce competition with those being trained as cordons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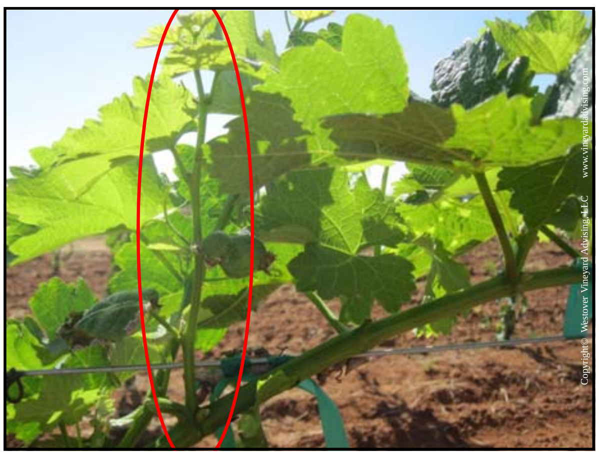
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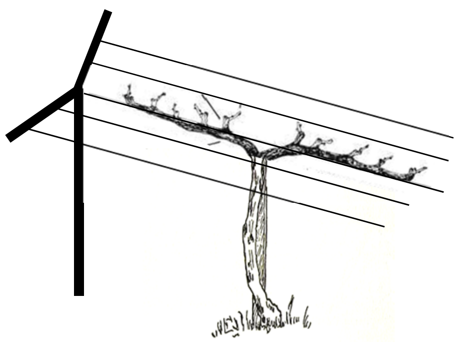
Watson Training System



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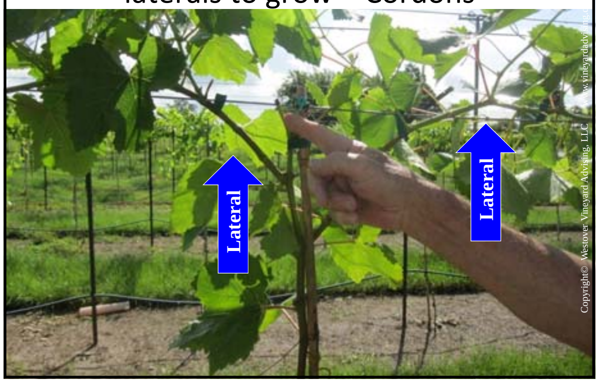
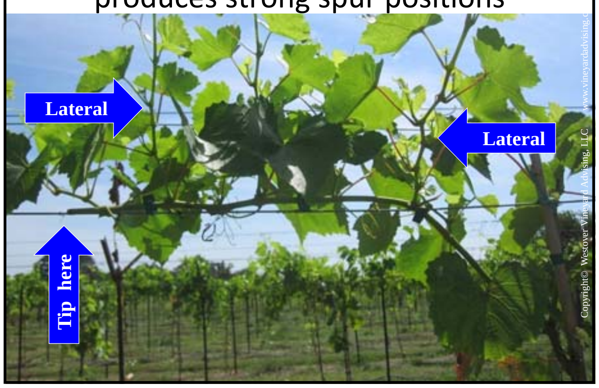
One strong shoot is trained as a straight trunk until it reaches past the cordon wire at 66”

Shoot tipping at cordon wire promotes laterals to grow = Cordons



Lateral growth on developing cordons produces strong spur positions



Dormant vine after first year – before pruning

Dormant vine after first year – before pruning

Dormant vine after first year – after pruning

Crop on Second Leaf Vines

Crop on Third Leaf Vines

Low capacity, stressed shoots, over-cropping potential

Low capacity, stressed shoots, over-cropping potential

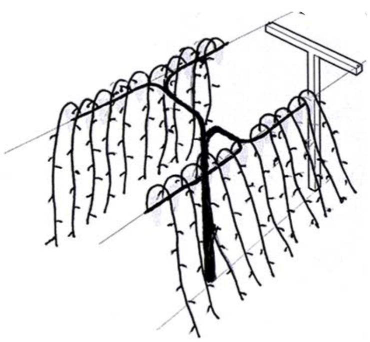
Trellis/Canopy At Maturity

Some Common Training Systems

Geneva Double Curtain

GDC

Geneva Double Curtain



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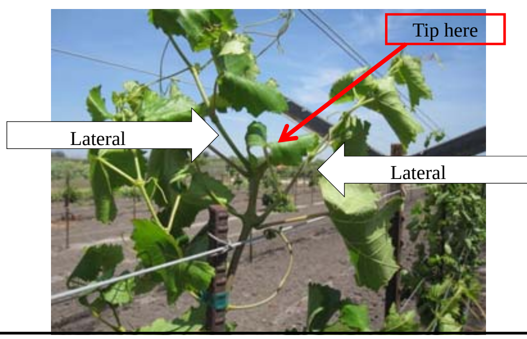
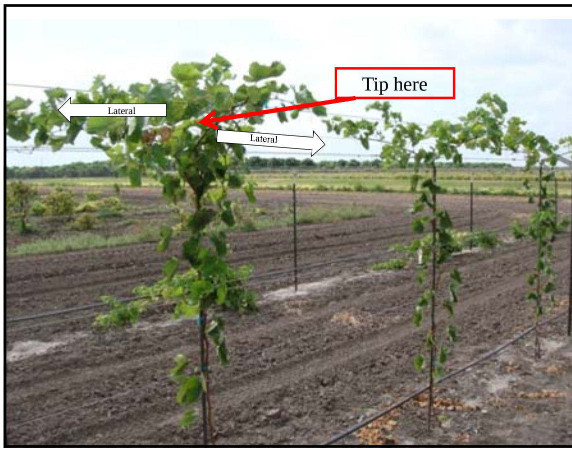
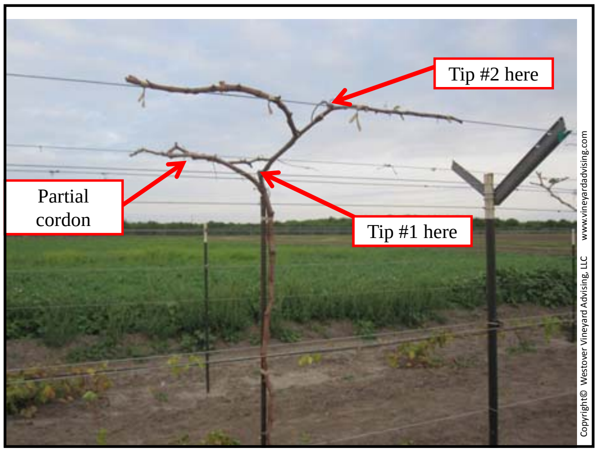
Geneva Double Curtain Pros

- ✓ High yields; high phenols also possible
- ✓ Good fruitfulness reported
- ✓ Reduced vigor on downward growing shoots

Tipping of main trunk shoot just above 50-55" support wire (3 to 4 inches above) to stimulate laterals just above the wire. Those laterals are trained out to the cordon wires on the crossarms.







Training System Evaluation in Georgia at Trillium Vineyards


2rd Year GDC in Georgia
Villard Blanc


2rd Year GDC in Georgia
Villard Blanc


2rd Year GDC in Georgia
Villard Blanc

2rd Year Watson in Georgia
Villard Blanc

Big Expectations!

Advice

- Consult with a professional
- Visit vineyards and talk to managers
- Think about the long term function
  - Mechanical harvest
  - Modifications for vigor
  - Economics
- **Make sure you understand the system!**

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Developing a Productive Vineyard Years 1-3

24th Annual Gulf Coast Grape Growers Field Day
February 5, 2016

TEXAS A&M AGRILIFE EXTENSION

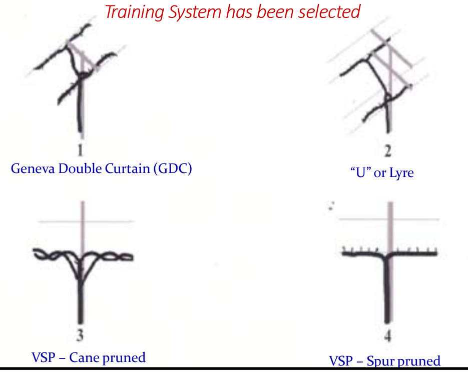
Fran Pontasch
Gulf Coast Viticulture

Grapevine Development Years 1-3

From Here
Year 1 = 1st Leaf

To Here
Year 3 = 3rd Leaf

Training System has been selected



Schedule Planting Date

- During spring temperatures – March, April, early May
- After all weeds are removed from vine
  rows Till
  Roundup (or Glyphosate equivalent) for broadleaf & grasses
  Surflan, Goal for persistent grasses
- After irrigation system is operational

Grapevine Planting Procedure

- Dig holes 10-16" deep
  6-12" in diameter
  (depending on plant material)
- Cover the roots with soil
- Step lightly around vine to eliminate air pockets around the roots
- Tug upwards to ensure roots are downward facing & not "J" rooted
- Water in the vines to settle the soil around the roots and eliminate air pockets

Grow Tubes (Vine Shelters)

PROS:
- Safer herbicide spray
- Encourage straight trunks
- Protection from rabbits and deer
- Reduce wind desiccation

Remove Tubes by Late Summer

CONS:
- Ants may colonize grow tubes
- Misses when spraying insecticides/fungicides
- Create hot temperatures around tender shoot
- Problems hardening off when not timely removed

Year 1 - 1ST Leaf
1st PRIORITY in DEVELOPMENT

Well developed root system

Must have:
-Weed-free vine rows
-Reliable irrigation for frequent watering

1st Year - Trunk Development

Select the shoot with best position health & size

No bull canes

Remove others

Tie up future trunk to training stake to keep shoot(s) straight

1ST Year - Vine Training
Establish straight trunk(s)

Single or Double Trunk

Depends on potential for freeze damage and site vigor

Single Trunk – much easier to maintain
Double Trunk – growth outlet for excessive vigor
back up trunk in serious freeze

Vine Training creates the structure needed for the grapevine to display vine leaves in a way that optimizes sunlight exposure for vine and fruit development.

Compound Buds

- Dormant buds on 1 year old wood give rise to shoots and clusters
- Lower buds must receive plenty of sunlight to be fruitful
- Training system improves vineyard management efficiency

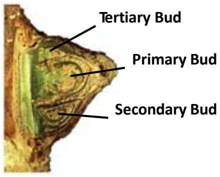


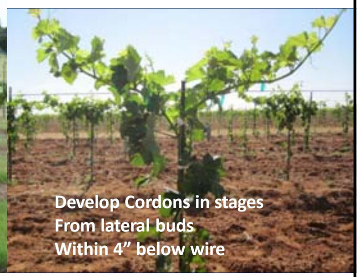
Image from: Martin Goffinet, 2004. Anatomy of Grapevine Winter Injury and Recovery.

Low Vigor Site First Year – Trunk establishment
Second year – Cordon formation

Regularly tie up shoots
Select best shoot
TRUNK MUST BE STRAIGHT

Remove all fruit

High Vigor Site First Year
Trunk establishment & Cordon formation



Structures that Weakens Grapevine Potential

Cordon developed too low
(lost production area)

Sharp Angles create stress points
(creates stress points)

First Year Irrigation & Nutrients

- Irrigate for small, developing root systems
  - frequently in small amounts
  - keep soil surrounding roots consistently moist

- Nitrogen - New vines tend to require small amounts of nitrogen to get established. Apply after roots become active.
  Consider zinc as well.

Major THREATS – 1st Leaf

Animal → Deer/rabbit feeding

Weeds → In Vine Rows

Inadequate Watering

Additional Threats:

Diseases - Downy Mildew, Anthracnose

Insects - Ants, Grasshoppers, Leafhoppers

2nd Year - Vine Training

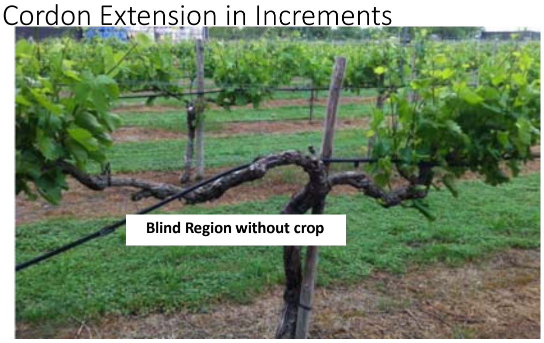
Low Vigor – Forming/Reforming Cordons

High Vigor – Forming/Reforming Spurs

2nd Year Cordon Formation & Extension

Develop Cordons IN STAGES
From lateral buds
Within 4" below wire

Cordon Extension in Increments



Apical Dominance

Spur Development

Spur Development determines:
- Shoot Density
- Canopy Size
- Leaf Area
- Cropload

Year 1-3 Crop Management Cluster Thinning

- Allow vine growth to fully mature
- Regulate cropload
- Improve uniformity

Remove Clusters Early

Vineyard Management – Year 2

Late Winter/Early Spring dormant pruning

All Season :
- Weed control & Mowing
- Irrigation
- Pests and disease control
- Nutrition
- Vine Training

During Grand Growth:
- Thin fruit
- Intense Vine Training

Harvest (at certain highly vigorous sites)

Year 3 – 3rd Leaf

Should be able to carry a light crop!

Watson System

First Year's Structure

Mature Vine Structure

Vineyard Management – Year 3+

Late Winter/Early Spring dormant pruning

All Season :
- Weed control & Mowing
- Irrigation
- Pest and disease control
- Nutrition
- Vine Training

Grand Growth:
- Thin fruit
- Shoot Thin
- Shoot Position

Bloom or Post bloom
Petiole samples

Grape Maturity
Harvest

Be available on short notice for disease and pest control

Grapevine Development Years 1-3
Summary of Top Priorities

Grapevine Development
Root growth & development
Straight trunk establishment
Cordon formation
Spur formation
Canopy development
Crop production

Vineyard Tasks
Planting
Irrigation
Weed Management
Vine Training
Pest Management – weeds
animals
disease & insects

PATIENCE REQUIRED

- Plant when the site is ready
- Plant correctly
- Plant uniformly & in straight rows
- Build cordons incrementally

*Management of one season determines the success of following seasons

Thank you!

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Vineyard Nutrition and Rootstock Trial Update

Gulf Coast Grape Grower Field Day
Cat Spring, February 5th 2016

Andrew Labay
Viticulture Program Specialist
Texas A&M Agrilife Extension Viticulture and Fruit Lab
Fredericksburg, Texas
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Why are nutrients important for plants?

- *They are necessary for plant growth and reproduction and they are non-replaceable.*
- Deficiencies:
  - Foliar deficiency symptoms
  - Growth & yield reductions
  - Predisposed to disease, winter injury and vine decline
- Oversupply consequences:
  - Excessive vigor, increased disease and poor fruit quality
  - Toxicity and plant death
- *Goal: maintaining adequate but not excessive nutrient availability is critical to optimum vine performance*

Common Essential Nutrients

	Nutrient	Symbol	Uptake form	Concentration range in plants, % by wt.	Mobility in plant
MACRO	Nitrogen	N	NO_3^-, NH_4^+	1 - 5	Mobile
MACRO	Potassium	K	K^+	0.5 - 4	Mobile
MACRO	Calcium	Ca	Ca^{2+}	0.7 - 2	Non-mobile
MACRO	Magnesium	Mg	Mg^{2+}	0.3 – 0.8	Mobile
MACRO	Phosphorus	P	$H_2PO_4^-$, HPO_4^{2-}, PO_4^{3-}	0.2 – 0.6	Mobile
MICRO	Iron	Fe	Fe^{2+}	0.002 – 0.03	Non-mobile
MICRO	Zinc	Zn	Zn^{2+}	0.0005 – 0.01	Non-mobile
MICRO	Boron	B	H_3BO_3, $H_2BO_3^-$, HBO_3^-	0.0003 – 0.001	Mobile
MICRO	Manganese	Mn	Mn^{2+}, Mn^{3+}, Mn^{4+}	0.0001 – 0.0008	Less-mobile
MICRO	Copper	Cu	Cu^{2+}	0.0003 – 0.0008	Less-mobile
MICRO	Molybdenum	Mo	MoO_4^{2-}	0.00003 – 0.001	Non-mobile

Nutrient Management in Vineyards

- General site assessment
  - What do we have to work with?
  - Soil depth, drainage, soil/water sample
- Visual observation
  - Do we have optimal growth?
  - Deficiency/Toxicity symptoms
- Tissue sampling
  - Are we in standard ranges?
  - Snapshot measurement of status

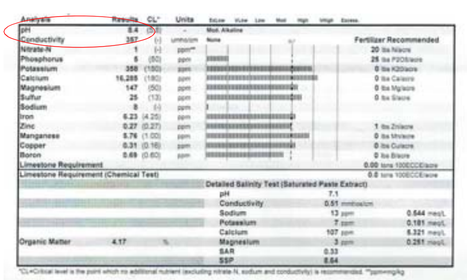
Soil/Water Sampling

What we can learn:

- pH
- Salinity issues (SAR, EC_w , TDS)
- Toxic ions (sodium, chloride and boron)
- Nutrient profile including relative quantity of magnesium, calcium and potassium

Texas A&M Agrilife Extension Soil, Water and Forage Testing Laboratory: http://soiltesting.tamu.edu

Soil Sampling



Analysis	Results	CL*	Units		Fertilizer Recommended
pH	8.4	[illegible]	-	Mod. Alkaline	
Conductivity	357	(-)	umhos/cm	None	
Nitrate-N	1	(-)	ppm**		20 [illegible]
Phosphorus	6	(50)	ppm		25 [illegible]
Potassium	358	(150)	ppm		0 [illegible]
Calcium	16,285	(180)	ppm		0 [illegible]
Magnesium	147	(50)	ppm		0 [illegible]
Sulfur	25	(13)	ppm		0 [illegible]
Sodium	8	(-)	ppm		
Iron	6.23	(4.25)	ppm		
Zinc	0.27	(0.27)	ppm		1 [illegible]
Manganese	5.76	(1.00)	ppm		0 [illegible]
Copper	0.31	(0.16)	ppm		0 [illegible]
Boron	0.69	(0.60)	ppm		0 [illegible]
Limestone Requirement					0.00 [illegible]
Limestone Requirement (Chemical Test)					0.0 [illegible]
Organic Matter	4.17		%		

Detailed Salinity Test (Saturated Paste Extract)			
pH	7.1		
Conductivity	0.51	[illegible]	
Sodium	13	ppm	0.544 meq/L
Potassium	7	ppm	0.181 meq/L
Calcium	107	ppm	5.321 meq/L
Magnesium	3	ppm	0.251 meq/L
SAR	0.33		
SSP	8.64		

- ❖ Ideal conductivity < 1.5 mmhos/cm
- ❖ Ideal SAR < 4
- ❖ Ideal B < 1 ppm; Na < 690 ppm

Reference: Interpretation of Soil and Water Analysis
W.L. Peacock and L.P. Christensen
http://iv.ucdavis.edu/files/24409.pdf

N Nitrogen Deficiency

Visual indicators:

- Low vigor: poor shoot growth, short internodal length, small leaves
- Uniform pale-green to yellowish color of leaves
- Reduction of clusters, berries or berry set
- Early leaf senescence


Photo credit: Jim Kamas


Photo credit: Peter Magarey (link)

N Common Nitrogen Sources

Common Sources	Formula	Form	%N	Relative cost	Comments
Anhydrous Ammonia	NH_3	Gas	82	1.00	Volatile; Special equipment required for application
Urea	$NH_2 - CO - NH_2$	Dry	46	1.67	Volatile on all soils
Ammonium sulfate	$(NH_4)_2SO_4$	Dry	21	1.89	Volatile on alkaline soils
Ammonium nitrate	NH_4NO_3	Dry	34	2.10	Less volatile; Expensive and restricted use
UAN - 32	Urea + NH_4NO_3	Liquid	32	1.69	Injected via drip irrigation

- ❖ Apply during periods of active uptake: fruit set to veraison ideal
- ❖ Young vines: light nitrogen rate at ~10 lbs. / acre or ¼ cup ammonium sulfate / vine
- ❖ Mature vines: 20 – 40 lbs. / acre depending on need
- ❖ Increasing organic matter may be beneficial
- ❖ Monitor via visual indicators and annual petiole samples

K Potassium Deficiency

What to look for:

- Early season – older leaves show yellowing and necrotic spots in leaf margins
- Late summer – older leaves bronze or redden between veins
- Marginal scorch and curling may follow (may resemble drought/PD/CRR)
- Petiole samples < 1% at bloom and < 0.8% late season

Photo credit: T. Zabadal. Article by R. Butler (link)


Photo credit: Jim Kamas

K Potassium Fertilization

Common Sources	Formula	Form	%K	Comments
Potassium sulfate	K_2SO_4	Dry; Liquid	43	Most popular; low solubility limits liquid formulation
Potassium chloride (muriate of potash)	KCl	Dry; Liquid	51	Caution chloride toxicity – may need to increase irrigation or apply in fall to allow leaching.
Potassium nitrate	KNO_3	Dry	38	Expensive and less available
Potassium / Magnesium sulfate	KSO_4 x $MgSO_4$	Dry	18	May offset induced Mg deficiency
Potassium thiosulfate	$K_2S_2O_3$	Liquid	21	For alkaline soils; Expensive
Potassium carbonate	K_2CO_3	Liquid	25	For acid soils; Expensive

❖Fall application suggested as a 3 – 5 foot band under trellis
❖Application rate from 400 – 1,200 lb./acre to correct deficiency (600 vines/acre) - depends on application timing, severity of deficiency, soil type, soil concerns (pH, salinity, drainage), Mg status, crop load…
❖Short term deficiency corrections via foliar spray?: K requirement is too high to be practically supplied through foliar fertilization. Not cost effective.

Mg Magnesium Deficiency

Symptoms:
- Basal leaf chlorosis beginning at margins moving inward between leaf veins
- Often appear post-bloom
- Wet bloom periods and large crops increase deficiency
- Can lead to loss of photosynthetic area


Sangiovese / GRN-1

Mg Magnesium Fertilization

Common Sources	Formula	%Mg	Comments
Magnesium sulphate (Epsom salt)	$MgSO_4 \bullet 7H_2O$	10 – 18	Can be banded, used in drip system or used as foliar application
Potassium/Magnesium sulphate	KSO_4 x $MgSO_4$	11	K antagonism possible

❖If soil pH is low (< 5.5) dolomitic lime (20% magnesium) can be used
❖For moderate to severe deficiency, fall application suggested as a 3 – 5 foot band under trellis: Magnesium sulphate at 300 to 600 lbs. / acre - depends on severity of deficiency, soil type, salinity, K status…
❖Short term deficiency corrections via foliar spray: 5 - 15 lbs. / 100 gallon of water per acre shortly after bloom.

B Boron Deficiency

- Slightly deficient:
  - Reduced fruit set
  - Small seedless berries
  - Fruit/flower necrosis
- Severe deficiency also with:
  - Early season: mis-formed shoots, death of shoot tips
  - Leaves: interveinal chlorosis, cupped upwards

Images: L.P. Christensen et. al. Fall Foliar Sprays Prevent Deficiency Symptoms in Grapes. *California Agriculture* April-June 2006.

B Boron Fertilization

Common Sources	Formula	%B
Borax	$Na_2B_4O_7 \bullet 10H_2O$	11
Boric acid	H_3BO_3	17
Sodium tetraborate (Fertibor, Granubor)	$Na_2B_4O_7 \bullet 5H_2O$	14-15
Sodium octaborate (Solubor)	$Na_2B_8O_{13} \bullet 4H_2O$	20-21

- ❖ Caution – large B applications can induce toxicity
- ❖ Can be banded in the fall, applied through drip or foliar
- ❖ 0.5 – 1 lbs. B / acre via drip or foliar spray 2 weeks before bloom
- ❖ Monitor bloom petiole values when applying boron

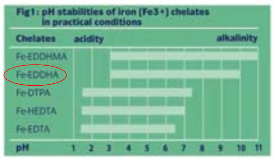
Fe Iron Deficiency

- Immobile – symptoms occur on new growth
- Involved in chlorophyll synthesis; deficiency limits growth/yield
- Precipitates readily in calcareous soils
- Visual observation may be better than soil/tissue analysis for Fe

GRN-3

GRN-2

Fe Iron Chelates for Fertilization



http://www.cmchemistry.com/about.php?cid=27

Tissue Testing

When	Where	How
Bloom (50%)	Petioles opposite basal clusters	80 – 100 petioles, no more than 4 petioles / vine, taken from both sides of canopy
Veraison (50%) / Late Season	First fully mature leaves of untrimmed shoots	

- ❖Be consistent in collection time
- ❖Separate samples for variety/rootstock/block differences
- ❖Clean with phosphate-free detergent and rinse in distilled water
- ❖Dry in paper bags before shipping to lab
- ❖Do not store or ship in sealed plastic bags

Tissue Testing

Nutrient	Bloom Petiole Sample Target	Veraison / Late Season Petiole Sample Target
N	1.2 - 2.5	1.2 - 2.5
P	0.15 - 0.4	0.15 - 0.4
K	1.5 - 3.0	1.5 - 3.0
Mg	0.5 - 0.75	0.5 - 0.75
Ca	1.2 - 3.0	1.2 - 3.0
Na	< 0.1	< 0.1
B	25 - 100	25 - 100
Zn	30 - 100	30 - 100
Mn	25 - 1000	25 - 1000
Fe	30 - 100	30 - 100
Cu	6 - 25	6 - 25

Image source: http://cru.cahe.wsu.edu/CEPublications/PNW622/PNW622.pdf
Target values from: Kamas (2014) Growing Grapes in Texas. Texas A&M University Press

Nutrient Management in Vineyards

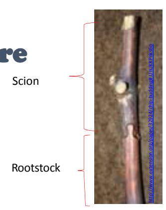
- Soil & water sampling
- Visual observation in the field
- Tissue sampling
- Vineyard history – crop load, disease, seasonal weather

↓

Vineyard Management decisions
- Scion/Rootstock choice
- Fertilization & soil adjustments
- Irrigation

Rootstocks in viticulture

– Disease resistance
  - phylloxera, nematodes
– Adaption to soil conditions
  - compactness, pH, salinity, lime, drought
– Manage scion performance
  - Increase / Decrease Vigor
  - Improve nutritional status
  - Timing of developmental stages
  - Yield and fruit quality



Rootstocks Trials

OBJECTIVE:
Evaluate the impact of rootstock selection on scion performance and disease tolerance

3 SITES AND 2 SCIONS:
- 'Sangiovese' (SV)
  - Stonewall, TX
  - Leakey, TX
- 'Blanc du Bois' (BdB)
  - Industry, TX

DATA COLLECTION:
- Vigor (annual pruning weights)
- Phenology (budbreak dates)
- Nutritional uptake (petiole sampling) and fruit quality
- Disease tolerance

Rootstocks used in trial

Rootstock	Abbreviation	Parentage
GRN-1	G1	*V. rupestris* x 'Cowart' (*M. rotundifolia*)
GRN-2	G2	(*V. rufotomentosa* x (Dog Ridge x Riparia Gloire)) x Riparia Gloire
GRN-3	G3	(*V. rufotomentosa* x (Dog Ridge x Riparia Gloire)) x *V. champinii*
GRN-4	G4	(*V. rufotomentosa* x (Dog Ridge x Riparia Gloire)) x *V. champinii*
GRN-5	G5	(Ramsey x Riparia Gloire) x *V. champinii*
Dog Ridge	DR	*V. champinii (V. candicans x V. berlandieri?)*
Salt Creek	SC	*V. champinii (V. candicans x V. acerifolia?)*
5C	5C	*V. berlandieri* x *V. riparia*
5BB	5BB	*V. berlandieri* x *V. riparia*
1103P	3P	*V. berlandieri* x *V. rupestris*

Grower Petiole Analysis Macronutrients

Vineyard Code	Lab Code	Year	%N		%P		%K		%Mg		%Ca		%Na	
1	A	2014			0.26	Normal	2.12	Normal	0.25	Low	1.28	Normal	0.1	High
1	A	2013	0.84	Low	0.31	Normal	1.19	Low	0.27	Low	1.83	Normal	0.13	High
1	A	2012	1.34	Normal	0.23	Normal	1.01	Low	0.18	Low	1.3	Normal	0.1	High
1	A	2014	1.34	Normal	0.17	Normal	1.5	Normal	0.5	Normal	2.42	Normal	0.27	High
1	A	2011	1.54	Normal	0.23	Normal	1.38	Low	0.28	Low	1.86	Normal	0.14	High
2	B	2014 A	0.92	Low	0.15	Normal	1.47	Normal	0.27	Low	2.54	Normal	0.26	High
2	B	2014 B	0.82	Low	0.23	Normal	2.42	Normal	0.22	Low	2.82	Normal	0.16	High
2	C	2013	0.89	Low	0.23	Normal	3.32	High	0.2	Low	1.38	Normal	0.43	High
2	B	2010	0.51	Low	0.16	Normal	1.37	Low	0.25	Low	2.17	Normal	0.31	High
3	C	2014	1.01	Low	0.24	Normal	1.34	Low	0.17	Low	1.81	Normal	0.17	High
4	B	2012	0.8	Low	0.35	Normal	1.36	Low	0.23	Low	2.44	Normal	0.55	High
4	B	2010 A	0.86	Low	0.43	High	1.77	Normal	0.17	Low	1.64	Normal	0.16	High
4	B	2010 B	1.2	Normal	0.3	Normal	2.45	Normal	0.23	Low	2.19	Normal	0.24	High
5	A	2013	1.73	Normal	0.47	High	3.21	High	0.53	Normal	2.1	Normal	0.14	High
6	C	2014 A	0.87	Low	0.43	High	1.36	Low	0.32	Low	2.81	Normal	0.12	High
6	C	2014 B	0.98	Low	0.41	High	2.21	Normal	0.41	Low	1.74	Normal	0.18	High
6	C	2014 C	0.98	Low	0.33	Normal	1.84	Normal	0.5	Normal	1.89	Normal	0.17	High
6	C	2014 D	0.9	Low	0.38	Normal	1.38	Low	0.34	Low	2.78	Normal	0.13	High
6	C	2013 A	1.58	Normal	0.45	High	1.43	Low	0.27	Low	2.32	Normal	0.08	Normal
6	C	2013 B	1.38	Normal	0.37	Normal	1.65	Normal	0.29	Low	1.91	Normal	0.12	High
Average			1.08	Low	0.31	Normal	1.79	Normal	0.29	Low	2.06	Normal	0.20	High
Target Range (Bloom)*			1.2 – 2.5		0.15 – 0.4		1.5 – 3.0		0.5 – 0.75		1.2 – 3.0		< 0.1	
Target Range (Harvest)*			0.8 – 1.4		0.1 – 0.3		1.5 – 3.0		0.5 – 1.0		1.0 – 3.0		< 0.1	

* From Kamas 2014 Growing Grapes in Texas

Grower Petiole Analysis Micronutrients

Vineyard Code	Lab Code	Year	B ppm		Zn ppm		Mn ppm		Fe ppm		Cu ppm	
1	A	2014			31	Normal	99	Normal	157	High	20	Normal
1	A	2013	20	Low	47	Normal	149	Normal	104	High	14	Normal
1	A	2012	15	Low	36	Normal	141	Normal	79	Normal	9	Normal
1	A	2014	25	Normal	53	Normal	133	Normal	89	Normal	7	Normal
1	A	2011	20	Low	45	Normal	200	Normal	105	High	34	High
2	B	2014 A	40	Normal	29	Low	418	Normal	20	Low	7	Normal
2	B	2014 B	42	Normal	33	Normal	340	Normal	18	Low	8	Normal
2	C	2013	32	Normal	39	Normal	152	Normal	49	Normal	11	Normal
2	B	2010	35	Normal	43	Normal	509	Normal	27	Low	6	Normal
3	C	2014	29	Normal	59	Normal	32	Normal	47	Normal	13	Normal
4	B	2012	52	Normal	31	Normal	102	Normal	35	Normal	5	Low
4	B	2010 A	26	Normal	64	Normal	58	Normal	41	Normal	5	Low
4	B	2010 B	29	Normal	67	Normal	126	Normal	45	Normal	5	Low
5	A	2013	25	Normal	142	High	255	Normal	87	Normal	18	Normal
6	C	2014 A	29	Normal	57	Normal	171	Normal	72	Normal	16	Normal
6	C	2014 B	26	Normal	9	Normal	134	Normal	54	Normal	14	Normal
6	C	2014 C	27	Normal	42	Normal	223	Normal	51	Normal	11	Normal
6	C	2014 D	30	Normal	62	Normal	331	Normal	68	Normal	16	Normal
6	C	2013 A	26	Normal	46	Normal	128	Normal	68	Normal	18	Normal
6	C	2013 B	25	Normal	48	Normal	220	Normal	69	Normal	22	Normal
Average			29	Normal	49	Normal	196	Normal	64	Normal	13	Normal
Target Range (Bloom)*			25 - 100		30 - 100		25 - 1000		30 - 100		6 - 25	
Target Ranges (Harvest)*			30 - 100		30 - 100		100 - 1000		30 - 100		6 - 25	

* From Kamas 2014 Growing Grapes in Texas

Rootstock Trial Petiole Sampling

Nutrient	Late-summer 2014	Spring 2015	Late-summer 2015
N	Low	-	Low
P	Low	-	Low
K	Low – Normal*	-	-
Mg	Low	Low	Low
Ca	-	-	-
Na	Normal – High*	-	Normal-High*
Fe	-	Low	-
Zn	-	-	-
B	Low*	-	-
Mn	-	-	-

- normal petiole values

Thank you!

Texas A&M AgriLife Extension Viticulture and Fruit Lab

- *Jim Kamas*
- *Dr. Justin Scheiner*
- *Beth McMahon*
- *Yessica Garcia*
- *David Smith*
- *Jacy Lewis*
- *Dr. David Appel*
- *Sheila McBride*

Texas Department of Agriculture Commissioner Sid Miller

Austin County Grape Growers Association

Texas Hill Country Wineries — taste all: savor texas excellence

Grapevine Trunk Diseases

24th Gulf Coast Grape Growers Field Day

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TEXAS A&M AGRILIFE RESEARCH | EXTENSION

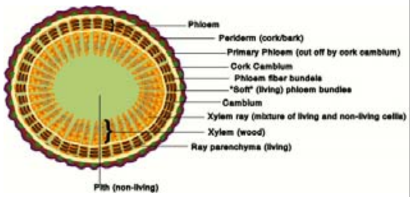
Presentation Outline

- Trunk disease and grapevine cankers defined,
- Impact of cankers,
- Control of grapevine cankers.

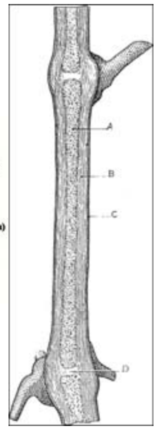
What are Trunk Diseases?

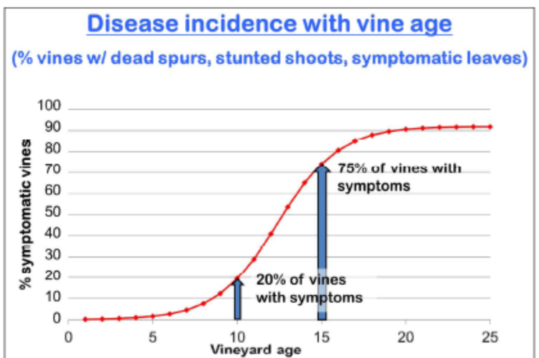
- Disease category consisting of necrotic, perennial lesions of mature wood (=cankers),
  - from small to large, often found near spurs,
  - sometimes characterized as vascular diseases,
  - Esca (a.k.a. black measles on adult vines, black goo or petri disease on young vines), bot canker, Eutypa dieback, dead arm,
- Mostly caused by fungi – well over 20 species,
- Usually associated in vineyards 10 yrs. or older,
- Occur worldwide, on all grape varieties,
- Can cause increased costs through several avenues.
  - Reduced yield, loss of fruiting wood, retraining vines, replanting, increased management costs.

Trunk/cane Anatomy



Cornell Fruit
http://www.fruit.cornell.edu/grape/pool/winterinjurycanes.html





From Duthie et al. 1991 and Munkvold et al. 1994

What Causes Trunk Diseases?

- Caused by a long list of taxonomically diverse fungi,
  - mostly Ascomycetes,
- They form spores in tiny “containers” growing on the surface of the dead, cankered wood,
  - “fruiting bodies”,
  - containers = pycnidia,
- Fungal spores are airborne,
  - Sexual and asexual conidia,
- Infection occurs primarily through wounds,
- More than one potential pathogen in any given canker.

DISEASE CYCLE OF EUTYPA DIEBACK

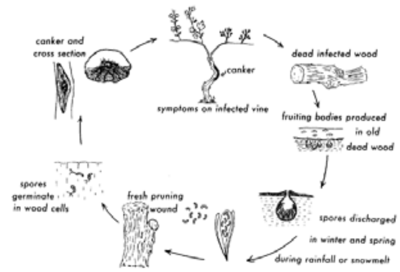


Figure 7

Published by the New York State Agricultural Experiment Station, Geneva, A Division of the New York State College of Agriculture and Life Sciences, A Statutory College of the State University, Cornell University, Ithaca. Authored by R. C. Pearson and T. J. Burr. Funded in part by an Extension Service—USDA, IPM Grant.

What Do they Look Like?

"It is difficult to associate one type of symptom with a particular pathogen"

- Internal and External Trunk Symptoms
  - perennial, expanding necrotic lesions (canker),
  - longitudinal splits and cracks
  - dead cordon arm, loss of spurs,
  - wedge shaped necrotic lesions in cross section (internal)
- Foliar Symptoms
  - chlorotic, tattered and cupped,
  - stunted shoots,
- Berries
  - bunch rot,
  - spotting.

What Do They Look Like?

Symptoms of Trunk Diseases

Black measles (esca)

http://iv.ucdavis.edu/Viticultural Information/

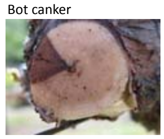
GTD Dieback

Internal Symptoms of Esca

http://iv.ucdavis.edu/Viticultural Information/?uid=205&ds=351

Eutypa

Bot canker



Fungi Associated With Cankers in Texas
Urbez-Torres, Adams, Kamas, Gubler

- Survey: 2007-2009 in Hill Country and South High Plains,
  - 45 vineyards,
  - 183 samples,
  - included 10 varieties.
- Fungal ID: fungi isolated from cankered vines,
  - preliminary ID based on morphology,
  - definitive ID based on DNA homology with known sequences.
- Pathogenicity: artificial inoculation of detached , lignified canes,
  - measurement of internal vascular streaking.

Results and Conclusions of the Previous Texas Study

- Greater diversity of pathogens than originally thought,
- First reports of numerous fungi on cankers in Texas,
  - *Lasiodiplodia theobromae,*
  - *Botryosphaeria dothidea,*
  - *Neofusicoccum parvum,*
  - *Diplodia seriata,*
- Increased understanding of these organisms will contribute to "…development of appropriate control methods".

Most Likely Pathogens in Texas
What we are seeing most often – associated organisms

"Bot Canker"

"Phomopsis cane and leaf spot"

"Dead arm"

"Esca "

"Miscellaneous associated organisms"

Lasiodiplodia theobromae
Telemorph: *Botryosphaeria rhodina*

Infection court = pruning wound

- Typical wedge shaped canker

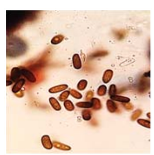
Bot Canker

Diplodia seriata
Telemorph: *Botryosphaeria obtuse*

Culture on PDA

Pycnidia of *D. seriata* on bark

Canker caused by Bortrysphaeria

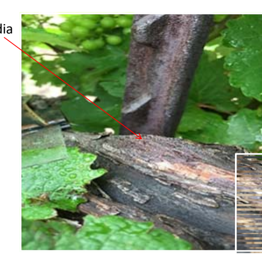


Spores

Diaporthe ampelina (Appropriate name)
Synonym: *Phomopsis viticola*

Masses of conidia

Culture on PDA



Internal discoloration

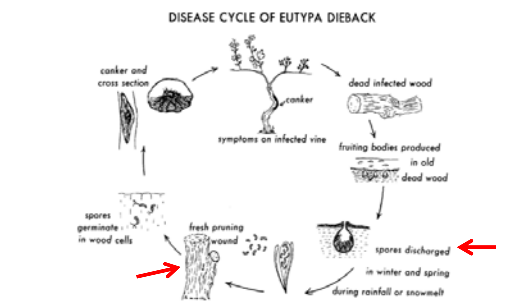


Figure 7

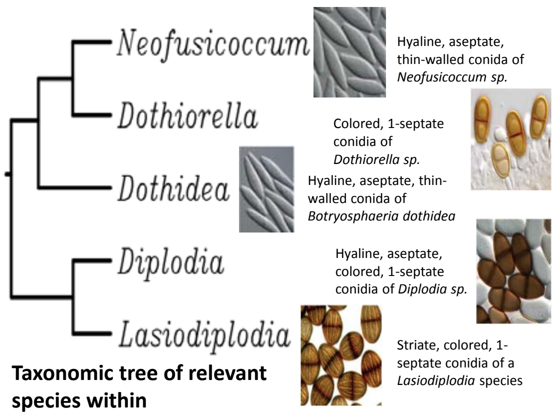
Published by the New York State Agricultural Experiment Station, Geneva, A Division of the New York State College of Agriculture and Life Sciences, A Statutory College of the State University, Cornell University, Ithaca. Authored by R. C. Pearson and T. J. Burr. Funded in part by an Extension Service—USDA, IPM Grant.

Disease (Common Name)	**Pathogen (Causative Agent)**
Black dead arm, Botryosphaeria canker, Excoriose	Fungi within the Botryosphaeriaceae family
Esca Complex, Black measles	*Phaeomoniella chlamydospora , Phaeoacremonium sp., Fomitiporia punctata, Togninia minima*
Eutypa dieback,	*Eutypa lata*
Petri disease, Young vine decline	*Phaeomoniella chlamydospora*
Phomopsis Dieback, Phomopsis cane and leaf spot	*Diaporthe ampelina* (= *Phomopsis viticola*)

Know your Disease

Bot/Eutypa Canker:
Relatively uniform discoloration (bark brown). Typical wedge shape

Esca Canker:
Discoloration includes a range of reds and browns. Spread/Shape is inconsistent



Taxonomic tree of relevant species within Botryosphaeriaceae family

What is Phomopsis?

Diaporthe spp. are known to cause two distinct diseases on grapevine:

- Phomopsis cane and leaf spot
  - affecting the green tissues
- Phomopsis dieback
  - affecting the permanent woody structure

Lesions on green shoots

Small leaf spots, each surrounded by a yellow halo

What is Esca?

Esca is a disease caused by a complex of pathogens that primarily include:

- *Phaeomoniella chlamydospora ,*
- *Phaeoacremonium sp.,*
- *Fomitiporia punctate,*
- *Togninia minima*

What is Esca?

Esca foliar symptoms include:

- "tiger-stripes"
  - light-green and/or chlorotic areas developing between the veins and at the margin of the leaves that eventually turn rust- or reddish-colored throughout the growing season
- "black measles"
  - gray to dark-brown speckling of the berries
- "vine apoplexy"
  - sudden wilting of the vine, including shriveling of the fruit that normally occurs in summer

What is Esca?

- Leaf symptom known as "tiger-stripes"

What is Esca?

Esca vascular symptoms include:

- "White rot"

yellowish spongy mass of wood, usually in the center of the trunk and/or cordons, which can be observed alone or along with dark brown to black spots in the xylem vessels

Know your Pathogens

- The Esca disease associates can be soil-borne.
- The Esca disease associates can live as an epiphyte on a vine
- This means if a vine harbors the esca complex retraining is likely to be ineffective
- The vine must be completely removed to prevent spread of disease

Vine Retraining Possible Outcomes

Symptoms typical of The Esca Complex

Canker caused by Botrysphaeriacea

Early Prevention is Critical!

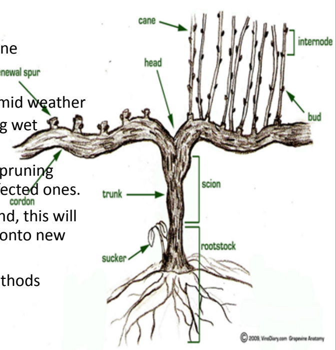
- There is a long lag phase between infection and appearance of symptoms
  - Several years
- Most of these fungi grow slowly in the vine wood
- Foliar symptoms do not appear until several years after the onset of infection, so that by the time the symptoms become visible the fungi are well-established
- The disease is present long before the vines begin to die back

Limiting Stress Factors That Lead to Disease (Opportunity Cost)

- Little or no soil cultivation prior to planting
- Freeze/frost damage – don't plant too early, especially if you're in a higher risk area.
- Improper Root Development
- Nutrient deficiencies
- Water stress
- Heavy crop loads during the first 3 years of establishment
- Large Pruning Wounds

Managing Trunk Diseases

- Burn old wood
  - Pruning Trash
  - Heavily infected areas of vine
- Vine Surgery if necessary
- Try to avoid pruning in wet, humid weather
  - Spores are dispersed during wet conditions
- It is most important to protect pruning wounds of vines nearby any affected ones.
- Prune from upwind to downwind, this will help stop the spread of spores onto new pruning wounds
- Use recommended pruning methods
  - Delayed pruning
  - Double pruning



Current Recommendations for Control

- Treat pruning wounds with a protectant
  - Topsin M (70WP) @ 2lb/acre (Group 1 Benzimidazole, Thiophanate-methyl), BOT and EUTYPA
  - Rally 40W @ 4-6 oz/acre (Triazole, Myclobutanil),
    - tractor applied post-pruning, ESCA
  - Tractor applied post –pruning
    - repeat as needed to be effective for 1 month,
    - particularly after rain.
  - Topical wound paints,
    - Vinevax (Trichoderma),
    - 5% Boric Acid paste,
    - fungicide amended wound paints.

Resources

- The Vineyard Doctor (eXtension)
  - https://vineyarddoctor.tamu.edu/index.jsp
- Texas Plant Disease Diagnostic Lab
  Attention: Albre Brown
  - http://plantclinic.tamu.edu/
- Aggie Horticulture
  - http://aggie-horticulture.tamu.edu/
- International Council on Grapevine Trunk Diseases
  - http://www.icgtd.org/
- UC Integrated Viticulture
  - http://iv.ucdavis.edu/Viticultural_Information/?uid=205&ds=351

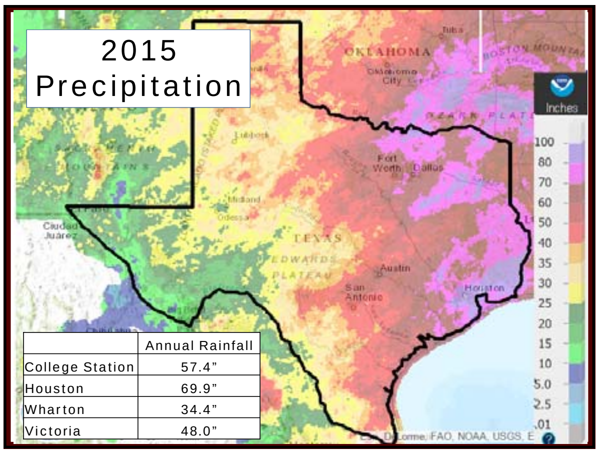
End

What We Learned From the 2015 Season

Justin Scheiner, Ph.D.
Assistant Professor and Extension
Viticulture Specialist
Texas A&M AgriLife Extension

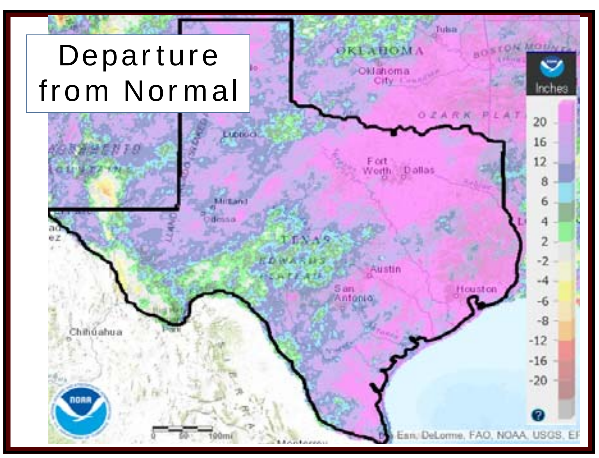
Texas A&M AgriLife Extension

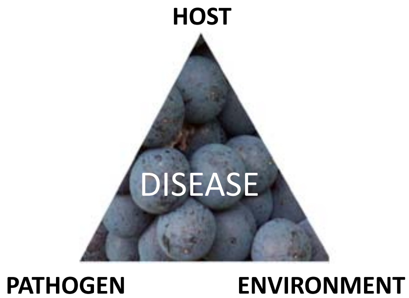
2015 Precipitation



	Annual Rainfall
College Station	57.4"
Houston	69.9"
Wharton	34.4"
Victoria	48.0"

Departure from Normal

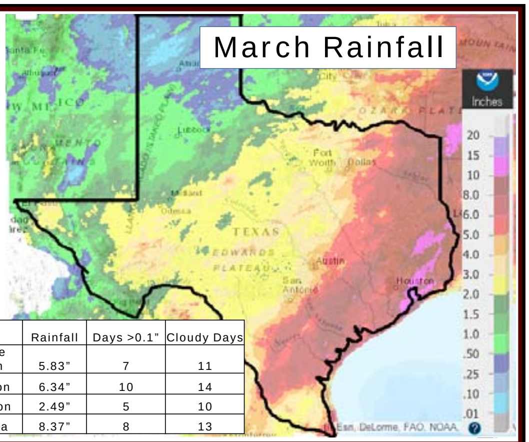




Fungal Disease Control by Phenological Stage

Dormant	1" Shoots	3 - 5" Shoots	10 - 12" Shoots
Trunk Diseases Anthracnose	Phomopsis Powdery Mildew	Phomopsis Black rot Powdery Mildew	Phomopsis Black rot Powdery Mildew Downy Mildew

March Rainfall



	Rainfall	Days >0.1"	Cloudy Days
College Station	5.83"	7	11
Houston	6.34"	10	14
Wharton	2.49"	5	10
Victoria	8.37"	8	13

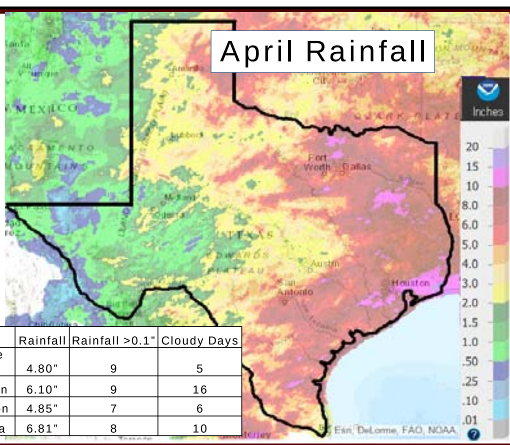
Phomopsis

Overwinters in infected wood

Anthracnose

Overwinters in infected wood

April Rainfall



	Rainfall	Rainfall >0.1"	Cloudy Days
College Station	4.80"	9	5
Houston	6.10"	9	16
Wharton	4.85"	7	6
Victoria	6.81"	8	10

Black Rot

Downy Mildew

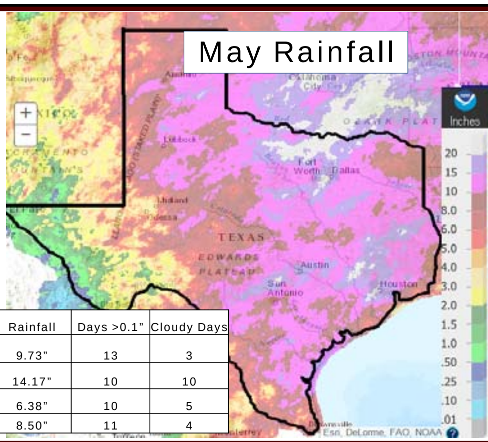
External Sources of Inoculum

Black rot on *Vitis mustangensis* Downy mildew on *Vitis cinerea*

Fungal Disease Control by Phenological Stage

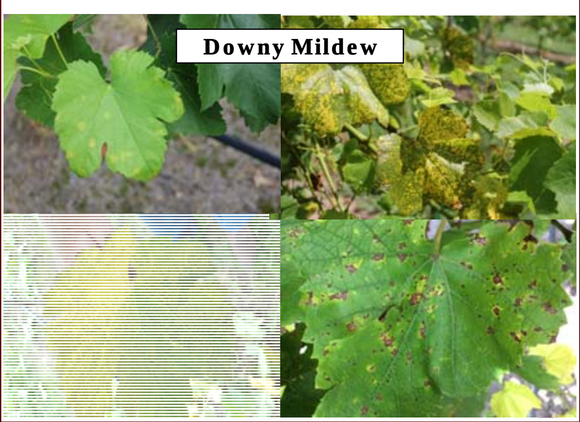
Immediate Pre-bloom	Post-bloom	Mid-Summer	Post-Harvest
Phomopsis Black rot Downy Mildew Powdery Mildew Grape Berry Moth	Phomopsis Black rot Downy Mildew Powdery Mildew Grape Berry Moth	Black rot Downy Mildew Powdery Mildew	Downy Mildew Powdery Mildew

May Rainfall



	Rainfall	Days >0.1"	Cloudy Days
College Station	9.73"	13	3
Houston	14.17"	10	10
Wharton	6.38"	10	5
Victoria	8.50"	11	4

Downy Mildew



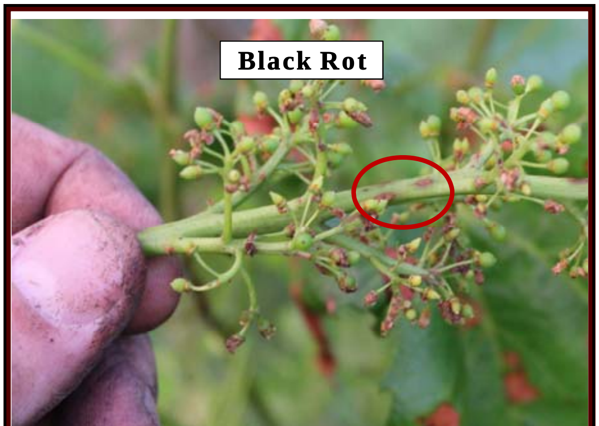

Downy Mildew


Downy Mildew on Lomanto


Downy Mildew - Inflorescence

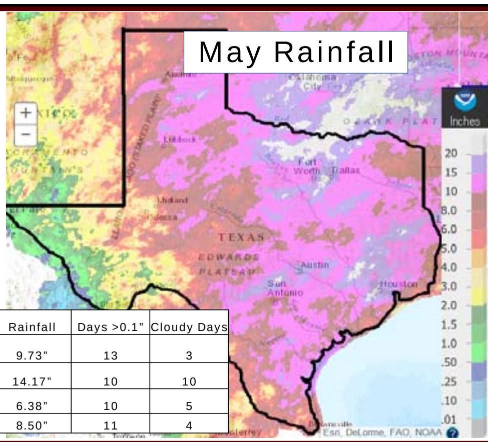
Downy Mildew – Black Spanish

Downy Mildew – Blanc Du Bois



Black Rot

May Rainfall



	Rainfall	Days >0.1"	Cloudy Days
College Station	9.73"	13	3
Houston	14.17"	10	10
Wharton	6.38"	10	5
Victoria	8.50"	11	4

Inflorescence Necrosis

Also known as early bunch stem necrosis

- associated with unbalanced carbon:nitrogen status
- very wet conditions

Abortion due to improper pollen tube development

- low soil oxygen
- low starch accumulation
- boron deficiency

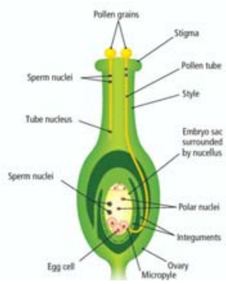


Image from: leavingcertbiology.net

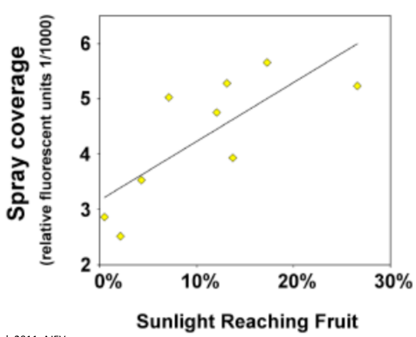
Other Factors That Can Reduce Fruit Set

- Rainfall at bloom
- Reduced photosynthesis
- Zinc deficiency
- Shade from a dense canopy
- Extreme temperatures
- Excessive vigor

Shading and Bud Fruitfulness

Open canopy for air circulation & spray penetration

Canopy Density and Spray Coverage



Austin et al. 2011, AJEV

Cluster Primordia Development

Yield = number of clusters x berries per cluster x berry weight

- Cluster primordia develop in dormant buds the season before the cluster is harvested.

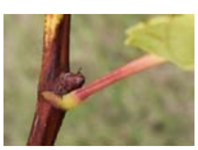
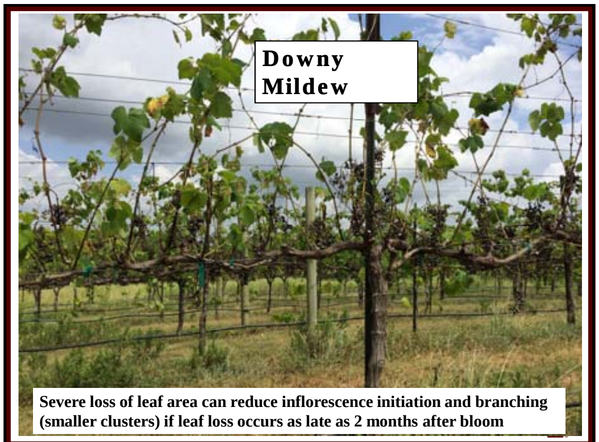


Image from: Martin Goffinet, Winter Injury to Grapevines and Methods of Protection

If photosynthate is limited during inflorescence initiation fruitfulness may be reduced.

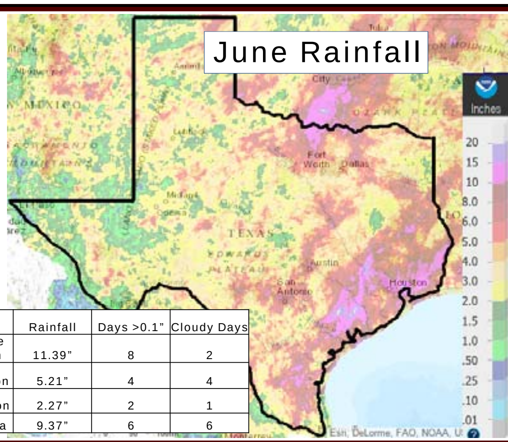
Hypoxic conditions can significantly decrease fruitfulness



Severe loss of leaf area can reduce inflorescence initiation and branching (smaller clusters) if leaf loss occurs as late as 2 months after bloom

Iron chlorosis due to waterlogging

June Rainfall



	Rainfall	Days >0.1"	Cloudy Days
College Station	11.39"	8	2
Houston	5.21"	4	4
Wharton	2.27"	2	1
Victoria	9.37"	6	6

Downy Mildew

Black Rot

Summer Rainfall in 2015

	July	August	September	October
College Station	0.31*	1.36	1.74	7.91
Houston	0.44	2.94	2.59	13.05
Wharton	0.15	2.47	4.92	7.17
Victoria	0.70	2.48	4.52	5.03

*inches

Source: NOAA

Considerations for 2016

- Adjustment fungicide program based on performance in 2015
- Potential for high inoculum levels
- Dead canes on vines with serious leaf area loss
- Carefully monitor vine nutrition



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