RUTGERS
New Jersey Agricultural Experiment Station

Red Leaves in the Vineyard: Biotic and Abiotic Causes

Hemant Gohil
Gloucester County Agent, Rutgers University
&
Daniel Ward, Extension Specialist in Pomology, Rutgers
Gary Pavlis, Atlantic County Agent, Rutgers
Mizuho Nita, Asst. Professor, Plant Pathology, Virginia Tech.

RUTGERS
New Jersey Agricultural Experiment Station

Red leaves in the vineyard are caused by many biotic and abiotic stresses

- Biotic (viruses and bacteria)
  Abiotic (nutrient deficiencies, cold injury etc.)

- Overlapping symptoms, makes it very difficult to identify the cause based only on visual symptoms

- The best strategy – Do not rely on guesswork, get the vines tested for accurate diagnosis ASAP

RUTGERS
New Jersey Agricultural Experiment Station

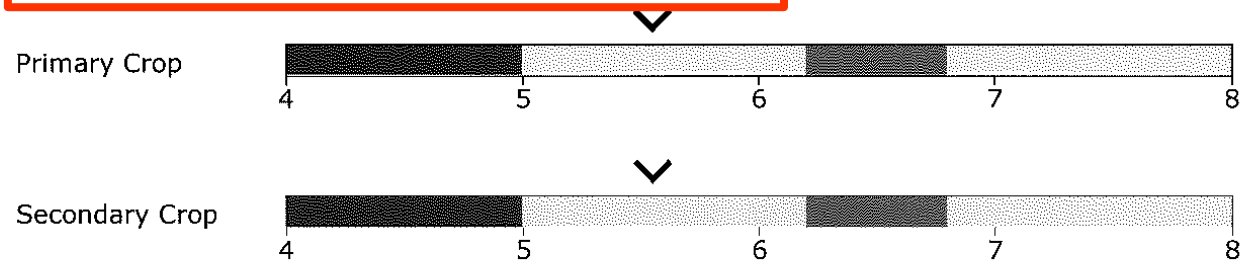
Nutritional Deficiencies: Potassium

Potassium (K) deficiency in Cabernet Franc. Note leaves turning red in between the vein. Photo by Hemant Gohil

Sample ID: Northwest field

Results and Interpretations

pH: 5.55 Strongly acidic

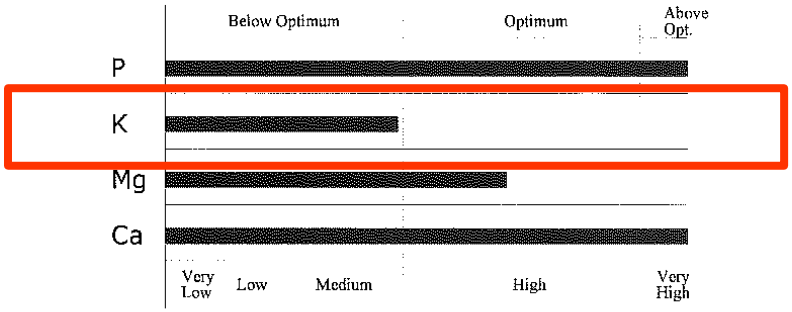


Lime Requirement Index: 7.74

The Lime Requirement Index (LRI) is a measure of the buffering capacity of the soil, its resistance to pH change, and is used to determine the appropriate amount of limestone, when necessary. LRI value near 8.0 indicates low buffering capacity of soil and a lower rate of limestone amendment compared to soil with high buffering capacity (LRI near 7.0).

Macronutrients (pounds per acre)

Phosphorus:	916	(Above Optimum)
Potassium:	143	(Below Optimum)
Magnesium:	211	(Optimum)
Calcium:	2650	(Above Optimum)



by Mehlich 3 extraction

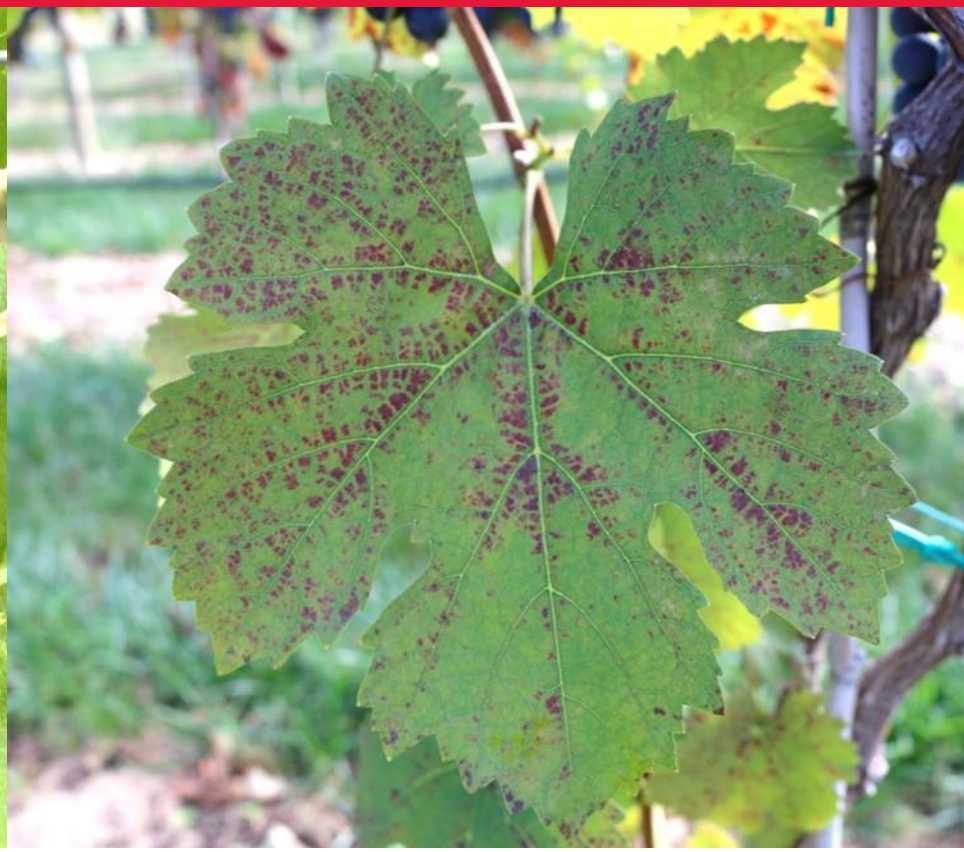
To correct K deficiency…

- The target K level in petioles.

  1.5% - 2.5% (if sampled during bloom
  1.2% - 2.0% (if sampled 70 days after bloom)

- Apply potash (KOH) fertilizer either foliar or to the soil depending on the urgency.

- If K deficiency is chronic after correction laboratory soil testing for nutrient and pH levels ASAP.



K deficiency

Virus infection

RUTGERS
New Jersey Agricultural Experiment Station

Nutritional Deficiencies: Magnesium

Magnesium (Mg) deficiency in Chambourcin. Note the wedges of discoloration. Photo by Hemant Gohil

Mg deficiency in Cayuga

To correct the Mg deficiency…

- Add Magnesium salt, $MgSO_4$ (Epsom salts) if soil pH does not require adjustments.

- Target Mg level in petioles:

  0.3% - 0.5% at bloom; or 0.35% to 0.75 % if sampled 70 days after bloom.

- If your soil is acidic, apply dolomitic limestone (Mg containing limestone) as it will also raise the pH, improving the rate of Mg uptake.

RUTGERS
New Jersey Agricultural Experiment Station

Nutritional Deficiencies: Phosphorous

Phosphorous (P) deficiency in Zinfandel. Note the reddening progression from the leaf margins. Photo by Gary Pavlis.

Virus Infected leave.

To correct the P deficiency…

- The target P level for leaf petiole 0.13% - 0.30 %
- Mono-ammonium phosphate (MAP) and di-ammonium phosphate (DAP) are common sources of P fertilizer.
- P offers greater flexibility in terms of timing of application as it is less mobile in soil and does not leech away easily.
- Adjust the soil pH if it is lower than the optimum to improve P uptake.

RUTGERS
New Jersey Agricultural Experiment Station

Viruses:
Grapevine Leaf Roll Virus

Grapevine leafroll disease symptoms on Cab Sauvignon. Photo by Mizuho Nita

Grapevine leafroll disease symptoms on Chardonnay. Photo by Mizuho Nita

RUTGERS
New Jersey Agricultural Experiment Station

Viruses:
Grapevine Leaf Roll Virus

Grapevine leafroll disease symptoms on Cabernet Sauvignon. Photo by Mizuho Nita

Grapevine Red blotch virus in Cabernet Franc.
Photo by Hemant Gohil.

RUTGERS
New Jersey Agricultural Experiment Station

Grapevine Leaf Roll Virus can be disseminated by mealybugs or scale insects

Photo by Mizuho Nita

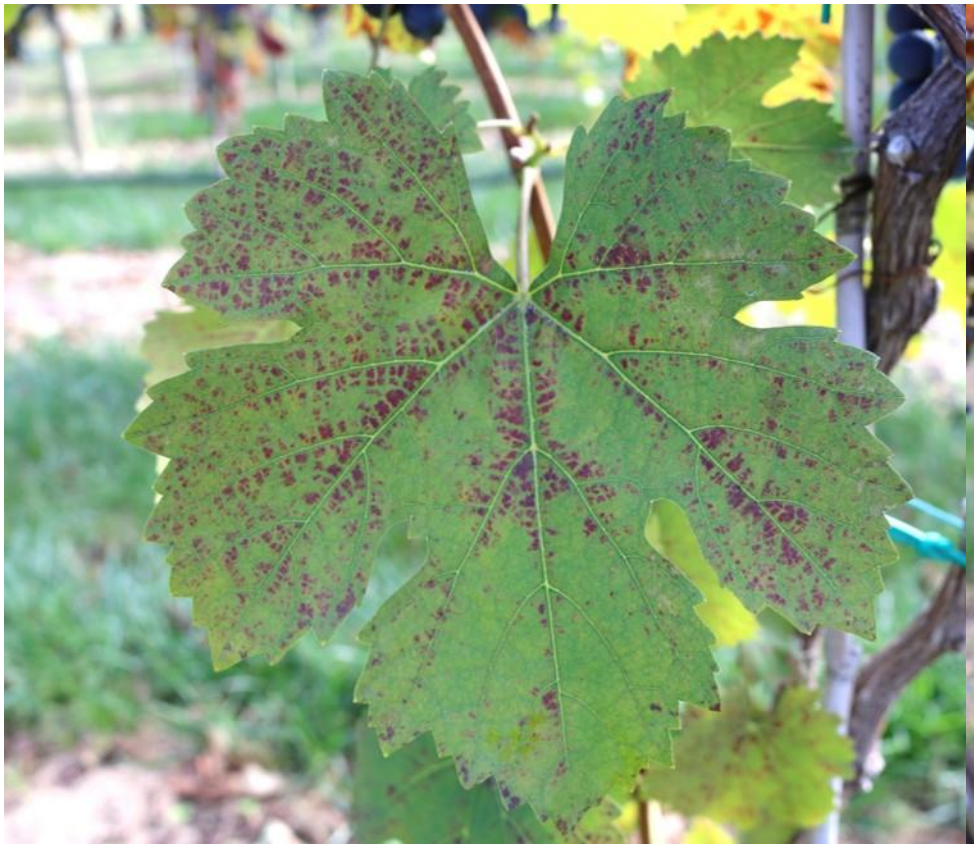
RUTGERS
New Jersey Agricultural Experiment Station

Viruses:
Grapevine Red Blotch Virus

Grapevine red blotch disease symptoms on Merlot. Photo by Prashant Swami

RUTGERS
New Jersey Agricultural Experiment Station

Red blotch Virus symptoms



RUTGERS
New Jersey Agricultural Experiment Station

Virus Testing Labs

Agri-Analysis LLC: 930 Riverside Parkway, Suite #30, West Sacramento, CA 95605 Phone: 800-506-9852 Email: info@agri-analysis.com
AL&L Crop Solutions: 7769 N. Meridian Rd., Vacaville, CA 95688 Phone: 530- 759-9460 Email: info@allcropsolutions.com
Eurofins STA Laboratories: 7240 Holsclaw Road, Gilroy, CA 95020 Phone: 888-782-5220 Email: juditmonis@eurofinus.com
Sunburst Plant Disease: Clinic 677 East Oliver Avenue, Turlock, CA 95380 Phone: 209-667-4442 Email: slivingston@sunburstpdcinc.com
WSU ELISA Virus Testing Lab: 24106 N. Bunn Rd., Prosser, WA 99350 Phone: 509-786-9382 Email: Tina_Vasile@wsu.edu

Sample collection

During the season

✓ Collect leaf samples along with petioles

In Winter

Collect cane samples with 3-4 nodes

✓

Do not collect small bits of canes

✗

Naidu Lab, WSU

RUTGERS
New Jersey Agricultural Experiment Station

Use proper labeling to determine any pattern of virus spread

Sr. #	Row	Sec	Plant	Cultivar	Symptoms	Red blotch	Leafroll-3
1	2	3	14	Petit verdot	Symptomatic	negative	negative
2	8	2	2	Petit verdot	Symptomatic	negative	negative
3	1	2	2	Cab franc	Symptomatic	positive	negative
4	3	18	2	Cab franc	Symptomatic	positive	negative
5	5	6	4	Cab franc	Symptomatic	positive	negative
6	5	3	1	Cab franc	Non-symptomatic	negative	negative
7	7	16	2	Cab franc	Symptomatic	positive	negative
8	9	11	1	Cab franc	Symptomatic	positive	negative
9	11	11	4	Cab franc	Symptomatic	positive	negative
10	11	17	2	Cab franc	Non-symptomatic	negative	negative

RUTGERS
New Jersey Agricultural Experiment Station

Certified Planting Material is the most effective strategy to prevent introduction of virus diseases

Foundation Plant Services Available Tests for Protocol 2010

Group	Pathogen	Symbols	ELISA	qPCR	PCR	Herb. Index	Woody Index
Nepoviruses	Grapevine fanleaf virus	GFLV	X	X	X	X	St. George
	Tomato ringspot virus	ToRSV	X	X	X	X	
	Tobacco ringspot virus	TRSV		X	X	X	
	Arabis mosaic virus	ArMV	X		X	X	
	Strawberry latent ringspot virus	SLRSV		X	X	X	
	Blueberry leaf mottle virus	BLMV		X	X	X	
	Raspberry ringspot virus	RpRSV		X	X	X	
	Tomato black ring virus	TBRV		X	X	X	
	Grapevine deformation virus	GDefV		X	X	X	
	Artichoke Italian latent virus	AILV				X	
Closteroviruses	Grapevine leafroll associated virus 1	GLRaV-1	X	X	X		Cab. Franc
	Grapevine leafroll associated virus 2	GLRaV-2	X	X	X		Cab. Franc
	Grapevine leafroll associated virus 2RG	GLRaV-2RG		X	X		
	Grapevine leafroll associated virus 3	GLRaV-3	X	X	X		Cab. Franc
	Grapevine leafroll associated virus 4	GLRaV-4	X gen	X	X		Cab. Franc
	Grapevine leafroll associated virus 5	GLRaV-5	X gen	X	X		Cab. Franc
	Grapevine leafroll associated virus 6	GLRaV-6	X gen	X	X		Cab. Franc
	Grapevine leafroll associated virus 7	GLRaV-7		X	X		
	Grapevine leafroll associated virus 9	GLRaV-9	X gen	X	X		Cab. Franc
	Grapevine leafroll associated virus 10	GLRaV-10		X	X		Cab. Franc
	Grapevine leafroll associated virus 11	GLRaV-11	X		X		Cab. Franc
	Grapevine leafroll associated virus Car.	GLRaCV	X gen	X	X		Cab. Franc
Vitiviruses	Grapevine virus A	GVA		X	X		Kober 5BB
	Grapevine virus B	GVB		X	X		LN33
	Grapevine virus D	GVD		X	X		
	Grapevine virus E	GVF		X			
	Grapevine virus F	GVE		X			
Foveavirus	Grapevine rupestris stempitting associated virus (all strains)	GRSPaV		X	X		St. George
Maculavirus	Grapevine fleck virus	GFkV	X	X	X		St. George
	Grapevine redglobe virus	GRGV		X	X		
Marafiviruses	Grapevine syrah virus-1	GSyV-1		X	X		
	Grapevine vein feathering virus	GVFV		X	X		
	Grapevine asteroid mosaic virus	GAMV		X	X		
DNA Viruses	Grapevine red blitch associated virus	GRBaV		X	X		
	Grapevine vein clearing virus	GVCV		X	X		
Phytoplasma	Universal detection	Phyto		X	X		
Pierce's Disease	*Xylella fastidiosa*	PD		X	X		

Key:
X Test performed at FPS.
X = test is available;
X gen.= ELISA using generic antibody which detects GLRaVs-4, 5, 6, 9 and Car in a single test;
qPCR= quantitative PCR= real time RT-PCR with TaqMan probe; PCR= will include RT-PCR for RNA viruses.

Source, Foundation Plant Service, UC Davis

Red foliar discoloration caused by crown gall. Photo by Mizuho Nita

A series of small crown gall formed under the bark of Merlot. Photo by M. Nita

RUTGERS
New Jersey Agricultural Experiment Station

Crown Gall symptoms on leaves

RUTGERS
New Jersey Agricultural Experiment Station

Strategies to prevent crown gall: Source clean plant material

RUTGERS
New Jersey Agricultural Experiment Station

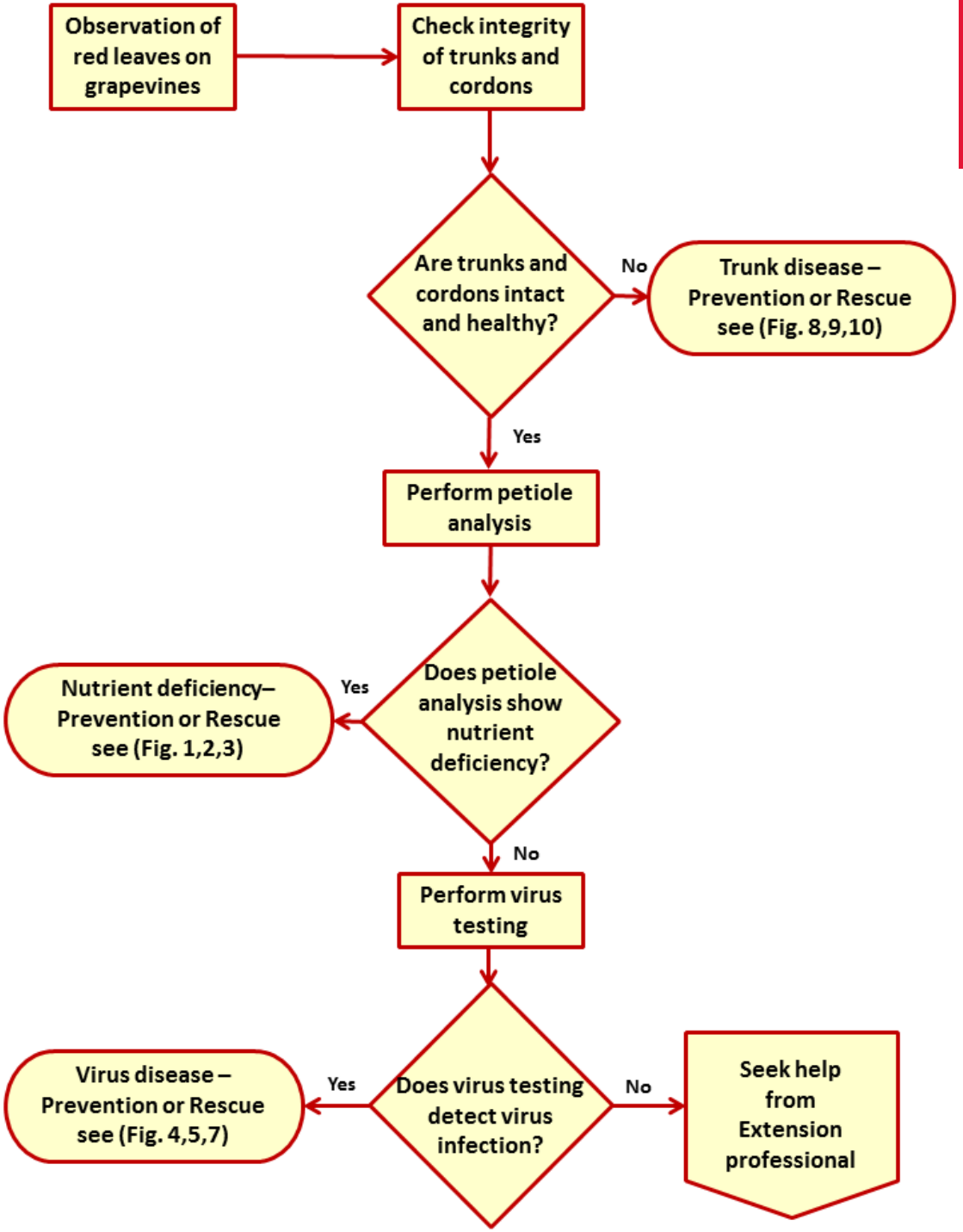
Strategies to prevent crown gall: retain multiple canes at the base

RUTGERS
New Jersey Agricultural Experiment Station

Strategies to prevent crown gall: Hilling-Up

Hilling-up plus multiple canes at the base is the best strategy to prevent crown gall.

Assessment of suspicious vines



Thank you!

Acknowledgement:

The Kenneth and Jennifer Osterman Travel Fund