Compost in the Vineyard

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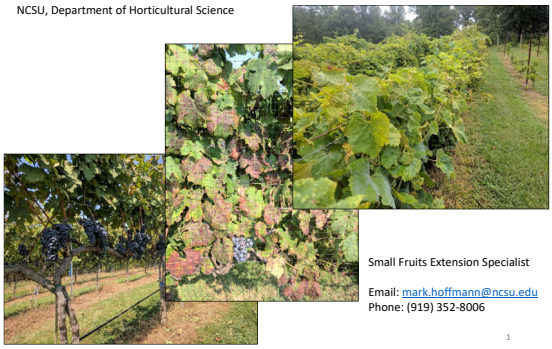

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- Refresher: Basics!
- What is compost?
- Common compost types
- Humus vs. OM?

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Vineyard management begins before planting!!!

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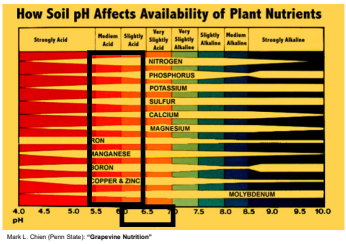
- **Optimizing the soil pH for Grapes (5.5, 6.0, 6.5 or 7.0?)**
- **Amending to optimize the level of major nutrients (P, K)**
- **Drainage!!!**



Mark L. Chien (Penn State): "Grapevine Nutrition"

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Grapevine Nutrition: pH matters!

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Low pH

- Al Toxicity
- Mg, Cl and P deficiency
- Soil will acidify over time (natural process of plant roots releasing acids into the soil)

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Vineyard management begins before planting!!!

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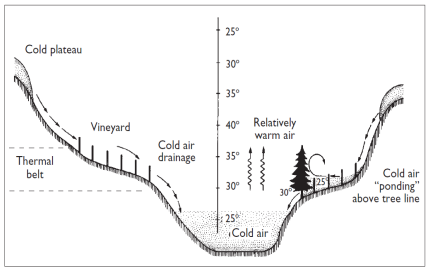

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Vineyard management begins before planting!!!

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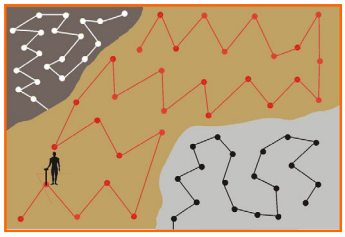
Sampling depth:
- **0-8 inches**
- **8-16 inches**

Min 6-12 months before planting



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Grapevine Nutrition: pH matters!

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Based on your soil samples

Send soil samples to
www.ncagr.gov/agronomi/sthome.htm

Fertilizer rule of thumb:
Optimal pH: 6.0-7.0

Phosphorous (P) is very immobile: apply only if your soil samples is low on phosphorous.
Optimal P in soil 30 ppm of P

Potassium (K) also moves relatively slow: controversial: too much K can alter juice chemistry (elevated pH levels)
Optimal K in soil: 40 ppm of K (recommendations from Virginia)

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Grapevine Nutrition: pH matters!

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What to do?

- Lime (not Gypsum unless you want to reduce Al toxicity)
- Dolomitic Lime adds Mg as well!
- Incorporate as deep as possible (not just apply on top of row!!)
- It takes time!!!!

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Grapevine Nutrition: pH matters!

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Table 4.—Typical characteristics of liming materials available in Oregon (dry weight basis).

Material	Calcium carbonate equivalent (CCE) (%)	Lime score	Ca (%)	Mg (%)
Common mined products				
Limestone ($CaCO_3$)	90–100	90–100	32–39	below 1
Dolomite ($CaCO_3 + MgCO_3$)	95–110	95–110	18–23	8–12
Specialty oxides and hydroxides				
Hydrated lime [$Ca(OH)_2$]	120–135	120–135	54	below 0.5
Burnt lime or calcium oxide (CaO)	150–175	150–175	71	0
By-products				
Sugar beet lime	70–75	40–50	25	below 0.5
Paper mill lime	10–100	0–70	10–40	below 0.5
Cement plant flue dust	110–120	105–115	—	1–2
Shrimp and crab waste[a]	30–40	—	15–20	—
CA lime (controlled atmosphere storage)	100	50–75	—	—
Wood ash	2–30	2–20	1–9	below 1

Oregon State Extension: Applying Lime to raise soil pH for Crop Production
https://catalog.extension.oregonstate.edu/em9057

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Grapevine Nutrition: Fertilizing

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Nutrition Monitoring

- **The TRI-PARTITE APPROACH**
- At least once a year soil samples
- Twice a year petiole samples (3rd year +)
- Visual assessment of foliage

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Grapevine Nutrition: Sampling

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•Sample at the same time of day, preferably in the morning.
•Samples should represent areas which are planted on the same soil type and are of the same age, variety and rootstock.
•Collect systematically throughout the vineyard block to ensure that the entire block is represented.
•Block with same variety, cultural practices, geography

- **Combined soil samples**
- **Ca. 100 Petiole Select only leaves from healthy shoots that are well exposed to sunlight for sampling**

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Grapevine Nutrition: Sampling

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Grapevine Nutrition: Sampling

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Bloom
collect petioles from leaves located opposite the first or second flower cluster from the bottom of the shoot.

70 to 100 Days after Bloom
collect petioles from the youngest fully expanded leaves (usually located 5 to 7 leaves back from the shoot tip).

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Grapevine Nutrition: Sampling

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Nutrient	Soil		Bloom petiole		Late-summer petiole	
Nitrogen	--[z]	--	1.2 - 2.2	%	0.8 - 1.2	%
Phosphorus	20 - 50	ppm	0.17 - 0.30	%	0.14 - 0.30	%
Potassium	75-100	ppm	1.5 - 2.5	%	1.2 - 2.0	%
Calcium	500 - 2000	ppm	1.0 - 3.0	%	1.0 - 2.0	%
Magnesium	100 - 250	ppm	0.3 - 0.5	%	0.35 - 0.75	%
Boron	0.3 - 2.0	ppm	25 - 50	ppm	25 - 50	ppm
Iron	20	ppm	30 - 100	ppm	30 - 100	ppm
Manganese	20	ppm	25 - 1000	ppm	100 - 1500	ppm
Copper	0.5	ppm	5-15	ppm	5 - 15	ppm
Zinc	2	ppm	30-60	ppm	30 - 60	ppm
Aluminum	*< 100	ppm				
Organic matter	3 - 5	%				

[z] Soil nitrogen is not normally evaluated for vineyards.

Mark L. Chien (Penn State). "**Grapevine Nutrition**"

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Grapevine Nutrition: Nitrogen

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- Sources:
Fertilizer
Legumes
SOM (ca 20 lbs/A per %OM/year)
Lightning

- Lost:
Leaching
De-nitrification

- Uptake:
Leaves, Wood, Fruit

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Grapevine Nutrition: Nitrogen

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Demand of N depends on many factors:
- Vine vigor
- Canopy density
- Fertilizer history and N inputs
- Soil and root conditions
- Laboratory analysis
- OM content!

Ca. 30% of N of previous season is mobilized pre-bloom!!!

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Grapevine Nutrition: Nitrogen

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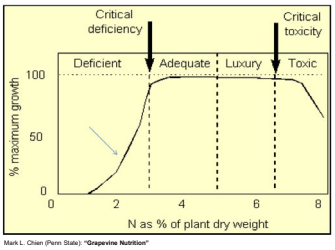

Mark L. Chien (Penn State) "Grapevine Nutrition"

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Grapevine Nutrition: Nitrogen Deficiency

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N-Deficiency

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Fertilizing Grapes with COMPOST

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Golden Rule:

Compost positive effects

- Reduces fertilizer requirements
- Changes microbial community
- Improves nutrient retention by increased OM
- Reduces nutrient leaching
- Improving buffering capacity
- Vines suffer less from drought
- May contribute to disease suppressivess

Compost negative effects

- Increase vigor
- Reduce fruiting
- Increase need for canopy management
- Increase need for disease management
- Increase cold injury

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Golden Rule:

http://www.ncagr.gov/agronomi/uyrwaste.htm

Have a history of soil and petiole samples!
Analyze your compost!

- Effect of compost on vineyards can last multiple seasons!
- Approx. 15-30% of total nutrients are released in 1st year, 8-15% 2nd year, 4-10 % 3rd year, 2-10 % 4th year, 1-5 % each following year.
  - **Rate of compost restricted by nutrient content**
- If nutrient levels are sufficient, compost can add to problems

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What is Compost?

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Compost is ORGANIC MATTER that has been DECOMPOSED

Decomposition process is facilitated by organisms: microrganisms, worms (vermicompost).

Decomposition process takes several weeks (vermicompost) to several months.

Compost is rich in nutrients

Compost composition varies

Photo by Fritz Westover, Texas AgriLife Extension.

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What is Compost?

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Think of compost as
Organic Matter + Nutrients + Microbes

Photo by Fritz Westover, Texas AgriLife Extension.

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What is Compost?

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Nutrients of non-composted material (especially manure) can result in high salt levels and leaching of nutrients.
Not completely decomposed material can increase the risk of harmful pathogens (especially animal manure) or herbicide residues (plant-based manure)!

Finished compost:

- uniform texture!
- Earthy smell
- C:N ration < 20
- pH between 5 and 8.5
- pH around 7 (neutral) is desirable
- Soluble Salts (SS) should be <5
- Moisture between 40-65%
- OM 30-70%
- Total N: 0.5-2.5%

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What is Compost?

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Compost applied one time in year one contributes nitrogen to the soil for next 5 years (from Travis et al. 2003)

10 tons of compost applied.
20 lbs of N/ton of compost

Year 1: 20 lbs N/T X .15 = 3 lbs N / T 10 Tons applied/acre X 3 lbs N/T = 30 lbs N/A
Year 2: 20 lbs N/T X .08 = 1.6 lbs N/T 10 Tons applied/acre X 1.6 lbs N/T = 16 lbs N/A
Year 3: 20 lbs N/T X .04 = .8 lbs N / T 10 Tons applied/acre X .8 lbs N/T = 8 lbs N/A
Year 4: 20 lbs N/T X .02 = .4 lbs N / T 10 Tons applied/acre X .4 lbs N/T = 4 lbs N/A
Year 5: 20lbs N/T X .01 = .2 lbs N/T 10 Tons applied/acre X .2 lbs N/T = 2 lbs N/A

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Various Composts

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Composted Animal Manure

Composted Animal Manure is not fresh animal manure!!!

Desirable composted manures:
- **Composted cow manure**
- **Composted poultry manure**

Never do's: Pig manure (pathogens)

Table 1. Approximate amounts of manure needed to provide 1 lb of nitrogen.

Manure Type	Amount of manure needed to provide 1 lb Nitrogen (N):	Phosphorus (P) content*:	Potassium (K) content:
Horse	800 lbs	2.4 lbs	4.5 lbs
Cow	650 lbs	2 lbs	2.5 lbs
Poultry (layers)	170-300 lbs	4 - 7 lbs	0.6 - 1.0 lbs
Composted Dairy Manure	1300 lbs	7 lbs	16 lbs

* Note that manures provide phosphorus and potassium as well as nitrogen. The quantities listed are the amounts of P and K provided by the amounts of manure shown.

Various Composts

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Wine Grape Pomace

- Wine Grape Pomace alone: very low in pH (<4)
- Add: lime and/or other composting materials to increase pH (pH > 6 is desired!!)
- Returns ½ - 1/3 of nutrients and OM which was removed from vineyard
- If moisture is to high (> 60%), fermentation will continue (not good!!)
- **Pile temperatures of 130-150 F for minimum two weeks is necessary to kill weeds, pathogens etc.**
- **1:1 ratio of pomace : manure bedding (straw+manure) can provide all nutrients needed for vineyard**
- **Min. 3 turns per pile required**
- Pile temperatures under 160F!!
- Takes 6-10 months!!!!

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Various Composts

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Green waste compost

- Composted plant material
- Yard trimmings and food residuals are 20-30% of US waste.
- **NEVER use fresh plant material!!! (plant pathogens, herbicides**) Yard trimming and low amount of wood chips/saw dust are key components.

NO NOs:

- Colored paper
- Diseased Plants
- Inorganic Material
- Animal products
- Manure
- Synthetic Chemicals

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Various Composts

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Vermicompost

Composting plant based material (e.g. paper) by worms

Endproduct is nutrient rich OM product, produced by earthworms
Excellent compost source

But: Use your vermicompost source wisely.

https://composting.ces.ncsu.edu/vermicomposting-2/

Expert on Vermicompost:
Rhonda Sherman: sherman@ncsu.edu; 919-515-6770

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Resources:

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- https://grapes.extension.org/compost-use-in-vineyards/
- https://www.arec.vaes.vt.edu/content/dam/arec_vaes_vt_edu/alson-h-smith/grapes/viticulture/extension/growers/documents/composting-grape-pomace.pdf
- https://www.arec.vaes.vt.edu/content/dam/arec_vaes_vt_edu/alson-h-smith/grapes/viticulture/extension/growers/documents/compost-application.pdf

https://composting.ces.ncsu.edu/

International Expert at NC State:
Rhonda Sherman: sherman@ncsu.edu; 919-515-6770

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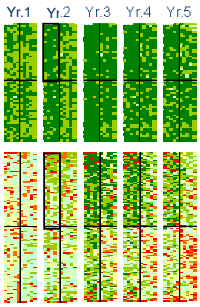
Humus



very strong growth
strong growth
medium growth
weak growth
very weak growth
dead grapevine

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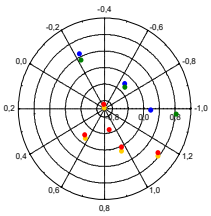
Humus



More beneficial microbes in organic fertilizer treatments years after application

o/p/l/d O/P/l/d o/P/l/d o/P/l/D

Huber, Hoffmann et al. 2009

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HUMUS

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Humus

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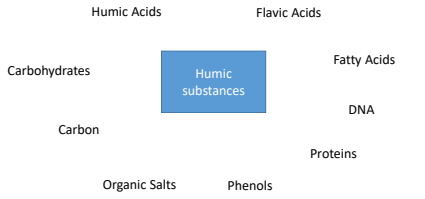
Organic Matter = breakdown products of plant, animal and microbial residues



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Humus

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Humus = 50-75% of Organic Matter
Depends on the Source

Good long-term humus source: Cover Crops

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Humus

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- Complex organic structures
- Based on complex soil interactions
- plant debris (based on lignin)
- Beneficial to soil fertility
- Beneficial to plant fertility
- Degrades slowly.
- Other OM degrades fast!

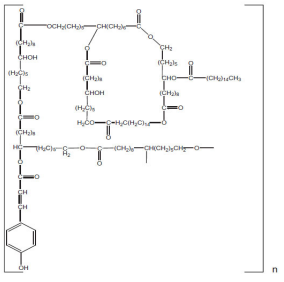

Figure 4. Model cutin monomeric unit according to Kolattukudy (2001).

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Humus: benefits

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- Promote growth of beneficial microorganism
- Improves soil water holding capacity
- Key component of loose, areate soil!
- Organo-mineral aggregates with other soil components
- Can help with pH Management, Soil Temperature and Evaporation
- Binds Minerals and makes them available for plants

- Roots can uptake Humic Acid (HA) and Flavic Acid (FA) (no research on grapevines though)
- HA and FA beneficial on cell physiology of plants

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Humus: benefits

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Practices:

- Cover Cropping
- Apply plant based organic material and incorporate in soil (with minimal tillage)
- Apply HA and FA products??? (Humate Soil Conditioner)?

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Thank you!

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Thank you for your attention

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