PRECISION SOIL MAP AND SOIL INTERPRETATIONS

Yano Vineyard

21845 SW Chapman Road
Sherwood, Oregon.

May 30, 2017

For: Seiji Yano

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INTRODUCTION

This project was done to provide soil profile information, classification and baseline soil interpretations for viticulture on the Yano property on 21845 SW Chapman Road, Sherwood, Oregon. Soil borings were made in the area of the terrain suited to winegrowing. Soil sampling locations were selected based on terrain and vegetation to address potential soil variability on the parcel. Soil profile descriptions were made in order to classify soils and to record soil drainage characteristics, soil depth to bedrock, surface thickness, soil texture of the surface and the subsoil. Boring locations were recorded with a global positioning system (GPS). Interpretations for viticulture are made based on these borings. A revised soil map is provided in the survey area along with an estimate of acreage suited to vineyards

BACKGROUND AND METHODS

Project Area

The site is mainly in cropland and includes some recently harvested forest land, and a small nursery. There are several barns and sheds and a house as well. Slope aspect on the area investigated is southeast and east and the northern part of the property rolls to the north.

The previous soil survey map of the site available online from the NRCS showed Laurelwood silt loams

Geology and Terrain

The geology of this site is deep loess over much of the parcel and moderately deep loess over basalt in several places.

Elevation ranges from 690 feet at the creek on the east property line up to about 873 feet above sea level on the ridge on the west property line (Fig 1).

Figure 1. Topographic map of parcel with 25 ft contours and borings 1-15.

Soil Mapping and Sampling

This property is about 33 acres and approximately 24 acres are of suitable terrain for winegrowing. There are an additional three acres that are currently the farmyard, barns, outbuildings that are slated for tear down and this area also includes farm lane and large compost piles. These three acres should be evaluated after clearing and site preparation work is completed.

Fifteen soil borings were made on approximately one boring per two acres on the average. The sampling scheme was designed to cover the range of soil variability, using terrain and aerial photographs as indicators of soil spatial variability. Soil samples are not evenly spaced, and sampling intensity varies with complexity of terrain with more samples made where slope configuration was more complex or where soils changed in a short distance. Borings were made with a backhoe to a depth of 40 to 60 inches.

A soil profile description was made for each soil boring; recording thickness and morphology of soil horizons. Soil colors were determined using a Munsell Color Chart. Available water holding capacity (AWHC) for each soil was estimated based on soil textures, structure, coarse fragments, depth to rock and available water retention data for these soil series. Depth to seasonally high water table was based on soil redoximorphic features (soil mottles that result from anaerobic conditions). Effective rooting depth for each profile was assumed to be that of the deepest observed roots or the lowest depth of distinctive rhizosphere soil morphology. Soils were classified according to USDA-Soil Taxonomy. Soil characteristics were compared to the current Official Series Descriptions (OSD's) from the USDA-NRCS.

RESULTS

Precision Mapping

The soils on this parcel are predominantly Laurelwood soil series, with a couple exceptions. On the ridge summit there is a small area of Nekia soils, in approximately the site where the new home is planned to be built. In the swale in the northeast corner of the property Kinton soils are mapped, these have a seasonal high water table and this areas is concave slope profile. The very steep north facing slopes were not sampled because they are generally poorly suited to winegrowing.

Data from soil borings are presented in Table 1. Soil boundaries are revised in a high intensity soil map (Fig. 2). The Laurelwood soils are pretty uniform with loess cover typically of 36 to 43 thick overlying a red clay paleosol. A paleosol is a soil from a previous climate, it is believed this red paleosol formed under warmer and wetter climate than the present one. This ancient soil was covered up with feet of wind-blown silt tens of thousands of years ago. The loess layer is younger and less weathered than the highly weathered clayey paleosol. The deepest loess observed here is 53 inches. The Laurelwood soils have high available water holding capacity and moderately high vigor potential. Additionally there is variability in expression of the fragipan and depth to seasonally high water table. The Laurelwood identified soils are well drained.

The Kinton soils in the northeast corner associated with the slumpy and concave slopes, has a strongly developed fragipan at depth of 32 inches and this feature extends to the depth of sampling and deeper. A fragipan is a dense, extremely firm and brittle layer in the subsoil. This layer causes water to perch during the rainy season. The perched water table is evidenced by gray and red redoximorphic features in the soil above and in the pan. The structure of the fragipan consists of coarse prisms and columns oriented with long vertical axes that dense interiors. The fragipan is weakly cemented and has iron and manganese oxide staining and bleached faces of the prisms. The narrow bleached zones between the prisms are less dense and roots grow in this pinched space and water movement is predominantly limited to this small volume between the dense prisms.

Precision Soil Map

Most of the parcel is Laurelwood soils. The soil map is revised and soils reclassified to in some areas to reflect the findings from more detailed soil sampling. The revised map delineates the other prominent soil features that occur on a fairly limited area including Kinton soils with a fragipan and high water table and Nekia soils with bedrock within 40 inches.

Most of the acreage is plantable to winegrapes (about 28 acres), except for the steep north-aspect slopes and the concave drainageway and slumpy ground. The presence of the fragipan and related high water table on the Kinton soils makes it important to artificially drain them prior to planting. After artificial drainage the Kinton soils should perform well, this does not include areas mapped Kinton that are in the drainageway and on slumpy ground which are not suitable.

Acres Suitable to Pinot Noir

Soils observed here are typical for vineyards in this area and consist mainly of well drained Laurelwood soils with a small area of Nekia soils on the ridge crest and Kinton soils in the drainage swale. The Kinton soils are suited to winegrapes if they are artificially drained. Portions in the drainageway or in the unstable portion of the slope are not included in the acreage of suitable soils.

A north slope of 20 percent gradient is used as a break for map units ST. The higher elevation slopes of this property are nearing the upper elevation for reliably ripening pinot noir.

Soils are mapped and discussed by soil series. Each map unit description covers the soil series concept, physiography, depth, drainage and properties outside of the soil series.

Ki- Kinton Soils

Loess Depth:	36 to 44 inches
Depth to Hard Basalt Bedrock:	Greater than 60 inches
Depth to Seasonally High Water Table:	32 inches
Depth to Fragipan:	32 inches

AWHC: 7 to 8 inches

The Kinton series consists of very deep, moderately well drained soils that formed in deep loess and underlying colluvium of basalt. These soils have well developed fragipan and a seasonally perched water table above and in the fragipan. Artificial drainage is recommended on these soils and irrigation may be beneficial in droughty years. As mentioned earlier there are small parts of this map unit around the boundary that are suitable to winegrapes if artificially drained and if they are not areas where there is a drainage channel or on slumpy ground. Once drained the Kinton soils produce high quality fruit. Vine vigor may be less than on Laurelwood because the fragipan limits root volume.

La – Laurelwood Soils

Loess Thickness: 40 to 53 inches
Depth to Weathered Basalt Bedrock: Greater than 60 inches
Depth to Seasonally High Water Table: Greater than 60 inches
No Fragipan
AWHC: 9 to 11 inches

The Laurelwood soil series consists of well drained and very deep soil formed from deep to moderately deep loess deposits over red clayey paleosol that is derived from residuum of basalt. These soils have high water holding capacity and provide good very deep rooting for winegrapes. They have a potential to yield high vine vigor. One of the hallmarks of vineyards with predominantly Laurelwood soils is the consistency between blocks. Block-to-block variability can be introduced where desired by using different clone and rootstock combinations.

Nk—Nekia

Nekia soils have deep red clay subsoils and have high organic matter content in A-horizon. Vine vigor is moderate on Nekia soils and they have moderate available water holding capacity and hence they may or may not be irrigated. These soils are well drained with moderately slow permeability. This is a small area on the ridge summit. The underlying rock is hard fractured vesicular basalt. The subsoil is reddish brown clay, with strong soil structure.

Available Water Holding Capacity (AWHC)

AWHC in the upper five feet of soil and represents an estimate of the water that can be stored in the soil profile that is available for plant uptake, which is the amount of water held between field moisture capacity and the permanent wilting point (reported in inches of water). For very deep soils like Laurelwood, where grapevine roots extend below sixty inches this AWHC value is an underestimate. The value reported is calculated from a model based on the sum of the weighted average AWHC for each soil horizon, using values reported in the literature and measured soil profile data at each numbered point.

The AWHC is a function of soil depth, texture, organic matter, bulk density, porosity, and soil osmotic potential. Root restricting layers decrease the depth of the soil profile and the AWHC.

Clay soils can hold more “total” water because they have greater pore space at a given bulk density, however because the average pore volume is smaller, clay soils hold a greater proportion water that is unavailable at low soil moisture tensions. Since the majority of grape roots are in the upper soil profile, it can be assumed that the AWHC values for the upper five feet provide a useful relative scale of the variability in water supply available to the vine for the classes used here.

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Soils on this site have enough AWHC that they can be managed under dry land conditions, and a rootstock selection may favor those that reduce vine vigor on the Laurelwood soil.

Managed competition involves selecting combinations of cover crop mixtures, mowing and tillage options that are suitable to the soil water and soil productivity balance. More vigorous grass cover crops can help reduce water available to vines in deep soils, and in droughty soils less competitive cover crops may be more appropriate and alternate row tillage can be used to further reduce competition. Mulching in the vine row will help conserve soil moisture and may be especially useful on all soils in the establishment year before vines have put down a deep root system.

Seasonally High Water Table (SHWT)(Soil Drainage Interpretation)

Most of this site is well drained Laurelwood. There are a few acres of soils with seasonal high water table like Kinton soils. The parts of the Kinton map unit that are not directly in the drainageway or on the slumpy terrain can be artificially drained prior to vineyard development. These soils have evidence of high water table below 32 inches in boring 9, and more of this map unit may contain poorly drained or seasonally inundated areas.

Microblocks

The influences of soils on winegrapes and on wines are the results of the effect of the soil profile as a whole, as opposed to one or a few soil factors. The idea that similar soils will yield similar influences on wine, at least within a given vineyard, is one basis for blocking by soil type. Using precision soil maps and precise soil location data (latitude and longitude) blocks can be designed to a microblock level, (sub acre capability), to a point where practical block size is limited by practical concerns such as the size of a fermentation vat etc. Since fruit from separate but similar microblocks can be combined to fill a small fermenter, the “practical” block size can be even smaller than an acre.

The predominance of relatively similar Laurelwood soils over this property should promote consistent soil properties over the vineyard. There are however differences in elevation, slope aspect and past land use that may affect wine grapes growing here. Previous aerial photos of the site (Figures 2-4) show how different areas were used since July 2000 and this can be a basis for blocking even where soils are of the same series.

The benefits of microblocking derive from allowing growers to apply management to a set of known soil conditions, and by allowing more informed evaluations of vine response and wine quality induced by those conditions. This capability is more fully realized when GIS solutions are used to design blocks. Such a solution could be as simple as generating latitude and longitude coordinates to translate digital microblock boundaries back onto the vineyard using GPS to locate points on the ground.

Soil Quality and Soil Conservation

Soil quality involves managing the physical, chemical and biological components of the soil towards the goal of overall soil health. Healthy soil has an active and healthy biotic community; it has good tilth and nutrient balance. Tilth is defined as the physical condition of the soil relative to ease of tillage, its suitability as a seedbed and its impedance to seedling emergence and root penetration. Organic soil amendments and additions of calcium as either lime or gypsum can improve soil aggregation, tilth and nutrient status of the soil and can stimulate the biotic community.

A soil quality target is to maintain or increase soil organic matter using cover crops and regular compost additions. Since the deeper soils have more potential for vigor more aggressive use of cover crops can be used, meaning they can be grown longer into the growing season or may be used in all rows.

Another soil quality goal should be maintaining high earthworm populations, through “earthworm friendly farming”, because of the many benefits of earthworms, especially the surface-feeding/deep-burrowing “night crawlers”. In addition to their improvement of soil hydrology, earthworms play many important roles in ecology of the vineyard soil. For example, earthworm casts are higher in plant nutrients, and casts have elevated pH and organic matter content compared to matrix soil. In as much as earthworms cast inside their deep earthworm burrows, they create favorable conditions for deep rooting vines trying to grow in subsoils that are notoriously acidic.

Historical records for the Willamette Valley have documented very severe erosion on foothill soils where soils were left unprotected or with poorly established vegetation in the winters when large runoff events occurred. These severe erosion events can be triggered by intense rain falling on saturated or frozen soils, or by rain on snow events. Such conditions may only have a calculated return period of 10 or 20 years, but if a grower is caught with sloping bare ground at such an unfortunate time, a lifetime’s worth of soil development can be lost in one year. Soil loss rates from 10 to 100 tons acre^{-1} year^{-1} have been recorded for such events in the Willamette Valley.

Areas of particular concern for erosion are slight swales where runoff water is concentrated and on very steep slope areas where runoff is more rapid.

It is important to protect these soils from erosion. Cover crops are typically used to control erosion. Various cover crop mixes are available to provide both cover and suitable level of competition with winegrapes.

Special care should be taken not to traffic these soils with heavy equipment when soils are moist or wet. Heavy equipment with high tire pressure on any thing but dry soil can cause severe long term soil compaction. It is perhaps obvious but worth repeating that severe soil compaction can occur in the land clearing and site preparation stage, especially before the trellis is erected. Once the trellis is up the wheel traffic will be confined to a relatively small portion of the ground, perhaps 15 to 30 percent, depending on row spacing and loads, pressure and width of tire tracks. By contrast research has shown that hay farming may result in close to100 percent trafficking of a field. If heavy equipment is used in vineyard development, designated roads and machine trails will reduce the overall negative impacts on soil density. Areas that are mechanically compacted should be subsoiled to 24 inches or so to help remediate compaction, unless doing so would bring up lots of rock to the surface.

Table 1. Soil Boring Data

Boring	Soil Name	Surface thickness IN	Depth to Basalt IN	Fragipan Depth IN	Depth to Seasonal High Water Table IN	AWHC IN
1	Laurelwood	20	>60	-	-	11
2	Laurelwood	22	>60	-	-	11
3	Laurelwood	20	>60	-	-	11
4	Laurelwood	11	>60	-	-	10
5	Nekia	7	36	-	-	6
6	Laurelwood	17	>60	-	-	10
7	Laurelwood	22	>60	-	-	11
8	Laurelwood	14	>60	-	-	10
9	Kinton	15	>60	32	32	9
10	Laurelwood	14	>60	-	-	10
11	Laurelwood	12	>60	-	-	10
12	Laurelwood	20	>60	-	-	11
13	Laurelwood	20	>60	-	-	11
14	Laurelwood	20	>60	-	-	11
15	Laurelwood	20	>60	-	-	11

Table 2. Soil Boring location.

Boring	Latitude	Longitude
1	45.347740	-122.907244
2	45.347105	-122.907527
3	45.346393	-122.907499
4	45.346722	-122.908327
5	45.347958	-122.908426
6	45.348587	-122.908479
7	45.348663	-122.906786
8	45.348857	-122.907567
9	45.349107	-122.903827
10	45.349462	-122.903846
11	45.349468	-122.905459
12	45.348315	-122.905062
13	45.348033	-122.904059
14	45.347108	-122.905031
15	45.346563	-122.904822

Soil Fertility and Chemical Analysis

Soil samples were drawn for laboratory analysis from a borings 3 and borings 9.

There are three surface soil samples (1A, 7A, 13A) and three subsoil samples (1B, 7B, 13B). Recommendations from A & L Laboratory are only based on surface samples. Additional recommendations here also consider the results fron subsoil samples.

Samples were analyzed for organic matter, pH, macronutrient and micronutrient levels and are data are provided in the attached soil laboratory reports. These data are provided for site specific baseline information and they can help inform future sampling and interpretations of surface soil test results.

The summary results of the analysis are below. The laboratory recommendations based on surface samples are also attached and I have provided further interpretations based on subsoil data.

Organic matter content:
surface: high to very high, 4,5 to 5.8 percent
subsoil: medium 2.3 to 2.4 percent

Soil phosphorus:
surface: very high 88 to 151 ppm
subsoil: very low to low 2 to 10 ppm

pH:
Surface: 5.2 to 6.1
Subsoil: 5.6 to 5.9

The laboratory recommendations call for 3.5 tons to 5 tons dolomite based on surface soil test. There are however medium to very high Mg levels in the subsoil so agricultural lime is recommended instead of dolomite (dolomite is usually used where there is a deficiency in Mg). Sample 1 which is extremely acidic in the surface was collected in a spot where there is a darker photo tone which may be related to past land use. More soil sampling for fertility is recommended to assess the variability seen in the baseline set of samples. Boring 1 is very different from 7 and 13. I have attached additional aerial images with borings and contour lines from years 2000, 2004, 2008 that show the changes in cropping and cover type during that timeline. These photos may be able to help future sampling, to explain variability in soil test results and also to layout vineyard blocks on soils that are otherwise similar.

Calcium (Ca):
Surface: 275 to 918 ppm, low to medium, % saturation 43 to 69
Subsoil: 900 to 1300 ppm, low to medium % saturation 48 to 62
Boring 1 has low calcium in surface and subsoil.

Potassium (K):
Surface: very high %saturation 10 to 14
Subsoil: low to medium %saturation 1 to 3

Magnesium (Mg):
Surface: low %saturation 5 to 7
Subsoil: med to very high % saturation 16 to 26
Magnesium leaches into the subsoil and tends to accumulate there.

Sulfur (S):
Surface: 4 to 10 ppm low
Subsoil: 35 to 59 ppm high to very high
Sulfur leaches into the subsoil and tends to accumulate there. Fertilizer recommendation from lab is for 10 to 20 pounds sulfur but given the large store of S in subsoil and the high organic matter content of the surface soil, it is not suspected that vines will be deficient in S, so no S addition is recommended.

Zinc (Zn)
Surface: low
Subsoil: very low

Copper (Cu):
Surface: high
Subsoil: very low

Boron (B):
Surface: very low
Subsoil: very low

See recommended amendments on Soil Lab Report attached at back of this report, and note changes to recommendations as given above.

Figure 2. Precision soil map (photo base July 2016)

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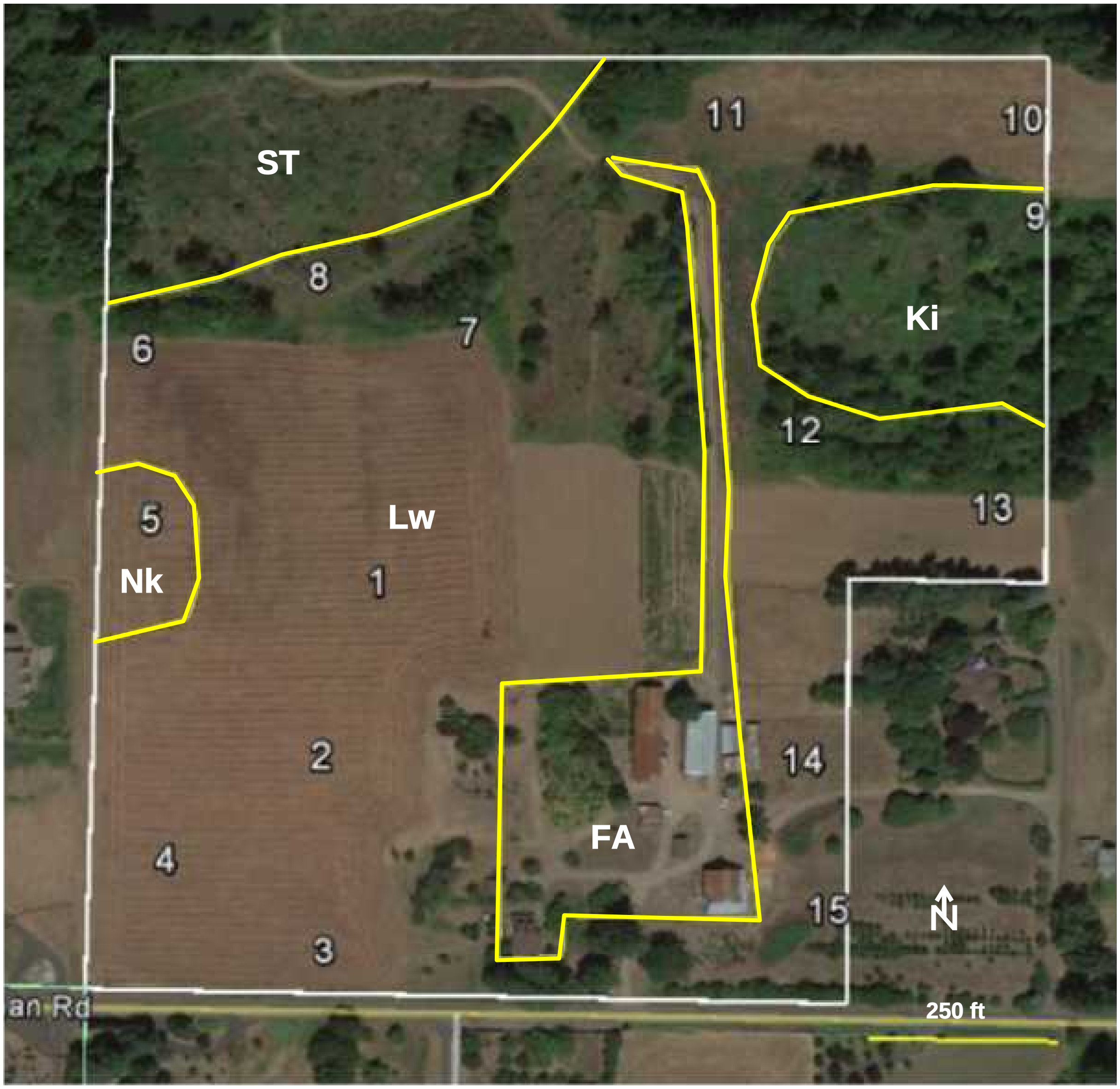

Map Unit	Description	Slope	Acres
Lw	Laurelwood	2 to 20 %	24.0
Nk	Nekia	2 to 7 %	0.5
Ki	Kinton	8 to 14 %	2.3
ST	Steep north aspect slopes	>20%	3.2
FA	Farmstead		3.0

Historical photos of Yano Farm

Figure 3. July 2000

Figure 4. July 2004

Figure 5. July 2008

A & L WESTERN AGRICULTURAL LABORATORIES

10220 SW NIMBUS AVE Bldg K-9 I PORTLAND OREGON 97223 I (503) 968-9225 I FAX (503) 598-7702

REPORT NUMBER: 17-125-114

CLIENT NO: 4249

SEND TO: RED HILL SOILS
PO BOX 2233
CORVALLIS, OR 97339

SUBMITTED BY: ANDY GALLAGHER

GROWER: YANO

DATE OF REPORT: 05/12/17

SOIL ANALYSIS REPORT

SAMPLE ID	LAB NUMBER	Organic Matter		Phosphorus		Potassium	Magnesium	Calcium	Sodium	pH		Hydrogen	Cation Exchange Capacity	PERCENT CATION SATURATION (COMPUTED)				
		* % Rating	** ENR lbs/A	P1 (Weak Bray) **** * ppm	$NaHCO_3$-P (OlsenMethod) **** * ppm	K ***** * ppm	Mg *** * ppm	Ca *** * ppm	Na *** * ppm	Soil pH	Buffer Index	H meq/100g	C.E.C. meq/100g	K %	Mg %	Ca %	H %	Na %
1A	59676	5.6VH	142	88VH	48**	177	24	275	7	5.2	5.7	1.1	3.1	14.4	6.3	43.8	34.5	0.9
7A	59677	5.8VH	145	107VH	46**	276VH	43L	918M	7VL	6.1	6.2	0.9	6.6	10.7	5.4	69.4	14.0	0.5
13A	59678	4.5H	119	151VH	72**	251VH	56L	863M	6VL	6.1	6.2	0.9	6.3	10.2	7.2	68.2	14.0	0.4

** NaHCO3-P unreliable at this soil pH

SAMPLE NUMBER	Nitrogen NO_3-N ppm	Sulfur SO_4-S ppm	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Excess Lime Rating	Soluble Salts mmhos/cm	Chloride Cl ppm		PARTICLE SIZE ANALYSIS SAND %	SILT %	CLAY %	SOIL TEXTURE
1A	2VL	10L	0.7L	7M	58VH	2.3H	0.2VL	L	0.1VL						
7A	1VL	4L	0.8L	4M	38VH	1.3H	0.2VL	L	0.1VL						
13A	1VL	4L	0.6L	3M	41VH	1.7H	0.1VL	L	0.1VL						

* CODE TO RATING: VERY LOW (VL), LOW (L), MEDIUM (M), HIGH (H), AND VERY HIGH (VH).
** ENR - ESTIMATED NITROGEN RELEASE
*** MULTIPLY THE RESULTS IN ppm BY 2 TO CONVERT TO LBS. PER ACRE OF THE ELEMENTAL FORM
**** MULTIPLY THE RESULTS IN ppm BY 4.6 TO CONVERT TO LBS. PER ACRE P_2O_5
***** MULTIPLY THE RESULTS IN ppm BY 2.4 TO CONVERT TO LBS. PER ACRE K_2O
MOST SOILS WEIGH TWO (2) MILLION POUNDS (DRY WEIGHT) FOR AN ACRE OF SOIL 6-2/3 INCHES DEEP

This report applies only to the sample(s) tested. Samples are retained a maximum of thirty days after testing.

Rogell Rogers, CCA, PCA
A & L WESTERN LABORATORIES, INC.

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10220 SW NIMBUS AVE Bldg K-9 I PORTLAND OREGON 97223 I (503) 968-9225 I FAX (503) 598-7702

REPORT NUMBER: 17-125-115

CLIENT NO: 4249

SEND TO: RED HILL SOILS
PO BOX 2233
CORVALLIS, OR 97339

SUBMITTED BY: ANDY GALLAGHER

GROWER: YANO

DATE OF REPORT: 05/11/17

SOIL ANALYSIS REPORT

PAGE: 1

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		* % Rating	** ENR lbs/A	P1 (Weak Bray) **** * ppm	$NaHCO_3$-P (OlsenMethod) **** * ppm	K ***** * ppm	Mg *** * ppm	Ca *** * ppm	Na *** * ppm	Soil pH	Buffer Index	H meq/100g	C.E.C. meq/100g	K %	Mg %	Ca %	H %	Na %
1B	59679	2.3M	76	3VL	8**	65L	358VH	1080L	22VL	5.6	6.3	2.6	11.2	1.5	26.2	48.0	23.5	0.9
7B	59680	2.3M	75	10L	15**	83M	157M	926L	13VL	5.7	6.3	1.6	7.8	2.7	16.5	59.1	21.0	0.7
13B	59681	2.4M	78	2VL	13**	76L	242M	1338M	19VL	5.9	6.4	1.8	10.8	1.8	18.5	62.0	17.0	0.8

** NaHCO3-P unreliable at this soil pH

SAMPLE NUMBER	Nitrogen NO_3-N ppm	Sulfur SO_4-S ppm	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Excess Lime Rating	Soluble Salts mmhos/cm	Chloride Cl ppm		PARTICLE SIZE ANALYSIS SAND %	SILT %	CLAY %	SOIL TEXTURE
1B	1VL	50VH	0.1VL	1VL	7L	0.1VL	0.1VL	L	0.1VL						
7B	1VL	35H	0.1VL	1VL	13M	0.2VL	0.1VL	L	0.1VL						
13B	1VL	59VH	0.1VL	1VL	6L	0.1VL	0.1VL	L	0.1VL						

* CODE TO RATING: VERY LOW (VL), LOW (L), MEDIUM (M), HIGH (H), AND VERY HIGH (VH).
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*** MULTIPLY THE RESULTS IN ppm BY 2 TO CONVERT TO LBS. PER ACRE OF THE ELEMENTAL FORM
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10220 SW NIMBUS AVE Bldg K-9 I PORTLAND OREGON 97223 I (503) 968-9225 I FAX (503) 598-7702

REPORT NUMBER: 17-125-114 **CLIENT:** 4249

SUBMITTED BY: ANDY GALLAGHER

SEND TO: RED HILL SOILS
PO BOX 2233
CORVALLIS, OR 97339

GROWER: YANO

DATE OF REPORT: 05/12/17

SOIL FERTILITY GUIDELINES

RATE: lb/acre **PAGE:** 1

Sample ID	Lab Number	Crop	SOIL AMENDMENTS				Nitrogen N	Phosphate P_2O_5	Potash K_2O	Magnesium Mg	Sulfur SO_4-S	Zinc Zn	Manganese Mn	Iron Fe	Copper Cu	Boron B
			Dolomite	Lime	Gypsum	Elemental Sulfur										
1A	59676	WINEGRAPES	9999				20				10	10				2.0
7A	59677	WINEGRAPES	7000				20				20	10				2.0
13A	59678	WINEGRAPES	7000				30				20	10				2.0

COMMENTS

LIME REQUIREMENT: Liming may be necessary if buffer index is less than 6.9. Guidelines are based upon common agricultural lime (100-score) per six-inch depth to raise SOIL pH to about 6.5. You may want to split high lime requirements over more than one year if you are unable to adequately incorporate the material.
NITROGEN: Use local conditions and experience with variety to determine rates and timing. Allow for nitrate levels in your water source also (ppm NO3 X 0.61 = lb N/ac-ft water). Monitor tissue-N.
SULFATE-SULFUR: Low soil levels may cause yellowing and lack of vigor. Maintain above 15 to 20 ppm to guard against deficiencies. Although, sulfates may have leached below sampling depth.
ZINC: Maintain soil levels above 1.0 ppm to ensure an adequate zinc supply. A tissue analysis at the appropriate time will determine more accurately, availability to the plant.

NOTES:

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