Soil Analysis Report

Sample ID: ST0000000 Sample Date: 10/29/2024

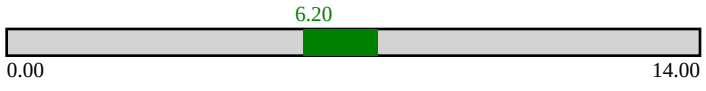
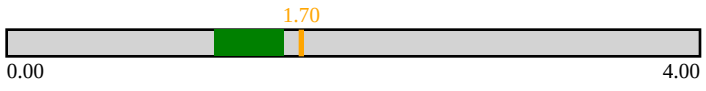
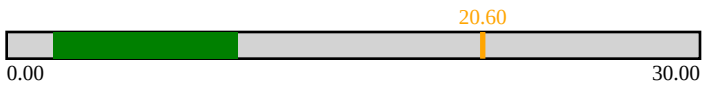
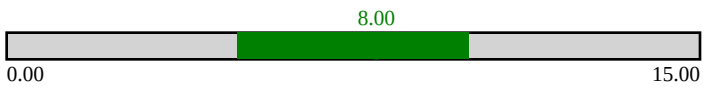
Summary of Findings

High organic matter and microbial activity are strengths, but pH, salt levels, and heavy subsoil compaction pose challenges. Nitrate is low, the K:Mg ratio is suboptimal, and sodium saturation is elevated. Recommendations will blend targeted conventional fertilizers, mechanical interventions, and regenerative steps like cover cropping and organic amendments to sustain yield and build soil health.

Key Outliers and Focus Areas

NO3-N: 5.9 ppm (Deficient). Nitrate is too low for high-yield goals. Immediate nitrogen supplementation is needed to avoid early-season N stress.
Na (%): 13.7% (High). Elevated sodium can disrupt soil structure and reduce infiltration. Gypsum application and improved drainage recommended.
P (Kelowna): 10.5 ppm (Marginal). Phosphorus at this level may limit productivity, so starter fertilizer and possibly additional P are needed.
K:Mg ratio: 0.2 (Deficient). A low K:Mg ratio indicates potential potassium deficiency. Supplement K to balance with Mg in soil solution.

Key Parameters Summary

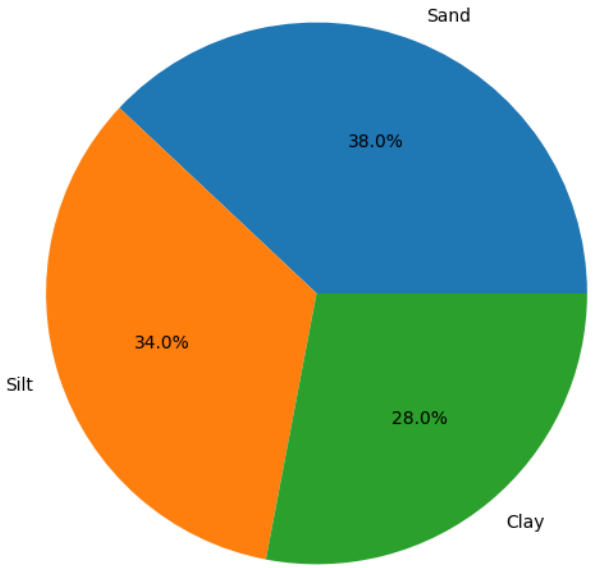
Parameter	Value	Graph
Soil pH	6.2	
Soil Bulk Density (g/cm³)	1.7	
Nitrate-Nitrogen (NO3-N in ppm)	5.9	
Ammonium-Nitrogen (NH4-N in ppm)	20.6	
Organic Matter (%)	8.0	

Soil Physical Properties

Parameter	Soil Type			Organic Matter	Usable Soil Depth	Soil Density	Aggr. Stability	Water Holding Capacity	Soil Aeration (Redox)
	Sand	Silt	Clay	%	inches	g/cm³	%	%	mV
Result	38	34	28	8.0	3.0	1.7	22.0	38.9	238.5
Comment	*Clay Loam*			*High*	*Low*	*High*	*Low*	*High*	*Low*
Desired Range	N/A			5 - 10	6 - 12	1.2 - 1.6	40 - 100	25 - 35	300 - 500

Total Soil in Plant Usable Pounds per Acre: 1,142,361 lbs/acre

This soil is a clay loam (38% sand, 34% silt, 28% clay) with a high bulk density of 1.7 g/cm^3 and moderate aggregate stability (22%). The 3-inch usable depth suggests compaction below the surface. To alleviate compaction without disrupting this season's crop, targeted deep ripping or vertical tillage in problem spots can be employed (NRCS, 2012). Complement this with high-residue cover crops (e.g., rye or oats) to develop stable aggregates via continuous root growth (Reicosky et al., 2011). Consider strip till or zone till to keep most of the soil covered and minimize disturbance (Brady & Weil, 2017), helping preserve soil moisture and improve aeration. Gradual adoption of minimum tillage will maintain yield potential while supporting the soil's long-term structural health (Busari et al., 2015).



Electrochemical Properties and Base Cation Distribution in Soil

Electrochemical Properties

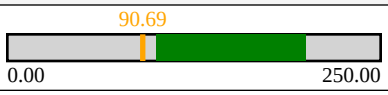
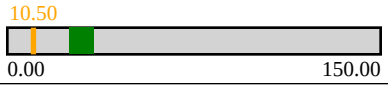
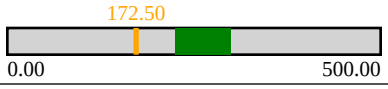
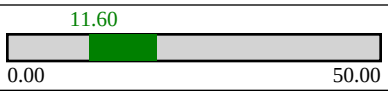
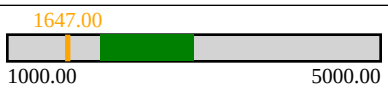
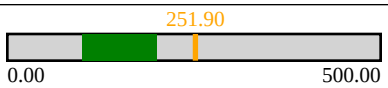
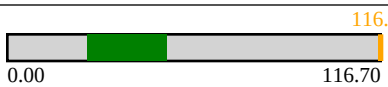
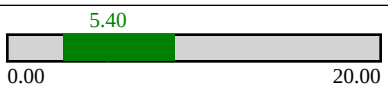
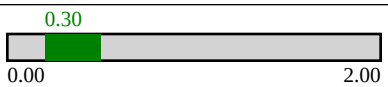
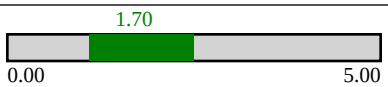
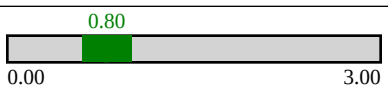
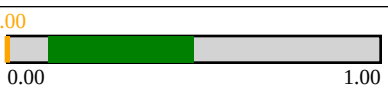
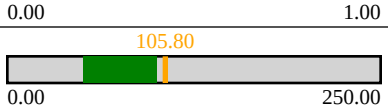
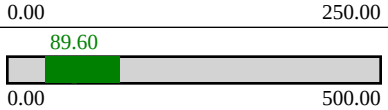
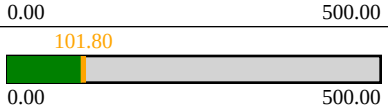
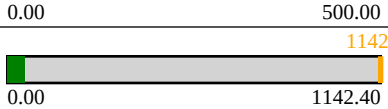
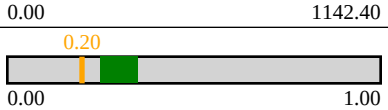
	pH	Buffer pH	Electrical Conductivity	Redox Potential	Base Saturation	Cation Exchange Capacity
Unit	-	-	dS/m	mV	%	meq/100g
Result	6.2	7.1	2.0	238.5	100.0	12.5
Comment	*Adequate*	*Low*	*High*	*Low*	*High*	*Adequate*
Desired Range	6 - 7.5	N/A	0.8 - 1.2	300 - 500	75 - 85	10 - 20

Base Cation Distribution in Soil

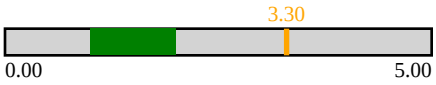
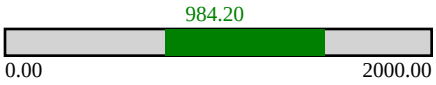
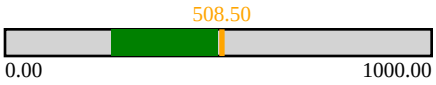
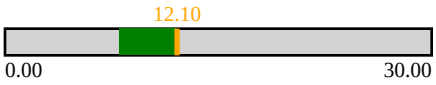
	Calcium	Magnesium	Potassium	Sodium	Hydrogen	Sodium Adsorption Ratio
Unit	%	%	%	%	%	-
Result	66.0	16.8	3.5	13.7	0.0	2.4
Comment	*Adequate*	*Adequate*	*Adequate*	*High*	*Low*	*Low*
Desired Range	65 - 75	10 - 20	3 - 5	0 - 2	10 - 20	0 - 3

With a pH of 6.2, the soil is suitable for most crops (Havlin et al., 2016). However, the base saturation includes 13.7% Na, and the EC of 2.0 dS/m suggests mild salinity stress. Where feasible, apply gypsum to aid in sodium displacement (Oster et al., 2012). Ensure adequate leaching after gypsum application if soil moisture conditions permit. Maintain or slightly augment organic matter inputs to form carbonic acid in the rhizosphere (Cuevas & Blom-Zandstra, 2020), which helps buffer soil pH naturally. Avoid over-application of synthetic inputs that might exacerbate salinity. If slightly higher pH is desired in localized spots, add small amounts of lime guided by the buffer pH of 7.1, aiming for a target pH near 6.5–7.0 (Brady & Weil, 2017).

Nutrient Availability

Nutrient	Short Term		Long Term		General Sufficiency
	lbs/acre	PPM	lbs/acre	PPM	Total Nutrients
Total Nitrogen	30.27	26.50	60.41		
Phosphorus	11.99	10.50			
Potassium	197.06	172.50	328.09	287.20	
Sulphur	13.25	11.60			
Calcium	1881.47	1647.00	5373.21	4703.60	
Magnesium	287.76	251.90	1309.15	1146.00	
Iron	133.31	116.70			
Manganese	6.17	5.40			
Copper	0.34	0.30			
Zinc	1.94	1.70			
Boron	0.91	0.80			
Molybdenum	0.00	0.00			
Chloride	120.86	105.80			
Silicon	102.36	89.60			
Sodium			116.29	101.80	
Aluminum			1305.03	1142.40	
K:Mg Ratio		0.20			

Biological Properties

Parameter	Value	Ideal Range	Graph
Soil Respiration	3.3 µg CO2-C/g/h	1 - 2	
High microbial activity; active soil biology.			
Total Organic Carbon	4.6 %	2 - 4	
Enhanced nutrient retention and soil structure.			
Humic Acid	80.3 PPM	200 - 400	
Increasing humic acid improves nutrient exchange and soil structure. Focus on trends rather than absolute values.			
Fulvic Acid	698.2 PPM	1500 - 2500	
Higher fulvic acid enhances nutrient mobility and availability. Focus on trends rather than absolute values.			
Reactive Carbon	984.2 mg/Kg	750 - 1500	
Reflects labile carbon available for microbes; higher values indicate active nutrient cycling.			
Total Soil Protein	508.5 mg/Kg	250 - 500	
Indicator of soil biological activity. Interpret relative to benchmarks or previous measurements.			
Active C:N Ratio	12.1	8 - 12	
Carbon-rich conditions; possible nitrogen immobilization.			

Biological Properties Summary

Soil respiration (3.3 µg CO_2-C/g/h) and OM (8%) are beneficial indicators (Franzluebbers, 2016). However, the low redox (238.5 mV) hints at anaerobic microsites. To balance immediate needs with robust biology, incorporate modest rates of well-matured compost or manure, ensuring no excessive salts or pathogens (Goss et al., 2013). Pair these with diverse cover crops from at least four plant families (e.g., cereals, legumes, brassicas, and broadleaf species) to provide varied root exudates for microbial communities (Schipanski et al., 2014). Conventional fertilizers can still be used to prevent nutrient limitations this season, but consider small increments of carbon-rich amendments to sustain microbial biomass and improve long-term fertility (Howard, 1940).

Nutrient Availability Summary

Nitrate is low (5.9 ppm), while ammonium is high (20.6 ppm). Split nitrogen applications using conventional forms (e.g., urea or UAN) can supply immediate crop demand while reducing losses (Havlin et al., 2016). Phosphorus is marginal (10.5 ppm), so a starter P fertilizer (e.g., 11-52-0) at planting is wise. The K:Mg ratio is 0.2, slightly below the recommended 0.25–0.35. A potassium supplementation (e.g., potassium sulfate) can help correct this ratio. Consider side-dressing additional K if early-season tissue tests show deficiency. Over time, green manures such as legumes or winter cover crops can recycle and slowly release nutrients, reducing the reliance on synthetics. This balanced approach meets yield targets while steadily enhancing biological nutrient cycling (Howard, 1940).

Recommendations

Your clay loam soil shows good organic matter but has areas needing immediate attention to ensure this season's yield. Low nitrate and marginal phosphorus can be quickly addressed through conventional fertilizers, while a potassium amendment will help correct the K:Mg imbalance. A targeted gypsum application, along with improved drainage, mitigates high sodium risks. Over the longer term, introducing diverse cover crops, reduced tillage, and quality compost inputs will enhance biological activity and soil structure. Balancing von Liebig's precision in meeting nutrient needs with Sir Albert Howard's organic principles helps maintain profitability now while building a more resilient soil ecosystem for future seasons.

Crop Selection and Ranking:

1. Oats
2. Barley
3. Wheat, winter

Crop best-fit rankings provided by Crop Growth Sciences are based on average yield data collected across Western Canada and current field nutrient conditions. These rankings are intended as general guidance and may not reflect specific conditions on individual farms. Variability in soil type, climate, and management practices should be considered when interpreting the data and making decisions.

Always contact an agronomist or crop consultant for specific recommendations

Laboratory Methods

Parameter	Method	ISO/Standard
Water Holding Capacity	Gravimetric	ISO 11274
Bulk Density	Cylinder Method	ISO 11272
Aggregate Stability	VAST (Solvita)	
Texture (sand, silt, clay)	Hydrometer	ISO 11277
Organic Matter	LOI (Loss on Ignition)	ISO 10694
Total Organic Carbon	Calculated from OM (Van Bemmelen Factor)	
Oxidized Carbon (Reactive)	Potassium Permanganate (Colorimetry)	
Humic & Fulvic Acids	Alkali Extractions	
Microbial Respiration	Alkali Absorption Method (+ Solvita)	ISO 14238
Total Protein Index	Autoclaved Citrate Buffer, Bradford Reagent	
NO3-N / NH4-N	KCl (Colorimetric)	ISO 14238
Phosphorus	Modified Kelowna (ICP OES)	
Sulfur & Chloride	Water (ICP OES)	
Exchangeable Cations (K, Ca, Mg, H)	Ammonium Acetate (ICP OES)	ISO 11260
Total Cations (K, Ca, Mg, Na, Al)	Concentrated HCl (ICP OES)	ISO 11466
Micro Nutrients (Fe, Cu, Zn, Mn, Mo)	DTPA (ICP OES)	ISO 14870
Boron, Silicon	Hot Water Extracted	
pH & EC	1:1 Water to Soil	