

Topsoil Report Ranges

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Customers who utilize our "Topsoil" analytical package occasionally ask what the reference source for our 'Typical Range' column is. It is important to state that these ranges characteristically reflect only loam to sandy loam soils, where optimal plant growth is sustained.

Many factors influence soil performance, such as structure, water holding capacity, compaction etc. which influence nutrient availability and microbial life. Environmental conditions such as temperature and moisture also influence soil performance. For example, high total salts have greater negative impact in dry soil conditions than when moist. When soil is moist, salts being soluble will leach away as well.

This article will outline the basis of 'typical range' for each test. Test results falling outside of the range are not necessarily detrimental, but are in all likelihood less than ideal. As there is no single reference source that can provide all of these ranges, the intent of this article is to explain why the reported ranges are optimal, and provide a reference where possible. The Topsoil Report offers customized amendment recommendations to adjust the soil to within typical ranges where possible. Where jobsite specifications are provided, amendments can be provided to meet these requirements.

pH – Soil pH influences the solubility and availability of plant nutrients, thus impacting the efficiency of nutrient uptake. The range where most nutrients (except zinc and manganese) have greatest availability to plants is between pH 6.0 and 7.5. When a soil tests lower or higher than this range, it is not necessarily detrimental; however, nutrients are less available to the plant as they form stable insoluble compounds with other elements.

Ontario soils tend to be calcareous, which is to say they have high calcium (and often high magnesium) due to the fact they are derived from limestone parent rock. Although pH measures H⁺ ion activity and not calcium content, calcareous soils have an abundant supply of calcium adsorbed to soil particles minimizing the ability for hydrogen ions to attach and increase soil acidity (lower pH).

Chart showing nutrient availability at differing pH values:
<http://web1.msue.msu.edu/monroe/soilweb2/availability.pdf>

Organic Matter – Organic matter is reported as per cent by weight. As organic matter (when dry) is quite light in mass, it may represent a significant volume. Organic matter exists in 3 forms:

"The Living": Everything from earthworms to microscopic nematodes, bacteria, and fungi.

"The Recently Dead": Recent additions of manure, compost, and plant residue; which contribute to the nutrient cycle.

"The Very Dead": Commonly known as humus which imparts a dark colour to the soil. This portion of organic matter can be centuries old, and although is no longer involved with the nutrient cycle, it is responsible for providing soil structure (along with the lignins, waxes, and 'glues' excreted by soil microbes).

In theory, the more organic matter the better as it is vital to soil structure. Adequate organic matter drains freely, yet holds moisture like a sponge. It keeps soil colloids stuck together in such a way that they resist erosion and compaction, and recover quicker when compacted. Organic matter provides porosity for oxygen infiltration and root penetration, as well as providing a source of nutrients for plants and food for microbes to mineralize more nutrients. However, as the common source for organic matter in manufactured soils and topsoil mixtures is compost (which is often very nutrient rich), diligence must be exercised so as not to build nutrients to excessive levels when increasing organic matter. Excessive nutrients can be detrimental (see Total Salts), which is why the standard organic matter amendment in the Topsoil Report is with sphagnum peat moss. Peat moss is inert and consistent. However, it is essentially a limited non-renewable resource that is a costly input. If compost is the desired amendment, it should have its nutrient profile tested so that the recipe can be adjusted accordingly.

Total Salts – Also known as Total Soluble Salts and Electrical Conductivity (EC). The electrical conductivity test indicates the amount of soluble salts in the soil. The source of these salts can be over-application of fertilizer, manure and/or compost; or de-icing salt contamination. Sodium and chloride are the two most common influences on high total salts, but even a macronutrient such as potassium can contribute to a high reading if it is present in excessive levels. High total salts interfere with the ability of roots to uptake water. Seed germination and seedling emergence are adversely affected by high levels of soluble salts. Chloride can be taken up by plants, and will concentrate in the leaves leading to chlorosis (yellowing due to lack of chlorophyll) and eventual necrosis. On the positive side, since salts are soluble they can be removed by leaching. A thorough saturation and drainage will help lower the total salt reading. The application of gypsum can also be beneficial in accelerating the leaching of sodium.

The table below is the ranges provided by OMAFRA for field soils.

Adapted from Table 2-4 Page 25 Soil Fertility Handbook Ontario Ministry of Agriculture, Food, and Rural Affairs Pub. 611		
EC "Salt" Reading mmhos/cm	Rating	Plant Response
0 to 0.25	Low	Suitable for most plants if fertilizer used as recommended
0.26 to 0.45	Moderate	As above, however this is higher than typical
0.46 to 0.70	High	May reduce emergence and cause slight to severe damage on salt-sensitive plants
0.71 to 1.00	Excessive	May prevent emergence and cause slight to severe damage on most plants
>1.00	Excessive	Expected to cause severe damage to most plants

Phosphorus – The range for phosphorus is between 10 and 60 ppm. Below 10 ppm, plants will emphasize root production at the expense of vegetative growth. Plants will be highly responsive to applications of phosphorus fertilizer when it tests in the single digit range. When soil phosphorus is greater than 60 ppm, additional fertilizer will have minimal benefit. It is not detrimental to plant growth if

soil tests greater than 60 ppm phosphorus, however, soil erosion may lead to water pollution and algal growth.

Potassium – Like phosphorus, potassium is a primary nutrient used in large quantities by plants. The range of 80 to 250 ppm is where plant growth is optimal. Tests lower than 80 ppm can be addressed with fertilization. Although soil tests at levels above 250 ppm are not necessarily detrimental, potassium is salty in ionic form and can contribute to elevated salt levels.

OMAFRA phosphorus and potassium recommendation tables for turf grass:
<http://www.omafra.gov.on.ca/english/crops/facts/fert-rec-tables-17.htm>

OMAFRA phosphorus and potassium recommendation tables for nursery stock:
<http://www.omafra.gov.on.ca/english/crops/facts/fert-rec-tables-19.htm>

Calcium – When pH is within the optimal range, calcium is likely present in adequate quantities. The range of 1000 to 4000 ppm is considered typical. However, Ontario soils are predominately calcareous and often have calcium levels in excess of this range. It is not detrimental to plant growth to have high calcium soils, but it increases the difficulty of lowering pH.

Magnesium – Like calcium, high magnesium soils are often typical but not detrimental to plant growth. Recommendations are given to increase magnesium when the soil test is less than 100 ppm, or when potassium is at equivalent or higher levels than magnesium since potassium inhibits the plant availability of magnesium.

Chloride – Although chloride is a plant nutrient, it is required in very small quantities. When chloride is at levels greater than 100 ppm, it can concentrate in leaves at toxic levels. High chloride levels contribute to high EC measurements. However, they are very water soluble and manageable by leaching.

Sodium – Similar to chloride, sodium is needed by plants in very small quantities. It can also have a toxic effect when at high levels (greater than 200 ppm). Sodium also can be easily leached, but if present at high levels the leaching can be accelerated by the addition of gypsum.

Sand-Silt-Clay percent – The percent ranges given for sand, silt, and clay are where soil will have optimal physical characteristics. Most samples that fall within these ranges will have a texture of Loam to Sandy Loam. Where the texture is neither of these, recommendations for the addition of coarse sand is provided for texture adjustment. Where jobsite specifications are provided with differing ranges, recommendations will be customized accordingly.