Reducing Soil Compaction

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Soil compaction is a form of soil degradation, which is defined as the compression of soil particles into a smaller volume. It reduces the size of pore space available for water and air.

Soil compaction may be caused by the combination of soil tillage and raindrop or irrigation water impact, hardpan tillage-induced compaction, wheel traffic-induced compaction and topographical-influenced compaction. Soil compaction affects both tilled and no-tilled crop systems. Parameters to be analyzed include soil density, porosity, structure, penetration resistance, soil biota, as well as water infiltration and percolation.

Soil compaction impairs water infiltration, crop emergence, root penetration and water and nutrient uptake; resulting in reduced crop yields.

Soil compaction management includes the reduction of trafficking, axle loads, contact pressures and tillage. The use of fibrous and tap-rooted crops in rotation and natural soil processes of wetting-drying and freeze-thaw has also been considered. Another strategy to combat soil compaction is maintaining or increasing organic matter (OM) content in soil. This can be achieved by reducing soil disturbance, promoting biologically healthy soil practices and adding OM in the form of crop residues, manure, or compost. The addition of OM to soil has been found to improve soil properties including water-holding capacity and general quality/health.

The addition of OM to improve soil quality has been the main agenda of Canadian Humalite International Inc (CHI), Edmonton, Alberta, Canada. Different from other types of OM, CHI manufactures products from low-energy coal (humalite). This material has around 7,000 BTU/lbs in energy value and is classed as a non-hazardous material. Product A was the product of interest in this field trial. It was manufactured by crushing, drying and screening raw humalite to have a mean particulate sizing of 2.1 mm. It had a pH of 4.1 and contained 53.3% OM, 31.4% moisture, 1.1% total calcium, 0.3% total magnesium and 0.3% total sodium.

The field trial was completed on a 104-acre commercial farm in Sturgeon County, Alberta, Canada from October 2015 until October 2016. Three test plots of 1.5 acre each were allocated for the trial, i.e. Control, Treated 1, and Treated 2.

In October 2015, 10 soil compaction readings at 6 inches deep were completed on each plot using a penetrometer. Ten soil samples were taken at 6 inches deep from each plot, and each was analyzed for moisture. For each plot, the samples were aggregated and analyzed for structure, degree of acidity (pH), electrical conductivity (EC) in dS/m and OM in %. All plots had practically the same soil properties containing a high percentage of clay. Product A was then applied on the surface of Control, Treated 1 and Treated 2 plots at application rates of 0, 160 and 400 lbs/acre, respectively.

In April 2016, 30 soil compaction readings at 6 inches deep were made on each plot using a penetrometer. Ten soil samples were taken at 6 inches deep from each plot, and each was analyzed for moisture.

In October 2016, 30 soil compaction readings at 6 inches deep were completed on each plot using a penetrometer. Again, 10 soil samples were taken at 6 inches deep from each plot and were analyzed for moisture.

Soil moisture and compaction data were analyzed for mean, standard deviation, and Fisher's least significant difference (=.05) using Matlab® v.17.

Table 1 shows that prior to the application of Product A in October 2015, each test plot had similar soil compaction (mean for all data = 213.3 psi) and moisture (mean for all data = 27.09%). After six months of application, OM significantly reduced soil compaction from 219.7a (mean for Control) down to 180.0b (mean for Treated 1) and 168.7b psi (mean for Treated 2). OM did not significantly increase soil moisture (mean for all data = 26.3%). After 12 months of application, OM reduced soil compaction from 154.0a (mean for Control) down to 142.7ab (mean for Treated 1) and 120.8b psi (mean for Treated 2). OM did not significantly increase soil moisture (mean for all data = 31.2%). These results indicated that soil compaction was directly related to the application of OM and soil moisture (note: October 2016 was wetter than two other months). The effect of Product A at 160 lbs/acre on soil compaction was reduced after 12 months of application.

In summary, the addition of Product A, which was rich in OM, significantly reduced compaction of high-clay soil by up to 23% over control after six months of application. An application rate of 160 lbs/acre Product A was found to be optimum.

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TABLE 1: SOIL PARAMETERS BEFORE PRODUCT APPLICATION (OCTOBER 2015)

	Control Plot (1.5 acre)	Treated 1 Plot (1.5 acre)	Treated 2 Plot (1.5 acre)
Sand:Silt:Clay (%)	17:31:52	15:35:50	13:33:54
pH (no unit)	6.2	6.1	6.2
Electrical Conductivity (dS/m)	1.4	1.4	1.3
Organic Matter - OM (%)	7.3	7.3	7.3