Haney/Soil Health Test Information Rev. 1.0

Ward Laboratories Inc.

The Haney Test or Soil Health Test is an integrated approach to soil testing using chemical and biological soil test data. It is designed to mimic nature's approach to soil nutrient availability as best we can in the lab. The Haney Test is designed to work with any soil under any management scenario because the program asks simple, universally applicable questions.

1. What is your soil's condition?
2. Is your soil in balance?
3. What can you do to help your soil?

Procedure Outline:

Each soil sample received in the lab is dried at 50° C, ground to pass a 2 mm sieve and weighed into two 50 ml Erlenmeyer flasks (4 g each) and one 50 ml plastic beaker (40 g) that is perforated to allow water infiltration. The 40 g soil sample is analyzed with a 24 hour incubation test at 24°C. This sample is wetted through capillary action by adding 20 ml of DI water to an 8 oz. glass jar and then capped. At the end of 24 hour incubation, the gas inside the jar is analyzed using an infrared gas analyzer (IRGA) Li-Cor 840A (LI-COR Biosciences, Lincoln NE) for CO2-C. The two 4 g samples are extracted with 40 ml of DI water and 40 ml of H3A, respectively. The samples are shaken for 10 minutes, centrifuged for 5 minutes, and filtered through Whatman 2V filter paper. The water and H3A extracts are analyzed on a Lachat 8000 flow injection analyzer (Hach Company, Loveland CO) for NO3-N, NH4-N, and PO4-P. The water extract is also analyzed on a Teledyne-Tekmar Torch C:N analyzer for water-extractable organic C and total N. The H3A extract is also analyzed on a Thermo Scientific ICP-OES instrument for P, K, Mg, Ca, Na, Zn, Fe, Mn, Cu, S and Al.

The methods use nature's biology and chemistry, in that, the soil analysis is performed using a soil microbial biomass indicator, a soil water extract (nature's solvent), and H3A extractant, which mimics organic acids produced by living plant roots to temporarily change the soil pH thereby increasing nutrient availability. These organic acids are then broken down by soil microbes since they are an excellent carbon source, which returns the soil pH to its natural, ambient level. The Haney Test doesn't measure just one thing to arrive at the plant available NPK, we use an integrated approach. For example, if the soil respiration number is 80 ppm CO2 and the organic C: organic N ratio from the soil water extract is above 20:1 we credit no N or P mineralization, as the C:N ratio decreases we credit more release from the organic N and P pools based on CO2 and the lower C:N ratio. For soil with high CO2, low C:N and a high soil health score, we add an additional calculation from the organic N pool, however, we do not credit more N release than we can measure from the organic N and organic P pools.

Nitrogen:

Total N: This number is the total N from the water extract from your soil (in ppm). It contains both inorganic N and organic N sources from your soil.

Inorganic N: This is the combined amount of plant available forms of inorganic N (NO3-N plus NH4-N). NO3-N is the form of N that is easily lost from soil through surface runoff, subsurface leaching, erosion, and in water logged conditions it can revert back to a gas. NH4-H is usually quickly converted to NO3-N by soil microbes but is less susceptible to leaching. The majority of inorganic soil N is in the NO3-N form. If the NO3-N levels are high (above 50 lb/ac), then we would use grasses to convert this easily lost form of N back to the organic form.

Organic N: Organic N is the total water extractable N minus the total water extractable inorganic N in ppm. This form of N should be easily broken down by soil microbes and released to the growing plant providing minimal chance of loss since the N is bound in large organic molecules. This pool represents the amount of potentially mineralizable N in your soil.

Phosphate:

This lists the same type of results as nitrogen but for inorganic P and organic P.

Soil Health:

Soil Respiration 1-day CO2-C: This result is one of the most important numbers in this soil test procedure. This number in ppm is the amount of CO2-C released in 24 hours from soil microbes after your soil has been dried and rewetted (as occurs naturally in the field). This is a measure of the microbial biomass in the soil and is related to soil fertility and the potential for microbial activity. In most cases, the higher the number, the more fertile the soil.

Microbes exist in soil in great abundance. They are highly adaptable to their environment and their composition, adaptability, and structure are a result of the environment they inhabit. They have adapted to the temperature, moisture levels, soil structure, crop and management inputs, as well as soil nutrient content. In short, they are a product of their environment. If this were not true they most likely would have died out long ago, but they didn't. Since soil microbes are highly adaptive and are driven by their need to reproduce and by their need for acquiring C, N, and P in a ratio of 100: 10: 1 (C:N: P), it is safe to assume that soil microbes are a dependable indicator of soil health. It is clear that carbon is the driver of the soil nutrient-microbial recycling system. This consistent need sets the stage for a standardized, universal measurement of soil microbial biomass through their respiration activity. Since most soil microbes take in oxygen and release CO2, we can couple this mechanism to their activity. It follows that soil microbial activity is a response to the level of soil quality/fertility in which they find themselves.

Water extractable organic C (WEOC): This number (in ppm) is the amount of organic C extracted from your soil with water. This C pool is roughly 80 times smaller than the total soil organic C pool (% Organic Matter) and reflects the energy source feeding soil microbes. A soil with 3% soil organic matter when measured with the same method (combustion) at a 0-3 inch sampling depth produces a 20,000 ppm C concentration. When we analyze the water extract from the same soil, that number typically ranges from 100-300 ppm C. The water extractable organic C reflects the quality of the C in your soil and is highly related to the microbial activity. On the other hand, % SOM is about the quantity of organic C. In other words, soil organic matter is the house that microbes live in, but what we are measuring is the food they eat (WEOC and WEON).

Water extractable organic N (WEON): This number is the amount of the total water extractable N minus the inorganic N (NH4-N + NO3-N). This N pool is highly related to the water extractable organic C pool and will be easily broken down by soil microbes and released to the soil in inorganic N forms that are readily plant available.

Organic C: Organic N: This number is the ratio of organic C from the water extract to the amount of organic N in the water extract. This C:N ratio is a critical component of the nutrient cycle. Soil organic C and soil organic N are highly related to each other as well as the water extractable organic C and organic N pools. Therefore, we use the organic C:N ratio of the water extract since this is the ratio the soil microbes have readily available to them and is a more sensitive indicator than the soil C:N ratio. A soil C:N ratio above 20:1 generally indicates that no net N and P mineralization will occur, meaning the N and P are “tied up” within the microbial cell until the ratio drops below 20:1. As the ratio decreases, more N and P are released to the soil solution which can be taken up by growing plants. We apply this same mechanism to the water extract, as the C:N falls; we credit more N and P mineralization on a sliding scale. We like to see this number between 8:1 and 15:1.

Soil Health Calculation: This number is calculated as 1-day CO2-C/10 plus WEOC/50 plus WEON/10 to include a weighted contribution of water extractable organic C and organic N. It represents the overall health of your soil system. It combines 5 independent measurements of your soil’s biological properties. The calculation looks at the balance of soil C and N and their relationship to microbial activity. This soil health calculation number can vary from 0 to more than 50. We like to see this number above 7 and increase over time. This number indicates your current soil health and what it needs to reach its highest sustainable state. Keeping track of this soil health number will allow you to gauge the effects of your management practices over the years.

Cover Crop Mix: This is a suggested cover crop planting mix based on your soil test data. This is a recommendation of what you can do to increase your soil health number, but it is not what you have to do. It is designed to provide your soil with a multi-species cover crop to help you improve soil health and thus improve the fertility of your soil.

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Available N-P-K:

These numbers represent the amount of N, P_2O_5, and K_2O present in your soil in lb/ac. The numbers include the inorganic NH_4-N, NO_3-N, and PO_4-P from the H3A extractant, as well as the amount of N and P that the soil microbes will provide based on soil microbial respiration, the organic C: organic N ratio, and the N and P from the organic pools.

Nutrient value per acre: Current fertilizer prices are multiplied by the nutrients present in your soil. This is the value in dollars of nutrients currently in your soil.

NO_3-N Only (traditional evaluation) lbs per acre: This value represents the amount of N in your soil when testing for only nitrate, similar to common soil tests.

Haney Test N Evaluation lbs per acre: This is the amount of available nitrogen measured using the Haney Test and is the same as the available N value on the report.

Nitrogen Difference lbs per acre: This number represents the difference in the amount of nitrogen we found using the Haney Test compared to the NO_3-N only approach.

Nitrogen savings per acre: This value represents the amount of nitrogen saved in dollars per acre when using the Haney Test compared to traditional testing measuring only NO_3-N.

Fertilizer Recommendations: This table provides recommended values for various plant essential nutrients in lbs per acre that your soil needs to produce your stated yield goal for a specific crop. You must provide a crop and yield goal for each sample in order to get recs.

Additional information is available on the website at www.wardlab.com and new information may be added as it becomes available. Any questions regarding soil health testing may be directed to biotesting@wardlab.com.

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