Soil Your Undies

Science Project

by

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Purpose

To find out how biologically active different soils are and what makes different soils like that.

Introduction

I was in grade 7 when I did this project.

I competed in both the Virtual and In-Person rounds of the first ever 4-H Canada Science Fair. After competing in these rounds, I was chosen to go on to represent 4-H Canada at the 2016 Canada-Wide Science Festival, which was held at McGill University in Montreal.

I had lots of fun completing with my project and competing in all the levels of the Science Fair. It was a great opportunity for me to discover more about science and meet new friends.

Hypothesis

A long-term No-Till field (Field #2) with manure fertilizing will be the most biologically active compared to the other four fields.

Field History

Field	2011	2012	2013	2014	2015
Field #1	Soybeans, No Till, Synthetic Fertilized*	Wheat with Red clover, No Till, Synthetic Fertilized*	Corn, Minimum Tillage, Synthetic Fertilized*	Soybeans, No Till, Synthetic Fertilized*	Wheat with Red clover, No Till, Synthetic Fertilized*
Field #2	Crop Unknown, Conventional Tilled, Manure Fertilized- Semi Solid*	Hay (Alfalfa), No Till, Manure Fertilized- Semi Solid*	Hay (Alfalfa), No Till, Manure Fertilized- Semi Solid*	Hay (Alfalfa), No Till, Manure Fertilized- Semi Solid*	Hay (Alfalfa), No Till, Manure Fertilized- Semi Solid*
Field #3	Oats, No Till, Synthetic Fertilized*	Corn, Minimum Tillage, Synthetic Fertilized*	Hay (Alfalfa), No Till, Synthetic Fertilized*	Hay (Alfalfa), No Till, Synthetic Fertilized*	Hay (Alfalfa), No Till, Synthetic Fertilized*
Field #4	Corn, Minimum Tillage, Manure Fertilized- Liquid*	Oats, Minimum Tillage, Manure Fertilized- Liquid*	Corn, Minimum Tillage, Manure Fertilized- Liquid*	Corn, Minimum Tillage, Manure Fertilized- Liquid*	Oats, Minimum Tillage, Manure Fertilized- Liquid*
Field #5	Soybeans, Minimum Tillage, Synthetic Fertilized*	Soybeans, Minimum Tillage, Synthetic Fertilized*	Soybeans, Minimum Tillage, Synthetic Fertilized*	Soybeans, Minimum Tillage, Synthetic Fertilized*	Corn, Minimum Tillage, Synthetic Fertilized*

*Applied according to crop needs.

Procedure

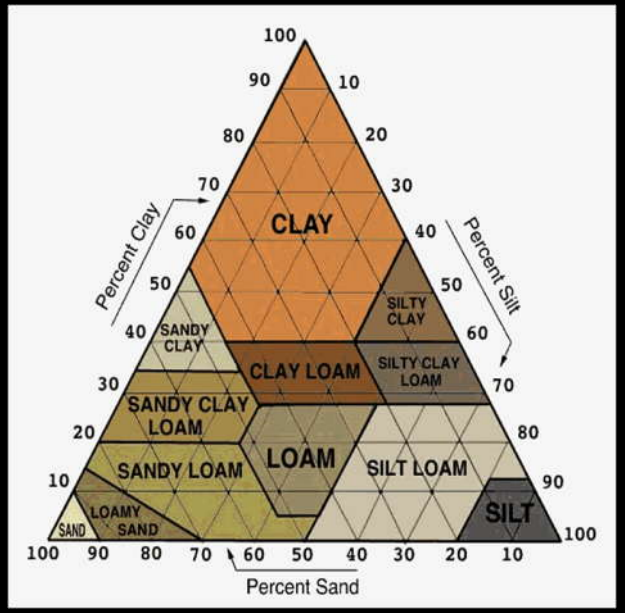
The Underwear Test

1. Bury 2 pairs of cotton briefs in separate holes 10ft apart and the holes 28cm deep in each of the 5 fields and bury the extra pair in 1 of the fields
2. After 1 month dig up the extra pair of briefs. If more than 60% decomposed, dig up the remaining briefs. If less than 60% decomposed wait 1 more month to dig other briefs up. After digging up underwear, rinse each pair so no dirt is left clinging to the underwear and lay out briefs on a table to dry.
3. Weigh dry underwear and calculate percentages of what is left of each pair.

Procedure (cont.)

The Jar Test

4. Collect 1 soil sample (approx. 5 liters) from each field, leave out to dry in bucket in a cool, dry area for 1 week.
5. Take 400ml of soil from each sample and put an inch thick layer on the bottom of the jar, fill 2 thirds full with water and add a pinch of salt.
6. Shake each jar vigorously and wait for the soil to settle at the bottom of the jar. When settled measure the whole soil layer and then measure the sand, silt and clay layers to calculate the percentage of each layer to overall to discover the soil type of the field from the soil type pyramid.



Procedure (cont.)

The Separation Test
(I developed this method for the project.)

7. Take the remainder of the soil sample, weigh it and separate the biotic matter from the soil by laying the soil on a window screen and spray the soil through the window screen with the hose.
8. Weigh the biotic matter and calculate a percentage for the biotic matter and a percentage for the rest of the soil and debris.

Results

Field	Soil Type	Jar Test	Underwear Test	Separation Test
Field #1	Silt Loam	Sand- 25% Silt- 70% Clay- 5%	18% Decomposed Underwear	0.59% Biotic 99.41% Soil
Field #2	Sandy Loam	Sand- 75% Silt- 20% Clay- 5%	21% Decomposed Underwear	0.94% Biotic 99.16% Soil
Field #3 ★	Loam	Sand- 45% Silt- 45% Clay- 10%	47% Decomposed Underwear	0.07% Biotic 99.93% Soil
Field #4	Silt Loam	Sand- 40% Silt- 55% Clay- 5%	14% Decomposed Underwear	0.53% Biotic 99.57% Soil
Field #5	Loam	Sand- 45% Silt- 50% Clay- 5%	2% Decomposed Underwear	0.03% Biotic 99.97% Soil

Conclusions

- I can conclude that Field #3 is the most biologically active soil as the field's underwear had decomposed by 47% from when I buried it two months before.
- I was surprised to see that even though Field #3 showed the most microbiology in the underwear test it was 2nd worst in the separation test with a small 0.07%. This leads me to say that there was so much microbiology that they even ate most of the dead roots as well as the underwear.
- Also, I now think soil doesn't really affect whether or not there is a significant amount of biology. I think the reason that my hypothesis was incorrect is the fact that Field #2 has a deeper tillage method than the other fields. So that, even though Field #3 was tilled later than Field #2, the deeper tillage method must have damaged the microbiology worse.

So What?

So, why do all the bacteria and fungi matter so much? Well, lets take a look at Dean Glenney's method of raising his crops. Glenny uses a method called "Fencerow Farming" and has been doing so for 20 years now, and his corn yield in 2010 was a huge 301 bushels per acre. The non-disturbed soil has created 100 times more of only seven types of bacteria while the neighbor had 26 types but 100 times less in numbers. More bacteria that work together creates more available nutrients to the crop, therefore encouraging more growth.

Also, Blake Vince in his 2014 Nuffield Scholar report stated that "Soils higher in Soil Organic Matter (SOM) are generally considered to be higher yielding. This may be because SOM acts as a bank account for nutrients. SOM helps to cycle nutrients and increase nutrient efficiency. Tillage of soil tends to destroy accumulated SOM by burning off soil carbon." (Section 2.2.iii.)This tells us that by tilling the fields it destroys microbiology that, as we established in this experiment, takes a long time to replenish.

To put it simply: More Microbiology = Higher Yield.

About The Science Fairs

4-H Canada Science Fair Pictures

Canada-Wide Science Fair Pictures