BATTLE RIVER IMPLEMENTS LTD.

January 2026

AGRONOMY UPDATE

Building Soil Health

Soil is the heart to any farm, and like any business, reinvestment is needed to maintain long term growth. Historically, we have depleted soils for instant results in yield instead of building soil health over the longer term for delayed long term yield advantages, however, the ability to invest in your soil is what marks the difference between a short-term and long-term successful farm. Only in the last 50 years or so has the agricultural community become aware of the power of biological element of soil and symbiosis, but, due to the increased complexity of biological systems, there has only been marginal understanding of how plant-microbe interactions work. This biological complexity combined with the seemingly infinite commercial products that claim to promote soil health, have made it difficult for producers to clearly understand the needs of their soil, especially in Canda where there is no public research available around the subject.

Like many biological phenomena, microbial and plant interactions in the rhizosphere cannot be directly quantified making it difficult to make recommendations without soil specific information. However, there are several overarching themes that are true regardless of soil profile. A study conducted by A & L Canda Laboratories showed that although microorganisms in bulk soil are generally the same throughout Canada, the microbes in the plant rhizosphere and inside plants are selected for by the plant to provide symbiotic benefits, such as increasing nutrient availability. In figure 1, the differences in microbial population between two neighboring corn field with the same fertilizer inputs show that the higher yielding corn was able to select for specific beneficial species, while the lower yielding corn could not select for certain microbial species due to poor soil health and nutrient imbalances. In another study comparing yield to micronutrient concentration in corn showed that higher yielding corn had greater concentrations of copper, zinc, and boron despite none of the micronutrients being applied to the different fields, as seen in figure 2. Therefore, the micronutrient availability in the soil was greater in higher yielding fields due to microbial activity compared to lower yielding fields. This is found to be true for macronutrients like sulfur and phosphorous as well.

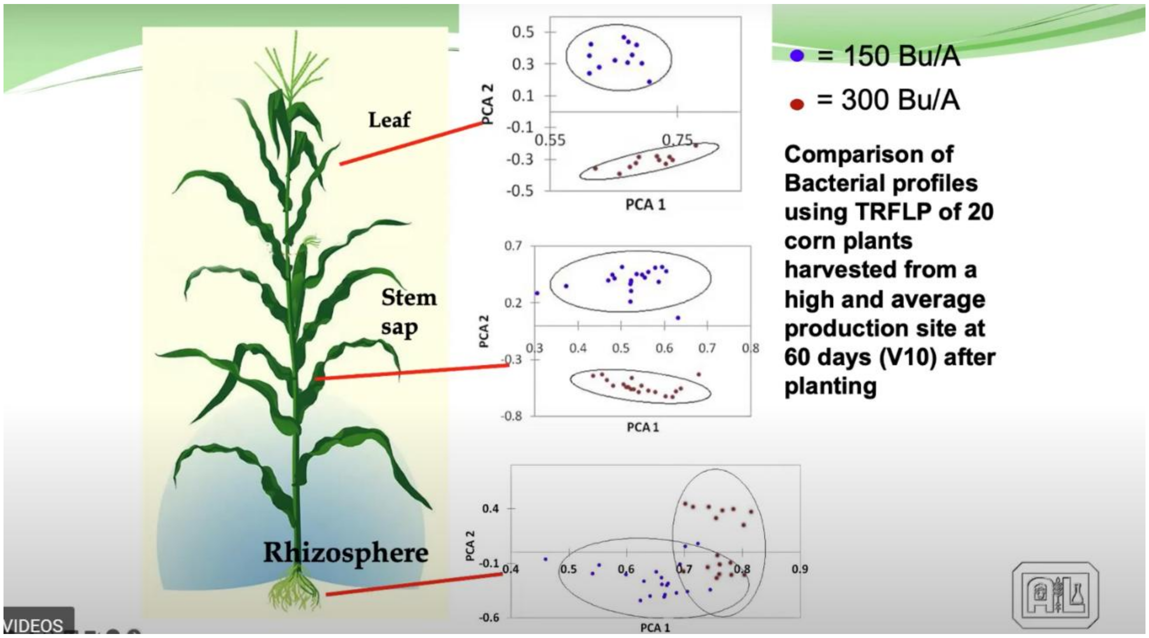

Figure 1: Comparison of microbial population throughout corn plants in neighboring corn fields with 150 and 300 bu/acre yields. PCA1 is microbial population at planting (large diversity in microbial population) while PCA2 is the microbial population after 60 days (selected microbial population) where negative PCA2 values show selection. From "The Engine of the Soil: Igniting the Evergreen Revolution"

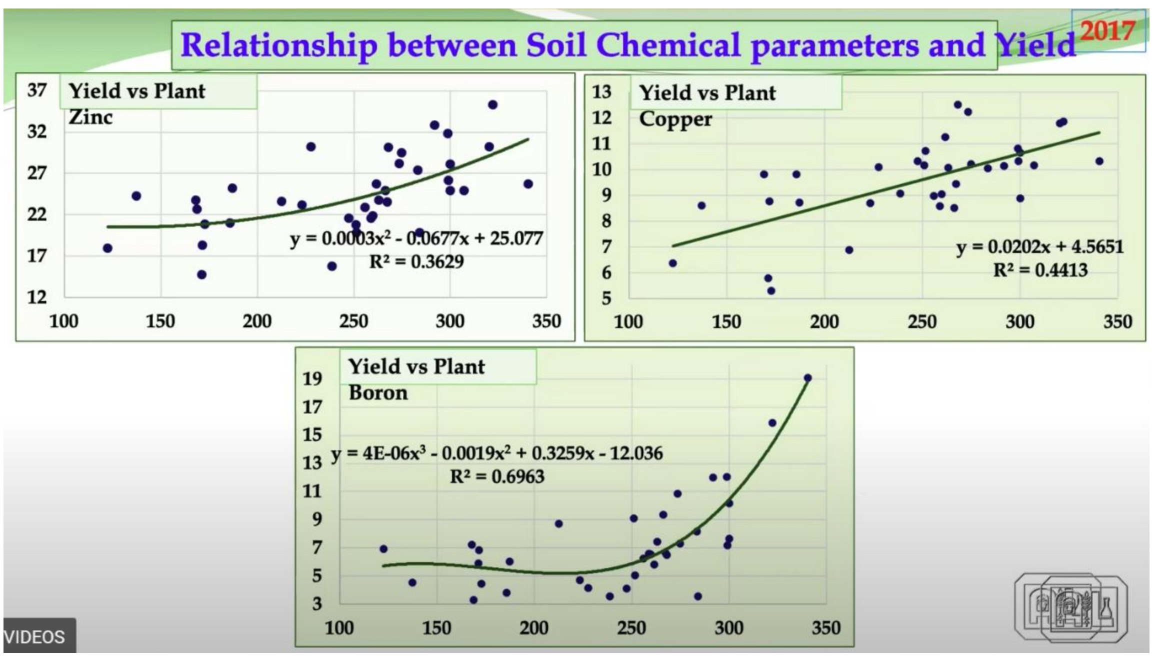

Figure 2: The correlation between yield and in-plant concentration of Copper, Zinc, and Boron of different fields with the same inputs. Demonstrating that higher yielding plots can access nutrients that lower yielding crops cannot. From "The Engine of the Soil: Igniting the Evergreen Revolution"

If the defining factor between higher and lower yielding crops with the same inputs is healthy soil microbial communities, then what makes a healthy soil? First and foremost, good soil properties, like low bulk density, pH between 5 and 6, sufficient drainage, and high cation exchange capacity (CEC) are key indicators in the amount of plant and microbial life that can be sustained. These properties are summarized into a fertility index (GFI) value with a higher value meaning greater fertility potential. Next, beneficial microbial communities thrive best in a higher percentage of potassium (0.6-0.9), but also a balanced potassium to magnesium ratio (>0.5). Phosphorous saturation, calcium, boron, soluble salts, and nitrate nitrogen are also contributing factors (Figure 3).

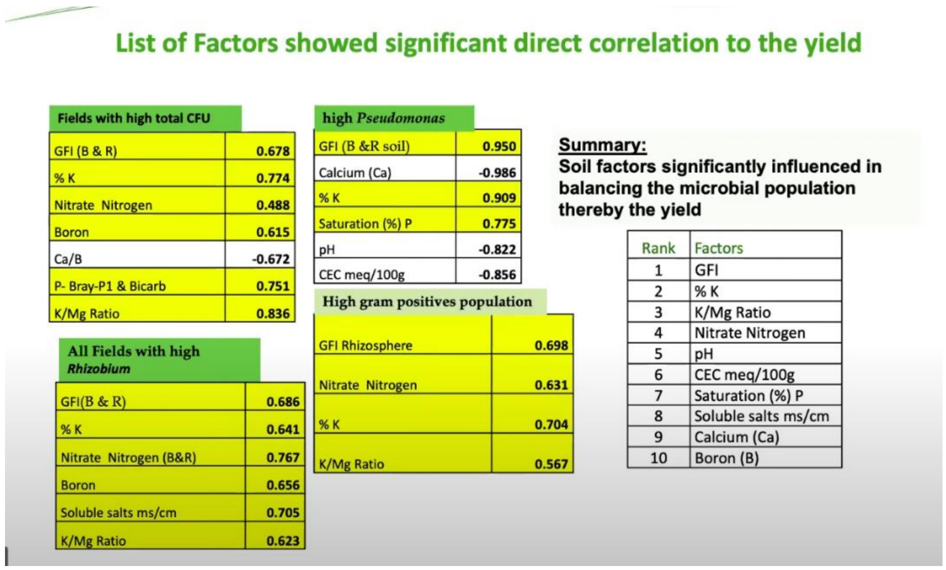

Figure 3: Summary of several studies on factors impacting presence of beneficial microbial communities. Fields with higher beneficial microbial populations also had greater correlation to ranked factors. From "The Engine of the Soil: Igniting the Evergreen Revolution"

With these factors in mind, what is the best way to build soil fertility to support symbiotic microbial populations? The answer is to think of fertility as long term plan over at least 5 years instead of a year-to-year replacement of what the crop takes off. Soil needs to be enriched to build and sustain beneficial microbial communities, so only applying what a crop takes off negates the overall soil buffering system, depleting nutrient resources over time. A good example of this is potash and sulfur, where the soil maintains a large amount of immobilized (not plant available) potassium and sulfur, that require additional input to release immobilized nutrient to make it plant available. A composite study in China has shown that mixed application of organic (compost and manure) and mineral (potash, nitrates, and phosphates) fertilizer has the greatest increase in yield, available nutrient, soil organic matter, and microbial activity while decreasing nutrient leaching (table 1). Therefore, to properly enrich soil, a collective approach of feeding the soil and not just the crop as well as mixed fertilization is necessary to increase yield and stability over the long term.

Fertilizer type	Crop yield increase (%)	Soil organic matter increase (%)	Available nutrient increase (%)	Microbial activity increase (%)	Reduction in nutrient leaching (%)	References
Mineral only	10–20	1–2	20–30	5–10	5–10	Timsina (2018)
Organic only	15–25	10–15	15–25	20–30	20–30	Tian et al. (2017)

Fertilizer type	Crop yield increase (%)	Soil organic matter increase (%)	Available nutrient increase (%)	Microbial activity increase (%)	Reduction in nutrient leaching (%)	References
Combined	25–40	15–25	30–50	30–50	30–50	Dincă et al. (2022)

Table 1: Table showing analysis of studies conducted with mineral only, organic only, and combined fertilization application. From "Enhancing soil health through balanced fertilization: a pathway to sustainable agriculture and food security"

A & L Canada Laboratories studies:

"The Engine of the Soil: Igniting the Evergreen Revolution"

https://youtu.be/WOe13abrZ30

Composite study of organic, mineral, and mixed fertilization strategies:

"Enhancing soil health through balanced fertilization: a pathway to sustainable agriculture and food security"

https://doi.org/10.3389/fmicb.2025.1536524

BATTLE RIVER IMPLEMENTS

Annika Carroll

Agronomist, AIT

(780) 608-5628