Biologicals for Drought

In drought-stricken years, the uncertainty of low yields can make it challenging to conduct trials and explore new agricultural products. Questions arise, such as:

"Is a biological product really a sensible choice during a drought year, or is it better to wait for more favorable environmental conditions to run a trial?"

It's important to consider the role of soil biology and its impact on germination and early plant health in drought years. If used and applied properly, the right biological products can be a huge asset at planting to develop a strong, healthy plant from square one.

We are going to share some of the research we are currently working on to back up these claims. Over the years, we have observed results in drought years, where crops have held on an extra week, or where the root development in the treated side allowed a producer to actually pull off a crop.

Field Observations

This is a graphic that shows a crop with mostly brown on the left. The center line is where product was dosed. On the right is a green field where it received treatment. This was lentils.

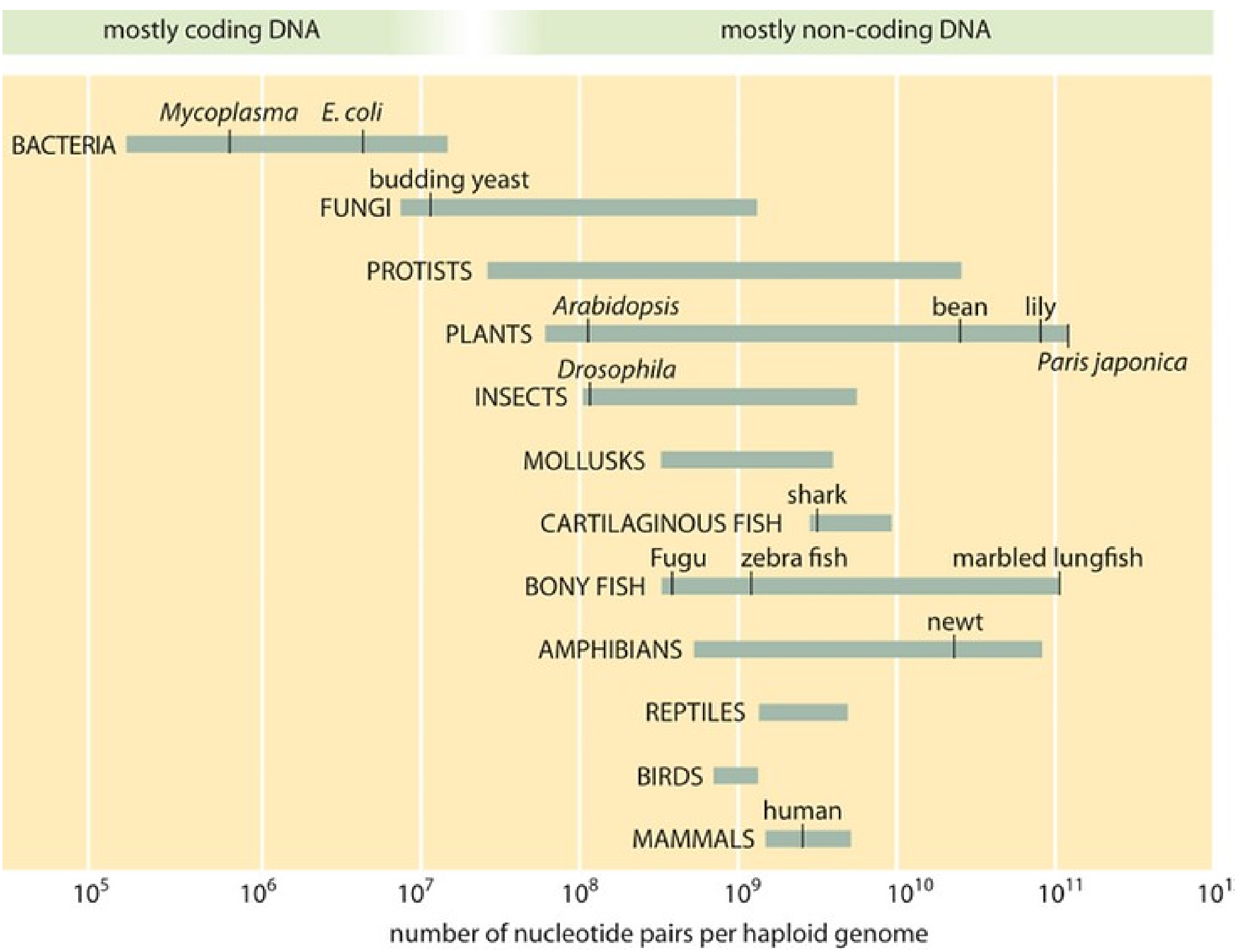
The first time we saw this was in 2019, on a field of lentils in Foremost, Alberta, where this producer had about 2" of rain during the growing season. Both sides of the line are not ideal, but it was clear to see what ACF-SR was able to do to the treated side.

Since then, we have put a lot of resources and research into the “WHY?”

Genome Sequencing & Drought Tolerance

The focus of our research at the tail end of 2023 and into 2024 has shifted due to new findings in genome sequencing of the bacteria we use. These findings have been groundbreaking when it comes to the discussion around drought.

What does genome sequencing mean?
Every living thing on Earth has a genetic footprint. It just so happens that because bacteria have been around for billions of years, they have much more information in their DNA than any other living thing on Earth.



This chart shows the number of nucleotides of various organisms: bacteria at

10^5 to 10^7, higher organisms with increasingly larger genomes, and humans at around 10^9 to 10^10 nucleotide pairs.

When we began looking at the DNA footprint of the bacteria species we use, the “WHY” became a lot clearer. We performed “whole genome sequencing” of our bacterial strains and analyzed the gene sequences for plant growth-promoting genes.

What we found most interesting about this data is how much relates to plant stress and drought tolerance. Look at the percentage number on “stress response.” While stress can mean many different growing-season stresses, other parameters in this data are directly linked to drought tolerance.

	B. licheniformis	*B. amyloliquefaciens*	*B. subtilis*	*R. palustris*
Ammonia production	0	3	3	9
Antioxidants	42	38	47	71
Biocontrol	142	120	120	113
Cytokinin	3	3	3	4
Heavy metal tolerance	21	18	19	40
Heat shock proteins	40	30	31	41
Auxins	15	16	16	13
Nitrogen fixation	2	1	1	50
Osmolytes	14	13	12	14
P acquisition	8	9	8	32
S acquisition	23	18	19	33
Salicylic acid	8	10	8	4
Salt tolerance	27	29	33	28
Siderophore	17	5	11	8
Stress response	24	30	32	13
Volatiles	6	2	3	7
Chitinases	2	1	1	0

A table showing the number of plant growth-promoting genes in four of TLC’s key strains of bacteria, highlighting genes related to stress tolerance, nitrogen fixation, phosphorus solubilization, etc.

Translating Genome Data into Real-World Results

Gene data mapping is a great start to understand the functionalities of our biological products. But what about actual plant performance? This is where things get really exciting.

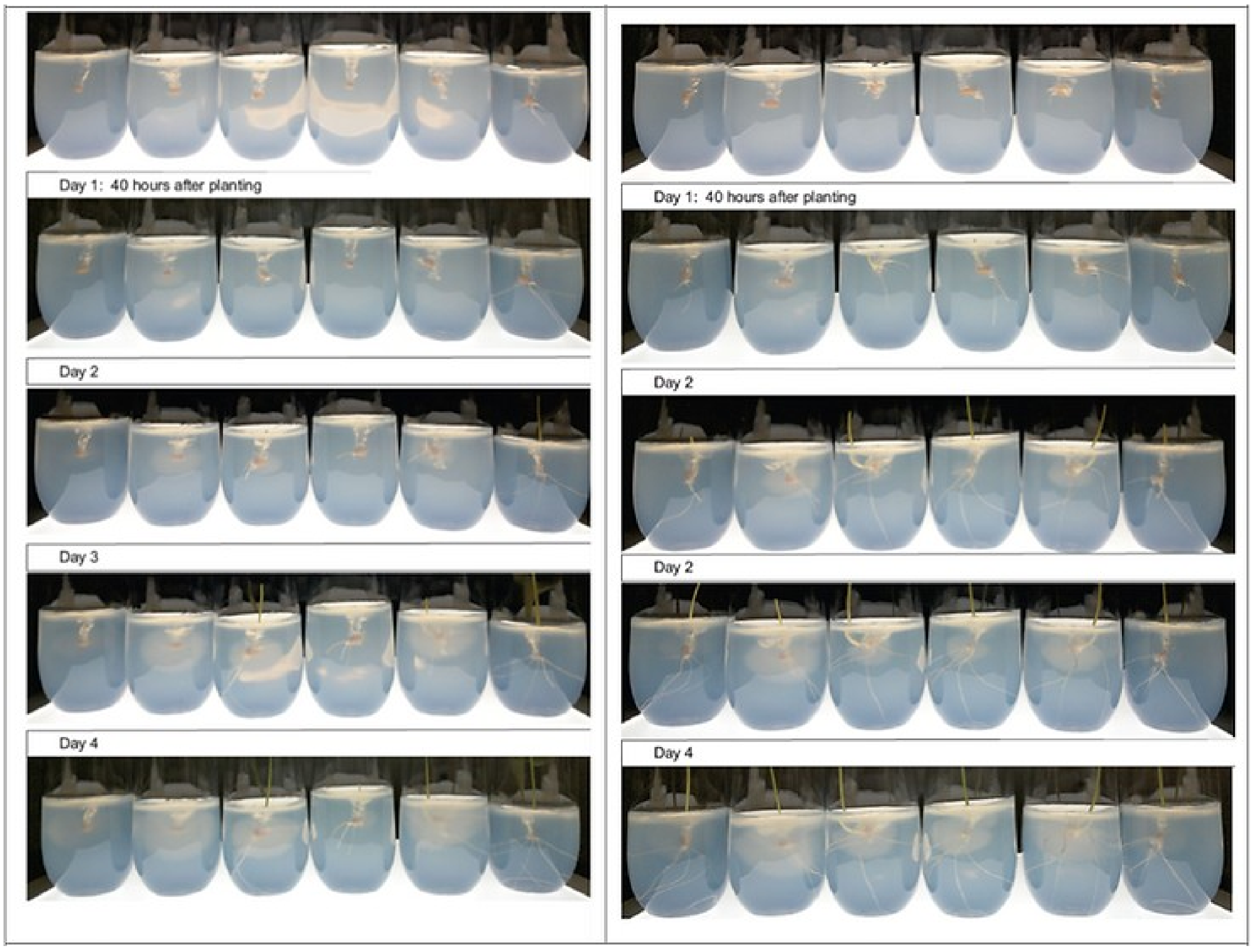
Greenhouse Trials & Methodology

Dr. Polina Volkova, Doctor of Biological Science and our Director of Research, has set up greenhouse trials where data is statistically relevant. This was done using two primary approaches:

1. **Artificial Soil**: To remove variability in soil parameters and isolate what our bacteria can do when applied solely on the seed under more controlled environments.

2. **Soil Trays**: A larger trial with 144 trays and ~1020 plants (treated and control) using different soil types (productive vs. non-productive).

Below is an image from our artificial soil seed-treatment trial on wheat under drought conditions (watering eliminated shortly after planting). You can see the plants on the right have much better root development; in fact, the treated plants had a 33% faster germination rate.



Side-by-side with control on the left vs. treated on the right in a clear, gel-based artificial soil, shown across multiple days (Day 1, Day 2, etc.). We use the artificial clear soil so that you can actually see root growth.

The results from this trial were staggering. After nine days, the treated plants had roughly an extra inch of growth and about 50% better overall plant development—despite zero watering from March 25 to April 3, 2024

Soybean Trials: Standard 1020 Trays

Now, let's look at some data on soybeans using standard 1020 trays as experimental units.

Soybean Run, Experimental Setup

- 3 “treatments”: Control, Seed Treatment liquid, and Seed Treatment Powder
- Seed Treatment dose equivalent to recommended field dose
- Each treatment had 8 trays (~24 seeds/tray * 8 trays = 192 seeds per treatment)
- All trays subjected to identical PAR (light), temperature, and humidity
- All trays randomly relocated in the greenhouse every 48 hours
- All trays received identical watering schedules, whenever watering occurred

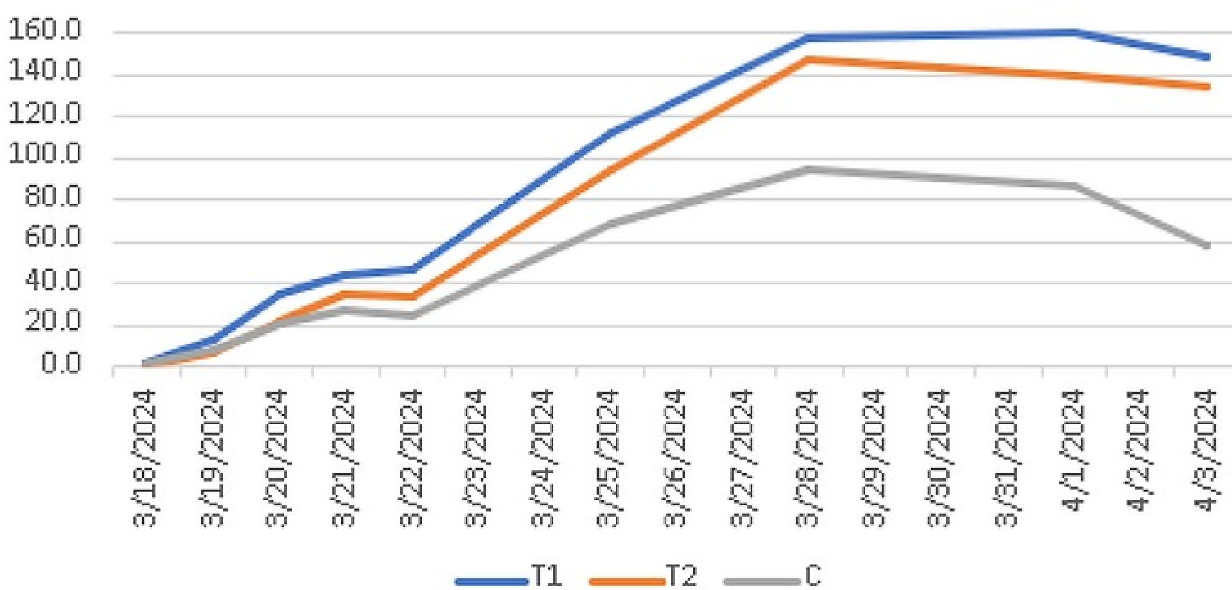
Product Dosing – ACF-ST

- Seed treatment (or control – just water) on March 15 (morning)
- Planting on March 15 (afternoon)
- Humidity domes kept on the trays through March 25

Second Product Dosing – ACF-SR

- Applied to half of the trays in each treatment group, selected randomly, on March 28
- Standard field dose rates used
- Watering was intentionally low (to simulate drought) from March 25 to April 3

Below is a graph showing average soybean length per tray, with the grey line representing the control:



Graph of total soybean seedling length per tray, comparing two treatments vs. control. The control line is grey. T1 is ACF-ST, and T2 is ACF-SR.

Drought Simulation Results

During the induced "drought," the performance gap became even more pronounced:

Tray	Change 3/25 to 4/3	Average Change in Group	Average Change in Group
33	29.5	59.625	Treatment 1, with second dose
37	66.5		
38	54		
40	88.5		
34	18	35.5	Treatment 1, NO extra dose
35	75.5		
36	33.5		
39	15		
41	49.5	41.875	Treatment 2, with second dose
44	64		
46	17		
47	37		
42	-16.5	39.625	Treatment 2, NO extra dose
43	49.5		
45	65		
48	60.5		
26	-84	18.875	Control (no seed treatment), with second dose
29	50.5		
30	63		
32	46		
25	-47	-9.75	Control (no seed treatment), NO second dose
27	44		
28	-2		
31	-34		

Chart showing seedling biomass changes under four conditions: ACF-ST only, ACF-SR only, a combination of both, and zero product.]

This data shows that trays receiving biologicals—whether seed treatment alone or combined with ACF-SR—dramatically outperformed the control. The treated plants continued to grow, while the control group actually lost biomass.

Conclusion & Key Takeaways

Our greenhouse and field data consistently demonstrate that the right biologicals can **significantly** boost plant performance, even under harsh, drought-like conditions.

How does this translate into the field?

- **Extended survival**: Crops hold on longer, buying time in a drought.
- **Stronger roots**: Enhanced root mass allows for more efficient water and nutrient uptake.
- **Better germination**: Faster and more uniform germination, critical in low-moisture conditions.

With the increasing frequency of droughts, our ongoing research strongly supports the use of proven biological solutions. Properly chosen and applied soil biology isn't just a "nice-to-have"—it's an essential piece of the puzzle in modern agriculture.