



# A journey to Validation —

## A summary of the latest information from the GMS research team

There comes a time in every person’s life when hopefully his or her effort, dedication, faith and perseverance is validated. Often, this fits into various areas in life such as family, faith, friends and occupation.

The men (hereinto known as “the innovators”) in the picture to the right share different backgrounds. One is a distinguished agronomist and agricultural researcher, another is a banker/farmer while a third is a teacher and researcher. The two farmers had the unique ability to cast aside premises and investigate something new, but unproven, their in-field tests helped form the foundation of the GMS program.

Over 64 years after this picture was taken, the sons and daughters and grandchildren, recently developed, with the help of both simple tests, and the latest technology, what their fathers and grandfathers knew, but could never see, test or validate.

The following is the latest research that the people of Growers Mineral Solutions family, to the representatives and customers both present and past, know, that this revealing information would make them smile, revealing much of what they could not show, or prove, back then.

The inventor of GMS, Dr. VA Tiegens (2nd from the left) was a simple man. Educated in an elite college, he went on to become a world-renowned researcher in area of agronomy to which only a handful of men belonged.

During field days at research centers, farmers would be surprised how easily such a man related with them. His willingness to spend his time and with a patient attitude answering their questions gained him much respect among the farming community.

The simple experiment to the right would, after an intense visual study, elicit a smile. The Solution we know as GMS did not come to being without first many failures, and seeing the roots choose the GMS side would have validated his efforts in working through the issues to get all the elements needed by a plant, without a high salt index that would have harmed them. This test would have been very satisfying to him to see.



The “Innovators” (L-R) Marvin Gooding -farmer; Dr. V.A Tiedjens; Wilbur Franklin Research/teacher; Leo Halbeisen –farmer; Joe Henry –owner, Growers Mineral Solutions: Date -Early 1960’s



Wheat seeds lined up and sprouted on blotter paper in pure water makes a choice between half-moon blotter papers saturated in a diluted solution of 10-34-0 and GMS.

## Seeing Sugar

The availability and inexpensive nature, relative to the past, of today’s technology brings forth multiple pieces of information from one test sample.

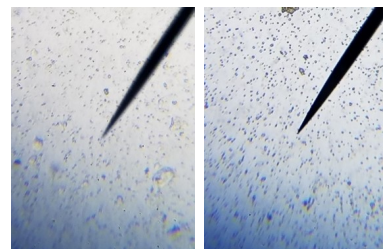
The developers of the GMS product and program knew by taste and the ability of produce to keep in storage longer must have something to do with better quality sugars produced by the GMS solution.

One of the goals of the GMS program is to remove/reduce excesses of standard NPK fertilization and the un-balanced availability often in a high salt form that they present to the plants.



One can only imagine the banter between the innovators after looking over the multi-layered outcome of this cucumber trial. The impact of these tests leads to a greater understanding of the GMS mindset, not to mention a more satisfying (both taste and nutrition) eating experience.

Visual proof of the higher brix (sugar) readings (top and bottle pictures)



Tissues tests revealed 10-30% higher brix, trace elements and even fat (yes! cucumbers have a detectable fat content!)

100 x magnifications of samples from left. Conventional Fertilizers (left) and GMS right)

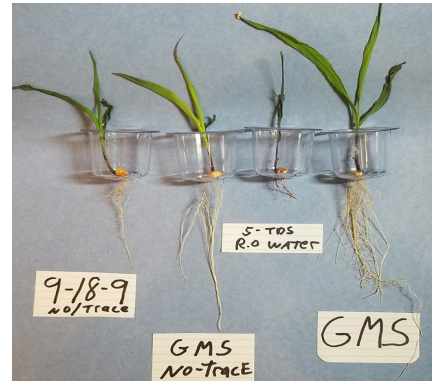
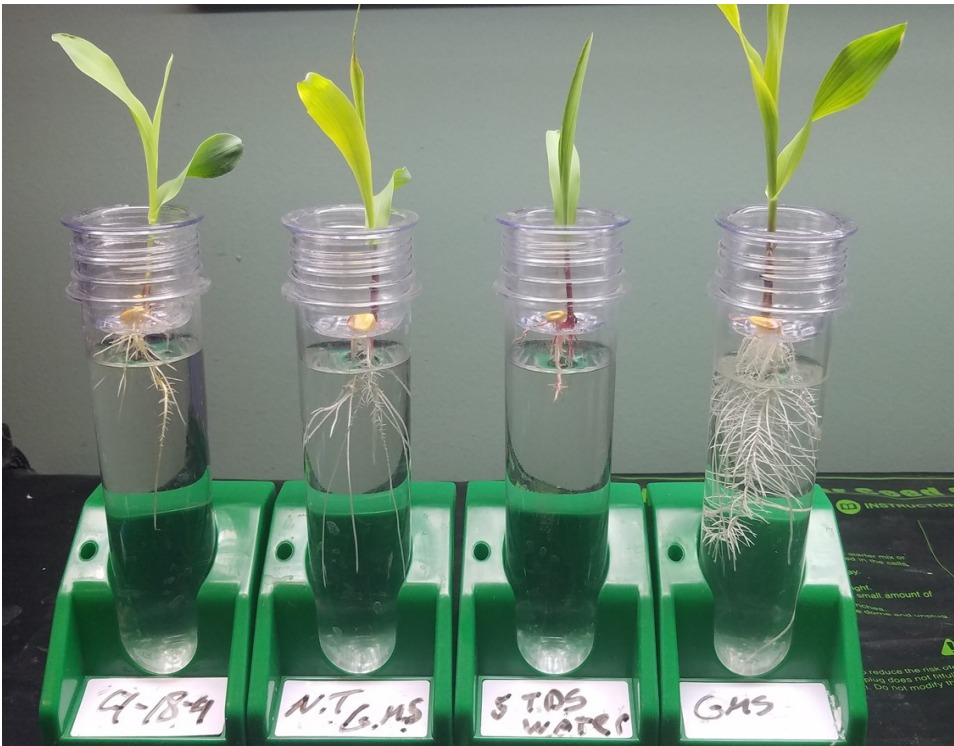


The Nutritional density clearly showed when dried.

## The picture that says it all

Considered the best visual test to date, 500-1 dilutions of 9-18-9, a 10-20-10 without trace elements, plain water and GMS were grown, revealing a huge lesson in the value of trace elements, raw material quality, and the effects so little of a high-quality fertilizer can have on plant development. For decades the Innovators along

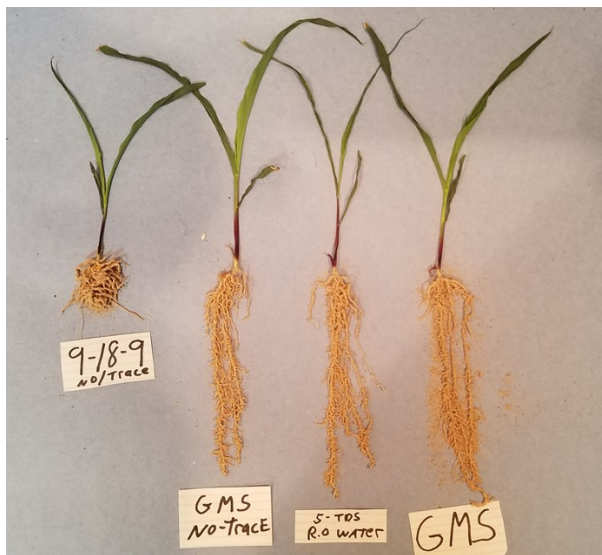
with GMS representatives and farmers, wondered about the value— added aspects of trace elements, especially recently, as many products market single and/or multi packets of added trace elements to their products.



After 3 days of open air drying.  
Final weight of seedlings (with roots)  
9-18-9- 0.34 grams  
GMS no trace elements-0.36 grams  
R.O. water -0.27 grams  
GMS - 0.39 grams

Note the stem and leaf differences of what is left after drying. This re-enforces the understanding that good nutrition has on dry matter content.

The Corn seedlings are from an open-pollinated variety with seeds taken from the same row off the cob.- Seeds are sprouted on blotter paper with filtered water, and are selected for uniformity based on root size, and number of roots, along with sprout size.



Seedlings dried and weighed

- 9-18-9 2.17 grams; 10-20-10 (no trace elements) 2.18 grams; Plain water only 2.53 grams; GMS 3.61 grams  
- A major difference was discovered when shaking sand free of the roots on the seedlings; the GMS hair roots were more numerous and finer, holding onto more sand, thus it is felt the higher weight of the GMS sample is in part due to some sand being difficult to shake free of the roots.

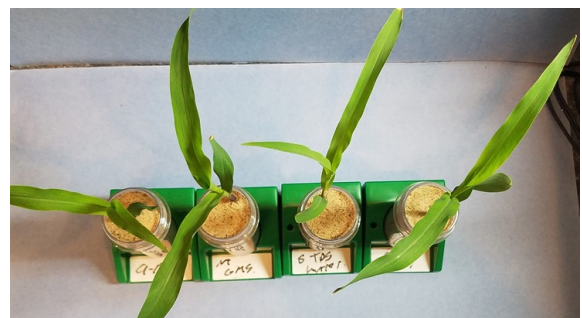
## Sand test

Using the same containers and dilutions from the hydroponic test, a new set of seedlings were grown in sand. The sand had no detectable biology but does have some levels of soluble and un-soluble nutrition.

What shocked the researchers was the failure again of the 9-18-9 solution, which was chosen

for these tests, as it was the best of the many different fertilizer formulations and analysis they subjected to different chemistry characteristic studies.

One of the farmers from the page 1 photo would have been very amused of this trial, as he once used a 9-18-9 fertilizer before GMS was developed!



An overhead picture shows the difference in leaf size. (L-R) 9-18-9; 10-20-10-no tr. elements; Water only; GMS

## The latest technology

Last year, the research people at GMS located a new testing kit that eliminated issues with testing the biological biomass in the soil.

Almost from the beginning, it was felt by those that used GMS for a number of years on their crops, and among those that used it as a mineral source for their animals, that it appeared to a positive effect on soil life.

While many agribusiness operations claim to

have the best soil test for biology, The research team found nothing but frustration with them, much of it from issues that arise from the time of gathering, to the time of testing. There were too many x-factors that distorted any accurate results being possible.

Enter the bio-meter, a real time 20-minute test that accurately allow results after gathering, allowing the research team to harvest real numbers, and validate what scores of GMS user's and developers always thought, but could never prove, till now.



*The biometer is a comparison test. Producing a number representing the bio-mass of fungi and bacteria.*

## Biology validation

Using a special technique, 15 grams of soil was placed in a small box with 1 ml. of water place in drops on top of the soil. The soil was lightly mixed producing saturated balls for the test.

As one of the first lab-controlled tests of the biological bio-mass in soil, it supports what we had done in a broad-based experiment we had did last fall. (see page 4)



*As a comparison, a test was run on the soil before being placed in the containers to be saturated with the test solutions. That bio-meter number was 215*

*The boxes of soil after treatment were placed at a steady temperature of 57 D. 24 hours later the first tests were pulled, and are shown in the chart to the right. Another test run was recorded at 72 hours.*

Soil @ 57 Degrees Control bio # =215	Bio# @ 24 hrs. -72 hrs.
Water	170-214-
9-18-9	215-252
10-20-10 no trace	305-307
<b>GMS</b>	<b>334-357</b>

## Biology enhancement

The Growers Mineral Solutions premise is based on enhancing soil biological activity in multiple ways.

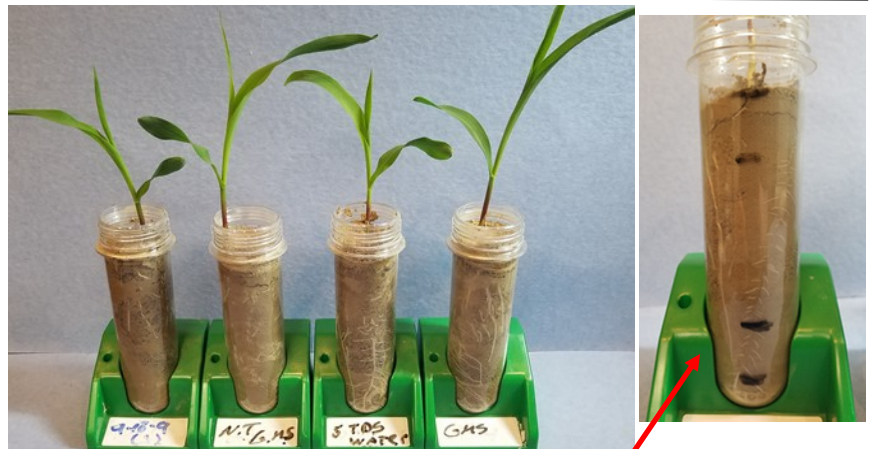
One of those ways is understanding the role of calcium in the soil, combined with clean balanced nutrition placed correctly, in a timely way, and in proper amounts, will have a positive effect on soil life and the farmers profitability.

Using the same 500 to 1 dilutions from the hydroponic trial (on page 2), vials of soil from a soybean field were saturated once.

Corn seedlings from the same row, on the cob were sprouted in pure water, and graded to a likeness of sprout and root size before being placed in the vials.

After the seedlings reached a certain height, the above ground portion was removed and weighed, and the soil removed to the depth of the seed. From there, 1 inch of soil was removed and mixed, and then run through the biometer. Another test was performed with a lower 1 inch of soil.

With a biometer number of **215** the soil at the assembly of the test, the resulting numbers speak for themselves.



*(L-R) 9-18-9;10-20-10 n/tr.; water only; GMS*

*Biometer# 215 at assembly of the test*

Vials watered once with 500 to 1 solutions	Bio-meter <u>top</u> 1" of vial	Bio-meter <u>Lower</u> 1 inch of vial	Weight of stem and leaves at the end of the trial
9-18-9 no/trace	211	201	0.70 grams
10-20-10 no/trace	305	278	0.67 grams
Water only	299	66	0.56 grams
<b>GMS</b>	<b>333</b>	<b>253</b>	<b>1.03 grams</b>

## Surprising information!

The bio-meter continued to be an eye-opener for the research team and as you will see although the trial last fall did give support to the biological enhancement of GMS, it was a surprise after 4 months of the trial conclusion that gave quite a shock!

But first, four rings were placed in the field and in the green and yellow ring the equivalent amount of GMS at 2 gallons to the acre was applied.



In the black and red ring, the equivalent to 300 lbs. of a 5-10-15 dry fertilizer with trace minerals was applied.

4 days and 22 days after the initial application Bio-meters samples were recorded. Areas outside the rings were pulled for a control sample.

Remember, the biometer is best used as a comparative in real time, so the number difference between the group of 4 days and 22 days may or may not be relevant, perhaps with experience and observation we will learn to understand the time variable between test numbers.

But what got our attention was the longevity of that application of GMS when 4 months later in the middle of winter we took the saved samples of the day 22 test run and performed another round of biometer tests. An eye opener indeed!

Biometer results 10-22-21	Sample location	Bio#
4 days after appl.	Outside ring (control)	104
4 days after appl.	Yellow ring (GMS)	133
4 days after appl.	Black ring (dry fert.)	68
22 days after appl.	Outside ring (control)	151
22 days after appl.	Green ring (GMS)	291
22 days after appl.	Red ring (dry fert.)	168

4 months after 22 day test above	Biometer#
Dry Fert. (red ring)	202
GMS (green ring)	304
Check (outside test rings)	204

## The “DINKY” amount no more

The Innovators and GMS representatives, along with customers, often took it on the chin from others with statements like “you cannot raise anything with such a dinky amount”

With “all hands-on deck” the entire research team and office personnel tackled developing the GMS Cost and Nutritional Analysis calculator also known as the CNA.

We took a basic per acre input calculator and enhanced it to give a true cost of applied nutrition based on product, purity, placement, availability, amount and cost per unit of the fertilizer applied.

The men in the picture on the front page—the “Innovators” would be overjoyed to have such a tool back then. It shows GMS and the “dinky”

amount accusation to be no longer relevant.

With simple ease, it shows the **Total pounds of applied nutrition** along with the **total pounds of available nutrition**. It then takes the **cost per acre** of the applied materials, and then reveals the **cost per**

**pound of available nutrition**, the true cost of using the various fertilizers farmers have to choose from.

The program uses the fertilizer availability chart shown to the right, a painstakingly assembled chart with inputs from many sources averaged and condensed into a usable form.

It is an eye opener for those who use it, and with GMS availability pulled from the top of the chart, it is no wonder the people who once called GMS “Dinky” are now silent.

So, this generation of GMS users honors those Innovators from the past, with solid evidence, tests and numbers of the true value of GMS, in its cost of use, purity of its NPK content, proof of the value of its trace element content, and now, evidence of its biological enhancement properties.

For today’s farmers facing a vast number of products to choose from, it is clear **Growers Mineral Solutions** covers a lot of areas of nutritional enhancement claimed by those other products, making it a profitable choice, as a farm’s foundational nutritional solution.

Fertilizer Availability Index	%
Hot Ortho Seed applied LIQ.	95
Cold Ortho Seed applied LIQ.	63
Hot Poly Seed applied LIQ.	60
Hot Ortho 2x2 LIQ.	48
Cold Ortho 2x2 LIQ.	41
Cold Poly Seed applied LIQ.	40
Hot Poly 2x2 LIQ.	30
Cold Poly 2x2 (3 element) LIQ.	20
Cold Poly 2x2 (2 element) LIQ. (10-34-0)	10
Dry 2x2	20
Dry Broadcast	10
28% / 32% LIQ. 2x2	20
28% / 32% LIQ Broadcast	10
Fertilizer Y-drop (LIQ.)	15
Fertilizer Strip Till (LIQ. & Dry)	20
Fertilizer Side dress (LIQ. & Dry)	15
ATS 2x2 additive	20
ATS Broadcast additive	10
Liquid Manure - N	60
Liquid Manure - P	100
Liquid Manure - K	85
Dry Manure - N	41
Dry Manure - P	50
Dry Manure - K	85

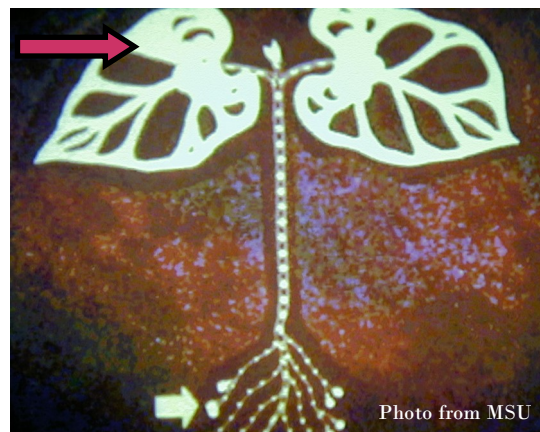
*Derived from Howard H. Johnson, "High Quality Plant Food Advantages." Environmental Development Services. L.M. Walsh, University of Wisconsin; R.L. Donahue, Kansas State University; J.O. Veatch, Michigan State University; H.H. Johnson, University of Minnesota*

# A journey to Validation –Foliage feeding

When Dr. VA Tiegens developed Growers Mineral Solutions, the information of foliar applied nutrients was almost non-existent. Was it possible, and by what mechanism would plants use foliar applied nutrients was not even considered back then.

One clue that plants did absorb leaf placed elements and transport them throughout the plant came from Michigan State University in the early fifties.

A drop of radioactive phosphorus (red arrow) was placed on the leaf and a Geiger counter showed rapid movement throughout the plant. (Green arrow)



For decades GMS would conduct on farm research plots and over the decades results would vary in soybeans 2-17 more bushels to the acre. With corn 2-23 more bushels to the acre.

In forages, which in tonnage gained can be difficult to measure (especially back then) tests on the foliage would often show striking increases in result numbers. (see chart to the right).

In vegetables and fruit, tissue tests would more often than not return significant gains when GMS was applied. (see below)

But how did the plants utilize GMS in such small amounts to produce such broad spectrum gains?

2nd cutting grass/alfalfa wet wrapped	Control	2.8 Gal- lons GMS foliage fed	% difference
Moisture %	12.6	16.4	
Crude Protein %	22	24.3	+10.45
Digest. Protein %	12.2	15.3	+9.2%
Acid Det. Fiber %	35.8	30.4	-15%
Neut. Det. Fiber %	44.6	42.2	-5.38%
TDN %	63	66	+4.76
ENE, % Therms/ CWT	54	56	+3.70%
NE/LACT. MCAL/LB	0.65	0.68	+4.61%
Calcium %	1.33	1.42	+6.76%
Phosphorus %	0.23	0.38	+65.2%
Magnesium%	0.12	0.18	+75%
Potassium %	1.17	1.80	+53%
Iron, ppm	171	238	+39.18
Manganese, ppm	40	55	+37%
Copper, ppm	8	13	+44%
Zinc, ppm	26	32	+23%
RFV	127	144	+13.3%

Cortland apples –core and peel removed	Untreated	Growers Minerals - total of 6 Gallon -3X
Protein	2.12%	3%
Calcium	0.04%	0.07%
Magnesium	0.05%	0.06%
Phosphorus	0.05%	0.08%
Potassium	0.59%	0.58%
Iron	115ppm	90ppm
Manganese	2ppm	4ppm
Copper	1ppm	1ppm
Zinc	1ppm	2ppm
Boron	0ppm	2ppm
Sulfur	0.02ppm	0.05ppm

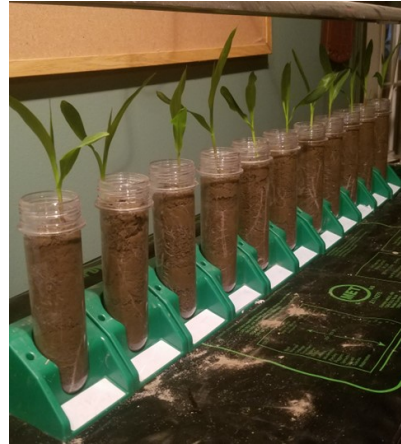
## A journey to Validation –Foliage feeding

To further investigate how plants were distributing foliar applied nutrients, special equipment was developed and simple multi– result tests were set up and recorded. The results were eye-opening, especially to the second and third generations of GMS customers and farmer/representatives who's father's spent so much time out foliage feeding their crops.



Foliage feeding applicator

Vials of soil with equal weight and same one-time watering of pure water were established and foliage fed twice (four days apart) with the equivalent to 2 gallon-acre of GMS, 10-20-10 no/trace, 28% nitrogen, molasses, and a 9-18-9 - in 13 gallon of water.



Corn plants were from the seed off the same cob, sprouted in pure water and graded to the same root and sprout size before planting.

Seedlings were grown until soil moisture was exhausted to facilitate root removal.

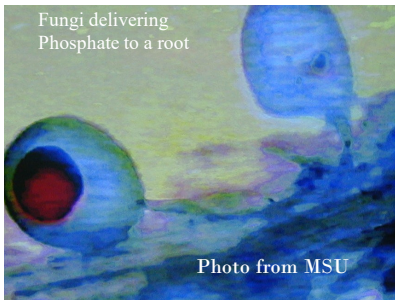
Root weight of the different applied foliar nutrition is shown after drying.

- The above ground plant parts were also dried and careful weighted.

**GMS** - 1.08 grams  
**10-20-10 n-tr.** - 1.08 grams  
**28% nitrogen** - 1.12 grams  
**Molasses** - .75 grams  
**9-18-9** - .77 grams



## A journey to Validation –Foliage feeding

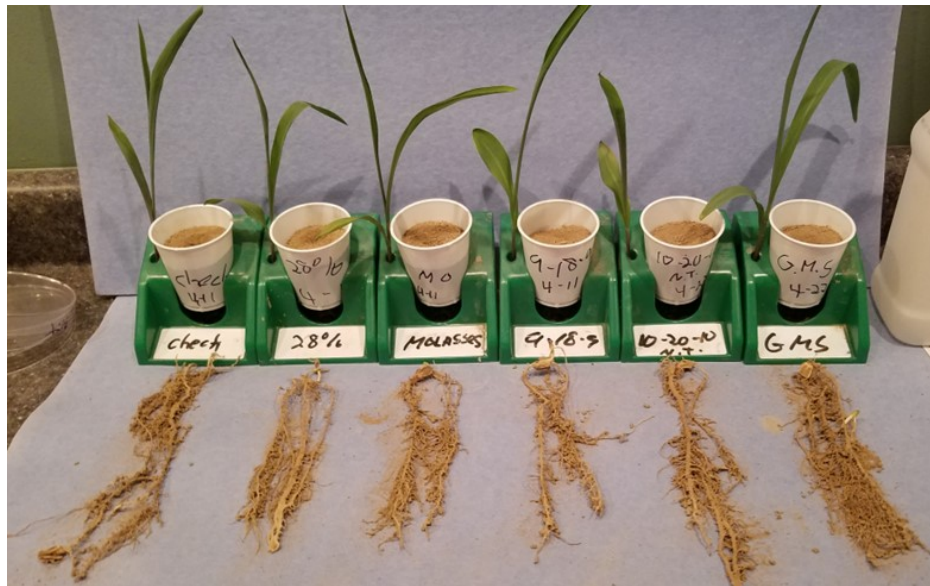


*Fungi delivering phosphate (red dot) to the root.*

As seen earlier, the recent purchase of the soil biometer enlightened the researchers of the value of GMS to soil biology.

The soil from each vial after root extraction was screened and mixed. A biometer test (right) revealed what had been always considered by thousands of GMS representatives and customers—GMS properly foliage fed enhances soil biology!

Soil biometer # at trial start	Biometer number
<b>215</b>	
<b>GMS</b>	<b>286</b>
<b>10-20-10 n/tr.</b>	<b>283</b>
<b>28% Nitrogen</b>	<b>174</b>
<b>Molasses</b>	<b>218</b>
<b>9-18-9</b>	<b>141</b>



L-R – Check (no spray material applied); liquid 28% nitrogen; blackstrap molasses; 9-18-9; 10-20-10 no traces: Growers Mineral Solutions.

With such favorable results of 2 applications of GMS on the corn seedlings, a second trial was done using one foliage fed application equivalent to 2 gallons to the acre GMS in 13 gallons of water.

This time a check vial (no foliage spray) was added and the results recorded to the right.

The men who started GMS so long ago would smile brightly at these results, for they further validate the versatility and value of **GROWERS MINERAL SOLUTIONS.**

One spray at 2 gallon/acre	Micro-Biometer #	Stem weight at harvest	Root weight (air dried)
<b>Check (not sprayed)</b>	162	.66 gram	.30 gram
<b>28% Nitrogen</b>	94	.58 gram	.30 gram
<b>Molasses</b>	152	.65 gram	.29 gram
<b>9-18-9</b>	112	.63 gram	.26 gram
<b>10-20-10 no/trace</b>	120	.56 gram	.28 gram
<b>GMS</b>	201	.79 gram	.35 gram