SOLUTIONS IN THE LAND

Terreplenish® Research 2011-2016

Summary

Feed Earth Now

Skokie, IL

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1/15/2015

Bringing agriculture into the 21st Century

Solutions in the Land, INC extends research to whole-system farm planning, leveraging unique value-added markets while reducing stormwater runoff and restoring the productivity of the soil. The focus of soil amendments have been largely on nitrogen, phosphorous and potassium. The health and diversity of the microbiological community in our agriculture soils are essentially ignored.

Feed Earth Now, Inc. is manufacturing a micro flora liquid and pulp product from food waste branded as Terreplenish®. We feel Terreplenish® has great potential to stimulate the regeneration of our precious agriculture soils while providing the producer more bottom-line profits. We are encouraging growers to use this products to experience the results in their own fields while reducing input cost, rebuilding soils and connecting sustainable production techniques with their marketing partner for agriculture products.

Currently, there is a surge of interest in who and how our food is produced. This driver will permit new restorative production practices to flourish. This is a critical time for new innovation to emerge in our chemically intensive agriculture.

Our in-field research of Terreplenish® has shown a boost in nitrogen availability, improved phosphorus uptake and healthier plants. Randomize, replicated, singulated trials are difficult as Terreplenish® is a community of microbes being applied to a community of microbes already in the soil. Across 68 plant species, we have observed not only healthier, more productive plants but also accelerated maturity resulting in lower field loss at harvest. The micobes in Terreplenish® capture atmospheric nitrogen and atmospheric water providing another ecological service in concert with nature.

In addition, the diverse community of microbes and secondary metabolites in Terreplenish® accelerates residue decomposition capturing essential nutrients from crop residue, build soil organic matter and increases the water holding capacity of the soil. This combination of microbes also keeps soil borne pathogens from increasing populations resulting in decreased need for chemical fungicides.

All of these statements are bold and need to be supported by university laboratory research. Following is the results of one of our lab test of Terreplenish®.

Conversion of Atmospheric Nitrogen to Soil with the Application of Terreplenish®

A. Introduction

(1) Effect to be measured is increased nitrogen in the soil from atmospheric nitrogen with a soil-applied diluted mixture of Terreplenish® and water. The primary microbial ingredients of Terreplenish® are Azotobacter and Pseudomonas heterotrophic bacteria. *Azotobacter* is a genus of free-living diazotrophic bacteria whose resting stage is a cyst. It is primarily found in neutral to alkaline soils, in aquatic environments, and on some plants. It has several metabolic capabilities, including atmospheric nitrogen fixation by conversion to ammonia. Their unique system of three distinct nitrogenase enzymes makes these bacteria potentially critical in supplying plant available nitrogen for growing crops. *Azotobacter* have the highest metabolic rate of any organisms.

Terreplenish® is made through a proprietary process that stabilizes the chosen microbes for predictable activity following proper application. In this process, several secondary metabolites are produced as a by-product that has many other beneficial plant health effects, but this paper deals with atmospheric nitrogen. With the nitrogen, it is noteworthy that a beneficial amount of H20 from the atmosphere is also integrated into the soil.

(2) The trials were conducted at Beaver Creek Gardens of Poplar Grove Illinois between August 16th, 2013 and September 25th, 2014. This gave us a preliminary indication of activities of Azotobaceria and Pseudomondas.

(3) Solutions in the Land, LLC was contracted in 2011 to present to write efficacy trial protocols, conduct trials and review the published literature on the active ingredients in the product known as Terreplenish®.

(4) Solutions in the Land, LLC profile:

Ronald G. Doetch, Managing Partner, Principal Investigator, University of Illinois, BS Agronomy, 1969, Wisconsin Integrated Cropping System Trials Advisory Board, 1996-2010, University of Wisconsin, Arlington Research Farm, Agriculture Efficacy Trials, 1970- present.

Cal Pickrum, Research Intern

R Douglas Galbraith, Research Intern

B. The Product Terreplenish®

(1) Application Guidelines

For Pre Plant Application: Apply 7-10 days ahead of seeding.

For Post Plant Application: Apply after emergence. Applications may be repeated every 7 days or every 3 in fast maturing crops< 45 days

(2) Dilution Guidelines

Suggested dilution 25- 50 parts water to 1 part Terreplenish®; 64ozs makes 25 gallons of solutions. Do not mix stronger than one 64oz container to 5 gallons of water.

(3) Re-entry time - ZERO
Safe for pet and child exposure immediately after application.
(4) Tank mixing with synthetic & chemical fertilizers is discouraged. Specifically soaps, salts and fungicides.
(5) Chemical analysis
Numerous trace amino acids, carboxylic acids, peptides, alcohols, ammonium salts -0.1%, complex sugars, esters, aldehydes; concentrate pH before dilution 4.0; Microorganisms> 108 CFU/ml,1%: Lactobacillus casei.
(6) Caution
Avoid spills and prolonged direct contact with the skin and wash with clean water Immediately to prevent injury or irritation. Do not ingest. The fermented products repeatedly have been shown to be free pathogens. Keep out of sunlight. Avoid prolonged exposure to oxygen by replacing cap after each use.

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Claim: Soil-applied Terreplenish® will convert atmospheric nitrogen and water to fixed soil nitrogen as a result of the life processes and rapid reproduction of the Azotobacter bacteria.

C. Materials, Methods and Procedures

Azotobacter is of interest because of its ability to form an unusual resting structure called a cyst. Azotobacter cells are rather large for bacteria, many isolates being almost the size of yeast, with diameter of 2-4µm or more. Azotobacter is able to grow on a wide variety of carbohydrates, alcohols and organic acids. The metabolism of carbon compounds is strictly oxidative and acids or other fermentation products are rarely produced.

The bacterium used in this study was off the shelf Terreplenish®. The pH of the medium was adjusted to 7 .0 The growth medium was inoculated with a dilutions of 1-25 Terreplenish® to pH 7.0 water grown at preculture medium for 22 h. Preculture medium was the N-free medium and it was inoculated with one loopfull of bacterial cell transferred from the solid medium. Preculture was cultivated at 35°C and 150 rpm. Growth was quantified with aerobic plate count method. The samples taken from the growth medium was diluted to appropriate concentration. Dilution solution was the N-free medium except the carbon source. The diluted cell 23 suspensions were inoculated over the solid N-free medium. And the plates were incubated at 35°C for 40 h then the white colored colonies were counted.

Nitrogen fixation capacity of Terreplenish® was quantified indirectly by measuring the products of nitrogen fixation activity; extracellular protein and ammonia concentrations. The ammonia

concentration was measured with Nesslerization Method following the procedures described in Standard Methods for the Examination of Water and Wastewater. Absorbance of the samples were measured at 400 nm against the blank solution prepared as the uninoculated 24 initial medium, since the salts contained in the medium interact with the reagent causing overestimation.

D. Results

As a study to further fix soil nitrogen with Terreplenish®, this nitrogen-fixing bacterium was cultivated in chemically defined nitrogen-free medium. Effect of several factors on growth and nitrogen fixation capacity of Terreplenish®, such as pH, temperature, aeration, inorganic salts and combined nitrogen was evaluated. Growth is measured as viable counts by plate counting using the ammonia and extracellular protein concentrations as criteria in growth medium under diastrophic conditions.

The dynamics of growth and nitrogen fixation at different physiological conditions and nutrient requirements of Terreplenish® in chemically defined N-free medium was determined.

Conclusions – In greatly varied medium similar to agricultural soil conditions, Terreplenish® secretes some substances available for plants, such as *protein, ammonia and water.*