



Roles Marketing International, Inc.

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ABOUT TURF FORMULA

Turf Formula

b i o - s t i m u l a n t

Superintendents and turfgrass managers routinely see the benefits of using **Turf Formula** and **Super-Cal** to achieve and maintain healthy greens and turf. The value of these products is not just when the grass is most actively growing in the spring and fall. It is just as important during the hot and dry periods during the middle of summer. Regardless of the season **Turf Formula** and **Super-Cal** help the plant in many ways:

- Loosen soil for better root penetration and greater oxygen uptake
- Promote more extensive, vigorous and healthy root growth
- Improve the uptake of essential plant nutrients
- Increase resistance to insects and disease by increasing soluble solids in the tissues and by increasing the thickness of cell walls
- Improve tolerance to high sodium salt soils

These benefits are even more important when the grass is under stress during the hot summer months. Greens are already under stress with extensive mowing done in the best of weather, but in the hot, dry summer months, it is important to do everything possible to reduce this stress to keep the greens actively growing. Because of the high usage that greens have in the summer and high environmental stress during hot weather, brown patches and other turf loss are unsightly on the course, and also costly to restore once the weather improves. A better approach is the use of **Turf Formula** and **Super-Cal** to promote better health and growth of the grass throughout the entire season.

Get results by adding Turf Formula!

- 36% Decrease in Brown Patch
- 35% Increase in Root Mass
- 33% Nematode Reduction
- 73% Salt Reduction in 90 Days



What The Research Says

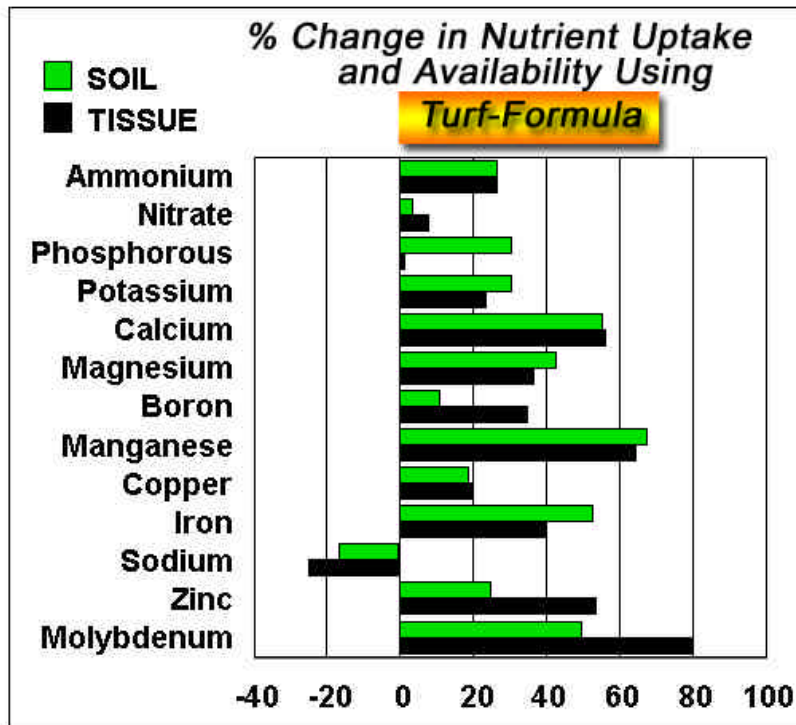
3400% Increase in Microbial Activity

The microbiology division of EMSL Analytical in New York, NY recently investigated the effects of Turf Formula® bio-stimulant and Super-Cal® liquid calcium when applied to soil media. The soil was tested for colony forming units (CFU) before treatment and then 24 hours later after treatment. The CFU/gram of soil went from 5,500,000 to 187,500,000. That is over 34 times more colony forming units per gram than the untreated soil.

Turf Formula® increases natural microbial activity within the soil, speeding up the bio-degradation process resulting in the production of organic matter and humus. This increases the amount of plant available nutrients as well as enzymes, amino acids, antibiotics, and natural growth stimulants that plants require.

Conclusion: Agri-Gro not only improves yield and plant growth, but has the potential to reduce environmental pollution by more efficient utilization of fertilizer nutrients and thus the potential reduction of applied fertilizers.

Figure 1: % of Change in Nutrient Availability and Uptake



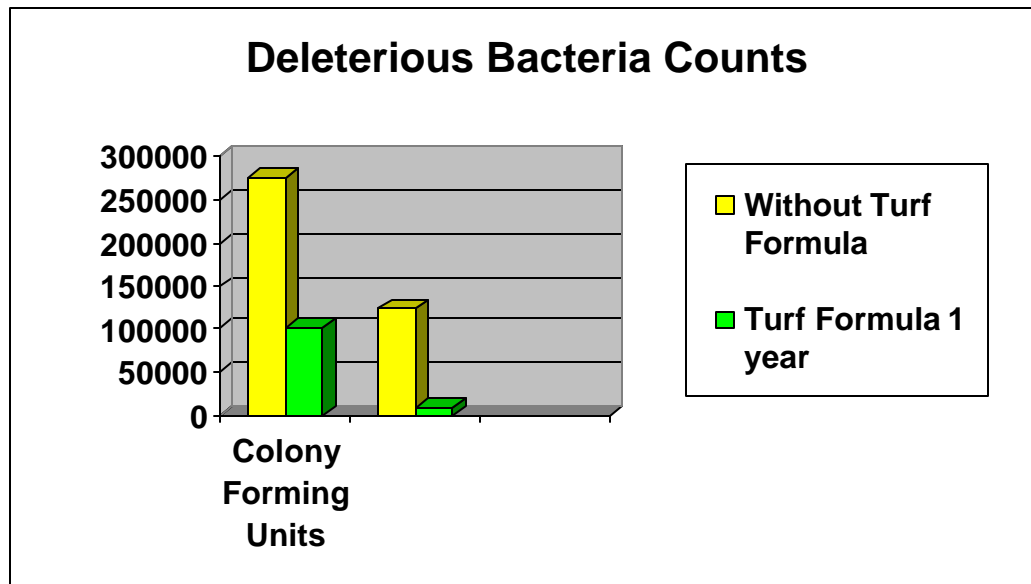
Research conducted by Lincoln University,
Jefferson City, MO

University research has shown **Turf Formula®** increases nutrient availability up to **68%**. Research also proves that **Turf Formula®** lowers sodium levels in the soil and plant tissue. Since sodium competes with potassium for uptake, high sodium levels can greatly reduce the plants ability to absorb nutrients. High sodium levels are also conducive to high nematode counts.



The number of total microbes in a growing environment is not as important as the types of microbes that are involved. Another component of the microbial effects of Turf Formula® is the ability of this product to reduce disease. Growth problems have been associated with certain genera of disease causing bacteria, primarily *Pseudomonas* sp., which have shown the potential to produce toxic growth regulators and plant poisons. A 12 month study using Turf Formula® & Super-Cal® resulted in the suppression of several groups of deleterious (pathogenic) microbes. The following graph shows the effect of Turf Formula® & Super-Cal® on the population of one group of deleterious *Pseudomonas* bacteria.

Figure 2: Deleterious Bacteria Counts



Tests conducted by Dr. David N. Sasseville Central Florida

These changes represent a 63% & 92% reduction in pathogenic microbes in 2 different tests. In other testing Turf Formula® & Super-Cal® have been shown to suppress certain other turf diseases such as Anthracnose, Fairy Ring Fungus and Brown Patch.

The effect of the increased microbial action is (1) the actual suppression of the pathogen itself, (2) promotion of beneficial antagonist organisms that suppress the pathogen, (3) strengthening of the plant's own defenses against the disease.

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- Fig.3

University of Missouri-Columbia & Dr A.H. Hunter of Orange City, FL



Studies on Turf Formula

In 1999, a greenhouse study was conducted at Lincoln University in Jefferson City, Missouri. Growing media was a clay loam soil taken from a Central Missouri site and mixed with washed pure quartz sand. The treatments included Turf Formula applied according to manufacture recommendations, and fertilizer treatments of complete Hoagland fertilizer solution, macronutrients alone, and micronutrients alone. The plants were harvested on three separate dates with soil and tissue analyzed for nutrient composition and dry weights of tissues determined. A randomized complete block design was used with 10 replications.

The key findings of this study include:

- Turf Formula significantly increased the availability of boron, iron and zinc in the growing media (soil mixture), the concentration of boron and iron in the vegetative tissues was increased by Turf Formula, but the total quantity of these nutrients taken up by the plant on a whole plant basis was not affected. The soil used for this study already had adequate levels of these nutrients for the plants' needs and thus the additional amounts were not used by the plant, but primarily accumulated in the soil. Consequently, the other observed effects of Turf Formula cannot be attributed to the application of these fertilizer nutrients, but to other active components of Turf Formula.
- The vegetative component of the plants (as measured by dry weights) was slightly smaller with Turf Formula than the control. Possible explanations include-
 - A) Reduced nutrient availability at the very early growth stages of plant growth when Turf Formula was applied. Since Turf Formula stimulates microbial populations, these organisms tie up plant nutrients causing reduced nutrient availability. The greatest effects occur upon initial application and stimulation of microbial growth. As the microbes die, these nutrients again become available to the plant at a later stage of development.
 - B) Growth regulating compounds within Turf Formula itself or by the stimulation of production of these compounds by soil microbes by Turf Formula.
- The smaller size of the plant was not reflected in the yield with Turf Formula; in fact, yield was significantly increased with Turf Formula on the initial harvest. The concentration of nutrients in the grass was significantly higher with Turf Formula, but Na was significantly reduced. The quantity of several nutrients which had moved into the grass was significantly higher with Turf Formula treatment. These included N, S, B, Ca, Cu, K, Mg, P and Zn. The soil concentration of nutrients with Turf Formula greatly dropped during the third harvest, but the quantity of nutrients in the vegetative tissues were not greatly increased indicating that the nutrients taken up from the growing media were translocated to the growing plant. The limitation in this data is that the plants did not complete their normal productive life cycle to be able to compare the total yield production.

Continued...



- In addition to boron, iron and zinc, Turf Formula resulted in significantly higher soil concentrations of N, Ca, Cu, K, Mg, Mn and P in the growing media than untreated plants and soil. And with the exception of Mn, these same nutrients had similar or significantly greater concentrations of nutrients in the vegetative tissues with the use of Turf Formula. Possible explanations for these results are:
 - Turf Formula enzymes or microbes stimulated by Turf Formula are "mining" the soil by making more nutrients available from the exchange sites on the soil, especially calcium, potassium and magnesium. This is supported by the nutrient treatment that received no macronutrients (N, P, K, Ca, Mg and S). Turf Formula resulted in an increase in available macronutrients in the soil indicating a "mining" effect of Turf Formula for the cations NH, K, Ca and Mg. The presumed effect here is to stimulate cation exchange or release of the soil particles. Additionally, the concentration of available P increased with Turf Formula treatment over the three harvest dates, but decreased over the same harvest periods without Turf Formula. It would be expected that the P levels would decrease over the harvest dates as the plants grew, but the increase in P levels indicate that Turf Formula is making P more available possibly by enzymatic action or promotion of microbes with enzymatic activity for P.
 - Turf Formula is interacting with the applied fertilizers to retain them in the soil in a more available form. Similar processes as above may be able to keep applied nutrients more available to plants, e.g. keep from being bound to soil particles or converted to unavailable chemical Compounds.
 - The nutrients tied up by the increased number of soil microbes are released by the dying microbes causing more available nutrients over time.
- Another interesting observation was that while Turf Formula promotes increases in cations, Na was consistently lower in Turf Formula treated soils and plants. This may be worthy of further investigation with saline soils since high Na competes with K for uptake by plants.

This study indicates that Turf Formula has potential to reduce fertilizer application to turfgrass, and that the effects of Turf Formula go far beyond its micronutrient content. With soils having adequate or near adequate micronutrient content, the greatest benefit is the increased availability of both macronutrients and micronutrients. Maintaining high levels of micronutrients and macronutrients, especially K, in the growing media until the plant needs them for root and seed development may play a critical role in the value of Turf Formula. Turf Formula also has potential to reduce environmental pollution by more efficient utilization of fertilizer nutrients and thus the potential reduction of applied fertilizers. Traditionally, fertilizers have been applied in large quantities early in the season, only to have a high percentage of the fertilizers lost to leaching, volatilization, and being tied up by biotic and chemical reactions. The use of micronutrients, enzymes and microbes such as provided by Turf Formula may offer a real opportunity to reduce the environmental impact of grass production while at the same time increasing the efficiency and profitability of grass production. Further research is needed to better understand the mechanism whereby Turf Formula is able to accomplish this, as well as how to maximize the benefit of Turf Formula to get the most efficient use of all fertilizer nutrients.—Study conducted by Dr. David N. Sasseville, Ph.D. Lincoln University, Jefferson City, MO.

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