

# White Paper



## *BioNatra: The Active Ingredient in Fertile Earth Formula Plant Food*



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## ***BioNatra Overview***

BioNatra™ is an all-natural biological growth activator from Fertile Earth Corporation of Salt Lake City, Utah. BioNatra is a complex biologically derived product that is used to increase soil fertility, improve crop yields and decrease the requirements for fertilizers and other chemical inputs such as pesticides, herbicides and fungicides. The product is derived from plants and naturally occurring microbes. BioNatra is non-toxic, non-carcinogenic, non-hazardous and contains no pathogenic microorganisms and can be applied in the presence of people and animals.

BioNatra was originally developed for the agricultural industry as a means of stimulating natural microbial activity in soil to improve overall crop yields and soil health. After 20 years of measured results in agriculture it was also discovered that the same principles that make BioNatra effective in soil also provide tremendous benefit to the treatment of wastewater and other sources of biological waste. The product accelerates the breakdown of volatile bio-solids and also eliminates odors in waste lagoons, extended aeration and drying beds, feedlots, etc. Consequently, Fertile Earth has formulated versions of BioNatra for both the agriculture and wastewater industries.

## ***BioNatra Development – Joseph Spruill, PhD.***

BioNatra was originally developed by Dr. Joseph Spruill; PhD, a biochemist and microbiologist. Dr. Spruill is best known for having developed the stabilization process for Aloe Vera but was also heavily involved in the study of the role of symbiotic microorganisms in human health and agriculture. During one study involving cancer patients, Dr. Spruill compared the digestive systems of healthy patients to those of unhealthy patients and found that the populations of certain kinds of naturally occurring beneficial bacteria were higher in healthy patients while the populations of deleterious or harmful bacteria were lower.

Dr. Spruill's applied these findings to the agricultural realm and found that healthy plant/soil systems also contain higher levels of symbiotic microorganisms since decaying organic matter and other inorganic compounds require natural biological processes to be decomposed as part of a natural and healthy ecosystem. He also found that organic decay resulting from healthy microbial activity yields other benefits such as increased nutrient availability and higher levels of growth promoting substances such as antibiotics, organic acids, enzymes and proteins that are beneficial to sustained and healthy plant growth.

**“The next great advances in agriculture will be in the utilization of plant and soil microbes.”**

**Dr. Robert J. Kremer, Soil Microbiologist  
USDA Agricultural Research**

As a result of his research, Dr. Spruill isolated and harnessed these beneficial bacteria and developed a sophisticated culturing and fermenting process to produce an extremely effective biological growth activator or bio-stimulant that would naturally activate and accelerate healthy microbial activity in soil to increase fertility, simulate root development and decrease other chemical inputs commonly used in agriculture.

## BioNatra – A Unique Product

BioNatra is a unique product that compliments and enhances existing growing practices:

- BioNatra has been tested in Agriculture of over 20 years. Results data are available from commercial growers as well agricultural universities and other independent bodies.
- While BioNatra contains no detectible living organisms, the product increases healthy indigenous microbial activity in a growing medium by as much as 2000% within the first 3-5 days after application.
- BioNatra increases soil tilth, friability and porosity while decreasing sodium levels making previously anemic or ungrowable soils more productive.
- BioNatra stimulates root development from 30-50 percent which increases nutrient availability and uptake as well as overall water efficiency.
- BioNatra is a source of essential micronutrients, proteins, enzymes and complexed carbohydrates not found in most fertilizers.
- BioNatra is a liquid product that can be easily applied in conjunction with most pesticides, herbicides, fungicides and fertilizers at a rate of approximately 1 quart per acre, per month through a spray rig or fertigation system.
- BioNatra is derived from many different types of beneficial bacteria; including aerobic and anaerobic microorganisms, making the product effective in oxygen rich as well as oxygen deprived environments.
- BioNatra can stay in solution for over 5 years without losing its effectiveness.

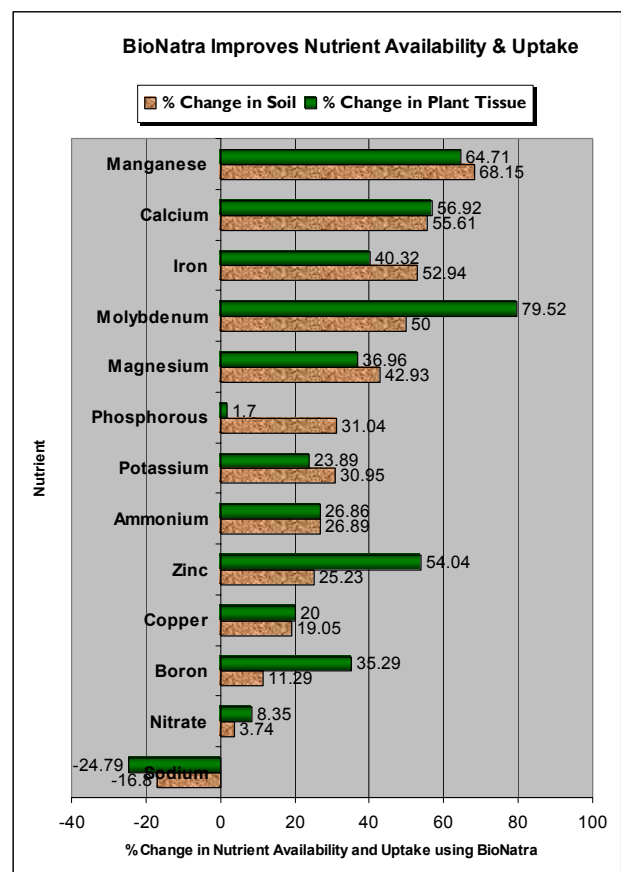
### A Bio-stimulant

BioNatra improves natural biological processes in soil that convert tied up<sup>1</sup> nutrients into a form of nutrition that plants can immediately utilize. BioNatra accelerates the break down and conversion of decomposing organic matter into Humus; an extremely beneficial source of nutrition for plants. The product also provides plants with micronutrients, vitamins, complexed carbohydrates, enzymes and growth hormones not found in fertilizers.

The benefits of BioNatra are not limited to its effect in the soil. The graph to the right illustrates BioNatra's impact on plant tissue as well as the soil.

### Foliar Application

Applying BioNatra to the foliage of plants increases photosynthesis and the plant's ability to metabolize carbohydrates, proteins and other growth compounds contained in the leaves. These compounds are then transferred to the root system. From the root



**Figure 1:** Research performed by Dr. David Sasseville, PhD. University of Missouri – Lincoln Extension

<sup>1</sup> Nutrients in the soil are said to be “tied up” when they are not available to plants because they are in a form that the plants cannot use or are “tied up” by other elements making them unavailable to the plant. (i.e. Soil too high in pH (alkaline) or too low (acid) makes minerals unavailable to plants.)

system they move out into the rhizosphere (the soil zone that surrounds the roots), feeding bacteria, algae, fungi and protozoa which in turn produce beneficial enzymes, organic acids, antibiotics, growth hormones and other nutrients. These growth stimulants are then re-absorbed by the roots in a form that plants can immediately utilize and are then transported back through the plant system producing higher yielding, healthier crops with more natural minerals and nutrients in the plant tissues (vegetation, fruits and vegetables).

## ***Natural Microbial Activity & Humus***

In nature, when plants and animals expire, they naturally decay with time, water, sun, air and naturally occurring microorganisms - also called decomposers<sup>2</sup>. BioNatra stimulates decomposers which microbial activity and results in the production of **Humus**<sup>3</sup> in the soil on which plants thrive. The castings and other byproducts from these excretions and decomposing microbes results in the production of Humic Acid in the soil; a primary ingredient to Humus and one of the best sources of nutrition to plants. The production of Humus in the soil combined with BioNatra's micronutrients and growth promoting substances provides the following benefits:

- *Increases the soil's ability to retain water.*
- *Improves soil structure; tilth, porosity and friability.*
- *Assists in seed germination and early plant growth.*
- *Improves natural chelation of resident soil minerals and fertilizer materials.*
- *Aids in the detoxification of pollutants (toxic residues, heavy metals and salts).*
- *Increases permeability of plant membranes for better water/nutrient absorption.*
- *Improves development of roots systems.*
- *Stimulates vegetative growth.*
- *Improves crop quality and yields.*
- *Improves natural resistance to disease, pests and drought, reducing the requirements for chemical pesticides, herbicides and fungicides.*
- *Stimulates plant metabolism.*
- *Improves pH-buffering capacity - minimizing the impact of pH extremes.*
- *Enhances cell division and elongation.*

The creation of Humus in the soil helps plants to grow in the way nature intended and provides the most optimal growing conditions for plants. Soils with low levels of microbial activity will not produce as well as those with elevated levels of beneficial microorganisms; even in the presence of manually applied fertilizers.

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<sup>2</sup> Decomposer: organism, usually soil bacteria, that derive nourishment by breaking down the remains or wastes of other living organisms into simple organic compounds.

<sup>3</sup> Humus consists of partially or wholly decayed vegetable/animal matter that provides one of the best sources of nutrition to plants and increases the ability of soil to retain water.

## BioNatra Increases Microbial Activity

When natural biological activity in the soil is low, partially decomposed organic matter can accumulate, minimizing the soil's effectiveness and increasing the dependence on fertilizers to sustain favorable growing conditions. BioNatra invigorates natural *biological* processes by increasing the populations of indigenous microorganisms in the soil. Morning Star Laboratories of Moonpark, California tested soils before and after BioNatra therapy (tested under an agricultural brand name). Test results on the untreated soil sample showed microorganism populations to be 31.8 million SPC/GM. The soil was then treated with one application of BioNatra and was re-sampled three days later. Microbial activity on the treated sample showed a 2000 percent increase in microbial activity in three days.

*"Soil microorganisms stimulate the rebuilding of the soil and often have been observed to do so at a more rapid rate than many other known methods such as crop rotation, mulching, and other soil treatments."*

Dr. William Jackson

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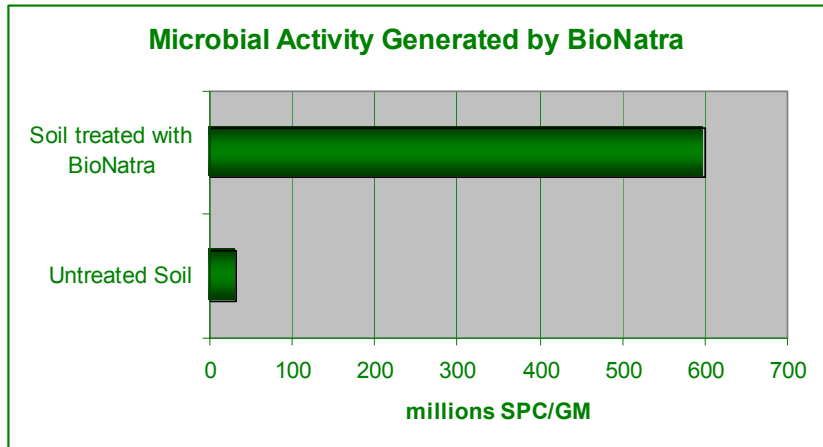
Natural microbial activity improves healthy bio-degradation which allows the earth to recycle itself and results in the production of humus; one of the best sources of plant nutrition. The result is increased availability of minerals nutrients as well as proteins, enzymes, antibiotics, hormones and other growth promoting substances that are beneficial to plants. The plant/soil system becomes healthier and requires less fertilizer, less water and produces healthier plants with higher crop yields.

## Crop Production

In greenhouse studies, every essential mineral nutrient increased in both soil and plant tissues treated with BioNatra. This includes the tissues of fruits, vegetables and other crops which are extensions of stems and leaves. The result is fruits and vegetables full of more naturally beneficial minerals and nutrients. Growers consistently report an increase not only in crop quality but also in yields.

## BioNatra: Sodium Levels

Test results also revealed that the only mineral element to decrease in both soil and plant tissues treated with BioNatra was Sodium. Since sodium competes for potassium for uptake, high sodium levels greatly reduce plant growth. This is important in starting lawns and gardens, particularly in saline and high sodium soils.



### Microbial Test Results

Test conducted by: Morning Star Laboratories Inc. Moonpark, CA

- Sample 1** Non-treated soil sample checked for microbial activity. **Results :31,800,000 SPC/GM**
- Sample 2.** Same soil as used in sample #1 treated with BioNatra then analyzed 3 days later. **Results: 600,000,000 SPC/GM**

**Summary** BioNatra stimulated a 2000 % increase in microbial activity within 3 days

## ***BioNatra vs. other Bio-Stimulants***

There are several Bio-Stimulants on the market that range from formulations containing beer, soap, seaweed extract and apple cider to more sophisticated solutions that actually contain live microorganisms. Some are effective, some are not; however, none are able to compete with BioNatra from a cost / performance stand point. Also, because BioNatra contains no detectable living organisms in solution, the product can be stored for over five years without losing its effectiveness.

## ***Performance***

Field tests conclude that BioNatra (combined with lower amounts of fertilizer) has been shown to consistently outperform fertilization alone. While additional competitive research is being performed, consumer testimonials indicate that BioNatra is also more effective than other bio-stimulant technologies, especially when comparing plant health, crop yields and the cost savings associated with lower requirements for water, fungicides, pesticides and herbicides.

## ***Cost-Effectiveness***

BioNatra can be efficiently and cost-effectively produced in mass quantities. Because the product is so cost-effective to produce, BioNatra is affordable to growers of any size. Commercial growers can often pay for BioNatra with the cost savings in pesticides, herbicides and fungicides alone.

## ***Shelf Life***

BioNatra has an extremely long shelf life. While BioNatra is derived from naturally occurring bacteria and fungi, the product has no detectable living organisms in solution. Dr. Spruill used a sophisticated stabilization process that allows BioNatra to have an extremely long shelf life. As long as the product is stored in a sealed container in a cool place, out of direct sunlight, BioNatra will stay in solution for over 5 years without losing its effectiveness. Other bio-stimulants containing live microbes or other organic materials have a tendency to break down and lose their effectiveness over time.

## ***Summary***

Because of the dominance of the chemical fertilizer industry, the focus on improving natural microbial activity as an essential part of a healthy plant/soil system is often overlooked. BioNatra, combined with an earth-friendly fertilizer (used in lower quantities) exponentially extends the useful life of the soil while providing better results. BioNatra is all-natural and is safe for use around children, animals and the environment.

## ***BioNatra Enhances Fertilizer Performance***

During field tests conducted by Dr. David Sasseville, PhD., the application of BioNatra resulted in significantly higher soil concentrations of nitrogen, calcium, copper, potassium, magnesium, manganese, phosphorus, boron, iron and zinc in the growing media, than untreated plants and soil. And with the exception of manganese, these same nutrients had similar or significantly greater concentrations of nutrients in the vegetative tissues with the use of BioNatra.

Possible explanations for these results are:

- a) BioNatra enzymes or microbes stimulated by BioNatra 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). BioNatra resulted in an increase in available macronutrients in the soil indicating a "mining" effect of BioNatra for the cations NH, K, Ca and Mg. The presumed effect here is to stimulate cation exchange or release off the soil particles. Additionally, the concentration of available P increased with BioNatra treatment over the three harvest dates, but decreased over the same harvest periods without BioNatra. 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 BioNatra is making P more available possibly by enzymatic action or promotion of microbes with enzymatic activity for P.
- b) BioNatra 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.
- c) The nutrients tied up by the increased number of soil microbes are released by the dying microbes causing more available nutrients over time.

## **Results Testing**

BioNatra has been tested in a wide variety of agricultural applications (field, fruit and vegetable crops) and diverse growing all over the world. With very few exceptions, the product consistently produces positive results. The following results were produced under an agricultural brand name of the product (available upon request).

### **Improved Germination**

BioNatra improves germination in seedlings. The images below provide illustrations of a 3 day germination tests on Alfalfa and Wheat.



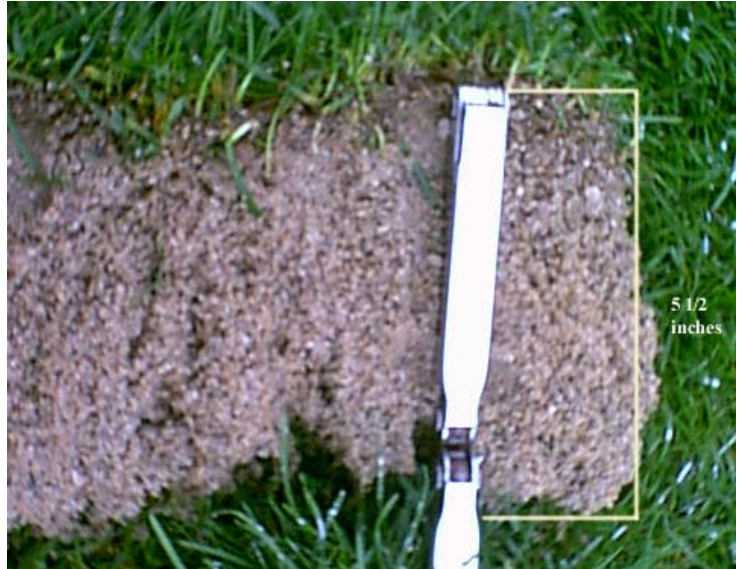
**Figure 2** Alfalfa Sprouts - 3 Day test.  
Dish on the left was treated with BioNatra.



**Figure 3** Wheat Sprouts - 3 Day test.  
Dish on the left was treated with BioNatra.

## **Turf**

BioNatra doubled the root mass of BYU turf in 60 days. BioNatra was consistently applied for 60 days to practice field sod and to the main football field turf at Brigham Young University's Lavell Edwards Stadium. The root zone at the beginning of the test measured 1.5" on the football field but measured 3" within 45 days. The practice field sod, planted in April of 2002 was ready to be harvested by the end of July, 2002. BYU reported a significant decrease in gestation time, improved sod recovery and 50% enhanced root development.



## **Cotton**

Cotton - BioNatra plot produced 119 pounds additional lint/acre over check plot (test replicated 4 times). University of Missouri, 1998.

Cotton - A single in furrow application of BioNatra produced 77 pounds additional lint/acre over check plot (test replicated 4 times). University of Arkansas, 1999.

## **Corn**

Corn — In a five year Independent study, the BioNatra plot with a 15% reduction in N and 33% reduction in P & K rates, increased corn yields by an average of 9 bushels/acre compared to the check plot which received full rates of NPK. Missouri research, 1994-1998.

## **Rice**

Rice — In a five year Independent study, BioNatra increased rice yields by an average of 11.4 bushels/acre despite a 25% reduction in fertilizer rates compared to the check plot which received full rates of NPK. This represents an average of \$55.81/acre more net profit each year. Missouri research, 1994-1998.

## **Soybeans**

Soybeans — In a five year Independent study, the BioNatra plot, with a 33% reduction in P & K rates, increased soybean yields by an average of 8 bushels/acre compared to the check plot which received full rates of P & K. This represents an average of \$51.03/acre more net profit each year. Missouri research, 1994-1998.

## **Tomatoes**

Tomatoes — BioNatra increased yields by 122% in weight and 104% in numbers in "Husky" tomatoes (test replicated 4 times). SEMO State University, 1998.

Tomatoes – Fertilizantes Tepeyac – Mexico: BioNatra plot (using 25% reduction in fertilizer and other crop protection inputs compared to control plot)

Application: 5 foliar applications. Conclusions: With a reduced rate of fertilizer the BioNatra plot out yielded the control plot resulting in a significant increase in grower revenue. The BioNatra treated tomatoes also had a longer shelf life compared to the non-treated.

### **Watermelon**

Watermelon — In 'Jubilee' and 'Crimson Sweet' varieties, BioNatra produced 243 more melons/acre weighing an additional 5,940 pounds over the check plot (test replicated 6 times). University of Tennessee, 2000.

### **Carrots**

Carrots — BioNatra increased yields by 113% in weight and 16% in numbers in 'Fullback' Carrots over the check plot (test replicated 4 times). SEMO State University, 1998.

### **Onions**

Onions — In a study comparing 16 different growth additives, BioNatra came out on top in all areas, producing the highest yield, grade and profit of \$633/acre more than the check plot (test replicated 6 times). Oregon State University, 1999.

### **Snap Beans**

Snap Beans — In Roma II and Hialeah varieties, BioNatra increased yields by 17.4 bushels/acre over the check plot. This represents an increase of \$144.25/acre in net profit (test replicated 6 times). University of Tennessee, 2000.

### **Potatoes**

Potatoes — BioNatra increased premium potato yields by 36.8% and grade A potato yields by 26% compared to the check plot. This represented an increase of \$815.00/acre more profit. University of Florida/Wetumpka Fruit Co. BioNatra was applied @ 1 quart/acre with regular spray program. Regular fertilizer and crop protection program was reduced by 25%. A total of 1-gallon BioNatra was used on the crop. Conclusions: BioNatra plot produced 5,500 lbs./acre more potatoes. Cooperator stated that the check plot was historically the best potato bed. Records for this plot dated back to 1946

### **Onions**

Onions — BioNatra increased yields by 93% over the check plot (test replicated 4 times). SEMO State University, 1998. This trial included seven other companies, representing sixteen additives. Agri-Gro came out on top in all areas, including yield, grade, and profit.

List of companies and products tested:

- Ag Concepts— Agzyme, Humaide, Jump Start, Kelp Treat
- Dynamite Marketing — Humi-Zyme RX
- Horizon Ag-Products — Agri-Plus, Quantum-H
- Huma Gro — Blend, Superphos, S, Cu, Ca, Pop-Up, Vitol
- Kozgro — Kozgro
- RSA Microtech — RSA Humic Acid
- UAP Northwest — Awaken

## ***BioNatra's Impact on Water***

Real world experiences have shown that the addition of BioNatra as part of a comprehensive plant/turf fertilization program may reduce water consumption (in some cases by as much as 30%). While the exact water reduction will be affected by many variables, this paper is designed to overview BioNatra's ability to enhance the "water use efficiency" of plants.

BioNatra promotes the production of Humus in soil through natural biological activity which stimulates the development of a more extensive root mass for better water and nutrient absorption. This increase in microbial activity promotes the release of nutrients and also accelerates the breakdown and conversion of organic matter (i.e. the decomposition of plant, animal and microbial residues) into usable plant food - the most natural source of nutrients for plants.

BioNatra is able to increase water efficiency in the plant in the following ways:

✓ **Increase in root mass; improving water uptake and absorption.**

BioNatra increases the availability of phosphorus and other essential plant nutrients in the soil. Phosphorus is important in root growth. With increased root growth, there is a larger root surface with which to take up water. Thus, water uptake is more efficient by the plant. Also, with a more extensive root system, the roots occupy a larger volume of soil, which in turn, increases the volume of water available to the plants.

✓ **Better water regulation and retention within the plant.**

BioNatra influences other essential plant nutrients making them more available to plants. For example, BioNatra increases potassium levels in the plant. Potassium regulates water uptake by controlling transpiration through the leaves. Potassium also helps to move nutrients into and within the plant. Other plant nutrients, such as calcium, influence the thickness of cell walls and also the thickness of the cutin layer on leaves, stems and fruits. The cutin layer is the waxy surface on plants that reduces water loss.

✓ **Improved porosity, friability and drainage in the soil.**

BioNatra increases the porosity of many soils and makes the soil looser. Roots have difficulty penetrating heavy clay soils. BioNatra increases the friability (looseness) of soils and allows roots to be grow longer and deeper, and they will tend to be more branched. This increased root growth increases the surface area of the roots and the volume of soil and amount of water available to the plant. Another aspect of increasing friability is that with increased pore space, the water holding capacity of the soil also increases. Thus, there is more water available to the roots in a given volume of soil. As the soil becomes more porous, water drains from the soil more easily. While this would appear to have a negative effect on water conservation for lawns and gardens, it does not. Plant roots require oxygen to grow and thrive. They require oxygen to be able to take up plant nutrients AND water. If the soil around the roots is too wet (a condition called "wet feet"), the plants do not have enough energy (from respiration) to take up water. That is why over watering can cause a plant to

wilt! Poorly drained clay soils tend to become wet and stay wet, making it difficult for plants to take up water. What is needed is a balance between water and air in soil pores. BioNatra, by increasing friability, porosity, and good drainage increases the water efficiency of plants and contributes to water conservation.

✓ **Reduction in sodium levels; increasing water retention and absorption.**

Another issue related to water conservation involves water quality. Research findings have validated that BioNatra reduces sodium levels in soils and in plants. Additional research has shown that BioNatra reduces the SAR (sodium absorption ratio) of water. This is important in the arid or coastal parts of the country where water high in salts is used to water lawns and gardens. High salt concentrations in the soil reduce the ability of plants to take up water. Reducing sodium levels in the soil will help plants better to utilize available water, and may even allow the plants to tolerate water that is higher in sodium levels. More research is needed on this interesting aspect of BioNatra, but the use of BioNatra in this way is very promising.

In summary, BioNatra is designed to promote plant growth and improve soil conditions. Water use efficiency and water conservation are only side benefits of the use of this product.