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## GFT Salt Detoxification Study



The environmental contamination of the greatest number of acres of farmland in the US is caused not by toxic chemicals or oil spills but by salt. Over 23% of irrigable land in the US is now salt impacted, and the number grows every year. In the California San Joaquin Valley alone, over 2.8 million tons of salt enter the valley each year, and only 350,000 tons leave it. Worldwide, the problem is estimated at over 20% of all irrigable lands being salt impacted.

When soil is damaged by salt contamination, the harm extends immediately to native grasses, trees, shrubs and crops, preventing seed germination and plant growth. Saline conditions also destroy favorable microorganisms vital to productive, balanced soil. Soil contamination is most prevalent in two main areas of environmental concern: agricultural irrigation/fertilization and oil production. In most cases, crop irrigation is pumped from underground aquifers that contain high amounts of soluble salts. When land is irrigated with this water, large amounts of salt accumulate on the surface. If salts are not leached adequately, there will be significant damage to plant roots.

Both chemical and natural animal fertilizers contain high amounts of salt. When farmers use fertilizers to increase production, they magnify the problem. The excessive "doses" of salt from these fertilizers cause salt content in the soil to continually increase. Farmers find they have to use more and more fertilizers to produce less and less crop yields and the salt levels steadily increase. Eventually the crops will be destroyed or production greatly reduced unless something is done to prevent, break down or "buffer" the existing salt buildup.

The salt "breakdown" process works like this:

- Salt is a metal and very reactive. Excessive salt amounts act as a toxin to aerobic soil microorganisms that require oxygen to establish their colonies and metabolize nutrients.
- Salt follows the water path and can be flushed from the soil. However, extensive flushing of salt into the soil with water only temporarily corrects the problem. It has not solved the problems which result from high soil salinity.

The GreenFlash Technologies' salt buffering product, SaltDetoxII-1061 (SD-1061), consists of four products mixed together, SoilRenew-602, SoilDetox-604, BioSoilBoost-101 and NPrime-660. SD-1061 contains live naturally occurring, micro-organisms, organic acids, organic complexing agents, enzymes, hormones and bio-polymers, which increase the availability of plant nutrients and act to build humus by enhancing soil microbial activity. Nutrients are mostly taken up in the

mineral form as nitrates, sulfates, phosphates, etc., but their availability to growing plants is directly related to aerobic biological activity.

SaltDetoxII-1061 also increases the efficiency of applied fertilizers and results in improved crop response. Organically complexed nutrients are less subject to loss from leaching, volatilization, chemical fixation, and clay fixation. The complexing properties of organic carbon found in SD-1061 serves another important function in many agricultural soils. SD-1061 buffers salts by: 1) dissociation (the process by which a chemical combination breaks up into simpler constituents); 2) improvement in the base saturation percentages which is the relationship between concentrations of four key soil elements – magnesium, calcium, potassium and sodium. These elements are not created or destroyed, but they can be unevenly distributed within the soil in plant-available and unavailable (insoluble) forms. In the case of sodium, where lower water-soluble concentrations are desired, SD-1061 shifts the concentrations into insoluble or immobilized compounds in the soil. This essentially removes sodium from the soil solution so it no longer destroys soil structure or causes root toxicity; and 3) organic chelation (the bonding of an organic compound to a single element or compound at several points instead of at one point) and immobilization of the component elements. Dissociated salts are far less damaging to crops and soil and remain dispersed in the soil profile. Multiple applications of SD-1061 during the growing season are most effective in salt management.

Using GFT's bioremediation and soil "balancing" products to recondition soil will enhance microbial growth by producing and converting organic materials into agents that will combine with salts. These agents act as a "buffer" for the plants. This buffering effect allows soil microorganisms to proliferate, protecting them from harmful osmotic pressures. These conditioners inhibit salt uptake by the plant by a chelating effect, making them less susceptible to salt damage.

A significant salt contamination problem also occurs in oil production fields. As with irrigation, oil pumped from injection wells contains an exceptional amount of saline water. When oil transmission lines rupture, the damage has a two-fold effect. Not only will the leak's salt content contaminate the surrounding soil, the leak also contains hydrocarbons that will destroy native flora, fauna and indigenous microorganisms.

While state and federal regulatory agencies enforce the cleanup of hydrocarbon contamination, until recently cleaning up salt problems was not considered economically feasible. Flushing with water didn't provide a permanent solution and there were no additional alternatives. After any such salt contamination, the land usually is written off as being unable to support plants.

Salt damage to soil cannot be ignored. Consumer liability is beginning to play a role. For instance, if a transmission line leaks on land that is used for cattle grazing or farming, the owner likely will demand the cleanup of the land. Using bioremediation for transmission line leaks will alleviate both the salt and the hydrocarbon damage.

The GFT agricultural line includes an assortment of salt "buffering" products which will not only buffer any salt contamination but will return salt-contaminated land to a rich and productive soil which will then support all types of crops. All of this occurs at a reasonable price and in a timely manner.

There are products that buffer salts through soil application (irrigation or spraying on soil) while others are formulated for foliar (leaf) application. They are "leaf friendly". GFT foliar products are organically complexed and salt-buffered to ensure maximum uptake and translocation. This reduces the occurrence of leaf-burn or phytotoxicity.

Plants have differing levels of tolerance to the salinity in the soil. As a general rule, the higher-value fruit and vegetable crops are relatively salt intolerant, while forage and field crops have a somewhat higher tolerance. A few examples are given below.

<b>Crop Salinity Tolerance</b>		
<b>Crop</b>	<b>Ec(0)</b>	<b>Ec(25)</b>
Barley	8.0	13.0
Wheatgrass	7.5	11.0
Soybean	5.0	6.2
Flax	1.7	3.8
Corn	1.7	3.8
Lettuce	1.3	3.2
Oranges	1.7	3.2
Strawberries	1.0	1.8

In this table salt tolerance is given in terms of electric conductivity, where Ec(0) represents the maximum salinity a crop can handle without suffering yield decreases (in mmhos/cm), and Ec(25) is the point where a 25 % yield decrease occurs and the crop's economics becomes questionable.

In a spring 2006 experiment in North Dakota, barley, with an 8.0 Ec (0), was grown on a field whose salinity had an Ec of 16.9. This is 2 times higher than the maximum salinity of barley before degradation. Photos of the field, before and after two years of production, are given below. As shown in the before photo, the field was covered with salt to the point it looked like

snow, and had never grown anything, even weeds. This field was treated with an earlier version of SD-1061, starting about one month before planting and continuing through the early growth period of the crop cycle.

The specific laboratory report for the soil being treated is given in Attachment 2. Note comments of analyst concerning the likelihood of successful crop growth.



**BEFORE GFT SALT DETOX TREATMENT**  
**Photo taken March, 2006**



**AFTER GFT SALT DETOX TREATMENT**  
**Photo taken August, 2008**

## Appendix 1 – Independent Lab Report

### GreenFlash Technologies Salt Buffering Process

The following analysis considers the salt buffering capability of two GFT products used together, SoilRenew-602™ and SoilDetox-604™.

Because salt buffering is happening on the microscopic level, we truthfully do not know what is exactly happening. Despite this lack of information, we can see the results and can make some educated theories as to why.

The salt remediation process begins with SoilRenew-602™ added to the soil with the following reactions:

First, SoilRenew-602™'s unique ingredients will activate certain beneficial bacteria which will sequester or consume the sodium into their bodies through metabolic processes. Once in these living organisms, the sodium will no longer be toxic to or available for uptake by the plants.

Second, SoilRenew-602™ stimulates the beneficial bacteria that live in and around the root rizospheres. When these populations are active and vigorous, they will not allow the sodium to damage the root hairs as they grow. They act as a buffer against toxicity

Third, SoilRenew-602™ carries 19% organic acid(s) which is principally made up of the aromatic acid group (phenolic compounds). These small organic compounds have a tremendous complexing (as opposed to chelating) capability. These short chain organic molecules will act as a transporter or carrier for nutrients to the biology and to the roots. Because they are of such a low molecular weight, they move freely in and through the entire soil solution, taking and releasing various ions in the process. The following two theories exist (and both may be at work here):

1. For many years we have thought that these aromatic compounds break the sodium free from its current combinations (with Ca, Mg, Clay, other heavy metals, etc...) and complex it to the organic acid molecule. It thus becomes an organic compound which will not then be toxic to the plant.
2. In recent nutrient uptake research, we have come to think that perhaps the other nutrients in the soil (Ca, Mg, Si, etc...) are being broken free from their sodium compounds and carried into the plant for nutrients uptake. This leaves the sodium alone to be carried away from the root zone by the water and even leached deeper into the ground. The sodium thus never gets a chance to be assimilated into the plant because it has no carrier.

This salt remediation process is aided dramatically with the addition of SOILDETOX-604 which does the following two things:

First, SoilDetox-604™ has many of the same compounds as its base as does SoilRenew-602™. This includes the organic acids and the metabolites extracted from bacteria and algae. These components improve the SoilRenew-602™ reaction for all the same reasons we explained above.

Second, SoilDetox-604™ has several surfactant type materials as added ingredients. These aid in the breaking down of sodium compounds and once freed up, work to move or carry the sodium away from the root zone.

#### APPLICATION & TIMING:

The very best program we have found for overcoming salt, or better said, sodium toxicity is to apply SoilRenew-602™ at the 1-2 quarts per acre rate with an equal amount of SoilDetox-604™ (BioStim-601™ may also be used). For greatest results, these applications should start as early in the season as possible, focusing treatment to be in the planting bed at least 15 days prior to planting. To see even more optimum long term results, repeat this application process every 15 to 20 days during the growing cycle.

#### RESULTS:

The results of what we see with this type of soil treatment is that, in a very high sodium soil environment, the plant will not take up toxic levels of sodium into its roots and that the root rizospheres remain healthy. When tissue samples are taken, the Na levels are significantly diminished. In untreated controls, the root systems are weak (small), the tissues show high Na and the leaves turn yellow.

#### ADDITIONAL CONSIDERATIONS:

1. It is good to remember that sodium will affect the plant all season long, but it is usually only deadly in its first growth stage. Therefore, in addition to SoilRenew-602™ and SoilDetox-604™, applications of PlantMagic-655™ or SpringBoost-650™ can help a young plant "grow through" a salt toxicity.
2. Apparently, a plant has trouble distinguishing between sodium and potassium. Applying higher amounts of potassium through the soil or foliage during the entire growing season will also assist in improved plant health.
3. Cultivation practices such as physically moving the salt with the irrigation to hills made on top of the rows or excess watering to push the salt away from the roots can also make a difference.