TECHNICAL BULLETIN

Effect of Soil Salinity on BIOSTART®

BIOSTART®

SOIL AND SALINITY

Salts are a normal part of any soil composition; however, in situations where soil salinity is increasing, damage to crops and decreased yields can be an issue. The level and composition of the salts in the soil are affected in several ways- namely irrigation water quality, composition of fertilizers and irrigation type. In situations where rain fall has been limited, salinity can increase due to simple concentration effects. During these dry growing seasons, the lack of water and the increasing salinity may cause damage to natural soil microorganisms, thereby limiting their ability to aid the plant growth cycle.

BIOSTART® and its four component Bacillus bacterial strains are delivered as bacterial spores which germinate and grow and then revert back to spore form when environmental conditions are not favorable for optimum growth. Additionally, these spore forming bacteria have been shown to resist increases in salinity, thereby still providing their benefits to the plants even in higher salinity soil. The following study demonstrates the ability of the BIOSTART® strains to tolerate increasing salt levels.

METHODS

The four BIOSTART® Bacillus strains were cultured in a nutrient rich environment for 48 hours to ensure a high cell population and complete sporulation. Spore cultures were heat shocked at 85°C for 5 minutes to ensure only spores remained. Spore cultures were serially diluted and plated on nutrient rich solid medium (Tryptic soy agar-TSA) supplemented with an increasing concentration of NaCl. Plates were then incubated at 37°C for 15 hours. For each strain, percent spores germinated was calculated using CFU/ml normalized to CFU/ml at 0.5% NaCl (%wt/v), the basal salt concentration in TSA.

RESULTS

All BIOSTART® spores were able to germinate and grow without inhibition in the presence of up to 1.5% NaCl (see Table 1). Neither colony size nor morphology had any distinguishable differences up to 1.5% NaCl. There was a reduction in the percent spores germinated in the presence of 3.5% NaCl (see Table 1) but again all colonies maintained similar colony size and morphologies. Strains 3 and 4 germinated in the presence of up to 10.5% NaCl but required a longer incubation period (20-30 hours) to do so.

The following table summarizes published data on the relative salt tolerance of some of the most popular production crops grown today.

Table 1: % spores germinated in the presence of NaCl

	%NaCl					
	0.5%	**1.5%**	**3.5%**	**5.5%**	**10.5%**	**15.5%**
Strain 1	100%	105%	7%	NG	NG	NG
Strain 2	100%	105%	7%	NG	NG	NG
Strain 3	100%	98%	73%	72%	40%*	NG
Strain 4	100%	99%	64%	61%	40%*	NG

NG indicates no growth after incubation at 37°C for 5 days.
* Due to the nature of the colony morphology at 10.5% NaCl, these values are best estimates only.

Table 2: Salt tolerance of crops

	Tolerance* (dS/m)	Tolerance* (% NaCl)
Corn	1.7	0.10%
Rye	11.4	0.68%
Soybean	5.0	0.30%
Tomato	2.5	0.15%
Wheat	6.0	0.36%

* see references below

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CONCLUSIONS

BIOSTART® made with spore forming Bacillus bacteria, offers a unique product to farmers and growers for many reasons. Based on the published salt tolerance of crops and the tolerance shown for the Bacillus strains in high salt concentrations, it is clear that the benefits delivered by using BIOSTART® as a soil additive can be still be achieved under high salinity conditions in the soil.

Its ability to tolerate extremely high salinity conditions is just one more benefit to this bacterial soil inoculant over other non-spore forming microorganisms.

References:
1. dS/m values are published http://www.fao.org/docrep/005/y4263e/y4263e0e.htm.
2. Percent NaCl values were calculated using a dS/m to mg/L conversion factor of about 600 (http://www.daff.qld.gov.au/plants/lifestyle-horticulture/nursery/conductivity-measurement)

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