

OCEAN ORGANICS TURF RESEARCH SUMMARY

Maximizing Stress Tolerance and Recovery in Intensively Maintained Turfgrasses

More than 40 years ago, Professor James B. Beard, the preeminent turfgrass physiologist of his time, said in his opening remarks at a Turfgrass Stress Management Symposium:

“Since almost all forms of predation that attack turfgrasses attack the weak first, it would seem that building the strongest possible turfgrass stand is job #1 for today’s professional turfgrass manager.”

He proceeded to point out that **managing stress from multiple sources** – often simultaneously – is what makes turfgrasses among the most difficult plants to maintain.

Helping golf course superintendents by developing sustainable, science-based, plant strengthening products has been Ocean Organics’ mission from the beginning. For over 40 years we’ve worked with scientists at more than two dozen public universities and numerous private research organizations to develop high-performance materials that increase stress tolerance and survival potential for intensively-maintained turfgrasses.

In recent years we’ve made significant progress finding solutions to problems associated with abiotic sources of plant stress. These stresses include overarching environmental, climatic and weather factors that result in higher and lower temperatures, UV overexposure, drought, salinity, and sodicity; water quality issues; and cultural stresses, such as foot traffic, low mowing heights and frequent aerifying, rolling and top-dressing.

“Statistically significant” means more than just numerical differences. It means the differences are large enough for the researchers to say with a high level of confidence that the differences are due to the treatments.

Research Highlights from 2006-2018

Summer Stress Decline – Cool Season Turfgrasses – 2008 to present

- Rutgers University, New Jersey, 2008 to present
- Virginia Tech University, Virginia, 2008 to present
- Van Dyke and Associates, Utah, 2012-2016

Excessive UV Exposure – 2008 to present

- Virginia Tech University, Virginia, 2008 to present
- Rutgers University, New Jersey, 2008 to present

High and Low Temperature Extremes – 2008 to present

- Rutgers University, New Jersey, 2008 to present
- Virginia Tech University, Virginia, 2008 to present
- Michigan State University, Michigan, 2016 to present

Drought, Water Quality, Salinity, Sodicity – 2006 to present

- Mahady and Associates, California, 2006-2008
- Rutgers University, New Jersey, 2008 to present
- University of California at Riverside, California, 2012-2014

You can’t manage what you can’t measure. Superior physiological health in intensively-maintained turfgrasses is measured by plant density (the number of plants per sq. inch), color, and other parameters (see below). One indicator is the Normalized Difference Vegetation Index. Higher NDVI indicates larger density of green leaves and higher chlorophyll content. Greenness is more than cosmetic — it’s an indicator of chlorophyll content — turf grass’s ability to harvest light energy to drive photosynthesis and greater physiological health.

DGCI	Dark Green Color Index — quantitative measure of greenness that is closely related to leaf N concentration.
EC	Electrical Conductivity
EL	Electrolyte Leakage
LAI	Leaf Area Index — characterizes plant canopies
NDVI	Normalized Difference Vegetation Index — showing live green vegetation
RWC	Relative Water Content
SAR	Sodium Absorption Ratio
SI	Stress Index
SWC	Soil Water Content
TQ	Turf Quality

Summer Stress Decline

Rutgers University, 2016 & 2017¹

In 2016 and 2017, Professor Bingru Huang et al. at Rutgers University found that XP® and Stress Rx® improved the quality and performance of creeping bentgrass under heat stress during the summer months both years.

Results from the 2017 Report:

Applying XP and Stress Rx together was most effective overall in helping turf to maintain better physiological health. The products:

- promoted higher turf quality
- improved NDVI and LAI
- increased shoot density and greenness
- decreased stress

¹ Ocean Organics: Effects of biostimulants on putting green summer performance, Final Report – November 2017, Stephanie Rossi and Bingru Huang, Ph.D., Rutgers, the State University of New Jersey.

- *“By applying these products together during periods of prolonged heat stress, it can be expected that putting greens will maintain better quality during the summer and recover more quickly following high temperature stress.”*

- Overall, plots receiving XP and Stress Rx performed most consistently and maintained DGCI values significantly higher than those of the untreated controls from June 19 to October 3.
- From July 17 to August 21, at the peak of heat stress, percent canopy coverage was significantly higher in plots receiving XP and Stress Rx.

The resulting turf quality suggests: “synergistic effects on visual turf quality when XP is combined with Stress Rx and applied to turf exposed to heat stress.”

“Treated plots consistently performed best overall throughout the summer stress period.”

Michigan State, 2016²

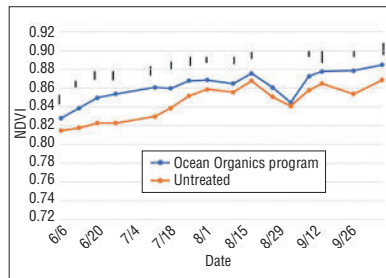
The Ocean Organics program in Creeping Bentgrass statistically:

- Improved turf quality during summer stress
- Reduced Dollar Spot
- Improved NDVI (Normalized Difference Vegetation Index)

Results

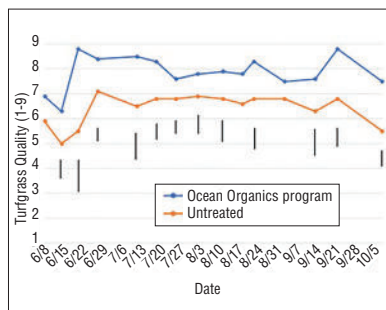
Higher NDVI indicates a larger density of green leaves and higher chlorophyll content. Treatments had significant effects on chlorophyll contents in 14 of 16 sampling dates, and the Ocean Organics treatment program had greater NDVI values when compared to the untreated control on all dates.

Higher Normalized Difference Vegetation Index (NDVI)



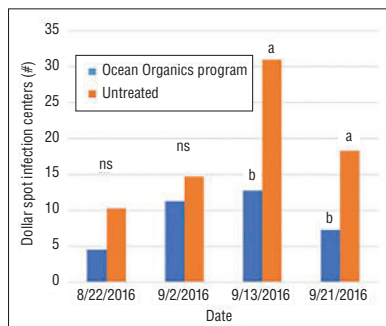
Improved Turf Quality (TQ):

Significant differences were found on 13 of 15 rating dates for visual turf quality, with the Ocean Organics treatment program having greater turfgrass quality compared to an untreated control.



Reduced Dollar Spot (DS):

Significant differences were found on 2 of 4 dates DS was present in experimental plots. On those two dates, the Ocean Organics treatment program had fewer DS infection centers than the untreated control.

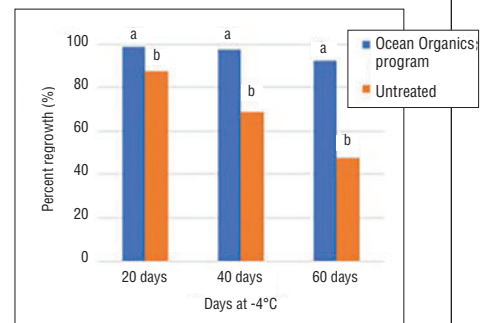


Michigan State, 2016³

The Ocean Organics program in Annual Bluegrass (*Poa Annua*) statistically:

- Improved Turf Quality during summer stress
- Reduced Dollar Spot
- Improved Color (DGCI)
- Increased Chlorophyll Content (NDVI)
- Improved Cold Temperature Recovery

In addition to increasing turf quality, improving color and chlorophyll content while reducing the incidence of dollar spot during the summer of 2016, the Ocean Organics treatment program also improved turf tolerance to cold temperature stress. Treated plots also had greater percent regrowth after 20, 40, and 60 days at -4°C when compared to the untreated control treatments.



Tristate/Rutgers, 2013⁴

Hoping to help superintendents avoid the ill effects of summer bentgrass decline, the Tri-State Turf Research Foundation has supported Dr. Bingru Huang and her research team from Rutgers University in their work to identify best management practices for alleviating SBD on bentgrass putting greens.

² Michigan State University Hancock Turfgrass Research Center, East Lansing, MI, Kevin Laskowski and Emily Merewitz, Ph.D., 2016.

³ Michigan State University Hancock Turfgrass Research Center, East Lansing, MI, Kevin Laskowski and Emily Merewitz, Ph.D., 2016.

⁴ *Foundation News*, A Publication Of The Tri-State Turf Research Foundation, Fall 2013, Vol. 16, No. 1, Research Update: Pitting PGRs and Biostimulants Against Summer Bentgrass Decline. “Rutgers Researchers Seek Practical Measures for Alleviating SBD on Creeping Bentgrass Greens”

In their second and final year, the researchers continued to examine the role plant growth regulators, biostimulants and seaweed extracts could play in sparing these greens from undue stress and decline.

Their report stated that seaweed extracts are among the most widely used ingredients in biostimulant formulations because they contain a large number of organic compounds, including amino acids, vitamins, simple and complex sugars, enzymes and proteins, as well as inorganic nutrients such as nitrogen, phosphorous, potassium and iron. Of those ingredients, plant compounds that influence cell division, leaf senescence and stress defense have shown the most promise in stimulating turfgrass growth and stress tolerance.

“Notable Results”

The commercial treatments provided by Ocean Organics had the most significant impact on alleviating summer bentgrass decline, with the most notable results during both spring and summer.

Heat & UV Exposure

Virginia Tech, 2012⁵

Study Objective:

Heat and UV-B stress can create a lethal combination during tough summer conditions. Our goal is to provide products that boost stress tolerance and give superintendents an added level of protection. In particular in these trials, we hoped to demonstrate that Stress Rx could lengthen roots during stress and recovery.

Results

On day 8 of heat and UV-B stress during Trial 2 at Virginia Tech, turf treated with Stress Rx had healthier

roots that were on average 52% longer than the controls.

Treatment with Stress Rx statistically improved root length in both Trial 1 and Trial 2 during the heat/UV-B stress period. With Stress Rx treatment, roots were between 35 to 87% longer than in controls. In Trial 2, recovery measurements were also taken. Stress Rx treatments had 54% longer roots than controls even after 8 days of recovery.

Drought & Summer Stress

Rutgers University, Year 1, 2010⁶

Drought and Summer Stress, Rutgers University, Year 1, 2010

Study Objective:

Having established earlier that enhancing Ocean Organics seaweed extract with additional osmoprotectants improves the salinity tolerance of turf, we investigated whether additional glycinebetaines (from another proprietary natural material) would improve drought tolerance of turf.

Results Year 1:

- “With the onset of major heat stress on 28 June, (OO treatment) maintained a significantly higher Total Quality than the unwatered control.”
- “...displayed significantly higher Relative Water Content than the unwatered control and maintained RWC close to that of the watered control.”
- “...resulted in significantly better Turf Quality, not only from a visual standpoint, but from a physiological perspective as well.”
- “After two weeks of regular watering, plots treated...maintained significantly higher TQ than the... control...”

Rutgers University, Year 2, 2011⁷

In addition to again testing Ocean Organics seaweed extract and glycinebetaine we tested an improved formulation which became “Stress Rx.”

Results Year 2

- “Notable differences between treatments became statistically significant after 21 day water withholding, at which time SWC (soil water content) dropped below 20%...”
- “At this time all plots treated with any of the three (OO) experimental products had significantly better TQ than the unwatered checks. This improved quality was due to higher leaf RWC (relative water content), less membrane damage via lower EL (electrolyte leakage), and better osmotic adjustment.”
- “Towards the end of the drought period, as SWC approached 15% and water deficit became severe, plots treated with experimental (Stress Rx) continued to display the best visual quality of all non-irrigated plots. Following collections of leaf samples, it was discovered that applying (Stress Rx) promoted far better RWC, EL, and OP (osmotic potential).”

Salinity Stress

U.C. Riverside, 2013-2014⁸

Evaluation of Products to Alleviate Salinity Stress in Bermudagrass Turf

Nineteen commercial and experimental products and programs were tested for their ability to alleviate salinity stress on Bermudagrass turf irrigated with saline water. Treatments were made April to October, 2013. In 2014, 30 products and programs were tested.

⁵ The Ocean Organics Strategic Stress Management Program showed superiority under high heat and prolonged UV exposure in trials by Dr. Erik Ervin at Virginia Tech in 2012.

⁶ Bingru Huang and Patrick Burgess, Rutgers University, Evaluation of Ocean Organics’ Biostimulant Stress Protectants for Improving Drought Tolerance and Post-drought Recovery of Creeping Bentgrass, 2010.

⁷ Patrick Burgess and Bingru Huang, Rutgers University, Evaluation of Ocean Organics’ Biostimulant Stress Protectants for Improving Drought Tolerance and Post-drought Recovery of Creeping Bentgrass, 2011.

⁸ Evaluation of Products to Alleviate Salinity Stress in Bermudagrass Turf 2013-14 Final Report. Research Report By: The University of California, UC Riverside, Turfgrass Science, and by California Turfgrass & Landscape Foundation.

Ocean Organics products/programs were the top performers both years.

**DeSal and Stress Rx:
Proven results to fight
salt stress, addressing
the soil and the plant.**

In the larger study:

- “The treatment containing DeSal and Stress Rx... increased turf quality at the end of the 2013 study period and decreased SAR and sodium (Na) content in the soil.”
- “The treatment containing DeSal and Stress Rx not only increased turf quality and Dark Green Color Index (DGCI) but also decreased EC, SAR and Na content in the soil.”
- *“Overall, the treatment containing DeSal and Stress Rx provided the best combination of salinity alleviation and turf quality in both years of the study.”*

Rutgers University, 2008⁹

Salt Stress on Creeping Bentgrass

Study Objective:

Seaweed extract from *Ascophyllum nodosum* naturally contains glycinebetaine, a known osmotic protectant (a molecule that protects cells from dehydration under salt and drought stress). The aim of this study was to evaluate whether Ocean Organics seaweed extract enhanced with additional glycinebetaine and similar substances (from proprietary natural materials) would improve salinity tolerance of turf. These eventually became the active ingredients in Stress Rx.

Results

“Our results suggest that application of (the Stress Rx prototype) served to increase creeping bentgrass tolerance of salt stress most likely by maintaining better cellular hydration and water relations through accumulating Glycinebetaine and increasing osmotic adjustment.”

**Mahady & Associates, Testing
Prototypes of NuRelease and
DeSal Technologies on Golf
Course Turf Under Play, 2004¹⁰**

In 2004, seven companies participated in a salt management trial conducted on behalf of the Northern California Chapter of the GCSA by a private turfgrass research group based in Carmel, CA. These parameters were assessed:

- *Electrical Conductivity (EC):* increases as a solution's salt concentration increases.
- *Total Soluble Salts*
- *Exchangeable Na⁺:* The quantity of Na⁺ on the exchange sites of soil particles.
- *Extractable Na⁺:* The amount of sodium extractable from a soil.



Ocean Organics®

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Results

DeSal was the top performing salt management product out of 7 programs in the replicated field trial conducted by Mark M. Mahady and Associates, Inc.

The Ocean Organics material tested became our DeSal® - NuRelease® technology.

**Hi-Lo GCSA and Mahady &
Associates, 2008¹¹**

Ocean Organics was one of nine firms that entered products and programs in a second salt management study; this time on Bermudagrass fairways in the Greater Palm Springs area of California. In addition to DeSal, the Ocean Organics program included a prototype of what evolved into Stress Rx – Salt Rx technologies.

Results

In a replicated field trial,¹² DeSal exhibited the greatest change in the concentration of critical salt management components* out of 9 programs tested.

*Including EC, soluble salts, exchangeable and extractable sodium and extractable chloride.

Summary of Results

From first to last soil test:

- Exchangeable sodium declined 45%
- Total Soluble Salts declined 29%
- Extractable sodium declined 45%
- EC declined 22%

**Contact your Ocean Organics
Distributor today, or call us at
800-628-GROW (4769).**

Email: kevin@oceanorganics.com

Proven, Superior Summer Stress Protection and Strategic Stress Management

⁹ Bingru Huang and Emily Merowitz, et al., Rutgers University, *Physiological Effects of Biostimulants on Turfgrass Salinity Tolerance*, 2008.

¹⁰ On the Poa annua chipping green at Corral de Tierra Country Club near Monterey, CA Final Report to Research Committee, N. CA GCSA.

¹¹ The Hi-Lo GCSA Research Committee, by Mark M. Mahady & Assoc., Inc. on fairways at the Shadow Hills Golf Club (Indio, CA).

¹² “A Review of Products for Salinity Management in Overseeded Bermudagrass Fairways” by the Hi-Lo GCSA Research Committee and Mark Mahady and Associates, Inc. – December 19, 2008.