Strategic Stress Management Starts Here

Science-Based Products and Programs for Professional Golf Course Superintendents and Sports Turf Managers

OCEAN ORGANICS CORPORATION

Manufacturers of High-Performance, Science-Based Plant Strengthening and Fitness Materials for Growth, Protection, Stress Tolerance and Recovery

Ocean Organics began as a seaweed processor. The value of seaweed extracts as plant strengtheners was already clear to us from prior work with seaweed-based materials in agricultural and biomedical applications in the 1970s. The seaweeds we harvest are in the brown family. They are "intertidal" species (predominantly *Ascophyllum nodosum*) that anchor themselves to rocks along craggy coastlines throughout the North Atlantic Ocean from Maine and the Maritime Provinces, through Iceland and down to the Western Coast of Ireland.

If there is a single word that best describes *Ascophyllum nodosum* it's probably "diversity." Sooner or later, almost everything makes its way to the sea. The seaweeds we use to make our plant strengthening materials contain at least trace amounts of every mineral element that exists on earth.

In addition, they contain an extraordinary array of diverse and unique constituents. They are prolific producers of the naturally occurring stress tolerance and plant strengthening compounds that form the basis of our materials for plant growth, protection, stress tolerance and recovery.

Using innovative and sustainable techniques, Ocean Organics produces seaweed extracts that are richer than others but with fewer solids and inert ingredients. The result: more beneficial active ingredients that deliver superior plant health and stress tolerance benefits; lower viscosity that allows easy mixing, application and plant uptake.

Cover: Sleepy Hollow Country Club, New York

Eastward Ho! Club, Massachusetts

TABLE OF CONTENTS

Science-Based Strategic Stress Management

The Ocean Organics Difference

Ascophyllum nodosum seaweeds are among the most stress tolerant plants on Earth. Every day they fluctuate between being completely submerged at high tide in water (3% saline) and being completely exposed at low tide to air temperatures well below 0° F in winter to nearly 100° F in summer.

The robust "root-like" organs that anchor *A. Nodosum* (also known as "North Atlantic Kelp" or "Rockweed") to the rocks are called "holdfasts" and they are aptly named. They tolerate constant wave action and withstand sustained violent storm surges. So it's not surprising – given that they have evolved and thrived in incredibly harsh environments – that they are prolific producers of naturally occurring stress tolerance and plant strengthening compounds, including:

- Antioxidants
- Osmoprotectants
- Protective and Photosynthetic Pigments (not "sunscreens")
- Amino Acids
- Polysaccharides
- Alginates

Strategic Stress Management Starts Here

Maine
Photos: Veronica Santate

Job #1 for Turfgrass Professionals

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 stand of turfgrass possible 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 materials has been the Ocean Organics mission for over four decades. During that time, we've worked with leading scientists at more than two dozen public universities and numerous private research organizations to develop **high-performance materials that increase stress tolerance and improve survival potential** for intensively-maintained turfgrasses.

Research Driven
•
Independently Tested
•
Scientifically Proven

Our products have been producing results on thousands of golf courses and sports fields worldwide for over 40 years.

Ocean Organics has emerged as a leader in science-based strategic stress management products and programs that are university tested, independently proven and sustainably produced in the USA.

In recent years we've made significant progress developing solutions to problems associated with abiotic sources of plant stress including summer stress decline in C3 cool season turfgrasses, salinity and sodicity alleviation in mixed stands of bentgrasses and *Poa annua* as well as C4s such as bermuda grasses. In addition, we've developed drought stress solutions, innovative complexing systems to maximize nutrient uptake, and a state-of-the-art surfactant product line.

Intensively-Maintained Turfgrasses…Perhaps the Most Highly-Stressed Plants on Earth

Golf course superintendents face the same problems that challenge all growers — diseases, insects, increasingly unpredictable weather, high and low temperature extremes, drought, salinity, and steadily deteriorating water quality.

However, there are also a host of unique stresses related to the cultural practices necessary to produce high quality, stress tolerant, and yet beautiful playing surfaces. Daily mowing at heights from 1/8th" to 1/10th" is commonplace today on upscale golf course greens throughout North America. That's 35-40% lower than 40 years ago.

Greens are significantly truer, faster and more demanding than ever.

Ball roll and green speeds have increased by 35-40% because of frequent and lower mowing heights, but that comes at an agronomic cost.

- 35-40% less leaf surface area is available for photosynthesis – at a time when photosynthetic output and efficiency are vital.
- More frequent rolling, topdressing and aerifying significantly increase abiotic stress levels.

Research over many years at Rutgers, Virginia Tech, University of California, Michigan State and other leading research institutions have shown that turf grass plants treated with Ocean Organics products have **higher turf quality, canopy density, and color; lower stress index, higher chlorophyll content, increased membrane stability, and better photochemical efficiency** (more light energy converted to chemical energy) compared to untreated controls.

Ocean Organics… the leader in science-based, high performance strategic stress management products.

Our Strategic Stress Management Program

Our objective is to help you improve the physiological fitness of the turfgrasses you manage in order to maximize both performance and survival potential under the widest variety of stress conditions.

Strategic Stress Management for intensively maintained turfgrasses starts with building the strongest stand of turf possible. Ocean Organics products and programs help you:

- Build more stress tolerant turf with superior quality, plant density, and root growth
- Maximize your turf's physiological performance even under high and low temperature extremes and UV exposures
- Help your turf survive under a wider variety of predictable and unpredictable stress conditions, including salinity, sodicity and drought.

The Ocean Organics Strategic Stress Management Program showed superiority under high heat and prolonged UV exposure in trials at Virginia Tech, Rutgers and UC Riverside.

*"Ocean Organics treatments clearly offered the **most notable results** during both the spring and summer... products promoted significantly higher turf quality, green leaf biomass, and plant density compared to the control during most of the experimental periods."**

Science-based Summer Stress Protection… Independently Tested and Proven

Summer stress decline in cool season grasses is a major challenge for most superintendents most years. It almost always involves high temperatures and UV overexposure, and often includes drought, salinity and sodicity.

Count on our program for turf quality, root viability, and recovery.

The Strategic Summer Stress Management Program

For 6 years beginning in 2008, Ocean Organics developed, tested and refined a program using 5 products to produce significant improvements in tolerance to summer stress and other serious abiotic sources of stress. Research was conducted at Rutgers University; Virginia Tech; University of California, Riverside; and with independent researchers and consulting agronomists.

This is the winning program:

	Spring	Summer	Fall
Stress Rx® Foliar Fertilizer		3-6 oz. per 1000 sq. ft. every 2 weeks	
XP Extra Protection® Foliar Fertilizer		3-6 oz. per 1000 sq. ft. every 2 weeks	3-6 oz. per 1000 sq. ft. every 2 weeks
SeaBlend® Granular Greens Fertilizer	Two 1/2 lb. N apps per 1000 sq. ft. two weeks apart		Two 1/2 lb. N apps per 1000 sq. ft. two weeks apart
Guarantee® Seaweed Extract	3-6 oz. per 1000 sq. ft. every 2 weeks		3-6 oz. per 1000 1000 sq. ft. every 2 weeks
NuRelease® Liquid Soil Additive		3/4 oz. per 1000 sq. ft. every 2 weeks	

* Pitting PGRS and Biostimulants Against Summer Bentgrass Decline…Rutgers researchers Seek Practical Measures for Alleviating SBD on Creeping Bentgrass Greens. Foundation News, Tri-State Turf Research Foundation. Fall 2013. Vol 16. No 1. Research by Dr. Bingru Huang and David Jespersen).

The Power of a Program Approach

In the Final Analysis, It's *Your* Program

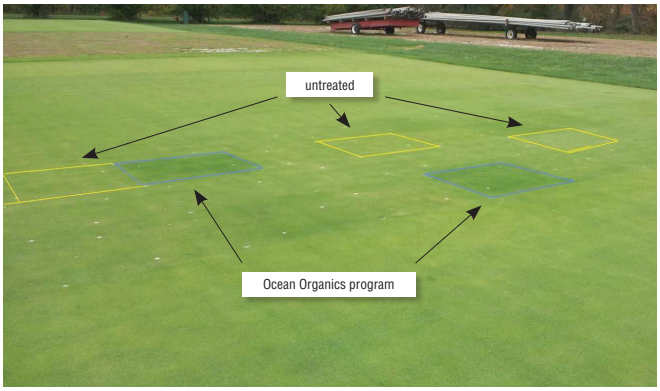
All of our products are stand-alone materials that deliver significant plant-strengthening benefits on their own. However, trials performed over many years demonstrate synergies when they are combined in programs. Here are some highlights.

Improved Heat Stress Tolerance

RUTGERS, creeping bentgrass

Products in the program: Stress Rx, XP, Guarantee, Seablend, NuRelease

The Ocean Organics program was the **#1 program two years in a row** in this competitive trial funded by the Tri-State Turf Research Foundation at Rutgers.

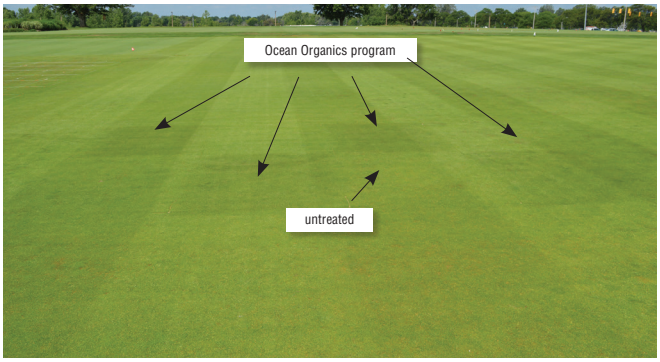


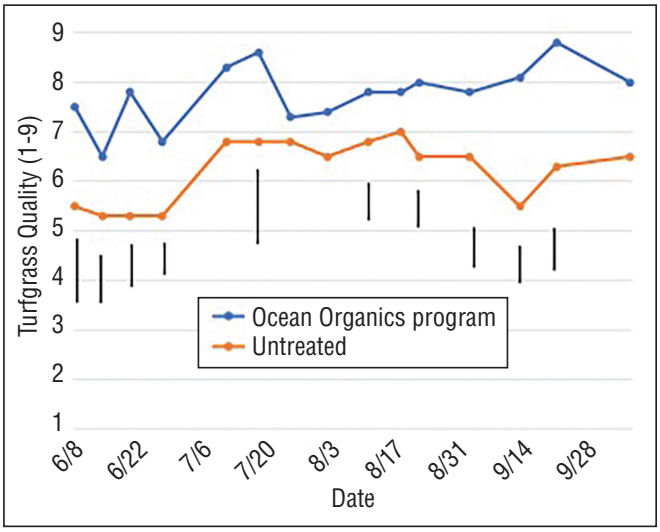
Ocean Organics plots had better quality, color, density, chlorophyll content, and green leaf biomass than controls and competitive products in this Rutgers Trial. Photo: Dr. Bingru Huang et al.

MICHIGAN STATE, *Poa annua*

Products in the program: Stress Rx, XP, Seablend, NuRelease

This field trial at Michigan State found that the Ocean Organics program not only showed statistical improvement in turf quality parameters under summer stress, but also statistically reduced dollar spot in both Poa annua and creeping bentgrass greens.

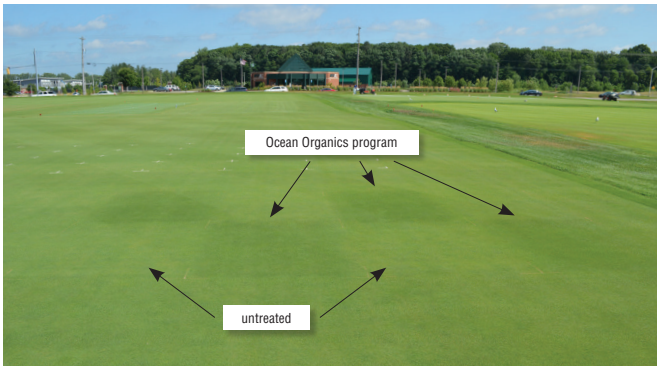


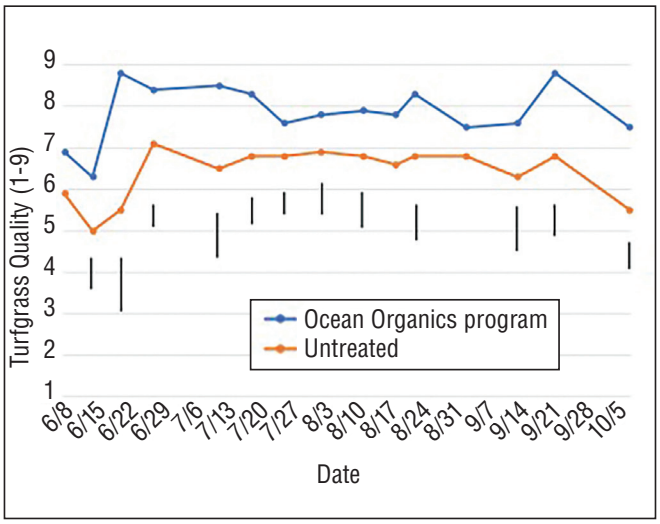


Ocean Organics' program statistically improved turf quality, color, NDVI (indicative of higher chlorophyll content), and reduced dollar spot as compared to untreated plots. Photo: Kevin Laskowski and Dr. Emily Merewitz (7/13).

MICHIGAN STATE, creeping bentgrass

Products in the program: Stress Rx, XP, Seablend, NuRelease

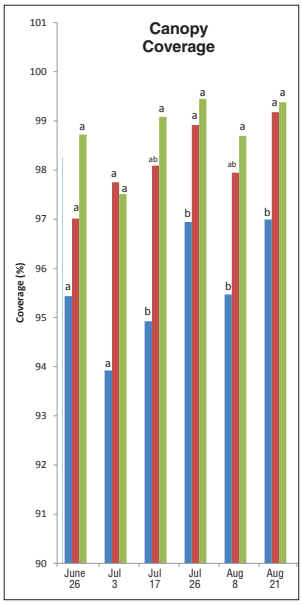




Ocean Organics' program statistically improved turf quality, NDVI (indicative of higher chlorophyll content) and reduced dollar spot as compared to untreated plots. Photo: Kevin Laskowski and Dr. Emily Merewitz (7/13).

RUTGERS, creeping bentgrass

Products in the program: Stress Rx and XP



Untreated control
XP (6 oz/1000 sq ft - 14d)
XP + Stress Rx (6 oz/1000 sq ft - 14d)

Plots treated with XP + Stress Rx had significant differences in canopy coverage as compared to untreated control plots.

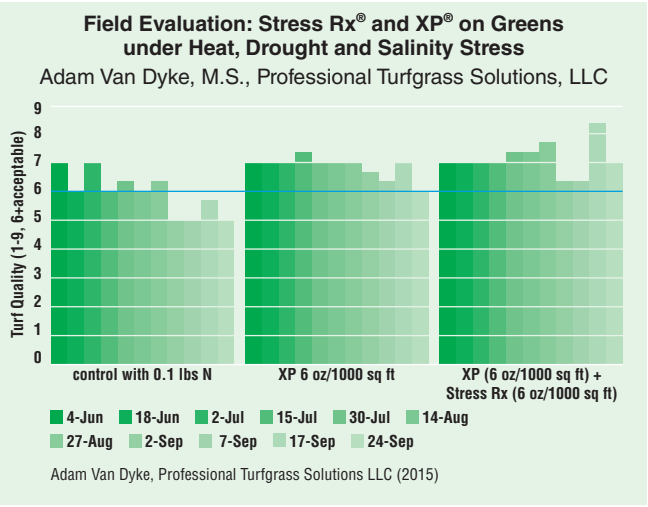
In three years of trial work at Rutgers (2016-2018), Prof. Bingru Huang et al. found that XP® and Stress Rx® improved the quality and performance of creeping bentgrass under heat stress during the summer months all three years.

Treatment with Stress Rx and XP statistically lowered the stress index and increased turf quality, canopy coverage, dark green color index (DGCI), NDVI (indicative of higher chlorophyll content), leaf area index, and root length, surface area and diameter. (See page 11.)

Improved Drought, Salinity Tolerance

UTAH, PROFESSIONAL TURFGRASS SOLUTIONS, creeping bentgrass greens

Field research performed on a golf course in Salt Lake City, Utah showed Stress Rx® and XP® statistically improved turf quality and enhanced recovery on creeping bentgrass putting greens under heat, salinity and drought stress.

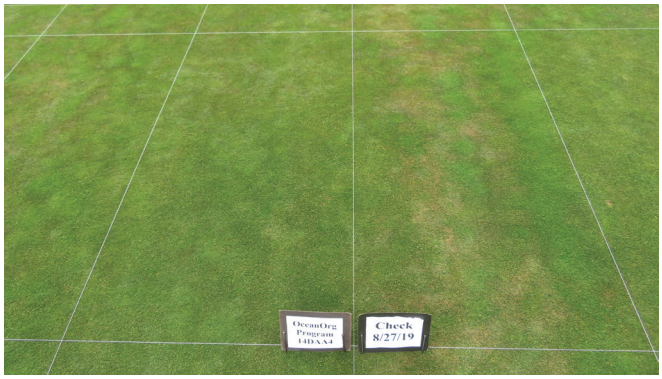


This is just a sampling of the research we have coordinated over the years. To see more data or for more information on the trial details, ask us for our research flyers.

NORTHERN CALIFORNIA, MAHADY AND ASSOCIATES, *Poa annua*

Products in the program: Nautilus, Stress Rx, DeSal, and XP

The Ocean Organics program **ranked #1** in average turfgrass quality and color out of 7 treatments in this field trial on a golf course fairway in northern California subjected to 60% deficit irrigation. Plots treated with the Ocean Organics program maintained acceptable turfgrass quality (6.0 or above) for a full 7 weeks after the initiation of 60% ET irrigation regime.



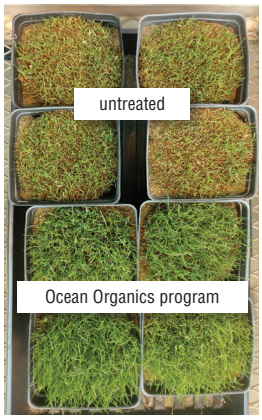
Ocean Organics Program 14 days after the fourth product application (left) versus an untreated check (right) on August 27, five weeks after the initiation of the 60% ET deficit irrigation program. Note the Poa annua stress in the untreated plot. Photo: Mahady & Assoc., Inc.

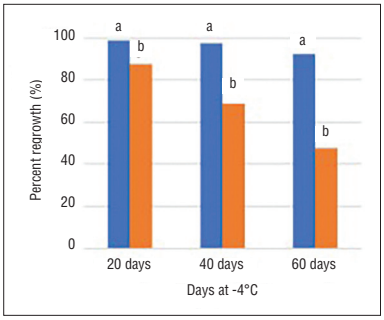
Improved Cold Tolerance Recovery

MICHIGAN STATE, *Poa annua*

Products in the program: Stress Rx, XP, Seablend, NuRelease

After 20, 40, and 60 days of being frozen in a low temperature growth chamber, samples were removed from the growth chamber and re-growth was allowed to occur. Percent recovery was then evaluated after a 20 day period. Treated plugs had significantly more regrowth than the control.





Ocean Organics program
Untreated

After 20, 40 and 60 days of being frozen, the plugs treated with our program had significantly more regrowth when compared to the untreated control (see chart above). 60-day plugs are shown to the left. Photo: Kevin Laskowski and Dr. Emily Merewitz

The Ocean Organics Liquid Line

Industry Leaders

The liquid line of plant growth products from Ocean Organics contains the most diversified combination of stress tolerance and plant strengthening ingredients available in the market. Our product development objective is to help you improve the physiological fitness of the turfgrasses you manage in order to maximize both performance and survival potential under the widest variety of stress conditions.

Research Driven, Scientifically Proven

We have tested our liquid line of products over many years at Rutgers, Virginia Tech, University of California, Michigan State, University of Florida, Mississippi State, University of Arkansas and many other leading research institutions. Research has shown that turfgrass treated with Ocean Organics products has higher turf quality, canopy density, and color; lower stress index, higher chlorophyll content, increased membrane stability, and better photochemical efficiency (more light energy converted to chemical energy) compared to untreated controls. Our liquid line of products has produced excellent results in both cool-season and warm-season turfgrasses. Strategic Stress Management for intensively maintained turfgrasses starts with building the strongest stand of turf possible and the liquid line from Ocean Organics is here to help.

Baltimore Country Club, Maryland

GUARANTEE® NATURAL FOR TURF

(0-0-1) Guarantee® Seaweed Extract – made from fresh *Ascophyllum nodosum* **– builds stronger root systems, strengthens plants, and improves plant stress tolerance.**

Highly Compatible; Excellent for Foliar Use As Well As Drip Irrigation

Ocean Organics is the only U.S.A.-based manufacturer of fertilizer products that is also an industry-leading seaweed processor.

The Ocean Organics Difference

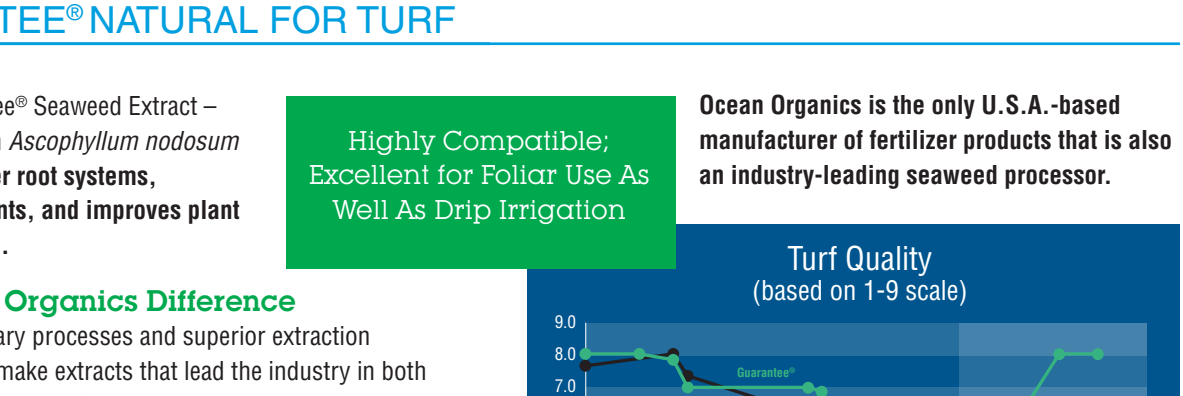
We use proprietary processes and superior extraction technologies to make extracts that lead the industry in both performance and ease of use.

Our extracts are highly compatible with other liquid fertilizer components and are delivered smoothly through irrigation systems.

Our innovative, high-performance plant growth materials are widely used on golf courses and in agriculture and horticulture to deliver:

- Superior tolerance to heat, U.V. overexposure, drought, salinity, cold and disease stresses
- Increased yields / performance characteristics
- Enhanced root development
- Improved health and vigor

Ocean Organics seaweed extracts were proven to offer additional stress tolerance benefits beyond those delivered by standard nutritional and plant protection programs by numerous third-party researchers.



Under heat stress and reduced irrigation in growth chambers, Creeping Bentgrass treated with Guarantee seaweed extract had higher Turf Quality, Percent Cover, and Chlorophyll Index during stress and recovery periods (Michelle DaCosta et al., U Mass).

Application Rates

For Intensively Maintained Turf: Apply 3–6 oz. (89–177 ml.) per 1000 ft² every 14 days. Rates will vary based on soil/tissue analysis and your agronomic needs.

Can be applied as a foliar spray or through fertigation.

Other Uses –Trees, Shrubs, Flowers, Flowering Plants, Stressed Plants

Standard Mixture: 1- 2 oz. (30-60 ml) per gallon (3.78 L) of water

Sizes: 2 x 2.5 gal cases, 15 gal drums, 55 gal drums, 275 gal totes

The Industry Leader: Superior Seaweed Extracts

Crystal Downs Country Club, Michigan
Photo: © L.C. Lambrecht, All Rights Reserved.

XP® EXTRA PROTECTION

(5-0-0) Foliar fertilizer with photoprotectants that **significantly increase stress tolerance and protect against UV exposure.**

A Powerful "1-2 Punch" of Protective Plant Ingredients and Micronutrients

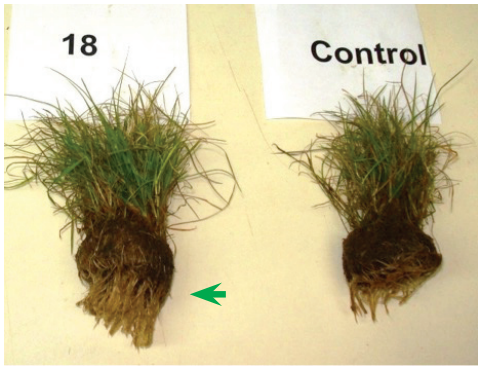
1) The unique plant-protective compounds in *Ascophyllum nodosum* are boosted with high levels of other botanical extracts that protect plants under heat and UV stress.
2) XP provides the most effective micronutrients (Fe, Mn, Mg) to boost summer color. Its amino acid-chelated micronutrients are ideal for foliar uptake. Soil-directed Fe provides superior extended color.

XP — Exceptional:

- Turf Quality
- Color
- Root Health
- Stress Tolerance Recovery

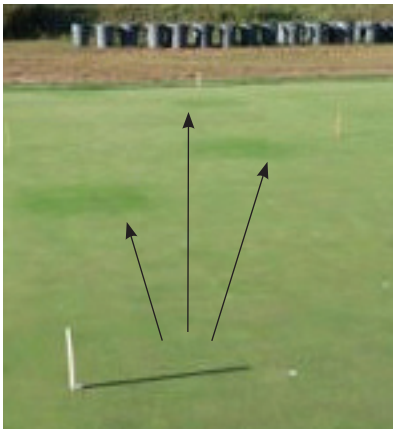
Backed by Research

Independent research over ten years at four universities, and with several private researchers, has confirmed XP improved turf quality and recovery under heat stress, salinity, deficit irrigation, and prolonged UV radiation. XP also improved chlorophyll content and protective carotenoid pigment levels.



XP is further strengthened by our **Pro-Amino® Technology** and proprietary botanical pigments. At Virginia Tech, we screened dozens of ingredients under UV and heat stress to evaluate stress tolerance and recovery.

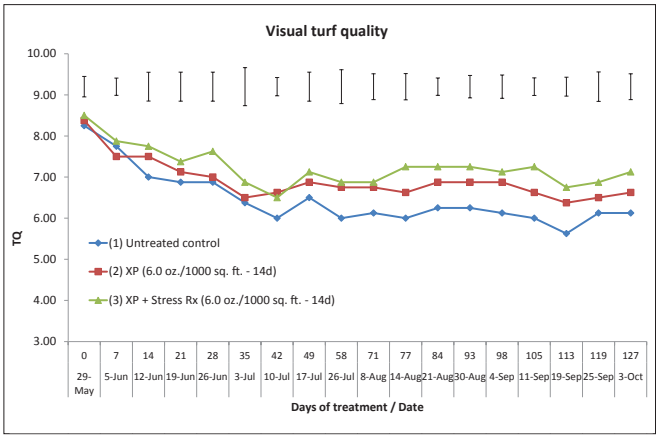
For years, Ocean Organics has been researching the role of pigments in seaweed's ability to improve stress tolerance. In addition to the xanthophyll in our seaweed extract, we formulated XP with additional botanical pigment sources to stabilize photosynthetic membranes and act as effective antioxidants.



In a summer bentgrass decline trial at Rutgers University, the Ocean Organics program that included XP and Stress Rx was the top **performer 2 years in a row**. The program resulted in higher turf quality, more green leaf biomass, and better plant density over the control (Huang et al).

Treatment	Rate (oz/1000 ft²)	Chlorophyll Content (mg/g FW) 1-May	15-May	29-May	12-Jun	25-Jun
XP	6	2.41ab	2.30a	1.87a	1.15ab	1.58a
StressRx + XP	3+6	2.51a	2.40a	2.02a	1.54a	1.83a
Control	0	2.15ab	2.08a	1.80a	0.86b	1.00b

Significant increases in **Chlorophyll Content** with XP and XP + Stress Rx in creeping bentgrass under deficit irrigation and heat stress. **Carotenoids** content also significantly increased in this trial (data not shown). (Ervin and Zhang, Virginia Tech).



On creeping bentgrass research greens at Rutgers University, plots treated with XP alone, and the combination of XP + Stress Rx, maintained statistically higher turf quality than the control plots during summer stress and recovery (Huang and Rossi, Rutgers).

Application Rates

Apply 177 ml. per 93 meters² (6 oz. per 1,000 ft²) every 14 days during the growing season. For large areas, apply 7.6 liters per 4,047 meters² (2 gal. per acre).

Apply in the early morning or late afternoon for best results. Use a spray adjuvant for superior coverage.

Allow foliar product to dry on plant prior to irrigation.

Sizes: 2 x 2.5 gal cases, 15 gal drums

STRESS RX®

(6-0-2) Foliar fertilizer with osmoprotectants. **Significantly increases turf's stress tolerance, survival potential and recuperative ability from heat, drought and salinity.**

Continuing Research Shows Ocean Organics Leadership in Turf Stress Management

Stress management is a proactive process. But even when your turf is already under stress, Stress Rx can really help. Stress Rx contains Ocean Organics proprietary seaweed extract along with the most complete range of biorational compounds available in a single foliar-applied product, including unique osmoprotectants, such as glycinebetaines and amino acids.

Drought and heat stress research at Rutgers showed that Stress Rx helped turf survive and recover from summer stress decline. In multiple trials, Dr. Bingru Huang et al. have found that when XP and Stress Rx were applied together, they were an effective combination in alleviating summer bentgrass decline. Multiple Rutgers trials also showed excellent results on Poa annua. Notable results:

- Significantly higher turf quality
- Significantly more green leaf biomass
- Significantly better plant density

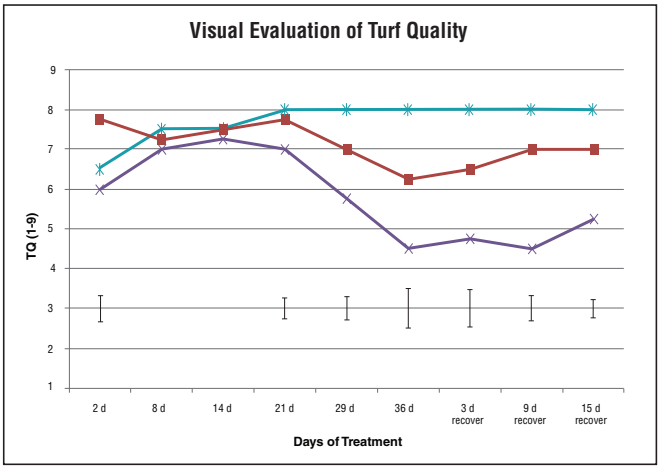
Stress Rx
significantly increases your turf's heat, UV, drought and salt stress tolerance, improves its survival potential, and promotes recovery.

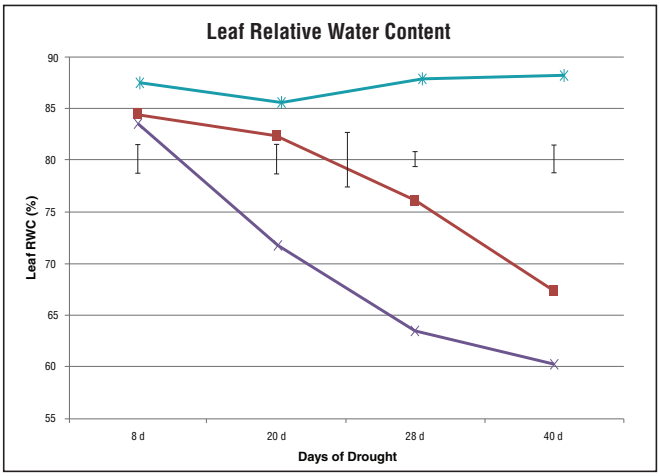
Application Rates

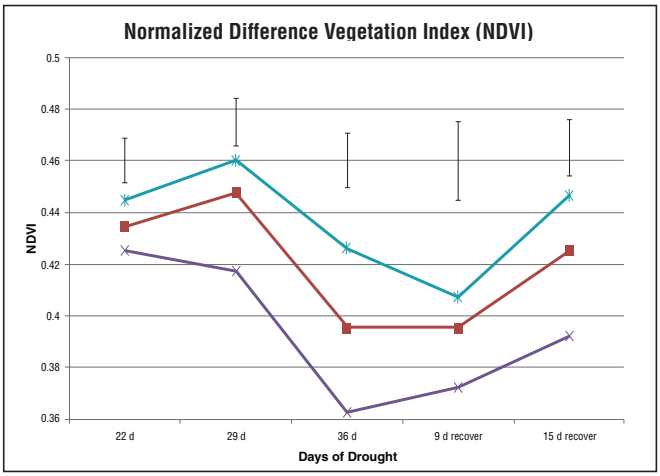
Apply 6 oz per 1,000 ft^2 (2 gal/acre) every 10-14 days. Apply in the early morning or late afternoon for best results. Use a spray adjuvant for superior coverage. Allow foliar product to dry on plant prior to irrigation.

Sizes: 2 x 2.5 gal cases, 15 gal drums

Ten Years of Research
Rutgers and Virginia Tech research shows Stress Rx improves turf quality, relative water content, membrane stability, osmotic balance, and root health under stress.







Stress Rx Wet Control Dry Control

Plots of creeping bentgrass treated with Stress Rx maintained statistically higher turf quality, NDVI (indicative of higher chlorophyll), Leaf Relative Water Content, and had lower Leaf Electrolyte Leakage (data not shown) than the dry control plots during drought and heat stress and also recovery (Huang and Burgess, Rutgers).

STRESS RX® FAIRWAY

(6-0-1) Fertilizer with osmoprotectants specifically formulated for fairway use. **Significantly increases turf's stress tolerance, survival potential and recuperative ability from heat, drought and salinity.**

Stress Rx Fairway from Ocean Organics significantly increases your fairway turf's heat, UV, drought and salt stress tolerance, improves its survival potential, and promotes recovery. Both Stress Rx and Stress Rx Fairway contain the most diversified combination of stress tolerance and plant strengthening constituents available:

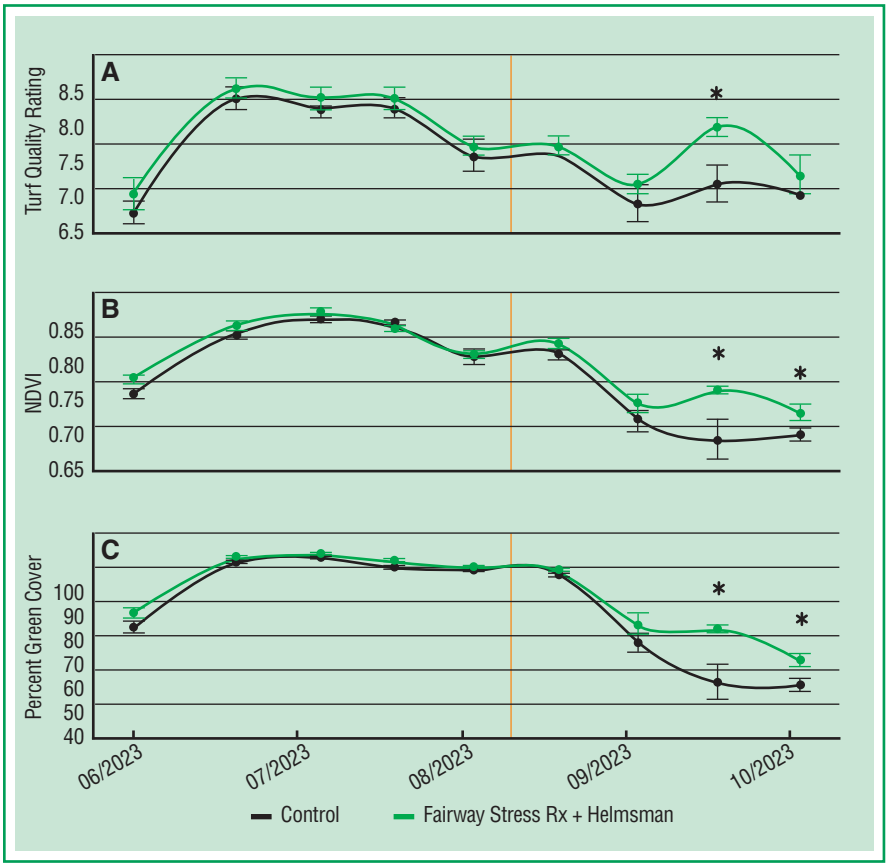
- Unique osmoprotectants, such as exclusive glycinebetaines (the compounds that allow seaplants to adjust and survive in salt water.)
- Powerful pigments like xanthophyll that stabilize photosynthetic membranes and act as effective antioxidants to scavenge plant-damaging free radicals.

To further enhance stress tolerance, osmotic balance and micronutrient chelation, Stress Rx and Stress Rx Fairway also contain Ocean Organics' unique PRO-AMINO™ TECHNOLOGY: 18 of 20 proteinogenic amino acids from 3 plant-derived sources. Stress management is a proactive process. But even when your turf is already under stress, the Stress Rx family of products can help.

Photo taken by Dr. David Jespersen on September 19th showing (A) control, and (B) Stress Rx Fairway + Helmsman.

Application Rates

Apply 3 oz per 1,000 ft² (2 gal/acre) every 10-14 days. Apply in the early morning or late afternoon for best results. Use a spray adjuvant for superior coverage. Allow foliar product to dry on plant prior to irrigation.



Treatment with Ocean Organics products, Fairway Stress Rx and Helmsman, statistically improved Turfgrass Quality, Normalized Difference Vegetation Index (NDVI), and Percent Green Cover in bermudagrass under drought stress. After the imposition of drought stress, the Ocean Organics treatment was able to maintain better overall performance and drought tolerance. Figures show differences in overall quality during the bermudagrass drought stress trial as measured by (A) Visual Turf Quality, (B) NDVI, and (C) Percent Green Cover (digital image analysis). Stress Rx + Helmsman statistically improved overall quality following the onset of drought stress. Bars represent standard errors, and asterisks indicate significant differences at p=0.05 on a given date. The orange line indicates when deficit irrigation was imposed. Trial performed by Dr. David Jespersen at University of Georgia, Griffin Campus.

CHITOGUARD

(0-0-2) Innovative **chitosan biostimulant** that **improves overall plant health under both abiotic and biotic stress**, but particularly when turf will be under attack from pathogens.

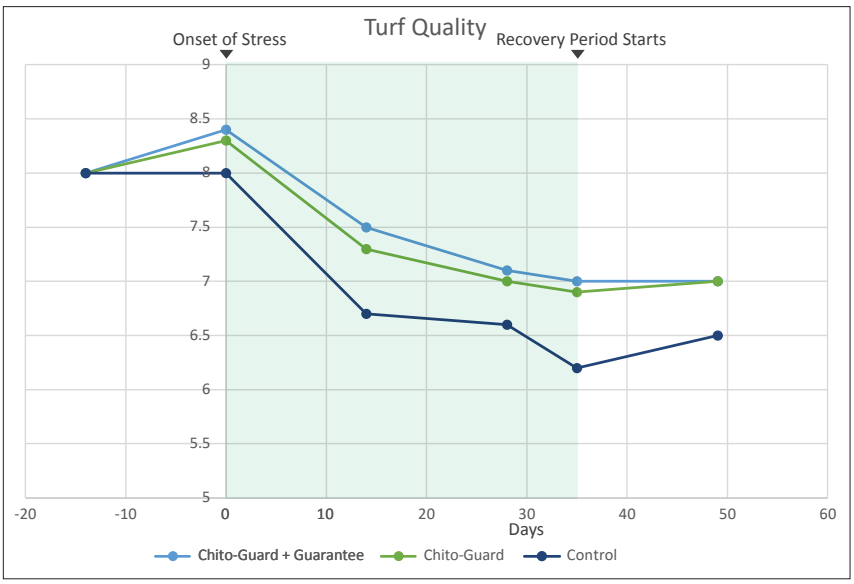
ChitoGuard is made from the most bioactive and bioavailable form of chitosan oligosaccharide on the market and includes a proprietary activator from Ocean Organics. Third-party research from multiple universities shows the benefits of incorporating ChitoGuard into your plant health program. It can be applied via foliar application or to the soil. By pretreating plants with ChitoGuard (bioavailable chitosan oligosaccharide), it primes the plant for a stronger response to pathogens. It is similar to a vaccine – exposing plants to molecular fragments commonly found in pathogens helps plants be on guard and respond more efficiently. Chitosan has also been shown to improve yield, nutrient uptake, root growth, and stress tolerance in various crops.

ChitoGuard improved root biomass and viability in creeping bentgrass under heat and drought stress conditions as observed at the end of the stress treatment (day 35). Photo credit: Dr. Xunzhong Zhang.

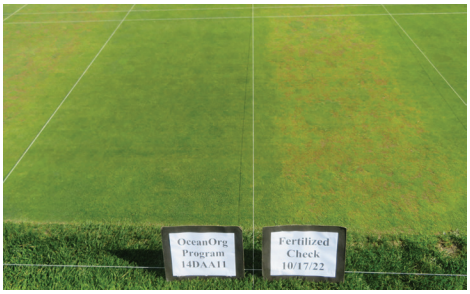
Stronger is Better

When turf faces abiotic and biotic stress, university research shows ChitoGuard improves

- Turf Quality
- Root Biomass & Viability
- Chlorophyll Content
- NDVI



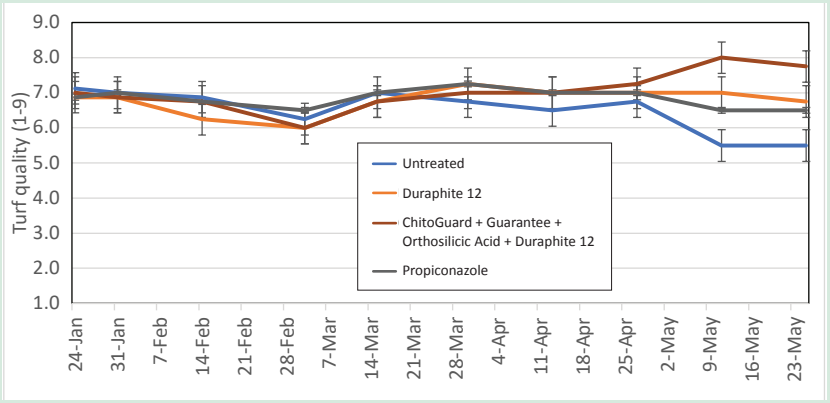
ChitoGuard with and without Guarantee Seaweed Extract improves turf quality in creeping bentgrass subjected to heat stress and mild drought stress in growth chambers. The addition of seaweed extract boosts turf quality during the stress period. Trial performed by Dr. Xunzhong Zhang at Virginia Tech.



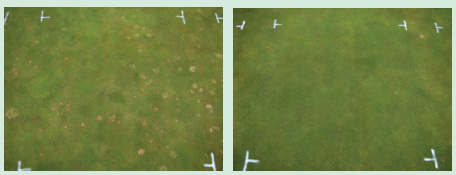
An Ocean Organics program that included ChitoGuard improved turf quality during a period of severe *Anguina pacificae* nematode pressure on a northern California *Poa annua* research green. The program included five Ocean Organics products and a fungicide program from Syngenta, but did not include any nematicides. From the report: "Note the robust *Poa annua* with good color and density." Photo: Mark M. Mahady & Associates, Inc., "2022 Evaluation of Products for Control of *Anguina pacificae* and Soil-Borne Nematodes on a Poa annua Putting Green."

Application Rates

Apply ChitoGuard at 6 - 10 oz/1000 sq. ft. either by foliar application or to the soil during peak periods of stress.



The treatment combining ChitoGuard, Guarantee Seaweed Extract, orthosilicic acid and Duraphite 12 resulted in consistently better turf quality during the stress of Microdochium patch infection as compared to the untreated control, Duraphite 12 alone, or Propiconazole in a field trial at Oregon State.



The Ocean Organics treatment consisting of ChitoGuard, Guarantee, orthosilicic acid, and Duraphite 12 improved turfgrass quality during Microdochium stress (top photo) relative to the control (bottom photo). Photo credit: Cole Stover, Oregon State.

Innovative Soil Nutrient Management

NuRelease, a proprietary formulation of specific, naturally occurring organic acids, is an innovative nutrient release soil treatment liquid and also a performance-enhancing fertilizer additive. NuRelease **maximizes nutrient release, bioavailability and uptake efficiency in the rootzone and facilitates plant nutrient uptake and absorption**.

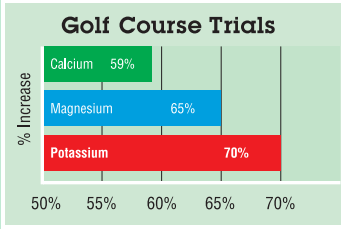
The Breakthrough Biocatalyst for Phosphorus... and Nitrogen, Potassium, Calcium, Magnesium, and Iron

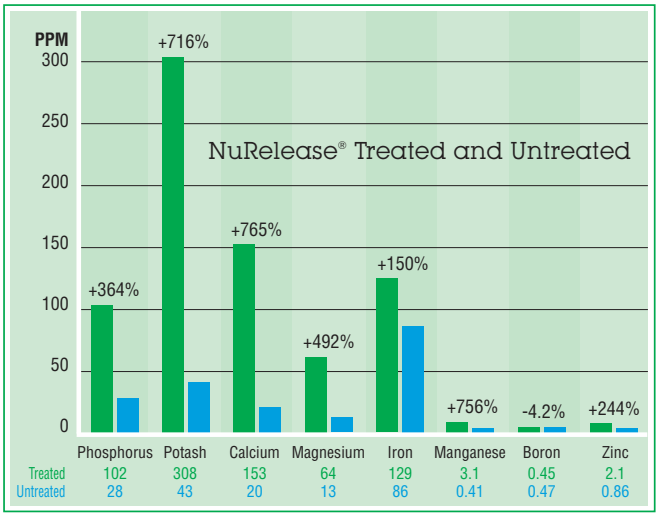
Phosphorus is essential for energy transformation and conversion of carbohydrate starch to sugar. Phosphorus absorption through roots declines as root growth declines. NuRelease makes phosphorus and divalent cations, like Ca, Fe, Mg, Mn, and Zn, more available to the plant.

When added to fertilizers, NuRelease® maintains nutrient solubility, facilitates plant nutrient uptake and increases foliar absorption.

Excellent Results on Midwest Golf Courses

In field tests on several golf courses, application of NuRelease made nitrogen, phosphate, potassium, calcium, magnesium, and iron more available to turf. At some sites, bioavailable forms of Ca increased by as much as 59%; Mg by 65%; and K by 70%.





South Carolina Soil Sample

Top 10 Reasons to Use NuRelease®

1. It will help you do more with less. You can apply 20-40% less Phosphorus with no compromise in turf quality, color or density.
2. It will improve the performance of the rootzones, rhizospheres and soils you manage.
3. It will also release Phosphorus-bound divalent cations like Ca, Fe, Mg, Mn and Zn...making them more bioavailable. NuRelease® also releases bound Sodium.
4. Great for repairing winter damage and promoting better spring seeding, sodding and sprigging.
5. **It will help you maximize your turf's photosynthetic capacity, respiratory efficiency and stress tolerance.**
6. It's extraordinarily versatile and effective across a broad range of soils and conditions.
7. **It works in cool soils so it will help desirable turfgrasses like bentgrasses out-compete poa annua in spring and fall.**
8. It's fast-acting, affordable, budget friendly and compatible with virtually everything you apply.
9. Use as a tank mix additive to improve stability as well as uptake of nutrients and other plant protection materials.
10. It's sustainable. You can lower phosphorus inputs and reduce risk of groundwater contamination while improving turf quality.

Independent Tests Confirm Efficacy

16 oz NuRelease®/acre outperformed 60 lbs/acre Triple Super Phosphate (TSP)

- **Adding 8 oz NuRelease® allowed P inputs to be reduced by 50%. Eight ounces of NuRelease® plus 30 lbs of TSP out-produced 60 lbs. of TSP alone.**

Application Rates

As a soil applied treatment: Apply 32 oz per acre (0.8 oz per 1,000 ft²) monthly and water into the rootzone.

As a fertilizer TANK-mix additive:
For one acre apply 16 oz monthly.
For 1,000 ft²: apply 0.4 oz monthly.

If you are applying foliar fertilizers and nutrients more frequently than once per month, divide the NuRelease monthly rate by the number of applications per month, and apply that amount each time. For example, if you foliar feed golf course greens every two weeks, apply 0.2 oz (6 ml) of NuRelease per 1,000 ft² each time.

Sizes: 2 x 2.5 gal cases, 15 gal drums

Managing Soil Health

DeSal is a salinity and sodicity soil treatment that addresses the underlying problems in the soil, **dramatically reducing sodium and total salts in the rootzone**. It's the **top performing product** in this category. Our proprietary blend of natural compounds mimics the natural sequestering power of exudates produced by healthy roots and soil microbes.

Detox the Soil and Correct Nutrient Deficiencies

Using our proprietary NuRelease® technology, DeSal:

- Dramatically reduces sodium and total salt concentrations in rootzones.
- Helps move sodium and total salts out of the rootzone.
- Releases calcium, critical to effective water and nutrient transport.
- Helps correct Ca, P, K, Mg, Mn, Fe, and Zn deficiencies.

Calcium released by DeSal in the rootzone has two functions. It displaces sodium on soil particles allowing the sodium to be more easily and economically flushed out. It also helps to supply the plant roots with calcium, which is known to improve salinity tolerance and protect plant cells.

Improve Water Uptake

The net result of reducing sodium, improving calcium availability and correcting critical nutrient deficiencies is better water uptake.

Salinity Tolerance, Quality, Reduced Sodium

The Two-Pronged Approach for Salinity Management

Target the Soil with DeSal; Target the Plant with Stress Rx® and XP® Extra Protection.

TOP PERFORMER IN RESEARCH

- In salinity stress field trials at UC Riverside on bermudagrass, Ocean Organics program using **Stress Rx** and **DeSal** was the top performer in improving turf quality.

*"**We tested 30** commercial and experimental products for their ability to alleviate salinity stress on bermudagrass irrigated with saline water… The highest quality was recorded in plots treated with DeSal + Stress Rx + XP. In fact, this was **the only treatment that resulted in higher quality** than the untreated control **for both years**…"*

GCM Online, August 2019 | Marco Schiavon, Ph.D., and James Baird, Ph.D.

- **DeSal was the top performing salt management product** out of 7 programs in a replicated field trial conducted by Mark M. Mahady & Associates, Inc. on the Poa annua chipping green of a country club near Monterey, California.
- In a replicated field trial funded by the Hi-Lo GCSA Research Committee and conducted by Mark M. Mahady & Associates, Inc. on fairways at a golf course in Indio, CA, of 9 programs tested, **DeSal exhibited the greatest change in the concentration of critical salt management components**.

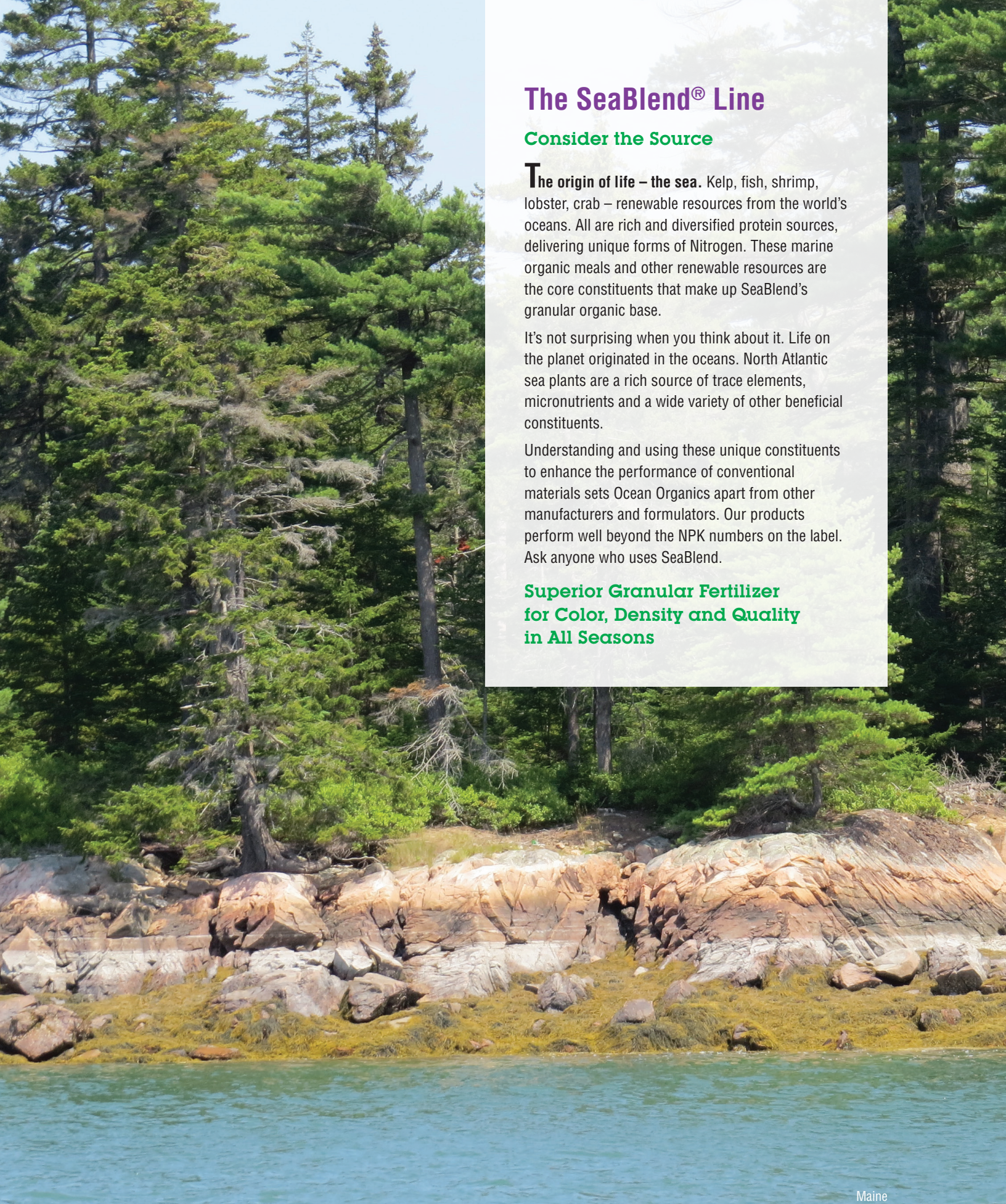
Application Rates

For saline and/or sodic soils: Apply 24 oz. per acre (0.5 oz. per 1000 ft^2) every 21 days. Following treatment, apply adequate irrigation to wash product from leaf surfaces into the soil. Follow with a flushing irrigation appropriate for the soil type within 24 hours. DeSal may be applied with irrigation water or with fertigation.

To enhance movement of salts away from the root zone, tank mix with a wetting agent (penetrant).

Follow post-treatment irrigation recommendations.

Sizes: 2 x 2.5 gal cases, 15 gal drums



The SeaBlend® Line

Consider the Source

The origin of life – the sea. Kelp, fish, shrimp, lobster, crab – renewable resources from the world's oceans. All are rich and diversified protein sources, delivering unique forms of Nitrogen. These marine organic meals and other renewable resources are the core constituents that make up SeaBlend's granular organic base.

It's not surprising when you think about it. Life on the planet originated in the oceans. North Atlantic sea plants are a rich source of trace elements, micronutrients and a wide variety of other beneficial constituents.

Understanding and using these unique constituents to enhance the performance of conventional materials sets Ocean Organics apart from other manufacturers and formulators. Our products perform well beyond the NPK numbers on the label. Ask anyone who uses SeaBlend.

Superior Granular Fertilizer for Color, Density and Quality in All Seasons

Maine
Photo: Debbie Seaver

SEABLEND®

The SeaBlend Family of premium, natural and organic-based granular fertilizers **produces outstanding color, density and quality; stimulates microbial activity and builds soil. It provides complete, balanced and diversified nutrition**.

SeaBlend has a rich base of ingredients including: Kelp Meal, Fish Meal, Crab Meal, Blood Meal, Feather and Alfalfa Meal, Potassium Sulfate, Magnesium Sulfate, Manganese Sulfate, Ferrous Sulfate, Zinc Sulfate Urea, and Methylene Urea.

- SeaBlend® (12-4-5)
- SeaBlend® (12-0-12)
- Fairway SeaBlend® (12-4-5 and 12-0-12)
- SeaBlend® AS (14-2-4)
- SeaBlend® Super Starter (5-7-5) For Rapid Establishment and Growth

Seablend Produces Outstanding Color, Density and Quality; Stimulates Microbial Activity, and Builds Soil.

In the Fall, you can't predict when cold weather will begin. If it's late, SeaBlend fully releases all nutrients so your turf builds carbohydrate reserves. If cold weather starts early, the synthetic ingredients in SeaBlend will still build reserves, while the organic ingredients become a dormant feed releasing in Spring for early green-up.

SeaBlend produces outstanding color; it builds soil and stimulates microbial activity. Unlike most organics, SeaBlend won't gum up mower rollers. And with a homogenous micro particle size, it's perfect for closely mowed bents and Bermudas, including the newer denser varieties. SeaBlend contains no bone meals or biosolids. The marine organics are high in chitin and calcium. The benefits of calcium in the soil are well known. Chitin in the soil has been shown to be inhospitable to nematodes.

Application Rates

Established Turfgrass and Landscape: Use as a fertilizer for greens, tees, roughs, fairways and ornamentals, three to four times each season. For one pound of nitrogen, broadcast at a rate of 93 sq. meters per 3.63 kg. (8.33 lbs. per 1,000 sq ft.).

New Turfgrass and Landscape Planting and Seeding: Incorporate into top 2-4 inches of soil prior to seeding, sodding or sprigging and landscape planting.

Application Coverage Rates

For 1 lb. of N/1000 sq. ft. apply 8.33 lbs:

- 1 bag (50 lbs.) covers 6,000 sq. ft.
- 7.25 bags (363 lbs.) covers 1 acre
- 40 bags (1 ton) covers 5.5 acres.

Size: 50 lb bags

Siwanoy Country Club, New York
Photo: © L.C. Lambrecht, All Rights Reserved.

SEABLEND® SUPER STARTER

A performance enhancing, organic-based starter fertilizer –

- **Accelerates establishment by 30-35%**
- **Lets you do more with less**

SeaBlend Super Starter enriches the rootzone with natural organics, high quality natural and synthetic fertilizers, and breakthrough biocatalysts. SeaBlend Super Starter promotes quick growth and establishment for newly seeded, sodded or sprigged turfgrasses and also helps give established turf a jump start in spring's cool temperatures. SeaBlend Super Starter is formulated with NuRelease® Technology and biologically produced organic acids.

These compounds complex the nutrients that are present, but locked up in the soil and make them available for root uptake – so you get more of the performance potential out of your rootzone. NuRelease Technology works in cool soils, so you can get off to a *super start* in spring.

- SeaBlend Super Starter's nutrients are derived from a combination of select, natural organics and high-quality chemical fertilizers – the best of both worlds. The ingredients and their proportions are selected to produce even and sustained availability of the major and minor nutrients.
- Like the other members of the SeaBlend family, SeaBlend Super Starter contains specific amino acids and microbes which work together to produce natural growth promoters in the root zone. This approach triggers the natural processes in the soil that have been part of plant growth for as long as there have been plants.
- SeaBlend Super Starter contains a proprietary, naturally-derived wetting agent to ensure rapid movement of the soluble nutrients into the root zone.
- SeaBlend Super Starter maximizes phosphorus utilization and minimizes nutrient runoff. It also releases phosphate-bound calcium, iron, magnesium, manganese and zinc in the soil and makes them more bioavailable for root uptake.

SeaBlend Super Starter – More Than Just A Fertilizer – Truly Complete Nutrition.

Application Rates

For use as a preplant fertilizer: For 1 lb of Nitrogen, 1.4 lbs of Phosphorus, and 1 lb of Potassium, apply 20 lbs of SeaBlend Super Starter per 1,000 sq. ft. Use a rotary or drop spreader. Incorporate into the top 2-4 inches of the soil prior to seeding, sodding, sprigging and landscape planting. Irrigate after planting.

For established turf: To stimulate turf growth and winter recovery in spring, apply 10 lbs per 1,000 sq. ft.

Size: 50 lb bag

SEABLEND® PLUS with SynGen™

SeaBlend with our proprietary SynGen surfactant –

- Improves nitrogen efficiency
- Improves soil wetting for better fertilizer efficacy and control
- Dramatically reduces potential for runoff, puddling, leaching and nitrogen loss due to volatilization.
- Increases nitrogen retention and uptake
- Faster color response
- Better and sustained growth

SeaBlend® Plus with SynGen is also available in **fairway** grades.

"The [Stress Rx+XP] plots had significantly better quality compared to just UMAXX nitrogen-treated plots by the end of summer."
Professional Turfgrass Solutions, LLC

"[The Ocean Organics program] ranked #1 for average turf quality and color from July 16 to October 8, 2019 when compared to all treatments."
Mark M. Mahady and Associates, Inc.,
Poa annua Fairways Subject to Deficit Irrigation

"Out of nine programs tested, the DeSal program 'exhibited the greatest change in the concentration... of exchangeable sodium, soluble salts, extractable sodium, extractable chloride, bicarbonates and EC'"
The Hi-Lo GCSA Research Committee and
Mark M. Mahady and Associates, Inc., 2008,
(Overseeded Bermudagrass Fairways)

"[DeSal] performed very well for salt management. Plots showed a sizeable reduction in EC, sodium and total soluble salts over the six-week trial."
Mark M. Mahady and Associates, Inc., 2005,
Management of Salts and Localized Dry Spot on Poa annua Putting Greens

"We tested 30 commercial and experimental products for their ability to alleviate salinity stress on bermudagrass. ***The only program that had an effect on turfgrass quality and soil chemistry was DeSal + Stress Rx + XP Extra Protection."***

•

Increased turf quality and Dark Green Color Index (DGCI)

•

Decreased EC, SAR and Na content in the soil.
"The best combination of salinity alleviation and turf quality in both years of the study."
U.C. Riverside, 2013-2014

"The Ocean Organics treatment program significantly increased turf quality, DGCI (Dark Green Color Index), and NDVI (Normalized Difference Vegetation Index) while reducing the incidence of dollar spot during the summer of 2016."

Michigan State, 2016

"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..."

Rutgers University, 2019

"During prolonged heat stress,[Ocean Organics] treatments were effective in allowing turf to maintain higher turf quality and performance... plots that received treatments had superior canopy coverage and DGCI through the duration of heat stress…plots treated with XP + Stress Rx consistently performed best overall throughout the summer stress period."

Rutgers University, 2017

"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.

•

Stress Rx treatments had 54% longer roots than controls even after 8 days of recovery.

Virginia Tech, 2012

"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."

Tristate Research Foundation/Rutgers, 2013

The Ocean Organics Surfactant Line

Turf Surfactants with a Difference

Nothing is more critical to managing intensively-maintained, highly stressed turf than controlling moisture and nutrient delivery. Ocean Organics Surfactants optimize both nutrient and water use efficiency.

Surfactants are increasingly critical in today's turfgrass management environment — and will only become more so.

The Ocean Organics Turf Surfactant Line is unique and proprietary

Of the more than 50 companies supplying surfactants to turf professionals in North America, less than 10% actually make the molecules that provide the basic molecular building blocks involved in surfactant technology. Instead of manufacturing chemicals, we focus our expertise on how to best apply these basic chemistries to the specific, unique performance requirements of intensively-maintained turf grasses — and we add value. Our products optimize both nutrient and water use efficiency and also provide unique ingredients that help boost plant fitness.

Each formulation contains a surfactant, an infiltration agent, and a biostimulant

- We include our industry-leading seaweed extract for its many benefits related to fitness and stress management. Because it has no Nitrogen, it never causes growth flushes.
- Penetrant agents help water and nutrients infiltrate through the mat layer and into the soil faster. They also keep the surface dryer.
- The Ocean Organics Surfactants are also phyto-safe.
- They are highly cost-efficient, having a lower end user cost per gallon and a lower cost per acre than competitive products.

Baltimore Country Club, Maryland

The Ocean Organics Surfactants: Increase Nutrient Uptake, Plant Vigor and Stress Tolerance • Promote Faster and More Complete Root Development • Aid Water Conservation

NAUTILUS®

Nautilus® promotes drier and firmer playing surfaces; consistent, uniform root zone soil moisture; and a slower, more consistent dry down that reduces hand watering.

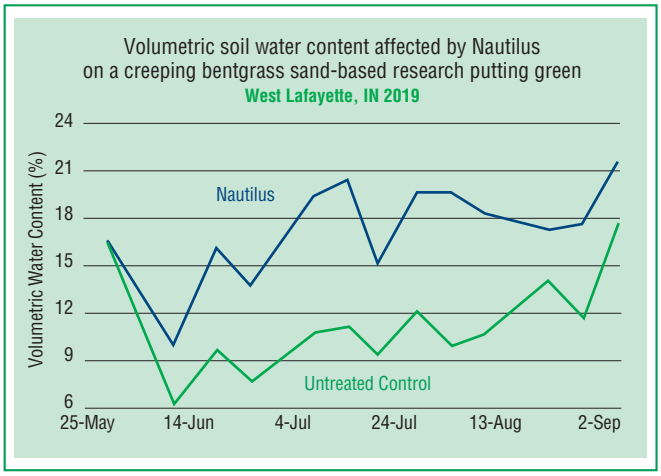
Nautilus employs our capped chemistry which is unique in how it attaches to hydrophobic soils to deliver lower soil moisture content while insuring a consistent dry down of the root zone.

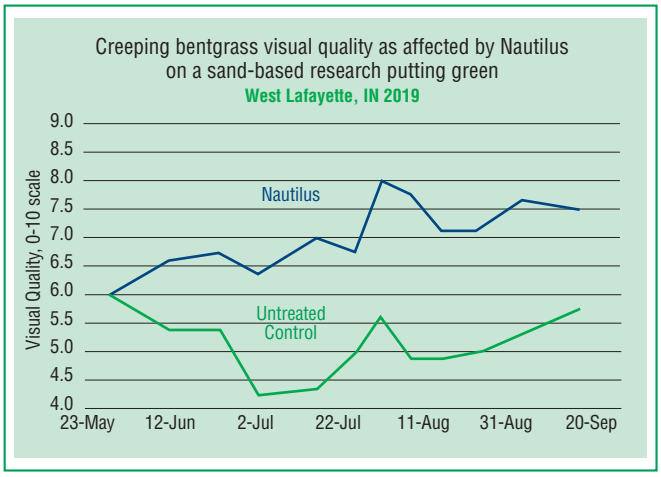
Nautilus:

- Provides firm, dry, and fast playing surfaces.
- Enhances the efficacy and control of fertility and pesticide programs (reduces leaching).
- Creates consistent uniform soil moisture in the root zone.
- Delivers a slower, consistent dry down that reduces hand watering.

STRESS RX, XP AND NAUTILUS

In 2018 at Rutgers, turf maintained significantly higher root length, surface area, and volume in the 0-10 cm root zone and significantly higher root diameter following heat stress with the addition of Nautilus to the Stress Rx and XP program.





Nautilus improved turf quality under deficit irrigation in this surfactant trial at University of Arkansas. Untreated checks to the upper left and lower right. Photo: Dr. Mike Richardson. August 8.

Application Rates

Apply 6 fl oz per 1000 ft2 in minimum of 2 gal of water every 28 days. After application, irrigate sufficiently to remove product from leaf surfaces.

For coarse soils/sand root zones: Use 1/3" irrigation water

For fine textured soils: Use 2/10"-1/4" irrigation water

Sizes: 2 x 2.5 gal cases, 30 gal drums, 275 gal totes

MARINER®

Mariner® promotes firmer and drier playing surfaces and improved root zone moisture uniformity when used in either a short or long term program.

Mariner uses our straight block chemistry.

Mariner:

- Provides firm, dry, and fast playing surfaces.
- Improves the efficacy and control of fertility and pesticide programs (reduces leaching).
- For both long (90 days) or short term (14-28 days) use.
- Delivers consistent uniform soil moisture in the root zone.

Application Rates

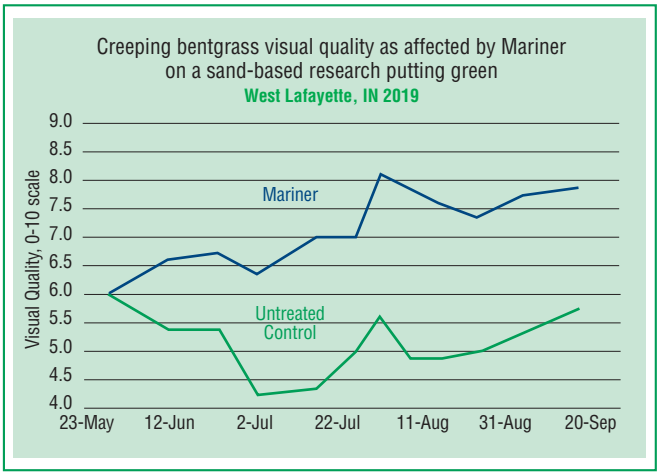
For Short-Term use: 4-6 fl oz/1000 ft² in minimum of 2 gal of water every 28 days.

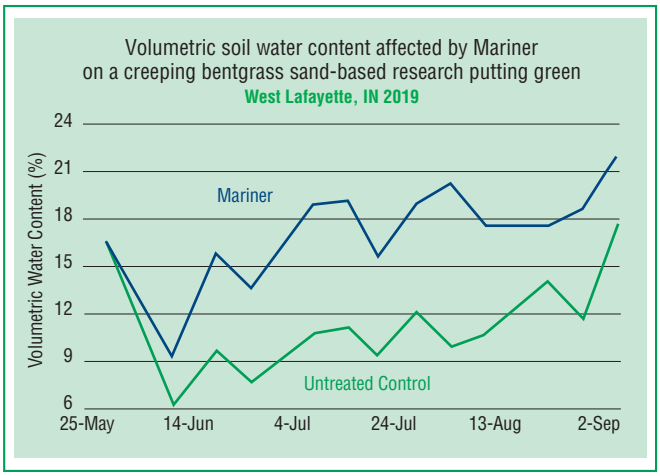
For Long-Term use (90 days control): Apply product at 8 fl oz per 1000 ft² in minimum of 2 gal of water. Follow up with second application of 8 fl oz per 1000 ft² in minimum of 2 gal of water 7-10 days later. After application, irrigate sufficiently to remove product from leaf surfaces.

For coarse soils/sand root zones: Use 1/3" irrigation water

For fine textured soils: Use 2/10"-1/4" irrigation water

Sizes: 2 x 2.5 gal cases, 30 gal drums, 275 gal totes





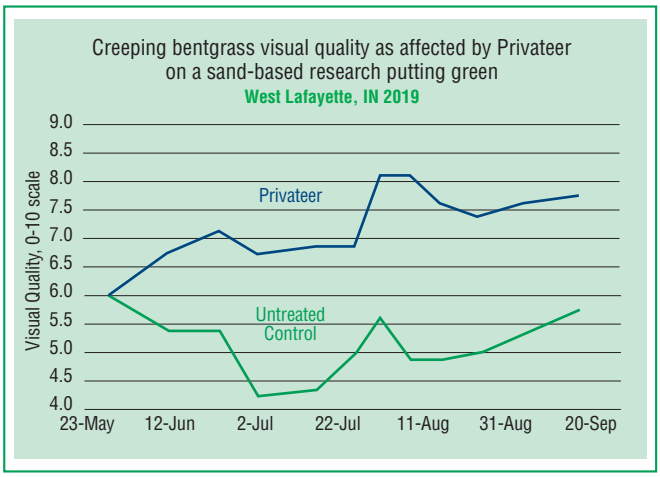
Mariner improved turf quality under deficit irrigation in this surfactant trial at University of Arkansas. Untreated check to the upper left.
Photo: Dr. Mike Richardson. August 8.

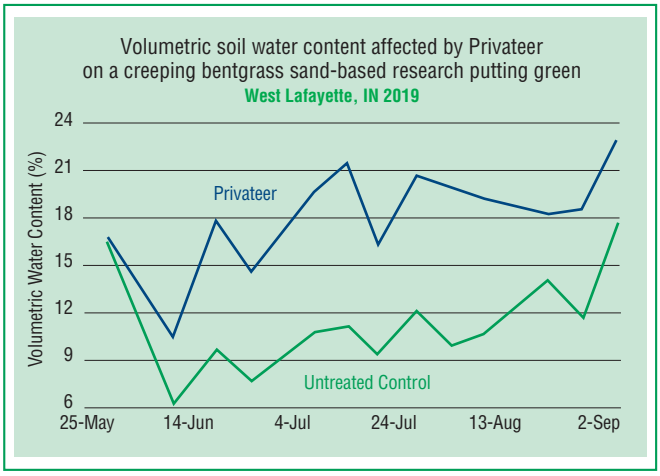
PRIVATEER®

Privateer® treats Localized Dry Spots (LDS) while increasing moisture uniformity in the root zone. Can be used as a curative or as a monthly program product.

Privateer:

- Treats and eliminates LDS.
- Can be used as a treatment for LDS or for its prevention.
- Maximizes water uniformity in the root zone.
- Assists in the rapid recovery of drought stressed turf.





Privateer improved turf quality under deficit irrigation in this surfactant trial at University of Arkansas. Untreated check to left. Photo: Dr. Mike Richardson. August 8.

Application Rates

Apply 4 fl oz per 1000 ft2 in minimum of 2 gal of water every 28 days. After application, irrigate sufficiently to remove product from leaf surfaces.

For coarse soils/sand root zones: Use 1/3" irrigation water

For fine textured soils: Use 2/10"-1/4" irrigation water

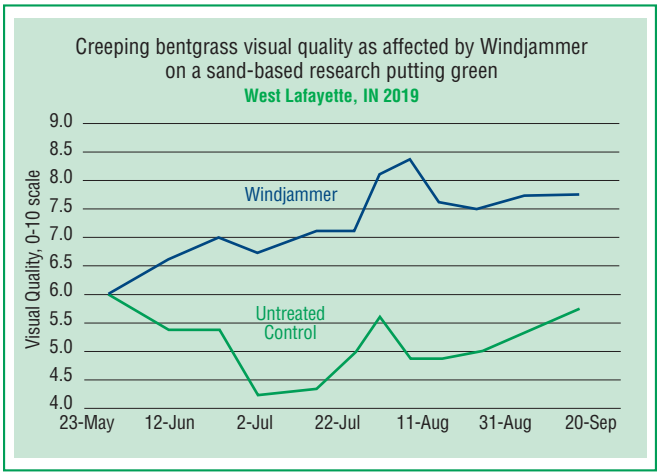
Sizes: 2 x 2.5 gal cases, 30 gal drums, 275 gal totes

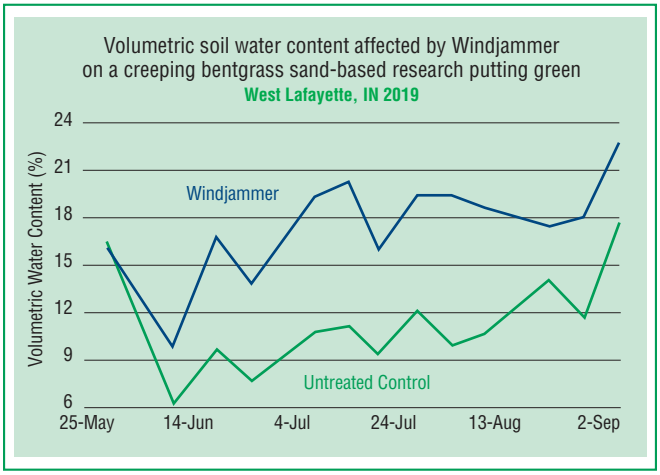
WINDJAMMER®

Windjammer® is our blend of unique surfactant molecules that provide firm, dry, and fast surfaces along with superior turf quality.

Windjammer:

- Reduces wilt.
- Produces superior plant moisture availability and turf quality.
- 6 times faster infiltration rate vs. the competition.
- Enhances the efficacy and control of fertility and pesticide programs (reduces leaching).





Windjammer improved turf quality under deficit irrigation in this surfactant trial at University of Arkansas. Untreated checks to the upper right. Photo: Dr. Mike Richardson. August 8.

Application Rates

Apply 4-6 fl oz per 1000 ft² in minimum of 2 gal of water every 28 days. After application, irrigate sufficiently to remove product from leaf surfaces.

Sizes: 2 x 2.5 gal cases, 30 gal drums, 275 gal totes

HELMSMAN®

Helmsman® is a surfactant for use on fairways and fine soils. It **increases the penetration of applied water and rainfall and improves irrigation efficiency. Helmsman addresses soil moisture problems on hillsides, mounds, and other difficult to access areas.** It can be injected or sprayed.

Helmsman:

- Greatly increases penetration of applied water and rainfall.
- Improves irrigation efficiency.
- Enhances the efficacy and control of fertility and pesticide programs (reduces leaching).
- Can be sprayed or injected.

Application Rates

Spray: 3 fl oz per 1000 ft² every 28 days. After application, irrigate sufficiently to remove product from leaf surfaces.

For coarse soils/sand root zones: Use 1/3" irrigation water

For fine textured soils: Use 2/10"-1/4" irrigation water

For Injection: Apply 12 oz per acre once a week.

Sizes: 2 x 2.5 gal cases, 30 gal drums, 275 gal totes

Baltimore Country Club, Maryland

TOPSAIL®

TopSail® is our unique blend of surfactant molecules for use on fairways and fine textured soils. Topsail can be used as a program product and/or a delivery agent for individual sprays (16oz/acre rate). Topsail addresses soil moisture problems on hillsides, mounds, and other difficult to access areas. It can be injected or sprayed.

TopSail:

- Greatly increases penetration of applied water and rainfall (3 times faster infiltration rate vs. the competition).
- Improves irrigation efficiency.
- Enhances the efficacy and control of fertility and pesticide programs (reduces leaching).
- Can be sprayed or injected.

Application Rates

Spray: 32 fl oz per acre every 28 days. After application, irrigate sufficiently to remove product from leaf surfaces.

For coarse soils/sand root zones: Use 1/3" irrigation water

For fine textured soils: Use 2/10"-1/4" irrigation water

For Injection: Apply 4-8 oz per acre once a week.

Sizes: 2 x 2.5 gal cases, 30 gal drums, 55 gal drums, 275 gal totes

Eastward Ho! Club, Massachusetts
Photo: © L.C. Lambrecht, All Rights Reserved.

Soil Water Repellency

Soil Water Repellency: Soil water repellency is a reduction in the rate and retention of water in soil caused by the presence of hydrophobic coatings on soil particles. For crop production and the maintenance of fine turf, water repellency can stress plants resulting in poorer yield quality or turf playability.

Consequences of Water Repellency:

- Drainage and leaching of nutrients due to “preferential flow” or preferential pathways through the soil
- Runoff of both natural and applied water
- Uneven distribution of applied chemicals
- Localized Dry Spot (LDS)

What is a Surfactant/Wetting Agent? A Surfactant/Wetting Agent is a substance that when absorbed prevents a surface from being repellent to a wetting liquid. It is used especially in mixing solids with liquids or spreading liquids on surfaces.

How do they work? Surfactants/Wetting Agents are typically sprayed on a surface and then liberally watered into the soil profile. As the molecule makes its way through the soils, it will attach to any hydrophobic or water repellent surface. Once anchored, the molecule will attract and hold water therefore aiding in the hydration of the water repellent soils.

MARINER® SURFACTANT BIO-TABS

A cure for LDS in a handy tablet for hose-end applicators.

Mariner Surfactant Bio-Tabs:

- Product excellence — 100% Active Ingredients.
- Tablets are not sticky, won’t dissolve until in applicator.
- Easy to handle.
- Contains 5% Ocean Organics Seaweed Extract.
- Contains highly-bioavailable Ocean Organics Humic Acid.
- Treats LDS.

Application Rates

Mariner Surfactant Bio-Tabs are specifically designed for spot treatment of severely affected areas using a hose-end applicator.

Mariner Surfactant Bio-Tabs should be used as required. Repeat applications as necessary. Rate of dissolution will depend upon water pressure and temperature. One tablet will treat approximately one green (watering for 20-30 minutes) or will spot-treat 6-7 greens.

Mariner Bio-Tabs do not require watering-in after application.

Size: Box of 6 - 8 oz. tablets

MARINER® and PRIVATEER® SWDG

Soluble Water-Dispersible Granulars

Our unique formulation includes our industry-leading seaweed extract for its many benefits related to plant fitness and stress management.

Privateer and Mariner SWGD are also phyto-safe.

Privateer and Mariner SWGD:

- Provide consistent, uniform soil moisture.
- Control soil/water repellency.
- Improve the efficacy and control of fertility and pesticide programs (reduce leaching).
- Greatly improve penetration of applied water and rainfall.
- Improve irrigation efficiency.
- Assist in the rapid recovery of drought/stressed turf.

For both long term (90 days) or short term (30 day) use.

Application Rates

For Short-Term (30 days control) use: Apply 2.5 lbs./1000 sq. ft.

For Long-Term use (90 days control): Apply 7 lbs./1000 sq. ft.

Following product application, irrigate with enough water to move active ingredients into the root zone. Apply 2/10 inch water for fine textured soils, 1/3 inch for sandy soils.

Size: 50 lb bag

Baltimore Country Club, Maryland
Photo: © L.C. Lambrecht, All Rights Reserved.

The Science of Seaweed

Diverse Natural Compounds – Diverse Benefits

We begin discussions about the science of seaweed with seaweed's agricultural benefits. Evidence in the scientific literature, as well as grower experience, make a clear case that seaweed extracts do the following:

- **Provide stress tolerance to heat, drought, salinity and disease**
- **Optimize macro- and micronutrient uptake to support increased crop yields and quality**
- **Improve soil and microbial characteristics in the rhizosphere for better root growth**
- **Improve plant appearance and color under abiotic stress**

Although the benefits of seaweed may be well documented, many growers can't help but ask the natural question: how does it work? Most scientists agree that seaweed extracts fall in the category of biostimulants and have multiple modes of action. We liken seaweed to a symphony orchestra—there are many different "instruments" that perform together to achieve the desired outcome. The chemistry of seaweed is vastly different than the "solo performance" of a pesticide for example. Researchers are still determining modes of action of various chemical components of seaweed; progress has been made, but there is still a long way to go.

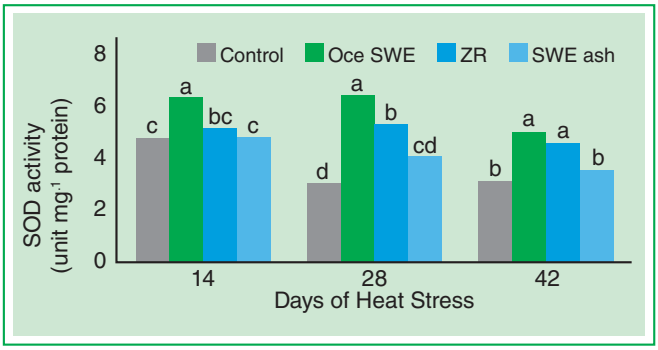
One thing we do understand is that no other biostimulant available has such a diversity of stress-fighting compounds. *Ascophyllum nodosum* is an intertidal species, so it is completely exposed to the elements for part of its life, and completely submerged in salt water at other times, leading to the development of distinct compounds that foster an array of crop benefits in the face of abiotic stress. Unique constituents include:

- **Oligosaccharides – short chain sugars that complex micronutrients**
- **Hormones – active at very low levels to play a variety of roles to aid in abiotic stress protection**
- **Antioxidants – fight free radicals created under stress**
- **Amino Acids – building blocks of proteins, effective at chelating micronutrients (our seaweed extract analysis shows 18 amino acids)**
- **Osmoprotectants (including betaines) – compounds that help plant cells adjust to drought and salt stress**
- **Pigments – compounds that help protect plants from harmful UV rays**
- **Polymers – large sugar polymers (such as alginates) that can help stimulate microbial communities**

The Science of Stress Protectants

One of the best understood benefits of seaweed is in the area of stress protection. Seaweed extracts have been shown in the literature, and in our own studies, to improve stress tolerance to heat, drought, salinity and disease. Much of the pioneering research on using seaweed for stress management has been performed by plant physiologists at Virginia Tech and Rutgers; stress tolerance research is of primary importance to these scientists as intensively-maintained turfgrasses, such as golf course greens, are under constant stress.

Under favorable growing conditions, plants produce their own natural compounds for health and survival. Certain of these naturally occurring compounds are vital for plants under stress, but the ability to produce them decreases as heat, drought, salinity and other stress levels increase. Dr. Erik Ervin's work at Virginia Tech established that our products' natural plant-available compounds can offer significant stress tolerance benefits. The figure below shows that as heat stress progressed, creeping bentgrass that was treated with Ocean Organics seaweed had



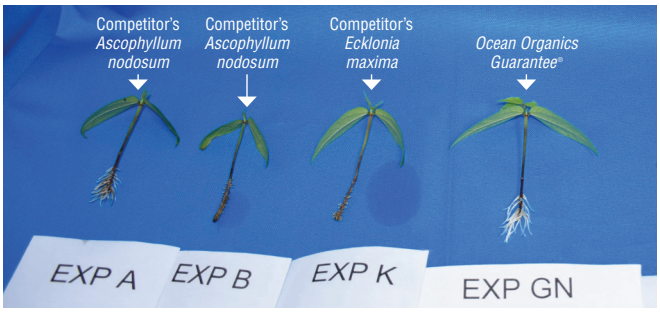
Ocean Organics Seaweed Increases Activity of an Important Antioxidant Enzyme Under Heat Stress. Creeping bentgrass under heat stress and treated with Ocean Organics seaweed extract (Oce SWE) had statistically higher leaf levels of superoxide dismutase (SOD, an antioxidant enzyme) than the control, a synthetic hormone, and seaweed ash (Zhang and Ervin).

Antioxidants

Plants under stress produce increasing levels of Reactive Oxygen Species (ROS), also known as free radicals. ROS are powerful oxidants that damage critical molecules like DNA, RNA and proteins. If you picture ROS as rebel compounds attacking cells, then antioxidants could be viewed as the cell's armed forces. Antioxidants react with ROS before they have a chance to react with vulnerable molecules in cells. The powerful antioxidant enzyme called super oxide dismutase helps neutralize an ROS called super oxide. Research shows that Ocean Organics seaweed boosted levels of this key antioxidant enzyme in creeping bentgrass grown under heat stress (see above).

statistically higher leaf levels of the protective antioxidant enzyme called superoxide dismutase (SOD). Antioxidants are critical in fighting free radical damage caused by a variety of stresses.

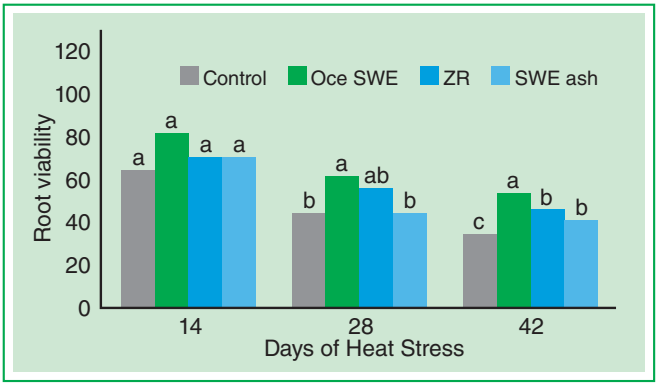
In addition to increasing heat stress tolerance, **our products also improve recovery from cold stress**, as shown in trials with Dr. Emily Merewitz at Michigan State University. Poa annua plugs treated with the Ocean Organics program had statistically better regrowth when compared to the untreated control.



Mung bean root bioassays performed by Dr. Xunzhong Zhang of Virginia Tech. **Guarantee** (far right) shows more robust root growth compared to seaweed extracts from other companies (three on left).

Healthier Roots Under Stress

When plants are under stress, their root systems suffer. Unfortunately, plants are often subjected to at least one and often multiple sources of stress. Many growers view frequent applications of seaweed extract as beneficial for overall stress protection for their crops' root growth. Although exact modes of action are not completely understood, studies show that certain compounds in *A. nodosum* seaweed extract appear to sustain roots under stress. Seaweed appears to improve microbial diversity in the rhizosphere and can help chelate micronutrients for better root uptake. Several studies have shown that soil applications of seaweed have stimulated microbial communities surrounding root systems. Dr. Erik Ervin's work showed that bentgrass root systems survived heat stress more effectively when treated with our seaweed. In laboratory assays performed by Dr. Xunzhong Zhang, plants treated with Ocean Organics seaweed showed more robust root growth than untreated plants.

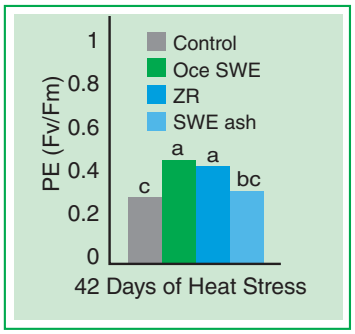


Ocean Organics Seaweed Improves Root Viability Under Heat Stress. Creeping bentgrass under heat stress and treated with Ocean Organics seaweed extract (Oce SWE) had statistically better root viability than the control, a synthetic hormone, and seaweed ash (Zhang and Ervin).

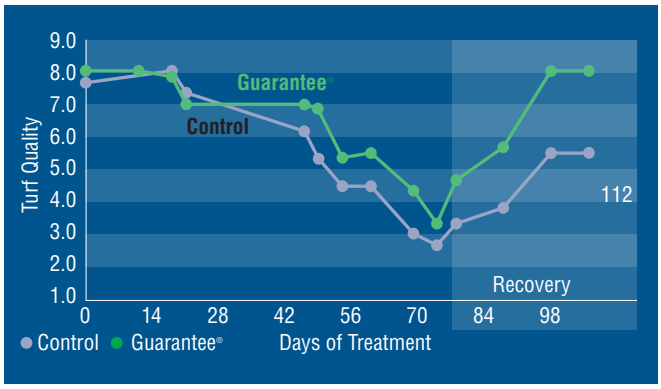
Supporting Photosynthesis Under Stress

Statistically higher photosynthetic efficiency and increased chlorophyll production

Photosynthesis is the conversion of light energy into chemical energy; it occurs in two phases. In the first phase (historically called the "Light Reactions"), photosynthetic reactions capture energy from the light of the sun and use it to create high-energy molecules. The second phase (which involves the Calvin-Benson Cycle) uses the resulting high-energy molecules made during the Light Reactions to capture carbon dioxide (CO_2) and make carbohydrates. Chlorophyll and other pigments are critical to the first phase of photosynthesis, allowing cells to absorb energy from light. Yet research shows that chlorophyll levels often decrease under a variety of abiotic stresses. Research using seaweed from Ocean Organics has shown improved chlorophyll levels under a variety of stresses. Seaweed also contains other protective pigments that are known to support the membranes where the "photosynthetic machinery" is located in cells (such as thylakoid membranes).



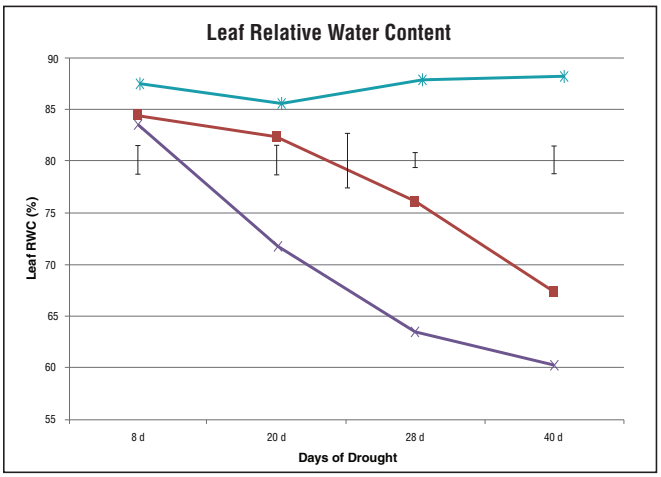
Ocean Organics Seaweed Improves Photochemical Efficiency (PE) Under Heat Stress. Creeping bentgrass under heat stress and treated with Ocean Organics seaweed extract (Oce SWE) had statistically higher photochemical efficiency (PE) than the control, a synthetic hormone, and seaweed ash (Zhang and Ervin, 2008).



Guarantee Improves Chlorophyll Index and Other Measures of Quality. Under heat stress and reduced irrigation in growth chambers, Creeping Bentgrass treated with Guarantee seaweed extract had higher Turf Quality, Percent Cover, and Chlorophyll Index during stress and recovery periods (Michelle DaCosta et al., U Mass).

Osmoprotectants: Helping Plants Survive Salinity and Drought Stress

Osmoprotectants, also called compatible solutes, help plants adjust to osmotic stress. This type of stress is most often caused by drought or salinity, but can also occur during temperature fluctuations. Osmotic potential is maintained within cells by the accumulation of these small molecular weight compounds. Relatively few compounds can accumulate in sufficient concentrations without inhibiting enzyme activity. Seaweed contains several kinds of osmprotectants, including betaines, sugars, and amino acids. These small molecular weight compounds help stabilize proteins and enzymes, as well as maintain membrane integrity under stress.



Plots of creeping bentgrass treated with Stress Rx maintained statistically higher turf quality, NDVI (indicative of higher chlorophyll), Leaf Relative Water Content, and had lower Leaf Electrolyte Leakage (data not shown) than the dry control plots during drought and heat stress and also recovery (Huang and Burgess, Rutgers).

Seaweed: Natural Trace Minerals and Complexing/Chelating Agents

Seaweeds are one of the most diverse natural sources of minerals known; they contain traces of the majority of primary, secondary and micronutrients needed by plants. There are 18 different elements that are now considered essential for plants to grow and thrive. Nine of them are macronutrients: nitrogen, phosphorus, potassium, calcium, sulfur, magnesium, carbon, oxygen, and hydrogen. The remaining nine are micronutrients (also called trace minerals or trace elements): iron, boron, manganese, zinc, copper, molybdenum, chlorine, cobalt, and nickel (C4 plants also require sodium). Ocean Organics seaweed extracts contain low levels of at least 13 of the essential elements.

Micronutrients are absolutely essential for plant growth because they help enzymes function. Almost all of the life processes in plants are enzymatic to some degree; even low levels of these micronutrients can be significant for plant and microbial enzymes to function properly. Even though essential micronutrients are required in much lesser amounts (they exist in plant tissue at parts per million levels), if one of them is deficient, plants will not reach maximum yield (this is called Law of the Minimum).

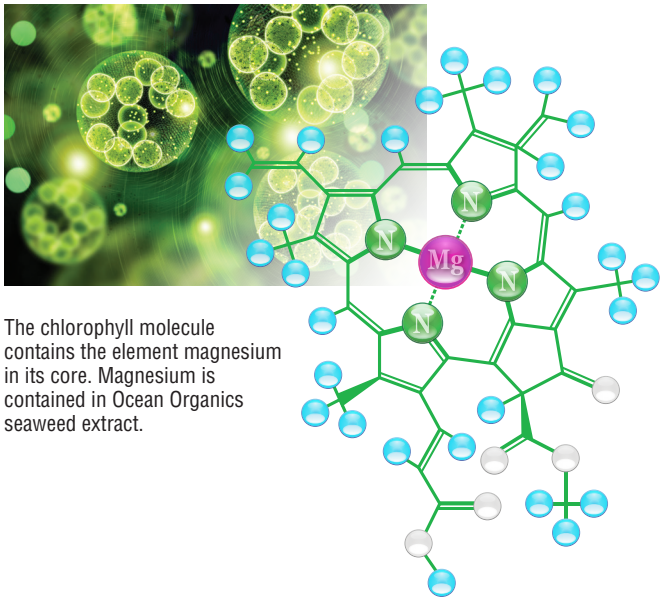
The Law of the Minimum governs maximum potential yields.

In addition to essential micronutrients, there are also those that can have important biological function, such as aluminum, iodine, silicon, vanadium, and selenium. Seaweed contains many of the essential micronutrients, as well as some that are not necessarily essential, but can be beneficial to plants or microbes for various reasons.

Seaweed is also a source of natural chelating and complexing agents. The sugars (polysaccharides and oligosaccharides) and amino acids in seaweeds are known to complex and chelate micronutrients, which are then more bioavailable for root or foliar uptake. Growers apply a variety of macro- and micronutrients and often include seaweed in the tank mix to enhance both foliar and root uptake. Researchers have reported that seaweed application has increased leaf macro- and micronutrient levels, and we have confirmed this in crops such as mandarins.

Seaweed's rich trace elements and complexing/chelating agents also have the potential to increase microbial diversity and beneficial microbial populations within the rhizosphere.

Our team at Ocean Organics looks forward to continuing our partnership with an inspiring group of researchers and industry leaders who delve into the science of seaweed.



The chlorophyll molecule contains the element magnesium in its core. Magnesium is contained in Ocean Organics seaweed extract.

The Science Behind Summer Stress Decline

Overcoming Summer Stress Decline (SSD) in cool season turfgrasses is probably the single biggest recurring challenge most golf course superintendents in North America face.

For many years conventional wisdom held that summer turfgrass decline was due to disease. It was treated with fungicides. In recent years, leading turfgrass physiologists concluded that the principle underlying cause of SSD is decline in carbohydrate reserves. Their reason is obvious in Chart 1. They theorized that the decline, including onset of disease, was due to the plant responding to high temperatures and prolonged UV radiation exposure, which causes carbohydrate decline and depletion.

Chart 1 shows that carbohydrate reserves peak in spring, plummet in summer, and rebound in fall. Ocean Organics products help maximize carbohydrate production in the good times and slow loss in the bad.

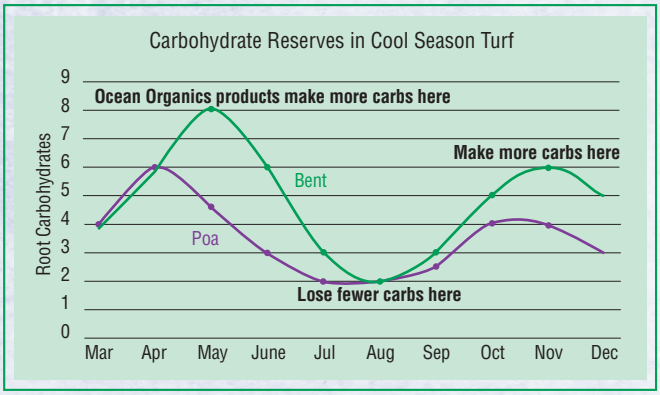


Chart 2 shows root and shoot growth...the two drivers of photosynthesis and carbohydrate production. Again, the peak is in early to late spring, with a steep decline (and roots ceasing growth altogether) in the hot months followed by a rebound in autumn. This is the phenomenon that caused Prof. Joe Vargas, plant pathologist from Michigan State, to quip: ***"God grows grass till the Fourth of July. After that it takes a professional."***

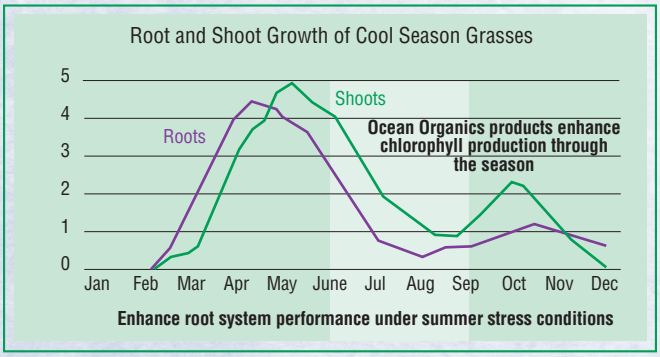
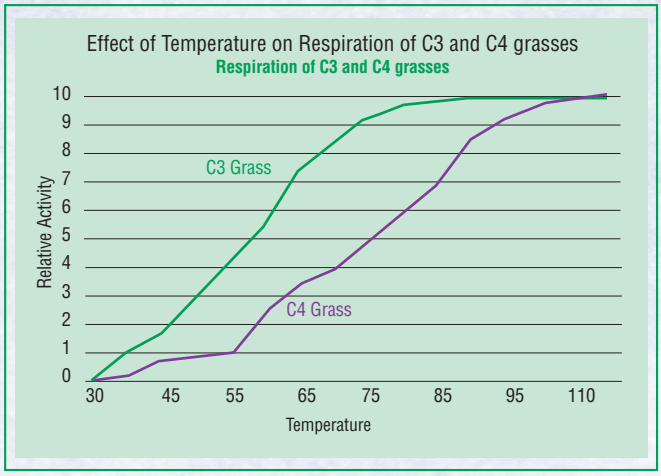
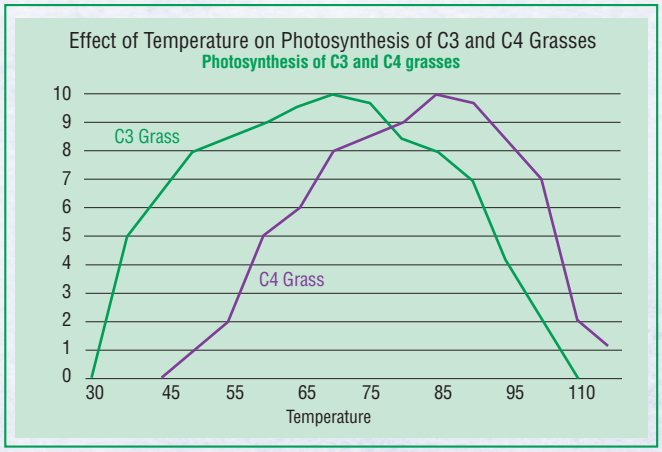


Chart 3 (Effect of Temperature on Respiration of C3 and C4 Grasses) shows that as temperatures rise, respiration increases, indicating that at a certain temperature, 100% of the plant activity is about respiration. In other words, all the carbohydrates produced are being consumed just to satisfy the plant's respiratory needs. In C3 grasses that temperature is 80° F. In C4 (warm season) grasses, it's about 95°.



Meanwhile, photosynthesis, which had been building in moderate summer temperatures, begins to decline (Chart 4). This means that the food-producing factory is shutting down, just as the plant needs more carbohydrates to fuel its immediate respiratory needs. As we saw in Chart 2, production is going down in these months. As temperatures approach 80°, 100% of the carbohydrates in C3 grasses are in the crown of the plant. For every degree over 80°, C3 plants have to withdraw from their "bank" of stored carbohydrates just to survive.



More carbohydrate reserves are the key to survival.

Ocean Organics Products and Programs Help Your Turf:
Make More Carbohydrates • Lose Less • Improve Photosynthetic Output • Improve Photosynthetic Efficiency
Increase Chlorophyll Production • Build and Maintain More Robust Root Systems
Increase root system performance under stress

Photosynthesis, Carbon Fixation, Photorespiration and UV Exposure

Photosynthesis—the conversion of light energy into chemical energy. The process by which green plants turn carbon dioxide and water into carbohydrates and oxygen using light energy trapped by chlorophyll. It's the process that makes life possible.

C3 Carbon Fixation—the majority of plants (85-95% of earth's biomass by most scientific estimates) use a C3 carbon fixation strategy to "fix" CO_2 and create carbohydrate precursors (sugars). C3 plants thrive in areas where sunlight and temperatures are moderate, carbon dioxide concentrations are around 200 ppm or higher and ground water is plentiful. So, for C3 turfgrasses like bent and bluegrasses, "ideal" growing conditions in the continental U.S. would be in the "cool" growing zone (see map).

Photorespiration—a counter-productive pathway in photosynthesis in some plants (e.g., C3) in which oxygen is mistakenly absorbed and carbon dioxide released.

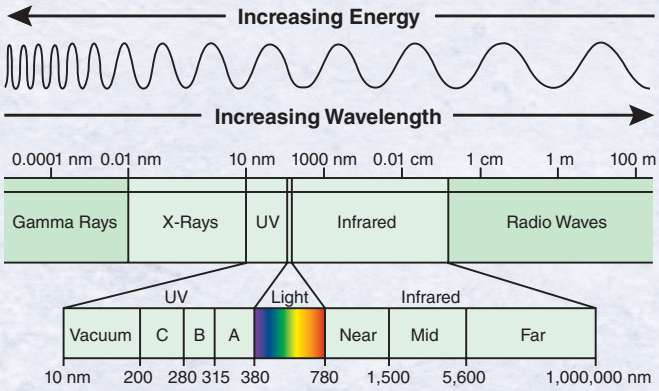
The "Achilles Heel" of plants that use the C3 carbon fixation pathway is photorespiration. As temperatures increase, instead of using the carbon in CO_2 to make carbohydrates and release oxygen into the atmosphere, C3 plants often absorb oxygen by mistake and release CO_2. The O they absorb by mistake releases free radicals which cause toxic stress and damage within the plant. The CO_2 released contributes to global warming.

UV Exposure—another related but very different dimension of SSD is the impact of shorter wave radiation like ultraviolet light that accompanies the narrow band of visible light in the electromagnetic spectrum plants use for photosynthesis.

High temperature stress is straightforward and measurable. Superintendents use a variety of methods (e.g., syringing) to cool turfgrass plants during the "dog days." But to deal with prolonged UV exposure, superintendents need products that directly address the damage.

SSD in C3 turfgrasses is a multifaceted problem. One dimension is high temperature stress. Ocean Organics products and programs are designed to solve multiple aspects of SSD.

The Electromagnetic Spectrum



UV overexpsure stress is different from high-temperature stress. Both must be addressed

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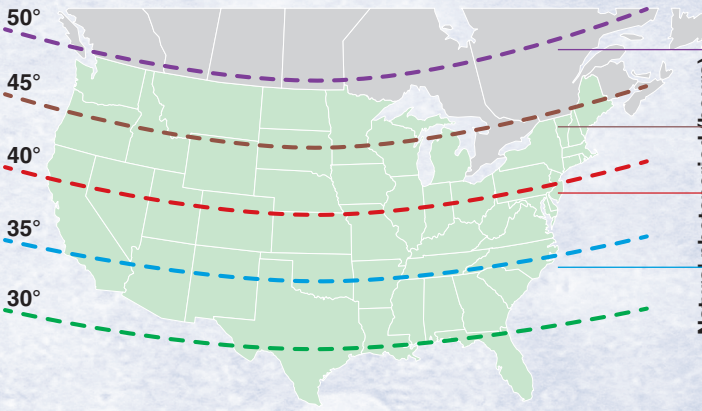
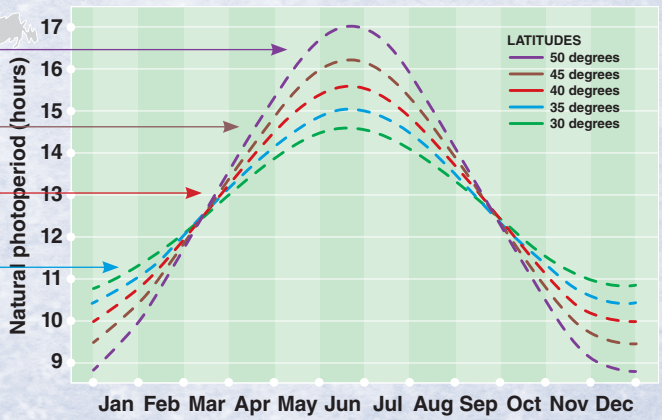
UV Stress: Different from Heat

On July 4th, while superintendents managing C3s in the southern U.S. may be coping with excessive photorespiration with daytime temperatures 10-12° higher than their counterparts in the north, superintendents in the north may be getting an hour or more daylight and potential photoinhibition from UV overexposure. Ocean Organics products and programs address high temperature and UV stress.

Latitude Map



Natural Photoperiods



Warm Season Research Highlights

Golf course superintendents growing warm season turfgrasses face unique challenges. Ocean Organics has emerged as a leader in improving stress tolerance in warm season grasses. Research at University of Florida, Mississippi State, University of Arkansas, University of Georgia, University of California Riverside and with other independent researchers has shown that Ocean Organics' products improve turf quality, color, density and stress tolerance under a variety of stressful growing conditions. Ask for the research.

Improved Heat Stress Tolerance

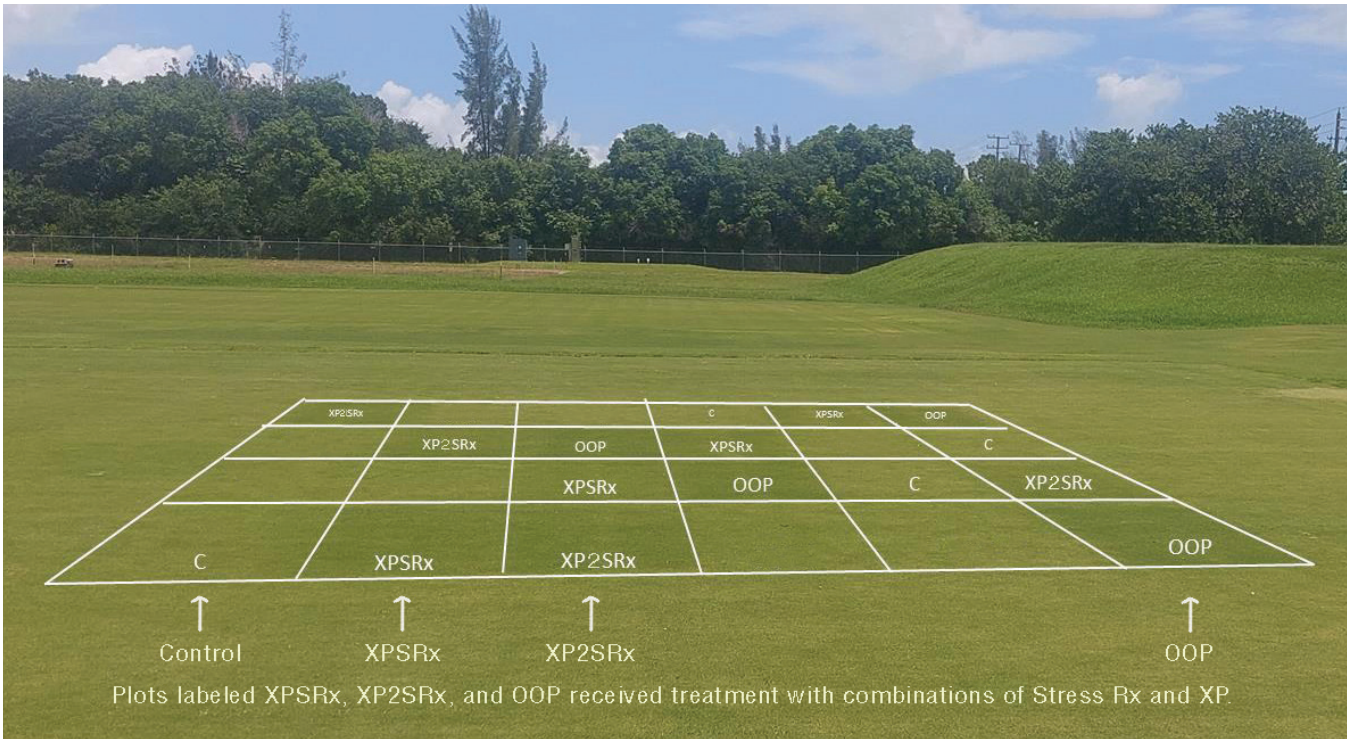
UNIVERSITY OF FLORIDA, Fort Lauderdale Research and Education Center UF-IFAS, 'Tifeagle' ultradwarf bermudagrass, Dr. Alejandra Sierra and Dr. Marco Schiavon

Products in the program: XP and Stress Rx

Treatment with XP® and Stress Rx® statistically improved Turfgrass Quality, Normalized Difference Vegetation Index (NDVI), Percent Green Cover, and Dark Green Color Index (DGCI) in 'Tifeagle' Ultradwarf Bermudagrass in a trial that ran from June through September.

"...after the flood and two months after last application of [XP], effect is still really visible." – Dr. Marco Schiavon

An unexpected aspect of this trial was when the plots that received XP (in combination with Stress Rx) kept their color for several months without additional application of the products. The research greens had also experienced severe flooding during this time. This observation by the researchers led to a continuation of the trial.



Day 56 (July 26). Plots treated with XP and Stress Rx displayed improved Turfgrass Quality, Normalized Difference Vegetation Index (NDVI) and Dark Green Color Index (DGCI) on Day 56 after initial application. Note that plots treated with XP-2 (a slight variation of XP) and the Ocean Organics program including the surfactant, Nautilus, also showed improved quality. Photo credit: Alejandra Sierra and Dr. Marco Schiavon

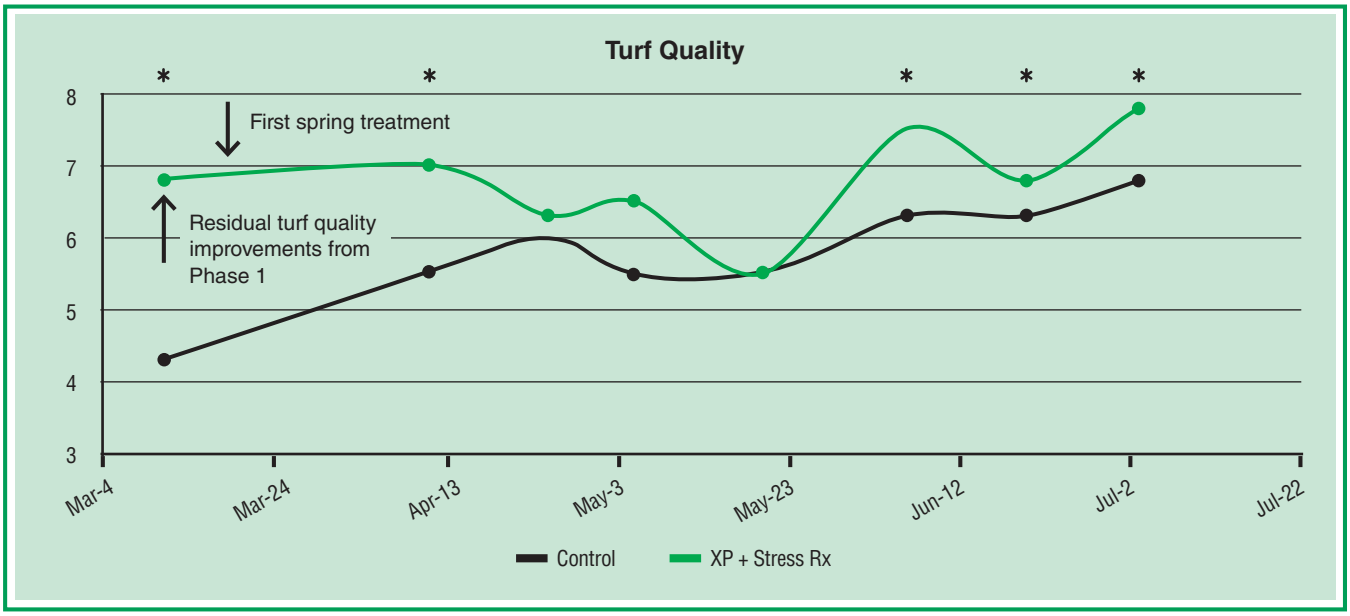
"Results suggest that XP + Stress Rx...can be a powerful tool in ultradwarf bermudagrass management, both as a regular application or as a curative treatment for stressed greens." – University of Florida Report

Improved Turf Quality and Color During the Spring Season

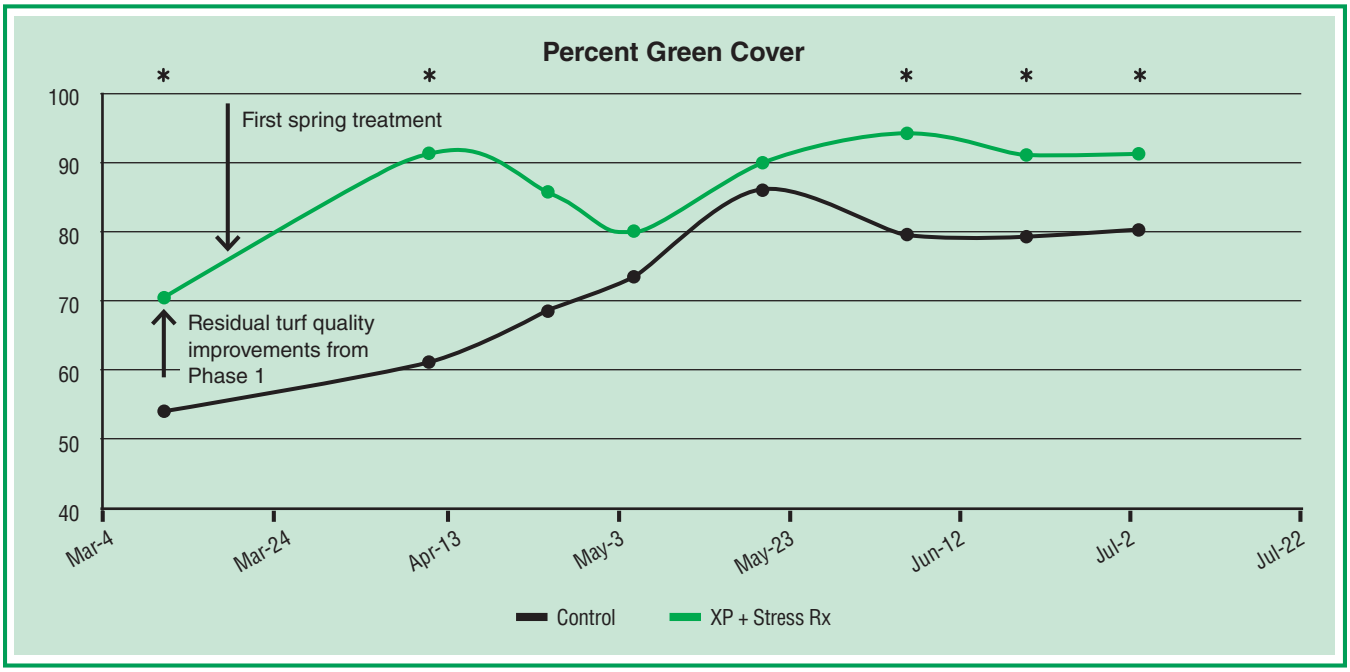
UNIVERSITY OF FLORIDA, Fort Lauderdale Research and Education Center UF-IFAS, 'Tifeagle' ultradwarf bermudagrass, Dr. Alejandra Sierra and Dr. Marco Schiavon

Products in the program: XP and Stress Rx

Treatment with XP® and Stress Rx® statistically improved Turfgrass Quality, Normalized Difference Vegetation Index (NDVI), Percent Green Cover, and Dark Green Color Index (DGCI) in 'Tifeagle' Ultradwarf Bermudagrass in a trial that ran from March through July (Phase 2 of this project).



The Ocean Organics products statistically improved Turf Quality throughout the trial compared to the control. Residual improvements from the final Phase 1 application in September remained visible at the beginning of the Phase 2 trial. This indicates a residual improvement in Turf Quality on the same plots even after a 6 month gap in application timing. Asterisks indicate statistical results.



The Ocean Organics products statistically improved Percent Green Cover throughout the trial compared to the control. Residual improvements from the final Phase 1 application in September remained visible at the beginning of the Phase 2 trial. This indicates a residual improvement in Percent Green Cover on the same plots even after a 6 month gap in application timing. Asterisks indicate statistical results.

Warm Season Research Highlights *continued*

Improved Turf Quality and Color During Overwintering and Spring Green Up

MISSISSIPPI STATE UNIVERSITY, Department of Plant and Soil Sciences, ultradwarf bermudagrass, Dr. Barry Stewart and Dr. Jason Eberhard

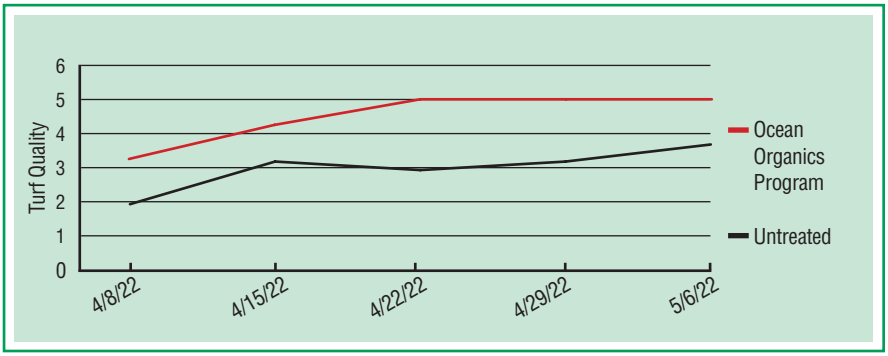
Products in the program: XP, Stress Rx, Nautilus, SeaBlend 12-0-12

Turf quality, chlorophyll content, and Dark Green Color Index in Ocean Organics Program Plots were all statistically higher than untreated controls throughout the majority of the study. The Ocean Organics Program also statistically decreased Spring Dead Spot relative to the untreated control.

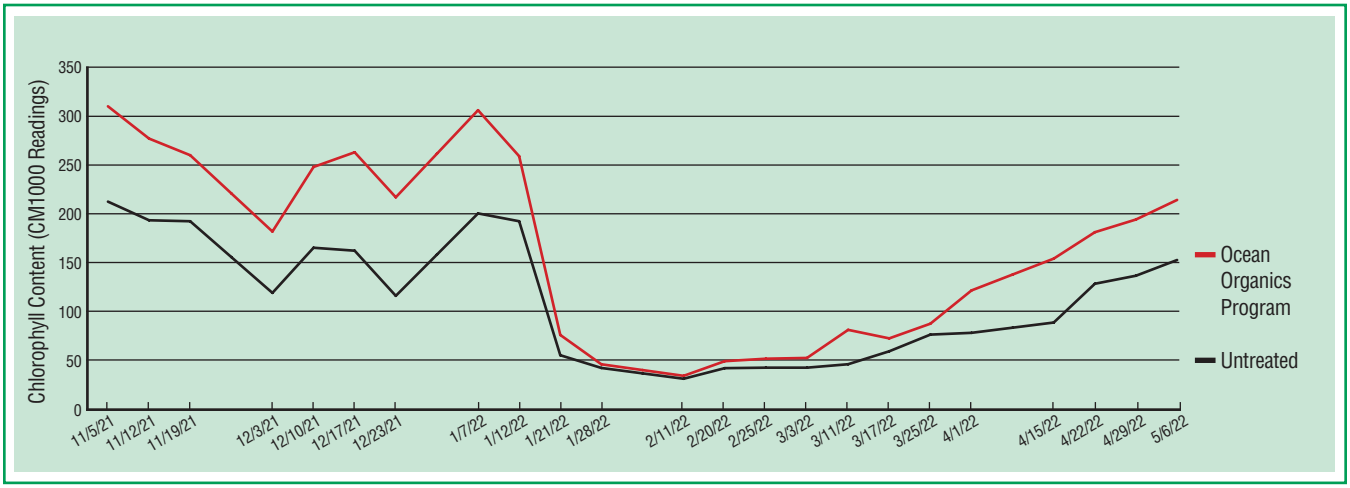
Ocean Organics Program plots are significantly greener.
Photo credit: Dr. Barry Stewart and Dr. Jason Eberhard

"After going truly dormant, the Ocean Organics program was the first treatment to show drastic improvement in the spring (a full 21 days before other treatments)."
– Mississippi State Report

Turf quality leading up to dormancy was statistically higher in the Ocean Organics Program plots.



Turf quality during spring green-up was statistically higher in the Ocean Organics Program plots.



Chlorophyll Content. The Ocean Organics Program statistically increased the chlorophyll content readings on 22 out of 23 sampling dates.

Spring Dead Spot. As shown in the table below, there was consistently less Spring Dead Spot in the Ocean Organics Program plots throughout the spring. On all four sampling dates, the Program plots had statistically less Spring Dead Spot. However, the other treatments did not statistically lower Spring Dead Spot and were in the same statistical grouping as the untreated control on all sampling dates. This indicates that the combination of products was more successful in mitigating Spring Dead Spot than the individual products alone.

April 29, 2022:

Untreated Plot 201

Ocean Organics Program Plot 20

"After going truly dormant, the Ocean Organics program was the first treatment to show drastic improvement in the spring (a full 21 days before other treatments)." – Mississippi State Report

Treatment	4/15/22	4/22/22	4/29/22	5/6/22
Untreated	30.00ab	33.75a	30.00a	22.50a
Program	10.00b	10.00b	13.75b	5.00b
P Value	0.04	0.01	0.01	0.01

The Ocean Organics Program statistically decreased Spring Dead Spot (%) relative to the untreated control throughout the study.

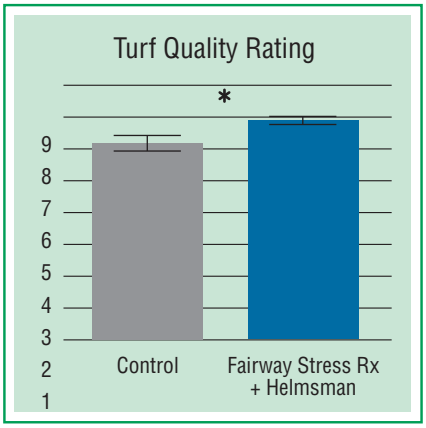
Improved Turf Quality and Color During Drought Stress

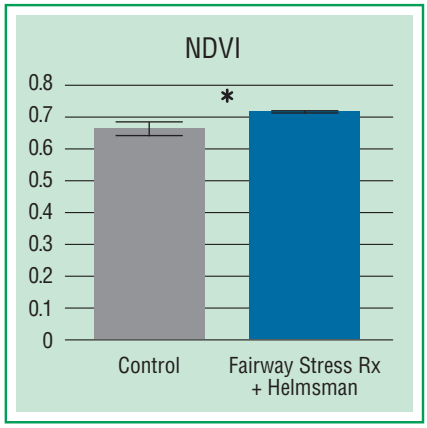
UNIVERSITY OF GEORGIA, (Griffin Campus), Dr. David Jespersen, 'Tifeagle' Ultradwarf Bermudagrass

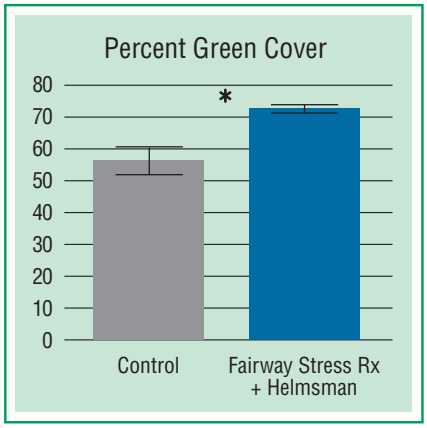
Products in the program: Fairway Stress Rx and Helmsman

Treatment with Ocean Organics products, Fairway Stress Rx and Helmsman, statistically improved Turfgrass Quality, Normalized Difference Vegetation Index (NDVI), and Percent Green Cover in bermudagrass under drought stress. After the imposition of drought stress, the Ocean Organics treatment was able to maintain better overall performance and drought tolerance.

Stress Rx + Helmsman statistically improved Turfgrass Quality, Normalized Difference Vegetation Index (NDVI), and Percent Green Cover on bermudagrass plots under drought stress. Photo taken by Dr. David Jespersen on September 19th showing (A) control, and (B) Stress Rx + Helmsman.







Stress Rx + Helmsman statistically improved (A) Turf Quality, (B) NDVI, and (C) Percent Green Cover (digital image analysis). Bar graphs highlight differences at the end of the trial, when water stress was greatest on September 19th. Bars represent standard errors, and asterisks indicate significant differences at p=0.05.

"...green cover as estimated by digital image analysis was ~28% greater in Stress Rx + Helmsman (71.5% compared to 56% in control plots)." – Dr. David Jespersen, UGA Report

Harvesting *Ascophyllum Nodosum* Sustainably

Ascophyllum nodosum, also called rockweed and knotted wrack in the northeast, is native to the North Atlantic Ocean and the Gulf of Maine. It is a large marine algae (macroalgae) that is an important part of the intertidal habitat along Maine's rocky coastline. Because *A. nodosum* is very effective at accumulating nutrients and minerals from ocean water, it has become a valuable resource; it is harvested for use in food, fertilizer, soil conditioners, animal feed, and other products.

Companies that harvest *A. nodosum* in the Gulf of Maine do so either by hand with knives or rakes, or by using specially-designed mechanical harvesters. Ocean Organics primarily processes *A. nodosum* that has been harvested by hand. Seaweed has an amazing ability to regenerate. Scientists estimate the biomass of unharvested *A. nodosum* beds is replaced with new growth every 3-11 years.1 Harvesters rotate sites in order to allow beds to recover.

No one cares more about the sustainability of seaweed harvesting than the companies who steward this resource. According to the Maine Sea Grant, as well as the Maine Department of Marine Resources, the Gulf of Maine contains more than one million tons of *A. nodosum*. Their research has shown that 30-40 % of the total *A. nodosum* standing crop could be harvested sustainably on an annual basis, yet the current level of harvest is only less than one percent. When it is cut at least 16 inches above the holdfast and above the lowest lateral branches, it can recover in 2-5 years. Ocean Organics is part of the Maine Seaweed Council and is committed to sustainability within our industry.

Ocean Organics processing plant, Waldoboro, Maine

Statistics in this section taken from:

1. "Rockweed, Ecology, Industry & Management. Maine Sea Grant in partnership with Maine Department of Marine Resources, 2011.

Baltimore Country Club, Maryland

Ocean Organics®

As the developers and manufacturers of high-performance, industry-leading stress management products and specialty fertilizers, our overarching research and development mission is to help golf course, agricultural and horticultural professionals maximize the performance and genetic potential of the plants and crops they grow, manage and protect... particularly under difficult, often stressful conditions. We prefer to work with renewable natural resources for economic as well as ecological reasons.

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