

Wetting agent of liever “watermanagement producten”



Surfactants

- Wat?
- Waarom?
- Hoe?

- Vragen
- AquaPremium

Kostka and Fidanza, 2020

What is a surfactant?

- Surfactants are compounds that lower the surface tension (or interfacial tension) between two liquids, between a gas and a liquid, or between a liquid and a solid.
- Surfactants may act as:
 - detergents
 - wetting agents
 - emulsifiers
 - foaming agents
 - dispersants
 - rheology modifiers
 - compatibilizing agents.

Surfactants

Kostka and Fidanza, 2020

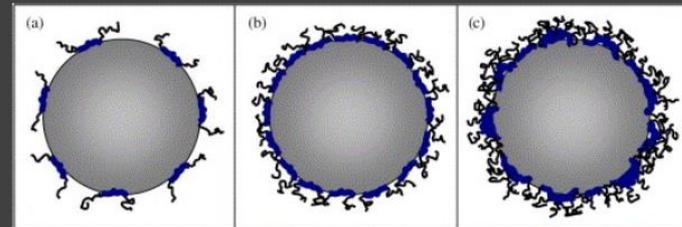
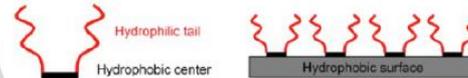
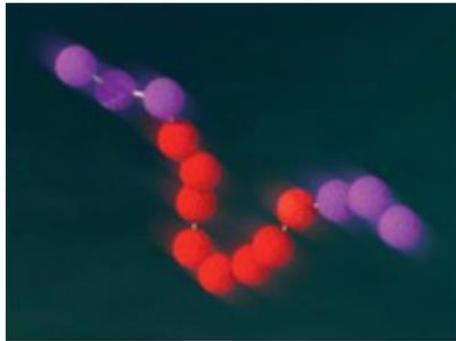
Types of Surfactants

- **Anionic Surfactants**
 - Negatively charged
 - May deleteriously impact soil structure
 - Often phytotoxic
- **Cationic Surfactants**
 - Positively charged
 - Are biocides (phytotoxicity of major concern)
 - Strongly adsorb to soil
 - May make soil water repellent
- **Non-ionic Surfactants**
 - Low phytotoxicity
 - No net charge
 - Major class of surfactants used for mitigating soil water repellency
- **Amphoteric Surfactants**
 - May be + or – charged
 - Not commonly used in agriculture

Gedrag surfactants

Kostka and Fidanza, 2020

How do surfactants behave in soils?



Credits:
Wang et al, 2014
Santander-Ortega et al, 2006

Reden van toepassing

Kostka and Fidanza, 2020

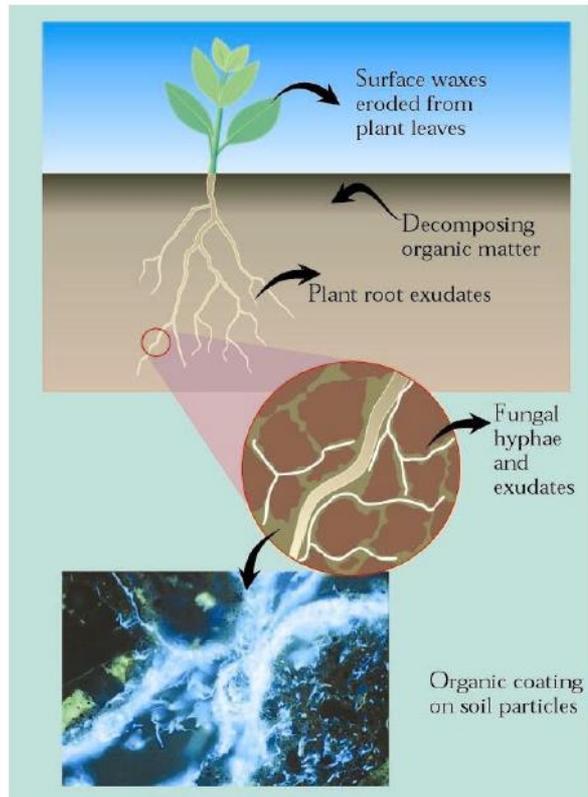


Photo courtesy of Paul Hallett, University of Aberdeen - https://www.researchgate.net/publication/228708562_An_introduction_to_soil_water_repellency

Soil Water Repellency

- Is of biological origin
- Impacts infiltration
- Reduces water stored in the root-zone reservoir
- Increases runoff
- Reduces irrigation efficiency
- Exacerbates leaching of pesticides and fertilizers
- Impacts turf quality
- Results in the development of localized dry spots
- Impacts turf surface playability

Bronnen waterafstotendheid

Kostka and Fidanza, 2020

Possible Sources of Water Repellency and Their Relative Contributions

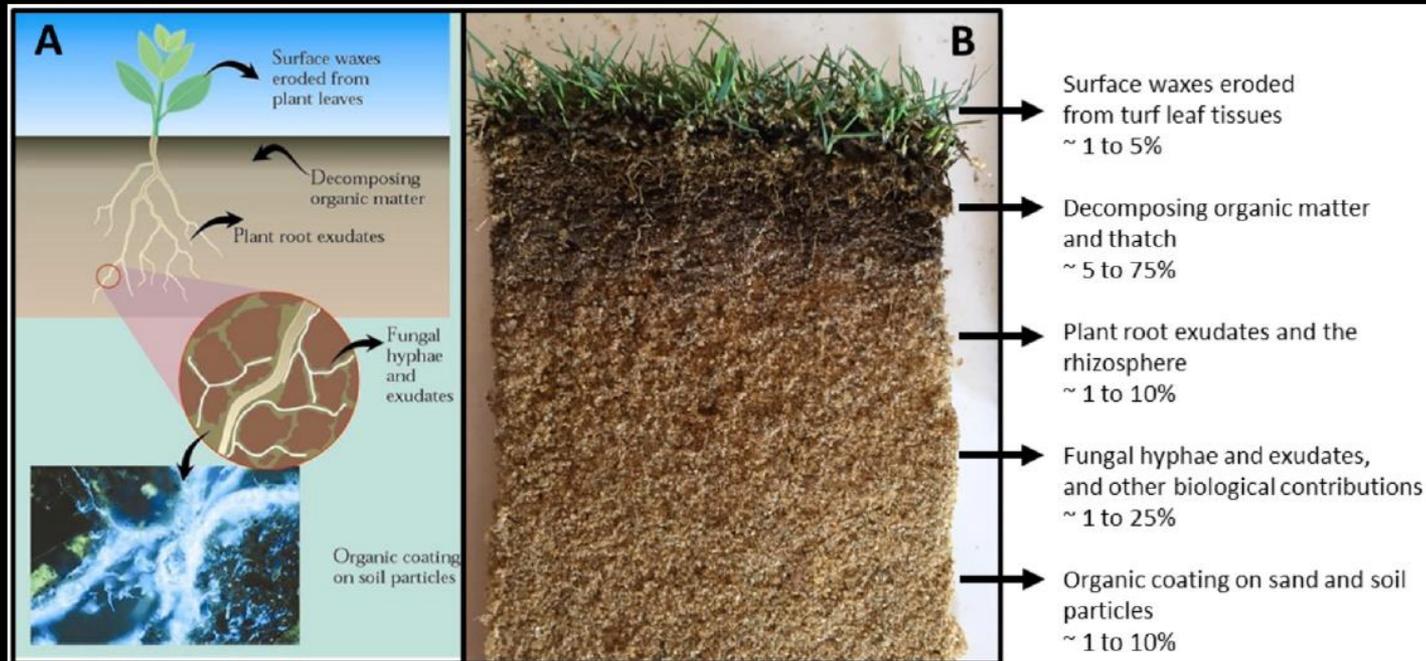


Photo A courtesy of Paul Hallett, University of Aberdeen - https://www.researchgate.net/publication/228708562_An_introduction_to_soil_water_repellency

Photo B courtesy of M.A. Fidanza

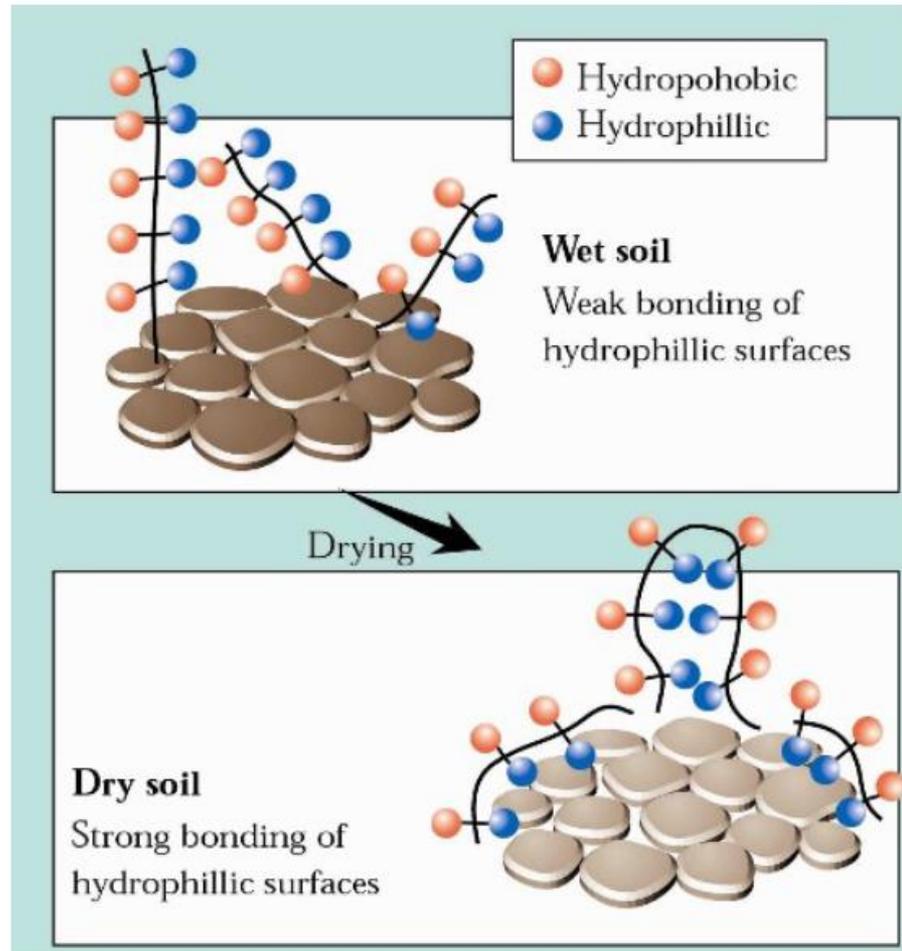


Photo courtesy of Paul Hallett, University of Aberdeen -
https://www.researchgate.net/publication/228708562_An_introduction_to_soil_water_repellency

Effect op waterinfiltratie

Kostka and Fidanza, 2020

How does water really infiltrate?

(GC DePan, Bosch en Duin, NL)
(Univ of Wageningen, NL)

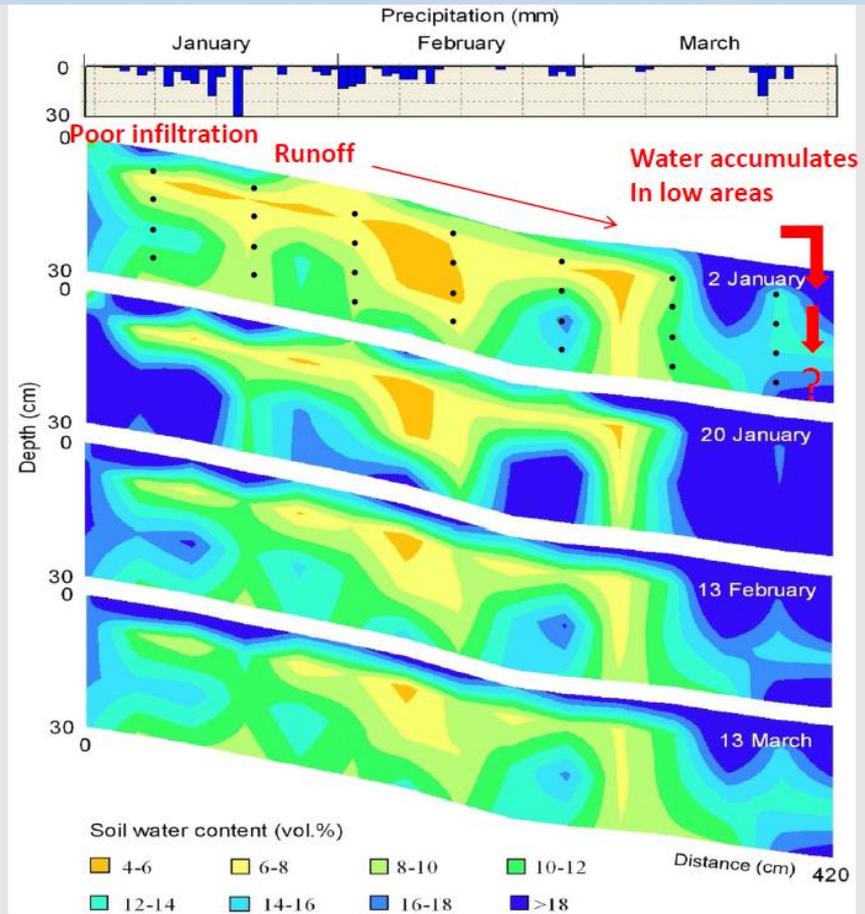
Soil moisture sensors at 4 depths

Measurements every 3 hrs (8x/day)

Data set covers 71 days

Applied water measured at
weather station (100 ft from plot)

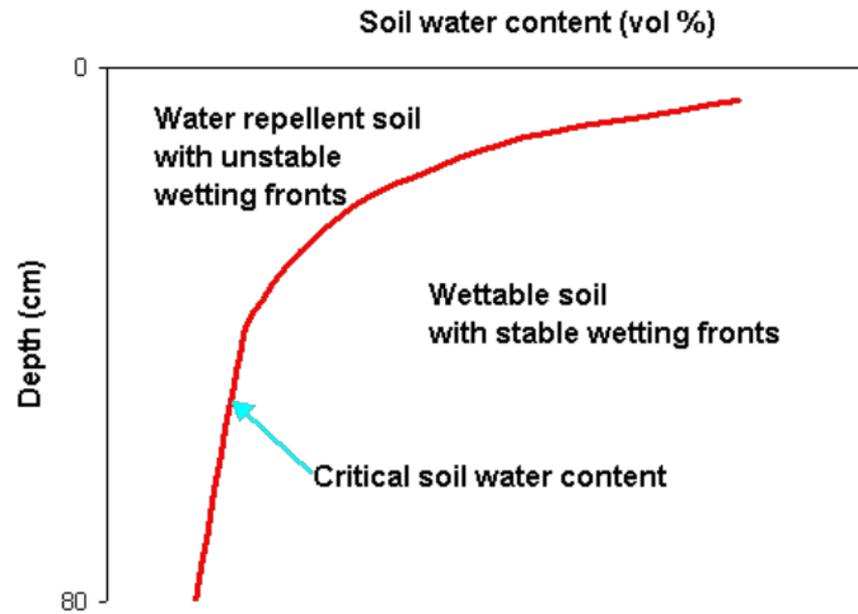
Oostindie et al, Vadose Zone J, 2011



Achtergrond

Costka and Fidanza, 2020

Concept of Critical Water Content

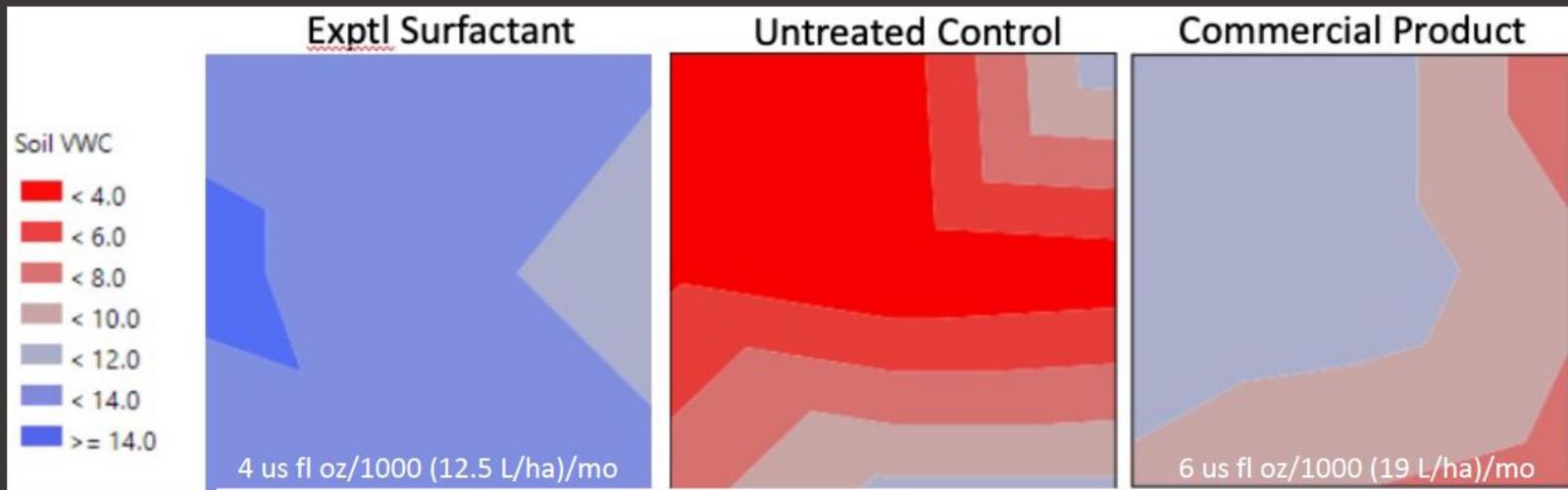


Source: Louis W. Dekker, Alterra, University of Wageningen, NL

Waterverdeler

Kostka and Fidanza, 2020

Can surfactants improve the homogeneity of water in the top 10 cm of the rootzone?



- Exptl Surfactant improved rootzone moisture homogeneity.
- Exptl Surfactant positively affects the Critical Water Content
- Does improving soil moisture distribution (reducing heterogeneity) make a product a water holder/retainer?
- Did both surfactants perform the same?

Effectief watergebruik

Kostka and Fidanza, 2020

Can efficiency of applied water be improved?

- Average Total Water Added Back (in Gallons) to a 15 sq.ft. (1.4 m²) Plot
- Jun 8 - Aug 8, 2016
- Clay Loam Soil

Required water inputs reduced 25-40%



Source: G. Nolan, Penn State Univ
Surfactants provided by Aqua-Aid

Betere water/lucht verhouding

Kostka and Fidanza, 2020

Surfactants can affect nitrogen efficiency

1. Improved plant N uptake,
2. Increased N retention in soil, particularly in sand, and
3. REDUCED the amount of N that leached from soils.

Data are % difference from the water + urea control.

Soil Type	Treatment	Plant N	Soil N	Leachate N
Sand	Surf + Urea	16%	144%*	-46%*
Sandy Loam	Surf + Urea	25%	105%*	-37%
Sandy Clay Loam	Surf + Urea	65%*	25%	-23%

* Statistically significant $p=0.05$

Source: D. Park, Clemson Univ.

Onderzoek op Rosendaelsche (rough)

- Meer N in wortelzone
- Meer in N in het blad
- Meer N efficiëntie – waardoor?

De bomen en het bos

Kostka and Fidanza, 2020

What does the soil surfactant market look like?

- How many soil surfactants /wetting agents products are there in the IE/UK professional turf market?
- What is the chemical composition of these products?
- Are formulations the same or different?
- Is the market generic or is there an innovation pipeline?

Fidanza et al.
J. of Hydrology and Hydromechanics
Submitted 2020

What was our search strategy?

1. It started with a spreadsheet
2. Google search – keywords:
 - Soil wetting agent
 - Soil surfactant
 - Manufacturer names
3. Trade Journals/Press Releases
4. Social Media – Twitter postings
5. Tradeshows
6. Review of labels
 - Formulation compositions
 - Google searches
7. Review of product Safety Data Sheets
 - Formulation compositions
 - Chemical Abstract Service Number Database
8. Archival online information
9. Patent Databases – ESPACE, USPTO
10. Industry network



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Kostka and Fidanza, 2020

Review – Surfactants:

- Modify critical water content
- Manage dry spots
- Can modify soil moisture heterogeneity
- Improve infiltration thereby:
 - Increasing root-zone water
 - Reducing runoff
- Maintain turf performance under deficit irrigation or drought
- Increase water use efficiency
- Improve nitrogen efficiency
 - Improve N uptake
 - Reduce N leaching
 - Increase N retention
- While there are a host of generic products, new technology is in the pipeline
- Ask for and expect research to support product selection.



PROGRASS Professional Grass Service

Kostka and Fidanza, 2020

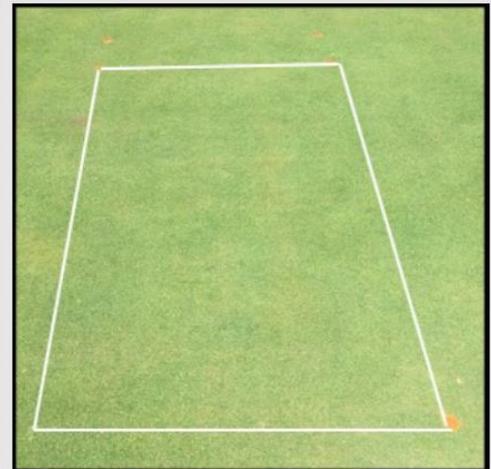
So, what does the future look like?



Product A
6 oz/1000 ft²
19 L/ha



Product B
5 oz/1000 ft²
15.6 L/ha



Product C
4 oz/1000 ft²
12.5 L/ha

Bigelow, 2018, Unpublished

Waterinfiltratie

Kostka and Fidanza, 2020

4 days after second application - How does water infiltrate? (Riverdale 2019)



Surfactant 1

Surfactant 2

Control

Measuring the Infiltration of 50 ml of water

Photo Credits:

Jumroom Supapol

RhizoSolutions

WATER INFILTRATION TEST CONTROL



Photo Credits:
Jumroom
Supapol

RhizoSolutions

WATER INFILTRATION TEST CONTROL



Photo Credits:
Jumroom
Supapol

RhizoSolutions

WATER INFILTRATION TEST LEADING COMPETITOR



Photo Credits:
Jumroom
Supapol



WATER INFILTRATION TEST
4 days after second application / Riverdale



Leading Competitor
19L/ha/mo



RhizoSolutions RST
19 L/ha, fb 12.5 L/mo



Control

Which product moves water better?

Photo Credits:
Jumroom
Supapol

Kostka and Fidanza, 2020

4 days after second application - How does water infiltrate? (Riverdale 2019)



Surfactant 1



Surfactant 2



Control

- Not all surfactants are the same.
- Surfactants improved infiltration however products performed differently
- Less applied water was lost to runoff and evaporation
- Water delivery to the rootzone reservoir was enhanced
- Make the most efficient use of a water

Photo Credits:

Jumroom Supapol

PROGRASS Professional Grass Service

Vragen uit de groep

Straatgras

- Onderzoek Wageningen:
 - aandeel roodzwenkgrassen groter in behandelde plots
 - minder straatgras en breedbladig onkruid

Waarom?

- Van zwenkgrassen is bekend dat ze het aminozuur m-tyrosine uitscheiden. Dit aminozuur gedraagt zich als een allelochemisch middel (beschouw het als een bioherbicide) dat zwenkgras een voordeel geeft bij de vestiging.
- Dus als fijn zwenkgras “gelukkig” is in zijn omgeving, produceert het m-tyrosine en scheidt het uit dit in de rhizosfeer.
- Verhoogd m-tyrosinegehalte in de rhizosfeer heeft een negatieve invloed op andere planten die in die grond groeien, waardoor fijn zwenkgras een concurrentievoordeel heeft.
- Deze ontdekkingen zijn afkomstig van onderzoek dat ongeveer tien jaar geleden is uitgevoerd aan de Cornell University.
- Maar zie ook onderzoek van Daniel Hahn.

“Penetrant”

- Geen wetenschappelijke term in kader van watermanagement!
- Is een marketing term
- Chemie is anders
- Gebruik:
 - curatief bij dry spots
 - (snellere) afvoer overtollig water in toplaag

Infiltrant

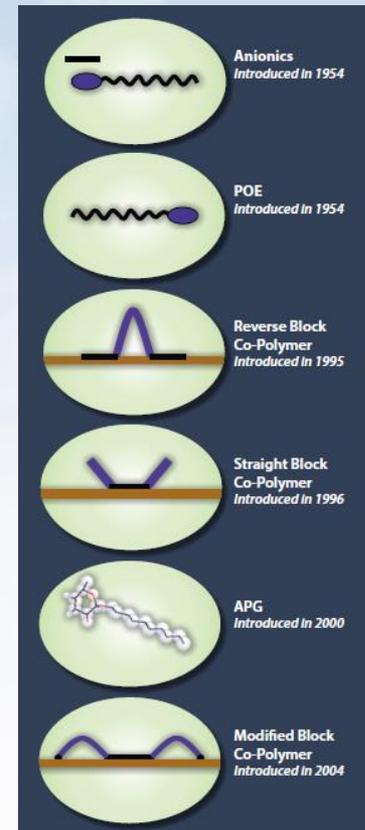
- Eigenlijk zijn alle wetting agents infiltranten
- Maar qua infiltratiesnelheid zijn er verschillen!

Humuszuren

- Wat?
- Waarom?
- Waar?

Afwisselend toepassen van producten

- Is geen wetenschappelijk onderzoek naar gedaan
- Zelfde molecuul?
- Wel verschil tussen preventief product (programma) en curatief product (droogte plekken)



Effecten van wetting agents

(Hoe zie je de werking – monitoring)

- Betere infiltratie
- Minder afspoeling (ondulaties, mounds)
- Hydratatie van de bodem vochtpercentages – verschillende dieptes!
- Vochtverdeling – uniformiteit
- Verwelking & droogteplekken
- Verbeterde graskwaliteit (dichtheid, soorten, onkruiden)
- Wortelontwikkeling (massa, structuur, lengte)
- Verbeterde N opname (bladanalyse)
- Minder N uitspoeling
- Resultaat op vilt afbraak ?

Onderhoud en gebruik wetting agents

- Drogen / dusten materiaal ok?
- Topbeluchten
wetting agent dieper in de grond
toplaag wel zachter!
- Inbrengen zand
combinatie met gekorrelde variant
(holprikken, topchanger, drill&fill)

AquaPremium



PRO GRASS Professional Grass Service



AQUAPREMIUM

Liquid Wetting Agent

- Private label van ProGrasS
- Productnamen in Europe bijvoorbeeld:

Argo Vita

Duitsland/Oostenrijk



UK/Ierland



AQUAPREMIUM

Liquid Wetting Agent

Greens

Preventief

- 12,5 liter product per ha in 800 liter water
- +/- maandelijks
- Eerste toediening voor eerste droogte in het voorjaar!!!

Curatief (bij droogteschade)

- 19 ltr product per ha in 800 liter water
- Evt. herhalen met 12,5 ltr product per ha in 800 liter water



AQUAPREMIUM

Liquid Wetting Agent

Fairwayprogramma's

- 1^e toediening
12,5 ltr product per ha
in 800 liter water
- Herhalen met
6,25 ltr product per ha
in 800 liter water
- Interval/frequentie
afhankelijk van weer
en lokale situatie
- 3 toedieningen per
seizoen van
12,5 ltr product per ha
in 800 liter water
- Eerste toediening in
natte winterperiode of
- Eerste toediening
voor eerste droogte in
het voorjaar!!!



AQUAPREMIUM

Liquid Wetting Agent

	Verpakking	Prijs (catalogus)	Prijs/ltr.
	10 ltr.	€ 195,=	€ 19,50
	200 ltr.	€ 3.230,=	€ 16,15
	972 ltr.	€ 14.130,=	€ 14,54



AQUAPREMIUM

Granular Wetting Agent





AQUAPREMIUM

Granular Wetting Agent

Preventief

- 0,6–1,2 kg/100m²



Curatief (bij droogteschade)

- 1,2 kg/100m²
- Indien nodig herhalen om de 7-14 dagen



AQUAPREMIUM

Granular Wetting Agent

	Verpakking	Prijs (catalogus)	Prijs/kg
	25 kg	€ 145,=	€ 5,80

Waterinfiltratie

RhizoSolutions

Independent Evaluation of Water Infiltration

RhizoSolutions vs Control and a
Leading Competitor on a
Bermudagrass Green in Thailand

Photo Credits: Jumroom Supapol

2/26/20

Confidential





RhizoSolutions

AquaPremium™

Powered by RhizoSolutions Technology

A New Standard For Stress Management In Turfgrass

AquaPremium™ is designed to be used in a monthly program on greens, tees and other high profile, high stress professional turf.

AquaPremium™ raises the performance of soil surfactant technology to new levels.



Professional Grass Service

RhizoSolutions



Control Plots Status – June, July & August 2018
TOUGH Testing Conditions

June



July



August



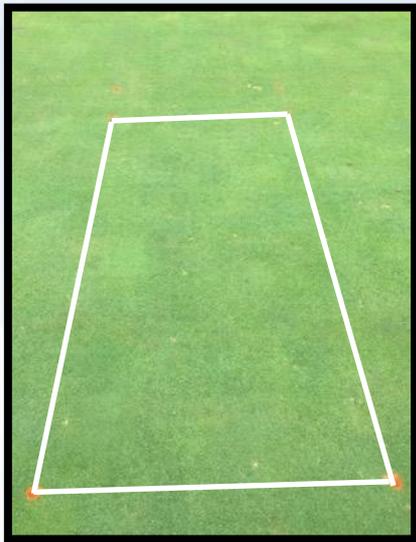
Bigelow 2018

RhizoSolutions



New Levels of Performance – July 2018

AquaPremium™
2 fl oz/1000ft²
65ml/100m²



AquaPremium™
4 fl oz/1000ft²
125ml/100m²



AquaPremium™
6 fl oz/1000ft²
190ml/100m²



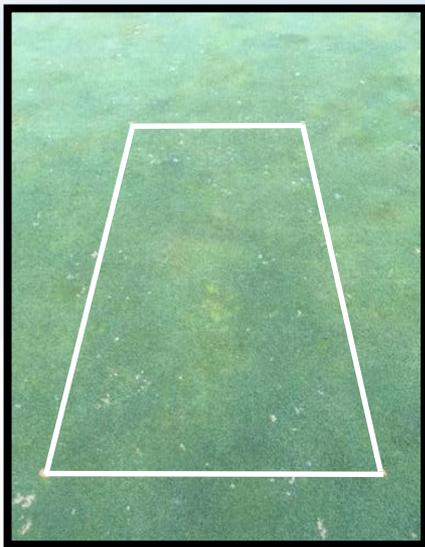
Bigelow 2018

RhizoSolutions



New Levels of Performance – August 2018

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Bigelow 2018

RhizoSolutions



New Levels of Performance – Competition – July

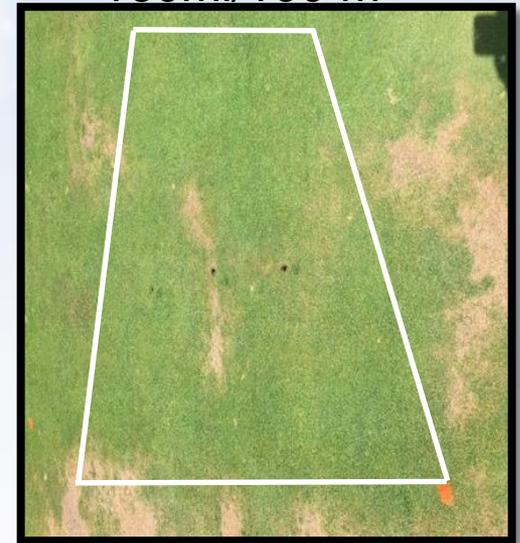
Revolution®
6 fl oz/1000 ft²
190ml/100 m²



AquaPremium™
4 fl oz/1000 ft²
125ml/100 m²



Fleet®
5 fl oz/1000 ft²
160ml/100 m²



Bigelow 2018

RhizoSolutions



New Levels of Performance – Competition – August 2018

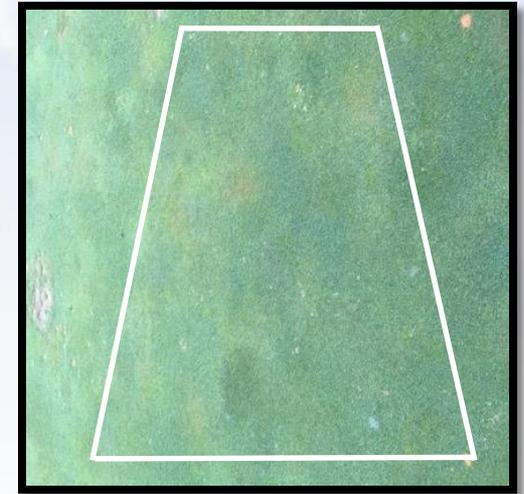
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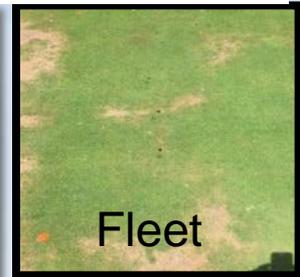


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5 fl oz/1000 ft²
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Bigelow 2018

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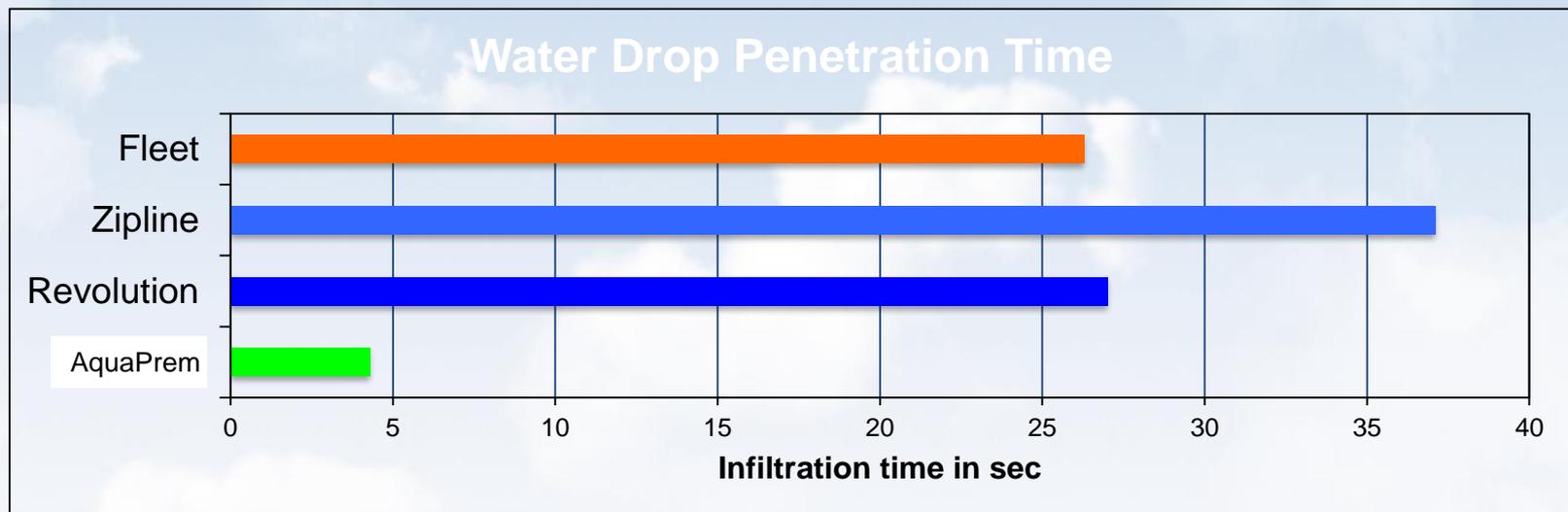


AquaPremium™ produced excellent playing conditions, extremely resilient turfgrass and high turf quality under severe stress.

AquaPremium™ SETS A NEW STANDARD FOR STRESS MANAGEMENT IN TURFGRASS



Managing Water Infiltration: AquaPremium™

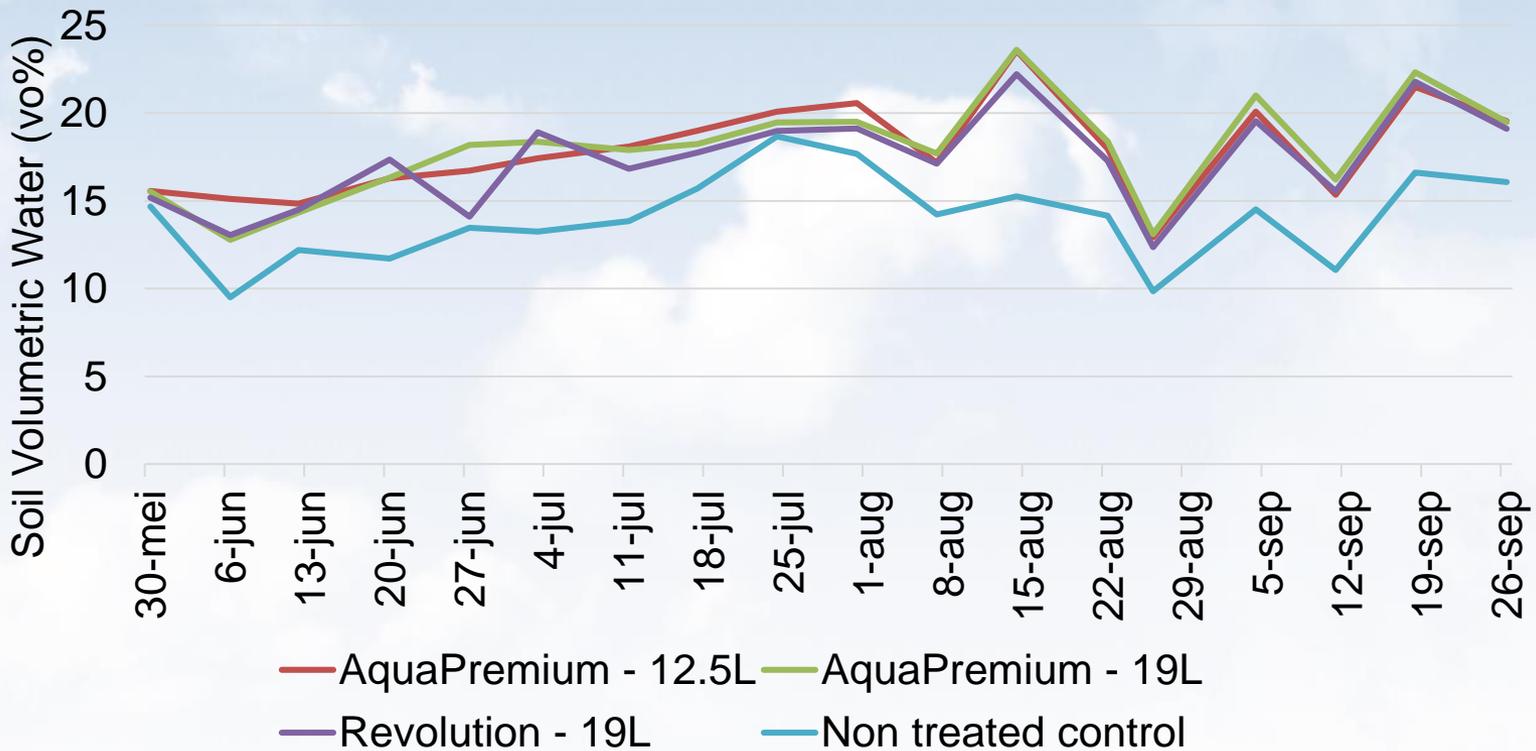


- AquaPremium improves the infiltration of water better than Revolution by a factor of over 6 times.
- AquaPremium is highly effective at managing water repellency in laboratory and field trials.
- AquaPremium surpasses the performance of competitors in managing water repellency – a major cause of turf stress.

RhizoSolutions



Volumetric Water Content: AquaPremium™

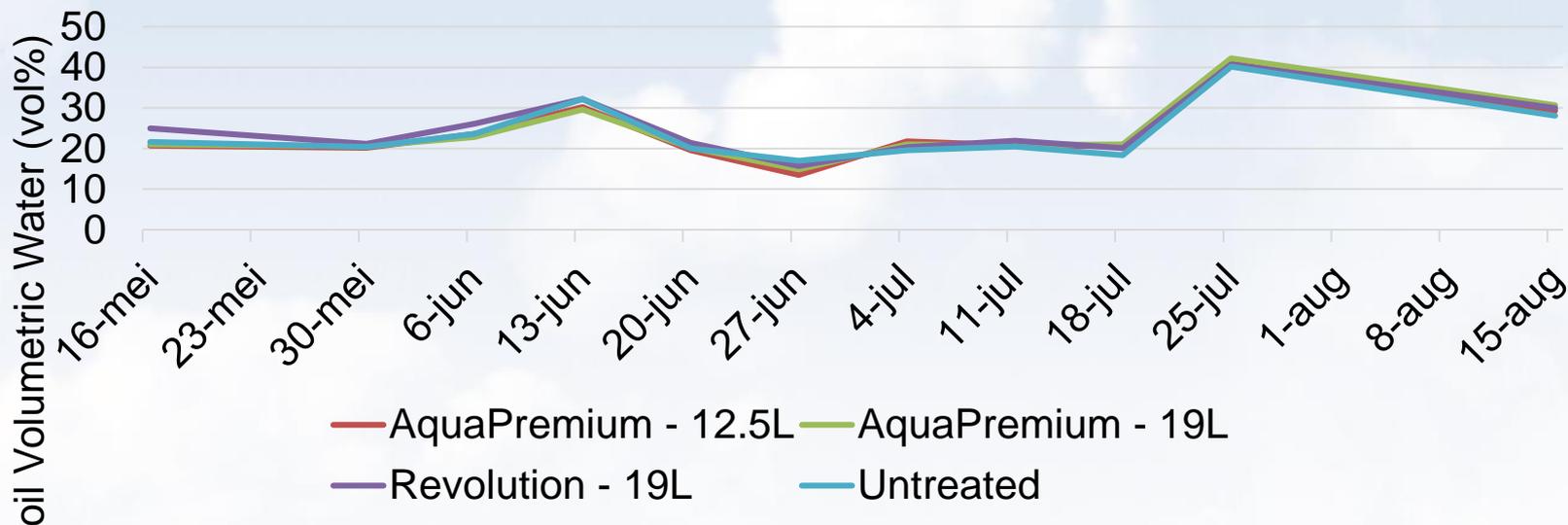


- AquaPremium is effective at managing volumetric water content to target levels



Volumetric Water Content: AquaPremium™

Sand Capped Loam – Very Wet Season, Penn State University - 2018



- AquaPremium is effective at managing volumetric water content to target levels in wet conditions. “Too wet” is not an issue with AquaPremium.

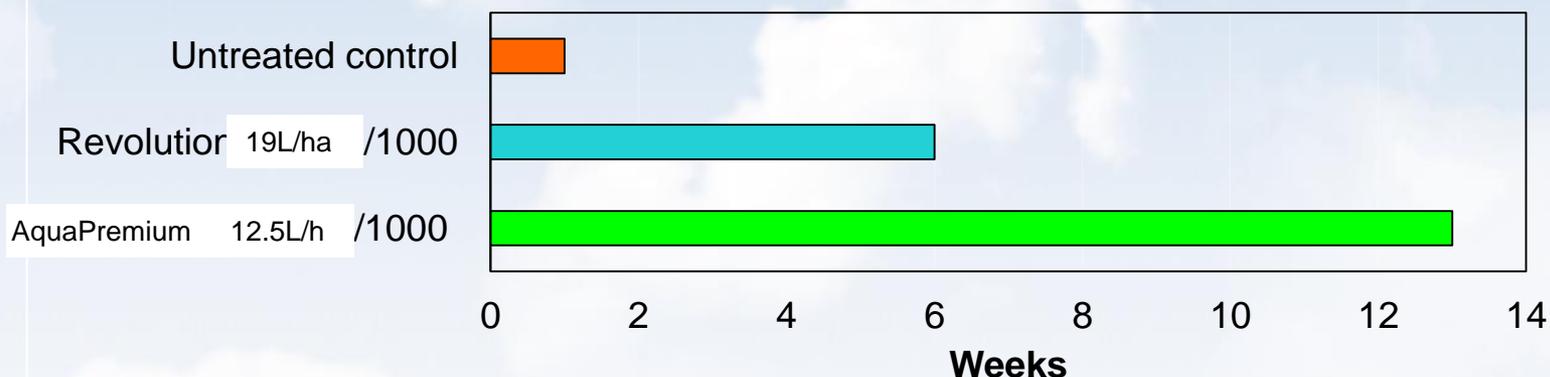


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Turfgrass Quality: AquaPremium™



Turf Quality – weeks at ≥ 6 (Purdue 2018)

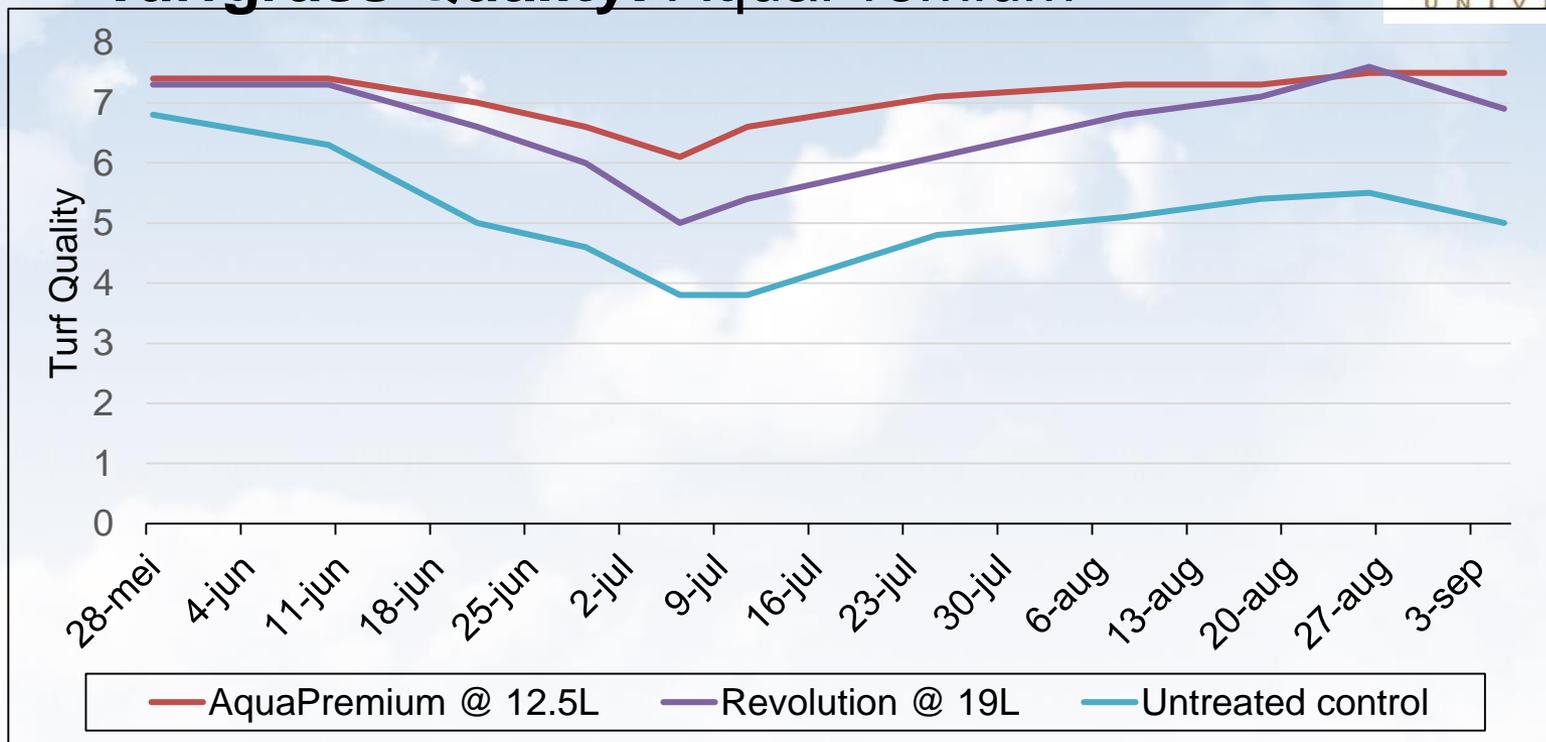


- AquaPremium has been proven to be highly effective at managing improving and maintaining high quality turfgrass, even under severe stress conditions.
- AquaPremium maintains turf performance better than the market leaders.

RhizoSolutions



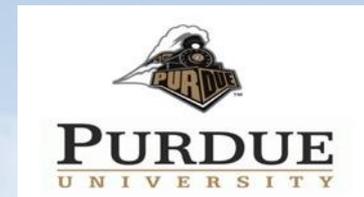
Turfgrass Quality: AquaPremium™



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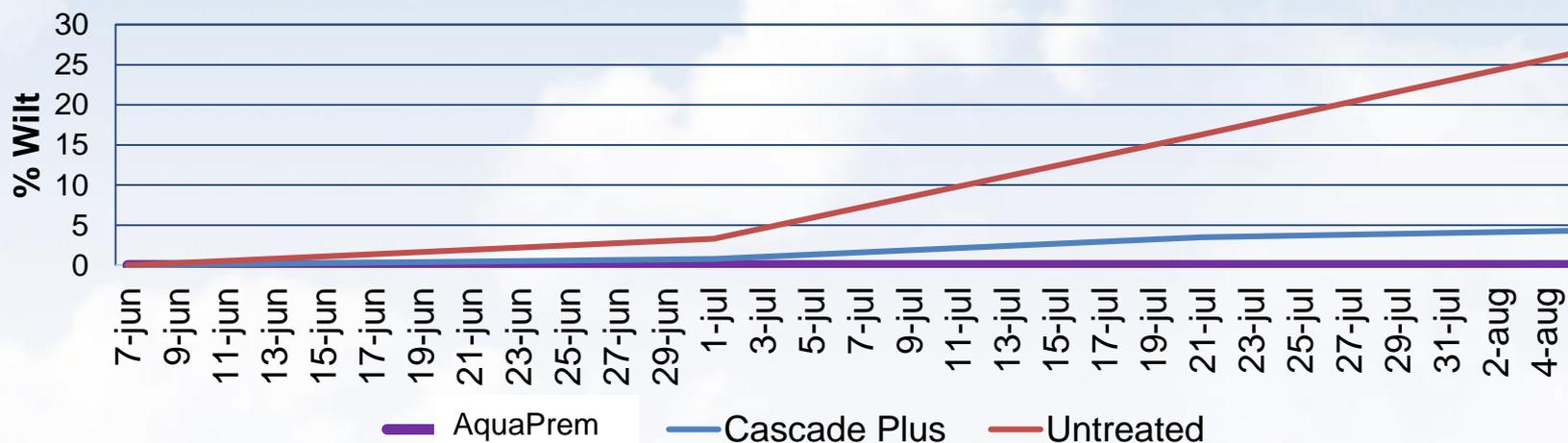


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Turfgrass Health: AquaPremium™

AquaPremium reduced wilt better than a leading brand
 North Shore CC, Glenview, IL, 2019
 D. Dinelli, CGCS, C. Bigelow, PhD



- AquaPremium is highly effective managing wilt, even under stress conditions. This allows the plant to continue functioning in a high stress environment and is a strong indication of improved plant health.



AquaPremium™

Powered by RhizoSolutions
Technology

Raising the performance of
soil surfactant technology to
new levels.





AquaPremium™

Powered by RhizoSolutions
Technology

May AquaPremium influence
disease incidence and
development?



AquaPremium included in a turf fungicide trial.

- **Year:** 2019
- **Trial Number:** 2019-5a
- **Location:** Pennsylvania State University (Berks Campus; Reading, PA; USA)

- **Turf species:** Creeping bentgrass ('PennTrio')
- **Mowing height:** 12.5 mm (fairway height-of-cut)
- **Rootzone:** sand-capped; 10cm sand over silt loam
- **Target:** dollar spot; site has a history of dollar spot incidence
- **Trt Applications:** 4L water-carrier/100 sq m
CO2 backpack sprayer; 9504E AI nozzle; 35 psi
- **Exp'tal Design:** 4 reps; RCBD; data analysis with Fisher's Protected LSD

- **Treatments/
am't/100 sq m:** Xzemplar SC, 8 ml
AquaPremium, 190 ml



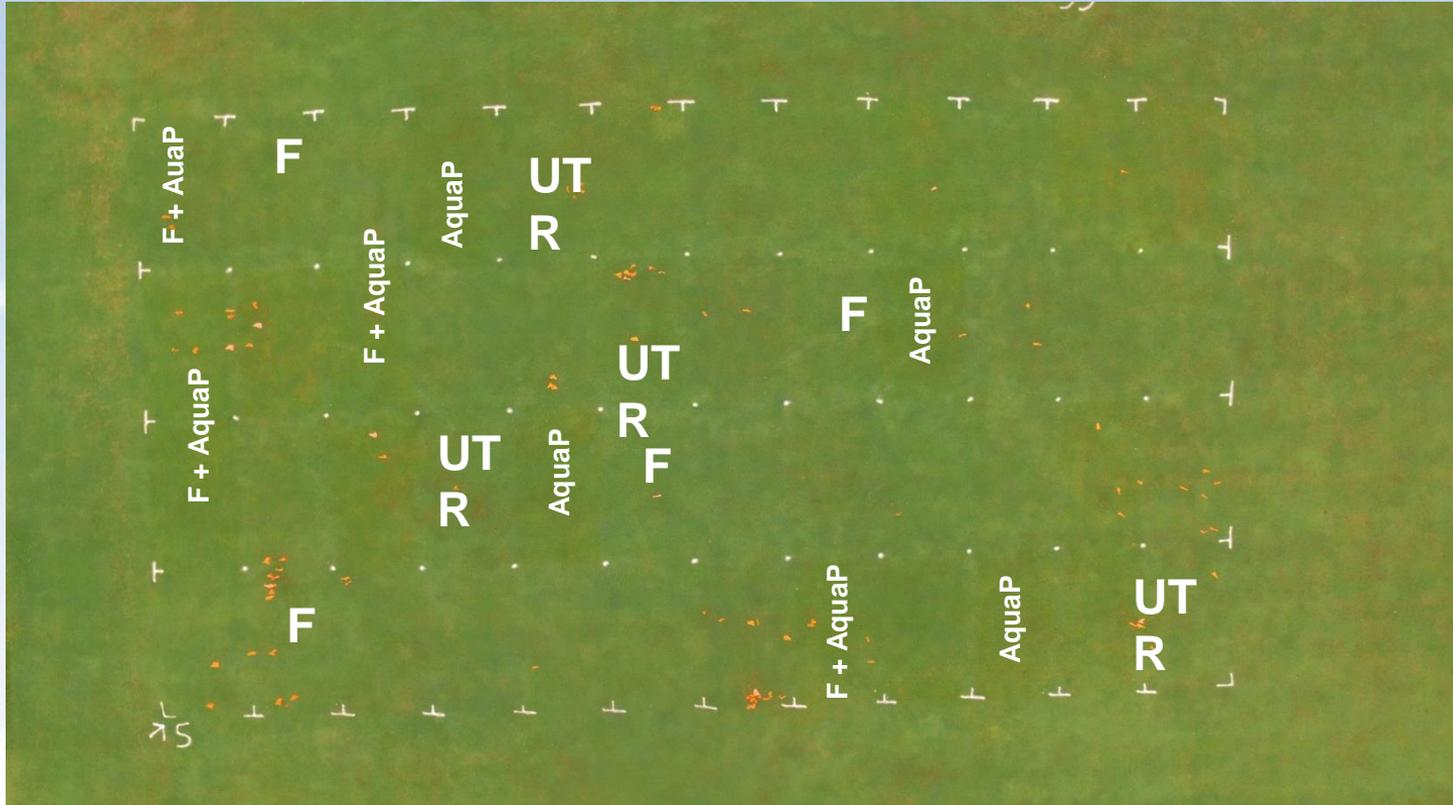
<u>Treatments</u>	<u>Appl Dates</u>	<u>dollar spot (mean # infection centers per plot)</u>									<u>AUDPC</u>
		<u>6/6</u>	<u>6/12</u>	<u>6/19</u>	<u>6/26</u>	<u>7/3</u>	<u>7/10</u>	<u>7/17</u>	<u>7/31</u>	<u>8/10</u>	
Xzemplar*	5/25, 6/15, 7/6	0b	0b	0b	0b	0b	0c	0b	3abc	17bc	122c
Xzemplar + AquaPremium	5/25, 6/22, 7/20	0b	0b	0b	0b	0b	0c	0b	2c	0c	21c
AquaPremium	5/25, 6/22, 7/20	0b	5b	10b	3b	5b	8c	8b	0c	3c	310c
Untreated	---	3a	25a	46a	26a	48a	72a	66a	8a	54ab	2562a

*Xzemplar is a registered trademark of BASF

Key Observations:

- Fungicide (fluxapyroxad) controlled dollar spot (fungicide applied at 21-day interval).
- Fungicide + tank-mix with AquaPremium (at 28-day interval) controlled dollar spot; no reduction in fungicide performance at that extended monthly interval.
- **AquaPremium alone controlled dollar spot; statistically comparable to fungicide alone.**
- Dollar spot epidemic subsided in late July due to weather, followed-by resurgence.
- Noticeably less dollar spot resurgence in AquaPremium or Xzemplar + AquaPremium.
- AUDPC (area under disease progress curve) – Reflects season long effects:
 - all treatments had statistically less dollar spot vs. untreated
 - AquaPremium statistically similar level of dollar spot control vs. fungicide alone (note, fungicide alone applied on 21-day intervals, AquaPremium on 28-day intervals).
 - fungicide + AquaPremium (28-day intervals) better, but statistically similar control to alone (applied at 21-day intervals)





Aerial view; July 31, 2019.

Flag in plot indicates active dollar spot infection center.

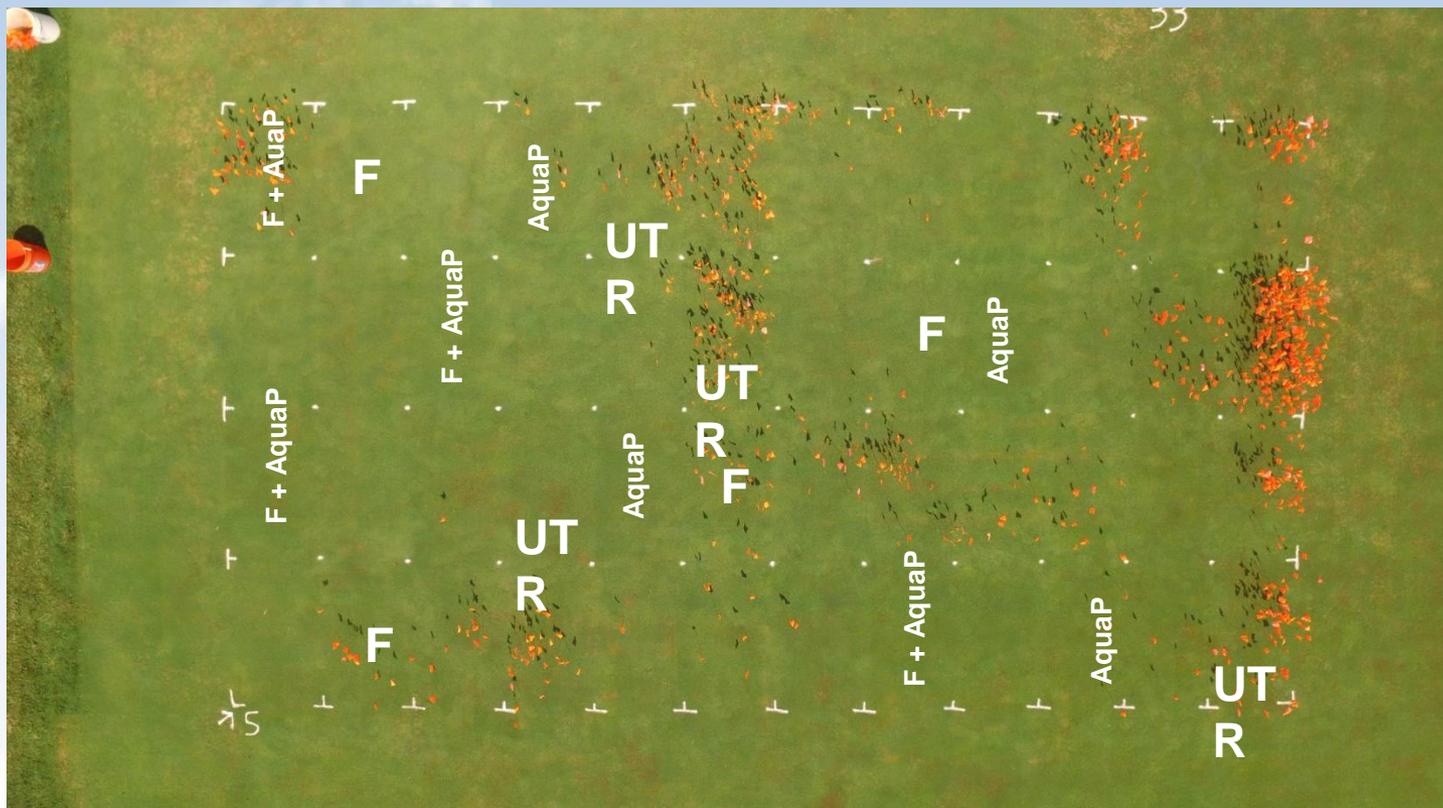
F = fungicide

UTR = untreated



PennState
Berks

PROGRASS Professional Grass Service



Aerial view; Aug. 10, 2019.

Flag in plot indicates active dollar spot infection center.

F = fungicide

UTR = untreated



PennState
Berks

PROGRASS Professional Grass Service

PROGRASS Professional Grass Service

 **RhizoSolutions**



Real world experience from the
Netherlands on how
RhizoSolutions' Technology
affects dollar spot

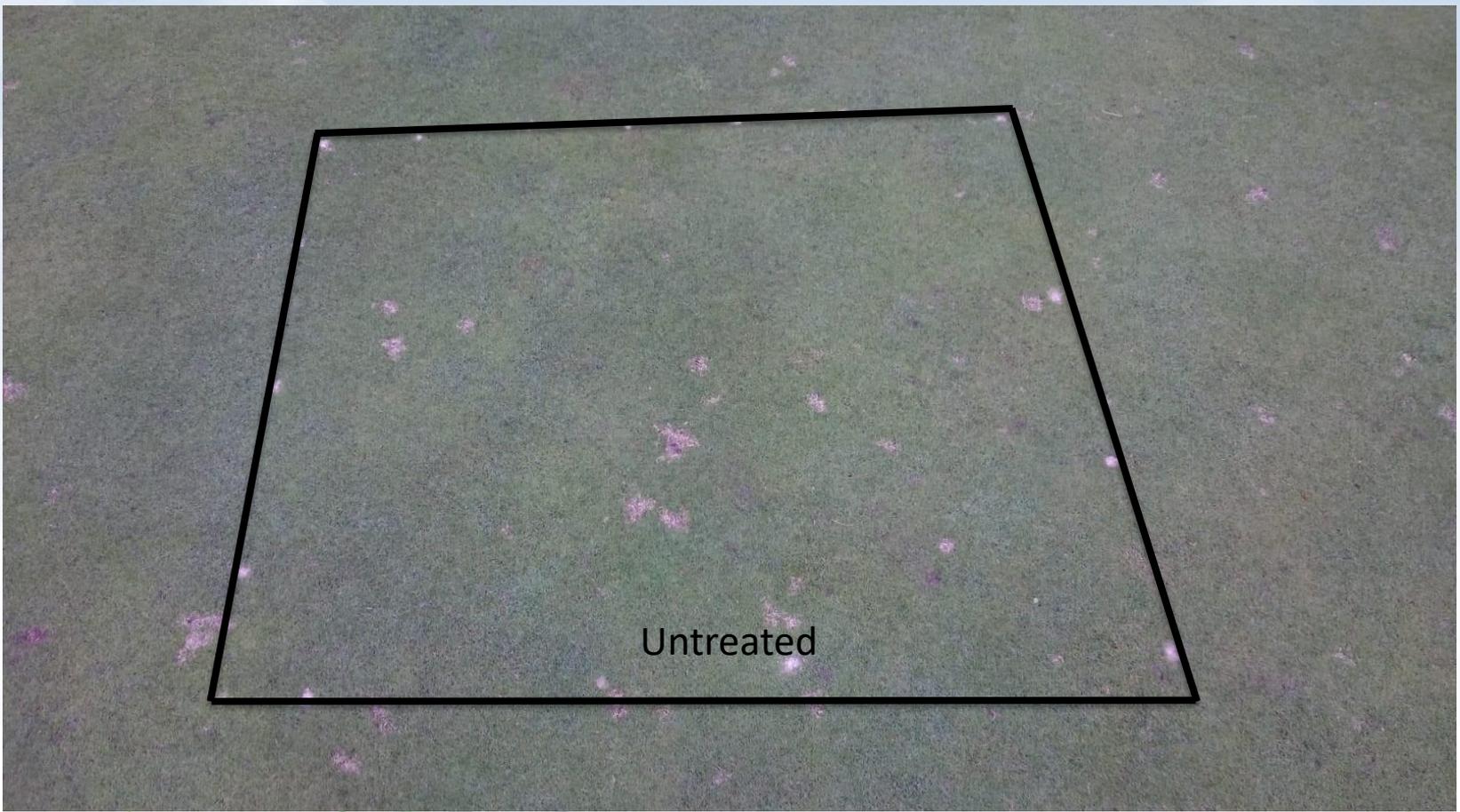
Lochemse Golfclub, Netherlands
August 2019

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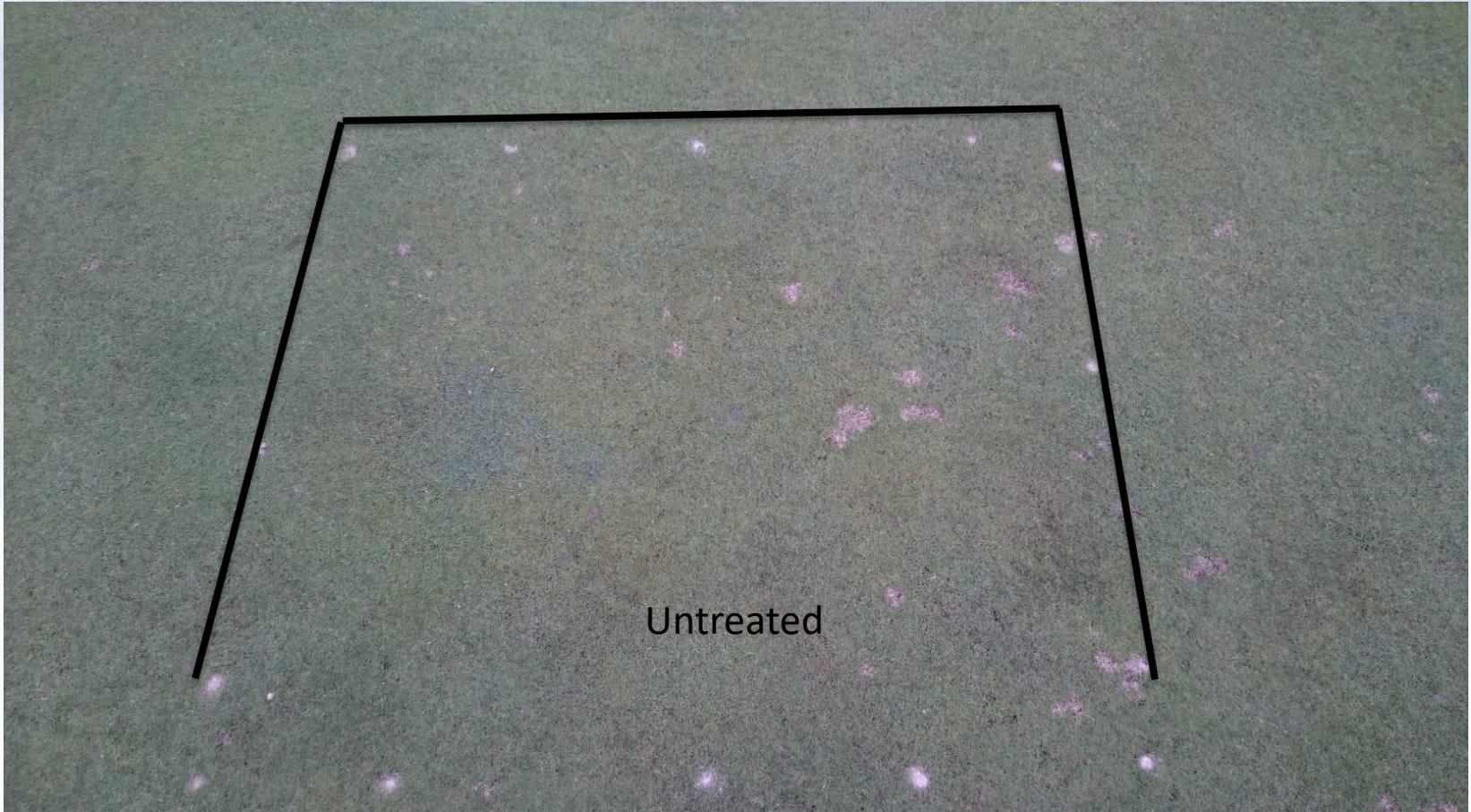


Effect of AquaPremium (12.5 L/ha) on Dollar Spot



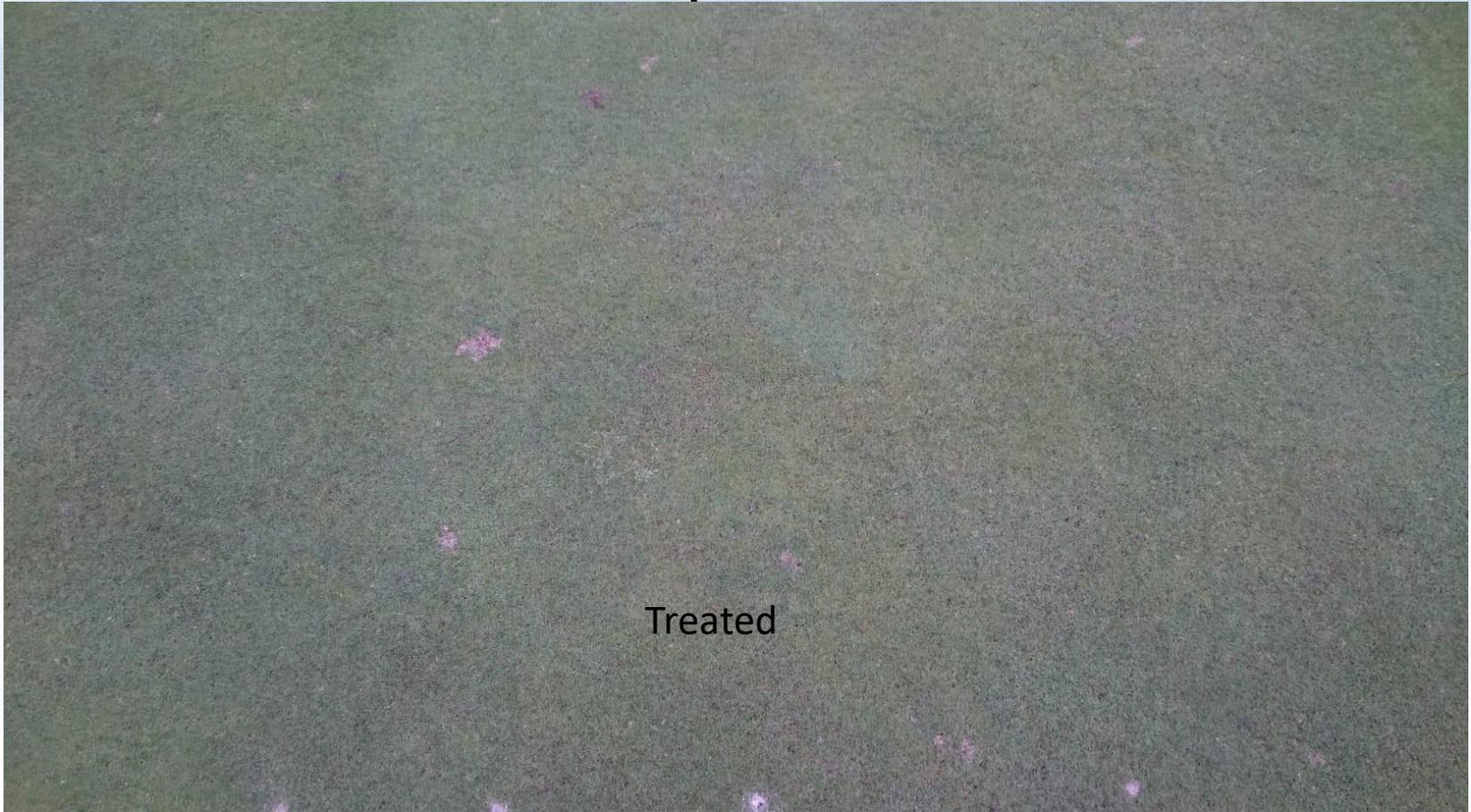
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Effect of AquaPremium (12.5 L/ha) on Dollar Spot



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Effect of AquaPremium (12.5 L/ha) on Dollar Spot



Treated

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Effect of AquaPremium (12.5 L/ha) on Dollar Spot



Treated



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Effect of AquaPremium (12.5 L/ha) on Dollar Spot



Belang van snelle infiltratie

- Door snelle penetratie is Aquapremium geschikt voor zowel preventief als curatief gebruik!
- Hetzelfde product ook in te zetten bij droogteschade/dry spots (handwateren)
- Aquapremium infiltreert dus ook snel in al ontstane, waterafstotende, droogteplekken

Nieuwe technologie

- Nieuwe molecuul technologie
- Belangrijkste verbeteringen t.o.v. alle concurrenten:
 - snellere infiltratie
 - beter managen van lucht/water balans in de wortelzone
 - verbeterde consistentie en kwaliteit gras
 - beter stress management (droogte/hitte)
- Lagere doseringen in vergelijking met andere producten
- Minder kosten maar met superieure prestatie

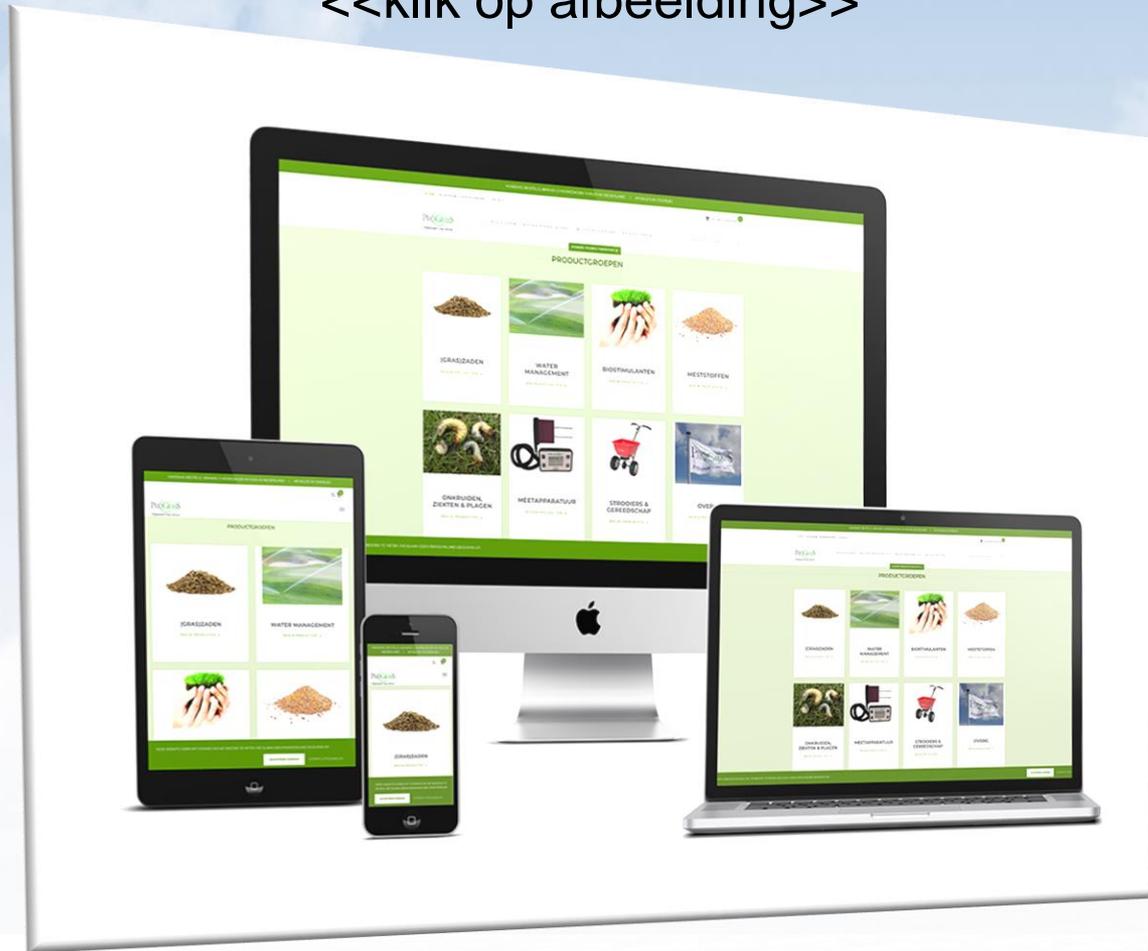


RhizoSolutions

- Producent en leverancier van ProGrasS
- Oud Aquatrols medewerkers (stonden aan de wieg van o.a. de eerste (Primer) en uiteindelijk meest gebruikte wetting agents.
- Onderzoek onafhankelijk over de gehele wereld bij gerenommeerde onderzoekstations en universiteiten.
- Ook al onderzoek naar natuurlijke/organische werkzame stoffen i.v.m. mogelijke wetswijzigingen in Europa.

Informatie – webshop

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PROGRASS Professional Grass Service