



# Effect of Primo Maxx in Improving Drought Tolerance & Improving Turf Quality Under Saline Irrigation Conditions

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## Improved Drought Tolerance

2

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## Improved Drought Tolerance/ Reduced Irrigation Requirement

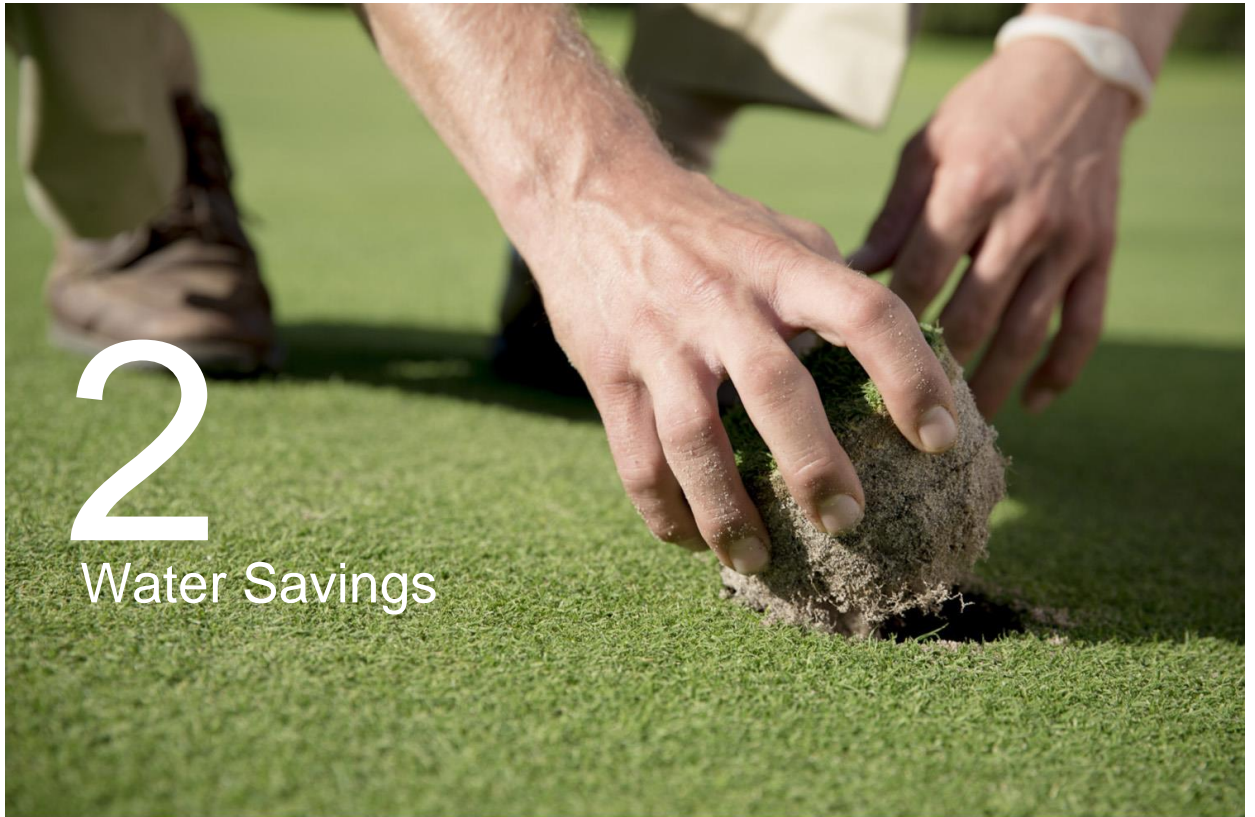
1. Produces smaller leaves with less surface area for transpiration
2. Improves rooting for access to deeper soil moisture
3. As GA levels are reduced, abscisic acid (ABA) levels increase which aids stomatal closure
4. Improved water use efficiency
5. Potential savings for cost of water and electricity to run the irrigation system





# 2

## Water Savings

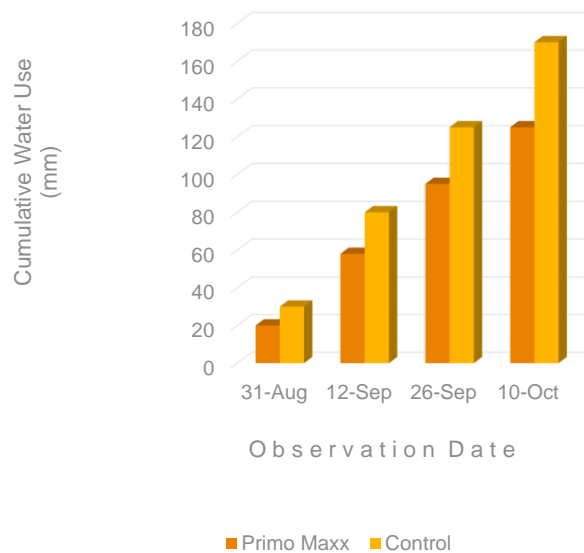


## Water Savings with Primo Maxx

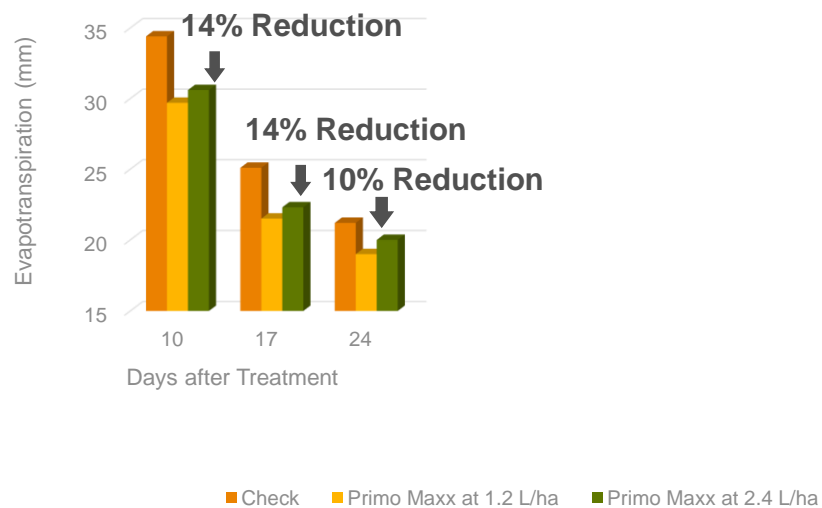
Dr. Petrovic  
Cornell University  
1995

Pennncross Bent  
1.27 cm  
1.3 kg N/M/yr

Primo Maxx (0.2 L/ha)  
on  
5 July,  
31 July,  
28 August,  
26 September



# Primo Maxx & Water Use

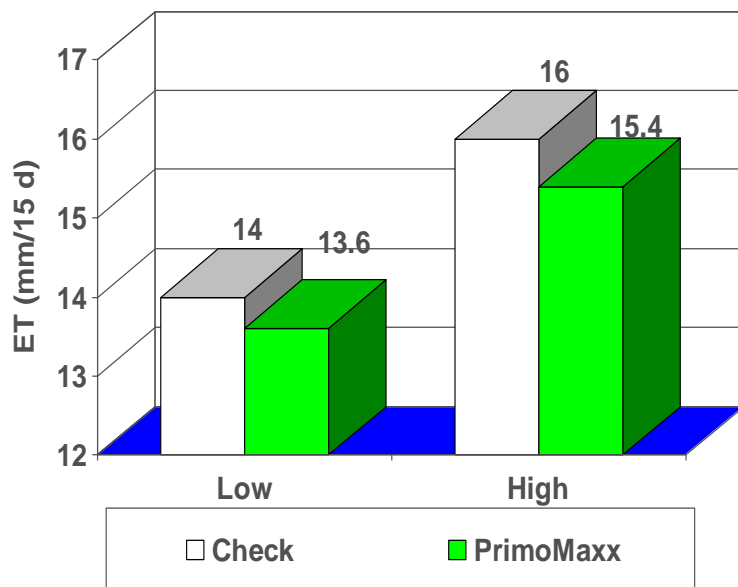


Arid Environment, University of California, Riverside

5 cm height, Tall Fescue, Irrigated based on Evapo-traspiration ( $ET_o$ )

## Primo Maxx, Irrigation, & ET Rates

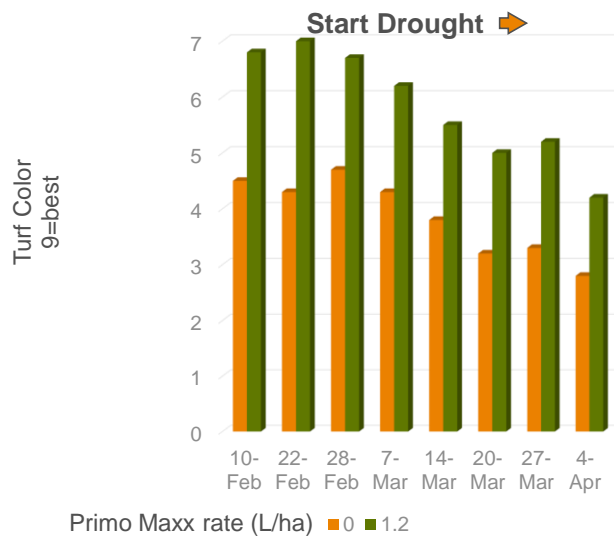
- Univ. Cal. Riverside, Green
- Sep-Oct 1995
- Primo Maxx at 2.4 L/ha
- Arid TF
- Irrigation  
Low every 7-24 d  
High every 3-4 d



LSD=1.3

Tall Fescue

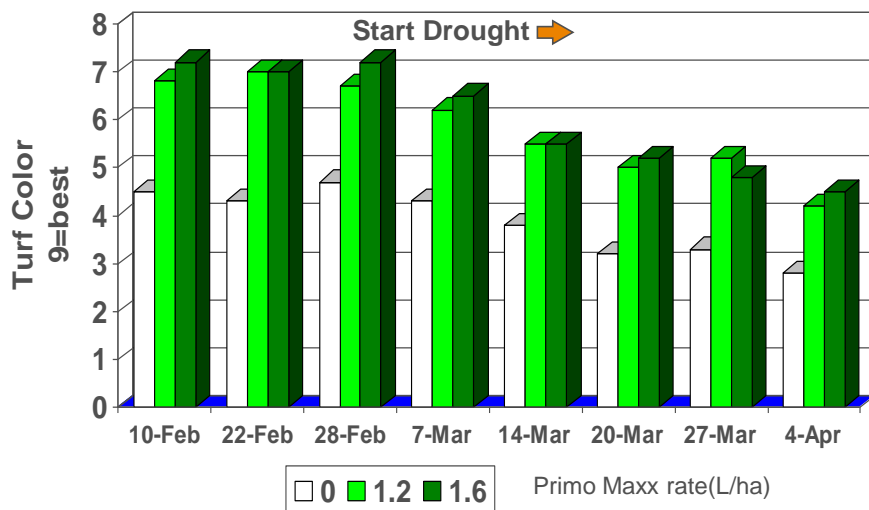
## Better Turf Color Going Into a Drought



Primo Maxx applications (L/ha) on 2/1/95 in the greenhouse and then water was withheld beginning 2/28/95. Texas A&M University, Dr. Richard White.

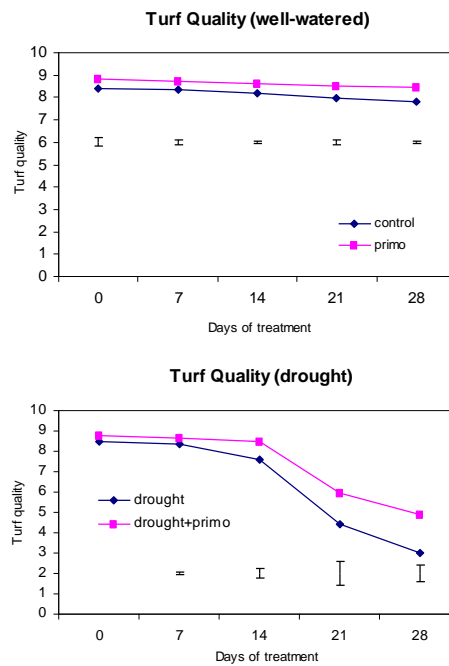


## Better Turf Color for Tifway after the onset of water stress



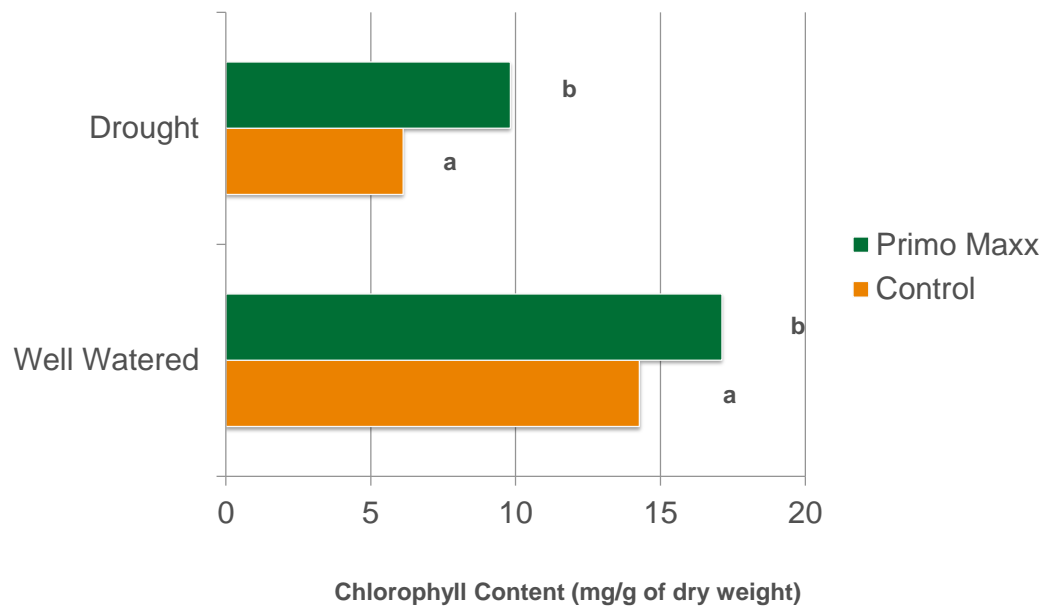
Primo Maxx applications (L/ha) on 2/1/95 in the greenhouse and then water was withheld beginning 2/28/95. Texas A&M University, Dr. Richard White.

Better turf quality of creeping bentgrass with Primo Maxx application under well-watered and drought conditions

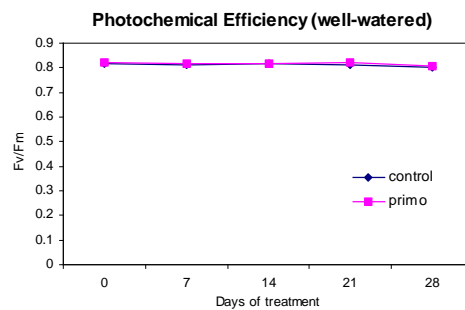


Dr. Bingru Huang, Rutgers University

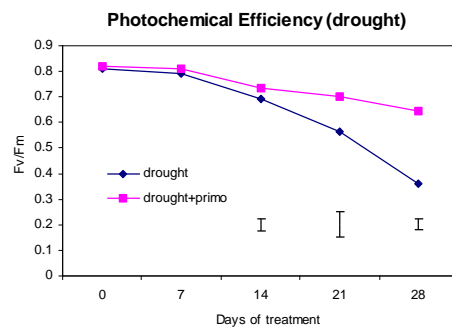
Higher leaf chlorophyll content of creeping bentgrass under drought conditions 28 Days after treatment with Primo Maxx application



Leaf photochemical efficiency (expressed as Fv/Fm ratio) of creeping bentgrass increased with Primo Maxx application under drought conditions



Plants were more efficient in utilizing the CO<sub>2</sub> to produce carbohydrates under drought conditions when treated with Primo Maxx



Dr. Bingru Huang  
Rutgers University

## How does Primo Maxx Improve drought Tolerance?

- Primo Maxx improves photochemical efficiency under drought conditions hence turfgrasses can photosynthesize more efficiently
- Primo Maxx helps in maintaining osmotic potential in the treated plant cells so that the cells maintain turgor under drought conditions which prevents them from desiccation
- Primo Maxx helps in regulating the synthesis of proline, an essential amino acid which helps in protecting the cells from heat damage. It also helps in producing heat shock proteins which protects the integrity of the cell walls under heat stress
- Primo Maxx suppresses the gibberellic acid production and increases the production of abscisic acid which ultimately regulates the opening and closing of stomata and hence helps in maintaining moisture in the plants under drought stress

# 3

## Improved Rooting

14

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## PGR's on root growth & development



Untreated    Maleic hydrazide    Metsulfuron-methyl



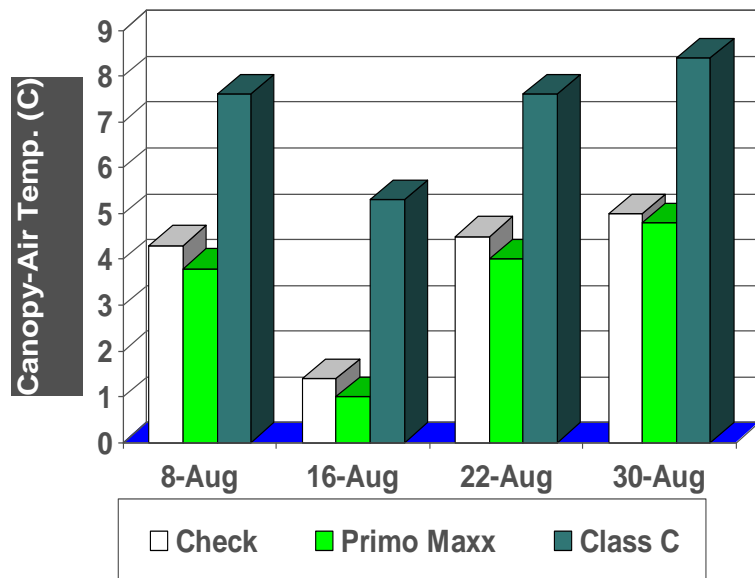
## Primo Maxx helps in lowering turf canopy temperatures

Kansas State Univ.  
Jun-Aug 1995

Lesmo at 2.5 L/ha  
on 6/2/95 &  
1.5 L/ha on  
7/18/95

Gator PR

Irrigation Stopped  
on 6/2/95



LSD= 1.49

0.92

1.72

1.42

# 4

## Pre-Stress Conditioning

17

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## Rutgers University: Dr. Bingru Huang Pre-stress Conditioning Research



**Without  
preconditioning  
and then subjected  
drought/heat stress**

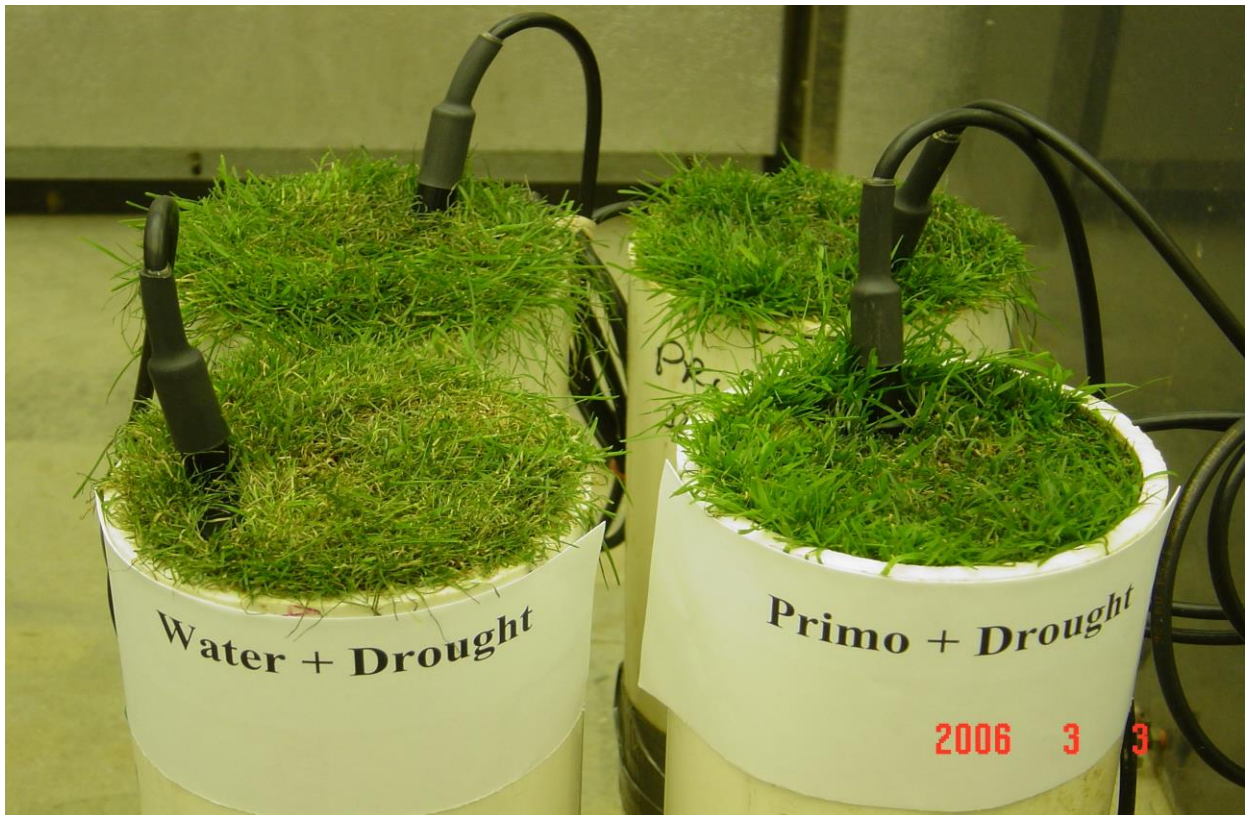
**Pre-conditioned  
by deficit  
irrigation and  
then subjected  
to drought/heat  
stress**

**Pre-conditioned  
with Primo  
Maxx and then  
subjected to  
drought/heat  
stress**

**Control  
without  
drought/he  
at stress**







## Summary

- Primo Maxx application resulted in higher turf quality, Residual Water Content, Photochemical Efficiency, and Chlorophyll content, compared to non-treated plants
- Primo Maxx application was able to help maintain growth and physiological activities of creeping bentgrass under drought stress
- This effect was mainly due to the promotion of drought avoidance by reducing water consumption through growth inhibition and/or maintaining water uptake and root growth under drought stress conditions
- Pre-conditioning the turfgrass with Primo Maxx application before heat, drought and moisture stress helps the turf to adjust to the stressful conditions compared to untreated turfgrass

A close-up photograph showing a person's hands lifting a sod of grass from a green field. The sod is being lifted from a hole, and the roots are visible. The background is a blurred green field.

5

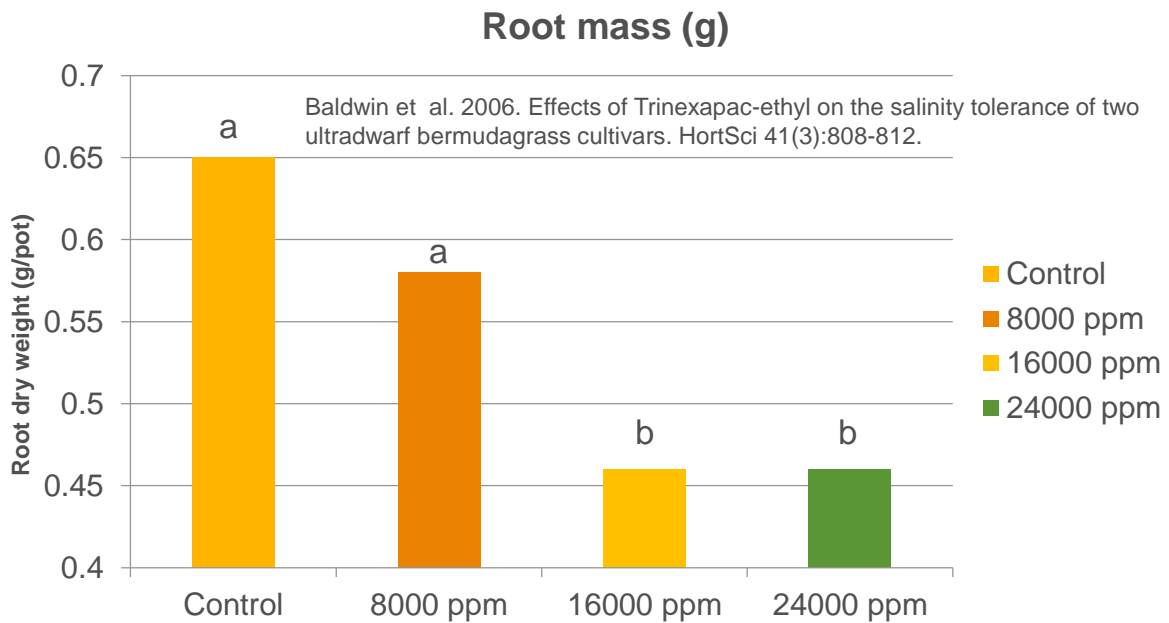
## Effect of Primo Maxx on Salinity Tolerance

22

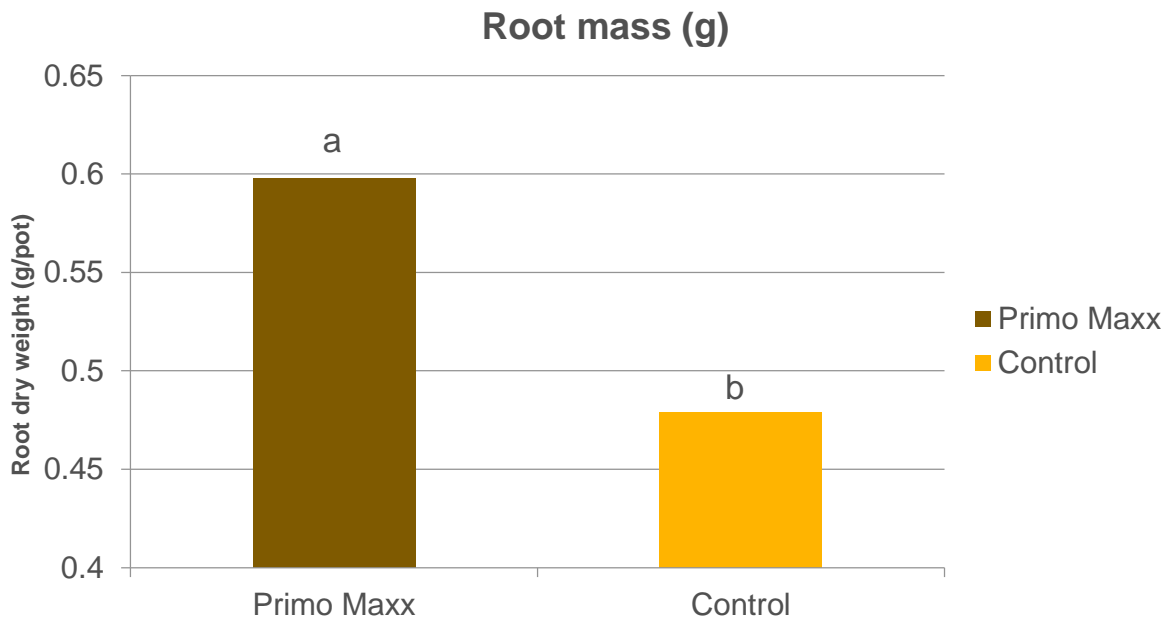
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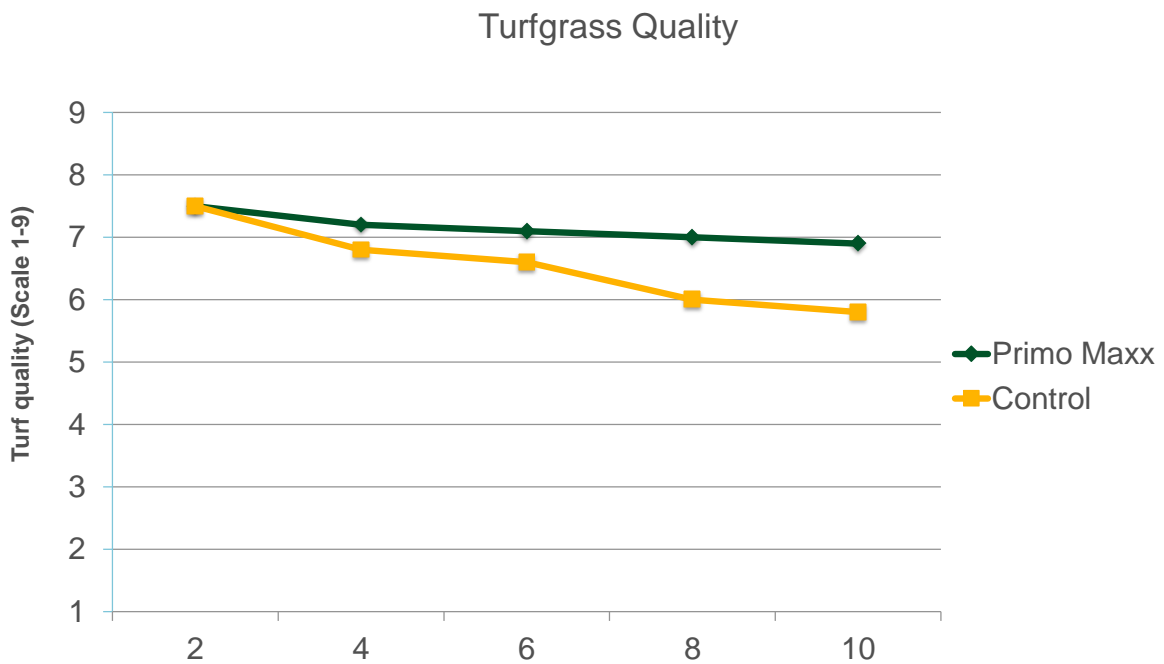


Combined root mass (g/pot) of 'Champion' and 'TifEagle' bermudagrass following 10 weeks of salinity application of 12.90, 25.80, 38.71 dS m<sup>-1</sup> (8000, 16000, 24000 ppm respectively) of sodium chloride (Pots were 11.45 cm in diameter and 15.24 cm in height)

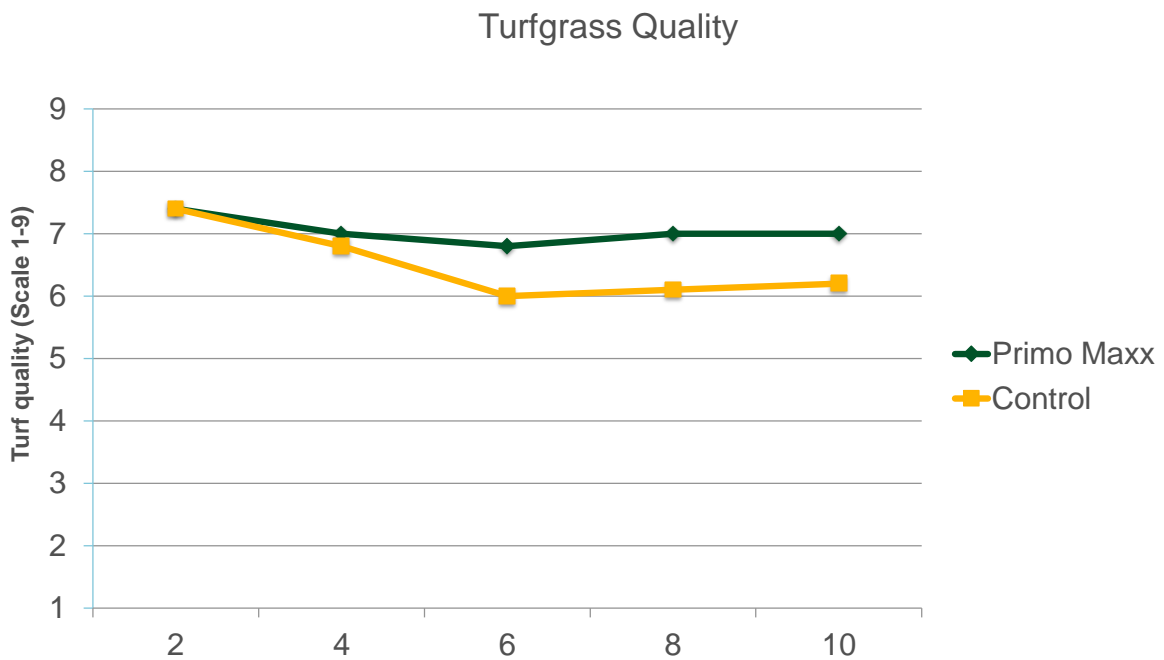


Combined root mass (g/pot) of 'Champion' and 'TifEagle' bermudagrass following 4 applications of Primo Maxx when exposed to salinity application of 12.90, 25.80, 38.71 dS m<sup>-1</sup> (8000, 16000, 24000 ppm respectively) of sodium chloride. (Pots were 11.45 cm in diameter and 15.24 cm in height)



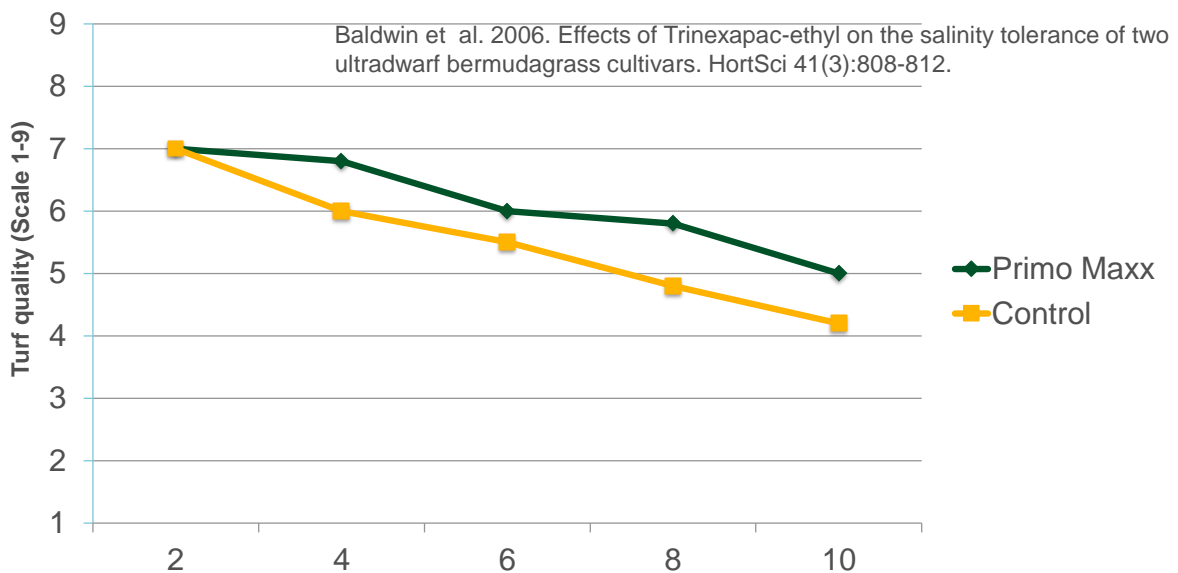


Effect of 4 biweekly applications of Primo Maxx on 'Champion' bermudagrass when irrigated with saline water ( $12.90 \text{ dS m}^{-1}$  or 8000 ppm) of sodium chloride

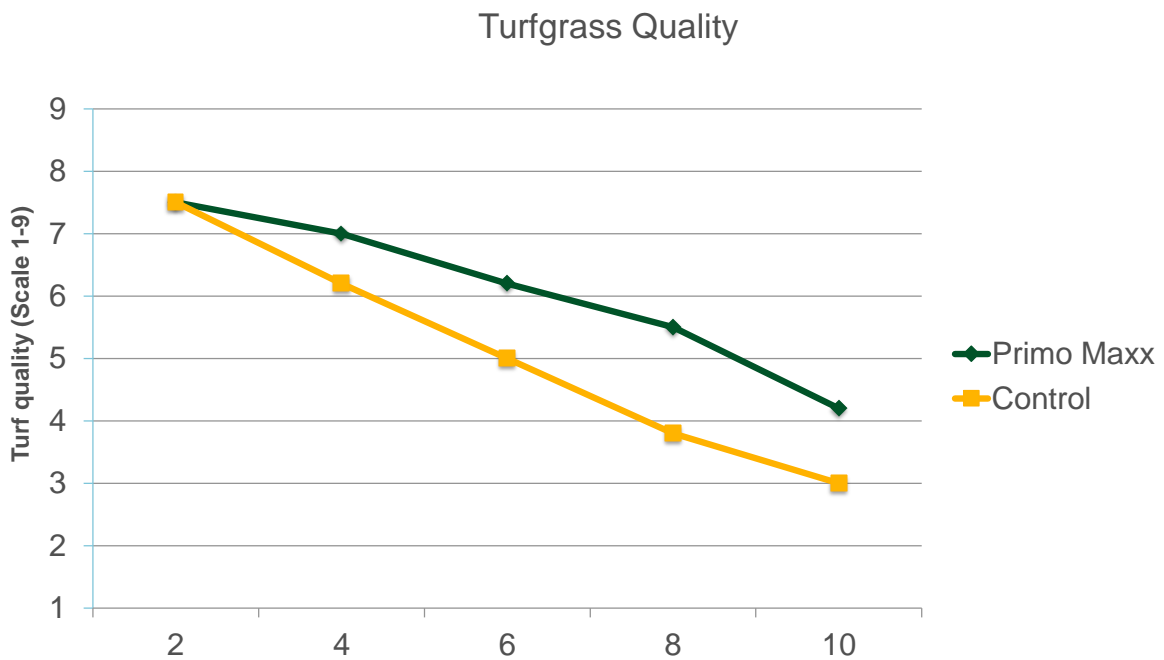


Effect of 4 biweekly applications of Primo Maxx on 'TifEagle' bermudagrass when irrigated with saline water ( $12.90 \text{ dS m}^{-1}$  or 8000 ppm) of sodium chloride

## Turfgrass Quality



Effect of 4 biweekly applications of Primo Maxx on 'Champion' bermudagrass when irrigated with saline water (25.80 dS m<sup>-1</sup> or 16,000 ppm) of sodium chloride



Effect of 4 biweekly applications of Primo Maxx on 'TifEagle' bermudagrass when irrigated with saline water (25.80 dS m<sup>-1</sup> or 16,000 ppm) of sodium chloride



## Summary

- Champion and TifEagle bermudgrass was tolerant to salt levels less than 15.78 and 6.00 dSm<sup>-1</sup> with trinexapac-ethyl application respectively
- Without trinexapac-ethyl application TifEagle had lower turf quality than Champion after 10 weeks when exposed to 12.90 dSm<sup>-1</sup> of salinity
- Salinity adversely affected root growth of both cultivars
- Trinexapac-ethyl application increased root growth by 25% for both cultivars under saline irrigation water

