TURF TRIAL INFORMATION

GREENMASTER® LIQUID ADVANCE

MTU®

Applications of MTU® and Pidolic Acid mitigate effects of drought stress in *Agrostis stolonifera.*

UNIVERSITÀ DI PISA

SUMMARY

- Independent trial completed at University of Pisa by Antonio Pompeiano PhD.
- Glass house trial completed on *Agrostis stolonifera* cores collected from, sand-based golf green.
- A single application of combined MTU® and Pidolic Acid (0.2L/ha) was compared to untreated control and to a seaweed extract (10L/ha) prior to onset of drought stress imposed by deficit irrigation.
- The combined MTU® and Pidolic Acid significantly ($P<0.05$) improved turfgrass quality under drought stress and significantly improved a number of turf stress metrics including total antioxidant capacity, amount of photosynthetic pigments and photosystem II activity.

METHODS

Uniform cores (9.5 cm diameter, 15 cm depth) of *Agrostis stolonifera* (L.) cv. 'T-1' were collected with undisturbed soil profile (from a mature sand-based putting green) and placed in a greenhouse throughout the experimental period. Air temperatures varied between 20 and 32 °C during the day, and remained above 15 °C at night, with daily maximum photosynthetically active radiation (PAR) levels ranging from 800 to 1350 $\mu mol^{-2}\ s^{-1}$, provided by sunlight.

Plants were divided into three groups: control group (W100) well-watered, while stressed plants will receive water equal to 75 or 50% of pot capacity (W75 and W50, respectively) every 48 h for 21 days. W50 represents moderate to severe drought stress for the species. Treatments consisted of a combination of MTU® and Pidolic Acid (MTUPA) (equivalent to 0.2 L ha^{-1}) or a seaweed extract (SWE) (equivalent to 10 L ha^{-1}), applied directly to the root system using a syringe, plus an untreated control. N fertigation was applied once at the beginning of the trial using ammonium sulfate [$(NH_4)_2SO_4$], at a rate equivalent to 5 g N m^{-2}. Plants were arranged in a randomized two-factor (treatment × drought) complete block design with 7 replicates per experimental condition.

Collected samples ready for treatment application.

A series of destructive measurements were conducted at the end of the treatment period (3 weeks after treatment). These included shoot and root dry weights, analysis of photosynthetic pigments, total antioxidant capacity and photosystem II efficiency.

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RESULTS

The assessment of biometric, physiological, and biochemical traits indicated a significant interaction between drought levels and treatment ($p < 0.05$) (Table 1).

Table 1: Selected trial results for Control (Con), MTU® & Pidolic Acid (MTUPA) and Seaweed Extract (SWE) under three levels of drought stress. Well-watered (W100), moderate stress (W75), severe stress (W50).

Treatment		Quality TQ (1-9)	Biometric Root DW (g)	Pigments Chl a+b (µg/g)	AntiOx TAC µmol	Chlorophyll fluorescence PhiPSII (yield)
W100	Con	7.7	0.188	1.350	34.9	0.677
	MTUPA	7.7	0.190	1.353	36.1	0.683
	SWE	8.2	0.194	1.477	36.4	0.678
W075	Con	5.7	0.160	1.254	48.7	0.551
	MTUPA	6.3	0.170	1.305	53.5	0.652
	SWE	5.8	0.165	1.261	50.3	0.565
W050	Con	4.3	0.126	1.135	57.3	0.434
	MTUPA	5.3	0.136	1.220	60.0	0.492
	SWE	4.3	0.130	1.158	57.6	0.442
	Significance	**	***	**	***	***

Turf quality and Biometric traits

Turf quality and biometric traits were evaluated under varying water conditions (W100, W75, W50). Under optimal watering (W100), the SWE treatment yielded the best visual and growth metrics. However, as drought stress increased, turf quality declined across all treatments. The MTUPA treatment demonstrated superior drought resilience, maintaining significantly better visual scores and biomass under moderate and severe stress (W75 and W50), with up to 23% improvement in colour and 22% in overall quality compared to the control. MTUPA also supported higher shoot and root weights under stress, suggesting enhanced drought tolerance.

Leaf photosynthetic pigment

Under optimal watering (W100), SWE treated plants showed the highest pigment concentrations, indicating superior photosynthetic potential. As drought stress increased (W75 and W50), pigment levels declined across all treatments. However, MTUPA treated plants retained significantly more chlorophyll, especially under moderate (W75) and severe (W50) stress, suggesting enhanced resilience. Overall, MTUPA was most effective in preserving pigment integrity under drought, highlighting its protective role in maintaining photosynthetic function.

Chlorophyll fluorescence

Photosynthetic efficiency, measured via ΦPSII, declined with increasing drought stress. Under well-watered conditions (W100), all treatments showed optimal values. As stress intensified, MTUPA treated plants consistently maintained higher ΦPSII values, especially under severe drought (W50), indicating better preservation of PSII function. At W75, MTUPA treatment retained significantly higher ΦPSII than control and SWE treatments. These results highlight MTUPA as the most effective biostimulant in protecting photosynthetic performance under water-limited conditions.

Antioxidant response

Drought stress triggered a marked increase in antioxidant activity in creeping bentgrass, with both Total Antioxidant Capacity (TAC) and Total Flavonoid content (TF) rising progressively under water-limited conditions. MTUPA treatment consistently induced the highest antioxidant levels, especially under moderate (W75) and severe (W50) stress, outperforming both control and SWE. These results suggest that MTUPA enhances oxidative stress protection more effectively, supporting its role in improving drought resilience

CONCLUSIONS

Creeping bentgrass performance under varying water conditions revealed distinct treatment effects. Under optimal watering (W100), SWE enhanced turf visual quality, growth traits, and pigment concentrations, indicating strong performance in non-stressful environments. However, as drought stress intensified (W75 and W50), MTUPA consistently outperformed both control and SWE treatments across multiple parameters. MTUPA treated plants maintained superior turf quality, higher pigment retention, and better photosynthetic efficiency (ΦPSII), especially under severe drought. Additionally, MTUPA induced the strongest antioxidant response, with elevated total antioxidant capacity, suggesting enhanced protection against oxidative stress. Overall, while SWE excelled under well-watered conditions, MTUPA demonstrated superior resilience and protective effects under drought, making it the most effective treatment for sustaining turf health in water-limited environments.

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