
UNIVERSIDAD POLITÉCNICA DE MADRID
ESCUELA TÉCNICA SUPERIOR DE INGENIERÍA AGRONÓMICA, ALIMENTARIA Y DE BIOSISTEMAS
IARIA
Keynote 3
Innovative Low-Water Turfgrass Management for Sustainable Urban Greening
Prof. Dr. Lorena Parra

Resume of the presenter

Background:

- Bachelor's degree in Environmental Sciences.
- Master's Degree in Environmental Assessment and Monitoring of Marine and Coastal Ecosystems + Master in Aquaculture
- PhD in Science and Technology of Animal Production.

Experience:

- Author/coauthor of multiple journal publications and participations in congresses.
- Editor of proceedings, panellist and chair in various congresses.
- Guest editor of several Special Issues of indexed journals.

Current position and Research topics

- Assistant Professor at Universidad Politécnica de Madrid
- Responsible research on Sustainable Gardening and Landscaping
- Sensors and remote sensing for precision agriculture/landscaping.
- Optimization of management for green areas sustainability

Resume of the UPM

Education:

The UPM offers 56 bachelor degrees and double degrees, 100 master's degrees, and 44 PhD programs.

28,000 undergraduate students, 5,700 master students, and 1,800 PhD students.

Research:

220 research groups

181 granted Horizon Europe projects and 549 Horizon 2020 projects

Over 320 new businesses and 150 start-ups.

Number 73 in the QS World University Ranking (2024) and the 94th in the QS Graduate Employability Rankings (2024).




Resume of Dept. of Agricultural Production

Department of Agricultural Production, part of the Higher Technical School of Agricultural, Food and Biosystems Engineering, located in the buildings of Agronomists, Agricultural and in the Practice and Experimentation Fields of the School.

Nowadays, the department includes 68 researchers in 9 research groups

i) Sustainable Plant Production and Protection Systems (10 researchers)
   i) Water and nutrient resource management in agricultural systems
   ii) Sustainable gardening and landscaping
   iii) Crop protection

Besides, there are 7 Educational Innovation Groups in the department.

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AGENDA

01. **INTRODUCTION**

The importance and current problems of gardens and urban greening

Turfgrass requirements

Turfgrass species

02. **MANAGEMENT ALTERNATIVES TO SAVE WATER**

C3/C4 mixes

Biostimulants

Soil ammenments

03. **MONITORING TECHNOLOGIES**

Ground based commercial equipment

Remote sensing techniques

Developed sensors

04. **FUTURE OF LOW-WATER TURFGRASS MANAGEMENT**

Reclaimed water and emergent pollutants

Varieties

Enhanced monitoring and tailored products




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INTRODUCTION

The importance and current problems of gardens and urban greening

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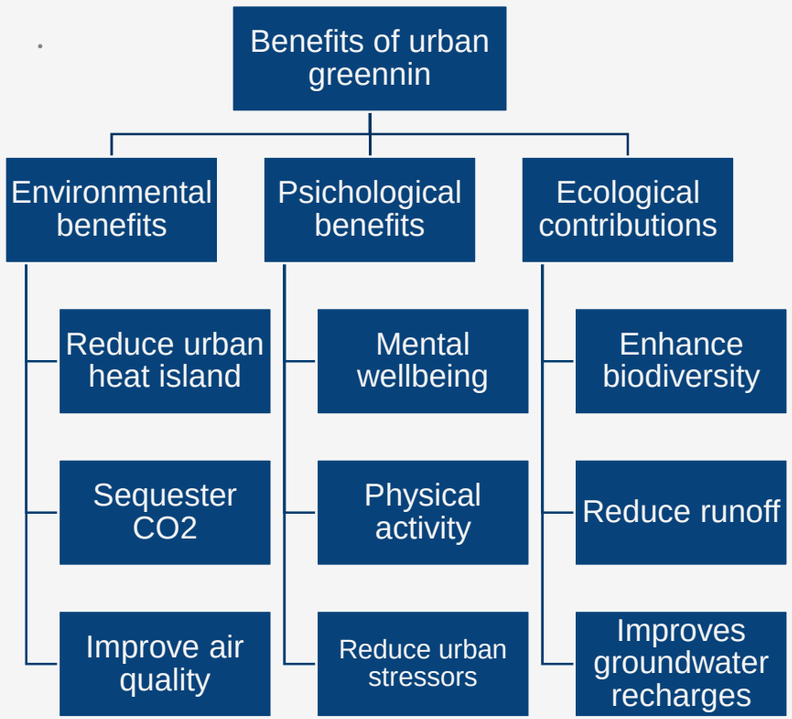
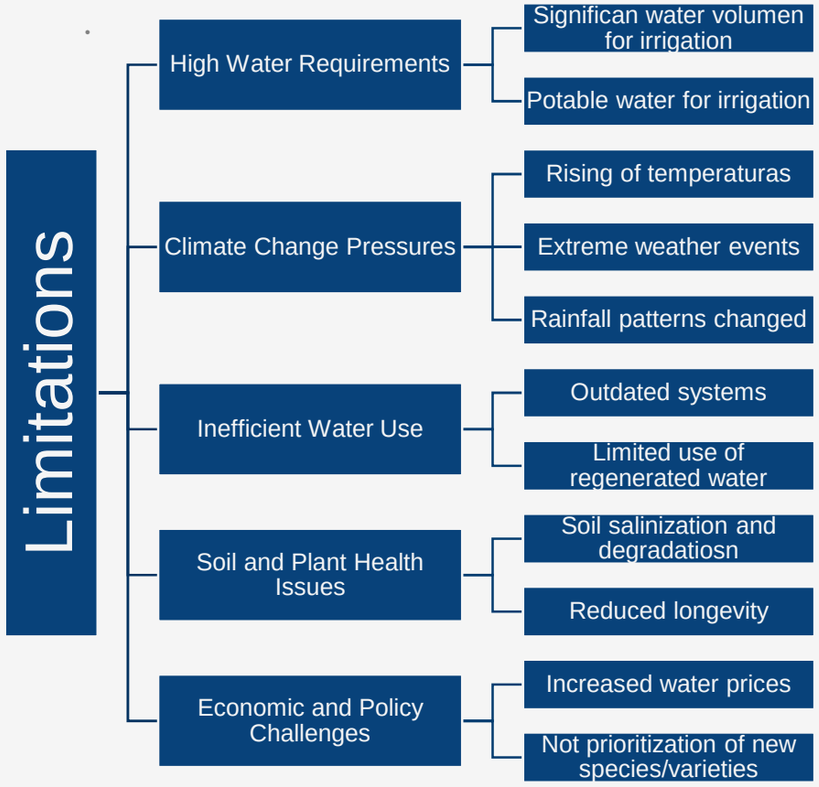


The problems of gardens and urban greening

INTRODUCTION

The importance and current problems of gardens and urban greening



INTRODUCTION

Turfgrass requirements

*	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Irrigation	3 perd week		1 per week			3 per week			7 per week			3 per week
Mowing	2 per month	1 per month				2 per month	3 per month	4 per month				3 per month
Redefining edges	According to needs					According to needs						According to needs
Fertilization												
Organic	According to needs											According to needs
Inorganic						According to needs						
Weeding						According to needs						
Aeration					According to needs							
PPP	According to needs					According to needs						
Overseeding	According to needs					According to needs						According to needs

Maintenance requirements: the most demanding maintenance among ornamental species

High variation among areas (climate, irrigation rate), species, and microclimate

INTRODUCTION

Turfgrass requirements

Different costs due to different maintenance levels, irrigation infrastructure, water sources, Grass tips etc.…

Northern Europe:

5 – 10 €/m² yearly

Water costs: (10 to 20%)

0.5 – 2 €/m² yearly

Semiarid regions:

15-25 €/m² yearly

Water costs (>50%)

8-15 €/m² yearly

INTRODUCTION

Turfgrass species

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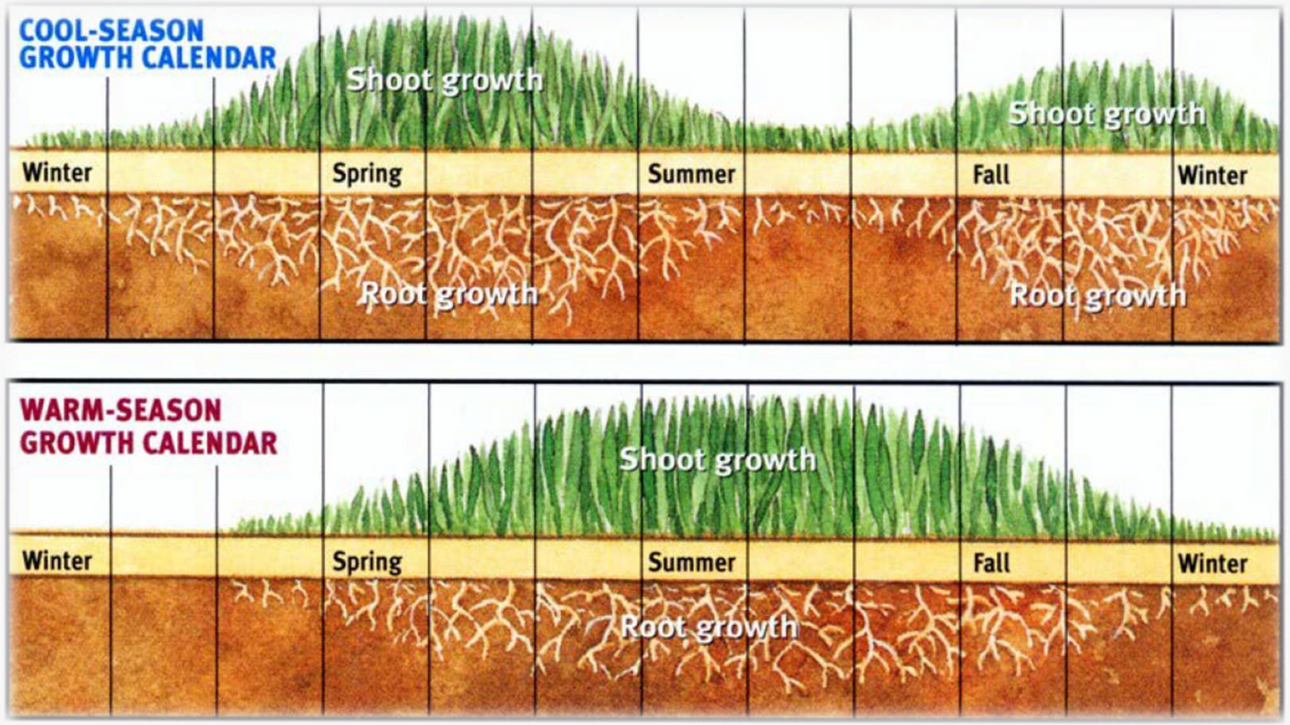
Warm season vs Cold season grasses



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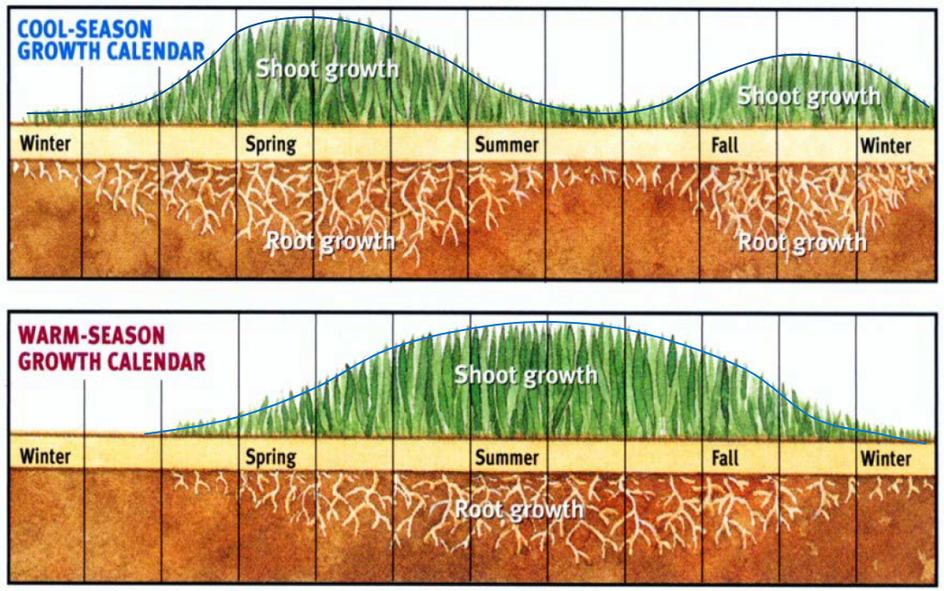
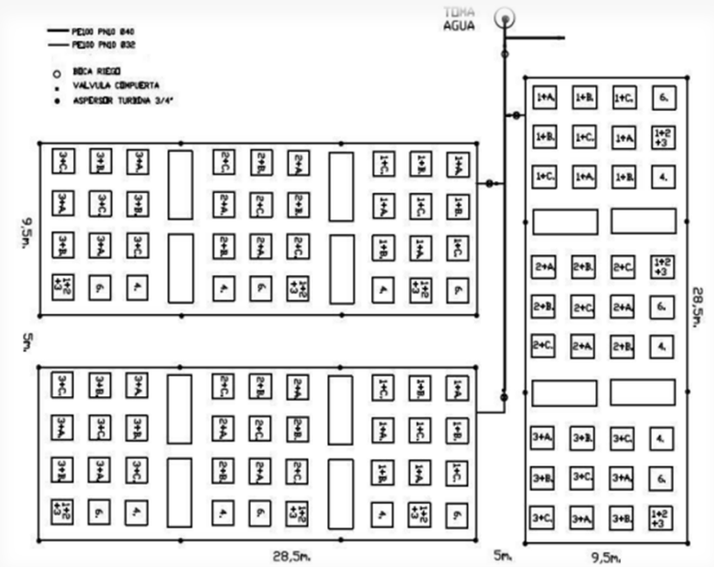
MANAGEMENT

C3/C4 mixtes



Experimental design

12 mixes (11 C3/C4 and 1 C3)



MANAGEMENT

C3/C4 mixes

Three irrigation regimes (100, 75, 50 % of ETP)

3 C3 grasses

3 C4 grasses

1 Control (*Festuca arundinacea, Poa pratensis, Lolium perene*)

Cynodon dactylon + *Brachypodium distachyon*	*Zoysia japonica* + *Brachypodium distachyon*	*Buchloe dactyloides* + *Brachypodium distachyon*
Cynodon dactylon + *Agropyron cristantum*	*Zoysia japonica* + *Agropyron cristantum*	*Buchloe dactyloides* + *Agropyron cristantum*
Cynodon dactylon + *Vulpia myuros*	*Zoysia japonica* + *Vulpia myuros*	*Buchloe dactyloides* + *Vulpia myuros*

Experimental design

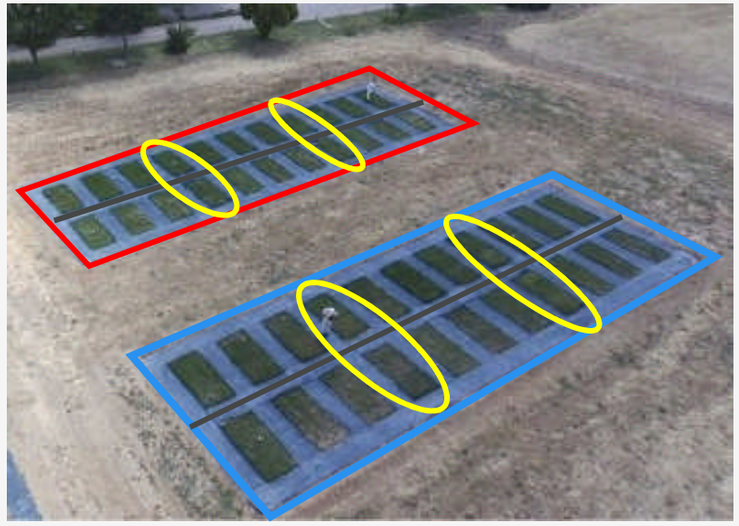
12 mixes (11 C3/C4 and 1 C3)

MANAGEMENT

C3/C4 mixes

Experimental design

7 mixes (6 C3/C4 and 1 C3)



MANAGEMENT

C3/C4 mixes

Two irrigation regimes

2 C3 grasses (*Poa pratensis and Festuca arundinacea*)

3 C4 grasses (*Cynodon dactylon, Buchloe dactyloides, Zoysia japonica*)

1 Control (*Festuca arundinacea, Poa pratensis, Lolium perene*)

Proyecto "Ensayos de mezclas de cespitosas más sostenibles para jardinería pública" (PDR18-Xerocesped) del Grupo Operativo "Xerocesped para naturación urbana", financiado por

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Fondo Europeo Agrícola de Desarrollo Rural

PROGRAMA DE DESARROLLO RURAL DE LA COMUNIDAD DE MADRID 2014-2020

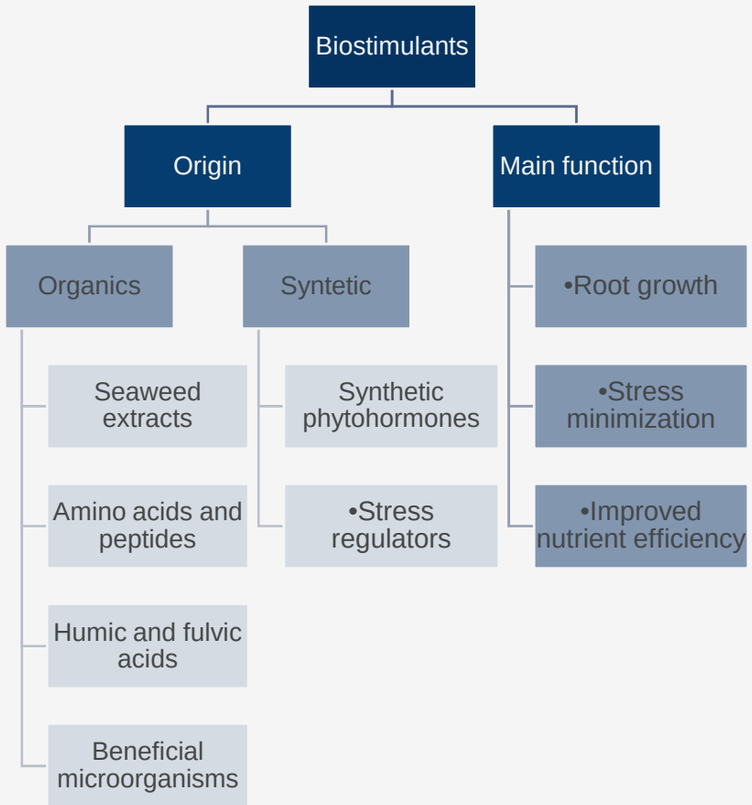
Resistance to deficit irrigation

MANAGEMENT

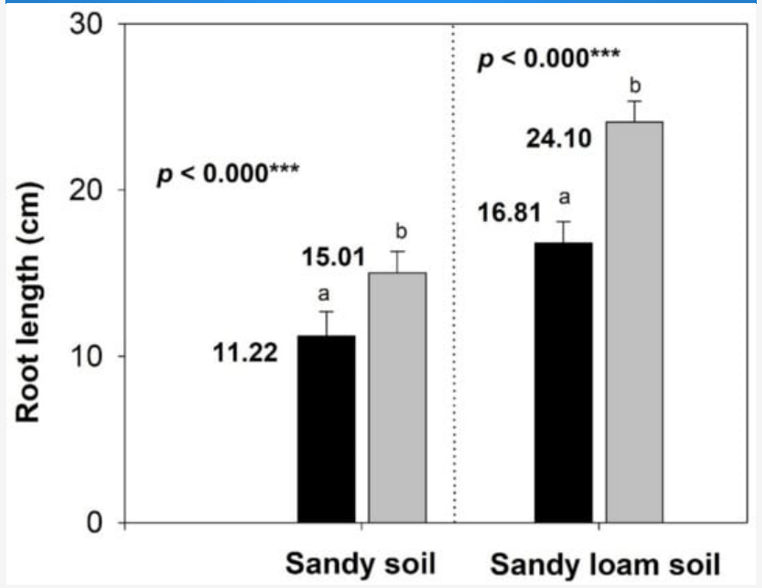
C3/C4 mixes

MANAGEMENT

Biostimulants



Root growth biostimulant



MANAGEMENT

Biostimulants

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Stress minimization

Table 15. Two-way ANOVA for NDVI in gardening turfgrass with reduced irrigation.

Source	Sum of Squares	df	Mean Squares	F	Sig.
Date	0.449211	5	0.0898422	34.43	0.0000
Treatment	0.0107417	2	0.00537083	2.06	0.1361
Error	0.167025	64	0.00260977		
Total (Corrected)	0.626978	71			

MANAGEMENT

Biostimulants

Two irrigation regimes

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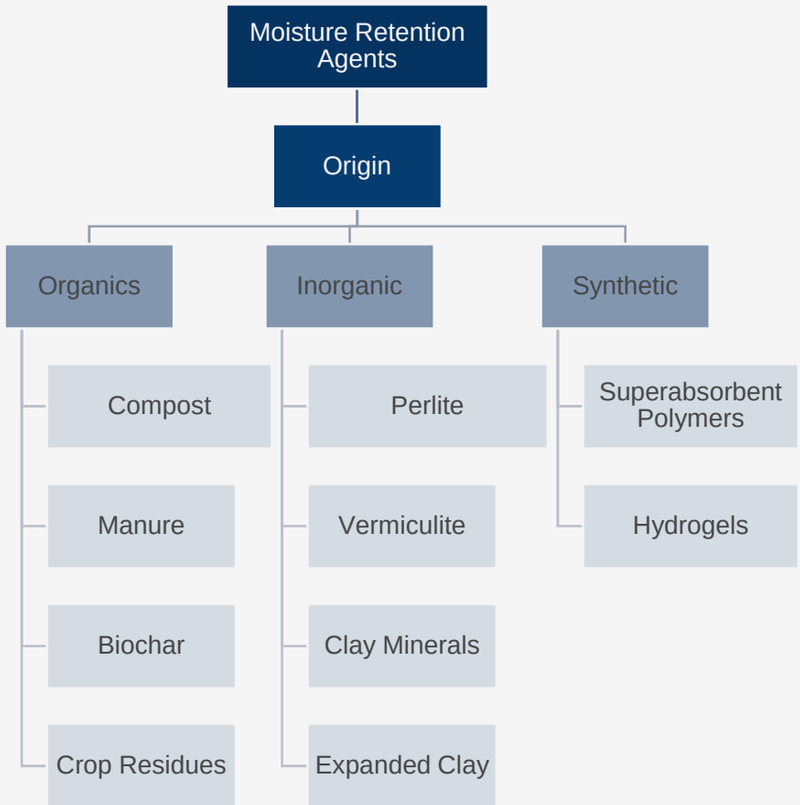
2 C4 grasses (*Cynodon dactylon, Buchloe dactyloides*)

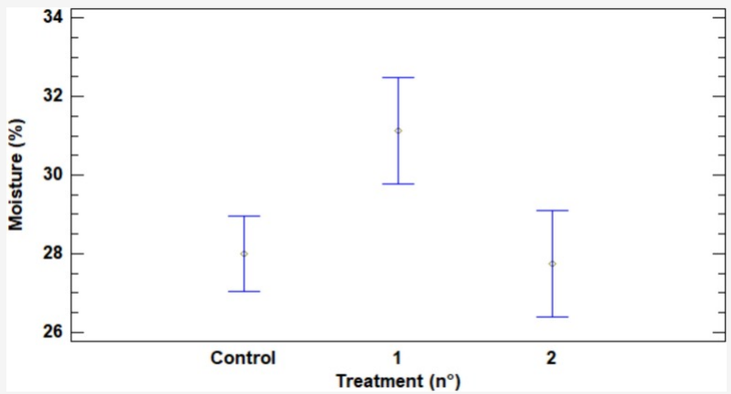
MANAGEMENT

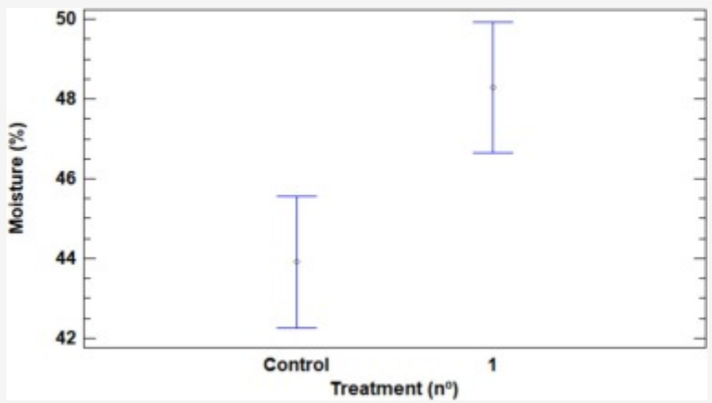
Soil ammendments



MANAGEMENT

Retain soil moisture





Soil ammendments

Two irrigation regimes

2 C3 grasses (*Poa pratensis and Festuca arundinacea*)

2 C4 grasses (*Cynodon dactylon, Buchloe dactyloides*)

1 Irrigation regime

Agrostis stolonifera (green Golf Course)

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Gardening purposes

MONITORING

Ground based commercial equipment

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GreenSeeker Sensor

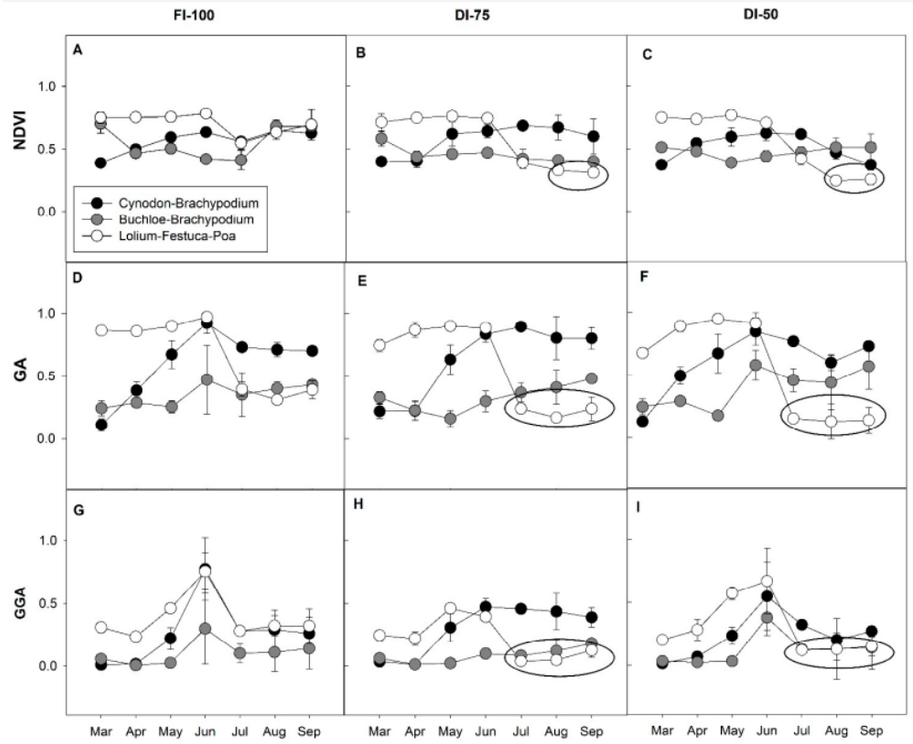
Infrared Thermometer Sensor

TDR 350 Soil Moisture Sensor

MONITORING

Ground based commercial equipment

Gardening purposes



MONITORING

Ground based commercial equipment

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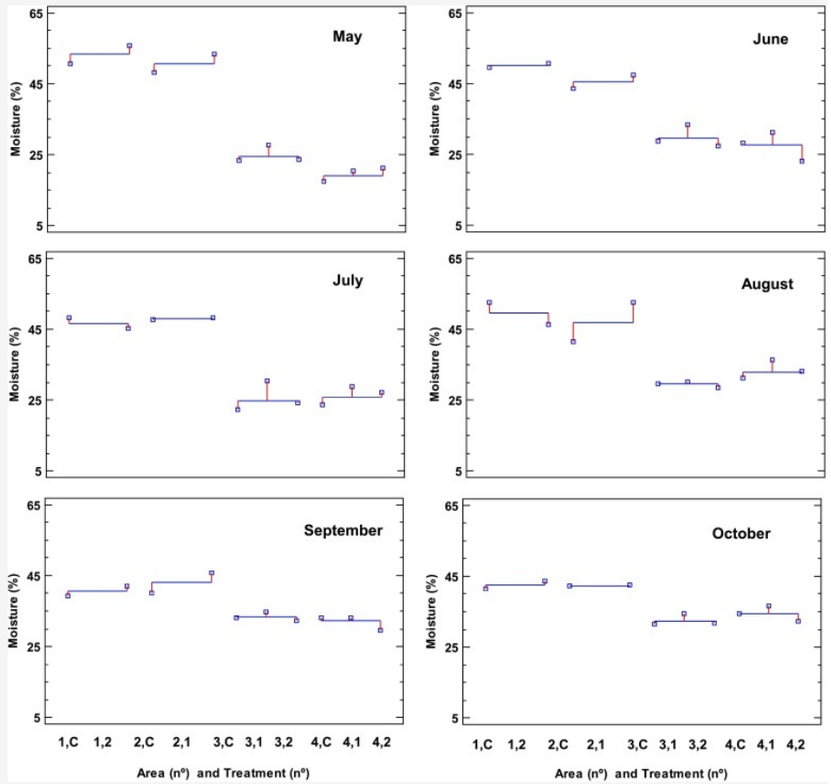
Gardening purposes



Golf Course

MONITORING

Ground based commercial equipment

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MONITORING

Ground based commercial equipment

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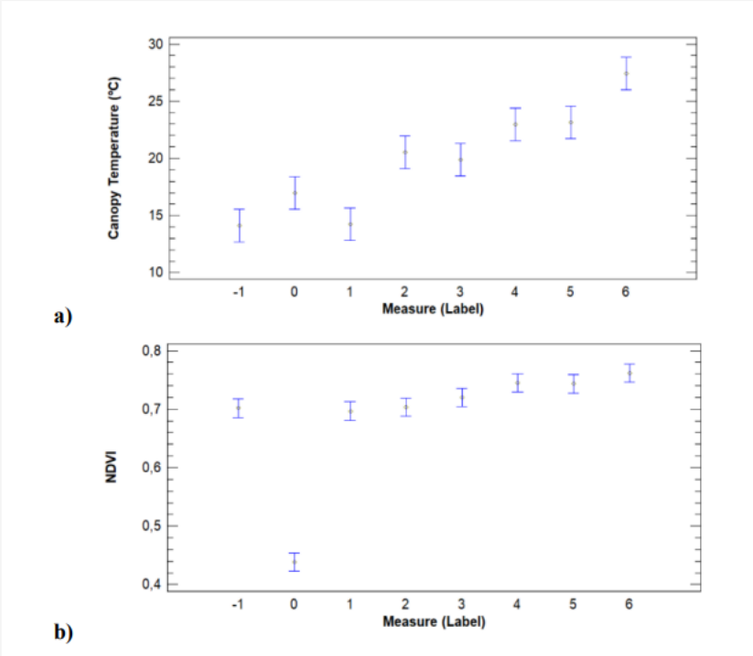
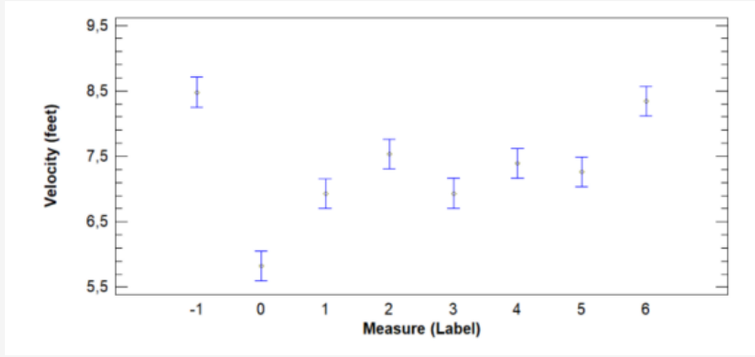
Golf Purposes

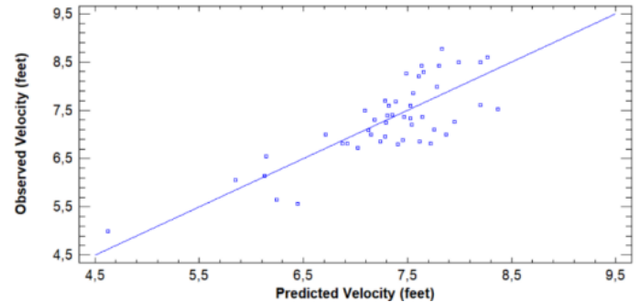


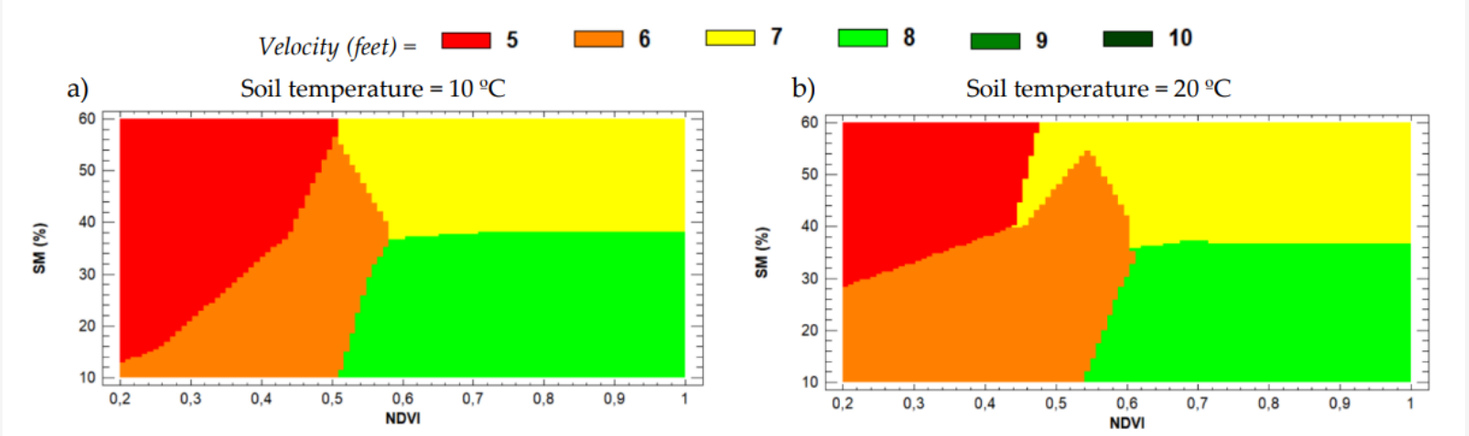


MONITORING

Ground based commercial equipment

Golf Purposes





MONITORING

Remote sensing techniques

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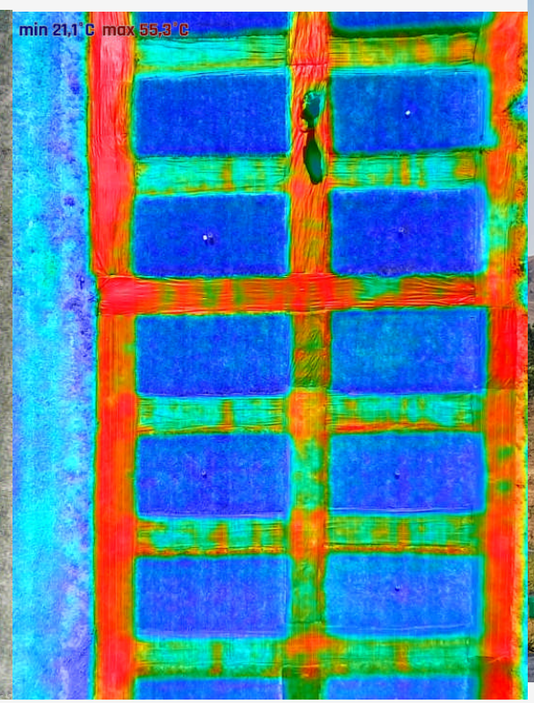
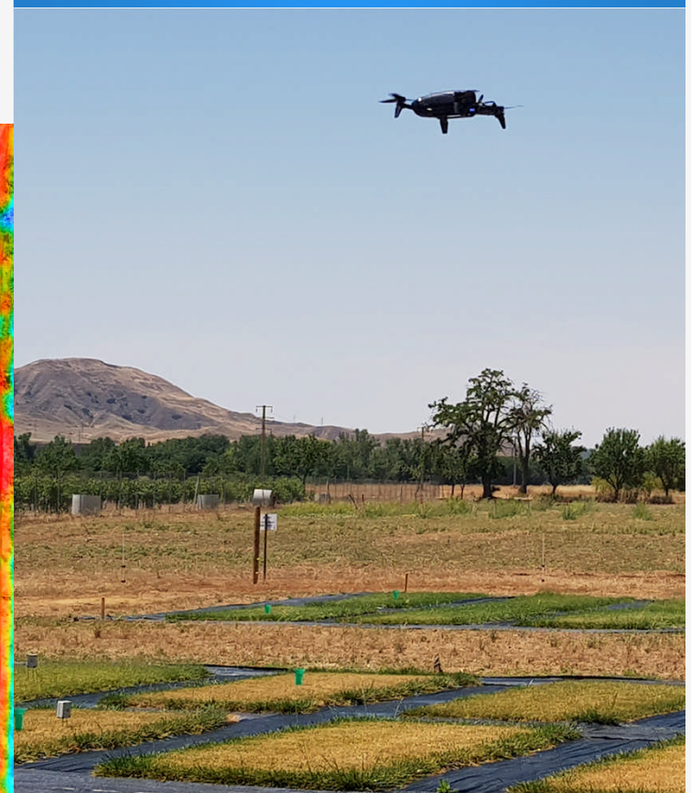
Parrot Bebop Thermal Pro



Drones for Gardening



MONITORING

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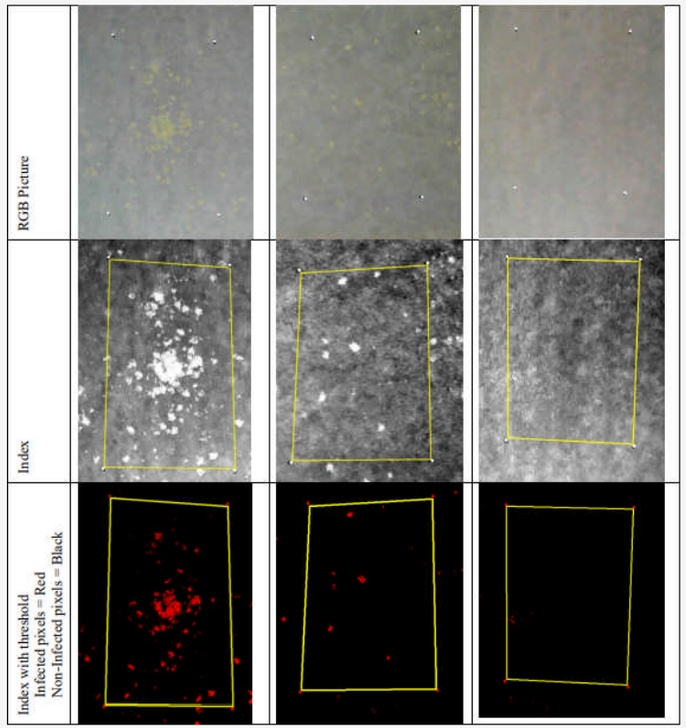
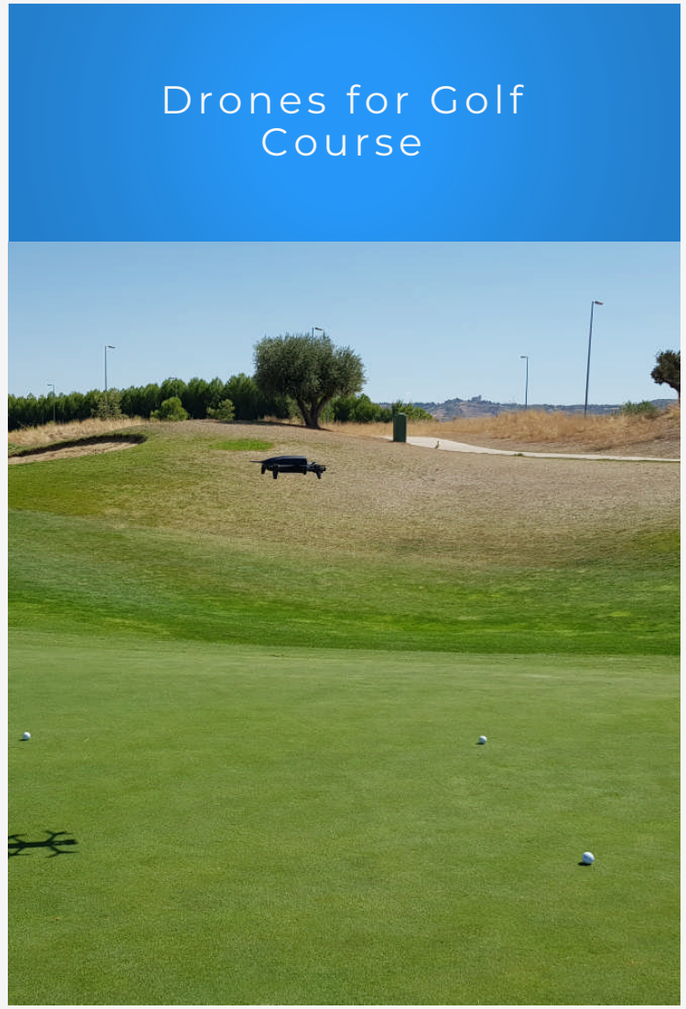
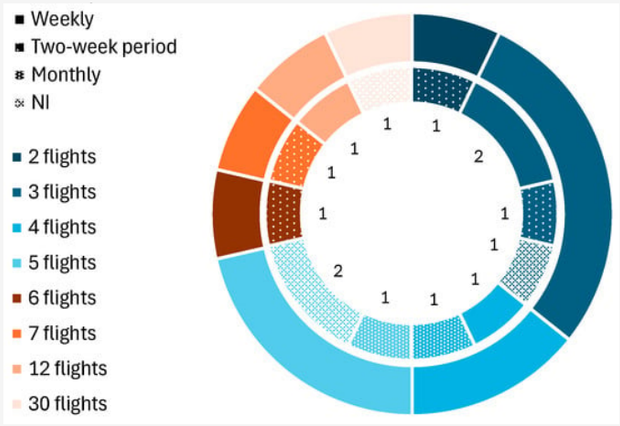


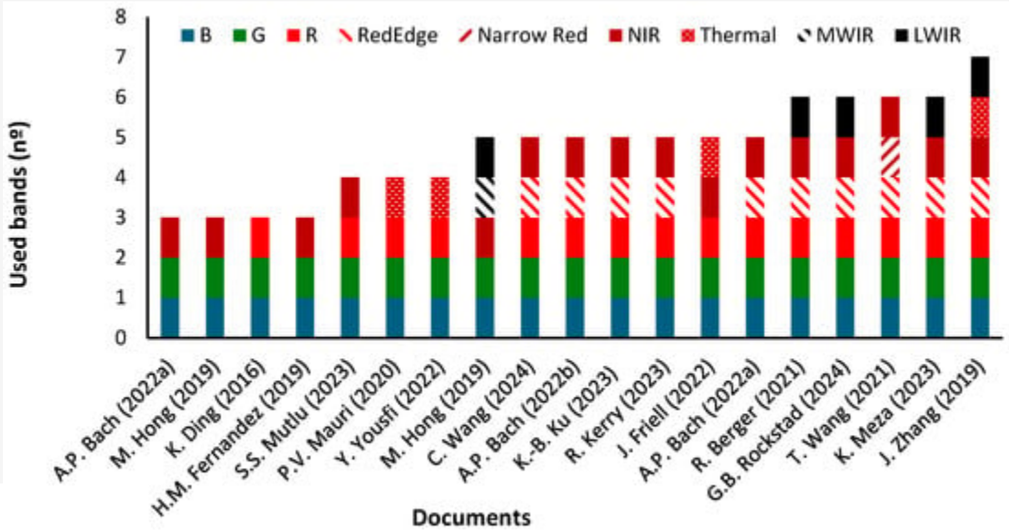


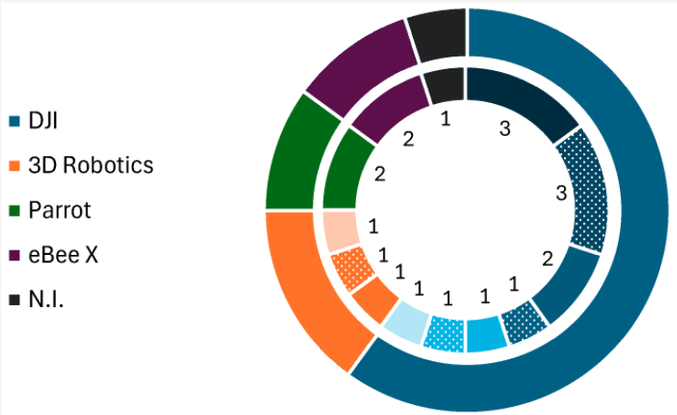
MONITORING

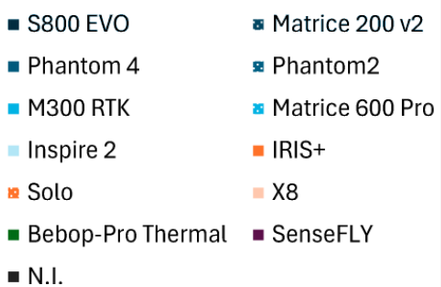
Remote sensing techniques

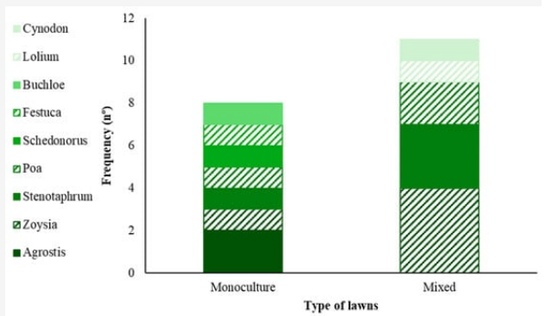
Drones for Irrigation Management











MONITORING

Remote sensing techniques

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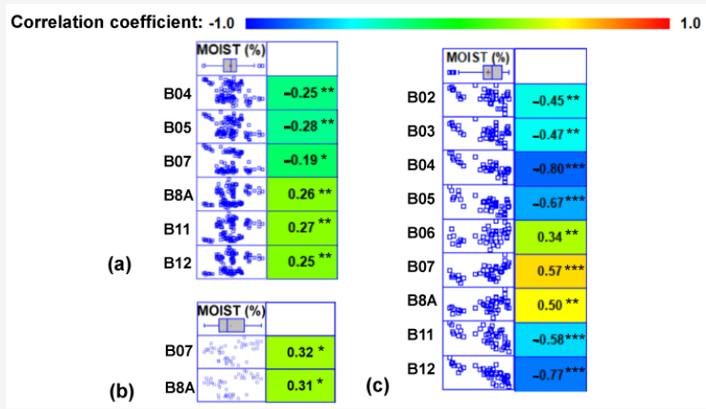
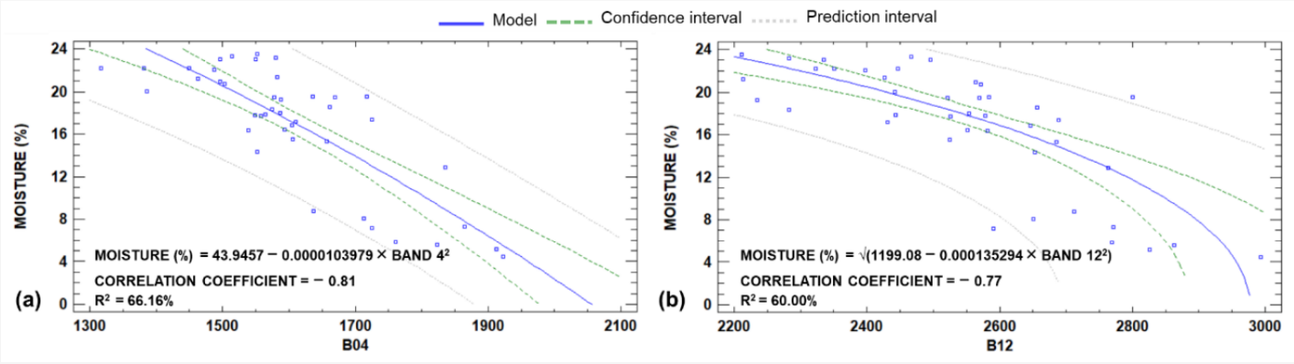
Multiple irrigation regimes

2 Soil Types (a) all soil types, (b) sandy soil, and (c) clay soil

Sentinel-2 Images

Remote Sensing for Irrigation Management





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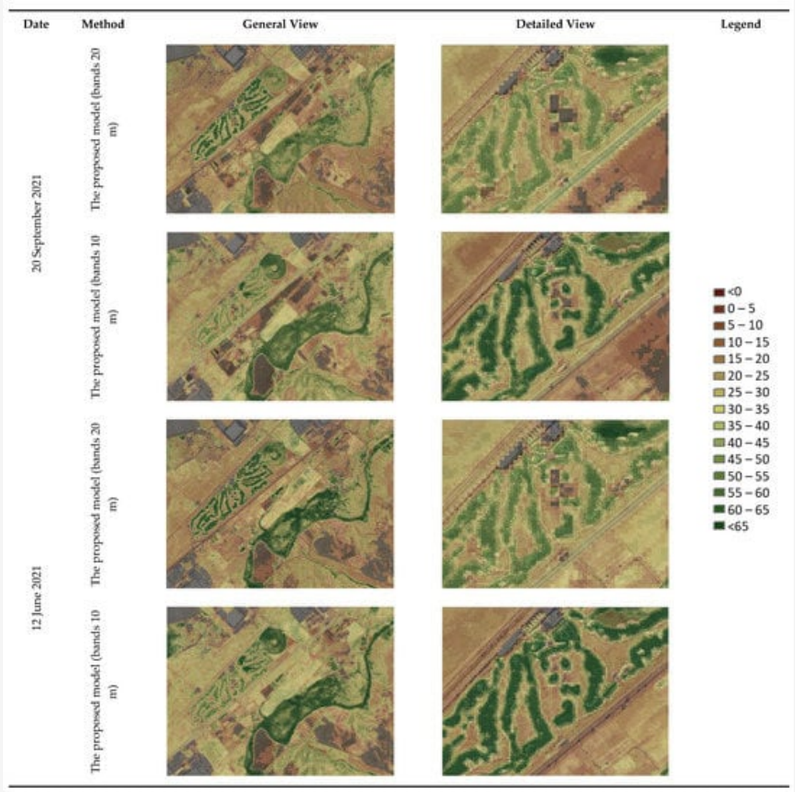
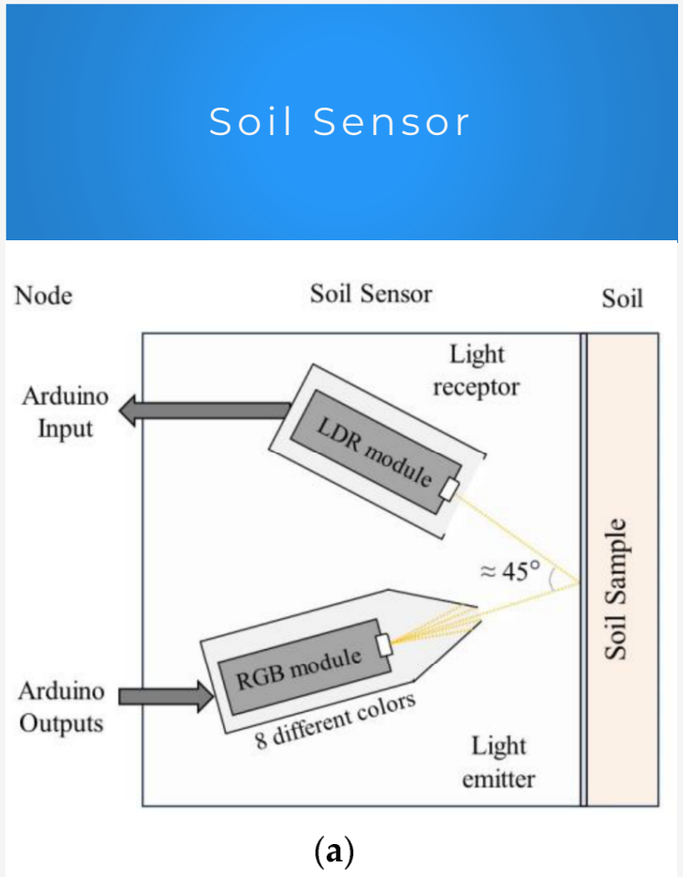
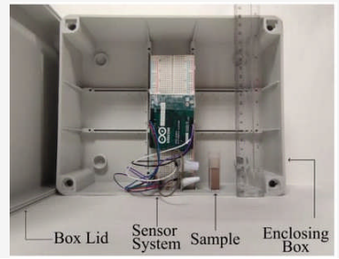


MONITORING

Developed sensors



(a)



A

Salt	Real \ Predicted	0	0.83	1.667	5
	0	100	0	0	0
	0.83	0	66.67	33.33	0
	1.667	0	0	100	0
	5	0	0	0	100

B

Salt	Real \ Predicted	0	0.83	1.667	5
	0	100	0	0	0
	0.83	0	100	0	0
	1.667	0	0	100	0
	5	0	0	0	100

C

Sand	Real \ Predicted	0	25	50	75	100
	0	100	0	0	0	0
	25	66.67	33.33	0	0	0
	50	0	0	100	0	0
	75	0	0	33.33	66.67	0
	100	0	0	0	0	100

D

Sand	Real \ Predicted	0	25	50	75	100
	0	100	0	0	0	0
	25	0	100	0	0	0
	50	0	0	100	0	0
	75	0	0	0	100	0
	100	0	0	0	0	100

E

Nitro phosphate	Real \ Predicted	0	0.833	1.667	5
	0	100	0	0	0
	0.833	0	66.67	0	33.33
	1.667	0	0	100	0
	5	0	33.33	0	66.67

F

Nitro phosphate	Real \ Predicted	0	0.833	1.667	5
	0	100	0	0	0
	0.833	0	100	0	0
	1.667	0	0	100	0
	5	0	0	0	100

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FUTURE

Reclaimed water and emergent pollutants

Reclaimed water as a solution

New water sources for irrigation of green areas.

Includes nutrients.

Cheaper than potable water.

But…

FUTURE

Reclaimed water and emergent pollutants

Problems linked to:

Salinization

Chloride

Nutrient balance

Emerging pollutants…

Microplastics

Medicins (Hormones, Antibiotics, Antifungics…)

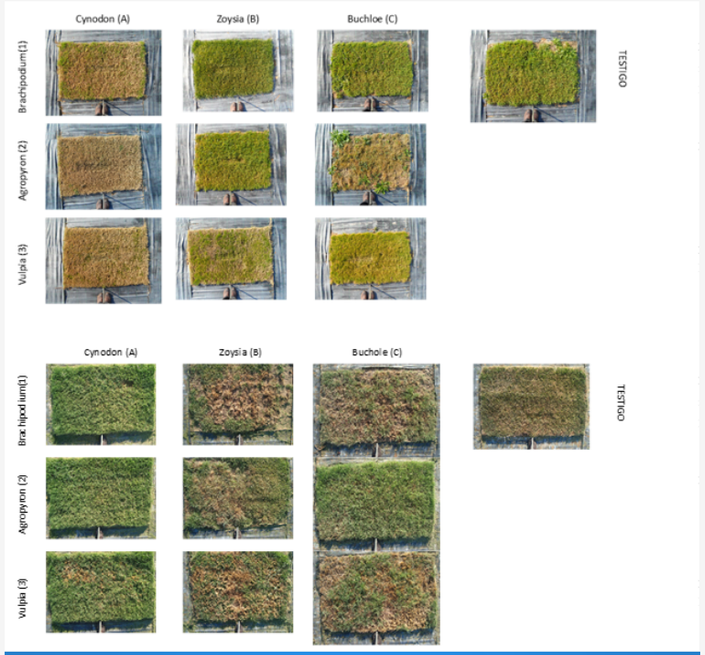
¿What about beneficial soil bacteria?.

FUTURE

Varieties

Development of new varieties is a constant

Role of epigenetics in turfgrass resistance



Tested under real future conditions

FUTURE

Varieties

Future is variable…

If the varieties are not selected under expected future CC scenarios and future water sources, we might be losing our time.

FUTURE

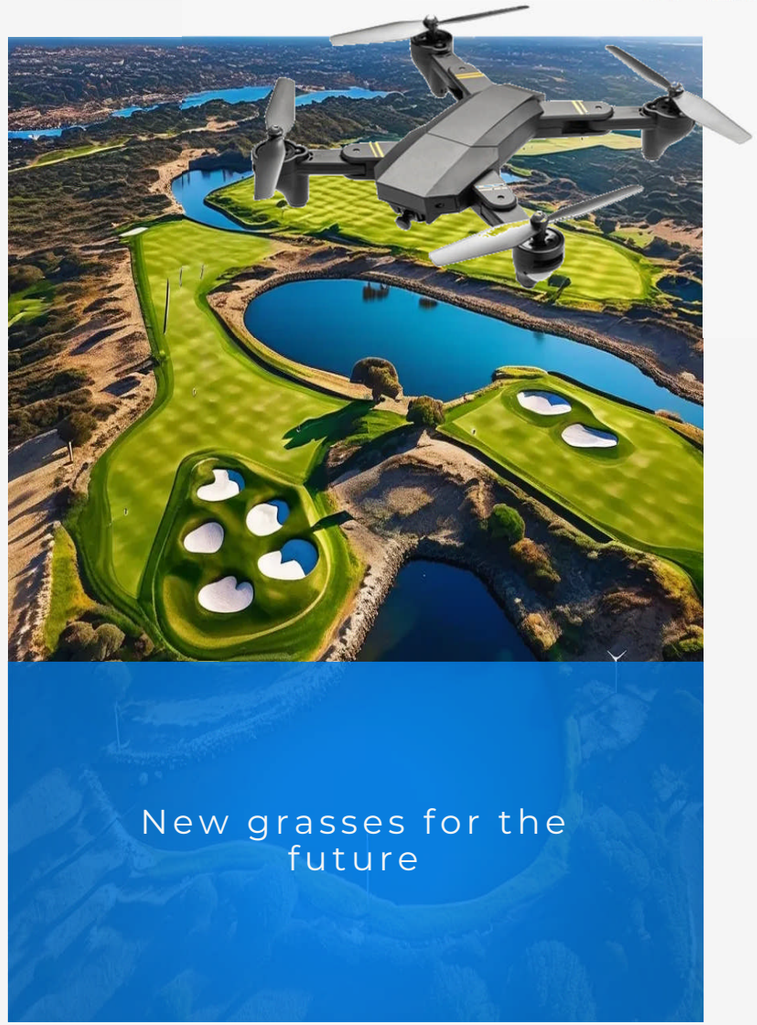
Enhanced monitoring and tailored products

Integration of drones, sensors and AI into the management

Adjusting irrigation

Adjusting nutrients doce

Adjusting phytosanitary treatments



Emergent pollutants

FUTURE

Enhanced monitoring and tailored products

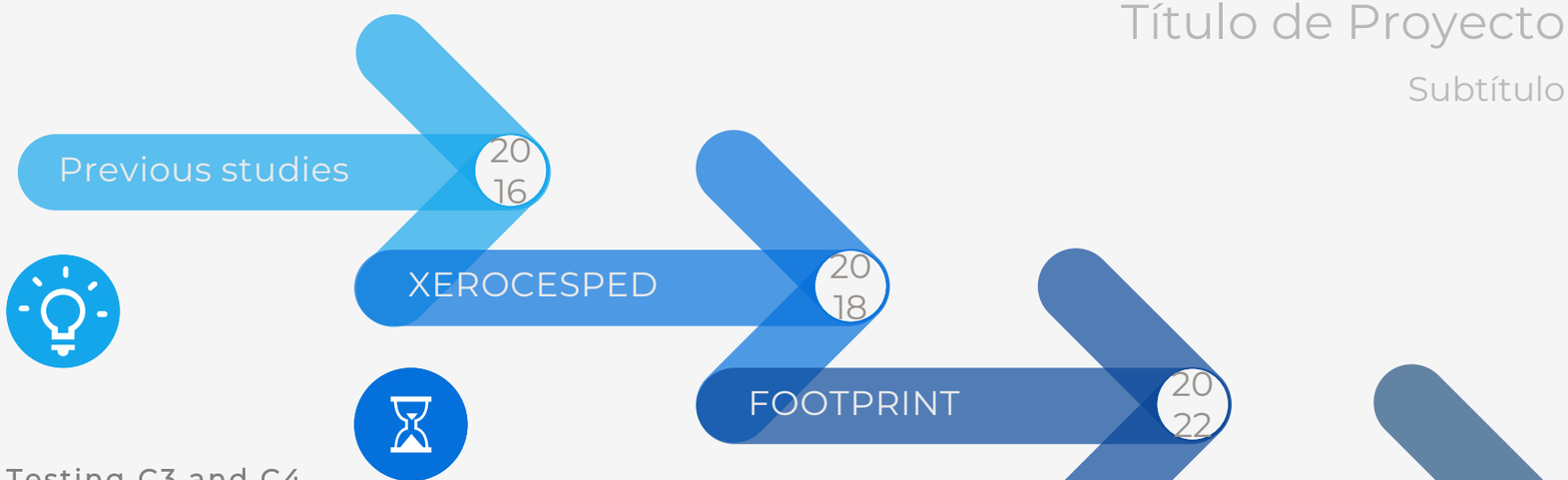
New tailored products

Tailored bacteria are given your soil status, irrigation regime, and grasses.

Equipment with integrated sensors for gardens and golf monitoring.

Título de Proyecto

Subtítulo



Testing C3 and C4 grasses

+

Automatization of monitoring technologies

No funding

Evaluation of C3 and C4 grasses under déficit irrigation

Regional funding

Assesment of carbon and water footprint of different styles of green areas

Regional funding

Effects of regenerated water on the turfgrass and graslands

Seeking Partnership

QUESTIONS

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