## Interreg Greece-Italy IR2MA



**European Regional Development Fund** 

**EUROPEAN UNION** 

Large Scale Irrigation Management Tools for Sustainable Water Management in Rural Areas and Protection of Receiving Aquatic Ecosystems

https://www.interregir2ma.eu/

## IR2MA Final Workshop 24/6/2021

WEB event | Organisation: University of Ioannina, Greece

## **Irrigation of Young Olive Trees with Treated Waste Water**

Fotia Konstantina





### Water reuse EU

- Needs
  - Water scarcity
  - Limited water resources
  - Limited good quality water resources
- Status water reuse for agricultural irrigation EU
  - 1.7 billion m³ /year
- Legal basis
  - 91/271/EEC European Wastewater Directive
  - 2000/60/EC Water Framework Directive
  - 2008/105/EC on Environmental Quality Standards
  - 2020/741/EC on Minimum Quality Requirements for Treated Waste Water Reuse (in force in 2023)





## Water reuse potential EU

#### **New EC Directive**

- could lead to a substantial increase of water reuse in agricultural irrigation up to 6.6 billion m<sup>3</sup> /year in EU countries
- less strict microbial standards in terms of E. coli
- no provisions for the maximum permissible concentrations of
  - selected heavy metals and metalloids
  - certain agronomic characteristics of the reclaimed water for agricultural irrigation





## Water reuse in Greece Need

- Typical Mediterranean climate
- Spatial not uniformity of rain
  - 300 to 500 mm in southeastern Greece 800 to 1200 mm in the northwestern parts
- Temporal not uniformity of rain
  - Wet winters dry summers (need for irrigation)
- Periodical droughts every almost 8 years
- expected to have an 18% precipitation decrease by midcentury, and 22% by the end of the century
- The EU Joint Research Center Report 2018
  - In Greece in 2050 > 20% pressure on water resources compared to 2010



Water reuse in Greece
Status
Agricultural use

**Arhanes** 

33 ha Grapes and olive trees

550 m3/d

#### Thessaloniki (Sindos) 165,000 m3/d 2500 ha Corn, sugar beet, rice, etc. Nea Kallikratia $800 \, \text{m} \, 3/d$ 150 ha Olive trees **Amfissa** $400 \, \text{m} \, 3/d$ Olive trees Levadia 3500 m3/d Kos Cotton, corn $3500 \, \text{m} \, 3/d$ 210 ha Olive trees, citrus Hersonissos **Iraklion** 9500 m3/d $4500 \, \text{m} \, 3/d$ 570 ha Grapes & Olive trees 270 ha Olive trees Malia 2500 m3/d 150 ha



Water reuse in Greece Status Agricultural use

## **Parks Forests**

#### Thessaloniki (Sindos) 165,000 m3/d 2500 ha Corn, sugar beet, rice, etc. Nea Kallikratia **Ierissos** 800 m3/d 1500 m3/day 150 ha Olive trees 25 ha **Konstantinos** 200 m3/day Chalkida Amfissa 4000 m3/day 10 ha $400 \, \text{m} \, 3/d$ 50 ha Olive trees Levadia Karistos 3500 m3/d 1450 m3/day Cotton, corn 30 ha Kentarchos 100 m3/ha 10 ha Hersonissos **Iraklion** 4500 m3/d 9500 m3/d 270 ha Olive trees 500 m3/day

8 ha

**Arhanes** 

550 m3/d 33 ha Grapes and olive trees 570 ha Grapes & Olive trees

#### Malia

Kos

10 ha

 $3500 \, \text{m} \, 3/d$ 

500 m3/day

210 ha Olive trees, citrus

2500 m3/d 150 ha



Water reuse in Greece
Status
Agricultural use

+

**Parks Forests** 

+

**Indirect Use** 

#### **Arhanes**

550 m3/d
33 ha Grapes and olive trees

#### Thessaloniki (Sindos)

165,000 m3/d 2500 ha Corn, sugar beet, rice, *etc*.

#### Nea Kallikratia

800 m3/d 150 ha Olive trees

15000m3/d

Amfissa

 $400 \, \text{m} \, 3/d$ 

Olive trees

#### Ierissos

1500 m3/day 25 ha

#### Larissa 25000m3/d

**Karditsa** 15000m3/d **Lamia** Ao

Konstantinos

200 m3/day Chalkida

10 ha 4000 m3/day 50 ha

Levadia

3500 m3/d

Cotton, corn

**Tripoli** 18000m m3/d

Hersonissos

270 ha Olive trees

500 m3/day

4500 m3/d

8 ha

#### Karistos

1450 m3/day 30 ha

Kentarchos

100 m3/ha 10 ha

#### **Iraklion**

9500 m3/d 570 ha Grapes & Olive trees

#### Kos

3500 m3/d 210 ha Olive trees, citrus 500 m3/day 10 ha

Malia

2500 m3/d 150 ha



### Water reuse in Greece Legal framework

• J.M.D.145116/2011 Determination of terms and procedures for the reuse of treated wastewater. Govern. Gazette B'354/8-3-2011

• J.M.D.191002/2013 Amendment of J.M.D. 145116/2011 "Determination of terms and procedures for the reuse of treated wastewater". Govern. Gazette B'2220/9-9-2013

• J.M.D. 127402/2016 on the reuse of olive mills waste Govern. Gazette B' 3924/7-12-2016



## Water reuse in Greece Potential

- restricted
- Athens's WWTP 35% of the country's population, located in the small island of Psitalia
- transport 20,000 m³/day of treated effluent from the island back to the city areas for landscape irrigation and industrial use
- estimated cost 0.40€/m³
- not cost effective





## Major draw backs

- Investments in infrastructure
- Strict quality standards according to local legal framework
- Not public acceptance (especially for edible plants)
- Farmers reluctance



New EC Directive is expected to raise the potential for water reuse



Trigation of Young Olive Trees with Treated

Waste Water

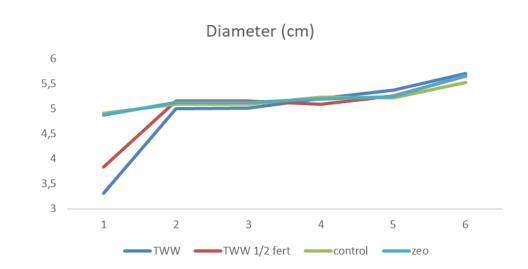
- 2 years experiment (2019-2020)
- Young olive trees (1 year)
- Nursery
- Treatments:
  - Treated Waste Water (TWW)
  - Treated Waste Water ½ fertilisation (TWW ½ fert)
  - Tap Water (control)
  - Zeolithos 5%
- Measurements
  - Height, stem diameter, # leaves
  - Dry weight leaves, stem, roots
  - Pigments (chlorophyll a, b, carotenoids)
  - Leaf area

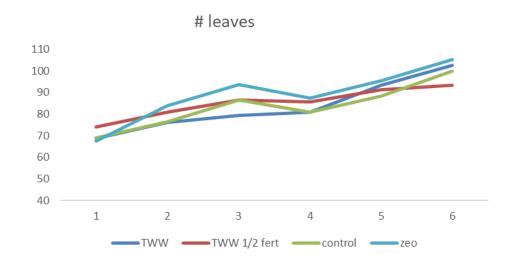




## Results height – stem diameter – # leaves



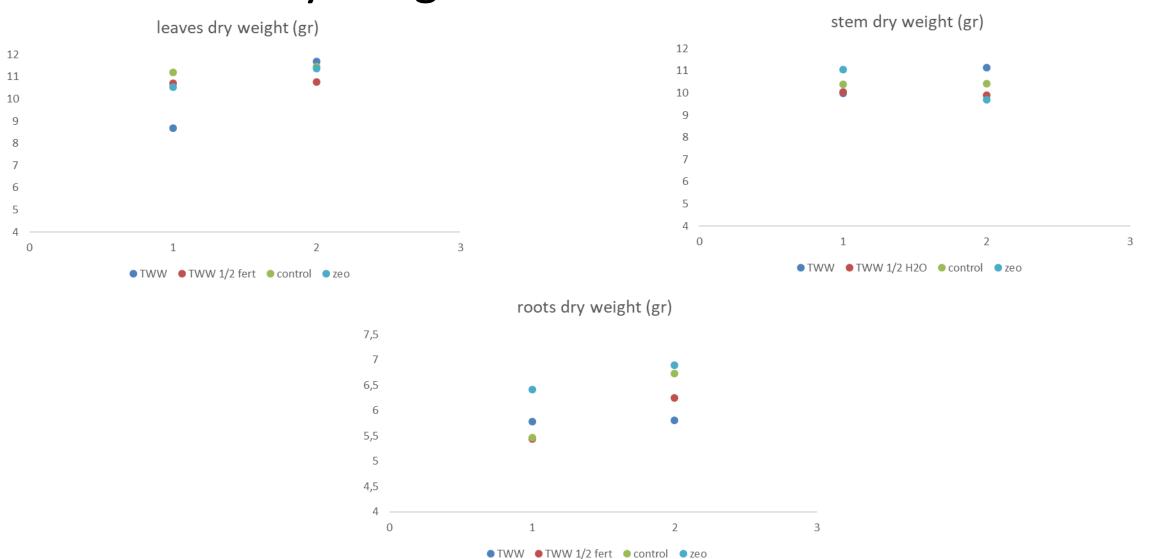






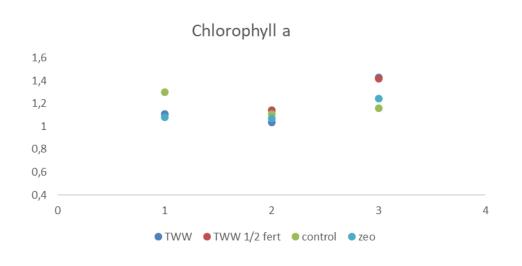
### Results

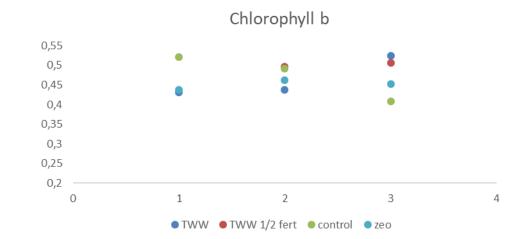
## Dry weight leaves – stem - roots

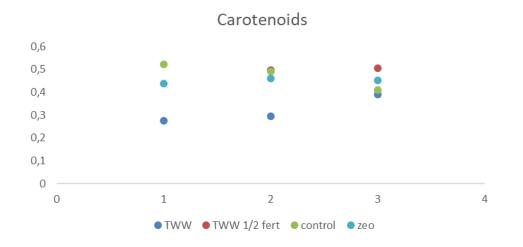




## Results Pigments

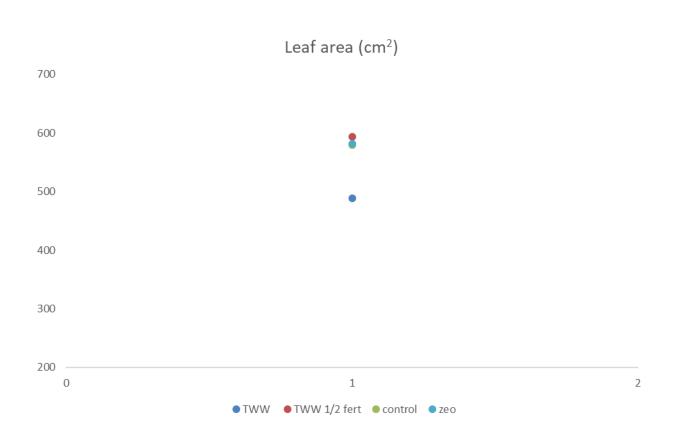








# Results leaf area





## Conclusion

- No significant difference in growth parameters between treatments
- TWW could be recommended as an alternative water source for young olive trees irrigation

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THANK YOU!

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