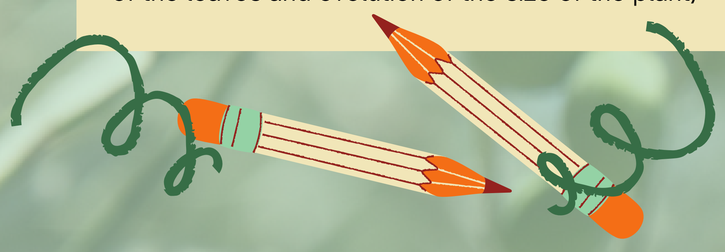
STUDY OF EXTREME CLIMATE CHANGES ON CULTIVARS

In recent years, extreme weather conditions suffered in our region (such as the droughts, floods, or extreme oscillations in temperature) have affected the most important crop in our region: the olive grove.
Due to the complexity of the cultivar, we studied as well the effects of extreme climate changes in a controlled environment with much simpler crops: green pepper and tomato.

Authors
Students: Mª Carmen Anguís Poza, Juan Diego Bautista Poyatos, María Beltrán Muñoz, Esther Benítez Pérez, Raúl Calvo Godoy, Manuel Domínguez Gómez, Amine Ech-Chaoui Farhat, Carmen Fernández Buendía, María Fernández Buendía, Julieta García Castañares, Irene Jiménez Judas, Marcos Jódar Fernández, Antonio López Palomares, José Molina Pérez, Francisco José Nebrera Ruíz-Funes, Lucía Perales Campos.
Teachers: Azucena Marset Castro, Juan Carlos Torres Montoro, María Dolores Peinado Anguís

OBJECTIVES

In cooperation with three different school departments (Biology and Geology, Physics and Chemistry and Technology) we built a greenhouse with smart irrigation by a humidity sensor.
In addition, through this study the students evaluated the impact of limiting factors such as water and soil acidity by observing and tracking the evolution of the state and growth of the plants (observing the coloration of the plant, desiccation of the leaves and evolution of the size of the plant)



METHODOLOGY

Simulated acid rain conditions: Sulphuric acid was added to tap water (pH 8.0) to prepare acidic solutions of pH 4.0 and 2.5.

Procedure to measure acidity in soil: 0.5g of soil sample dissolved in 20 mL distilled water (olive tree cultivar) 0.1 g of soil sample dissolved in 20 mL distilled water (tomato and pepper cultivars)
The diluted sample is measured with a pHmeter and pH test strips.

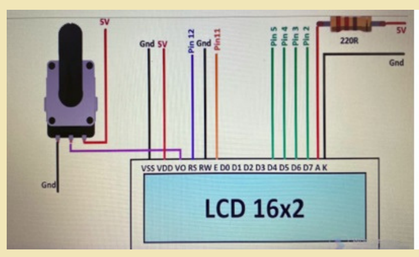
Dessication of the leaves, decoloration and leave count was done by observation

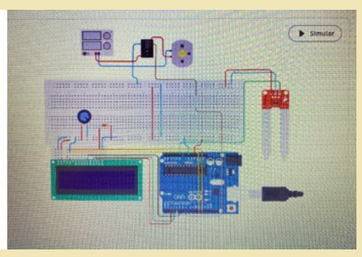
Irrigation conditions:
For tomatoes and green peppers: Low water (10 mL), High Water (50 mL); Low water & low acidity (10 mL, pH= 4.0), high water & high acidity (50 mL, pH=2.5)

For olive trees: Low water (100 mL,) High water (500 mL), high acidity conditions (250 mL, pH=2.5), low acidity conditions (250 mL, pH=4.0)

SMART IRRIGATION SYSTEM

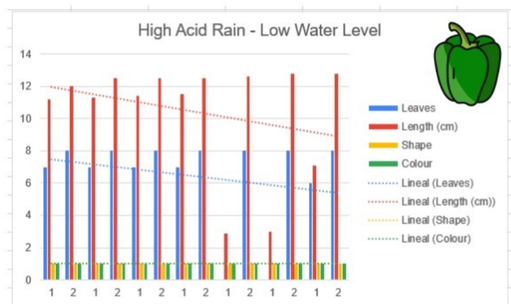
To investigate how the weather and irrigation conditions affect cultivars, we proposed the construction and automation of a greenhouse.
The prototypes built simulated intelligent irrigation in a greenhouse. This process was carried out through pipes through which the water circulates and the flow of the water is controlled by a pump controlled by an Arduino program. The humidity sensor is integrated into the soil of the planter. If it detects less than 50% humidity, the water pump is activated and irrigation begins. When the humidity exceeds 80%, the pump stops and stops watering. The percentage of humidity appears reflected in the LCD screen.

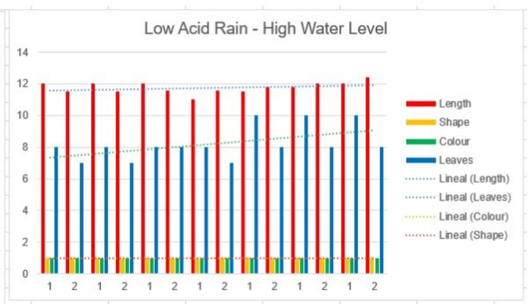


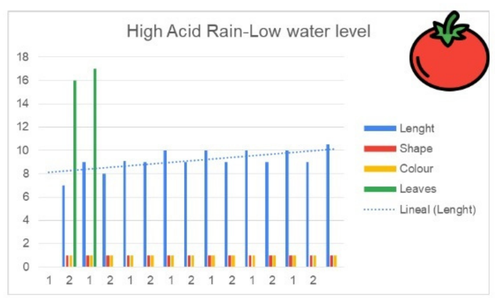


SMART IRRIGATION COMPONENTS USED:
-16x2 LCD -10 kΩ potentiometer
-1 kΩ resistor
-Arduino UNO board
-Humidity sensor
-Relay
-Water Pump
-9V battery to operate the pump

RESULTS







Sample collection	Cultivar	Irrigation	Added acidity	pH in soil	Sample collection	pH in soil	Sample collection	pH in soil
31/03/2023	Olive	Control 1 250 mL	None	9,6	14/04/2023	9,3	21/04/2023	9,4
31/03/2023	Olive	Control 2 250 mL	None	9,8	14/04/2023	9,0	21/04/2023	9,5
31/03/2023	Olive	100 mL	None	9,9	14/04/2023	9,5	21/04/2023	10,4
31/03/2023	Olive	500 mL	None	9,7	14/04/2023	9,1	21/04/2023	10,0
31/03/2023	Olive	250 mL	Low 4.0	9,3	14/04/2023	9,8	21/04/2023	9,7
31/03/2023	Olive	250 mL	High 2.5	9,6	14/04/2023	9,8	21/04/2023	10,2
31/03/2023	Tomato	50 mL	High 2.5	8,2	14/04/2023	6,7	21/04/2023	5,8
31/03/2023	Tomato	50 mL	None	7,7	14/04/2023	7,5	21/04/2023	7,8
31/03/2023	Tomato	50 mL	Low 4.0	7,1	14/04/2023	7,9	21/04/2023	8,1
31/03/2023	Tomato	50 mL	None	7,7	14/04/2023	7,7	21/04/2023	8,3
31/03/2023	Tomato	10 mL	None	7,3	14/04/2023	7,7	21/04/2023	8,2
31/03/2023	Tomato	10 mL	Low 4.0	7,0	14/04/2023	7,6	21/04/2023	8,0
31/03/2023	Tomato	10 mL	None	7,5	14/04/2023	7,5	21/04/2023	8,3
31/03/2023	Tomato	10 mL	High 2.5	7,2	14/04/2023	7,4	21/04/2023	7,6
31/03/2023	Pepper	50 mL	High 2.5	7,1	14/04/2023	6,4	21/04/2023	6,2
31/03/2023	Pepper	50 mL	None	7,4	14/04/2023	7,6	21/04/2023	8,2
31/03/2023	Pepper	50 mL	Low 4.0	7,3	14/04/2023	7,4	21/04/2023	8,4
31/03/2023	Pepper	50 mL	None	7,3	14/04/2023	7,6	21/04/2023	8,1
31/03/2023	Pepper	10 mL	None	7,1	14/04/2023	7,1	21/04/2023	8,4
31/03/2023	Pepper	10 mL	Low 4.0	6,7	14/04/2023	7,4	21/04/2023	7,8
31/03/2023	Pepper	10 mL	None	7,4	14/04/2023	7,6	21/04/2023	9,1
31/03/2023	Pepper	10 mL	High 2.5	7,3	14/04/2023	7,2	21/04/2023	7,5

ANALYSIS

Variation in water level: There was a major capacity to drought resistance in olive trees because the growth of this plant has been greater than the others irrespective of the treatment applied. Pepper plants were the worst for drought conditions due to the death of all plants when they have come across with low water levels. In tomato plants, there was no significant difference between low and high water levels despite the fact that not all individuals managed to survive. There were no registered changes in color or leaves shape in any plant species and type of treatment either.
Variation in acid rain: Apart from fatal results in pepper plants due to variation in water level, we observed a good resistance and growth of this species in both acid rain conditions. In the case of tomato and olive plants there was a slight decrease in growth and number of leaves as a consequence of high acid rain. Nevertheless, it will be necessary to study more to determine a safer conclusion.
Impact of the acid rain on the soil: We registered just two clear cases of acidification of the soil in two of the plants irrigated with high acidity water, and, surprisingly, an important number of the plants increased the pH of the soil, meaning this a slight basification of the medium.

CONCLUSION

We can sum up that olive and tomato species could resist in a better way than pepper plant the effects of global warming. There is a sense of these results because tomato and olive trees above all are both species that have lived and developed along the mediterranean geography, where climate conditions are tough. We have also proved that the impact of the acid rain on cultivar's soil manifests in the long term.

LITERATURE

Related literature
Proc. 2nd Balkan Symp. on Veg. & Potatoes; Eds. G. Paroussi et al.Acta Hort. 579, ISHS 2002

Background image
Imagen de kotkoa en Freepik