ENGAGE
The Power of Nutrition

Integrate®

Trial Report and Business Case

Zucchini

Crop | **Zucchini**

Region of trial | **Viator, Almeria, Spain**

Co-operators | **Agroliner and TECNOVA Foundation**

Trial Duration | **10 weeks**

In the summer Engage Crop Solutions and Agroliner commissioned Technova to evaluate of the effects of Integrate water saving technology for the improvement of wetting of agricultural soils under water deficit conditions. The trial was made during a zucchini crop developed under greenhouse production in south-east of Spain where summer temperatures are the most extreme in Europe.

LOCATION

The trial was conducted in the Experimental Centre of the National Technological Centre of the Auxiliary Industry of Agriculture, TECNOVA Foundation, located in Majada Ortigas, Viator, in the province of Almería.

TRIAL FACILITY

The trial was undertaken in a multispan greenhouse of 420m^2 of total area, made of steel tubes and wire, with lateral and zenithal enclosures of flexible plastic cover, to a height of 6.5m, 4.5m in the gutter. This greenhouse was ventilated using a passive, automatically controlled ventilation system of lateral and zenith windows.

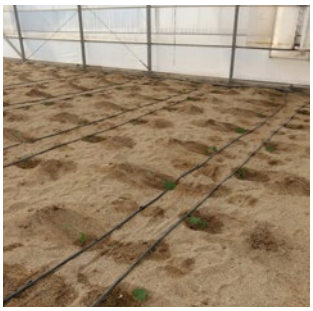
The soil of the greenhouse is commercial standard for the area of Almeria using imported soil with three different layers: a heavy imported soil of 30cm depth placed over the original soil of the Experimental Centre, covered with a layer of manure of 3cm depth and an upper sand layer of 10 cm depth used as mulch.

Drip irrigation was used to apply fertigation during the trial, using paired rows of dripper lines located at a distance of 1.2 m apart and 50cm spacing within in the rows. The irrigation system was self-compensating to provide a flow of 3 litres hour per dripper and the fertigation system controlled automatically with a programmed irrigation unit using a four tank system of concentrated nutrient solutions.

Figure 1. *Trial site at the National Technological Centre of the Auxiliary Industry of Agriculture, TECNOVA Foundation*

CROP MANAGEMENT

The field trial was developed for a cycle of autumn-winter zucchini crop (three months long) however for the purposes of the trial, the crop would be run through the summer months. The Zucchini crop, variety 'Cronos', was transplanted 9 May, in the greenhouse, 35 days after germination in the nursery and with three full leaves developed. The plant density used for the trial was 1 plant m^2 and during the trial, the zucchini crop was vertically supported using black polypropylene cords up to the wire structure of the greenhouse. The duration of the crop cycle totalled 86 days with the plants finally removed 3 August.



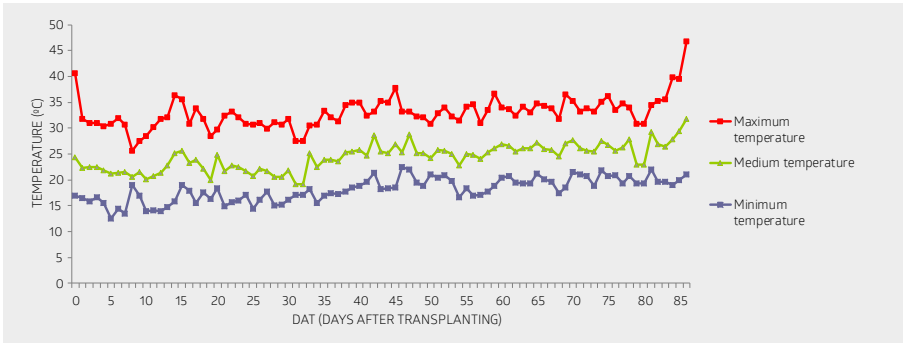
The nutrient solution was supplied using commercial standard fertilisers. The composition of the nutrient solution applied during the zucchini crop is indicated in ***Table (right).***

Parameters	NO_3-	H_2PO_4-	SO_4-	K+	Ca^{+2}	Mg^{+2}	CE
(mmol l-1)	10.1	1.8	1.8	6.6	3.3	1.6	2.4

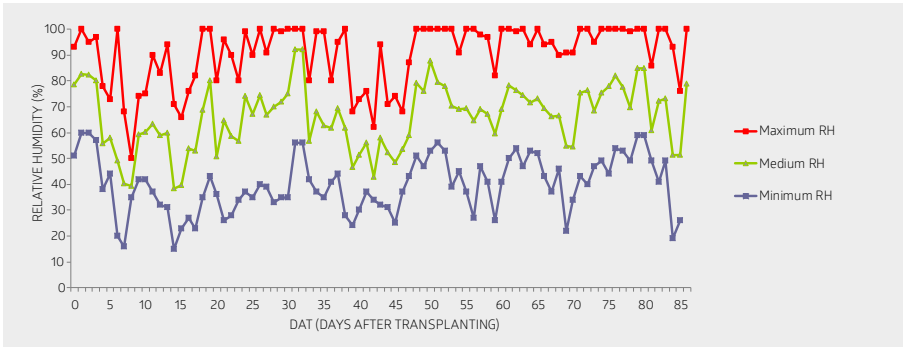
ZUCCHINI CROP DEVELOPMENT

Due to the time of year it was important to measure two climatic parameters during the field trial: temperature and relative humidity of the air. Measurements were taken using two psychrometers, with one dry temperature sensor and one wet temperature sensor. Climatic data was recorded every second, estimating an average data point every five minutes.
The median air temperature during the trial ranged between 19.1 and 31.8ºC, with an average value of 24.4ºC. The median air relative humidity ranged between 38.5 and 92.3%, with an average value of 66.1%. (Readings taken are shown in ***Charts 1 and 2, right***)

EVOLUTION OF AIR TEMPERATURE INSIDE THE GREENHOUSE - Chart 1



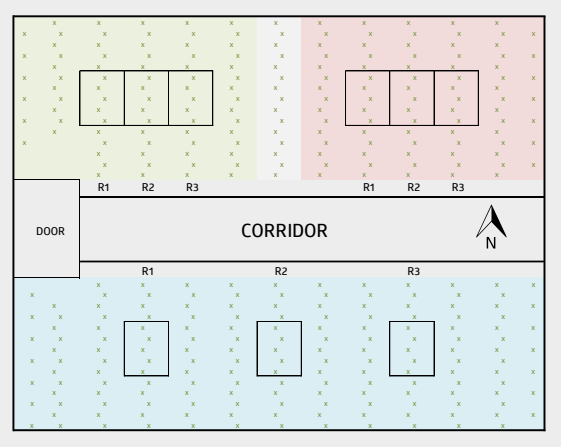
EVOLUTION OF AIR RELATIVE HUMIDITY INSIDE THE GREENHOUSE - Chart 2



EXPERIMENTAL DESIGN

Three experimental treatments were evaluated during the trial. Irrigation levels were set using the PrHo irrigation estimation programme. (© 2008 Cajamar Foundation)

The treated plots were designed with multiple replicates of rows to allow for data generation and within each plot 3 harvesting areas were assigned for measurement of crop quality and yield. The number of plants per plot is as ***Table (right)***.



Plot	Parameter	Integrate application rate
Treatment T0 - Control	100% of the water and nutritional needs of the crop provided (204.4L/m^2)	None applied
Treatment T1	70% of the water and nutritional needs of the crop provided (146.4L/m^2)	4 x 2.0L/Ha from planting applied every 25 days
Treatment T2	50% of the water and nutritional needs of the crop provided (107.8L/m^2)	4 x 2.0L/Ha from planting applied every 25 days

Plot	Plant number
Treatment T0 - Control	166 plants
Treatment T1	77 plants
Treatment T2	82 plants

ACTUAL WATER APPLICATION AND INTEGRATE APPLICATION

Due to the automation process the actual water/nutrient solution contribution applied to the zucchini differed slightly from the estimation during the trial. Plots T1 and T2 were reduced in application to 72% and 53% reduction respectively. This was also the case for T0 which received slightly less than 100% of estimated volume. The reduction of the volume irrigation in treatments T1 and T2 began on 24 May (16 days after transplanting), so all the experimental treatments received the same volume of water during the first 15 days after transplanting. The first application of Integrate was made on the 11 May, 2nd application 5 June, 3rd application 28 June, and the 4th application 24 July.

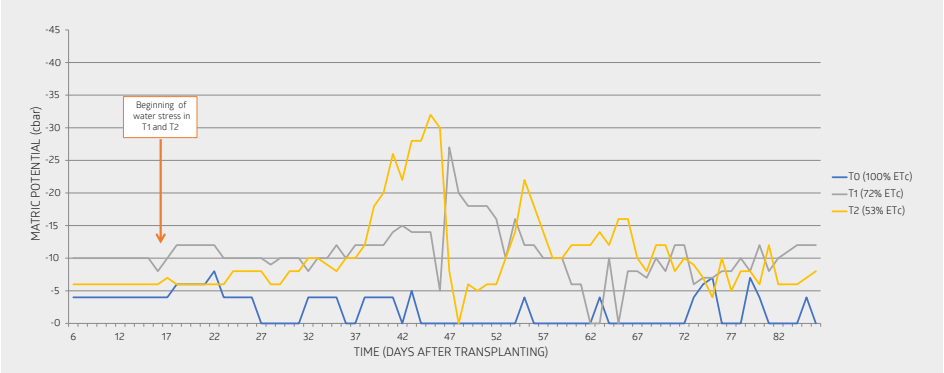
RESULTS

Evaluation of Soil Moisture

The soil moisture potential was measured by the use of manual tensiometers, installed at three different depths in the soil (10, 20 and 35 cm from the surface of the sanded soil).

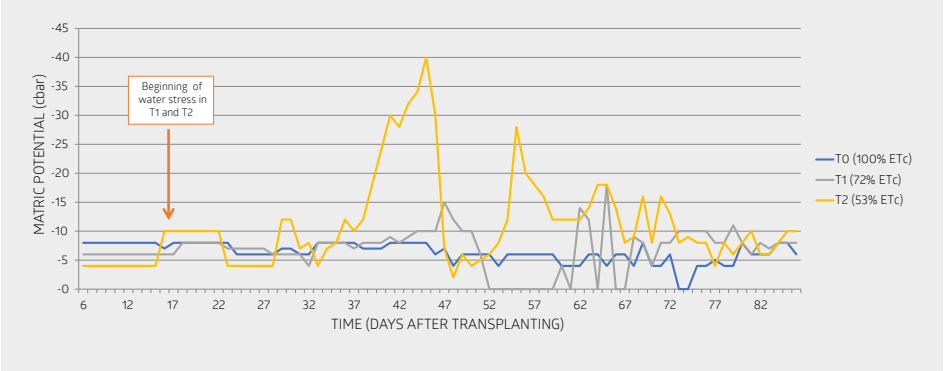
The readings of the tensiometers were made daily, first thing in the morning and before applying an episode of irrigation to the crop. The following data was collected from each of the tensiometers.

EVOLUTION OF THE SOIL MATRIC POTENTIAL AT 10 cm DEPTH - Chart 3



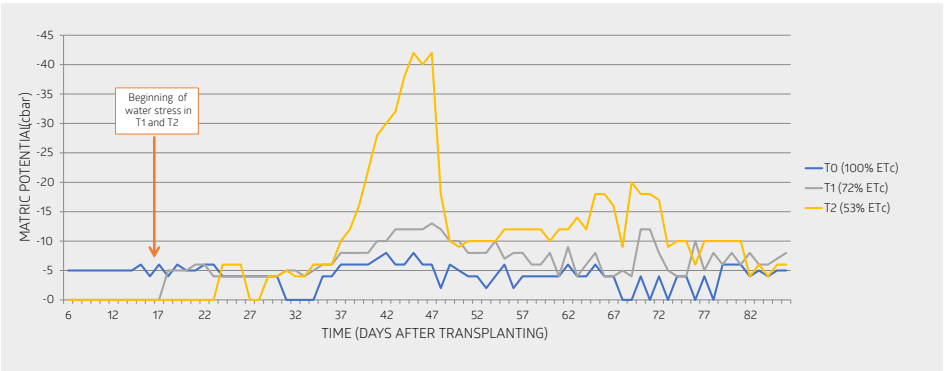
T0 (100%)

EVOLUTION OF THE SOIL MATRIC POTENTIAL AT 20 cm DEPTH - Chart 4



T1 (72%)

EVOLUTION OF THE SOIL MATRIC POTENTIAL AT 35 cm DEPTH - Chart 5



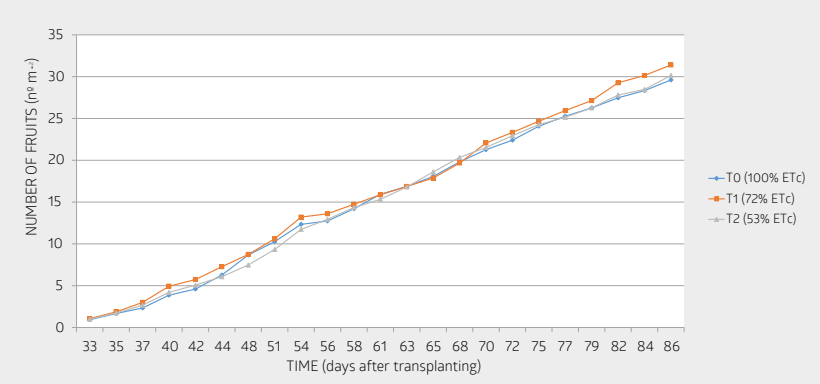
T2 (53%)

YIELD

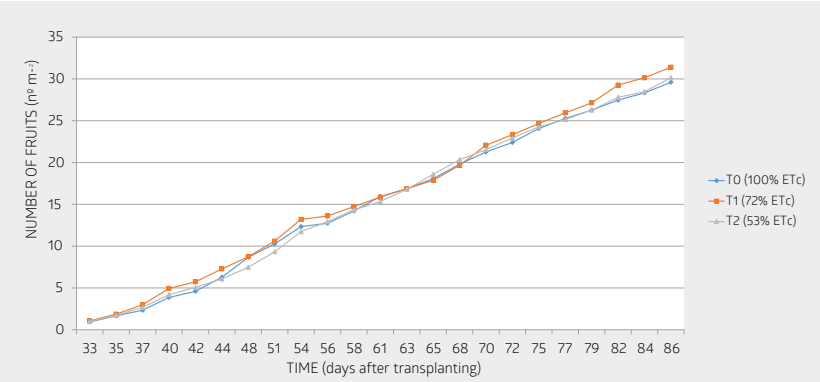
Yield data was obtained plots by the collection of fruit (23 harvests) from five plants within each of the three treatments across the growing period and were characterised by measuring the fresh weight and the number of fruits harvested. In each plot fruit was graded for quality distinguishing between marketable fruits and non-marketable fruits. The harvests were replicated three times across each plot to generate as much data as possible.

The charts below show the results of both the accumulated yield expressed as average values of fresh weight of harvested fruits in each fruit harvest and in each evaluated experimental treatment. There are two charts for both total yield and marketable yeild of commercial and total fruit yield (commercial fruits + non-commercial fruits) harvested during the trial.

EVOLUTION OF THE NUMBER OF TOTAL FRUITS - Chart 6



EVOLUTION OF THE NUMBER OF COMMERCIAL FRUITS - Chart 7



The charts clearly show that treatment 1 (-30%) produced both the most yield across the growing period with treatment 2 (-50%) producing more yield than the control at 100%. Statistically there was only a slight difference in increased yield.

The chart left show the both the total number of fruits and the number of class 1 marketable fruit.

CONCLUSIONS

Although the charts show that both fruit weight and number have increased under the use of Integrate they were not considered to be statistically differences in the accumulated fresh weights in the different graded parameters compared the toe commercial control nor was it significantly different between the two Integrate plots of T1-28% saving irrigation and T2-**47% saving in irrigation**.

This official independent trial has proved that monthly application of Integrate water saving technology allows the realisation of a sustainable reduced management of water and nutrients, without producing losses of quality and production in the zucchini crop.

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