OPTIMAL UTILIZATION OF WATER RESOURCES

1. INSTITUTIONAL VIDEO OF PRIMAFLOR

Run the video first up to 2 minutes 45 seconds

2. PRIMAFLOR

Ladies and Gentleman good afternoon, I would like to thank the conference organisers for the opportunity to participate and to describe our experience and how we have used technology to optimize the use of water. To put the challenge in context, we are growing in the driest area in all of Europe, a real desert, in which the water is the limiting factor.

I have been with Primaflor for 22 years and as the video has shown we grow lettuce and other leafy vegetables, almost 60 different crops, all year round, to supply the most demanding customers in Europe. The UK is our main export market and our reference point for a continual improvement and innovation.

3. THE COMPANY'S MISSION

The aim of Primaflor is to optimize the use of human and material resources. We are in business to make profit and the only way to be more competitive and survive in the present conditions, when the costs of energy, fertilizer, labour and other inputs are continuously increasing, is by being more efficient. Iceberg lettuce is a commodity and the price is very volatile, depending on the volume available every week, as such we have to produce better quality at lower cost.

To give you a sense of scale we cultivate more than 4,300 Has, we use 10 Hm3 of water and 6,700 tonnes of fertilizer. Adding the energy cost to this, which is directly associated with the water we use, we spend more than 6 M€ every year in providing crops with water and nutrition; as such, the optimization of the use of those inputs are essential for the sustainability of our growing activity.

4. MARKETS

We distribute our products in most European countries; it is a very complex market, with a wide range of demands to which we have to adapt.

We have to produce following the rules of the most demanding customers, therefore, customers committed to the supply chain, in which the production procedures are as important as the prices and the product, generates a steady relationship, which makes the complete business more sustainable.

We are a McDonald's Flagship Farm and assess our sustainability not only against our economic performance but also our environmental performance and our ethical practice. It is important that we fully understand that sustainability can only be achieved by succeeding in all three areas.
Awards such as Mc Donald's Flagship farms continuously encourage us to improve across all standards, a challenging aspiration and not always easy to

achieve, but important to our relationship with key customers that means we can operate in a market that is not just about price.

5. SOURCES OF WATER

To look at the water in more detail, we have several sources depending on the location of the farm and the availability throughout the growing season; therefore, the final water cost is a combination of the cost of all the water sources.

The Negratin-Almanzora Water Diversion Project is the main source of water, covering the irrigation needs of 18 irrigation communities, with losses of less than 0.5%, being the highest efficiency. The water is transported through a 120 Km pipe length of 1 to 1.3 m diameter and 10 reservoirs. This installation has a capacity to transport up to 65 Hm3 of water a year and cover an area of 24.000 Ha.
The two hydraulic power stations installed, produce up to 1.2 Kw/m3, which is 80% of the total energy consumed for pumping water from the Negratin reservoir (1.5 Kw/m3), which is an important environmental and economic factor.

The price paid by the irrigation communities is 0.22 €/m3, which is significantly lower than the average price paid, which is 0.40€/m3.

The irrigation communities in the region joined an irrigation organization in 1990 to develop the project and in 2004 the valve was open to supply water from the Negratin reservoir, located in the province of Granada. The cost of the project was 180 M €.

Reverse Osmosis or Desalination plants are the alternative source of water particularly when the quality of the available water is poor or is not another source available

We have two types of plants, which are used for Reverse Osmosis:

Public RO plants, projects of such dimensions, designed to produce 120.000 m3 of water per day and costing more than 350 Million €. We have a few examples, which were built many years ago, but they are only working at 12% of their capacity, due to the high production cost. The energy consumed to produce 1 m3 is around 3.3 kWh, however the plant uses sea water and the farms are generally located at higher altitudes, as such the final energy consumed is around 4 to 4.5 kwh, which at optimum conditions gives a final cost of 0,60€. per m3 of water. The Spanish government has established a price of 0.35€/m3 for this water, but we have to add the cost for pumping and distribution.

Private RO plants, much smaller in size, more practical and easier to manage. Production capacity runs between 500 to 15,000 m3/day, and generally the water is used to complement other water resources. The estimated production cost is of 0.40€/m3 (using salt water from a borehole).

Boreholes are the main source of water for our production area during the summer growing season, located near Sierra Nevada, where the subterranean aquifers have huge water reserves, with optimum quality. This water comes from the snow and has a much lower cost of 0.12€/m3.

The key point is that all water is expensive and consumes power. Quite simply it will get more expensive.

6. ICEBERG LETTUCE IRRIGATION SYSTEMS

When the first iceberg lettuce crops began in Spain, in the late 70's, the irrigation systems and the technology used was imported directly from the USA, from the Salinas and the Imperial Valley. Direct seeding, sprinklers for germination were used followed by furrow irrigation.

But during the 80's, transplant and drip irrigation systems were introduced, mainly in the Southeast of Spain, Murcia and Almeria, where most of the iceberg lettuce crops in Spain are located. There are other regions, located in the North of Spain, which irrigate with sprinklers, but they are not very significant.

Here you can see on the chart the evolution of the irrigation systems applied in iceberg lettuce production. A subsurface drip irrigation system is the most commonly used system today. But we can see quite significant differences between irrigation installations, drip lines used and strategies applied by the growers in Spain.

The drip line we use is a pressure compensated integrated dripper, with a low flow of (0.6 litre/h) and a high density of (0.2 m between drippers). The drip lines are installed 8 cm deep in the bed, between two plant rows and are retrieved after harvesting to prepare the soil for the following crop.

The higher efficiency achieved is a consequence of the high uniformity, no run off water losses, low drainage losses and lower evaporation.

7. ICEBERG LETTUCE IRRIGATION INSTALLATION

The design is focused on getting the maximum uniformity of water distribution, as well as the fastest operation time in order to give short time and high frequency irrigations.

We have organized the farms in irrigation units of between 30 and 40 Ha. These unit sizes allow us to optimize the installations and the irrigation control.
One fertigation equipment unit is used for controlling all the elements in each irrigation unit, all of which are connected to a network by WIFI for remote control. The fertigation equipment allows us the possibility to connect all kind of probes or devices for managing the irrigation.

Each irrigation unit is divided into 6 or 7 sections, each with a maximum flow of 350 m3/h, this helps us to standardise the installations, which in turn makes it easier to manage.

Each section is made up of several plots, each plot has 1 or more solenoid valves, which are controlled by radio from the head centre – the main control point.

8. ICEBERG LETTUCE IRRIGATION MANAGEMENT

The conventional way of irrigating is determined by the person responsible for the irrigation operations and is therefore subject to interpretation and human error. It is not easy to find qualified workers able of irrigating correctly, and who have a unified criteria. As such, to optimize our system we use an irrigation program and a reference to key measurements to adjust the irrigation strategy.

We have several weather stations installed in each growing area, we also receive forecasts every morning. The irrigation plan, which is an estimation of the water needed for the crop is forecasted for the following week and adjusted with real time information.

But the Iceberg lettuce, or the lettuce in general, has a very small root system, most of the roots are located in the first 30 cm of soil. Irrigation ‘little and often’ is required to optimize water uptake by the plants, as such, short time and high frequency irrigations are adequate to increase the efficiency and minimize losses due to drainage. A strategy based on adjusting irrigation doses to maintain the adequate soil moisture at the layer of 30 cm soil depth and avoiding deeper water flow, which is not used by the plant, is the way to optimize the irrigation efficiency.

Soil moisture probes, capacitance technology, with sensors at 10, 20, 30, 40 and 50 cm, connected to the fertigation machine, allows us to follow the soil moisture displayed as graphs, and adjust the irrigation to give the desired soil moisture level.

As you can see on the graph, this is the complete evolution of the soil moisture along the crop, but focusing our attention on a specific day, we can see how the soil moisture reaches lower levels, which in turn is detected by the probe sensors. The strategy which we have established is to fill up the first 30 cm and avoid deeper water flows, therefore, we can adjust the full point at the level we have estimated to cover the desired moisture levels.

By introducing that value in the computer the irrigation will stop when the full point is reached. Summarizing, we set the irrigation time and the system will then stop the irrigation when the desired soil moisture is reached, changing automatically the dose in relation to the water needed to refill the soil. This then gives us a graph in which all the irrigations reach the full point.

The systems I have described allow us to visualize and prevent leakage of water and nutrients, which is a considerable economic and environmental advantage; key to our business sustainability.

9. IMPACT OF WATER MANAGEMENT ON LETTUCE QUALITY

The irrigation management is not only affecting the economy and the environment, obviously it affects the yield and the quality of the lettuce. This has been demonstrated through our work developed during the last 3 years in collaboration with CEBAS-CESIC research centre.

We have done 6 trials, since April 2009, in which we have applied 5 different doses of water -50%, -25%, standard, +25%, +50%, in two crops, iceberg lettuce and romaine. After those 6 trials in different climate conditions, and having tested many different parameters, such as, head weight, visual quality, shell life, vitamin C, phenolic compounds, dry matter, etc., as you can see on the slide the most significant results have been summarized.

The maximum head weight was obtained when we reduced the standard dose of water by 25% and the visual quality of the fresh cut lettuce was not influenced.

10. CONCLUSIONS

The present market conditions require a high dose of innovation to maintain and develop the business. Essentially, we have to produce the conventional crops with better quality and at a lower cost. We also have to continue to develop new products and make improvements in all the different aspects of our activity, which generates an added value to the market.

Water, fertilizer and energy are resources closely linked. They are a significant part of the production cost and have a direct influence on the yield, quality and environment; therefore, **we have the responsibility to optimize the efficiency of their use.**

The system we have developed to optimize those factors, in which we have invested economical and human efforts during the last years, pushed by the circumstances present in the market and production, **makes our business** more **sustainable.**

Critical to this success is the support of our customers, who value our efforts and encourage us to continue developing and innovating newer, better and more efficient means of producing.

Thank you very much.