

# Mexico: LED Technology Increases Strawberry Production

Agroindustrial engineering researchers and graduates from the Autonomous University of Querétaro (UAQ), Amealco campus, have designed a system that, by means of a vertical structure and the use of specialized light-emitting diode (LED) lamps, allows increasing strawberry production (*Fragaria*) in greenhouses.

The project was developed by Jesus Morales Garcia and the coordinator of agroindustrial engineering at the Amealco campus of the UAQ, Luciano Avila Juarez, who assured that this system not only increased the production of the fruit, but also allowed producers to better use the space in greenhouses, and promoted the increase of phytochemicals or nutraceutical elements in the strawberries cultivated.

"This was Jesus's thesis project, which basically consisted of giving light supplements to strawberry plants and an elicitor called methyl jasmonate (MJ), with the goal of increasing productivity and phytochemicals in the strawberries to help prevent certain chronic degenerative diseases in people. Once he graduated, in 2015 we put him in the Fund for Special Rectory Projects (Foper) that awards resources to initiatives that solve problems both in the UAQ and in society in general," he said.

Agroindustrial engineer, Jesus Morales Garcia, said this project arose from his professional interest in linking agriculture with technological innovation.

"I've been working on topics related to solar energy and led lighting since I was a student, so I decided to investigate in scientific sources how supplementary LED lighting with specific spectra can be used for plants so that they can perform photosynthesis in bio factories. We have a company in which we design such lamps and distribute them in several states of the country," he said.

In that sense, Luciano Avila Juarez, said that another factor of innovation that was proposed for the project was the design of a five-level vertical structure, that allows better usage of the space for the cultivation of low sized plants, such as the strawberry.

"The goal was making the most of space, because that is usually a problem in agriculture, especially in strawberry cultivation where the yields per unit area are usually low. In addition we resumed previous studies regarding the ideal photoperiod for the production of strawberries, hence we added lamps that were special for plants," he said.

Avila Juarez said that in the five-level vertical structure the plants were placed in trays containing an organic substrate based on coconut powder (*Cocos nucifera*) and an organic peat that is supplied by an automated system of drip irrigation with controlled climate, which was designed by students of the Faculty of Engineering of the University.

"Once the greenhouse, which is about 666 square meters, was full we achieved a yield of 380 grams per square meter per week, which is equivalent to about 160 tons per hectare. Conventional strawberry production in Michoacan, Irapuato, or Guanajuato, stands at about 40 tons per hectare; 80 tons per hectare if they have macro tunnel with irrigation. We can achieve 160 tons per hectare in our system because we have five levels up, which multiplies production," he stressed.

### Free of pesticides

Another advantage offered by this system, according to Avila Juarez, is the safety of the strawberry crops of the campus Amealco UAQ, as they are irrigated with rainwater and do not require the application of pesticides.

"This is very important because for many people have said that strawberries have cysticerci and other parasites. The strawberry we produce is free of all that, in fact, the rainwater we use for irrigation is not only used for strawberry but for all crops. For this type of crop in particular, a surplus of water must be added to oxygenate the roots, we reuse it in other crops, such as lettuce (*Lactuca sativa*) or spinach (*Spinacia oleracea*); nothing goes to waste," he said.

He also said that following Jesus Morales Garcia's project, the UAQ had registered the ¡Qué fresa! brand so that the fruits of these crops could be distributed on the campus and faculties of the university.

"This strawberry is packaged in 450 grams packages and distributed in the UAQ. The income we generate, from strawberry and other products, also serves to create jobs for people in the municipality of Amealco. We have nine people working full-time in the greenhouses, and we purchase the agricultural inputs we require in Amealco, to move the economy of the region," he said.

He also said that since the beginning of the project there had been two technology transfers for private producers, through the University Technology (Tuni) brand of the Faculty of Engineering, which designs irrigation systems and climate control for the production of seasonal organic vegetables.

"We have already generated 200 thousand pesos approximately for the transfer of technology in the last three years, through irrigation and climate controls that the students themselves develop and for

which they receive scholarships and compensation. Students in the agroindustrial engineering career acquire knowledge in electronics focused on the development of automated systems for agricultural processes," he said.

### Protected agriculture

According to the coordinator of Agroindustrial Engineering, there is federal support for the development of protected agriculture in the municipality of Amealco de Bonfil, which is mainly focused on the production of tomato (*Solanum lycopersicum*), which in turn has rendered the region less profitable given the over-saturation of the market. As a result, the UAQ has sought to combine efforts between producers and authorities with the aim of training and transferring technology to search for alternatives, such as strawberry, that could even be exported.

In this regard, Luis Felipe Samayoa Moran, who has a diploma in vegetable growing in greenhouses from the Faculty of Engineering at the Amealco campus, said this type of training allowed producers to acquire knowledge to move from traditional agricultural schemes to agribusiness using technological tools.

"The rural population throughout the country is accustomed to the traditional system; but agriculture is becoming increasingly more complicated, as the land is already in a process of major erosion and there is a shortage of water, which limits production. The UAQ's proposed protected agriculture, in terms of science and technology, offers alternatives not only to peasants or farmers but also to academics, students, researchers and society in general," he concluded.

Currently, with this technology applied to greenhouses, the Amealco campus of the Autonomous University of Querétaro produces tomato, strawberry, serrano chili (*Capsicum annuum* cv. 'Serrano Sinahusia'), jalapeno chili (*Capsicum annuum* 'Jalapeño'), chili pepper (*Capsicum annuum*), onions (*Allium cepa*), cucumbers (*Cucumis sativus*), spinach, chard (*Beta vulgaris* subsp. *Vulgaris*), beet (*Beta vulgaris*), carrots (*Daucus carota*), and different types of lettuce.

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