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The advantages and positive results obtained from the application of Engeenuity-Engeenuity Life Sciences S.A's APSE technology in the cultivation of sweet potatoes can be found in this document.

RESULTS OF THE EXPERIMENTAL PROJECT FOR THE GROWING OF SWEET POTATOES WITH “APSE” TECHNOLOGY

Engeenuity Life Sciences S.A.

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1. Background

- Peñas Chatas Agro-Export SA, is a company with Panamanian capital, incorporated in Panama, with the purpose of producing and commercializing agricultural products and which is in Peñas Chatas, Ocú (Herrera). The target market for production is the national market.
- The production has been carried out since 2015 on the "Las Cruces" farm in Peñas Chatas with a cultivable area of 14 hectares, dedicated to the cultivation of Sweet Potato variety "Covington".
- In January 2018, after several meetings, an agreement was formalized for an experimental project between the companies Peñas Chatas Agro-Export, SA and Engeenuity Life Sciences SA, which has developed the APSETM Technology to be applied to the water that is It is used for irrigation and subsequent washing for product selection, expecting higher crop yields, better quality, greater durability and more safety as results, in addition to reducing the cost of production.

2. Executive Summary of the Experimental Project

The experimental project consisted of the application of the APSETM Technology on the cultivation of sweet potato variety "Covington" conducted by Peñas Chatas Agro-Export, SA, in one of its 2-hectare satellite farms in the vicinity of Peñas Chatas. The 2 hectares are fully equipped with a drip fertigation system.

In principle, the application of APSETM Technology was conducted on a 1000 m2 plot, and another continuous plot of another 1000 m2 was dedicated to serve as a witness, in which the same production system that the company has been applying was used. to their crops from the beginning, but with the productive improvements that were evolving.

The results of both plots were compared and showed substantial benefits in the experimental plot versus the control plot, which are reflected in the corresponding section of this document.

3. Justification of the Experimental Project

Peñas Chatas Agro-Export SA, has been growing "Covington" variety sweet potatoes for the local market since 2015. Although it has been adapting the production system to the place to obtain the highest possible yield, these have been increasing but not at the levels that this variety produces, since the production in the main farm never exceeded 1.19 kg / m2, in addition the crops were attacked by a tiny beetle that deposits a larva in the soil and this develops in the skin of the sweet potato that although it does not exceed the surface area does make the quality of the sweet potato almost non-commercial. The company managed to minimize the effects of this larva, but by using a systemic insecticide as a preventive measure, which was far from offering an ecological product as was, in principle, the intention of the company.

Upon contacting Engeenuity Life Sciences SA and learning about the effects it produces on crops when applying its technology, it was decided to carry out an experimental test to verify the results, that, if positive, the technology would be applied to the total surface area in production.

Engeenuity Life Sciences SA committed to the company to increase the production of sweet potatoes per m2, improve the quality of sweet potatoes, minimize the effects of the beetle larva infestation, raise the product to ecological quality and lower production costs, which sufficiently justifies the experimental project carried out between both companies.

4. Introduction to APSE™ Technology

APSE™ Technology is a waste-free, non-electricity-dependent process that applies physical processes to biological systems to significantly improve food and water quality. It applies Biophotonics and Passive Ultrasound technologies.

BioPhotonics uses light modulation techniques to produce an electromagnetic biostimulus that improves the health of cells in organic products or living organisms.

Parasites, bacteria, fungi, and many other pathogens can be controlled using our biophotonic devices.

BioPhoton-X(TM), a technology developed by Engeenuity-Engeenuity Life Sciences SA, captures, retains and radiates UV, visible and near infrared electromagnetic energy in the form of photons that leads to the photolysis of water molecules (the division of hydrogen and oxygen from molecules H2O) and acts as a catalyst for the creation of low levels of radicals (reactive oxygen species) such as superoxide (O2-), hydrogen peroxide (H2O2) and the hydroxyl radical (* OH). The reaction of organisms to free radicals is to produce enzymatic and non-enzymatic detoxifying / antioxidant substances, such as the enzyme Superoxide Dismutase and the forms of Catalase and Peroxidase to maintain redox homeostasis. But when exposed to consistently elevated ROS levels, this reaction in bacteria does not produce a sufficient antioxidant response to overcome even low levels of these free radicals / reactive oxygen species (ROS) and their growth is impaired and reproduction is impaired. In higher organisms, such as plants, mammals, even humans, the presence of even slightly elevated levels of superoxide and other ROS leads to levels of superoxide dismutase, catalase and peroxidase production that not only return the organism to a state of redox homeostasis but also provide an excess of antioxidants that perform additional oxidative stress reduction functions. This is called Hormesis, in which a stressed environment leads to the strengthening of the host's natural defenses and is demonstrated in many human superoxide dismutase reactions.

Superoxide dismutase is an enzyme found in all living cells. An enzyme is a substance that speeds up certain chemical reactions in the body.

The technological principles on which it is based are:

- ✓ Advanced physical process without waste, without electricity, applied to biological systems that dramatically improves health and water quality in food.
- ✓ Light-charged APSETM displays remain active for days and emit low intensity and infrared pulses applied to water and food in contact or proximity.
- ✓ APSETM displays are constructed of FDA food grade materials, photonic and optical nanotechnology.
- ✓ The special passive ultrasound valves that improve the process.

All these applications make the reproduction of harmful microorganisms restricted through microbiostasis:

- Better water sanitation.
- improved food safety.
- fresh and more preserved products.

The improved properties of APSETM treated water,

- Improves absorption / hydration.
- Extend conservation.
- Environmentally safe pest control.
- Healthier for consumers.
- Higher harvests and lower costs.

5. Objectives of the Experimental Project.

The main objective of this Experimental Project for the production of sweet potatoes of the "Covington" variety is that, through the application of APSETM Technology, it is possible to achieve: increase production, improve quality, lower costs, and increase profits, prolong life. useful and improve the food safety of the sweet potatoes produced in the project.

6. Brief Description of the Activities Carried Out in the Experimental Plot.

A 1000 m2 plot was chosen as experimental (PE).

6.1 In the Experimental Plot (PE)

In order to increase production, improve quality, lower costs and increase profits, the following equipment and materials were installed, and the activities included in the ASPE TM Technology Application Protocol were carried out:

1. The ASPE TM technological system was installed at the outlet of the PE irrigation arc, which consisted of:
    - 1 x 50 gallon PVC tank.

- 110 V supply through a solar power generation system.
- 1 lamp MMS1 Red color plus ELS accessories
- 1 ELS mid-range photonic display
- MMS stamps # 8 ELS
- 1 ELS ultrasonic EUS2 valve.

2. The necessary ELS # 7 Biofertilizer-Antifungal packages were supplied to apply every 10 days to the PE cultures.
3. The water in the PVC tank used for irrigation was treated with APSETM Technology.
4. The habanas to be planted in the PE were cut and selected.
5. They were immersed in a container with Biofertilizer-Antifungal ELS # 7, diluted in treated water.
6. The treated habanas were sown in the prepared furrows, in a 3-bolillo plantation frame, at a rate of 3.5 habanas per m2.
7. The daily irrigations were given in the PE, which required the soil and the cultivation.
8. Biofertilizer ELS # 7 was applied every 10 days to the cultivation of the Experimental Plot diluted in the water treated with APSETM Technology.
9. PE sweet potatoes were harvested in plastic storage baskets 93 days after being planted.

6.2 At the Processing Plant

In order to extend the shelf life of sweet potatoes, as well as give the sweet potatoes greater food safety:

1. Previously, the following was installed in the Processing Plant:
   - 1 water pump of 2 hp and 60 psi, to cover the 30 psi requirements of the last valve in the circuit.
   - 1 x 500 gallon PVC tank.
   - 1 500 gallon PVC tank cut in half.
   - Connections: hoses, connectors, pressure gauges and supports for the recirculation circuit.
   - 2 ELS ultrasonic EUS1 valves
   - 110 V power supply.
   - 1 lamp MMS1 Red color plus ELS accessories
   - 2 ELS mid-range photonic displays
   - MMS stamps # 8 ELS

2. The sweet potato baskets were taken to the company's Processing Plant to be cured, washed, and selected according to the requirements of the different markets, and the following activities were carried out:

i. It was treated with ASPE TM Technology, in water contained in the 500 gallon tank.
ii. Harvested sweet potatoes were carefully washed.
iii. They were selected and placed in plastic storage baskets, in 3 qualities: Exportable, Public Market and Industry.
iv. The half tank was half filled with treated water.
v. The baskets with sweet potatoes were introduced into the half tank with treated water, and kept submerged for 5 minutes.
vi. The sweet potato baskets were removed and cured for 4 days before being distributed to the market.

7. Brief Description of the Activities Carried Out in the Witness Plot.

A plot contiguous to the PE, of 1000 m2, was chosen as a control plot (PT).

7.1 In the Experimental Plot (PE)

1. The habanas to be planted in the PT were cut and selected.
2. The selected habanas were sown in the prepared rows, in a 3-bolillo plantation frame, at a rate of 3.5 habanas per m2.
3. The daily irrigations were given in the PT, which required the soil and the cultivation.
4. The fertilizer was applied 25 days after sowing in a 1-2-3 ratio and at 60 days a potassium fertilizer was applied through fertigation for 10 consecutive days.
5. Weed cleaning tasks were carried out 30 and 60 days after sowing.
6. The PE sweet potatoes were harvested in plastic storage baskets 111 days after being planted.

7.2 At the Processing Plant

The sweet potato baskets were taken to the company's Processing Plant to be cured, washed, and selected according to the requirements of the different markets, and the following activities were carried out:

1. Harvested sweet potatoes were carefully washed.
2. They were selected and placed in plastic storage baskets, in 3 qualities: Exportable, Public Market and Industry.
3. The baskets of sweet potatoes were selected and cured for 4 days before being distributed to the market.

8. Results obtained.

The results obtained from the application of ASPE TM Technology, by Engeenuity-Engeenuity Life Sciences SA, in collaboration with the producer company Peñas Chatas Agro-Export SA, to the cultivation of Sweet Potato, can be assured that they are positive:

The results of the 1000 m2 PE with ASPE TM Technology, compared to those of the 1000 m2 PT grown with fertigation technology and with traditional management, were the following:

8.1 Greater Production of Sweet Potatoes.

The production of PE versus PT was as follows:

Plot	Kg Produced	Kg / m2	Difference in Kg Produced	Difference in Kg / m2 Produced	Difference% of Production	conclusion
Experimental	2,368.18	2.37	436.36	0.44	22.59	The experimental plot produced 22.59% more than the Control plot
Witness	1,931.82	1.93				

8.2 Higher Quality Sweet Potatoes.

The quality was measured based on the selection of exportable quality sweet potatoes (A), public market quality (B) and quality for the industry (C); the higher the quality, the better the sale price:

Parcela	Qualities	Kg sold	Difference in Kg Qualities	Difference in Kg / m2 Qualities	Difference% in Kg of Qualities	conclusion
Experimental	**TO**	**948.42**	426.96	0.43	81.88	The experimental plot gave 81.88% more sweet potatoes of A quality than the Control plot
Witness	TO	521.46				
Experimental	**B**	**581.99**	-131.28	-0.13	-18.41	The experimental plot gave 18.41% less sweet potatoes of quality B than the Control plot
Witness	B	713.26				
Experimental	**C**	**625.10**	-52.98	-0.05	-7.81	The experimental plot yielded 7.81% less sweet potatoes of quality C than the Control plot.
Witness	C	678.07				

	Experimental plot		Witness Plot	
Qualities *	Kilos Sold	% Kilos Sold by quality	Kilos Sold	% Kilos Sold by quality
TO	948.42	**44%**	521.46	**27%**
B	581.99	**27%**	713.26	**37%**
C	625.10	**29%**	678.07	**35%**

* Qualities

TO Exportable Quality

B Public Market Quality

C Industry Quality

8.3 Shorter time of the Sweet Potato Growing Cycle.

The cultivation time was shortened by 8 days, with better production and quality of sweet potatoes.

Plot	Sowing Date	Harvest Date	Cultivation days
PE	03/03/2018	05/07/2018	**93**
TEA	07/03/2018	07/17/2018	**111**

8.4 Cost of Growing Sweet Potatoes.

The production cost of the PE was similar compared to the PT, but it must be taken into account that since it is an experimental plot there is an extra cost for greater monitoring. At the end of the cycle it could be seen that some of these costs can be substantially reduced when the technology is applied to a normal extensive crop.

8.5 Profitability of the cultivation of sweet potatoes.

The difference in income of the PE versus the PT was 31% greater than that of the PT:

P. Experimental B. / Entered	P. Witness B. / Entered	Difference in B. / Entered	Difference in% of B. / Income
2,546.97	1,947.26	599.71	**31%**

8.6 Postharvest Results

Regarding the application of ASPE TM Technology, in Postharvest handling, in order to extend the shelf life of sweet potatoes in storage and on the shelf, it is still under evaluation and it cannot be fully measured, but it can be advance that at 30% of the process, they are proving positive.