

DOCKETED	
Docket Number:	19-BSTD-03
Project Title:	2022 Energy Code Pre-Rulemaking
TN #:	236170
Document Title:	Ubigro Comments - UbiGro is the Solution for Greenhouse Growers
Description:	N/A
Filer:	System
Organization:	Ubigro
Submitter Role:	Public
Submission Date:	12/28/2020 3:54:43 AM
Docketed Date:	12/28/2020

*Comment Received From: Ubigro
Submitted On: 12/28/2020
Docket Number: 19-BSTD-03*

UbiGro is the Solution for Greenhouse Growers

My name is Scotty Moore, a proud member of the UbiQD Advisory Board. Our flagship agtech innovation, UbiGro, is the world's first and only Quantum-Dot (QDs) Infused Luminescent Greenhouse Film, that's easily installed. The film is suspended 6 inches inside the greenhouse beneath the polyethylene cover and uses a support structure with durable cables attached to purlins that support the suspended film.

Business Case: (3) Key Benefits:

Generating Positive ROI After One Harvest
Enhance Crop Yields by 5 to 20%
Sustainably Reducing Per-Unit Energy Cost

See Case Studies
<https://ubigro.com/case-studies>

Additional submitted attachment is included below.

Boost Yields by Optimizing Sunlight

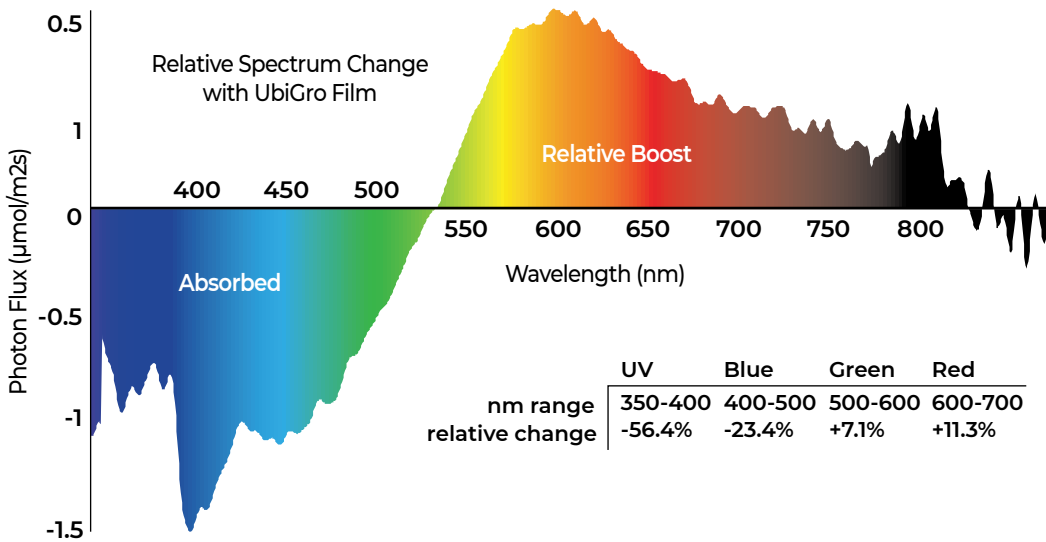
UbiGro is a spectrum-modifying, retrofit greenhouse film that contains quantum dots, a luminescent nanomaterial that shifts sunlight color. This unique optical property enables the UbiGro film to provide optimum light spectrum to plants, boosting overall crop yields and improving crop quality. An easy-to-install and cutting edge technology, UbiGro is an electricity free way to control the light spectrum in greenhouses to enhance crop yields.



UbiGro greenhouse film can be retrofit into any greenhouse architecture and is designed to optimize sunlight by shifting some UV and blue light towards the red.

How it Works

Light from the sun is absorbed by quantum dots in the UbiGro film. The quantum dots shift some of the shorter wavelength colors, like UV and blue, towards the red. The optimized light is absorbed by crops, improving yield, cycle time, and crop quality. UbiGro retrofit films are designed to absorb some of the sun's UV and blue light and convert it to a warm glow. This glow boosts the relative PAR in the orange and red portions of the spectrum.



Increased Photosynthetic Efficiency

Boosting the orange/red portion of the spectrum triggers plants to focus more energy on producing fruit/flowers. UbiGro's spectrum mimics the late summer sun to trigger more fruit/flower production and can improve crop quality.



Boosted Fruit & Flower Production

Diffuse light is known to reach deeper into the plant canopy. The quantum dots in the UbiGro film emit light in all directions which allows light to be absorbed by the entire plant and enhances fruit and flower yields.



Improved Full-Canopy Absorption

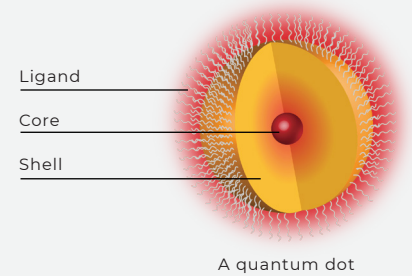
UbiGro color-shifts sunlight to include more orange and red light, improving the photosynthetic efficiency in plants. By converting light more efficiently into biomass, plants grow faster and larger, producing more fruit/flowers.

Technical Specifications

PAR Transmission	85%
UbiGro Width	1.25 m
UbiGro Thickness	350 μm
Peak Emission Wavelength	600 nm
Quantum Dot Composition	CuInS ₂ /ZnS

What are Quantum Dots?

Colloidal semiconductor nanocrystals, or quantum dots, are nanoparticles so tiny that it would take roughly 10,000 of them to span the width of a human hair. Quantum dots have remarkably high light conversion efficiency and exhibit size tunable photo-luminescence over a wide range of colors.



About UbiGro

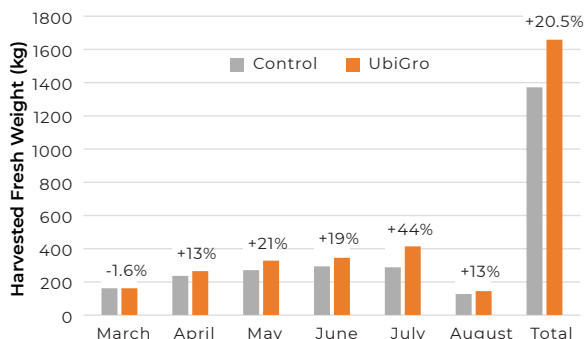
UbiGro is a line of greenhouse films enhanced with quantum dots. It is capable of optimizing the solar spectrum for crops, thereby increasing quality and yield. UbiGro is designed to fit seamlessly into greenhouses of any design. UbiGro is manufactured by UbiQD, a nanomaterials company based in Los Alamos, NM.

UbiQD's mission is to feed and power cities of the future with quantum dot based solutions.

Luminescent Greenhouse Films Improve Crop Yield

UbiGro films were installed and tested in a hydroponic greenhouse located at Growing Opportunities Farm in Alcalde, NM. In this five-month plant trial, two sections of UbiGro films were suspended over a row of 126 beefsteak tomato plants. The tomato production under these films was compared to a control row located in the same greenhouse that was only exposed to un-modified sunlight. There were three rows of tomatoes in between the two test rows, which served as barrier rows, ensuring the light conditions for the film and control row were distinct. The 30'x90' greenhouse had a double polyethylene cover that was whitewashed to lower light intensity during the summer.

Beefsteak Tomato Production



The UbiGro film enhanced tomato production in 4 of 5 months of the trial, with a total yield enhancement of +20.5%.

The films were installed on March 8th, 2019, 76 days after harvesting had begun on the crops. The plant trial continued for five months and completed after their final harvest on August 9th, 2019. All growing conditions besides the light environment were kept identical for both sides of the trial including: watering and nutrient regimen, humidity and temperature, harvesting and pruning regimen, integrated pest management regimen, etc. The farm harvested ripe tomatoes twice a week and the fresh weights for both rows were reported after each harvest. A yield enhancement was consistently observed throughout the duration of the trial. This resulted in a +20.5% overall increase in fresh



+20.5%
yield increase

weight harvested under the UbiGro films relative to the control. The benefit was most pronounced in high-light level months, June and July. There were no observed differences in color, flavor, or overall quality of the fruit harvested from the two separate rows of tomatoes. Films were tested for stability regularly throughout the plant trial and the relative luminescent quantum yield, or photon conversion efficiency, was compared (above). The quantum yield of the film correlates with the brightness of the emission, and therefore indicates the performance of the film over time. Over the course of the five-month summer trial, the UbiGro films showed no degradation in quantum yield, indicating no change in the optical properties of the film. The films have remained installed in the greenhouse for an additional 77 days and the film has maintained its original optical performance.

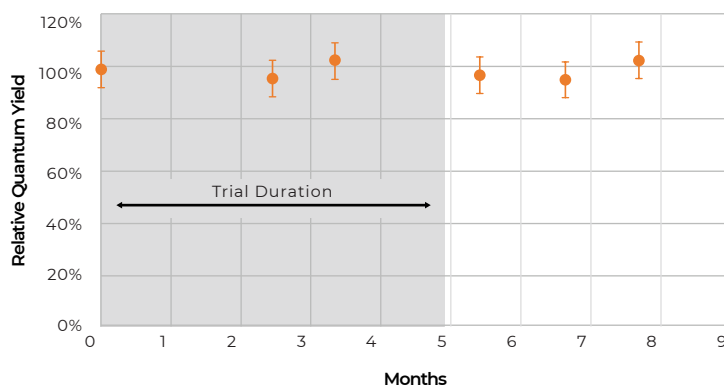
Trial Summary

Farm	Growing Opportunities
Location	Alcalde, NM
Crop	Hydroponic Tomatoes
Total Plants	252
Yield Boost	+20.5%

Economics

An improvement in crop yield will benefit the economics of a farm, but what is that yield enhancement worth to the farmer? Taking this plant trial as a case study, we can calculate the value that the yield-boosting UbiGro film brings to the economics of the farm. Based on historical production data, this 2880 ft² greenhouse produces on average 29,750 lbs/yr. The farm sells beefsteak tomatoes for \$2.50/lb

UbiGro: Stability in Greenhouse



(wholesale price), and the tomatoes retail for \$4.99/lb. This equates to \$74,375 in wholesale revenue from this single greenhouse. A +20.5% increase in yield, as shown in this study, translates to \$15,247 in increased revenues per year.

In order to quantify the value of the increase in revenue, we must calculate the increased profit. There are variable costs associated with producing and selling this extra produce, including harvesting, packaging, and transportation. However, fixed costs are not increased with the additional yield. These costs include real estate (rent/mortgage), heating/cooling, electricity, marketing, and labor (such as cleaning, seeding, vegetative labor, etc.). Given that the gross margin on the baseline production of beefsteak tomatoes at Growing Opportunities farm is 68% (32% COGS), we can estimate an 84% gross margin on any extra production (16% COGS) realized as a result of the superior UbiGro spectrum. In this example, that translates to \$12,807 additional profit per year from this greenhouse. Over the projected 4-yr life of the installed UbiGro film, the farm would take in over \$51,000 in extra profit from this greenhouse alone.

www.UbiGro.com
info@ubigro.com

134 Eastgate Dr.
Los Alamos, NM 87544