ChucaoTech Nanobubbles provide significant benefits in Alfalfa Irrigation

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The Significance of Oxygen in Plant and Crop Soils

For over 70 years, the necessity of supplying adequate oxygen to the root and microbial zones in crop soils has been acknowledged and recommended. Although the importance of oxygen in the root zone is recognized, effective and economical methods to infuse more than ambient levels of oxygen into irrigation water and soil have been elusive—until now.

The Breakthrough in Nanobubble Technology

A decade ago, a remarkable discovery was made: the existence of small bubbles that defy many traditional aeration concepts. They have no buoyancy, do not float to the surface in water, do not coalesce into larger bubbles, and can be generated easily and economically. These nanobubbles or ultrafine bubbles have been shown to increase the dissolved oxygen (DO) level of water to more than 4x other methods. In addition to high DO, the bubbles release their gas over time, functioning like a storage facility for oxygen.

ChucaoTech's Innovative Solution

ChucaoTech has introduced a distinctive nanobubble (NB) injection system that merges low-energy generation with minimal operating and maintenance costs. The installation process is quick and requires little disruption to the irrigation system. This system consists of an injector tube that harnesses the existing irrigation water pump energy to create nanobubbles using either compressed air or concentrated oxygen.

Due to its innovative design and performance, **ChucaoTech** has gained international acclaim, earning the 2024 PwC Innovation Award and the 2024 Avonni Agricultural Innovation Award for its significant contributions to water sustainability and enhancing agricultural productivity.

CHUCAOTECH
NANOBUBBLES FROM PATAGONIA

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How Enhanced Dissolved Oxygen Can Elevate Crop Yields and Boost Farm Profitability

- **Elevated levels of dissolved oxygen (DO)** in irrigation water enhance microbial biomass, including beneficial fungi.
- This boost in microbial biomass facilitates improved nutrient uptake by plants, supports nitrogen and phosphorus mineralization, and accelerates crop growth. As a result, this efficient nutrient transfer can lead to a decrease in the quantity of nutrients needed.
- An increase in fungi and other microorganisms also fortifies soil aggregate stability, leading to better soil porosity and moisture retention, which ultimately reduces overall water consumption.
- With reduced oxidative stress on plants and enhanced vegetative vigor, there is considerable potential to lessen the dependence on pesticides and fungicides.
- By minimizing inputs while maximizing crop yield, biomass, and quality, you can ultimately achieve greater profitability.

Demonstrating On-Farm Results of Nanobubble Air and Oxygen in Irrigation

- To illustrate the concrete benefits of using nanobubble air and oxygen in irrigation, we have compiled information and data from several client farms growing alfalfa in the Southwestern United States. Alfalfa (*Medicago sativa*) is notably sensitive to dissolved oxygen levels in water. The client farms differ in geographic locations and soil conditions.
- The data presents a comparison between a standard irrigation method and one that utilizes nanobubble oxygenation. The only variation in crop results stems from the addition of nanobubble air or oxygen in the irrigation water.

Note: The nanobubble generator that was used for both client sites have a maximum irrigation capacity of 3280 gpm, which corresponds to an area of approximately 410 acres of alfalfa, or about 9 gpm/acre.

Examples of irrigation installations, oxygen concentrator, injector retro- fitted into existing irrigation pump station.

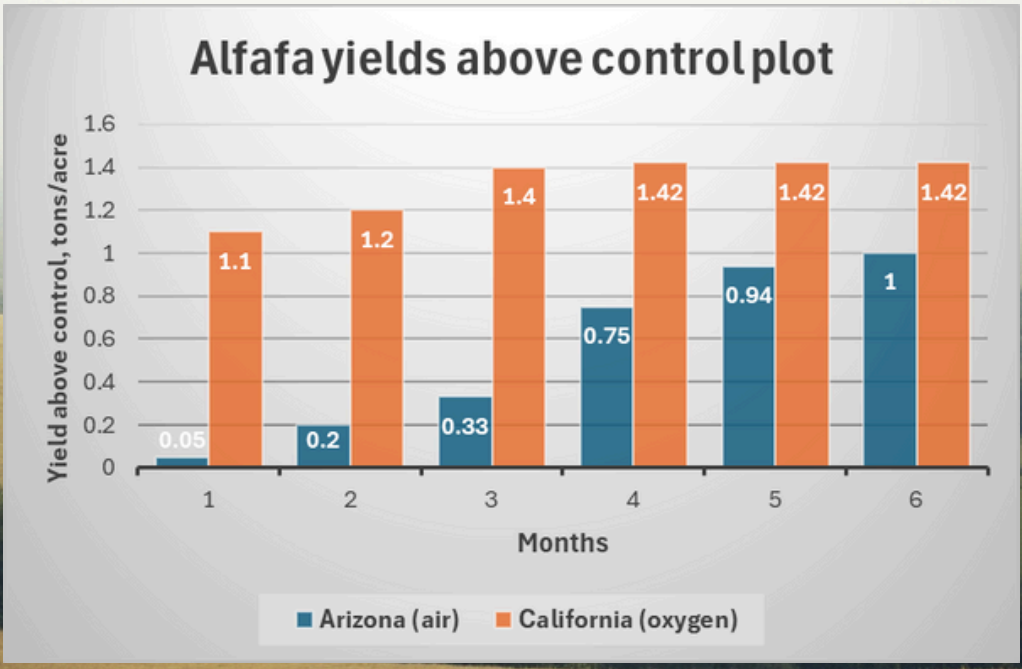
The **energy** required to generate nanobubbles comes from the irrigation pump. no additional energy is required, high concentration oxygen or an air compressor requires electrical energy, which is all of the energy required to add nanobubbles to irrigation water.

Alfalfa in Arizona

- The Chucaotech nanobubble injector used an air compressor for the addition of oxygen to the irrigation water. The dissolved Oxygen (DO) in the source water had 6–7 ppm, after the nanobubble air injection the **DO maintained 9–10 ppm** going to the irrigated fields.
- In the second season, the yield in the first month increased by **0.05 tons/acre**, by the 5th month, yield increased to just short of an **extra 1 ton/acre**.
- The value of Alfalfa was $200/ton, the annual harvest of 6 cuttings brought **$1200/acre increase**.

Alfalfa in California

- The Chucaotech nanobubble injector used an oxyegn concentrator for the addition of oxygen to the irrigation water.
- The dissolved Oxygen (DO) in the source water had 6–7 ppm, after the nanobubble O2 injection the **DO maintained 14-15 ppm** going to the irrigated fields.
- In the first season, the yield in the first month increased by **1.1 tons/acre**, by the 3rd month, **yield increased to an extra 1.4 tons/acre**.
- The value of Alfalfa was $230/ton, the annual harvest of 6 cuttings brought **$2070/acre increase**.



Our analysis of the yield increase per acre for both locations, along with the associated capital and operational expenses, indicates a return on investment (ROI) ranging from 4 months to 1 year, depending on the use of adding oxygen or air nanobubbles to the irrigation water.

Conclusions

Both systems provide remarkable profitability and can yield a return on investment in less than 12 months. This swift return is a crucial indicator of the commercial potential of nanobubble technology for agricultural irrigation.

- **Oxygen nanobubbles** demonstrate a more immediate impact: a notable increase in yield can be seen within the first month, making them particularly suitable for intensive production operations that involve multiple harvests per year and high-value crops.
- **Air nanobubbles**, on the other hand, present a cost-effective alternative with a slower yet consistent response curve, making them an economical choice for producers looking to enhance their irrigation while minimizing capital investment.

Nanobubble (NB) oxygen/air technology provides three primary advantages for both operations and production systems:

1. **Enhanced water efficiency**: By increasing the dissolved oxygen levels in irrigation water and improving aeration within the root zone, plant water absorption is improved, and losses from runoff, evaporation, or inefficient irrigation areas are minimized. Recent studies indicate that nanobubble systems can enhance water penetration and distribution within the soil.
2. **Optimization of energy and operational resources**: By boosting nutrient absorption efficiency, reliance on fertilizers, pesticides, or other chemical treatments can be lessened. Additionally, by enhancing irrigation water quality—through reduced pathogens and biofilms, as well as improved oxygenation—maintenance costs for irrigation infrastructure are decreased.
3. **Sustainability of the production system**: The implementation of nanobubble technologies aligns with the increasing demand for resilient, efficient, and environmentally responsible agricultural practices. By promoting healthier roots, enhancing vegetative vigor, and reducing chemical inputs, crops are better aligned with precision agriculture practices and sustainability objectives.

In summary, the technology developed by ChucaoTech represents an innovative, scalable, and eco-friendly solution for the future of agriculture. This positions it as a valuable tool for producers eager to achieve high productivity, resource optimization, and adherence to sustainability standards.

Please get in touch with us for more information, detailed design and recommendations for sizing nanobubble generation systems, gas supply, and installation support. A typical installation can take hours to a day or two, depending on the size.

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