



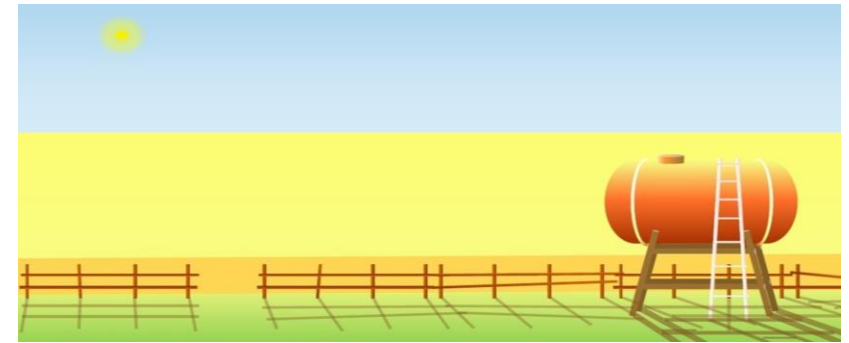
**SCIS.LTD**  
Smart Business Development Solutions

OK NOZZLE

ULTRA-FINE BUBBLES

**AGRICULTURE &**

**HORTICULTURE SOLUTIONS**



# ULTRA-FINE BUBBLES – NANOBUBBLES FEATURES

Ultra-small size

High Stability

Negative Charge

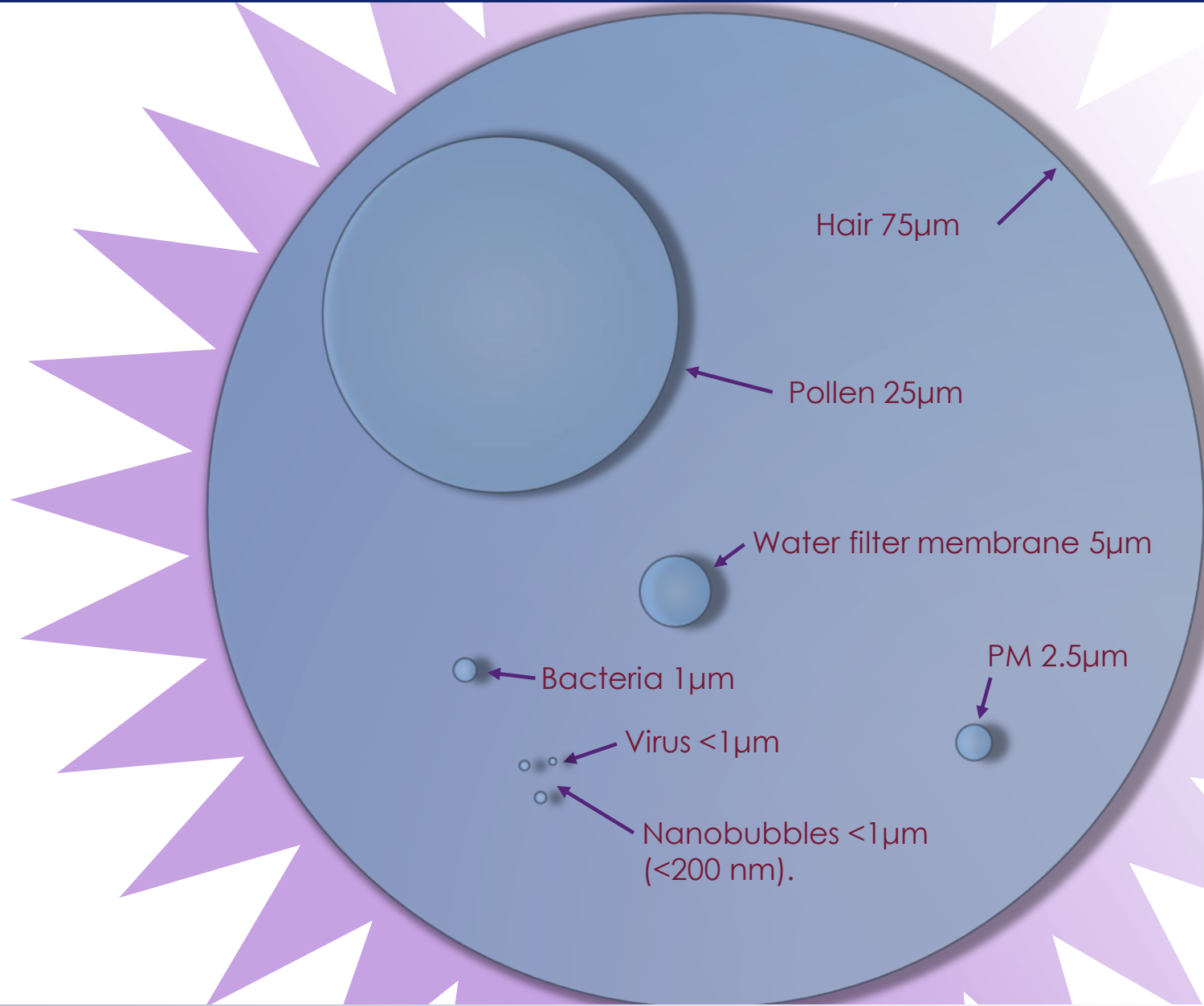
High Penetrative Ability

Brownian Movement Tendency

Reduction of the Surface Tension of Water

High Surface Area to Volume Ratio

High Surface Tension and Gas Pressure Inside



## ULTRA-FINE BUBBLES – NANOBUBBLES SURFACE TENSION

There is a tendency of liquids at rest to attain the smallest possible surface area.

At the borders of the liquid-air system, the surface tension appears because the mutual attraction between molecules of water is higher than the attraction between molecules of water and molecules of air.

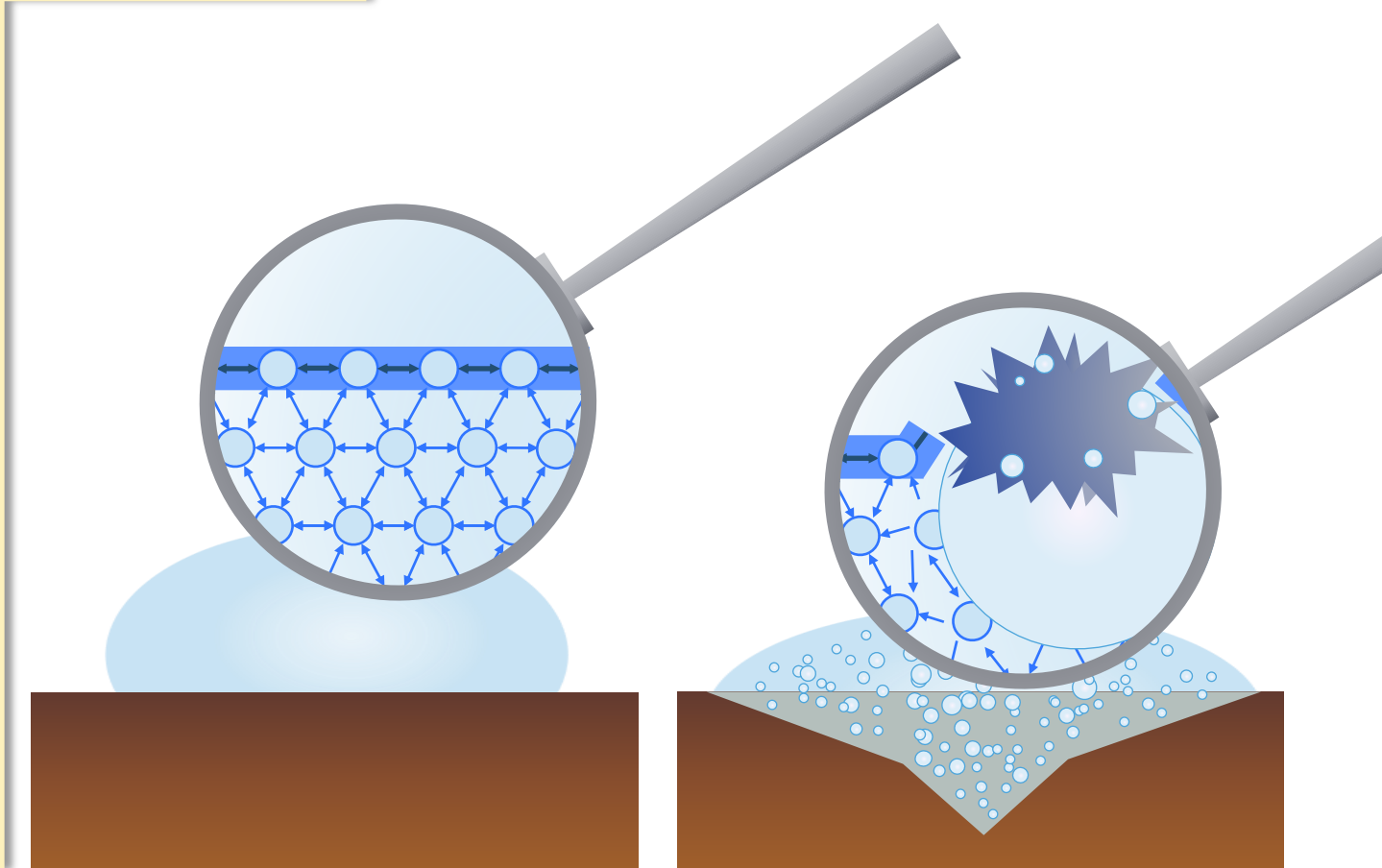
Among the liquids that exist in nature, the surface tension of water is the second highest next to mercury.

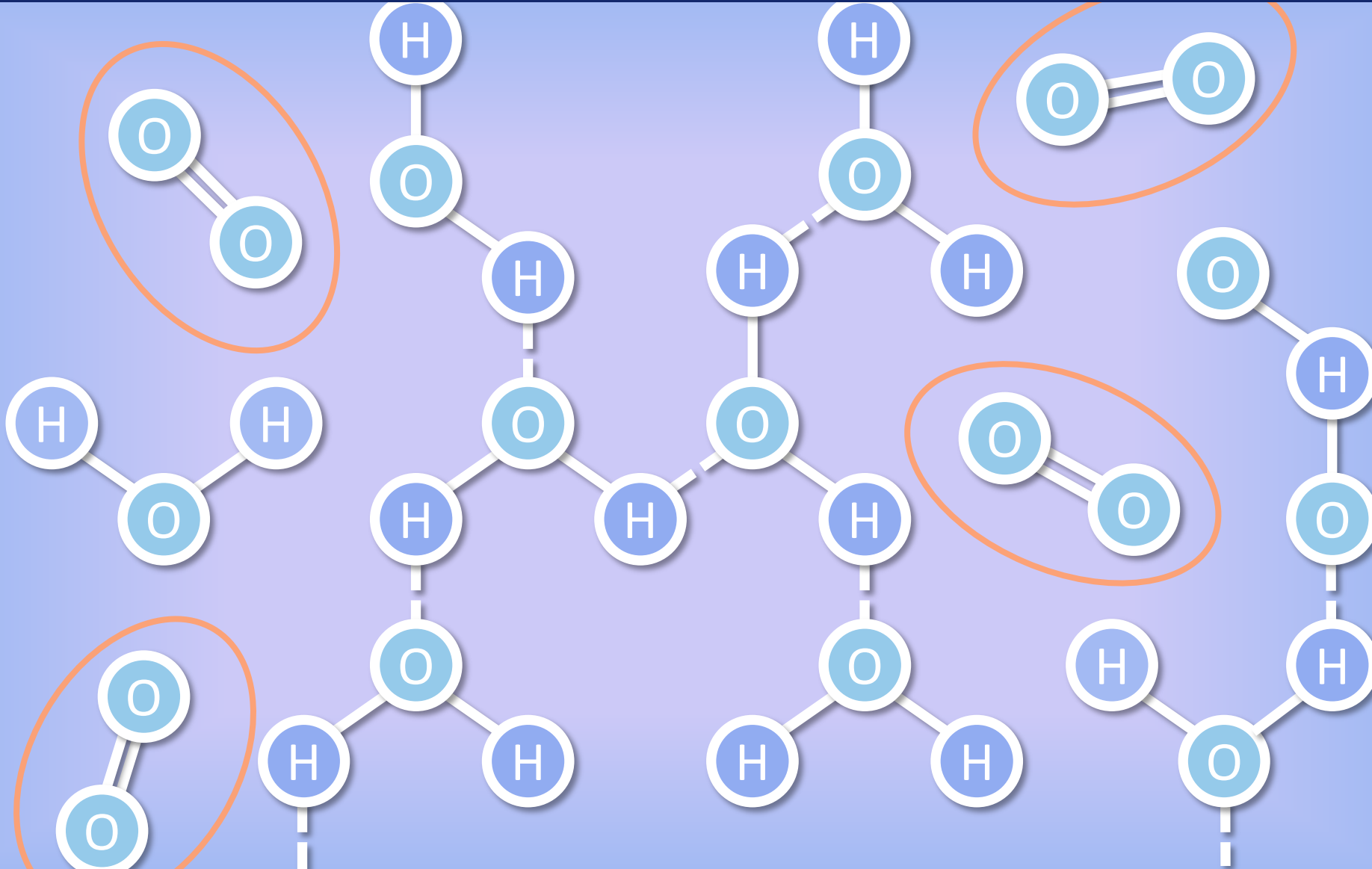
At the same time, the lower surface tension, the better dissolving properties of the liquid, its fluidity and absorbency.

One of the most beneficial effects of ultrafine bubbles for agriculture and crop production is their unique ability to reduce the surface tension of water, thereby significantly increasing its penetrating ability.

Thanks to this effect, oxygenated water reaches the roots of the plant without any hindrance.

Depiction of the surface tension of the drop of water and the effect of the implementation of nanobubbles

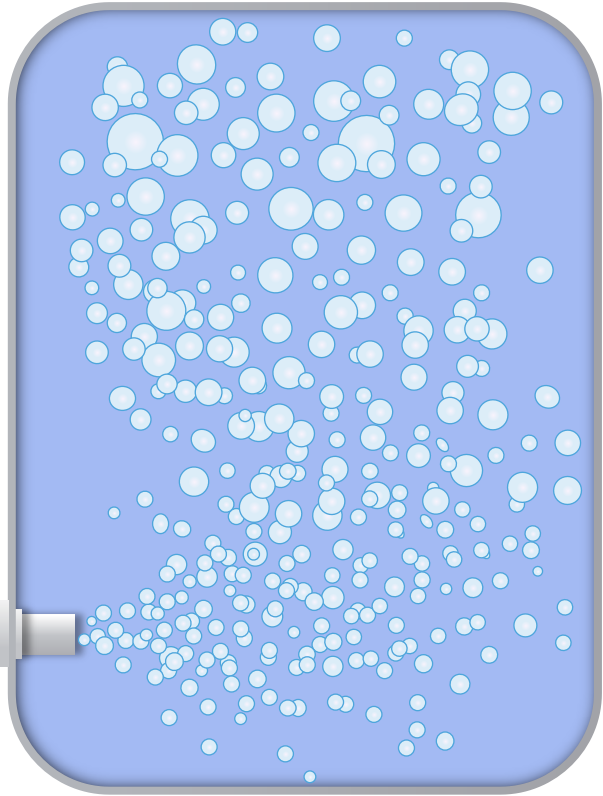




**Dissolved oxygen is the gaseous oxygen (O<sup>2</sup>) dissolved in water**, which characterizes the oxygen regime of water reservoirs or water flows.

The concentration of DO determines the value of the redox potential, and to a large extent, the direction and speed of the processes of chemical and biochemical oxidation of organic and inorganic compounds and is decisive in assessing the ecological and sanitary state of water resources.

**DO transfer efficiency with nanobubbles is more than 85%!**



Indistinguishable to the naked eye, the nanobubbles are subject to chaotic, Brownian motion. They collide with other bubbles, burst and dissolve in the water, increasing the concentration of dissolved oxygen.

The percentage of DO transfer to water through the introduction of nanobubbles is incomparably higher than with any other aeration method. Over 85% regardless of water temperature!

Moreover, the process continues for a long time even after the nanobubbles supply is stopped. Ultra-fine bubbles are less than  $1\mu\text{m}$  and very stable. They could exist in water for several weeks or even months.

Thus, the use of nanobubbles is useful not only in traditional agricultural and horticultural farms, but also extremely effective in modern hydroponic systems, vertical farms, etc.

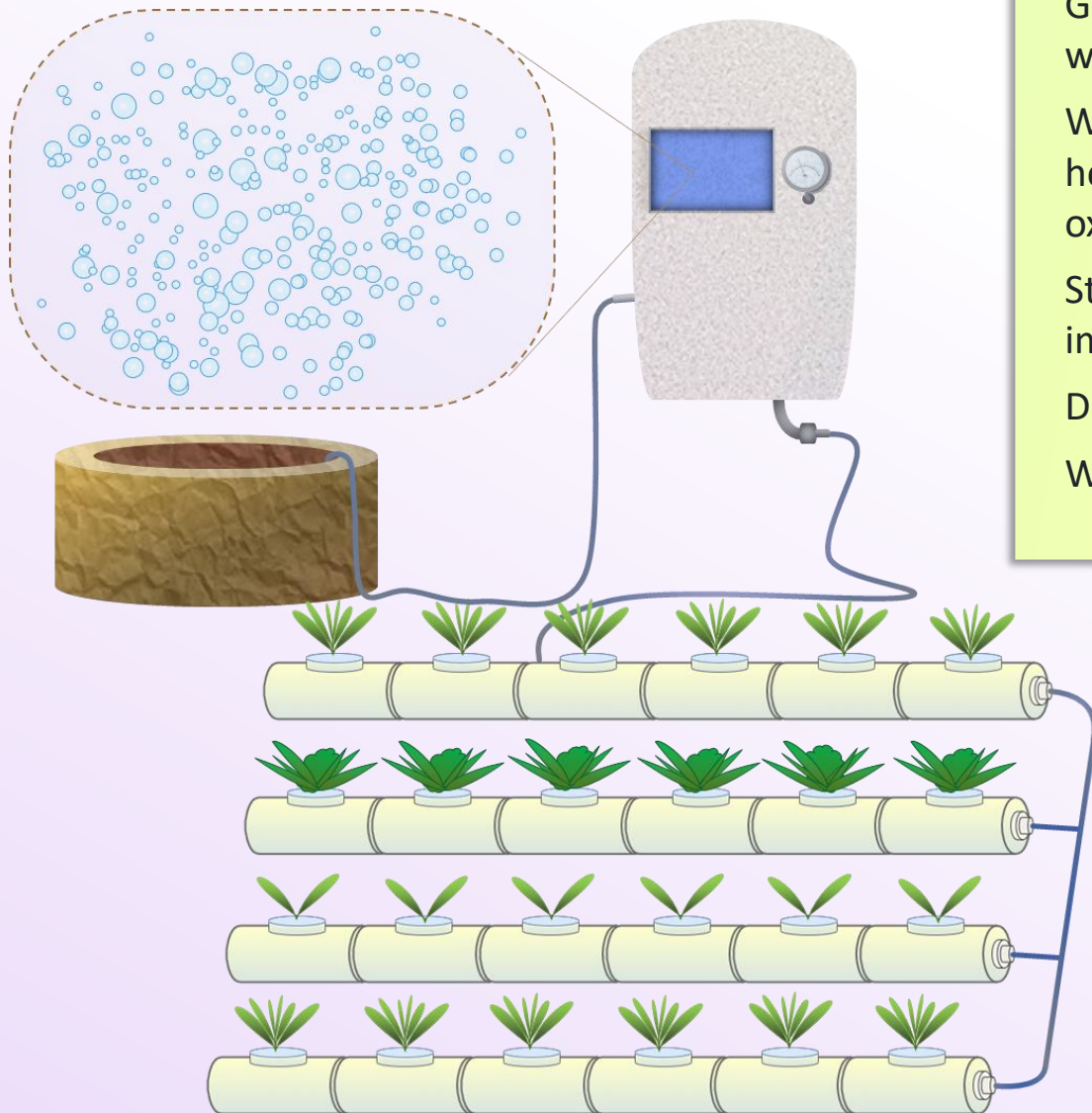
Dissolved oxygen is crucial for improving yields and plant growth rates.

Water, saturated with oxygen, effectively penetrates the root membrane of a plant, nourishes the whole root system, significantly increasing its volume.

A plant stimulated in this way is more resistant to diseases and weather and temperature damage. The oxygen-rich environment leaves no room for bacteria or pathogens to thrive.







Greenhouse crops perform best with high levels of dissolved oxygen in irrigation water.

Water with DO of 5-8 mg/l is considered the minimum acceptable rate for plant health. Most greenhouse crops do better with even higher DO levels. Dissolved oxygen levels above 8 mg/l are considered good for greenhouse plants.

Studies have shown that high concentrations of DO (20-30mg/L) are effective in improving plant growth performance in all types of hydroponic systems.

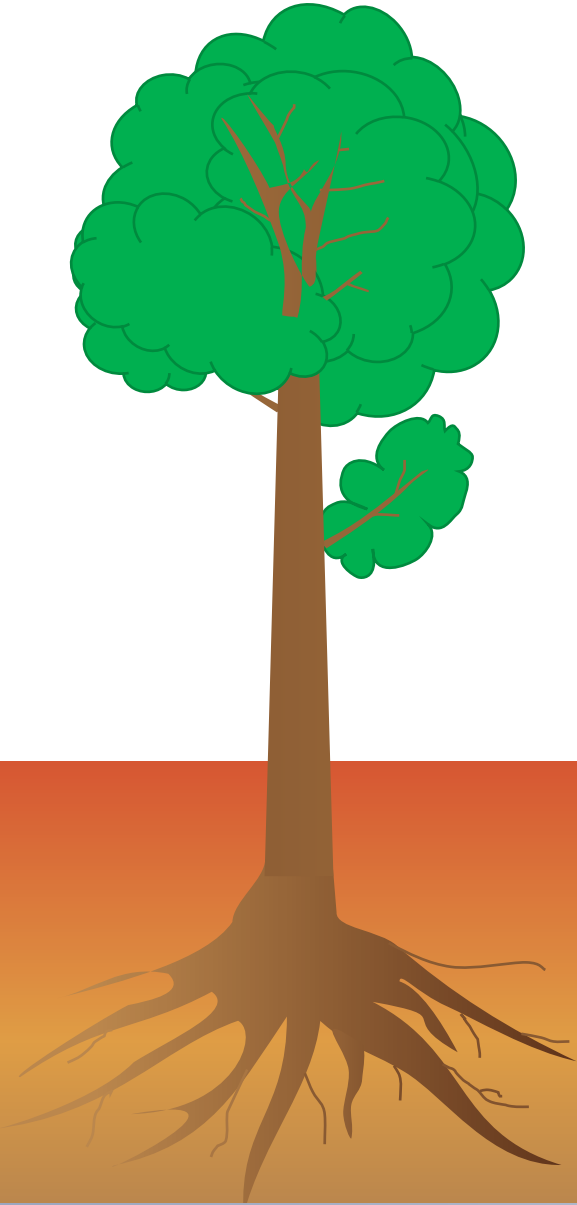
Dissolved oxygen helps plants achieve and maintain normal growth rates.

Without access to sufficient amounts of DO, roots of a plant may die.

In greenhouse and hydroponic systems, dissolved oxygen levels must be maintained at a consistently high level.

However, the most common problem for the greenhouses is a drop in the level of DO in irrigation water. At times, it falls as low as the level of hypoxia (less than 4 mg/l).

There are a number of obstacles associated with ensuring a sufficient concentration of dissolved oxygen in irrigation water. The introduction of reliable nanobubble generation technology not only eliminates such obstacles, but also implements the natural cleaning process for the circulation system of irrigation water.



Researches show that higher levels of dissolved oxygen in the root area of most crops result in increased root mass.

A plant with a larger root mass grows faster and bears fruit more abundantly.

The roots are the organs from which the plant receives most of the resources for growth.

Roots nourish the plant by absorbing water from the soil with nutrients dissolved in it, and also ensure that these substances are carried to the other parts of the plant.

In the roots, various organic substances are synthesized (growth hormones, alkaloids, etc.).

In some plants, reserve nutrients (starch, sugars, etc.) are stored in the main root.

The implementation of the plants watering system with nanobubbles, enriches the rhizosphere and leads to the appearance of many new root hairs. Through these hairs, water and minerals are taken up by the root.

More hairs - more nutrients for plant development!

Healthy, well-oxygenated roots have better respiration and are able to selectively absorb more ions in solution, vital mineral salts, nitrogen, phosphorus, and potassium. When there is less oxygen in the water than in the plant, the water permeability of the roots decreases, which in turn reduces (sometimes even reverses) uptake of nutrients.

To ensure stable yields, it is necessary to supply water with sufficient dissolved oxygen concentration constantly. The nanobubbles provide a high DO concentration and are able to stay in the water for a long time, making possible to reduce the amount and time of watering.



Despite the fact that plants are producers of oxygen, they also need it for life themselves. Ensuring sufficient levels of dissolved oxygen in the irrigation water improves the overall health of the plant.

The increased level of dissolved oxygen leads to an increase in the uptake of nutrients and the efficiency of its conversion into energy for development, which in turn enhances the growth and development of roots, vegetative and flower characteristics of the plant. Increasing the level of dissolved oxygen in irrigation water significantly increases the resistance of plants to stress caused by adverse conditions, and also reduces the threat of various opportunistic microorganisms.

A healthy plant is a more efficient plant. DO is not just another additional nutrient that makes a plant healthier.

There are also direct economic consequences. By consistently maintaining proper DO levels, you can reduce watering time, reduce nutrient and micronutrient inputs, and reduce or eliminate input of costly chemicals such as fungicides.

In addition, evidently, a plant growth is increased by DO supersaturation, which shortens growing time and increases fruiting or flowering yields.

The technology of application of nanobubbles in agriculture is not limited to the benefits for crops, irrigation systems and soil.

Developments in the field of fertilizer production bring a significant benefit to the industry. During the manufacture of dry fertilizers, the inclusion of nanobubbles in the production system greatly accelerates the drying process, increases shelf life, and eliminates clumping.

Creating an environmentally friendly, liquid fertilizer based on animal waste products (e.g. pigs) is a simple and affordable, cost-effective solution. Saturation of the solution with ultra-fine bubbles not only increases the shelf life of the fertilizers themselves, but also their effectiveness, maintaining a high concentration of dissolved oxygen in them for a long time.



# ULTRA-FINE BUBBLES – AGRICULTURE AND HORTICULTURE APPLICATIONS

The use of nanobubble generation technology in agriculture and horticulture helps to reduce the production cycle, accelerates the growth of plants, protects them from pests and diseases, improves the quality of irrigation water and its penetrating ability.

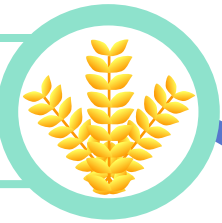
This modern innovation is easy to incorporate into any existing enterprise, optimize it, make it the most productive.

From growing cereals and vegetables on vast, open spaces to cultivating vegetables, mushrooms, flowers in man-made establishments with simulated conditions - any type of plant production could increase its production performance with a simple device designed to generate ultra-fine bubbles as efficiently as possible.

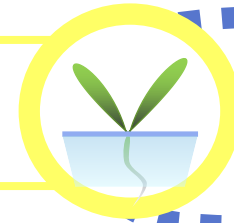


The implementation of a system with nanobubbles could significantly reduce or completely eliminate the need of use of harmful substances in agriculture.

**Open Farmlands**



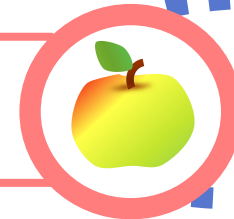
**Hydroponic Systems**



**Crop Production:  
Greenhouses, Nurseries**



**Eco-Friendly  
Fertilizers**



**Water Treatment & Cleaning Of  
Water Circulation Systems**





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