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Liu BINJIANG, *et al.*
ElectroCulture & ElectroHusbandry

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China is making its vegetables grow bigger, faster and stronger ... using electricity

Scientists hail breakthrough as results of the world's largest experiment confirm fruit and vegetable output can soar without chemical pesticides and fertilisers

by Stephen Chen

Chinese growers have the answer to a question that has been baffling scientists for three centuries: Can electricity boost plant growth?

To find out, China has been conducting the world's largest experiment and the results are transforming agricultural production in the world's most populous nation with a jolt.

Across the country, from Xinjiang's remote Gobi Desert to the developed coastal areas facing the Pacific Ocean, vegetable greenhouse farms with a combined area of more than 3,600 hectares (8,895 acres) have been taking part in an "electro culture" programme funded by the Chinese government.

Last month the Chinese Academy of Agricultural Sciences and other government research institutes released the findings of nearly three decades of study in areas with different climate, soil conditions and plantation habits. They are hailing the results as a breakthrough.

The technique has boosted vegetable output by 20 to 30 per cent. Pesticide use has decreased 70 to 100 per cent. And fertiliser consumption has dropped more than 20 per cent.

The vegetables grow under bare copper wires, set about three metres (10 feet) above ground level and stretching end to end under the greenhouse roof. The wires are capable of generating rapid, positive charges as high as 50,000 volts, or more than 400 times the standard residential voltage in the US.

The high frequency electricity kills bacteria and virus-transmitting diseases in the air or soil. It also suppresses the surface tension of water on leaves, accelerating vaporisation.

Within the plants, the transport of naturally charged particles, such as bicarbonate and calcium ions, speed up and metabolic activities, like carbon dioxide absorption and photosynthesis, also increase.

Professor Liu Binjiang, government agriculture scientist and a leading member of the project, said the electric current flowing through the wires is only a few millionths of an ampere by volume – lower than a smartphone cable's workload.

"It does absolutely no harm to the plants or to humans standing nearby," he said.

Thanks to the positive findings of the study, the area devoted to electrified farms in China is now growing with unprecedented speed, according to Liu, from 1,000 to 1,300 hectares each year.

That means up to 40 per cent growth in electro culture farming could be achieved within the next 12 months.

"Most recent investments have come from the private sector," Liu said. "The business is taking off. We are supplying the technology and equipment to other countries including the Netherlands, United States, Australia and Malaysia.

"China is a step ahead of the world."

THE HISTORY

It was not always so. In fact, China was more than 200 years late to the game.

In 1746, just a few years before Benjamin Franklin sent a kite to catch lightning in a storm, Dr Maimbray of Edinburgh in Scotland electrified two myrtles.

He observed the trees put forth new branches in October, something which had never happened before.

The news travelled. Many similar studies were carried out across Europe, some confirming Maimbray's findings, others not.

One experiment in Turin, Italy, for instance, found the plants became unfruitful and wilted after an unusually prolific period.

In 1902, physics professor S. Lemstroem visited the Arctic region and discovered some trees grew faster under the aurora borealis than those in milder climates further south.

Lemstroem attributed the phenomenon to the natural electrical conditions produced by the aurora, also known as the northern lights. He conducted a series of experiments in the laboratory to prove it and even wrote a book to promote his hypothesis.

British physicist Sir Oliver Lodge, a key inventor in the development of radio, read the book and reportedly achieved a 24 to 39 per cent increase in wheat grain yield in an eight-hectare experiment.

It caught the attention of governments. The British and American authorities each commissioned separate studies on electro culture in the early 20th century.

The British findings were positive, while the American results were negative.

These experiments were mostly small and conducted in open fields, with conditions which varied from one location to another. The wide range of natural elements affected the final output and there was no universal standard for hardware design or technical details such as voltage and frequency.

The scientists in these pioneering studies also lacked advanced equipment, such as today's portable spectrum analyser, to study the plant's response to electricity at the molecular level.

As a consequence, explanations of the observed phenomenon remained speculative and interest waned with the advent of chemical fertilisers and pesticides to achieve mass agricultural production.

CHINA TAKES THE LEAD

Public interest in electro culture revived with the rise of organic farming and the Chinese government started funding experiments in the technique in 1990.

He Feng, senior technician of Yufa Jingnan Vegetable Production and Sales, one of Beijing's largest vegetable producers, said the company had taken part in the programme since 2014 and the results were "very satisfactory".

In just two years the electrified vegetables had brought in extra revenue of nearly 1.2 million yuan (US$175,000).

"We are still running the equipment, which consumes very little power," he said.

One hectare of electrified greenhouse requires about 15 kilowatt-hours of electricity per day, which is about half the power usage of an average American family.

Inside the greenhouse the air smells like the aftermath of a summer thunderstorm. Humidity is low and the plants rarely get sick.

The biggest burden is the installation cost, He said, with the necessary hardware costing tens of thousands of yuan. Without government support, the company could not have afforded to wire up all its greenhouses.

Liu Yongyi, owner of City Luhai Xinghua Sightseeing Agriculture company in Beijing's Daxing district, which is also engaging in electro culture, said the technology would significantly improve China's food safety by massively reducing the use of pesticides.

"Pesticide residue is a huge threat to public health. Electricity provides a physical solution to disease and pest control. It is much cleaner than chemicals. The government should subsidise the electro culture revolution," he said.

Liu said visitors to the farm were intrigued when they saw the system at work and he believed the public would be quick to embrace the technology.

"The theory is easy to understand. I believe people would be willing to pay a premium for electrified vegetables and fruits in the near future," he said.

Professor Guo Yalong, a researcher at the Chinese Academy of Beijing's Institute of Botany, said the impact of electricity on plant "definitely exists".

"Electricity is like air and water. It is part of the natural environment," said Guo, who was not involved in the project.

"Many ionised particles in plants have either negative or positive charges. They can respond to the presence of a man-made electric field nearby," he said.

China has greenhouses covering more than 4 million hectares, producing nearly 1 trillion yuan worth of vegetables each year.

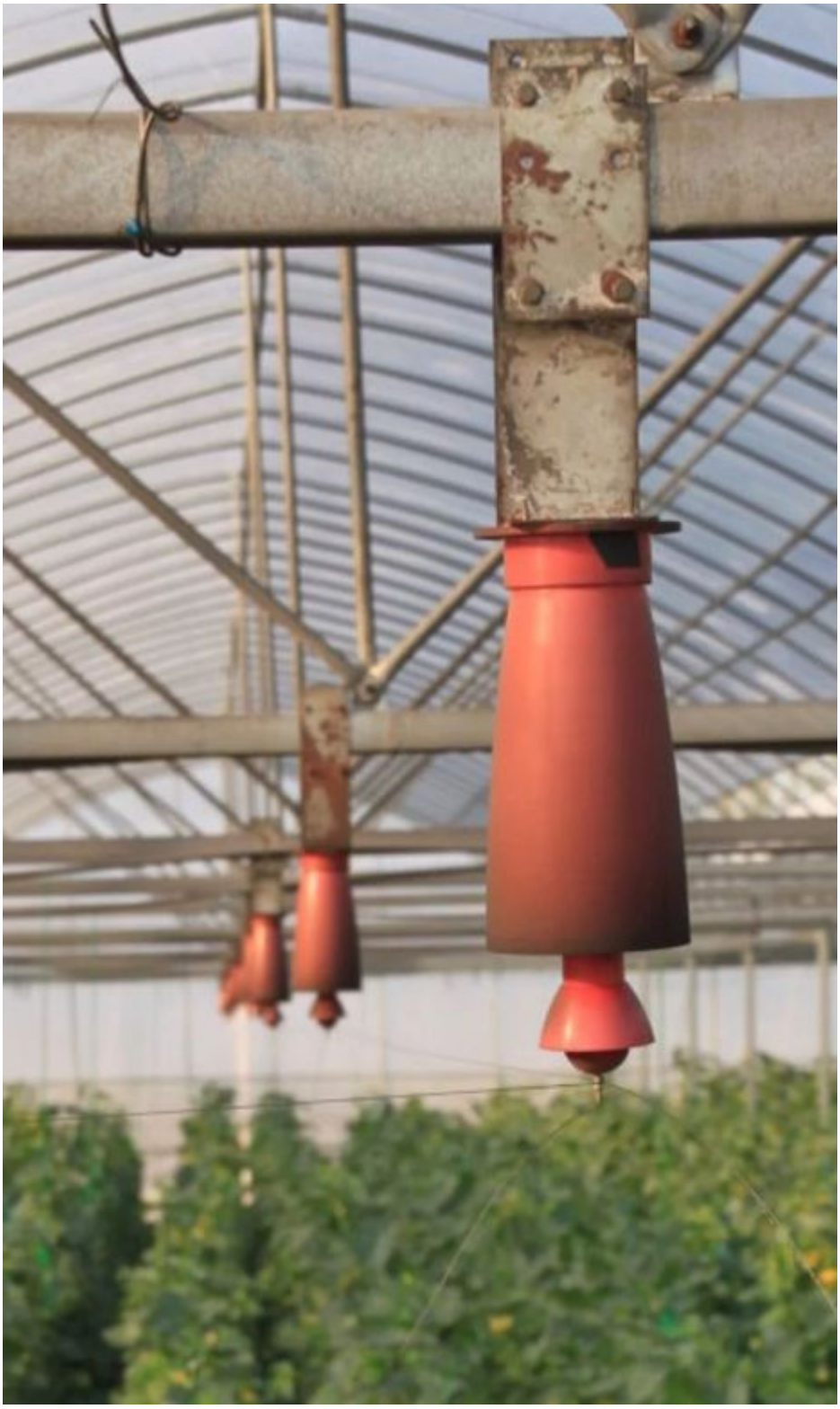
Professor Liu said there were no plans to electrify them all, as the investment would be unaffordable for most farmers.

His project team is taking a different approach and developing a compact, all-in-one vegetable growing chamber using electro culture technology.

"Each family would be able to grow their own food in the kitchen, on the balcony or in the backyard," he said.

The chamber uses an artificial light source and electric field to stimulate plant growth and prevent diseases. Operation is automatic and almost care and maintenance free.

"One day these tiny chambers may become an alternative to large scale farms," Liu said. "That would trigger another agricultural revolution."



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https://www.newscientist.com/article/mg24332440-800-inside-chinas-attempt-to-boost-crop-yields-with-electric-fields/

Inside China's attempt to boost crop yields with electric fields

In greenhouses across China, scientists are exposing lettuces and cucumbers to powerful electric fields in an attempt to make them grow faster. Can electroculture work?

by Donna Lu and David Hambling

AT FIRST blush, the huge commercial greenhouse on the outskirts of Beijing doesn't seem unusual. Inside, lettuces sit in neat rows and light pours in through the glass above. But there is a soft hum and an intense feeling in the air, almost as if a thunderstorm is on the way. The most obvious sign that this is no ordinary growing space is the high-voltage electrical wiring strung over the crops.

This place may be different, but it is far from unique. Over the past few years, greenhouses like this have sprouted up across China, part of a government-backed project to boost the yield of crops by bathing them in the invisible electric fields that radiate from power cables. From cucumbers to radishes, the results are, apparently, incredible. "The overall quality is excellent," says Liu Binjiang, the lead scientist on the project. "We're really entering a golden age for this technology."

Using electricity to boost plant growth – not by powering heaters or sprinkler systems, but simply by exposing plants to an electric field – is an old idea. It is also controversial. Electroculture was tested in Europe many decades ago and found wanting, with the results too inconsistent to be any use. The mechanism was also mysterious: no one knew how or why electric fields might boost growth. So what exactly is going on in China's new greenhouses? Can you really improve agriculture through the power of electric fields – and if so, how?

It was Finnish physicist Karl Selim Lemström who introduced the world to the idea of electroculture in the …

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https://www.scmp.com/news/china/science/article/3043280/chinas-electrifying-idea-stop-african-swine-fever-high-voltage

China's electrifying idea to stop African swine fever: a high-voltage pigsty

Researchers to wire up pens for 2,000 pigs and generate an electric field they believe can kill germs

A farm in central China that previously conducted the experiment reported no cases of swine fever

by Stephen Chen

Scientists are planning a high-voltage electricity experiment at a farm in southwestern China to create cleaner conditions for animals and explore whether doing so could help halt the African swine fever
pandemic.

Cables will be installed around pens housing about 2,000 pigs to create an electric field – an invisible force surrounding an electric charge – which the scientists believe will purify the air. They aim to test whether a method already believed to improve animal welfare can restrict the spread of the pandemic, which has decimated China's hog herd.

The experiment will be conducted at a medium-sized hog farm in Chengdu, in China's largest pig-rearing province, Sichuan.
Led by Professor Liu Binjiang, a government scientist in northeastern China, it was inspired by Liu's work on a national "electro culture"
programme that has been shown to benefit crops by using a combination of electric field and artificial lighting to stimulate plant growth and reduce diseases.

This time, Liu and collaborators will generate a static electric field of 50 kilovolts – more than 400 times the voltage in a standard US household plug.

They believe the high-voltage discharges could break down chemicals such as ammonia that generate unpleasant odours, reduce biological aerosol by 50 to 90 per cent, kill germs and generate negatively charged particles in the air that bind to air-polluting chemicals and make them harmless.

Despite the high voltage, the volume of electrons in the cable will be extremely low, at about 1 microampere, producing an electric field that would not be harmful to animals or staff, according to the researchers.

Pig pens are to be wired with cables and dischargers to generate an electric field, which is believed to purify air. Photo: Professor Liu BinjiangPig pens are to be wired with cables and dischargers to generate an electric field, which is believed to purify air. Photo: Professor Liu Binjiang
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"The air quality [for the pigs] should improve when the device is powered up," Liu said. "Electricity is one of the many ways to improve living conditions for farm animals. We have a long to-do list."

When the high-voltage electricity was used to improve air quality at a farm in central China's Hubei – one of the provinces hit worst by African swine fever – none of its pigs died from the virus, according to Liu.

Electrifying pig farms to create force fields that scrub the air of deadly viruses could be the next big breakthrough China needs to restrict the spread of ASF.

It had been deployed to enhance animal welfare and prevent airborne diseases such as foot and mouth, but the lack of African swine fever cases was a surprise. It led the team to hypothesise that the electric field had caused a change in the environment that prevented the virus thriving.

The deadly African swine fever pandemic has tended to spread more easily among pigs living in dirty, unhealthy conditions, according to some studies.

PATENTS

https://worldwide.espacenet.com/patent/search/family/034148888/publication/CN2609910Y?q=in%20any%20%22Liu%20Binjiang%22&queryLang=en
Inventors: LIU BINJIANG, et al.

CN2609910
Electric purifying aseptic sterilizing device for animal house
[PDF]

Abstract
The utility model relates to an electric purifying aseptic detoxicating device for a livestock and poultry house, which can purify air and kill pathogenic microorganisms in the air and on the object surfaces in the livestock and poultry house at any time, and is characterized in that the electrode net which consists of a main supporting insulator, an auxiliary supporting insulator, a high voltage electrode wire and an ozone generating assembly, and is suspended above the inner space of the livestock and poultry house is supplied with power through a direct high voltage power supply which is controlled by a time controller. Therefore, a space direct corona electric field is formed by

the electrode net, the ground surface of the livestock and poultry house and the building structural surfaces, and meanwhile, the electrode net discharges electric power into the air and produces high energy charged particles and ozone. The space direct corona electric field, the high energy charged particle and ozone simultaneously purify and sterilize the dust carrying germ and virus, flying foam in the air and pathogenic microorganisms on the surfaces of solid and liquid medium in the livestock and poultry house.

CN202011770
Electric treatment device for cultivation water body
[PDF]

Abstract
The utility model discloses an electric treatment device for a cultivation water body, which is provided with a shell, wherein a first electrode with the two ends connected with the shell is arranged on a center line of the shell; a first electrode contact is arranged at one end of the first electrode; a second electrode fixed on the inner wall of the shell is sheathed at the middle part of the first electrode; a second electrode contact penetrating through the shell is connected with the second electrode; and a water inlet and a water outlet are respectively arranged on the shell at the two ends of the second electrode. Injurious protozoa or large living beings in the cultivation water which enter the shell by circulation can be killed instantly with the insect-killing efficiency of 100%, thereby ensuring that no bacteria and insects live in the whole pond. The electric treatment device for the cultivation water-body does not need aeration treatment and the like and has the advantages of simple structure, convenience in use, good sterilizing and insect-killing effect, low treatment cost of the water body and the like.

CN102167426A
Electric treatment device for culture water body
[PDF]

Abstract
The invention discloses an electric treatment device for culture water body. The device comprises a shell; the center line of the shell is provided with a first electrode of which two ends are connected with the shell; one end of the first electrode is provided with a first electrode contact; a second electrode which is fixed on the inner wall of the shell is sleeved in the middle of the first electrode; a second electrode contact which passes through the shell is connected with the second electrode; and the shell of two ends of the second electrode is provided with a water inlet and a water outlet. The device can instantly kill harmful protozoa or large-scale organisms of the culture water which circularly enters the shell and guarantee the water in the whole pond can be sterile, and the insect killing efficiency is 100 percent. In the device, aeration treatment and other treatment are not needed, and the device has the advantages of simple structure, good sterilization and insect killing effect, low water treatment cost and the like, and is convenient to use.

CN1833479A
Electrical treatment method and appts for soil continuous prodn obstacle
[PDF]

Abstract
An electric treating method for getting over the continuous cropping obstructions of soil, such as infectious diseases and pests, the harmful substances including organic acid and high pH value, features that two electrodes connected to the positive and negative ends of power supply respectively are parallelly and oppositely buried in the soil whose water content is 5-40% and a voltages is applied across them for electrolyzing the soil. Its apparatus features that the positive end of the second winding of a transformer is connected via diode to one electrode and its negative end is directly connected to another electrode.

CN2917839Y
Soil sequential cropping obstacle electricity treating plant

[PDF]

Abstract

The utility model discloses a continuous cropping obstacle electric processing device for the soil. The utility model is provided with a transformer B and is characterized in that: the secondary positive terminal of the transformer B connects with an electrode (1) via a diode D, the negative terminal of the transformer B connects with an electrode (2). By adopting the method, the device may get rid of the soil-borne diseases, and organic acids and harmful matters excreted by root system, and continuous cropping obstacles such as quite high PH valve of the soil.
