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# NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA



# GB/Z 43996.1-2024

# Fine bubble technology - Agricultural applications - Part 1: Test method for evaluating the growth promotion of hydroponically grown lettuce

微细气泡技术 农业应用 第1部分：评价水培生菜生长促进作用的测试方法

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**Standardization Administration of the PRC**

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## Foreword

This document is in accordance with the provisions of GB/T 1:1-2020 "Guidelines for standardization work Part 1: Structure and drafting rules for standardization documents" Drafting: This document is part 1 of GB /Z 43996 "Agricultural Application of Microbubble Technology": GB /Z 43996 has published the following part:

--- Part 1: Test method for evaluating the growth promotion effect of hydroponic lettuce;

--- Part 2: Test method for evaluating the germination promotion effect on barley seeds: This document is modified to adopt ISO /T S23016-1:2019 "Agricultural application of microbubble technology Part 1: Evaluation of hydroponic lettuce growth The document type was adjusted from ISO technical specifications to my country's national standardization guidance technical documents: This document has made the following structural adjustments compared to ISO /T S23016-1:2019:

--- 3:2 of ISO /T S23016-1:2019 has been deleted, and the subsequent item numbers have been moved forward: The technical differences between this document and ISO /T S23016-1:2019 and their reasons are as follows:

--- Changed the reference documents of the introductory words of terms and definitions, and replaced ISO 20480-1 and GB/T 41914:2 with GB/T 41914:

1 Replaced ISO 20480-2 (see Chapter 3) to adapt to my country's technical conditions;

--- The term "micro bubble generation system" and its definition (see 3:2 in ISO /T S23016-1:2019) have been deleted to improve operability: Acting nature: Please note that some of the contents of this document may involve patents: The issuing organization of this document does not assume the responsibility for identifying patents: This document was proposed by the Chinese Academy of Sciences: This document is under the jurisdiction of the National Technical Committee for Standardization of Microbubble Technology (SAC/TC584): This document was drafted by: Taizhou Juna New Energy Co:, Ltd:, Shaoxing University of Arts and Sciences, Shanghai Ocean University, Nanjing Guoke Agricultural Science and Technology Development Co:, Ltd:, Shaoxing Science and Technology Industry Investment Co:, Ltd:, Ningbo Haibo Group Co:, Ltd:, Southeast University, Beijing

University of Aeronautics and Astronautics, Tongji University University, National Center for Nanoscience and Technology, Jiangsu Agricultural and Animal Husbandry Science and Technology Vocational College, East China University of Science and Technology, Shanghai Advanced Research Institute of the Chinese Academy of Sciences, Zhengzhou Light Industry University of Technology, Wuzha Village Shareholding Economic Cooperative, Zhangqiao Town, Taixing City, Taizhou City, and Shanghai Fruit Industry Association: The main drafters of this document are: Liang Qifeng, Ding Rong, Liang Hejun, Zhu Rong, Chen Xiaoqing, Xia Shaohua, Lü Junpeng, Liu Shu, Li Pan, Chen Lan, Wang Jianguo, Zhai Xujun, Xu Xiao, Shao Yue, Chen Guyi, Yuan Wenjun, Li Jixiang, Liu Nan, Xu Jingxiang, Zhu Mengxue, Wang Jianjun, and Zhu Longzhou:

In recent years, the application of micro-bubble technology in water environment, mechanical cleaning and other fields has been successful: The application in the fields of breeding and food industry has also attracted great attention from the market, because it can enhance the growth of agricultural and aquatic products and improve the quality: Various related industries are using micro bubble generation systems to transform micro bubbles into The technology was introduced into farmland, opening up a new market for micro-bubble generation systems: However, the transfer of technology from microbubble technology to the fields of agriculture, aquaculture and food industry technology has not yet been achieved: There is no consensus on the microbubble generation technology or its generation technology, and the evaluation results of the microbubble promotion effect cannot be simultaneously recognized by microbubble generation system suppliers and users: In addition, due to the diversity of agricultural and aquatic products, it is difficult to adopt a systematic approach to select and apply micro-bubble generation: system: Performance evaluation based on standardized processes to obtain objective evidence aims to connect the two technologies and promote microbubble technology in the global market In order to accelerate the formation of a healthy global market, technology stakeholders are eager to develop relevant evaluation methods: This document aims to meet the requirements of the Food and Agriculture Industry by specifying a method for the evaluation of fine bubble generating systems used in agriculture, aquaculture and the food industry: The evaluation was conducted by applying the fine bubble water produced by the fine bubble generation system to lettuce cultivation and measuring its growth: As a popular vegetable, the test data generated by the evaluation of lettuce can also be used to represent the test system's The growth process of lettuce is much simpler than other vegetables, which makes the test process easier: The parameter measured is the yield of lettuce during a specified growth period with and without microbubbles: Changes: Due to the continuous development of technology, performance parameters are rapidly improving, so no quantitative standards for evaluation are specified in this document: GB /Z 43996 "Agricultural Application of Microbubble Technology" aims to provide a general guide to the principles and It is required to be standardized and is planned to consist of four parts:

--- Part 1: Test method for evaluating the growth promotion effect of hydroponic lettuce: The

purpose is to establish the effect of ultra-fine bubble water on the growth promotion of hydroponic lettuce: Growth test method:

--- Part 2: Test method for evaluating the effect of ultra-fine sparkling water on promoting germination of barley seeds: Germination test method:

--- Part 3: Guidance on the minimum number concentration of ultrafine bubbles for promoting germination of barley seeds: Minimum concentration of ultra-fine bubbles for buds:

--- Part 4: Test method for the number concentration of ultrafine bubbles that promotes germination of barley seeds: Test method for ultrafine bubble number concentration of seed germination: Agricultural Application of Microbubble Technology Part 1: Evaluation of the growth promotion effect of hydroponic lettuce Test Methods



## 1 Scope

GB/Z 43996.1-2024 gives a test method for one of the most frequently made and least substantiated claims about fine bubble technology: that aerating irrigation or nutrient water with micro and nano bubbles makes plants grow better. The proposed mechanism is plausible - more dissolved oxygen at the root zone, where hydroponic systems are often oxygen-limited - but plant growth responds to light, temperature, nutrient concentration and cultivar at least as strongly, so a trial that does not control them can produce whatever result the person running it hoped for. Hydroponic lettuce is chosen as the test subject precisely because it removes the most troublesome variable of all, the soil, and grows fast and uniformly enough to give a measurable answer in weeks. This part describes a method for evaluating the growth-promoting effect of fine bubble water on hydroponically grown lettuce by measuring the increase in stem and leaf volume over a defined growth period. As a GB/Z it is a guiding technical document. Under ICS 19.020 and CCS A20, it is written for fine bubble equipment suppliers, for agricultural research institutes, and for the growers evaluating a claim before buying.

This document describes a method for evaluating the growth-promoting effect of microbubble water on hydroponic lettuce by measuring the increase in stem and leaf volume during a specific growth period: Testing method: This document applies to tests to evaluate the growth promotion effect of fine bubble technology on hydroponic lettuce in agricultural applications:

## 2 Normative references

The contents of the following documents constitute the essential clauses of this document through normative references in this document: For referenced documents without a date, only the version corresponding to that date applies to this document; for referenced documents without a date, the latest version (including all amendments) applies to This

document: GB/T 41914:

1 Microbubble technology Microbubble use and measurement general rules Part 1: Terminology ( GB/T 41914:1- 2022, ISO 20480-1:2017,IDT) GB/T 41914:

2 Microbubble technology - General rules for the use and measurement of microbubbles - Part 2: Classification of microbubble properties ( GB/T 41914:2-2022, ISO 20480-2:2018, MOD)

## 3 Terms and definitions

The terms and definitions defined in GB/T 41914:1 and GB/T 41914:2 and the following apply to this document: 3:

1 Plant Factory Promoting systematic batch growth and production of plants under controlled internal environmental conditions (such as temperature, carbon dioxide and liquid fertilizer, etc:) facilities: 3:

2 Fine bubble waterfinebubblewater Water containing fine bubbles used in plant factories (3:1): 3:

3 Raw water Used in the production of fine sparkling water (3:2) and as reference water: 3:4 fine bubble section Use micro-bubble water in areas where plants are grown:

Note: In this document, the plant grown is lettuce: 3:

5 Control section The area where plants are grown using raw water (3:3) as a comparison to the fine bubble area: