

ISO/~~DIS~~ PRF 23016-1:2024(en)

ISO/TC 281/~~WG 3~~

~~Date: 2024-09-10~~

Secretariat: JISC

Date: 2025-05-28

Fine bubble technology — Agricultural applications — ~~—~~ ==

Part 1:  
Test method for evaluating the growth promotion of hydroponically  
grown lettuce

iTeh Standards  
(<https://standards.itih.ai>)  
Document Preview

ISO/PRF 23016-1

<https://standards.itih.ai/catalog/standards/iso/733ef9dc-68b1-429a-a137-14e78acfea2c/iso-prf-23016-1>

**PROOF**

Edited DIS - MUST BE USED FOR FINAL DRAFT

ISO/~~DIS-PRF~~ 23016-1:~~2024~~(~~F~~2025~~(en)~~)

© ISO ~~2024~~2025

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ~~ISO's~~ISO's member body in the country of the requester.

ISO ~~Copyright Office~~ copyright office  
CP 401 • Ch. de Blandonnet 8  
CH-1214 Vernier, Geneva  
Phone: + 41 22 749 01 11  
~~Email:~~ E-mail: [copyright@iso.org](mailto:copyright@iso.org)  
Website: [www.iso.org](http://www.iso.org)

Published in Switzerland.

# iTeh Standards (<https://standards.itih.ai>) Document Preview

ISO/PRF 23016-1

<https://standards.itih.ai/catalog/standards/iso/733ef9dc-68b1-429a-a137-14e78acfea2c/iso-prf-23016-1>

Contents

Foreword..... iv

Introduction.....v

1 Scope..... 1

2 Normative references..... 1

3 Terms and definitions..... 1

4 Test method for growth promotion performance on lettuce ..... 2

4.1 Conditions of test environment..... 2

4.2 Test system and related apparatus ..... 3

4.3 Materials for test..... 5

4.4 Preparation for test..... 5

4.5 Preliminary test for confirmation of reproducibility..... 5

4.6 Test procedure..... 6

4.7 Calculation of degree of growth promotion ..... 8

5 Test report..... 8

Annex A (informative) Example of test results for lettuce growth promotion performance.....10

Annex B (informative) Example of recording format for measurement figures of environmental parameters..... 14

Annex C (informative) Example of confirmation test results .....15

Bibliography .....30

Document Preview

<https://standards.iteh.ai/catalog/standards/iso/733ef9dc-68b1-429a-a137-14e78acfea2c/iso-prf-23016-1>

## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at [www.iso.org/patents](http://www.iso.org/patents). ISO shall not be held responsible for identifying any or all such patent rights.

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 281, *Fine bubble technology*.

This first edition of ISO 23016-1 cancels and replaces ISO/TS 23016-1:2019, which has been technically revised.

The main changes are as follows:

- ~~—~~ a new [Annex C](#) ~~Annex G~~ has been added to give an example of confirmation test results.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

## Introduction

The recent progress in the application of fine bubble technology exhibits successes in the various technical fields such as environmental technology in water and washing and cleaning technology for mechanical engineering. The applications for agro- and aqua- farming and food industrial field also draw high interests of markets in view of fine bubble enabled performance in enhancing growth of agro- and aqua- products, improving their quality, saving resources for farming and ensuring safety of the food products. Various industries engaged in such products are introducing the fine bubbles to their farming field by applying fine bubble generating systems, eventually creating new market for the generating systems.

However, since technology transfer from fine bubble technology to technology fields of agro- and aqua-farming and food industries is not well supported by common understanding of the fine bubbles or their generating technology, results of evaluation on fine bubble enhanced performance cannot be accepted commonly by both generating system suppliers and its users at the transaction scene. Furthermore, a variety of agro- and aqua- farming products makes it difficult to adopt a systematic approach for selection and application of generating systems.

The performance evaluation based on objective evidence resulting from standardized procedures is intended to bridge the two technologies and facilitate diverse fields of applications for fine bubble technology in the global market. In order to accelerate sound global market formation, development of test procedures is urgently demanded by both technology stakeholders.

This document is intended to meet these needs by specifying the test procedure to be applied to the generating system for agro- and aqua- farming and food industries uses. The evaluation is made by applying fine bubble water generated by the object system to lettuce and by measuring its growth. The product, lettuce, is globally accepted and the yielded test data represents the performance of the tested system over other products in such major product family as, for example, leaf vegetable. The growth process of lettuce is much simpler than other vegetables making the measuring process much easier in the test procedure. The specified test conditions, namely the environment for growth, are also easy to be controlled allowing many testing plants globally available. The parameter measured is the change in the harvested mass of lettuces with application of fine bubbles compared to that without application in a specified period of growth.

Since the performance in terms of parameters is improving rapidly as the technology evolves, the quantitative criteria for the testing are not specified in this document.