

Tentative Translation

JAS
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JAPANESE AGRICULTURAL
STANDARD

**Cultivation environment management of leafy vegetables
in plant factory with artificial lighting**

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Ministry of Agriculture, Forestry and Fisheries

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Incorporated Administrative Agency
Food and Agricultural Materials Inspection Center

Contents	Page
1 Scope	1
2 Terms and definitions	1
3 General requirements	2
4 Facility requirements	2
4.1 General	2
4.2 Clean areas	2
5 Management requirements	3
5.1 Cultivation control	3
5.2 Shipment control	5
5.3 Material control	5
5.4 Worker management and training	6

Foreword

This Japanese Agricultural Standard has been established by the Minister of Agriculture, Forestry and Fisheries through deliberations at the Council for the Japanese Agricultural Standards as the result of proposal for establishment of Japanese Agricultural Standard submitted by the Japan Plant Factory Industries Association, Panasonic Corporation, and Mitsui & Co., Ltd. with the original bill being attached, based on Article 4, paragraph 1 of the Act on Japanese Agricultural Standards.

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Cultivation environment management of leafy vegetables in plant factory with artificial lighting

1 Scope

This document specifies the management of the cultivation environment of leafy vegetables in plant factories with artificial lighting.

2 Terms and definitions

For the purpose of this document, the following terms and definitions apply.

2.1

plant factory with artificial lighting

facility for the stable production of leafy vegetables that controls the growing environment in closed spaces using artificial lighting instead of sunlight

2.2

cultivation environment management

management system to cultivate leafy vegetables by controlling the growing environment, and maintaining the characteristics of cultivated leafy vegetables during the packaging and shipping processes

2.3

clean area

clean section classified by the degree of cleanliness within *a plant factory with artificial lighting* (2.1)

2.4

culture solution

solution prepared by adding elements required for the growth of leafy vegetables to water suitable for food manufacturing (see 5.1.5)

NOTE Required elements include carbon, hydrogen, nitrogen, phosphorus, potassium, magnesium, and sodium.

3 General requirements

3.1 Control criteria

In order to implement cultivation environment management that meets customer requirements, control criteria related to Articles 4 and 5 shall be established, maintained, and continuously improved.

NOTE The requirements specified in this document are focused on the control points and their processes that constitute the cultivation environment management system. Control criteria are to be established in consideration of the requirements of customers including food manufactures, wholesalers, and retailers. Therefore, different criteria can be established for each type of leafy vegetable to be provided to customers.

3.2 Zoning

The facility shall be divided into clean and other areas, and leafy vegetables shall be cultivated and packaged in clean areas.

4 Facility requirements

4.1 General

Facilities shall:

- a) adopt condensation prevention structures to prevent microbiological growth;
- b) have exhaust equipment if there is a possibility that the facilities will be fumigated in order to control microorganisms and insects, etc.;
- c) have drainage equipment to ensure that discharged water meets legal laws and regulations for wastewater treatment applied to locations in which plant factories with artificial lighting are built.

4.2 Clean areas

Clean areas shall:

- a) have equipment to prevent infestations of rodents and insects, etc. at the entrance;

NOTE Equipment includes light traps and sticky traps.

- b) provide workers who enter clean areas with space to change into clean work clothes and shoes, etc. dedicated for clean areas, and equipment to clean their hands and fingers at the entrance;

NOTE Equipment to clean hands and fingers includes cleaning equipment with running water.

- c) have equipment to remove foreign matter that adhered to the work clothes and shoes, etc. of workers who enter clean areas at the entrance;

NOTE Equipment includes an air shower and shoe disinfection tanks.

- d) have equipment to purify ambient air when such air is introduced into clean areas;

NOTE Equipment includes filters.

- e) have dust-proof construction;

- f) have floors, whose surface is finished with waterproof materials to prevent puddling, and whose structures are easy to clean.

- g) ensure that any equipment that comes in contact with culture solution or water is corrosion-proof;

- h) have equipment to remove foreign matter and prevent microbiological growth in culture solution during leafy vegetable cultivation processes;

NOTE Equipment that removes foreign matter includes filters and magnets, and equipment that prevents microbiological growth includes UV pasteurizers, heat sterilizers, and ozone generators;

- i) ensure that equipment, machines, and apparatus that entail risks of foreign matter interfusion to leafy vegetables or microbiological growth are corrosion-proof, durable, or antifouling;

- j) have equipment to detect foreign matter that adhered to leafy vegetables to be shipped except in cases where visual inspections are conducted to detect such substances.

NOTE Equipment includes metallic detectors and X-ray inspection machines.

5 Management requirements

5.1 Cultivation control

5.1.1 Seeds whose production history can be confirmed shall be used for cultivation.

NOTE Production history items include seed supply sources, lots, varieties, and production area.

5.1.2 The growing environment shall be controlled by regulating factors including light, temperature, humidity, carbon dioxide concentration, nutrient elements, and moisture.

5.1.3 Microbiological growth in the culture solution used for cultivation shall be controlled (e.g. aerobic plate count of less than 1×10^5 / mL and absence of E. coli bacteria) to ensure that leafy vegetables meet the shipment criteria (see **5.2.2**).

5.1.4 With regard to the culture solution used for cultivation, the relevant information about the impact on humans and the environment, and the safety information required to address any harm (e.g. safety data sheet) shall be retained if available.

5.1.5 Water for cultivation shall be suitable for food manufacturing.

NOTE Water suitable for food manufacturing refers to tap water provided by public utilities as specified in Article 3, paragraph 2 of the Water Supply Act (Act No. 177 of 1957), private water supply as specified in paragraph 6 of the same article, and simple private water supply as specified in paragraph 7 of the same article.

5.1.6 The cleanliness of equipment, machines, and apparatus that come in contact with culture solution or leafy vegetables to be cultivated shall be maintained by cleaning or sterilizing, etc. The locations of facilities, or machines and apparatus whose cleanliness is subject to monitoring shall be identified. The cleanliness of relevant locations, etc. shall be checked periodically, and necessary measures shall be implemented based on the results.

NOTE Methods of checking the cleanliness include visual inspections of foreign matter, adenosine triphosphate (ATP) measurements by sampling, and aerobic plate counting.

5.1.7 The cleanliness of floors in clean areas shall be maintained.

5.1.8 The locations for monitoring the number of airborne bacteria in clean areas shall be identified. The number of airborne bacteria in relevant locations shall be calculated periodically, and necessary measures shall be implemented based on the results.

NOTE Methods of calculating the number of airborne bacteria include the calculations of bacteria that adhered to the culture media and the calculations of bacteria in aspirated air.

5.1.9 Agricultural chemicals shall not be used for leafy vegetables during their cultivation and after harvesting.

5.1.10 In the event there is an infestation and proliferation of rodents and insects, etc. in clean areas, extermination of the target rodents and insects, etc. shall be implemented. Identification of the causes and recurrence prevention measures shall be implemented.

NOTE Extermination methods include fumigation.

5.1.11 Harvested leafy vegetables shall be managed to prevent cross-contamination by culture solution and other materials.

5.2 Shipment control

5.2.1 On the packages, containers, and invoices of leafy vegetables to be shipped, identification numbers and/or codes shall be affixed in order to ensure the traceability of records on cultivation control (see 5.1) and material control (see 5.3).

NOTE In addition to identification numbers and/or codes, it is advisable to specify the transportation and storage temperatures (e.g. below 10 °C) after shipments.

5.2.2 The shipment inspection frequency is to be determined reasonably in accordance with the types, production quantity and conditions of leafy vegetables, as well as the properties of foreign substance whose contamination and interfusion should be prevented, while leafy vegetable shipment criteria are to be established as part of control criteria (see 3.1). Shipment inspections [e.g., inspections of foreign matter, microorganisms (aerobic plate and E. coli bacteria counts, etc.) and visual appearance inspections of physiological disorders, etc.] shall be conducted in accordance with the frequency and shipment criteria. If the inspection results do not meet the relevant shipment criteria, then identification of the causes and recurrence prevention measures shall be implemented.

NOTE In addition to shipment inspections, it is advisable to conduct appearance inspections after storing under the conditions reasonably determined in accordance with assumed distribution and other conditions.

5.2.3 Inspections of residual agricultural chemicals for leafy vegetables shall be conducted periodically.

NOTE It is recommended to conduct periodic inspections including the timing for changing seed lots. With regard to components to be inspected, it is necessary to take account of the components of agricultural chemicals that can be used for the sterilization of relevant seeds.

5.3 Material control

5.3.1 In order to prevent the interfusion or infestation of foreign matter, rodents, and insects, etc. in clean areas, materials used for cultivation, packaging and packing of leafy vegetables shall be accepted only after confirming that their outer packages are free from breakages and smudges.

5.3.2 When storing accepted materials used for cultivation, packaging and packing of leafy vegetables, they shall not be stored directly on the floor in order to prevent the interfusion or infestation of foreign matter, rodents, and insects, etc. In cases where accepted materials are packed, they shall be stored in their packings

5.3.3 The packing materials (e.g. cardboard) used for packing accepted materials shall not be brought into clean areas.

5.3.4 With regard to materials used for the cultivation, packaging, and packing of leafy vegetables, the relevant information about their impact on humans and the environment, and safety information required to address any harm (e.g. safety data sheet) shall be retained if available.

5.4 Worker management and training

The workers shall be provided with necessary training in order to ensure that they implement cultivation environment management pursuant to the control criteria with regard to **5.1** to **5.3**.

NOTE Training contents include, but not be limited to the following items:

- changes to clean work clothes, gloves, masks, caps, and shoes, etc. prior to entering clean areas;
- sterilization of hands and fingers by rinsing them under running water and using antiseptic solution prior to entering clean areas;
- removal of foreign matter that adhered to work clothes and shoes, etc. prior to entering clean areas;
- check the health of workers prior to commencing work (for example, there is a method to prevent workers from working in clean areas in cases where they fail to meet reasonably determined criteria in terms of body temperature and stool examinations).