Measures for Radioactive Materials in Foods

# Setting of Standard Limits for Radioactive Materials in Foods and Distribution/Consumption Restrictions

**Food Safety Commission of Japan (FSCJ)**

**Ministry of Health, Labour and Welfare (MHLW)**

**Establishment of the provisional regulation values due to urgent need (March 17, 2011)**

→ Request an assessment (March 20, 2011) → FSCJ

**Urgent Report (March 29, 2011)**

ICRP) Effective dose: 10 mSv/year
As an emergency response,
it cannot be regarded as inappropriate.

Radioactive cesium
5 mSv/year is a level rather on the safe side.

→ Send assessment results → MHLW

**Decision to maintain the provisional regulation values (April 4, 2011)**

**Conducted risk assessment continuously**

**The Commission compiled the assessment results. (October 27, 2011)**

→ Send assessment results → MHLW

**Establishment of the standard limits: 1 mSv/year**
**The new standard limits were put into force in April 2012.**

**Radiation Monitoring Survey** → **Exceeding the standard limits** → (When extensive areas are found to be affected) **Distribution restrictions** → (When significant levels of radioactive cesium were detected) **Consumption restrictions**

食品安全委員会 内閣府 Food Safety Commission of Japan

厚生労働省 Ministry of Health, Labour and Welfare

Prepared based on the FSCJ's briefing material "Health Effects of Radioactive Materials in Foods" and the MHLW's "Measures for and Current Status of Radioactive Materials in Foods"

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# Publication of the Inspection Results Concerning Radioactive Materials in Foods

The national government proposes food items to be inspected and inspection frequencies, and respective prefectural governments formulate their inspection plans and carry out inspections accordingly.

Inspection results are publicized by the Ministry of Health, Labour and Welfare and respective local governments.


"Measures for Radioactive Materials in Foods," Ministry of Health, Labour and Welfare

http://www.mhlw.go.jp/shinsai_jouhou/shokuhin.html (in Japanese)

Database of radioactive substances in food:

http://www.radioactivity-db.info/ (in Japanese)

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Ministry of Health, Labour and Welfare

# Standard Limits Applied from April 2012

○ Immediately after the accident, foods in conformity to the provisional regulation values were generally assessed to have no ill effects and their safety was guaranteed. However, the annual dose limit was reduced to 1 mSv from 5 mSv, which had been permitted under the provisional regulation values, and current standard limits were set based thereon from the perspective of further ensuring security and safety of foods.

## ○Provisional regulation values for radioactive cesium*1

| Category | Regulation value |
|---|---|
| Drinking water | **200** |
| Milk and dairy products | **200** |
| Vegetables | **500** |
| Cereals | |
| Meat, eggs, fish and others | |

## ○Present standard limits concerning radioactive cesium*2

| Category | Standard limit |
|---|---|
| Drinking water | **10** |
| Milk | **50** |
| General foods | **100** |
| Infant foods | **50** |

(Unit: Bq/kg)

*1 The regulation values were set also taking into consideration radioactive strontium.

*2 The standard limits were set also taking into consideration radioactive strontium, plutonium, etc.

Prepared based on the Ministry of Health, Labour and Welfare's website, "Measures for Radioactive Materials in Foods"

# Food Categories [Reference]

## ● Basic idea

Drinking water, infant foods and milk, for which special consideration is required, are separately classified into three different categories, while the others are all classified into a single category as general foods. In this manner, all foods and drinks are classified into four categories.

| Food category | Reasons to establish the limits | Range of foods |
|---|---|---|
| Drinking water | 1. Water is essential for human life and there is no substitution for water, and its consumption is large.<br>2. WHO's guidance level for radioactive cesium in drinking water is 10Bq/kg.<br>3. Strict management is possible for radioactive materials in tap water. | ○ Drinking water, water used for cooking and tea drinks, which is a substitute for water |
| Infant foods | ○ The Food Safety Commission pointed out that "the susceptibility to radiation may be higher in childhood than in adulthood." | ○ Foods approved to be labeled as "fit for infants" based on Article 26, paragraph (1) of the Health Promotion Act (Act No. 103 of 2002)<br>○ Foods and drinks sold as intended for infants |
| Milk | 1. Children consume a lot.<br>2. The Food Safety Commission pointed out that "the susceptibility to radiation may be higher in childhood than in adulthood." | ○ Milk (cow milk, low-fat milk, processed milk, etc.) and milk drinks specified in the Ministerial Order concerning the Ingredient Standards for Milk and Dairy Products (Order of the Ministry of Health and Welfare No. 52 of 1951) |
| General foods | For the following grounds, foods other than given above are categorized as "general foods."<br>1. Can minimize the influence of individual differences in eating habits (deviation of the foods to be consumed)<br>2. Easy to understand for the general public<br>3. Consistent with international views, such as those of the Codex Alimentarius Commission | ○ Foods other than given above |

Prepared based on the Ministry of Health, Labour and Welfare's website, "Measures for Radioactive Materials in Foods"

Measures for Radioactive Materials in Foods

# Outline of the Results of the Food-related Health Risk Assessment

(Food Safety Commission of Japan (FSCJ), on October 27, 2011)

- **Potential effects of radiation are found when the lifetime additional effective cumulative dose exceeds around 100 mSv. However, radiation dose accumulated in ordinary daily life such as from natural radiation and X-ray exams, etc. is excluded.**

- **In one's lifetime, the susceptibility to radiation may be higher in childhood than in adulthood.(thyroid gland cancer and leukemia)**

  - Risks of leukemia increased in children under the age of five at the time of the accident. (Noshchenko et al. 2010; Data relating to the nuclear accident at Chernobyl)
  - Risks of thyroid gland cancer are higher for children younger at the time of radiation exposure. (Zablotska et al. 2011; Data relating to the nuclear accident at Chernobyl)

  << However, both data contain uncertain points in the estimation of radiation doses, etc. >>

- **It is difficult to identify health effects concerning radiation exposure below 100 mSv.**

  - Inaccuracy in estimation of the amount of exposure
  - Effects of radiation and effects caused by other factors are unlikely to be distinguished.
  - Study population for epidemiological data serving as grounds is not large enough.

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# Basic Knowledge on the Food-related Health Risk Assessment

■ **A study reporting no identification of increased cancer risk in high natural radiation areas in India where the cumulative radiation dose is 500 mSv*1 or higher**

**(Nair et al. 2009)**

## Risk of leukemia mortality

**Radiation-exposed population** ⇔ **Radiation-non-exposed population**

Statistical comparison

↓

**The risk increased for radiation exposure exceeding 200 mSv*1.**
**No differences were observed for radiation exposure less than 200 mSv*1.**

## Risk of cancer mortality*2

**Population exposed to radiation from 0 to 125 mSv** / **Population exposed to radiation from 0 to 100 mSv**

That risk increases as exposure dose increases was statistically

**Confirmed** / **Not confirmed**

*1 In a case of exposure to β-particles or γ-rays, values are multiplied by a radiation weighting factor of one(1).
(Shimizu et al. 1988; Data on atomic bomb survivors in Hiroshima and Nagasaki)

*2 Data covering all solid tumors
(Preston et al. 2003; Data on atomic bomb survivors in Hiroshima and Nagasaki)

# Approach for the Establishment of the Standard Limits ◆ Grounds for the Standard Limits

**Q. Why were the standard limits set based on the annual permissible dose of 1 mSv?**

**A. (i) They are in line with the international indicator based on scientific knowledge.**

**The Codex Alimentarius Commission, which establishes international specifications for foods, has set indicators so that the annual dose does not exceed 1 mSv.**

Note) The International Commission on Radiological Protection (ICRP) considers that stricter requirements below 1 mSv/year would not achieve any significant additional dose reduction. Therefore, based on this, the Codex Alimentarius Commission specifies indicators.

**(ii) They are intended to reduce radiation exposure as low as reasonably achievable.**

**Radiation monitoring surveys have shown considerable decreases over time in radioactivity concentrations measured in foods.**

# Radionuclides Taken into Consideration

## Q. Why are the standard limits set only for radioactive cesium?

○ **The standard limits were set in consideration of all radionuclides whose half-life is one year or longer out of the radionuclides that are supposed to have been released due to the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS based on the assessment by the Nuclear and Industrial Safety Agency.**

| Regulated radionuclides | (Physical) half-life |
|---|---|
| Cesium 134 | 2.1 years |
| Cesium 137 | 30 years |
| Strontium 90 | 29 years |
| Plutonium | 14 years - |
| Ruthenium 106 | 374 days |

* The standard limits are not set for radioactive iodine, which has a half-life as short as 8 days and is no longer detected, nor for uranium that exists within the premises of TEPCO's Fukushima Daiichi NPS at the same level as naturally occurring uranium.

○ **However, as measurements of radionuclides other than radioactive cesium take time, the standard limits are not set for each of them but are calculated and set so that the total dose from other radionuclides does not exceed 1 mSv if only the standard limits for radioactive cesium are met.**

* The maximum doses from radionuclides other than radioactive cesium that people may receive from foods can be calculated by age bracket based on such data as radioactivity concentrations in soil and easiness of transition of radioactive materials from soil to agricultural products. For example, for people aged 19 years or over, doses from radionuclides other than radioactive cesium account for approx. 12% of the total.

## A. While also taking into consideration effects of other radionuclides in calculation, cesium that accounts for the largest percentage and is most easily measured is used as the indicator.

# Approach for the Calculation of the Standard Limits (1/2)

**How was the standard limit figured out to be 100 Bq/kg for general foods based on the annual permissible dose of 1 mSv?**

## 1. Preconditions for calculation

- **For drinking water, the standard limit is set to be 10 Bq/kg in line with the WHO's guidance level.**

  → The annual permissible dose allocated to general foods is **approx. 0.9 mSv (0.88 to 0.92 mSv/y)**, which is obtained by subtracting that for drinking water (approx. 0.1 mSv/y) from the total annual permissible dose of 1 mSv.

- **Domestically-produced foods are assumed to account for 50% of all distributed foods.**

  * The standard limits are calculated on the assumption that domestically-produced foods contain radioactive materials at levels close to the maximum permissible limit.

## 2. Conversion from radioactivity concentrations (Bq) to radiation doses (mSv)

**Radiation dose** (mSv) = **Radioactivity concentration** (Bq/kg) × **Amount of consumption** (kg) × **Effective dose coefficient** (mSv/Bq)

**Under the preconditions mentioned in 1. above, the maximum limit for radioactive materials in 1 kg of general foods is calculated so that doses from general foods do not exceed the annual permissible dose for general foods.**

**(e.g.) < In the case of males aged between 13 and 18 >**

**0.88 mSv = X (Bq/kg) × 374 kg (50% of the annual consumption of foods) × 0.0000181 (mSv/Bq)** (effective dose coefficient in consideration of the effects of all covered radionuclides)

**X = 120 (Bq/kg) (rounded off to three digits)**

* For adults, the effective dose coefficient for Cs-134 is 0.000019 and that for Cs-137 is 0.000013. The effective dose coefficient thus differs by radionuclide. Therefore, based on respective radionuclides' concentration ratios in foods, the effective dose coefficient in consideration of the effects of all covered radionuclides was used for the calculation of the maximum limits.
* Concentration ratios change over time as each radionuclide has a different half-life. Therefore, the coefficient on the safest side over the coming 100 years was adopted.
* The above explanation is just the outline. For more detailed calculation methods, refer to the reference material of the Pharmaceutical Affairs and Food Sanitation Council.

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# Approach for the Calculation of the Standard Limits (2/2)

## 3. Calculation of the upper limits by age bracket

**Intervention level: 1 mSv/y**

Subtract permissible dose for drinking water (approx. 0.1 mSv)

**Permissible dose to be allocated to general foods (approx. 0.9 mSv) determined**

**Age brackets are divided more finely than for the provisional regulation values**

The upper limit is calculated in consideration of **the amount of consumption** and **the conversion factor (effective dose coefficient)** by age bracket.

* **Effects of radionuclides other than cesium** are also taken into account.

| Age bracket | Gender | Upper limit (Bq/kg) |
|---|---|---|
| Under 1 year old | Total average | 460 |
| 1 to 6 years old | Male | 310 |
| | Female | 320 |
| 7 to 12 years old | Male | 190 |
| | Female | 210 |
| 13 to 18 years old | Male | **120** |
| | Female | 150 |
| 19 years old or older | Male | 130 |
| | Female | 160 |
| Pregnant women | Female | 160 |
| **Minimum value** | | **120** |

**Standard limit 100 Bq/kg**

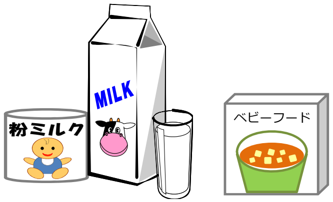
**The standard limit is set based on the strictest upper limit (the minimum value) out of those for all age brackets.**

- **The standard limit results in reflecting requirements for all age brackets.**
- **The standard limit secures an extra margin of safety from the upper limit especially for infants.**

## 4. Standard limits for milk and infant foods

These categories are established in consideration of young children. Therefore, the standard limits should be stricter so that consumption of these foods would not cause any harmful effects even if all of them contain radioactive materials up to the upper limits.

→**The standard limits for milk and infant foods are both set to be 50 Bq/kg**, namely half of the 100 Bq/kg for general foods.



Measures for Radioactive Materials in Foods

# Survey of Distributed Foods (Market Basket Survey)

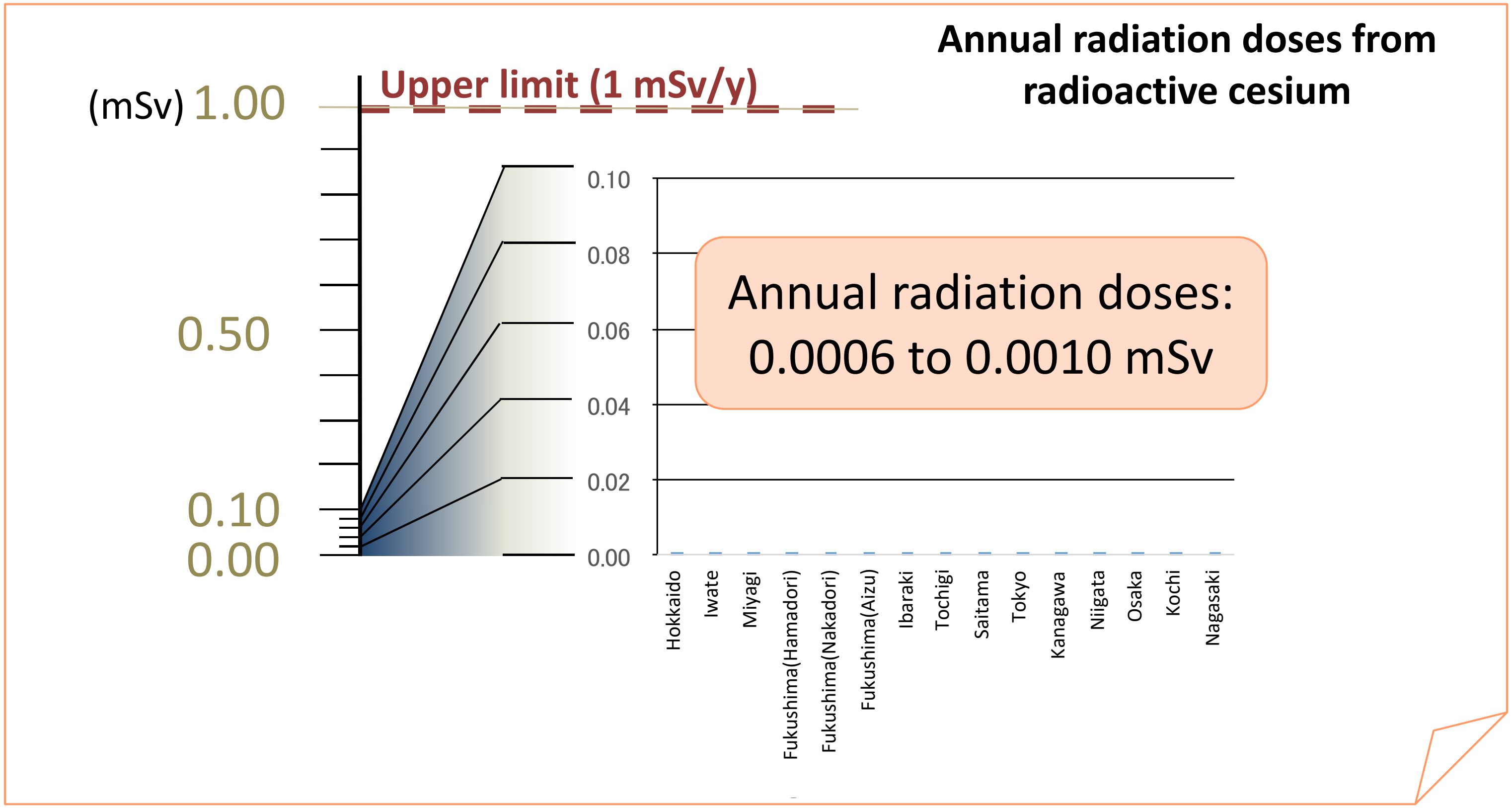
- **A survey was conducted by purchasing foods distributed nationwide and precisely measuring radioactive cesium contained therein.**

  Foods were purchased based on average food consumption by region (based on the National Health and Nutrition Survey) and purchased foods were mixed for measurement.

  ◆Purchased foods were simply cooked in line with ordinary dietary circumstances and measurement was conducted.

  ◆Regarding fresh foods, those produced in the relevant region or the neighboring areas were chosen if possible.

- **Based on the measurement results, radiation doses that people would intake from foods in a year were calculated (surveyed in February and March 2017).**




**Measured effective doses were 1% or lower of 1 mSv/y, based on which the standard limits were established.**

Prepared based on the Ministry of Health, Labour and Welfare's website, "Measures for Radioactive Materials in Foods"

# Prefectures and Food Items to be Inspected (Items for which Cultivation/Feeding Management is Difficult and Log-grown Mushrooms)

## Food items for which cultivation/feeding management is difficult and relevant prefectures to be inspected

| | | Aomori | Iwate | Akita | Miyagi | Yamagata | Fukushima | Ibaraki | Tochigi | Gunma | Chiba | Saitama | Tokyo | Kanagawa | Niigata | Yamanashi | Nagano | Shizuoka |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Items with radioactivity concentrations exceeding the standard limits | Wild mushrooms and wild plants | □ | ● | □ | ◎ | ◎ | ◎ | ● | ◎ | ◎ | ● | □ | □ | □ | ◎ | ◎ | ◎ | ◎ |
| | Wild bird and animal meat | □ | ◎ | □ | ◎ | ● | ◎ | ◎ | ◎ | ◎ | ● | □ | □ | □ | ● | □ | □ | □ |
| Items with radioactivity concentrations exceeding half of the standard limits but not exceeding the standard limits | Wild mushrooms and wild plants | □ | □ | ● | ● | □ | ● | □ | ● | □ | □ | □ | □ | □ | □ | □ | □ | □ |
| | Honey | — | — | — | — | — | ● | — | — | — | — | — | — | — | — | — | — | — |
| Marine fish | | — | □ | — | □ | — | ◎ | ◎ | × | × | ◎ | × | — | — | — | × | × | — |
| Inland water fish | | — | ◎ | — | ◎ | — | ◎ | ◎ | ◎ | ◎ | ◎ | — | — | — | — | — | — | — |

## Log-grown mushrooms to be inspected and relevant prefectures to be inspected

| | Aomori | Iwate | Akita | Miyagi | Yamagata | Fukushima | Ibaraki | Tochigi | Gunma | Chiba | Saitama | Tokyo | Kanagawa | Niigata | Yamanashi | Nagano | Shizuoka |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Log-grown mushrooms | ▲ | ● | ▲ | ● | ▲ | ● | ● | ● | ● | ● | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |

Classification based on inspection results for the latest one year (from April 1, 2016, to February 28, 2017)

◎:Items wherein radioactivity concentrations exceeding the standard limits were detected (for fishery products, those wherein radioactivity concentrations exceeding half of the standard limits were detected)

●:Items wherein radioactivity concentrations exceeding half of the standard limits were detected (excluding those wherein radioactivity concentrations exceeding the standard limits were detected)

□:Items requiring inspections in consideration of the difficulties in management (wild mushrooms and wild plants), the mobility (wild bird and animal meat), or the status of distribution restrictions (marine fish)

▲ : Items requiring cultivation management and monitoring based on the influence of radioactive materials on materials used for production

—:Items that are not classified by relevant prefectures as those requiring inspections based on inspection results for the latest one year

×:Nothing applicable

Prepared based on the Ministry of Health, Labour and Welfare's website, "Measures for Radioactive Materials in Foods"

厚生労働省 Ministry of Health, Labour and Welfare

# Prefectures and Food Items to be Inspected (Items whose Cultivation/Feeding is Manageable (excl. Log-grown Mushrooms))

Food items whose cultivation/feeding is manageable (excl. log-grown mushrooms) and relevant prefectures to be inspected

| | | Iwate | Miyagi | Fukushima | Tochigi |
|---|---|---|---|---|---|
| Items with radioactivity concentrations exceeding half of the standard limits but not exceeding the standard limits | Vegetables | – | – | ● | – |
| | Fruits | – | – | ● | – |
| | Beans | – | – | ● | – |
| | Meat | – | ● | ● | – |
| Rice | | – | – | ■ | – |
| Soybeans | | – | – | ■ | – |
| Buckwheat | | ■ | – | – | – |

* Items requiring continued monitoring as being significantly affected by feeding management (milk and beef meat) are inspected in Iwate, Miyagi, Fukushima, Tochigi and Gunma Prefectures.

<u>Classification based on inspection results for the latest one year (from April 1, 2016, to February 28, 2017)</u>

● :Items wherein radioactivity concentrations exceeding half of the standard limits were detected (excluding those wherein radioactivity concentrations exceeding the standard limits were detected)

■ :Items that are classified as inspection targets in the Appendix

– :Items that are not classified by relevant prefectures as those requiring inspections based on inspection results for the latest one year

# Concepts of Inspection Planning and Establishment and Cancellation of Items and Areas to which Restriction of Distribution and/or Consumption of Foods Concerned Applies

| | Local governments marked with ◎ and ● (those marked with ■ and ▲ should conduct inspections correspondingly) | |
|---|---|---|
| | Municipalities (exceeding half of the standard limits) | Other municipalities |
| Exceeding half of the standard limits | 3 or more samples | 1 or more samples*1 |
| Beef meat | Once every three months for each farm household*2 | |
| Milk | Periodically for each cooler station*3 | |
| Inland water fish<br>Marine fish | Periodically*4 | |

*1: It is permissible to divide a prefecture into multiple zones across municipalities and conduct inspections for three or more samples in each of those zones.

*2: For farm households whose feeding management has been recognized as appropriate by the relevant local government, it would suffice to conduct inspections once every 12 months or so.

*3: This does not apply in cases where the relevant local government recognizes appropriate feeding management and there are no areas subject to distribution restrictions for raw milk and where inspection results for the latest three years are all below half of the standard limits.

*4: Inspections of marine fish by Iwate Prefecture are to be conducted in consideration of the past inspection results.

(For marks, ◎, ● ■ and ▲, refer to p.52 and p.53 of Vol. 2, "Prefectures and Food Items to be Inspected")

Prepared based on the Ministry of Health, Labour and Welfare's website, "Measures for Radioactive Materials in Foods"

厚生労働省 Ministry of Health, Labour and Welfare

# Procedures for Inspections of Radioactive Materials in Foods

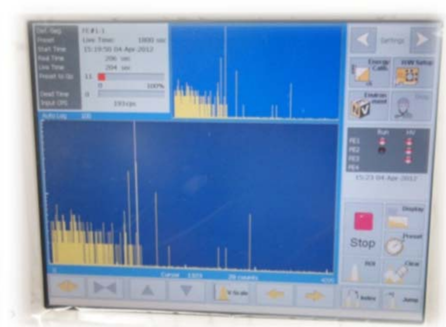
**Inspections are to be conducted combining a rigorous inspection (i) and an efficient screening test (ii).**

**(i) Radionuclide analysis using germanium semiconductor detectors**
**(ii) Screening by measurement of radioactive cesium using NaI scintillation spectrometers**
← Introduced to inspect a larger number of samples in a short time

## < Procedures >

**Shredding** → **Weighing** → **Measurement** → **Analysis**

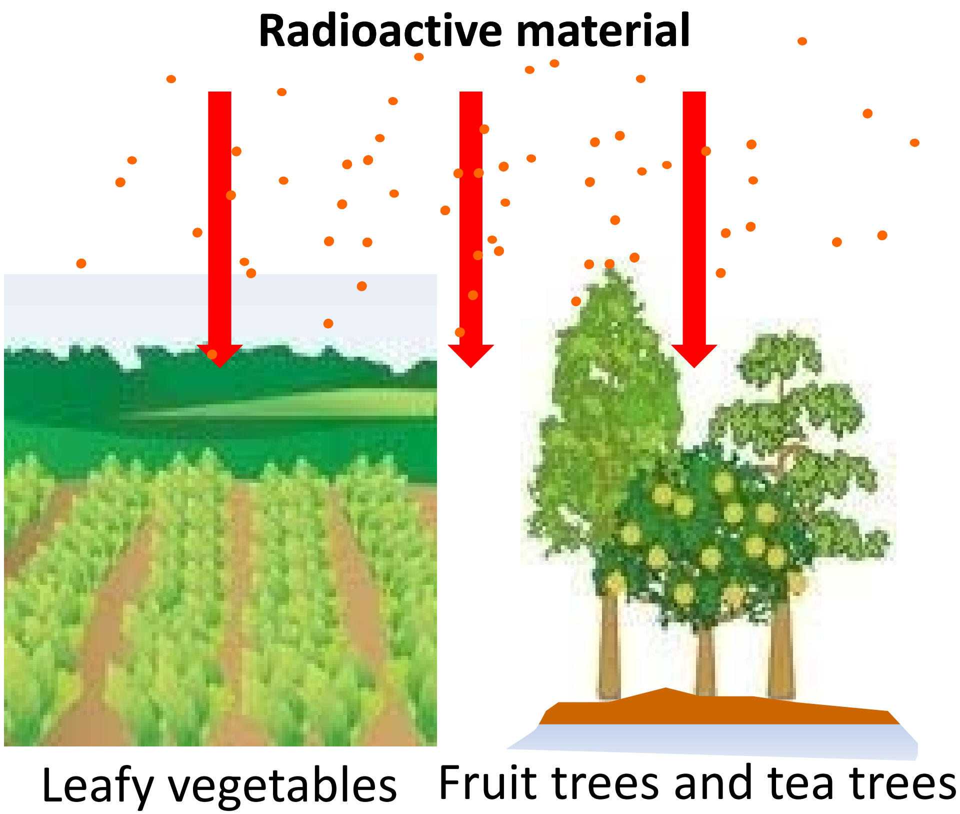


Prepared based on the Ministry of Health, Labour and Welfare's website, "Measures for Radioactive Materials in Foods"

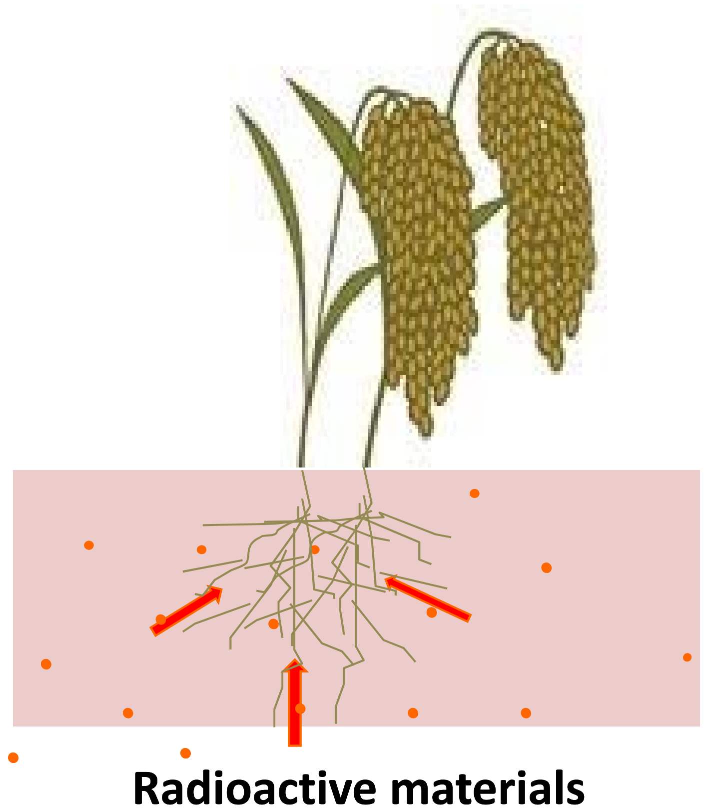
# Contamination Routes for Agricultural Products

Direct contamination due to radionuclide fallout (immediately after the accident)




Radioactive materials adhering to trees translocate to fruits or shoots.

Radioactive materials that fell onto soil are absorbed into crops from the roots.




Prepared based on the "Responses at Farmland" by the Ministry of Agriculture, Forestry and Fisheries (MAFF)

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Measures for Radioactive Materials in Foods

# Measures for Reducing Transfer of Radioactive Materials to Crops (1/5) - Decontamination of Farmland -

## Stripping of topsoil (Topsoil removal)

Scrape away the topsoil to remove radioactive materials which remain in shallow depth

## Inversion tillage

Replace topsoil with subsoil, thereby reducing radioactivity concentrations in the soil layer where plants take root

Prepared based on the "Responses at Farmland" by the Ministry of Agriculture, Forestry and Fisheries (MAFF)

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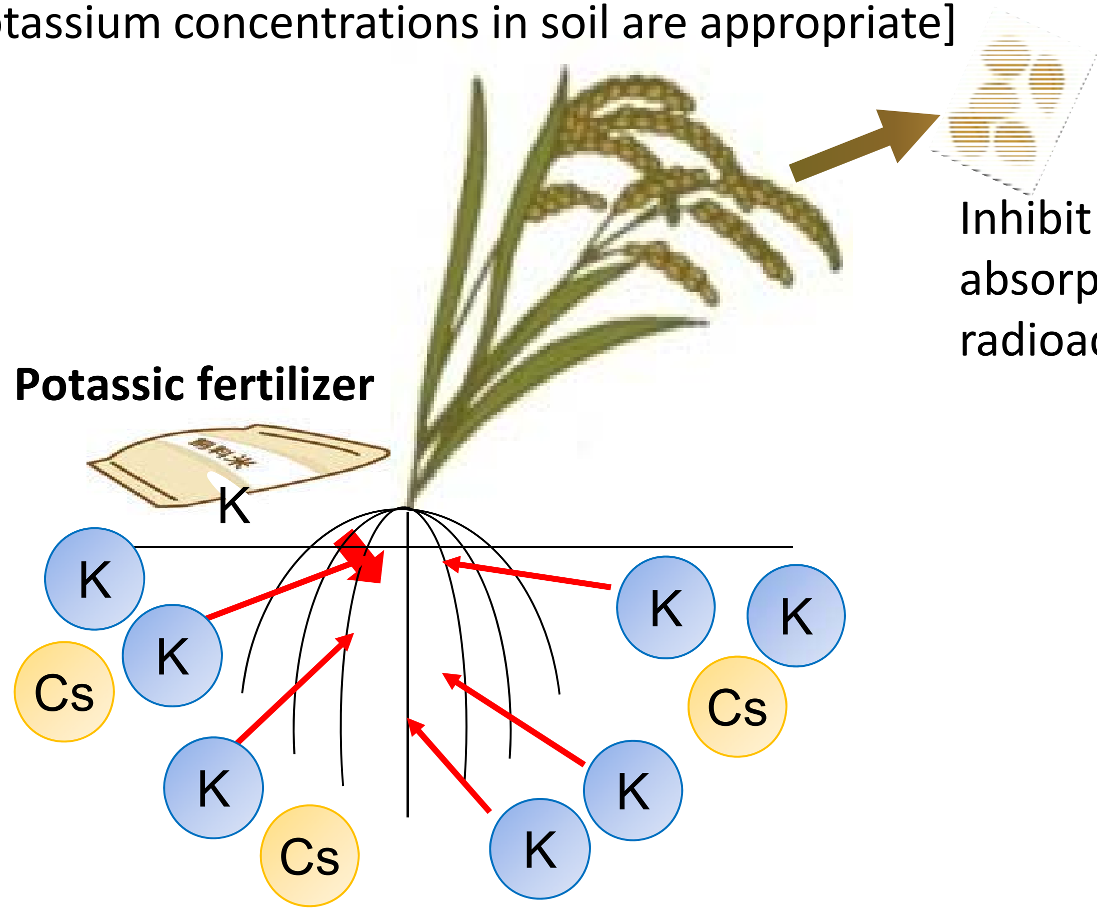
# Measures for Reducing Transfer of Radioactive Materials to Crops (2/5)

## - Measures to Inhibit Radioactive Cesium Absorption through Potassic Fertilization -

- **In paddy fields where detected radioactive cesium concentrations in brown rice are higher, potassium concentrations in soil tend to be lower.**
- **Potassium in soil has similar chemical characteristics as cesium and proper use of potassic fertilizer can inhibit growing crops from absorbing cesium.**

[When potassium concentrations in soil are appropriate]




Prepared based on the "Inspection Results Concerning Radioactive Materials in Foods" by the Ministry of Agriculture, Forestry and Fisheries (MAFF)

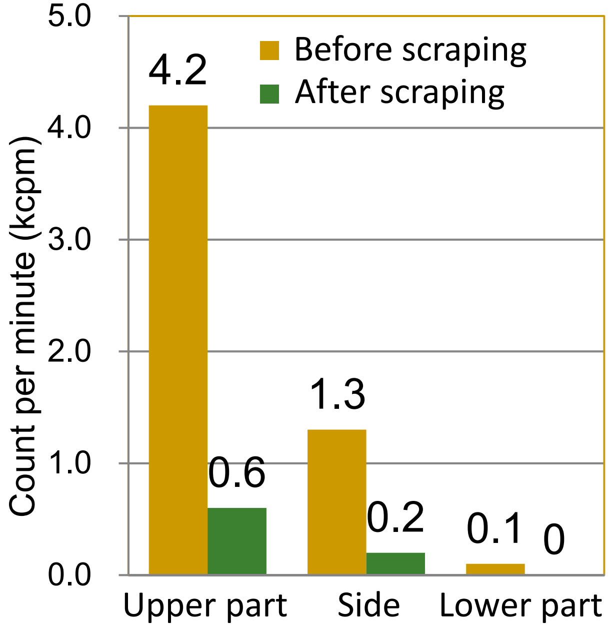
# Measures for Reducing Transfer of Radioactive Materials to Crops (3/5) - Washing of Fruit Trees and Removal of Bark -

**Wash off radioactive cesium adhering to trees with high-pressure water and scrape away bark to reduce radioactive cesium concentrations**

## High-pressure washing of a persimmon tree

## Scraping of bark from a pear tree

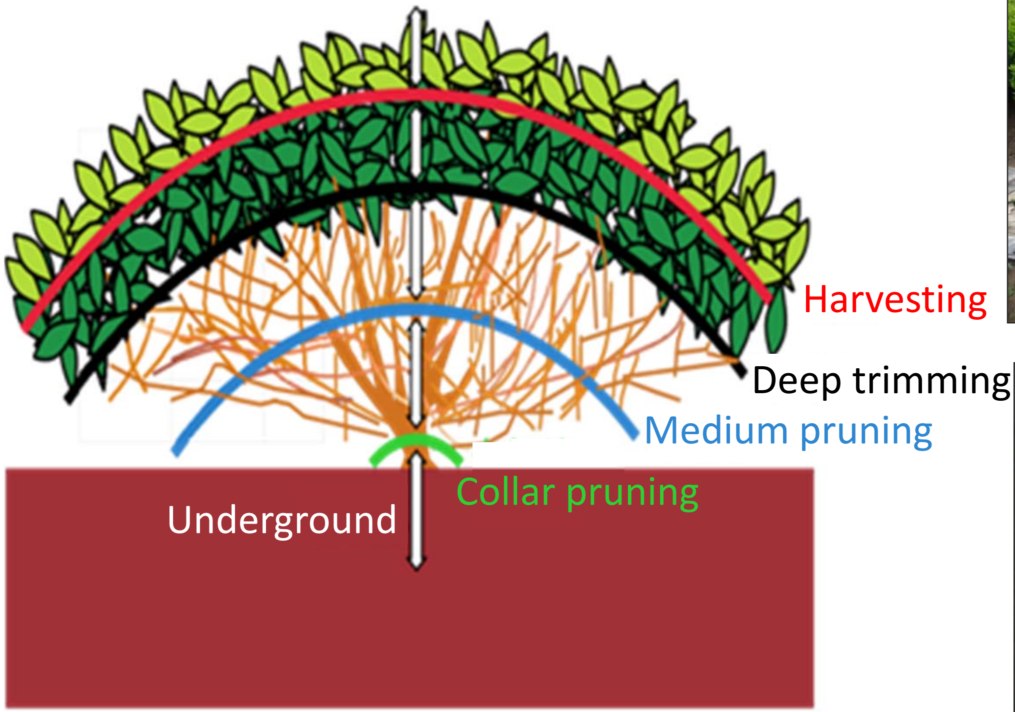
Scraping of bark from major branches of a pear tree and radiation doses




Prepared based on the "Inspection Results Concerning Radioactive Materials in Foods" by the Ministry of Agriculture, Forestry and Fisheries (MAFF)

# Measures for Reducing Transfer of Radioactive Materials to Crops (4/5) - Pruning of Tea Trees -

**Reduce transfer of radioactive cesium from leaves and trees to new leaves by pruning and deep trimming**






Prepared based on the "Inspection Results Concerning Radioactive Materials in Foods" by the Ministry of Agriculture, Forestry and Fisheries (MAFF)

# Measures for Reducing Transfer of Radioactive Materials to Crops (5/5) - Management of Fertilizers, etc. -

- In order to prevent farmland soil from being contaminated with radioactive cesium, the reference value of 400 Bq/kg in fertilizers, soil amendments and soils for cultivation was set.(*)
- Several local governments and other organizations have conducted inspections and imposed a voluntary ban or other measures for reduction of radioactive cesium on fertilizers and materials in which radioactive cesium concentration exceeded the reference value.

* The reference value was set so as not to exceed the normal range of radioactive cesium concentration in soil before the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS, even with continuous application of these agricultural materials for long periods.

Prepared based on the "Responses at Farmland" by the Ministry of Agriculture, Forestry and Fisheries (MAFF)

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