temporary translation
NEA International Workshop on Post-Accident Food Safety Science

Mechanism and measures of radiation absorption in livestock

Fukushima Agricultural Technology Centre
Livestock Research Institute

Introduction

Test implementation status about radioactive substance in Livestock Research Institute

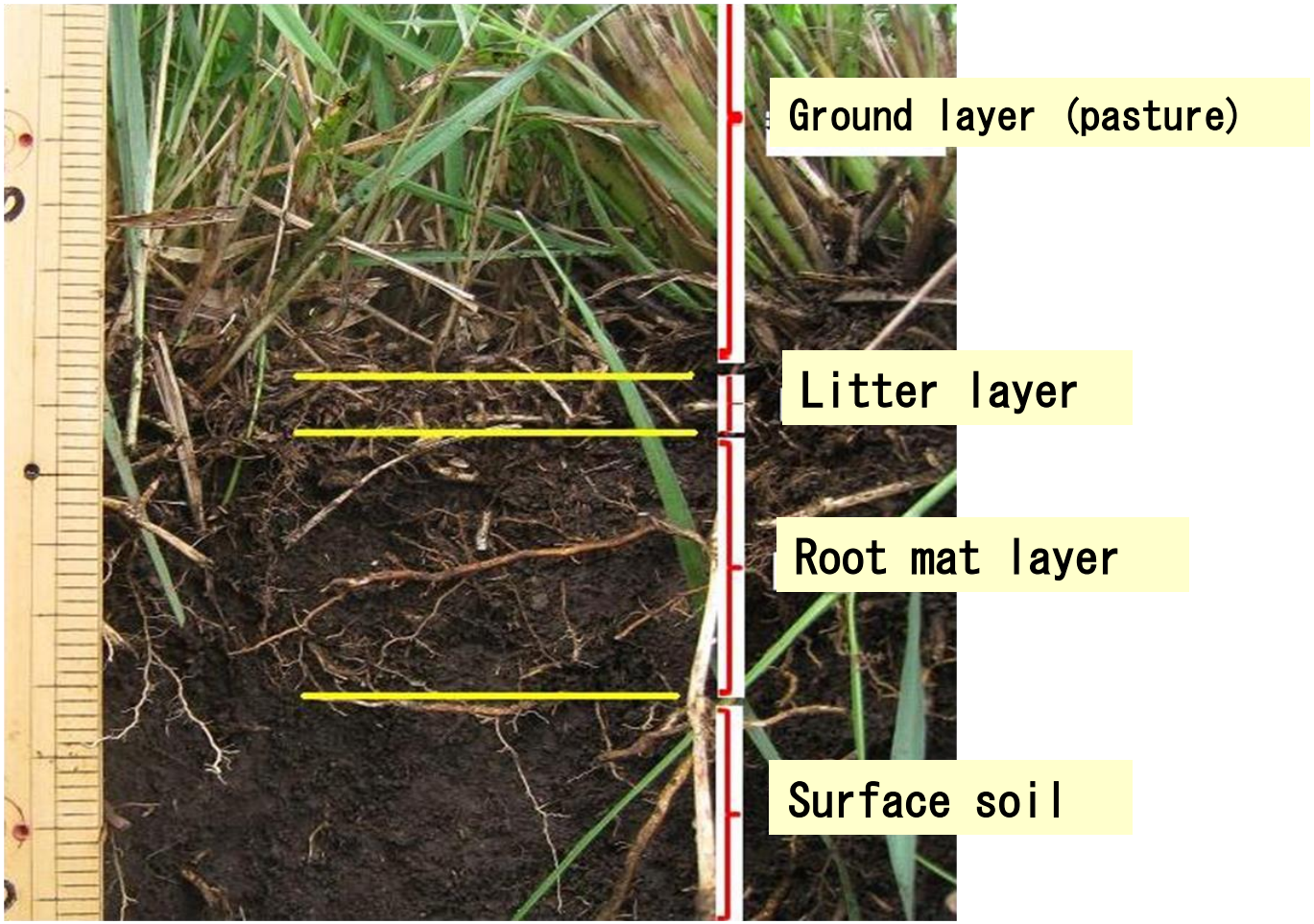
（Total number of issues)

	2011	2012	2013	2014	2015	2016	Total issues
Grasp of the distribution condition	3	6	2	4	—	1	16
Absorption control measures	3	10	4	7	7	5	36
Safety of livestock products	7	8	4	4	5	5	33
Total	13	24	10	15	12	11	85

1. GRASP OF THE DISTRIBUTION CONDITION

1. Grasp of the distribution condition

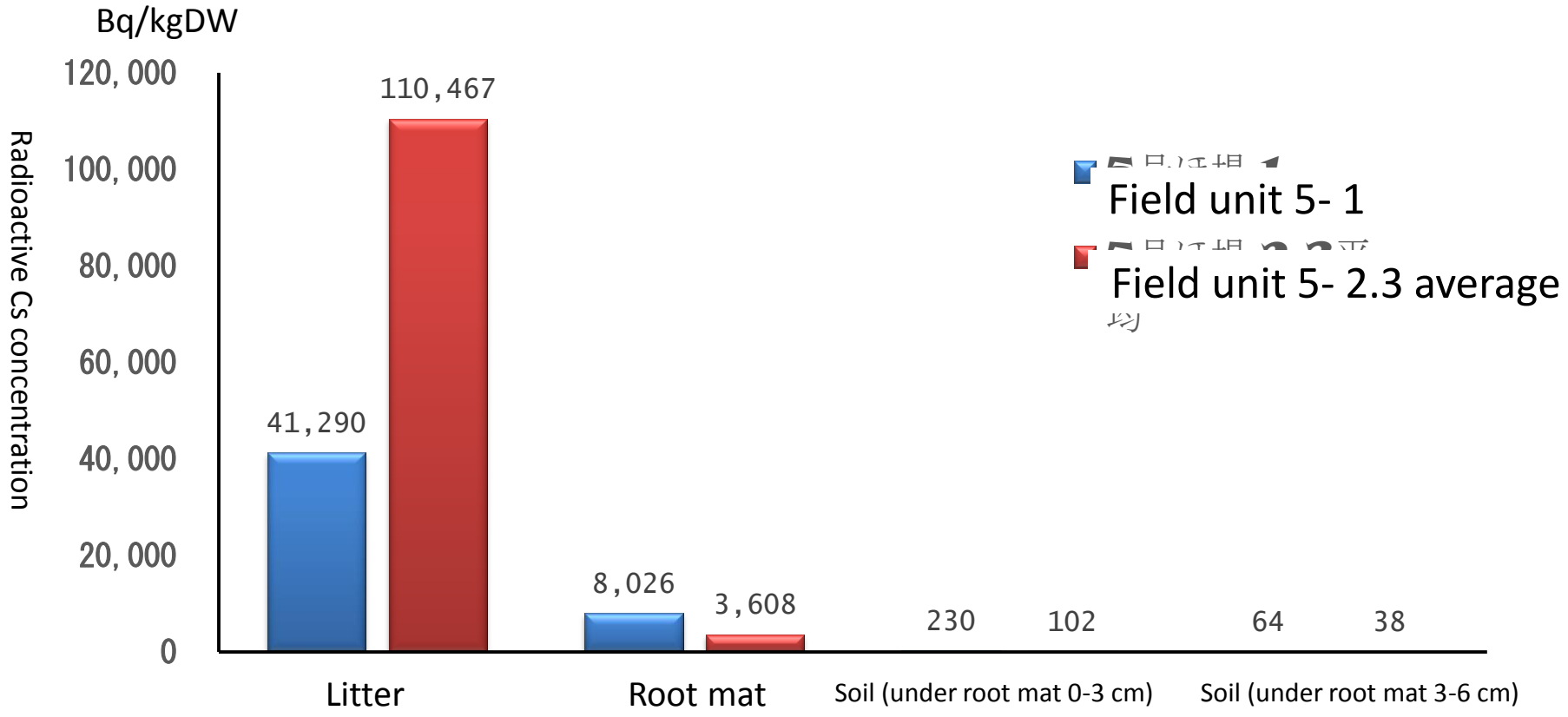
Vertical distribution of radioactive cesium in meadows 1



Vertical cross-section of meadow (ground and soil)

1. Grasp of the distribution condition

Vertical distribution of radioactive cesium in meadows 2



94% of fall-out radioactive Cs are distributed to litter layer and root mat layer.

2. ABSORPTION CONTROL MEASURES

For meadows

- measures (at first)
- Results of the measures
- Review of measures – tillage method -
- Results of the review

2. Absorption control measures

Measures in meadows (at first)

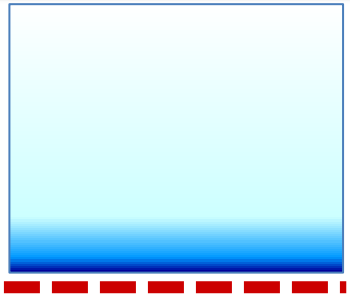
Cs concentration is high on surface

表層

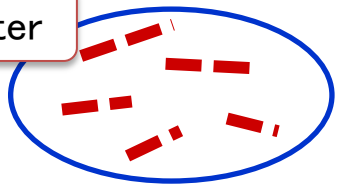
深層

Reversal tillage by plow

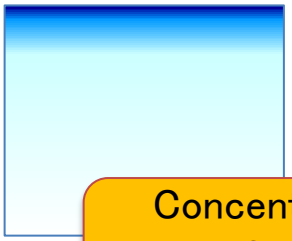
The concentration is lower on surface
→It remains in the deep



Litter



Remove litter ※

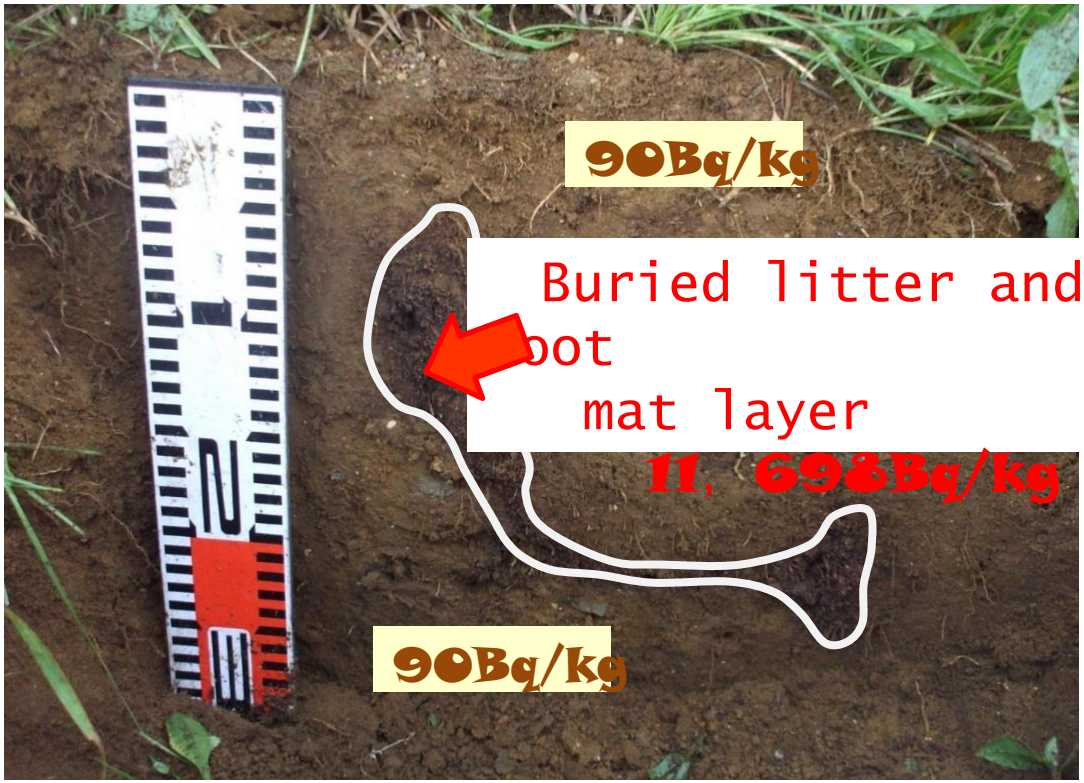


Concentration of surface layer becomes

※Litter : Residual of dead leaves on surface of meadows

2. Absorption control measures

Results of the measures



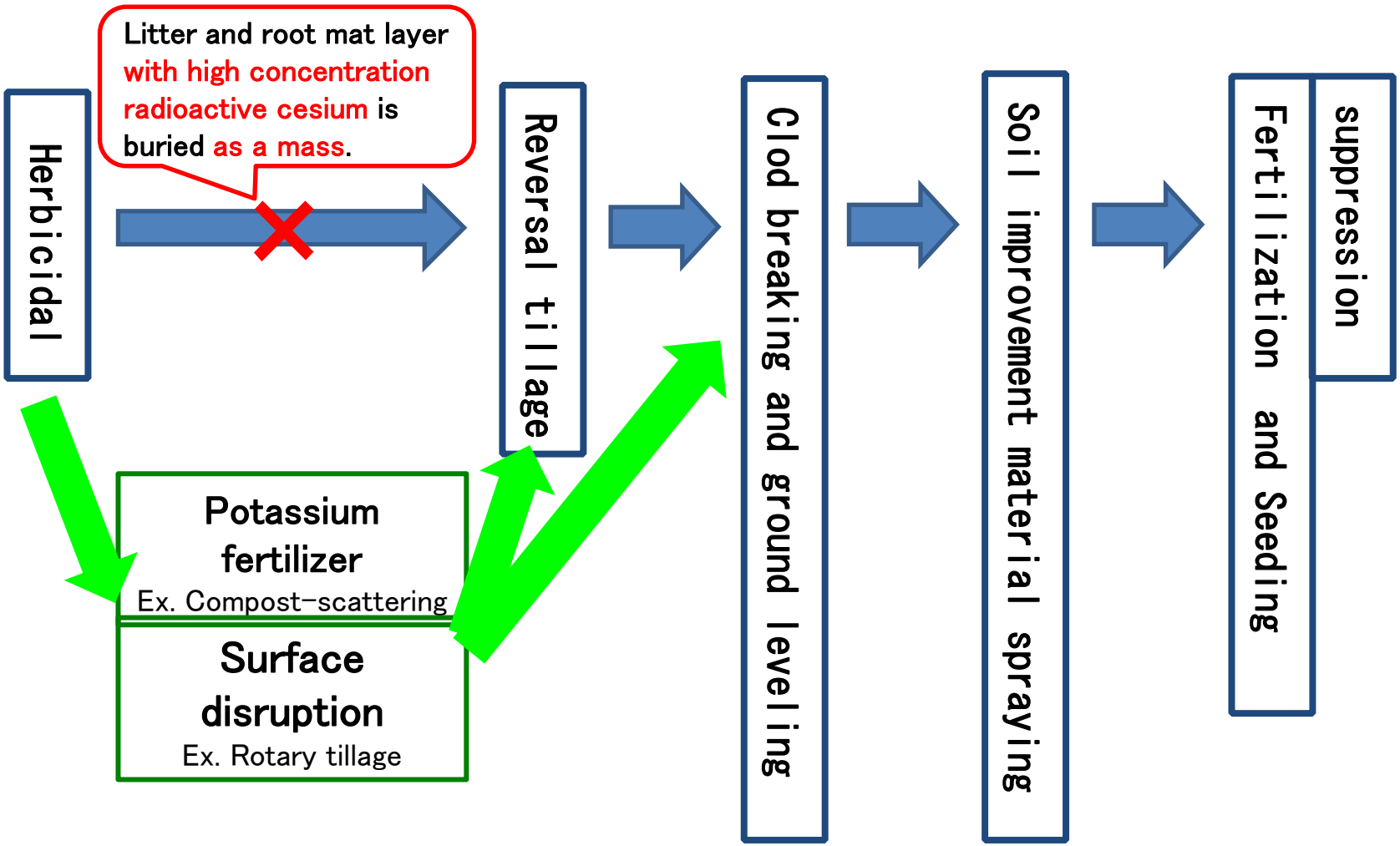
Examples exceeded radioactive Cs standard on grass (Field for reversal tillage by plow)

→Confirmed litter and root mat layer with high level radioactive cesium into soil

→Grass roots reached to it, and assumed that they absorbed radioactive Cs.

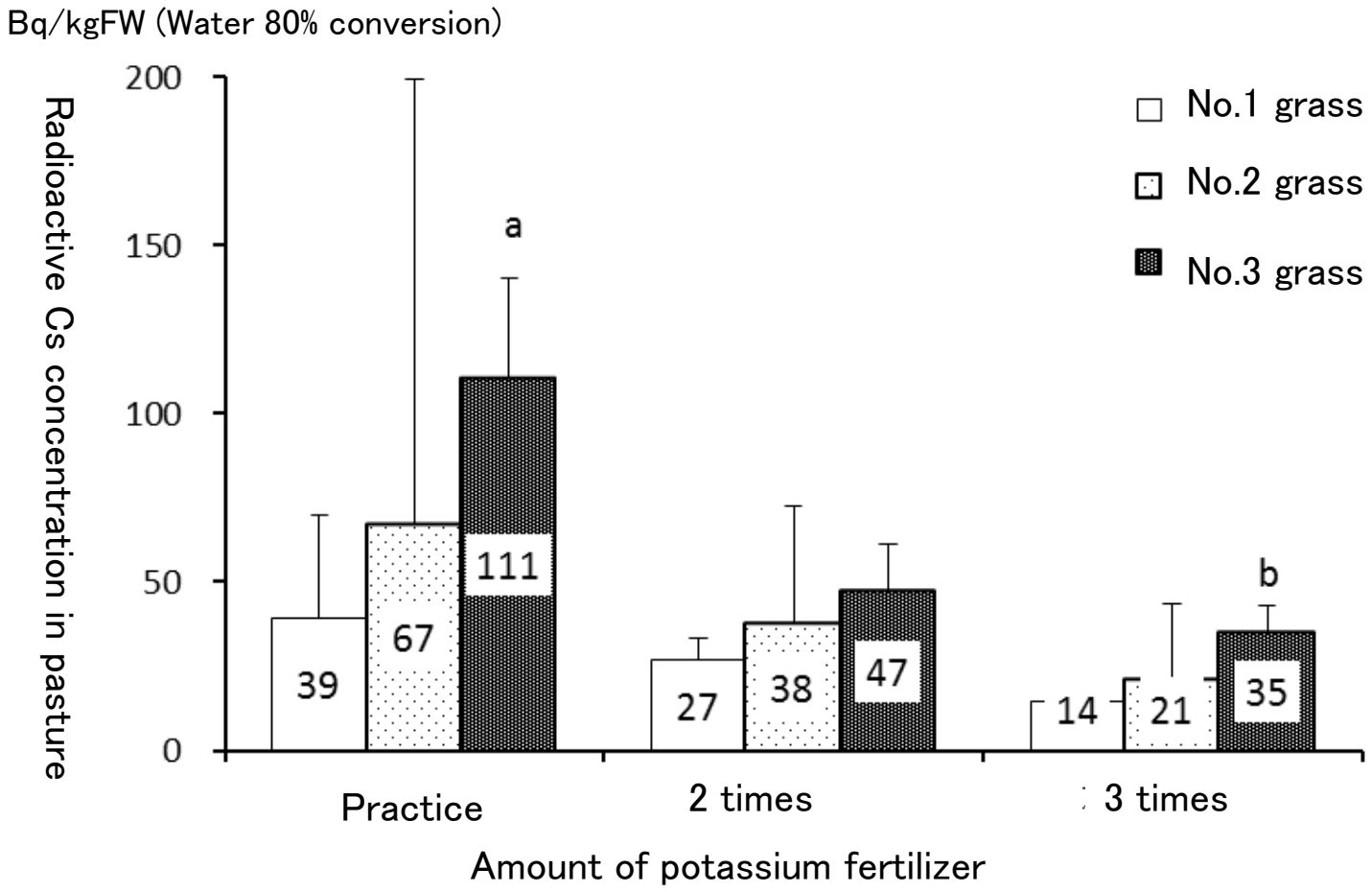
2. Absorption control measures

Review of measures – tillage method –



2. Absorption control measures

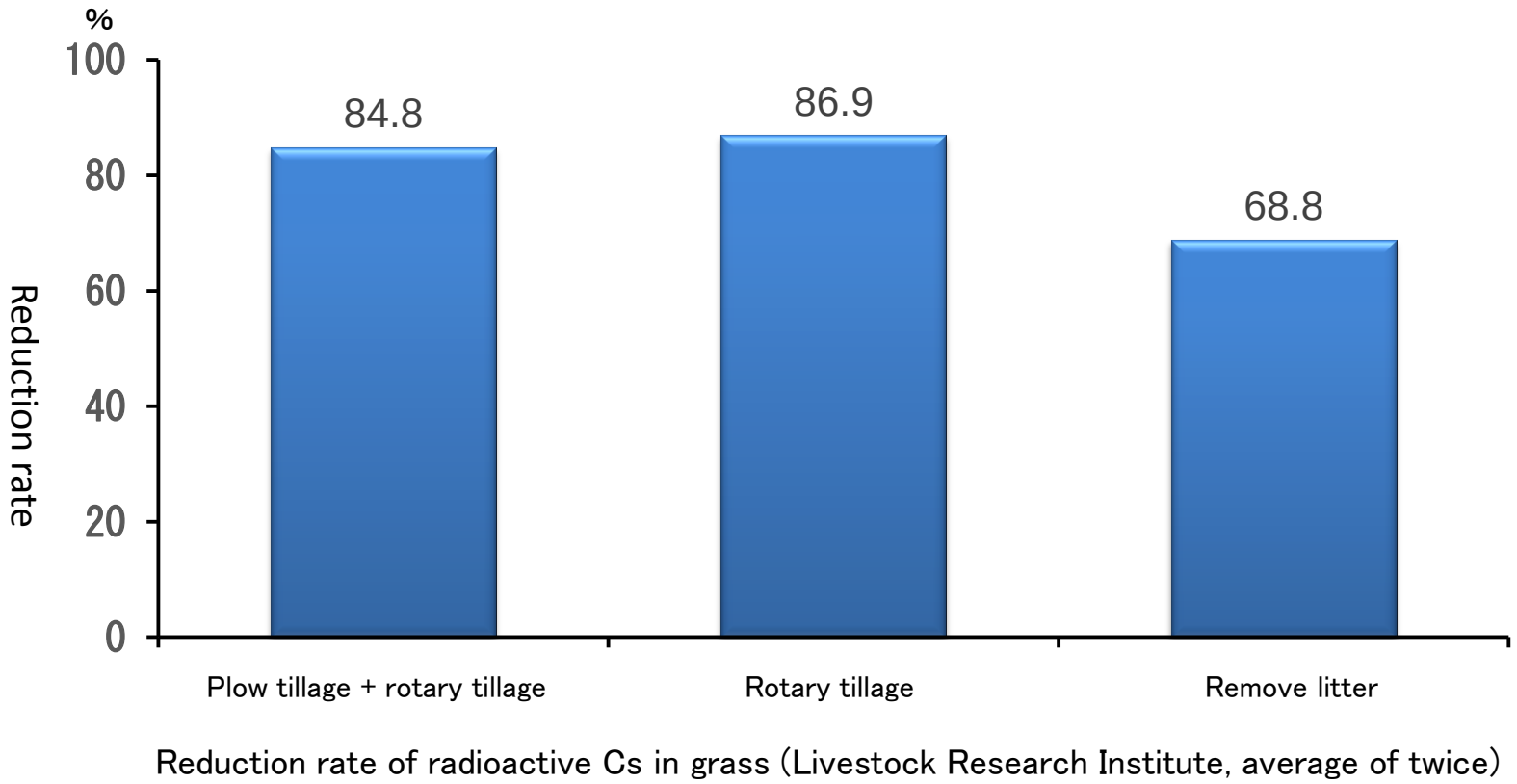
Results of the review on meadows 1



Absorption of radioactive Cs to grass can be controlled by increasing potassium fertilizer.

2. Absorption control measures

Results of the review on meadows 2

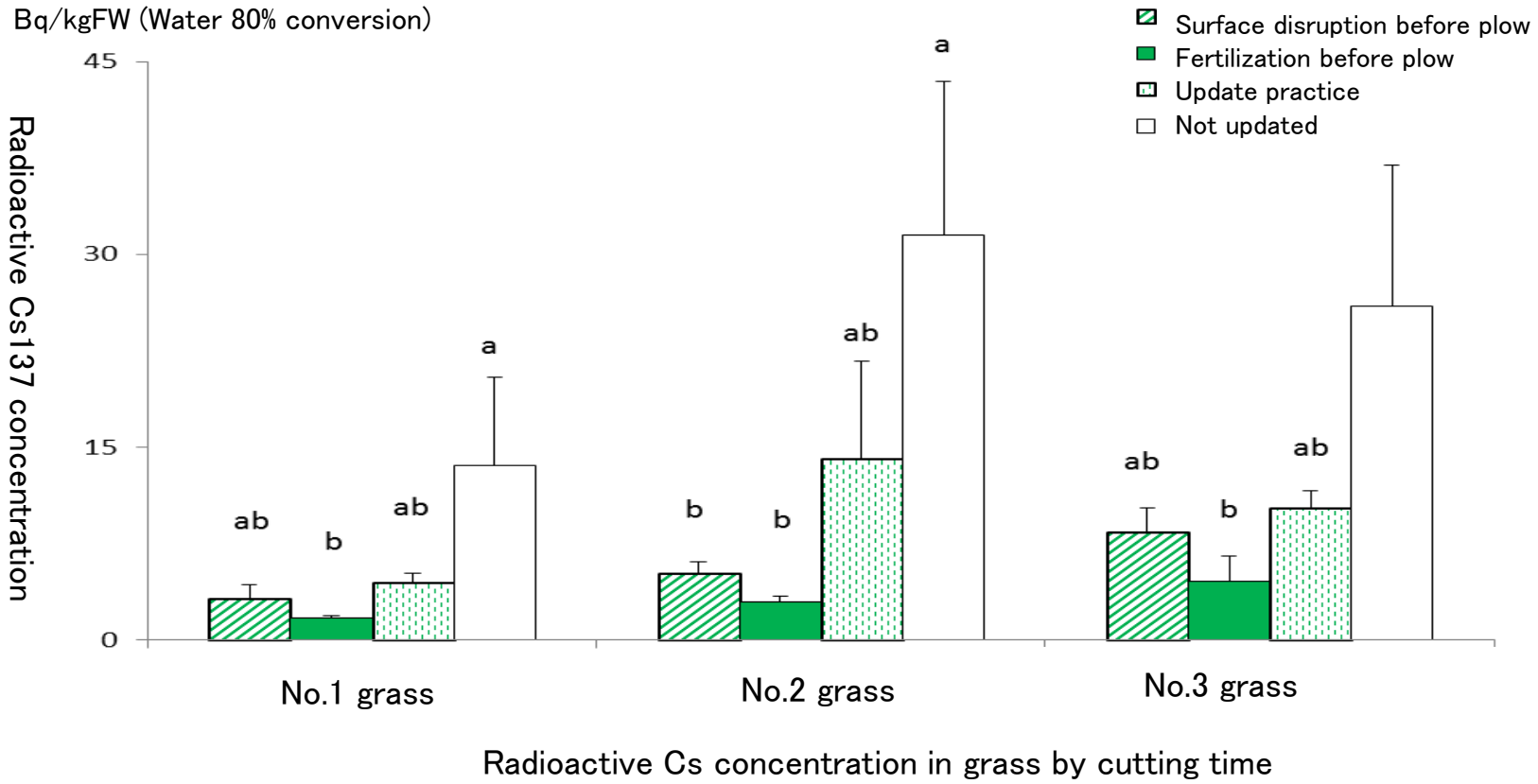


Reduction rate of radioactive Cs in grass (Livestock Research Institute, average of twice)

Radioactive Cs in grass stops to approx. 70% by removing litter.
Plow tillage + rotary tillage, or rotary tillage reduces it to approx. 85%.

2. Absorption control measures

Results of the review on meadows 3



Radioactive Cs concentration in grass by cutting time

Grassland update time

- Surface disruption by rotary tillage before plow tillage
- Potassium fertilizer

→ Can reduce radioactive Cs concentration in grass

3. SECURING SAFETY OF LIVESTOCK PRODUCTS

- Development for portable measuring instrument of grass roll bale silage
- Inhibition of radioactive cesium resorption for dairy cattle
- Grasp of radioactive cesium concentration in beef cattle
  - （1） From blood
  - （2） From muscle

3. Securing safety of livestock products

Development for portable measuring instrument of grass roll bale silage 1

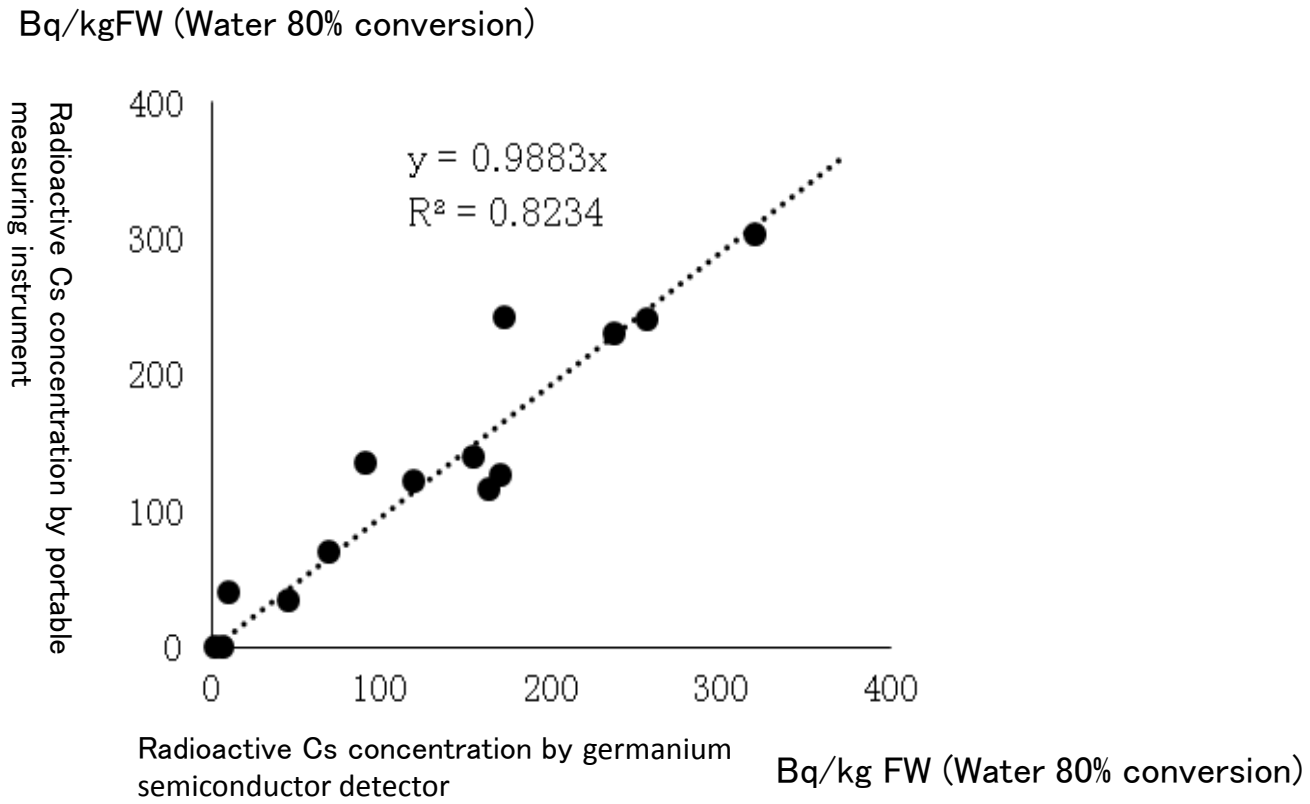
- **Preparation 60 min**
  ※including background measurement
- **Measuring /unit 8 min**

Loading and transporting measuring instruments for radioactive material on light trucks

→ Measure roll bale on a garden, and confirm excess over the standard value

3. Securing safety of livestock products

Development for portable measuring instrument of grass roll bale silage 2



Average values by germanium semiconductor detector for roll bale have a high correlational relationship with those of portable measuring instrument, and they are corresponding to each other.

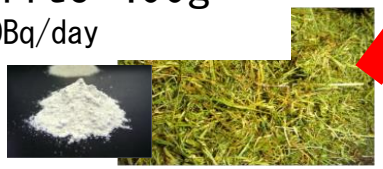
3. Securing safety of livestock products

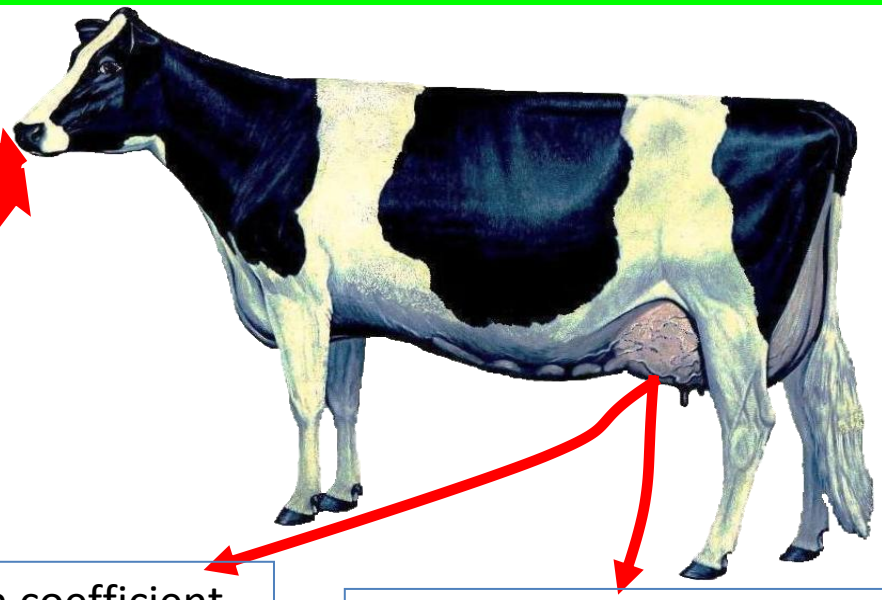
Inhibition of radioactive cesium resorption for dairy cattle 1

Control area
4,348Bq/day

Zeolite 200g
4,125Bq/day

Zeolite 400g
4,600Bq/day





Transition coefficient

Control area
3.46×10^{-3} ⇩ Reduction

２００g 1.56×10^{-3}
４００g 1.50×10^{-3}

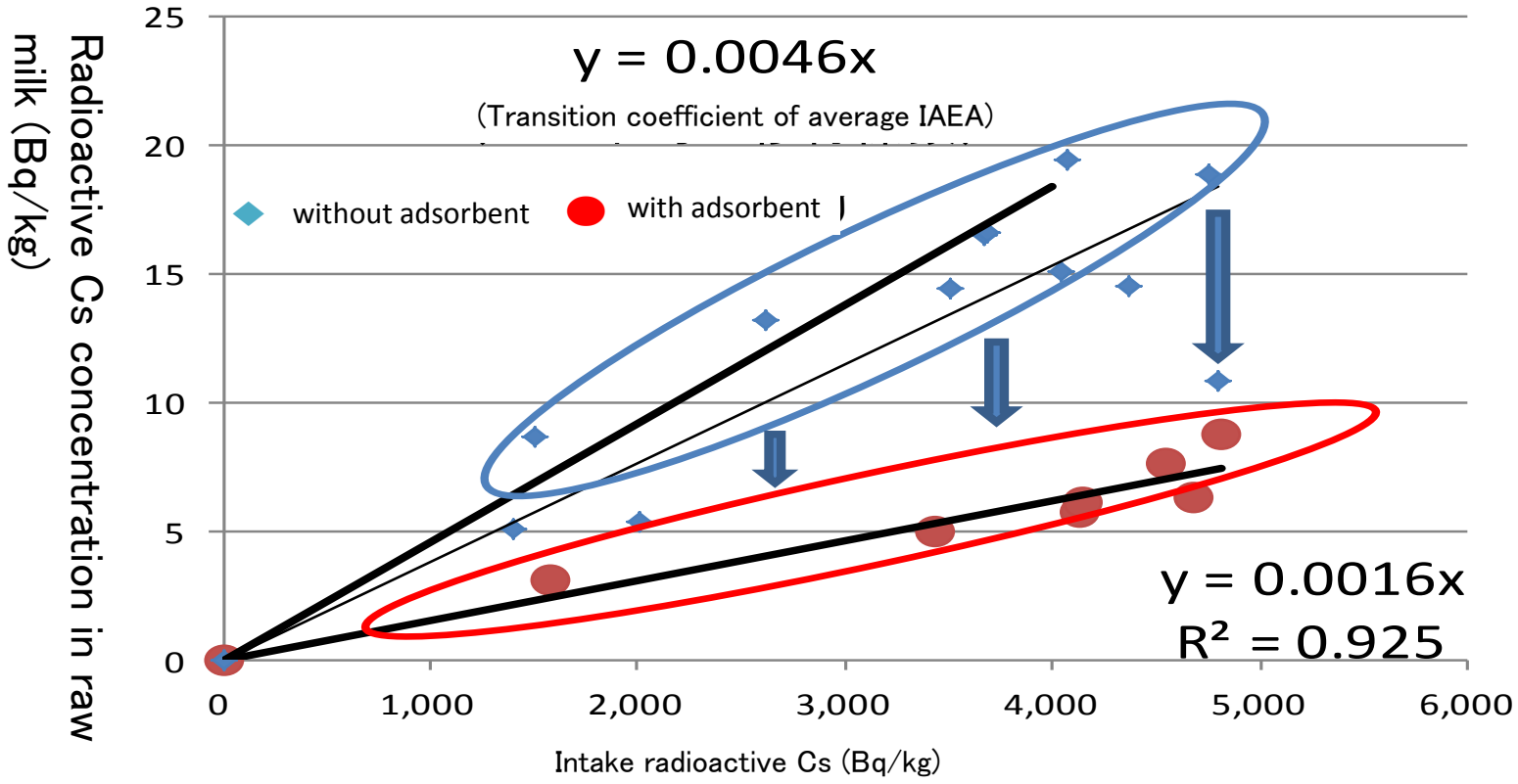
Distribution ratio(%)

Control area 10.8
⇩ Reduction
２００g 4.9
４００g 4.8

Impregnating with zeolite (A feed, 200 g or 400 g /day) to dairy cattle feed, transition coefficient and distribution ratio of radioactive Cs for dairy cattle decrease by more than 50 percent.

3. Securing safety of livestock products

Inhibition of radioactive cesium resorption for dairy cattle 2

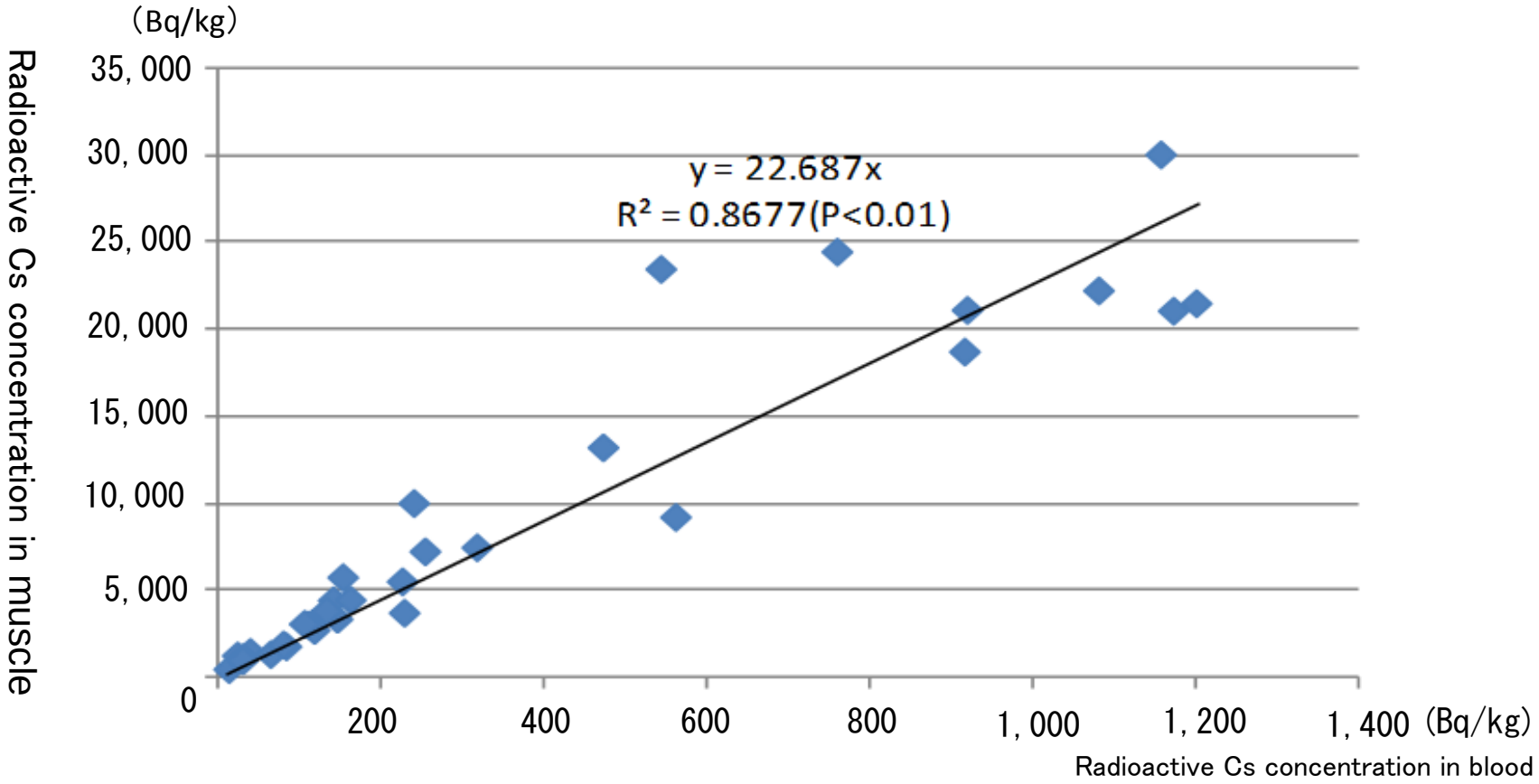


The difference of Cs transition to raw milk between with adsorbent and without adsorbent

By adsorbent (zeolite, bentonite, etc.), radioactive Cs transition coefficient to raw milk decreased compared to the average value of IAEA study.

3. Securing safety of livestock products

Grasp of radioactive cesium concentration in beef cattle (1) from blood



Correlation of blood and muscle in the radioactive Cs concentration

Correlation of blood and muscle in the radioactive Cs concentration is very high (r=0.932).

→ It is possible to estimate radioactive Cs concentration in muscle from blood.

3. Securing safety of livestock products

Grasp of radioactive cesium concentration in beef cattle (2) from muscle

The past

- Gathering blood of cows
- Measuring by gerumanium semiconductor detector

Time consuming

The future

- Non-destructively
  : From body surface
- Measured by NaI detector

Immediately, on site

The consignment test from Japan Science and Technology Agency (2014)

【Institutes fo joint research】

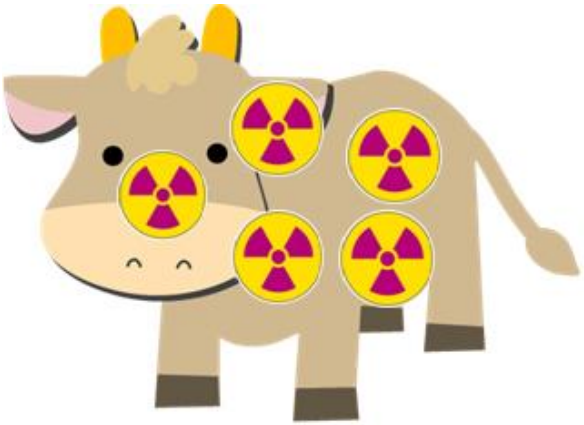
- Tohoku University electronic light Science Research Center
- Fukushima University of Science and Engineering group Symbiotic Systems Science
- Comtech Engineering Co,. Ltd.
- Japan Envirnment Research Co., Ltd.
- Rad Solutions inc.

3. Securing safety of livestock products

Grasp of radioactive cesium concentration in beef cattle (2) from muscle

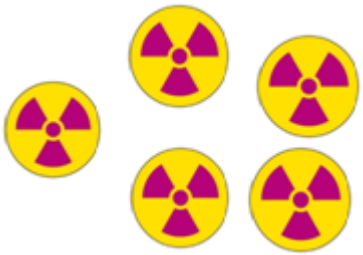
The principle of presumption （Measured under the same conditions）

Target cattle － Cleaned cattle ＝ Amount of pollution



②Measurement of target cattle

①Measurement of background
(water filled drum can)

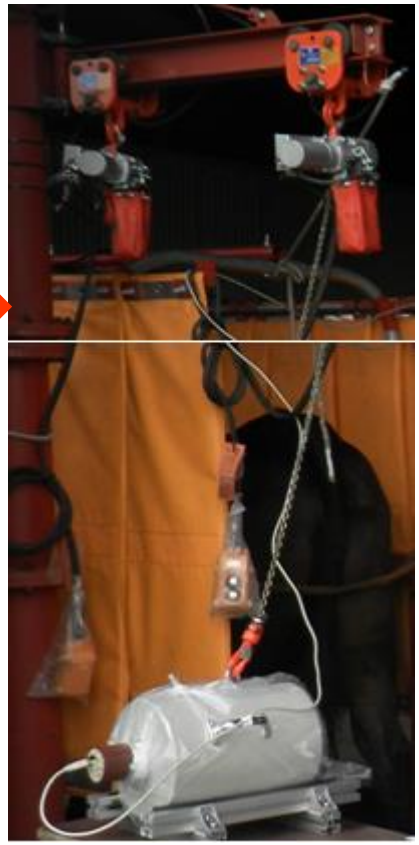


③Estimation of pollution
in target cattle

3. Securing safety of livestock products

Grasp of radioactive cesium concentration in beef cattle (2) from muscle

Overall picture of development equipment



3. Securing safety of livestock products

Grasp of radioactive cesium concentration in beef cattle (2) from muscle

Comparison of radioactive cesium concentration in muscle

Unit: Bq/kg

		Estimate by development equipment						Ge semiconductor detector (data in muscle)					
		Cs-137		Cs-134		total-Cs		Cs-137		Cs-134		total-Cs	
No.	Unit number	Concen-tration	Error	Concen-tration	Error	Concentration	Error	Concen-tration	Error	Concen-tration	Error	Concentration	Error
1	8606	38.7	2.6	20.7	2.4	**59.5**	3.5	38.6	3.9	12.8	3.2	**51.4**	5.0
2	4809	34.6	2.6	16.0	2.3	**50.6**	3.4	30.0	3.1	11.8	2.8	**41.8**	4.2
3	4805	14.8	2.2	6.3	2.0	**21.1**	3.0	12.4	3.1	8.9	3.0	**21.3**	4.3

3. Securing safety of livestock products

Grasp of radioactive cesium concentration in beef cattle (2) from muscle

Measurement order

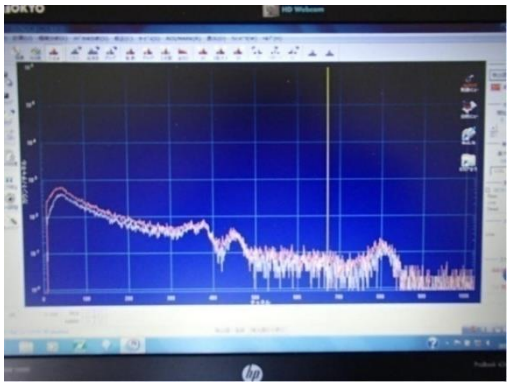
Preparation: Washing cattle body

① Measurement of background

② Retention

③ Measurement from body surface

④ Analysis of spectrum data



⑤ Analysis (codefukushima)

3. Securing safety of livestock products

Grasp of radioactive cesium concentration in beef cattle (2) from muscle

Utilization

Test results (Oct 2013 – July 2016, grown-up cattle auction listing about 2,000)

There is no estimate more than the food standard, 100 Bq/kg.