Agricultural aspects of radio-contamination induced by Fukushima Nuclear Accident

—wide range of the studies by the Agricultural Dept. Univ. of Tokyo—

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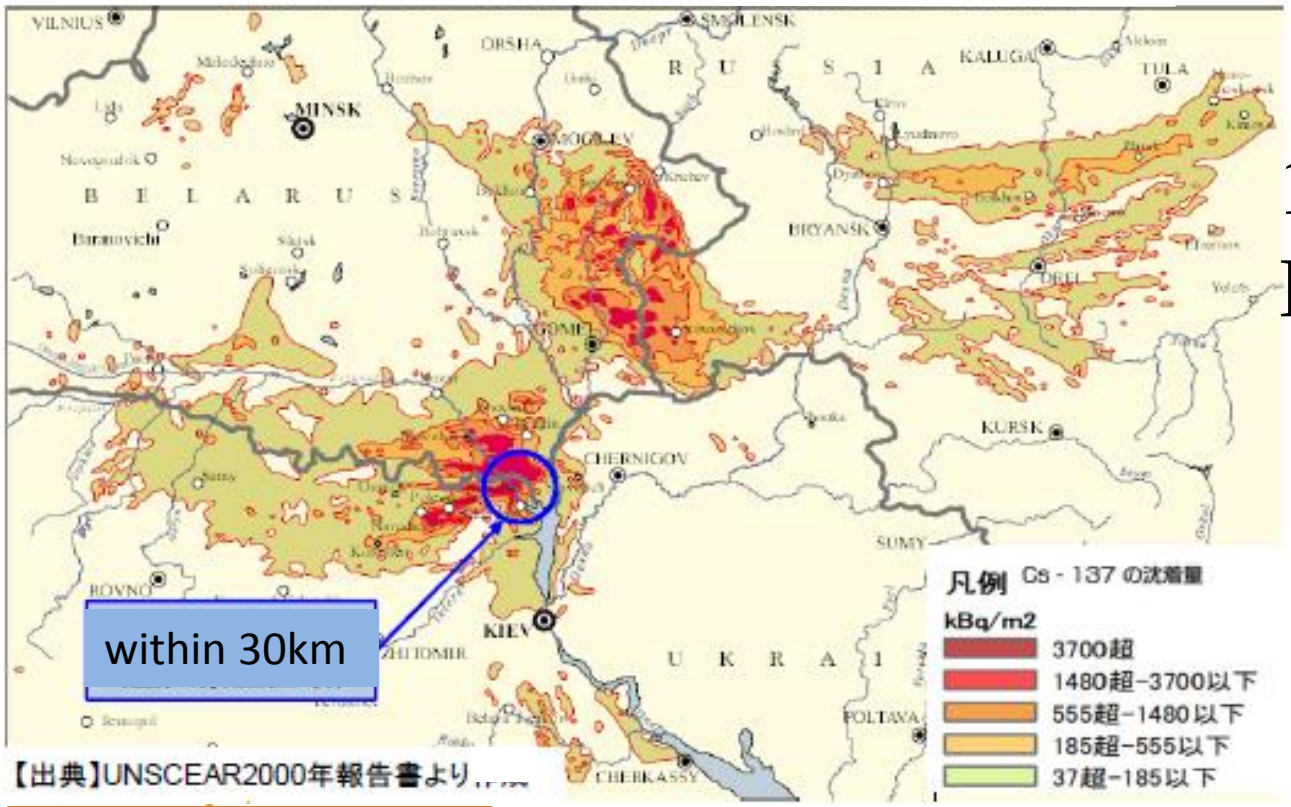


1989
December

Adjusted to the same enlargement

2011 November

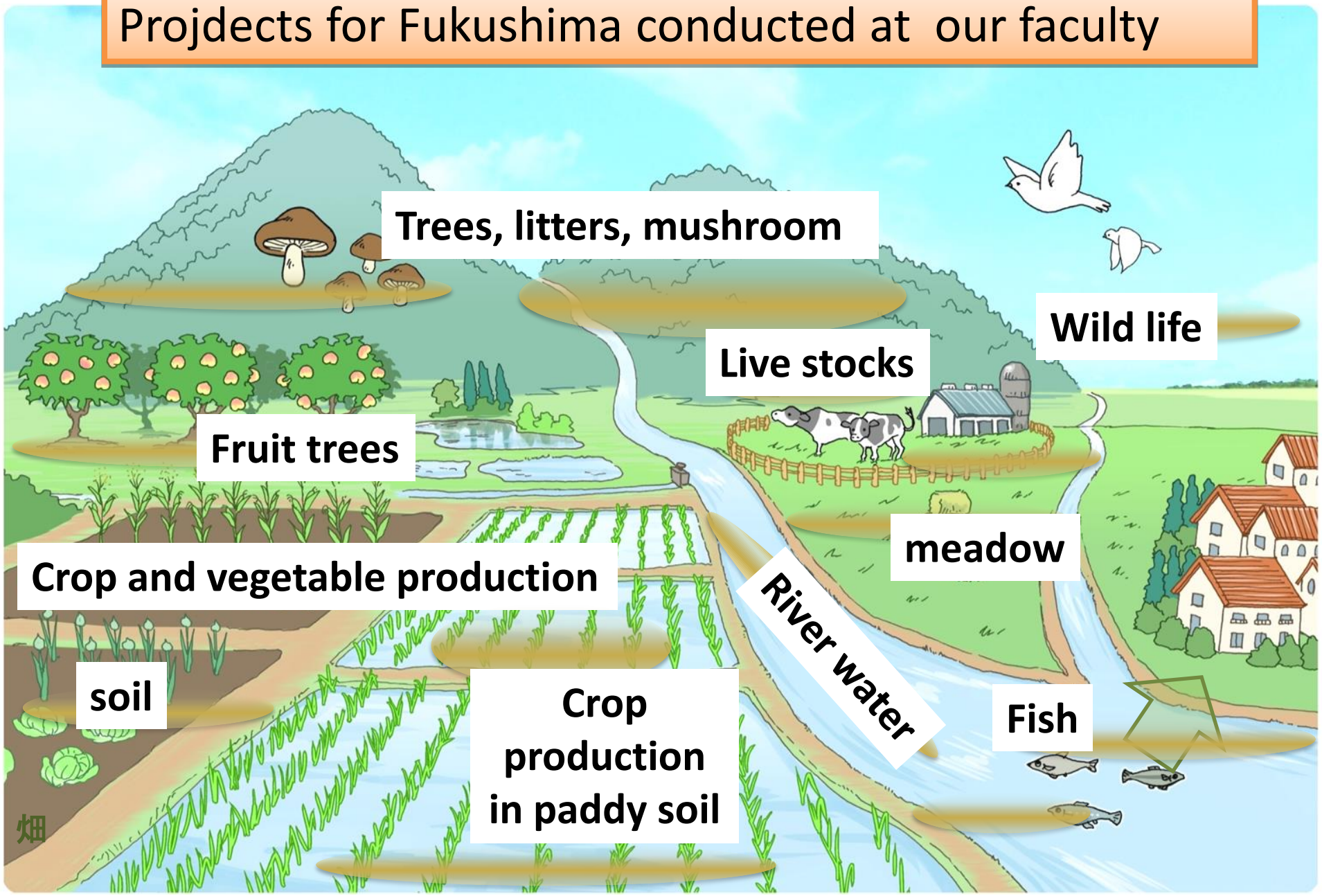
○ **:30km from the reactor**

Contaminated area:～6%
Radioactive Cs amount: ～1/6
Fall out distance:～1/10

Representative fallout effects in agriculture

1. Soil
2. Plants
3. mountains
4. Animals and others

Projdects for Fukushima conducted at our faculty



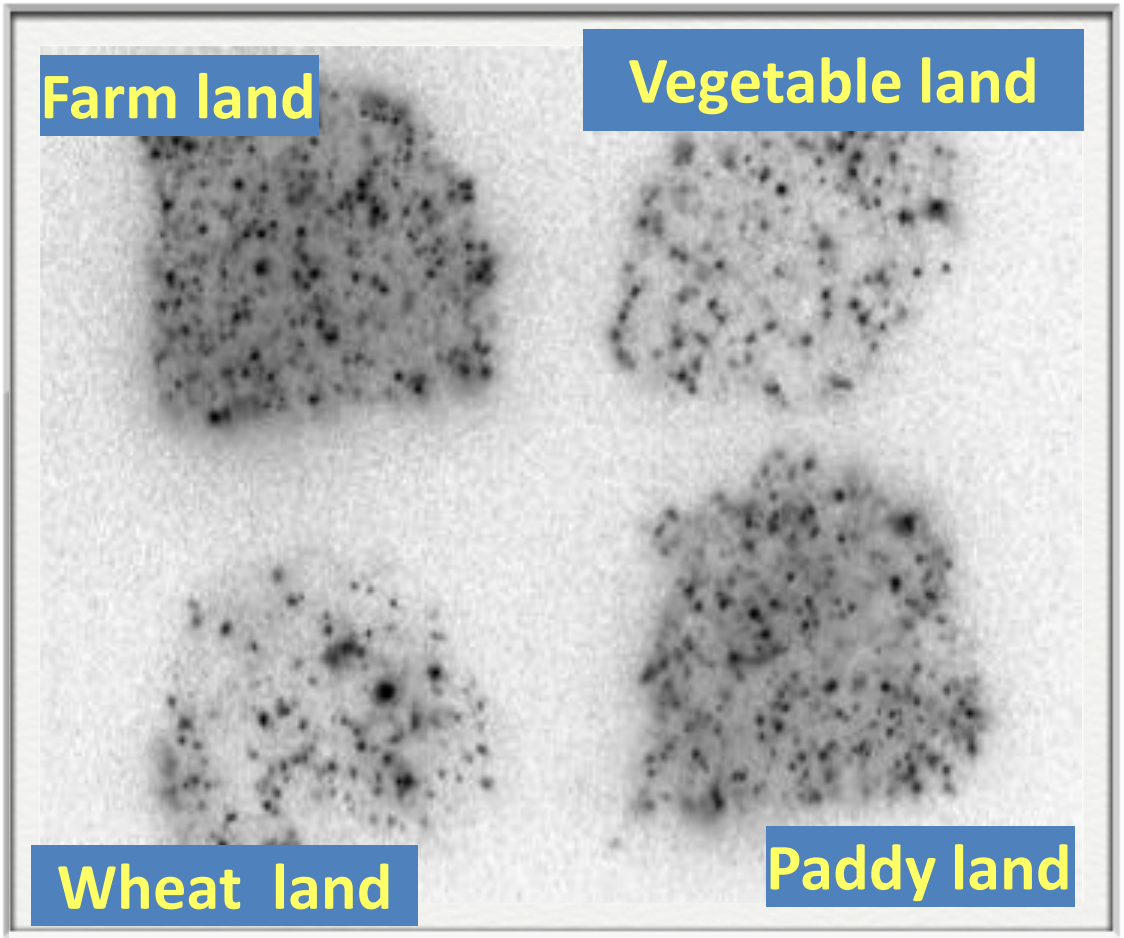
Soil contamination

Only at surface

Farming land

Wheat field

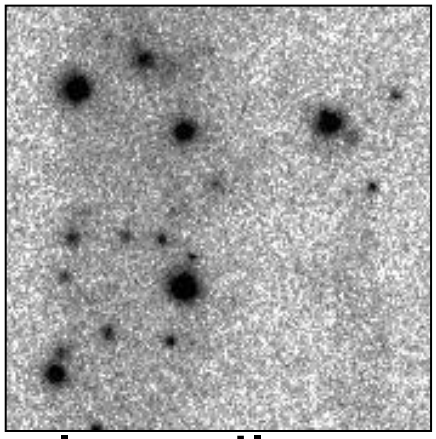
April 21, 2011



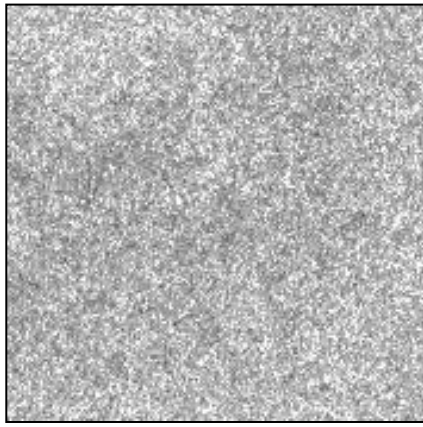
Soil contamination

Autoradiograph of separated soil

Only at
clay & organic matters

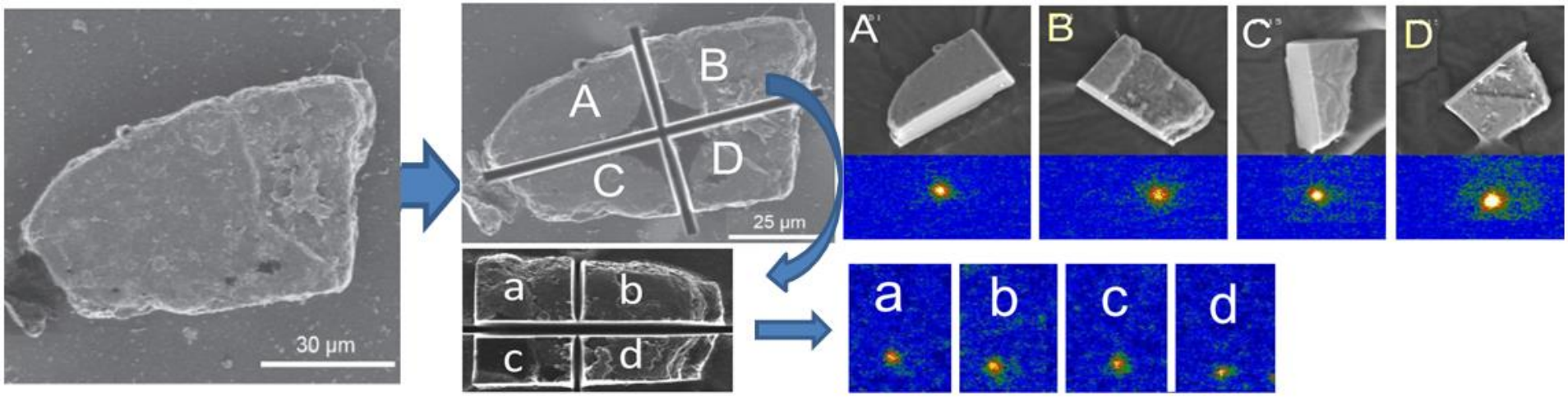


clay+silt+
organic matter



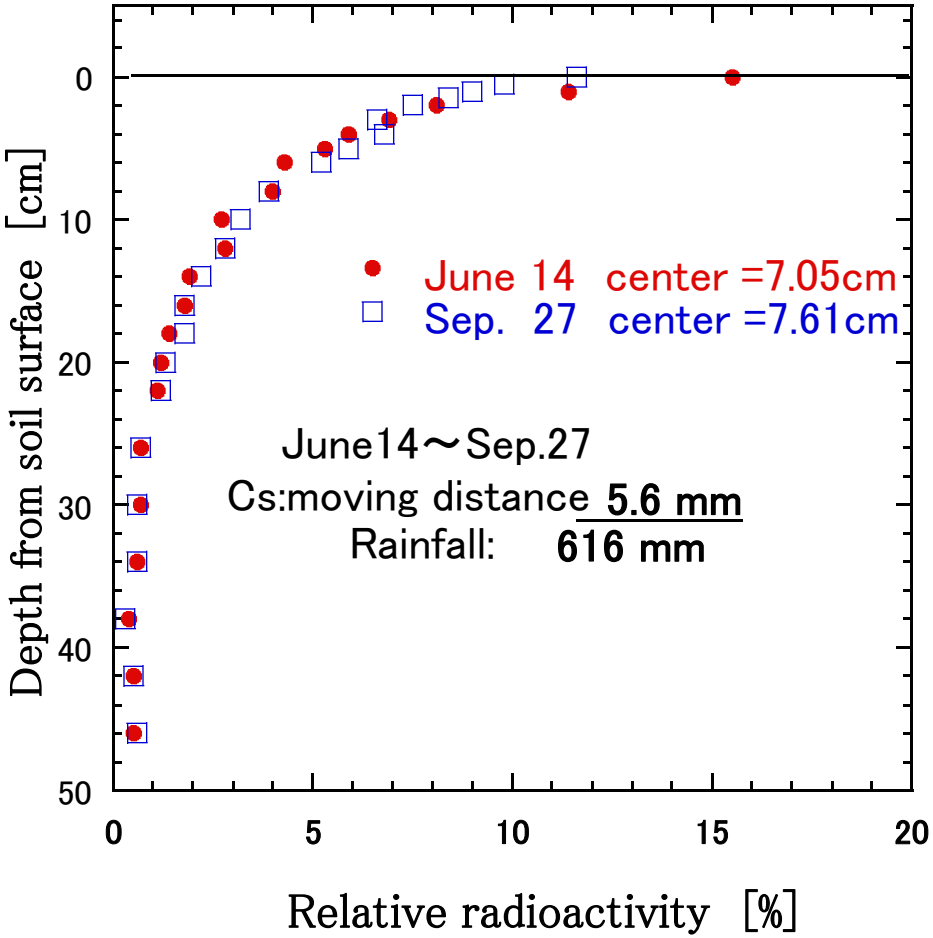
sand

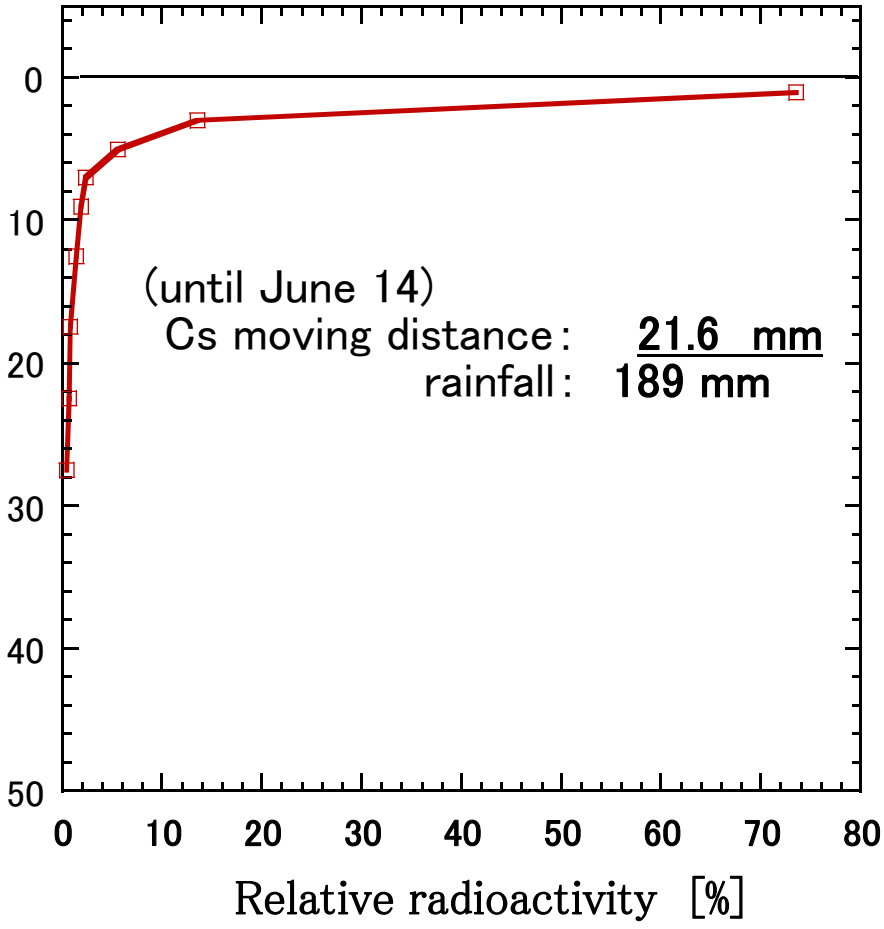
^{137}Cs is firmly adsorbed on clay, weathered biotite.



Radioactivity movement of Koriyama-City

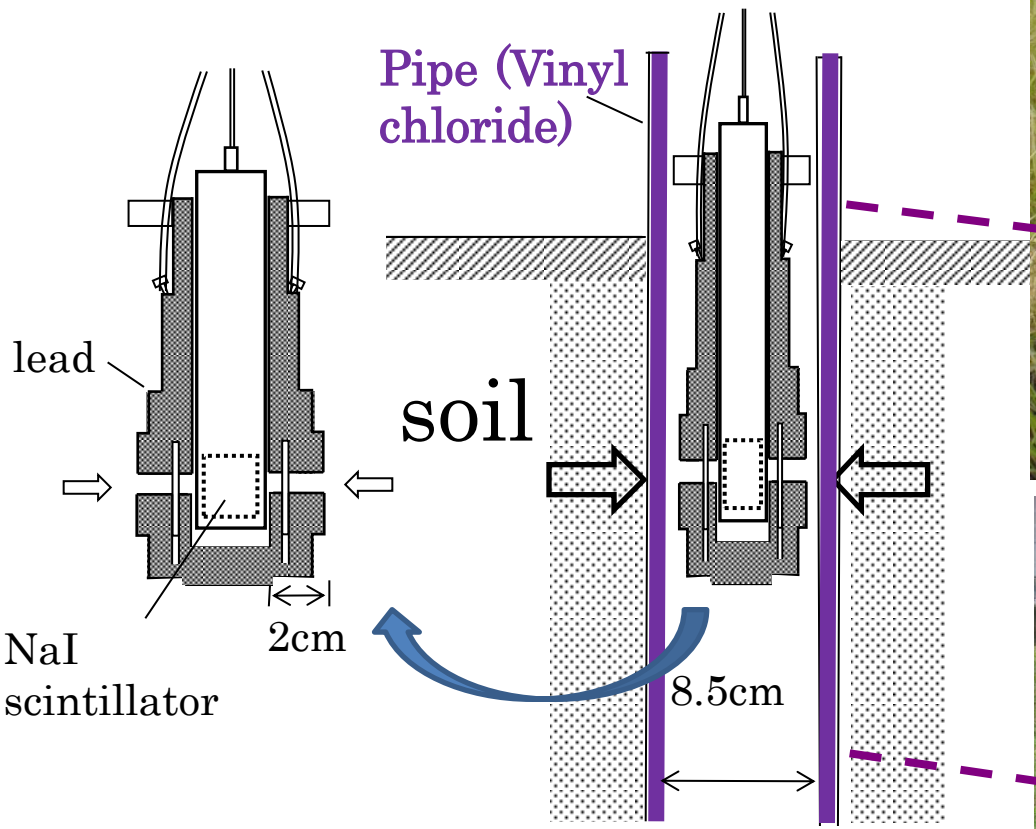
(movement of gravity center)





by S. Shiozawa

Gamma –ray measurement in soil



by S. Shiozawa

Soil plays an important role to fix Cs*

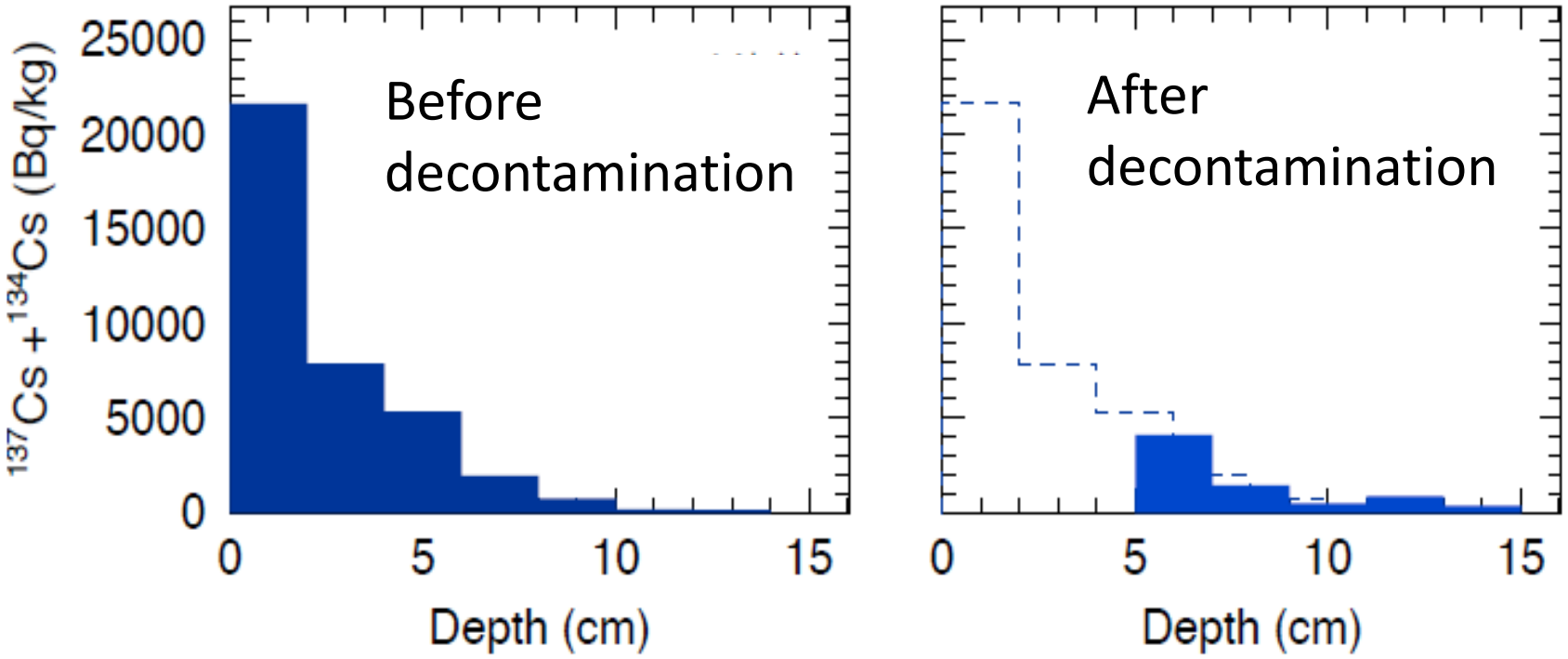
- Fall out was found as spots in soil.
- Most of Cs* was fixed on the surface of the soil.
- Difficult to dissolve Cs* from soil.
  (10 - 20 %, at most, at an early stage)
- Adsorption to soil comes stronger with time.

- Cs* was adsorbed especially on the fine clay.
  Weathered biotite
- Now Cs* profile in the soil moves downward
  1 - 2 mm/year.

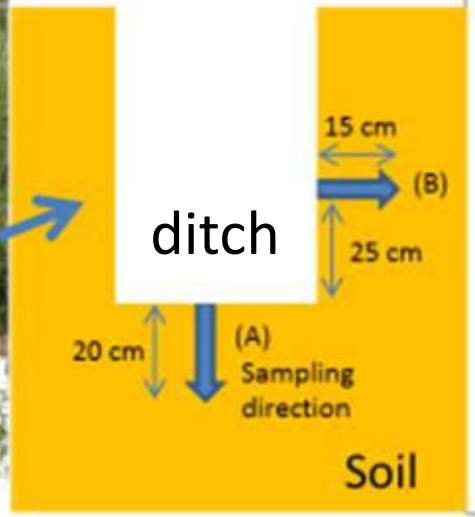
Decontamination trial in paddy field（April, 2012）

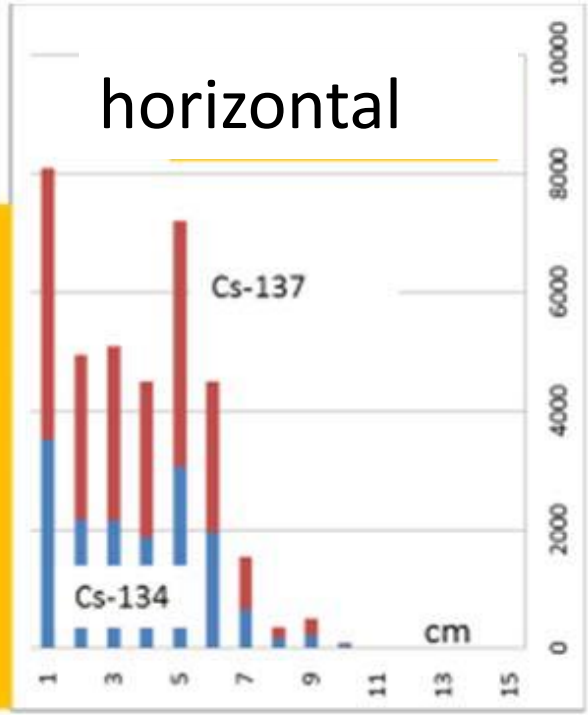
by M. Mizoguchi & NPO

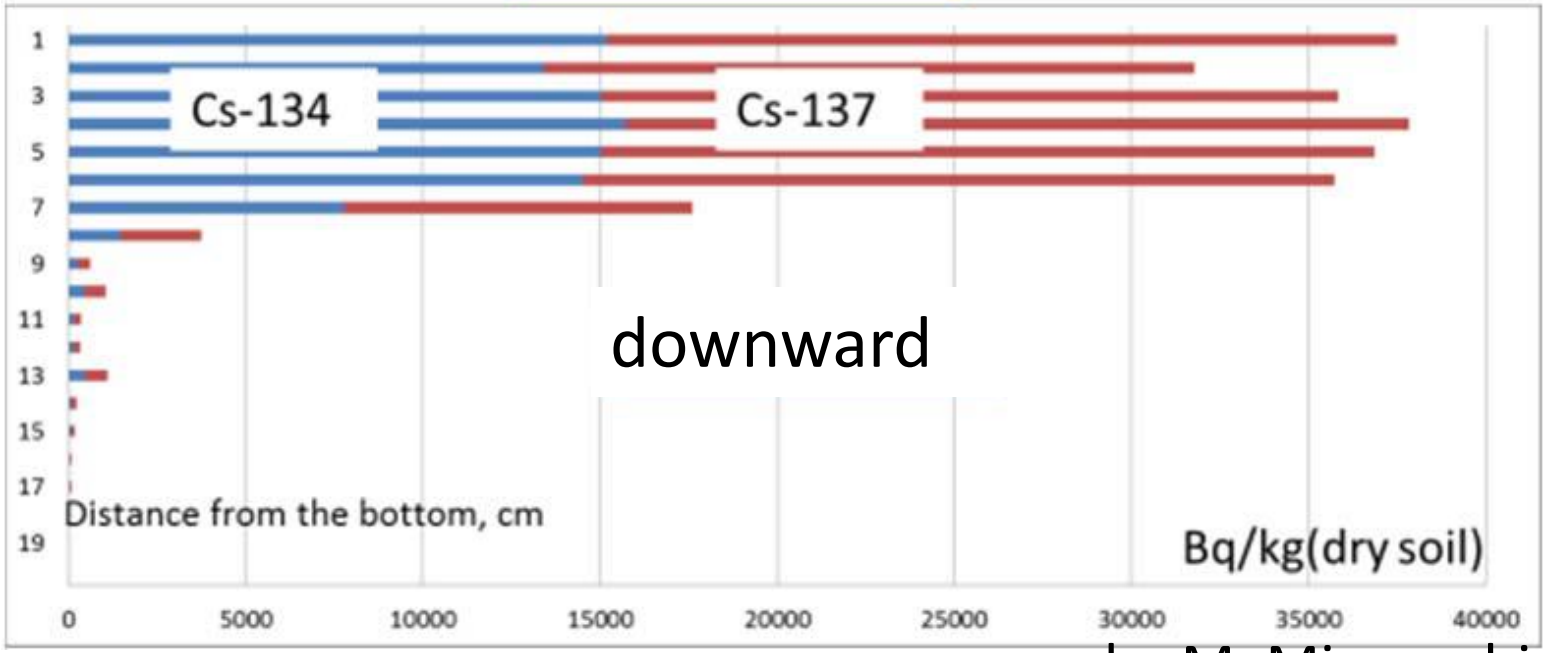
Gathering the clay in water after stirring



http://www.fukushima-saisei.jp/







by M. Mizoguchi & NPO

Representative fallout effects in agriculture

1. Soil
2. Plants
3. mountains
4. Animals and others

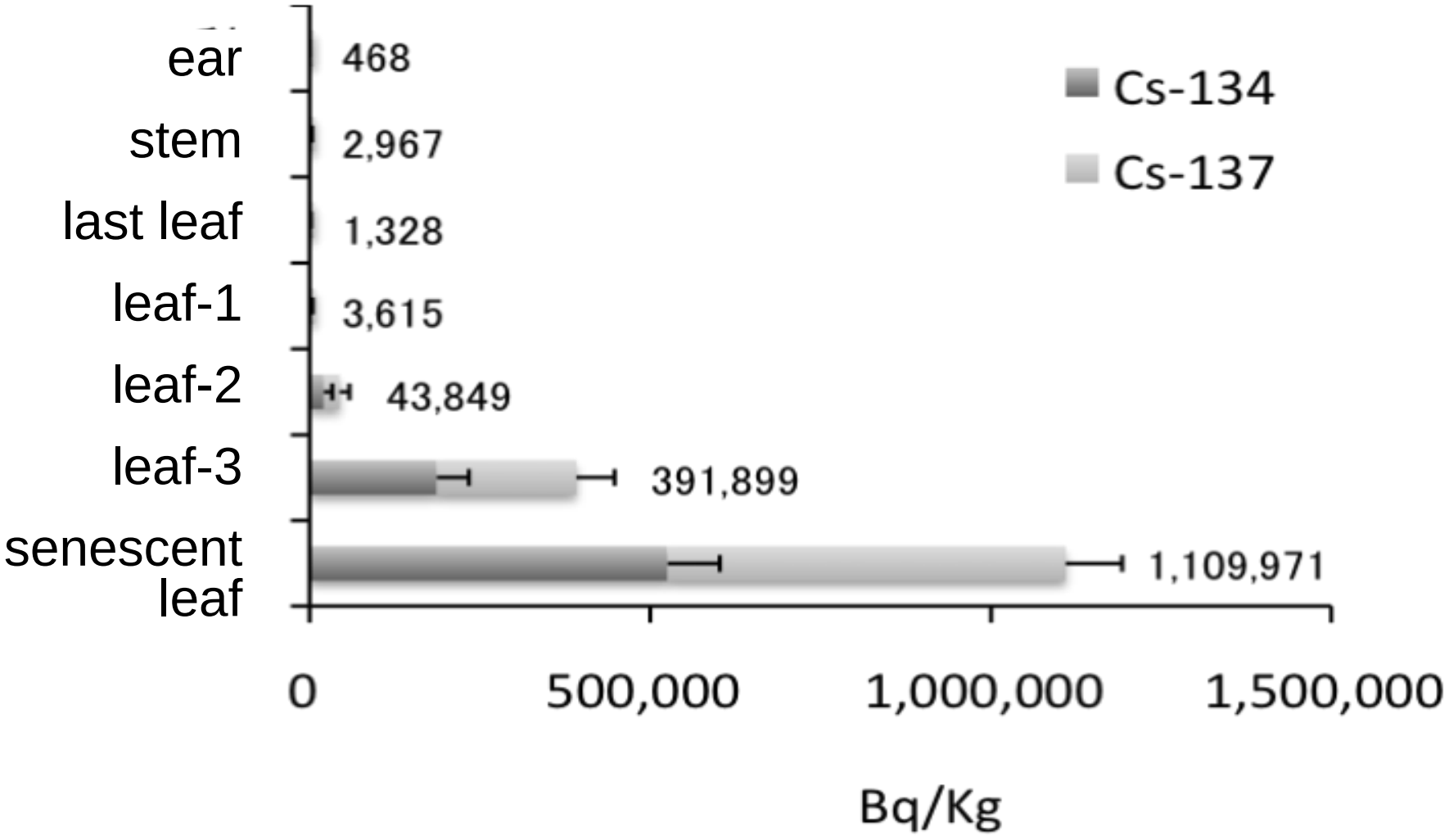
A wheat grown in Fukushima

Wheat field
early in March

Picture of the sample
（2011/05/16）

Radioactivity image by an imaging plate
(2011/05/20)

Radioactivity was found as spots in the oldest leaf.

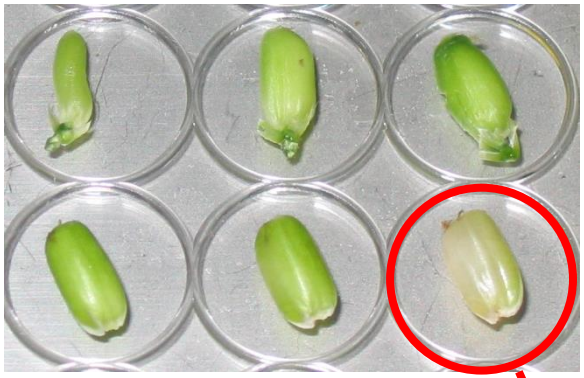

ear
stem
last leaf
leaf-1
leaf-2
leaf-3
senescent leaf
468
2,967
1,328
3,615
43,849
391,899
1,109,971
Cs-134
Cs-137
0
500,000
1,000,000
1,500,000
Bq/Kg

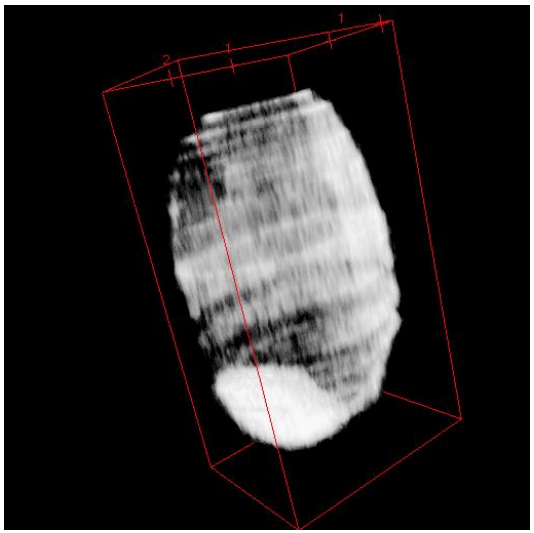
Cesium adsorption on soil

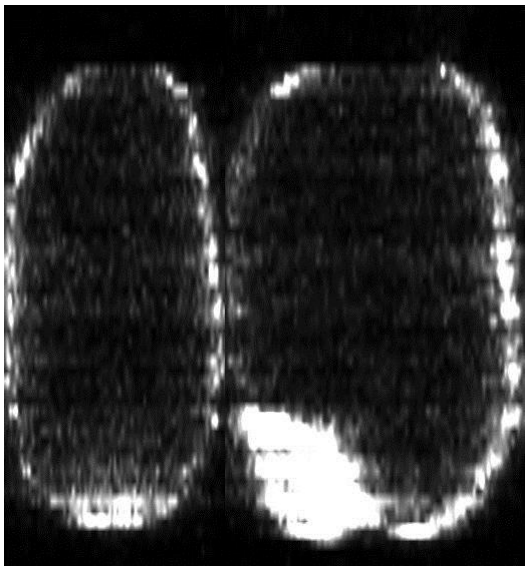
^{137}Cs

Distribution of ^{137}Cs in a rice grain.
after 3, 5, 7. 9. 12 and 15 days of flowering

by an Imaging Plate (IP)







3D image of ^{137}Cs

Soil-plant study

Iitate-village (30m × 3.6m)　divided into 60 areas (1.2 m x1.5 m)

1.5m

1.2m																				
	C1	C2	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	C20
	B1	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	B20
	A1	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	A20

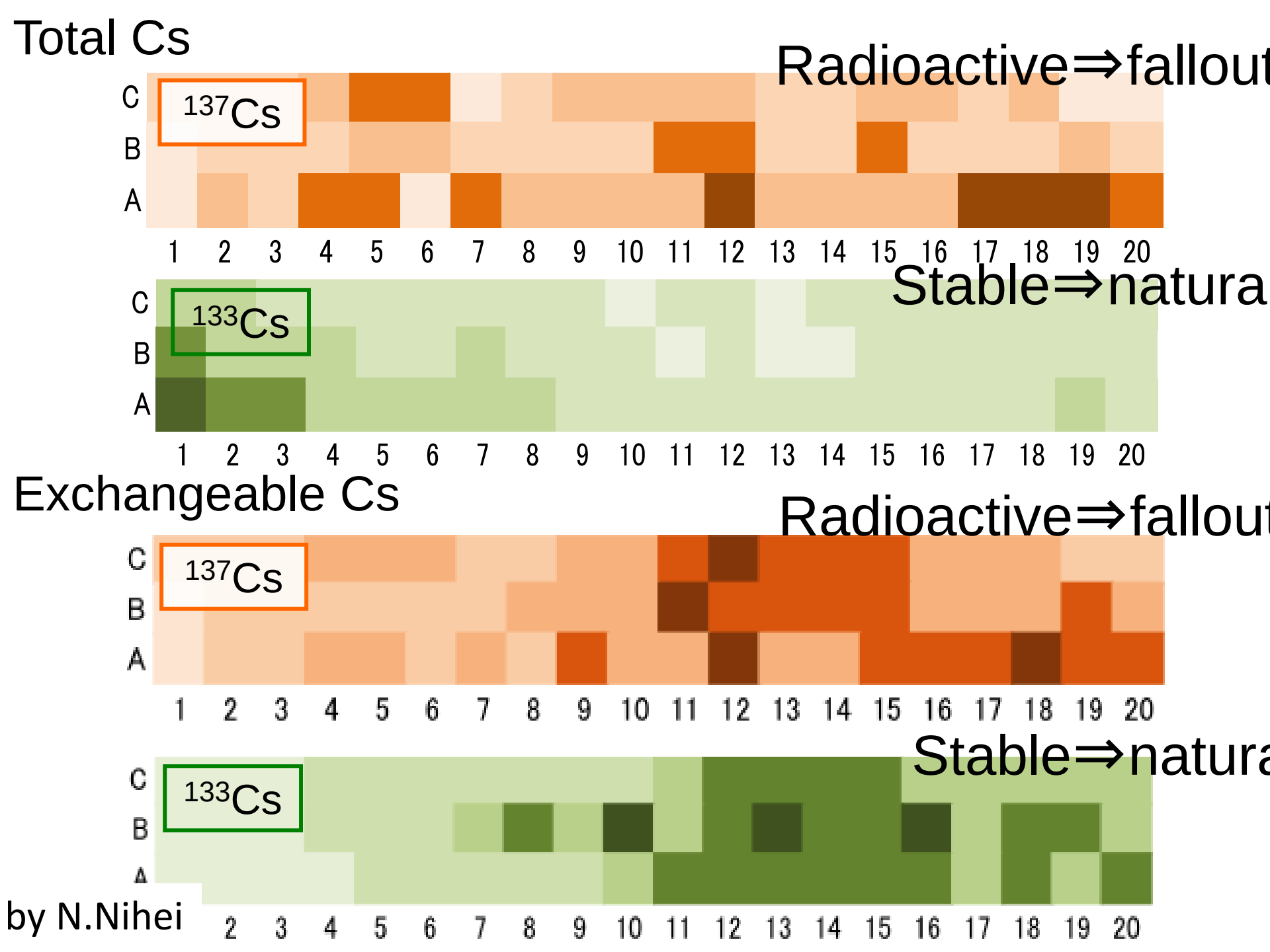
4m

30m

- Soil　0-15 cm soil
  5 cm in diameter

- Buckwheat
  8/7～10/21

by N.Nihei


Total Cs
Radioactive⇒fallout
137Cs
C
B
A
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Stable⇒natura
133Cs
C
B
A
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Exchangeable Cs
Radioactive⇒fallout
137Cs
C
B
A
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Stable⇒natura
133Cs
C
B
A
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
by N.Nihei

Total Cs:

- Stable ^{133}Cs is not scattered
- No relationship between ^{133}Cs and ^{137}Cs

^{137}Cs stayed where it touched

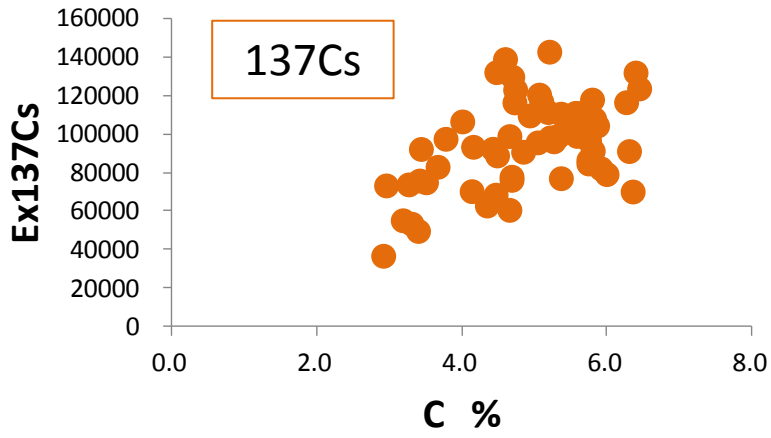
⇒ organic matter or clay

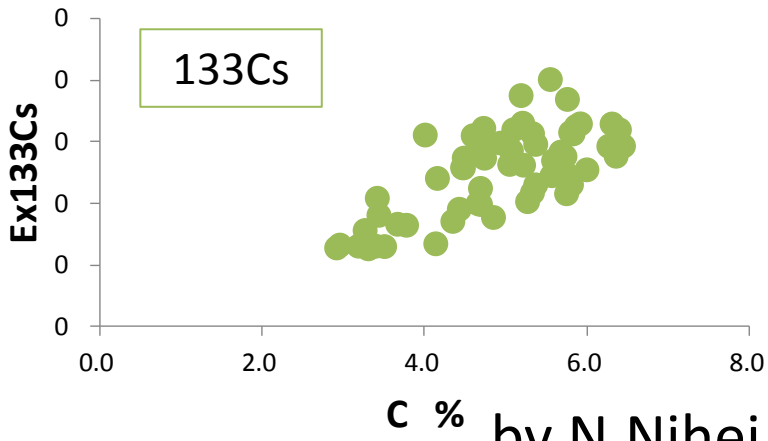
Exchangeable Cs:

- Strong relationship between ^{133}Cs and ^{137}Cs

⇒Similar scattering pattern (variation coefficient)

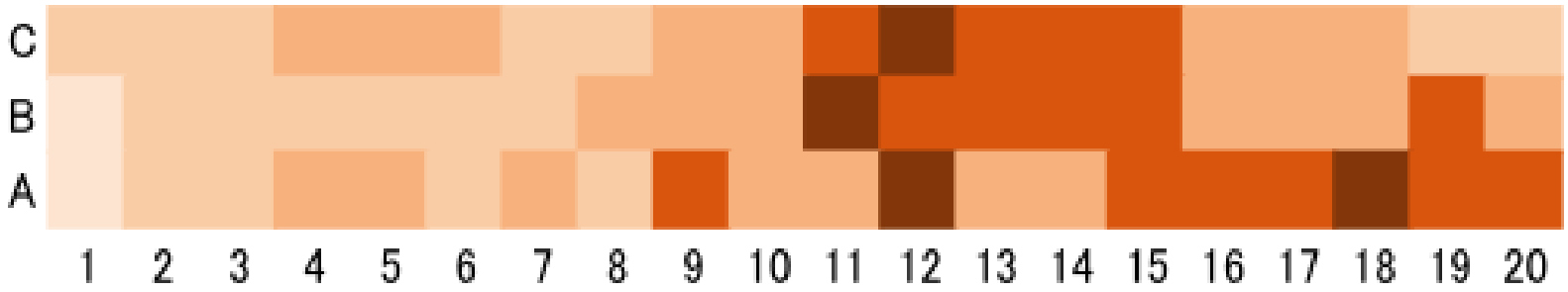
- Strong relationship between organic matters



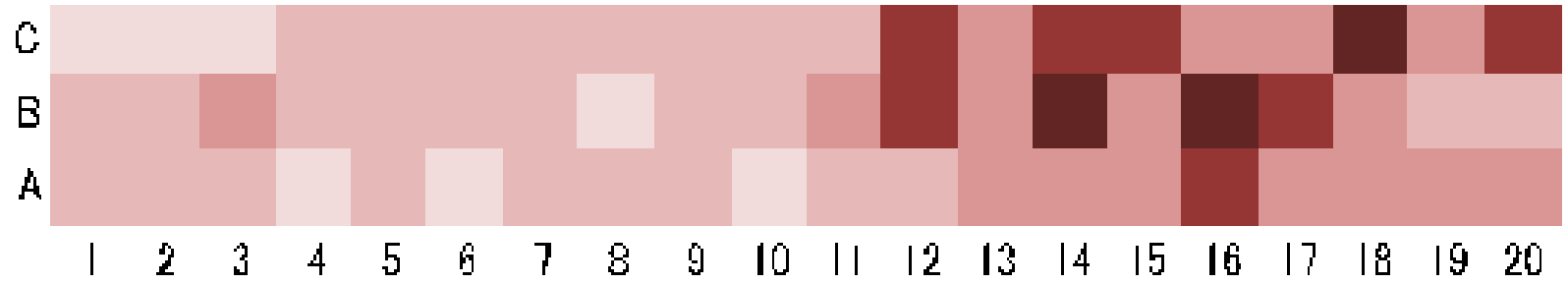


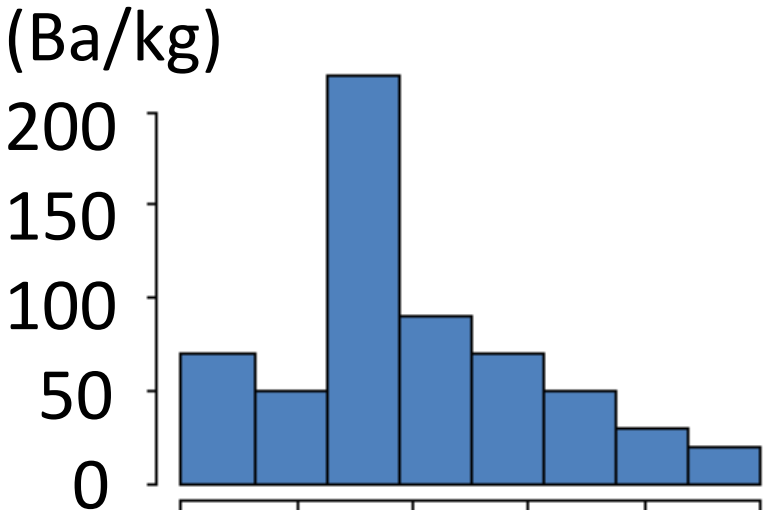
by N.Nihei

Exchangeable ^{137}Cs



Buckwheat ^{137}Cs content





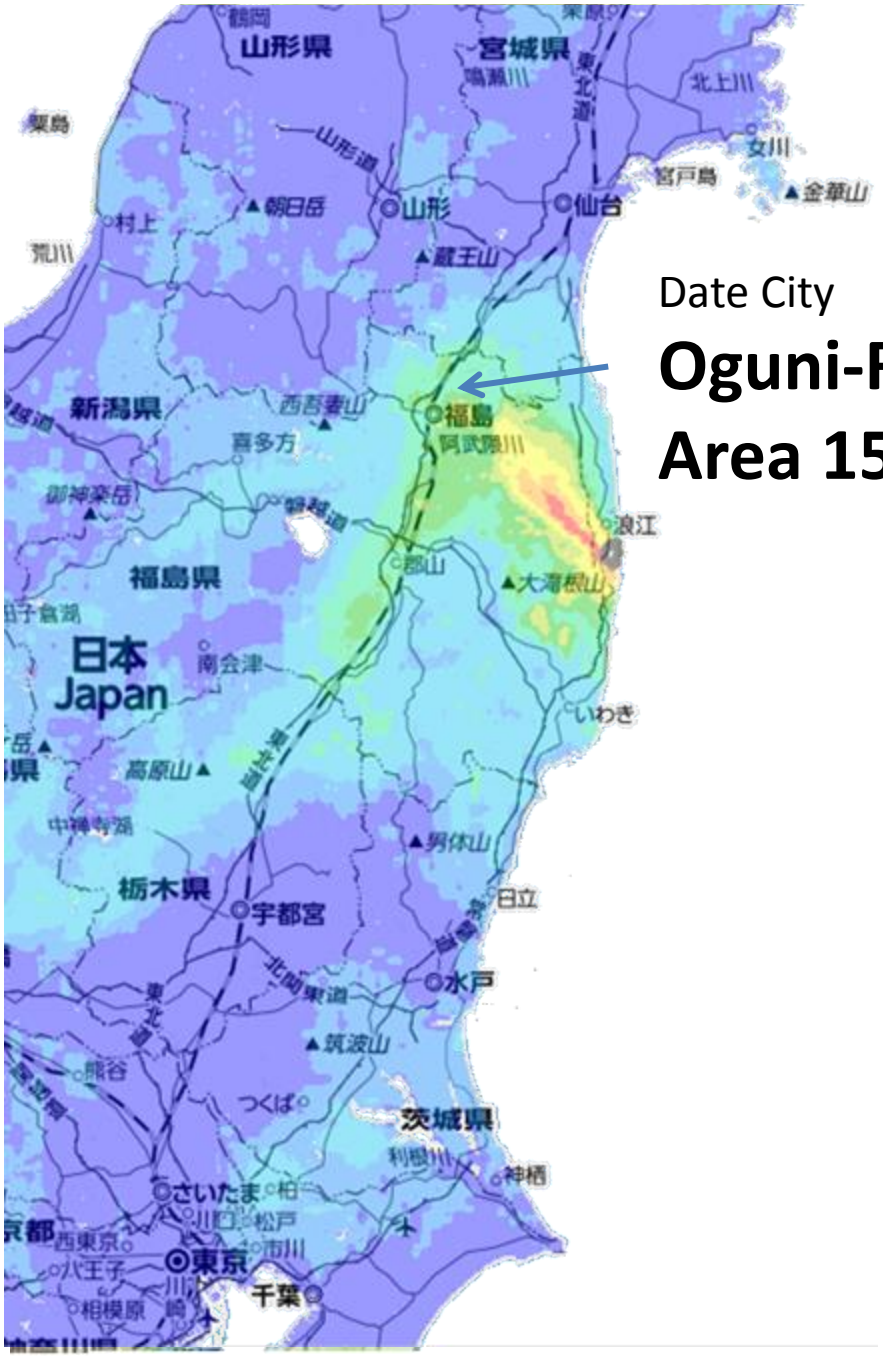
Extraction soln.

- Ammonium acetate
- Hydrogen peroxide
- Nitric acid
- Hydrogen fluoride

by N.Nihei

Representative fallout effects in agriculture

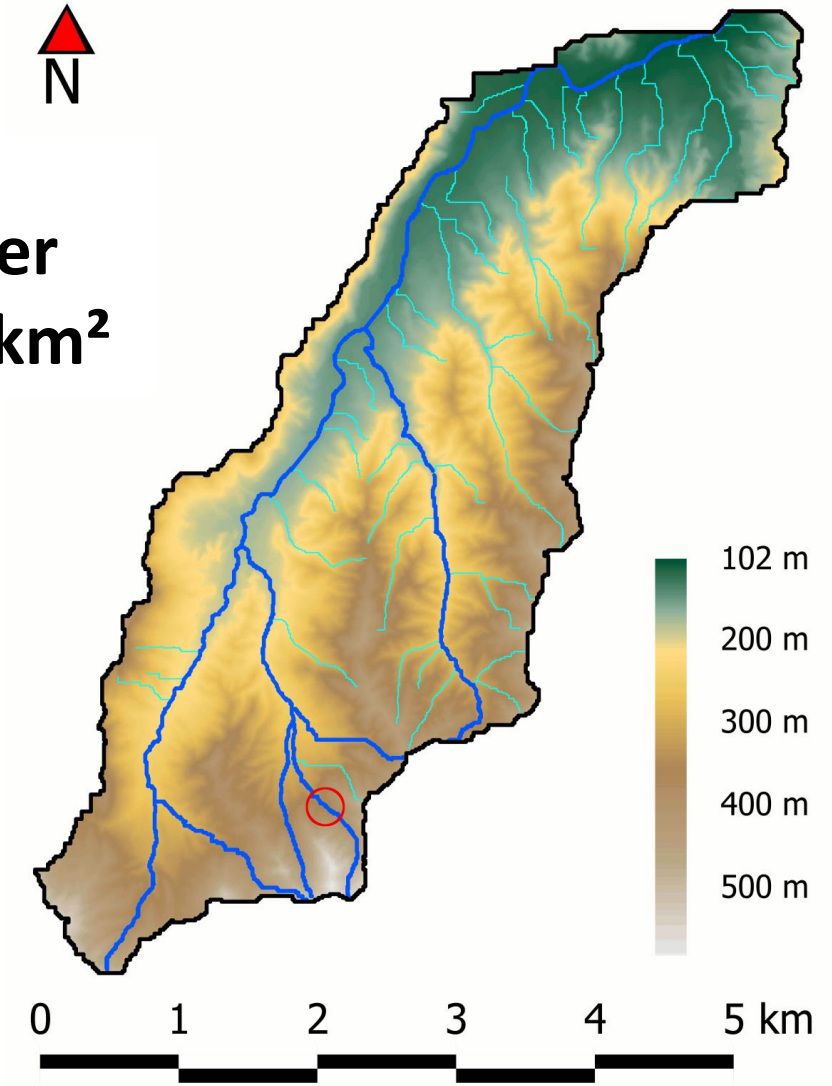
1. Soil
2. Plants
3. mountains
4. Animals and others



Date City

Oguni-River

Area 15.6km²



by N. Ohte

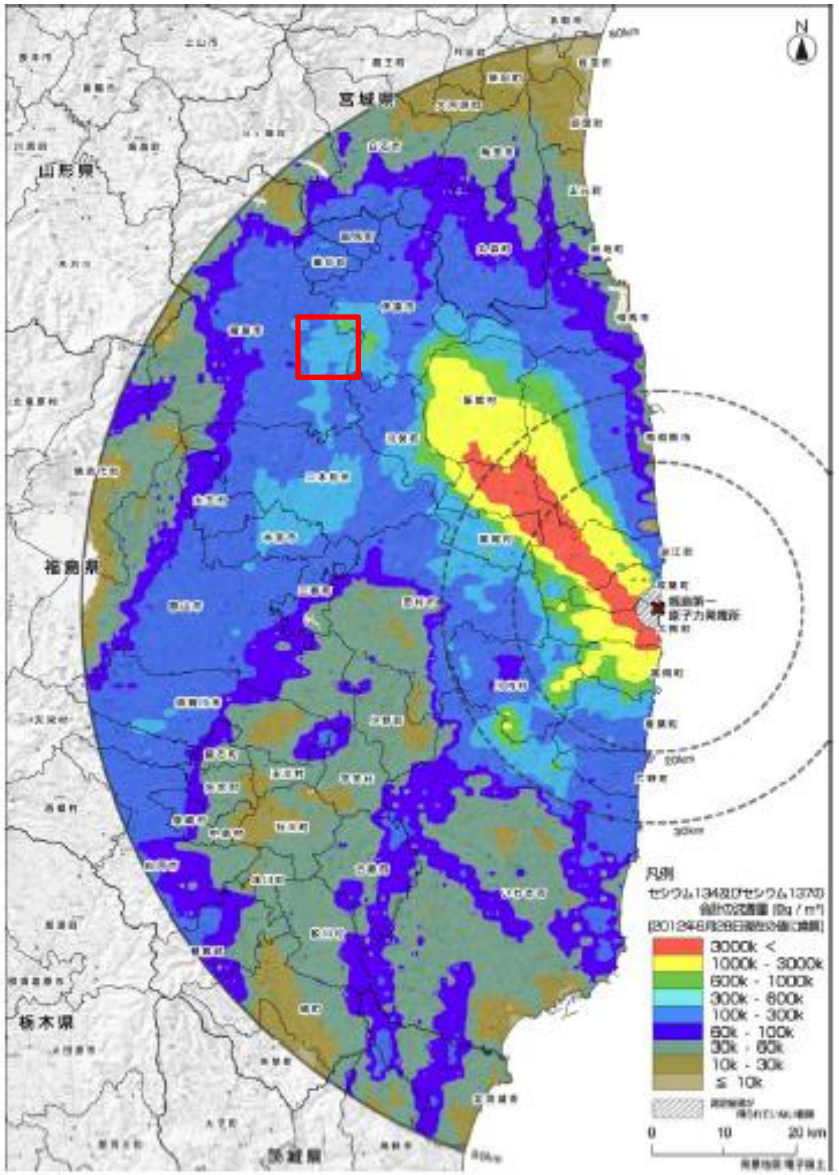
Litter collection

Water amt. and flow

Water flow along the trunk

by N. Ohte

Accumulation of radioactive Cs: 300000-1000000 Bq/m^2



27.7Bq/m^2/112days
→～ 90Bq/m^2/year
Corresponds to
0.01-0.03% of accumulated Cs（1 in several thousand)

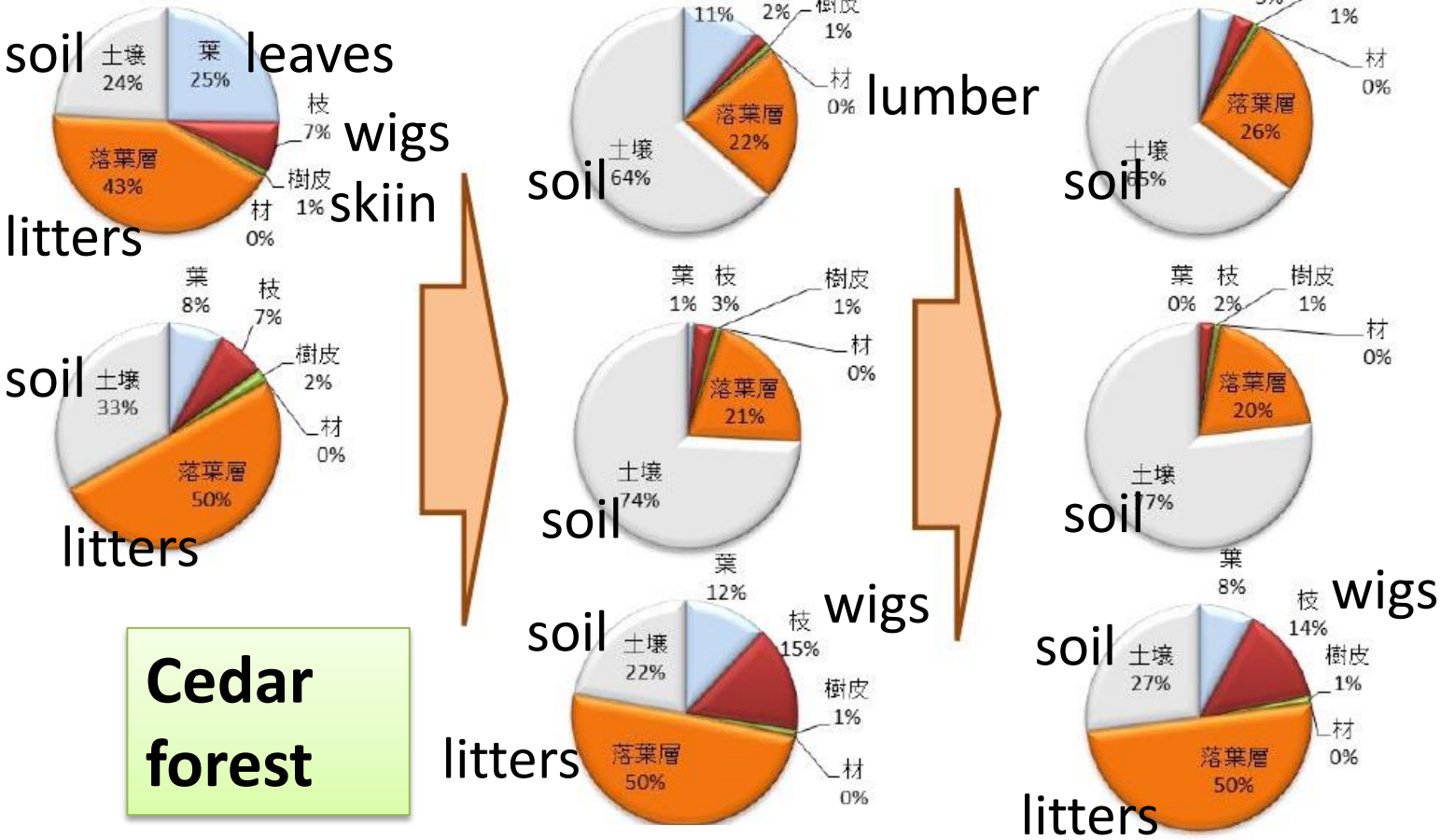
by N. Ohte

Cedar forest

Pine tree forest

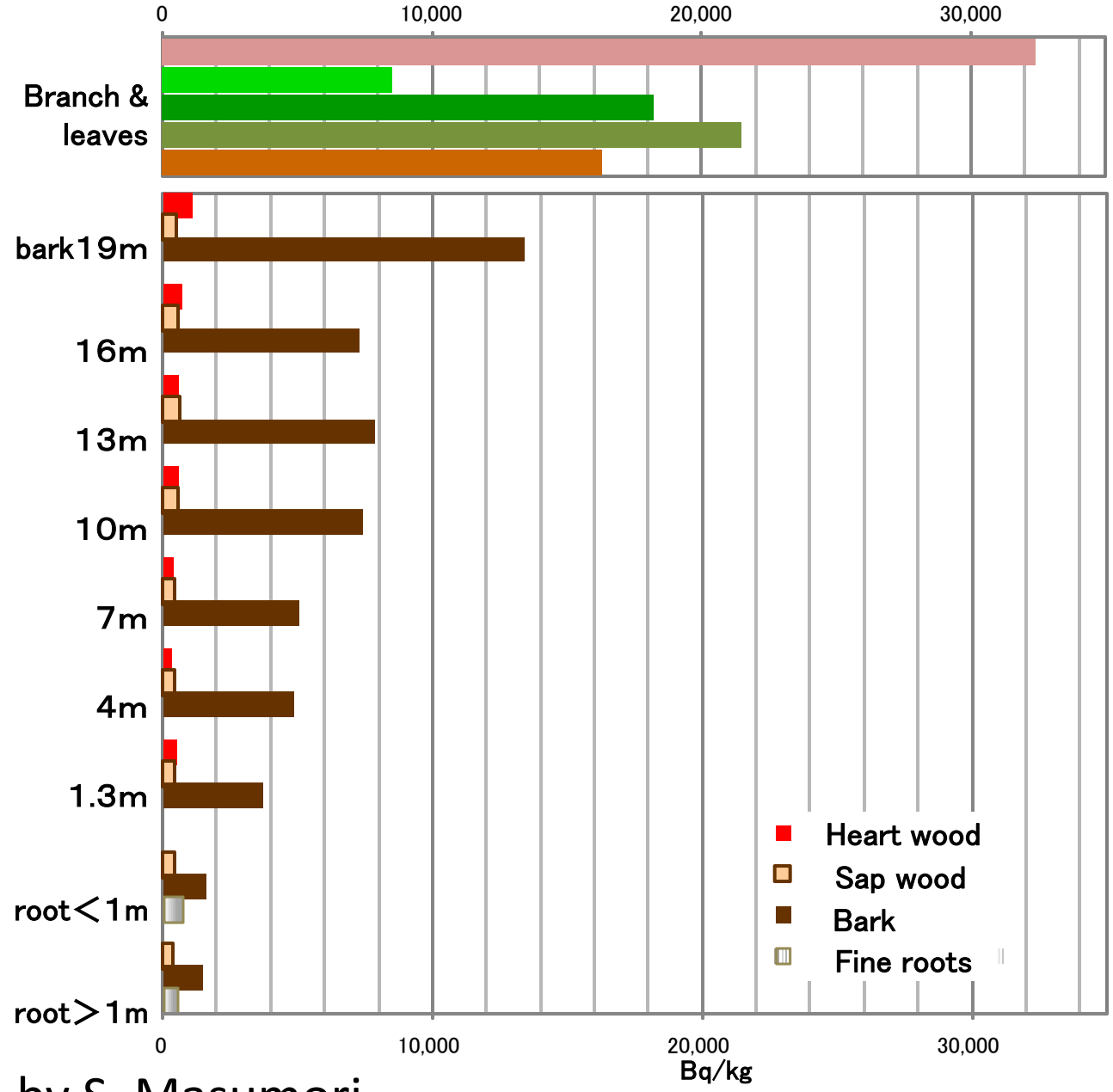
Cedar forest

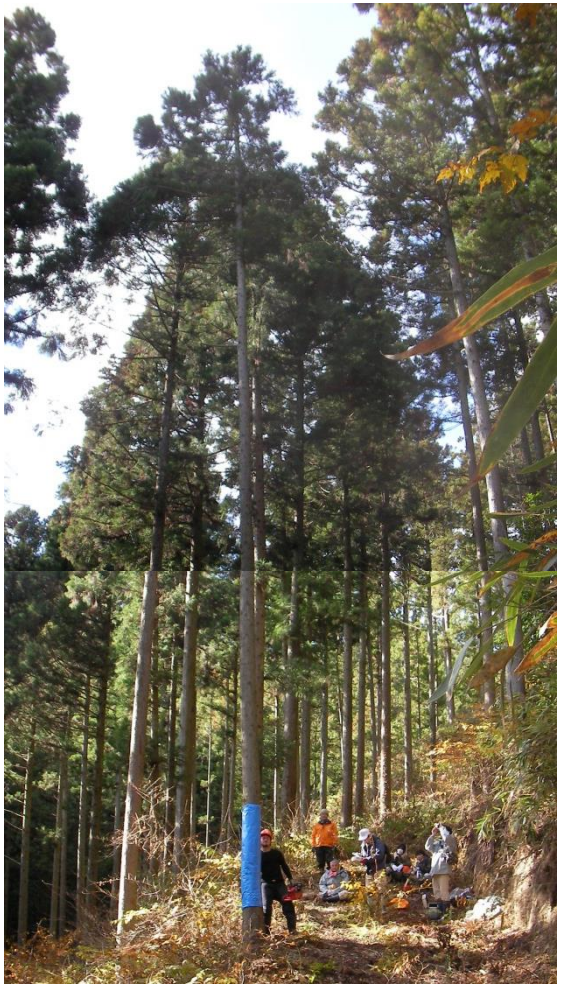
2011 **2012** **2013**



2012

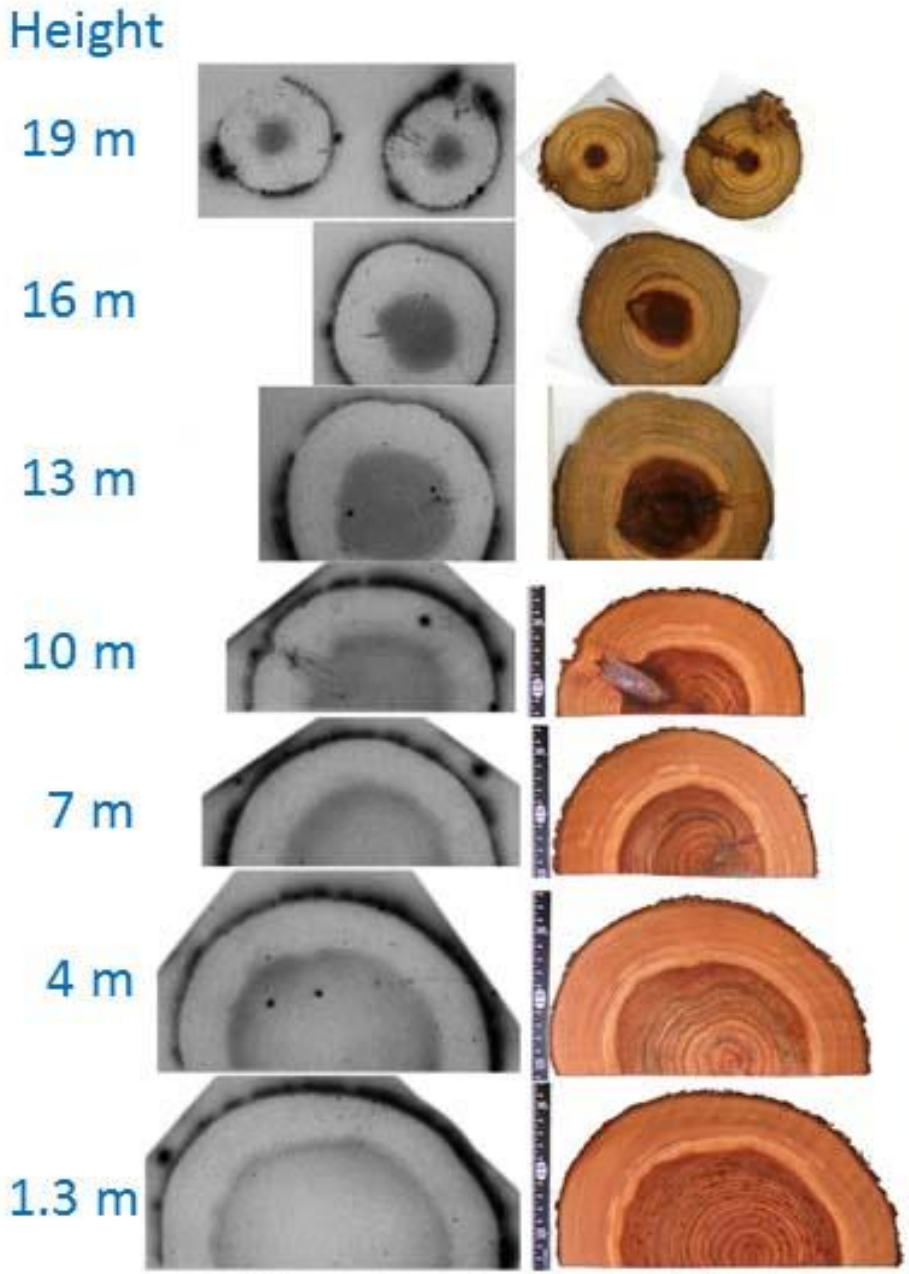
Cedar tree





Cedar tree height : 23.2m
Under the branch :15.7m
Environment :1.8 μSv/h
Litter :120,000 Bq/kg
Soil 0～2cm 2,000 Bq/kg
Soil 2～5cm 1,500 Bq/kg

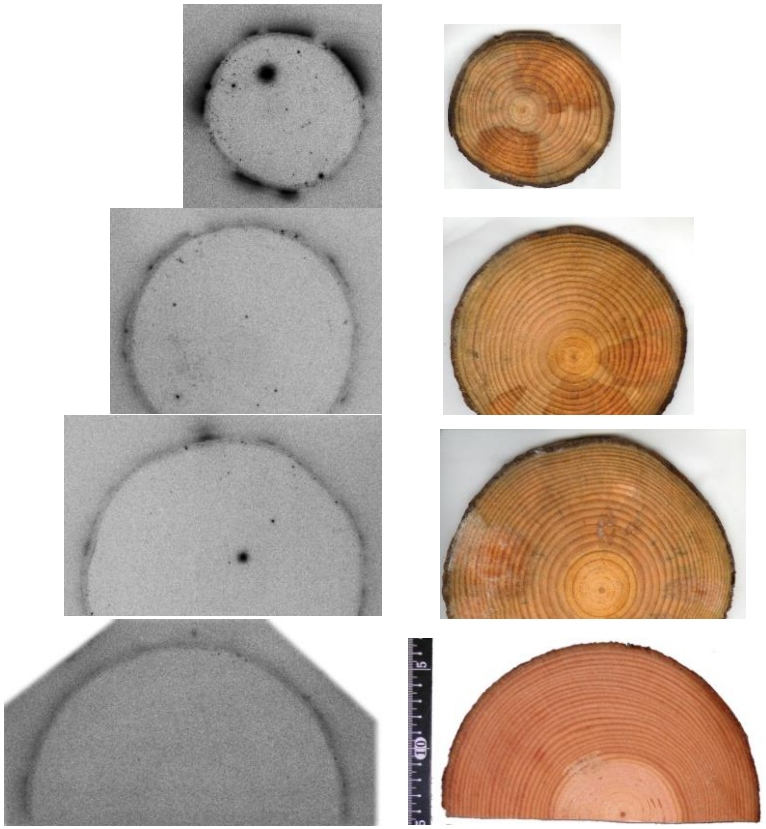
by S. Masumori



by S. Masumori

2012

Pine tree

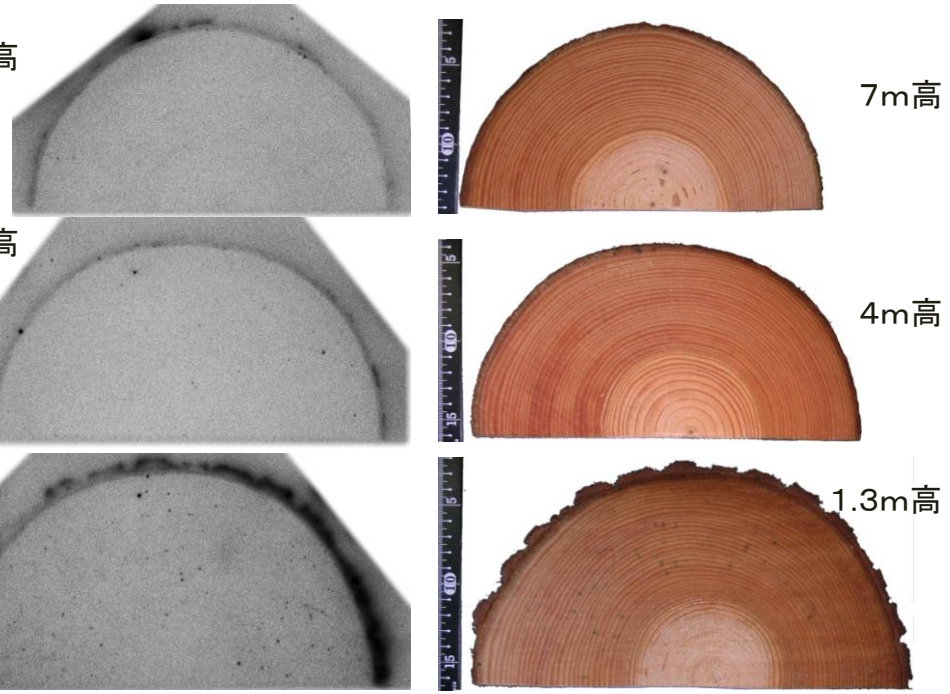


19m高

16m高

13m高

10m高



7m高

4m高

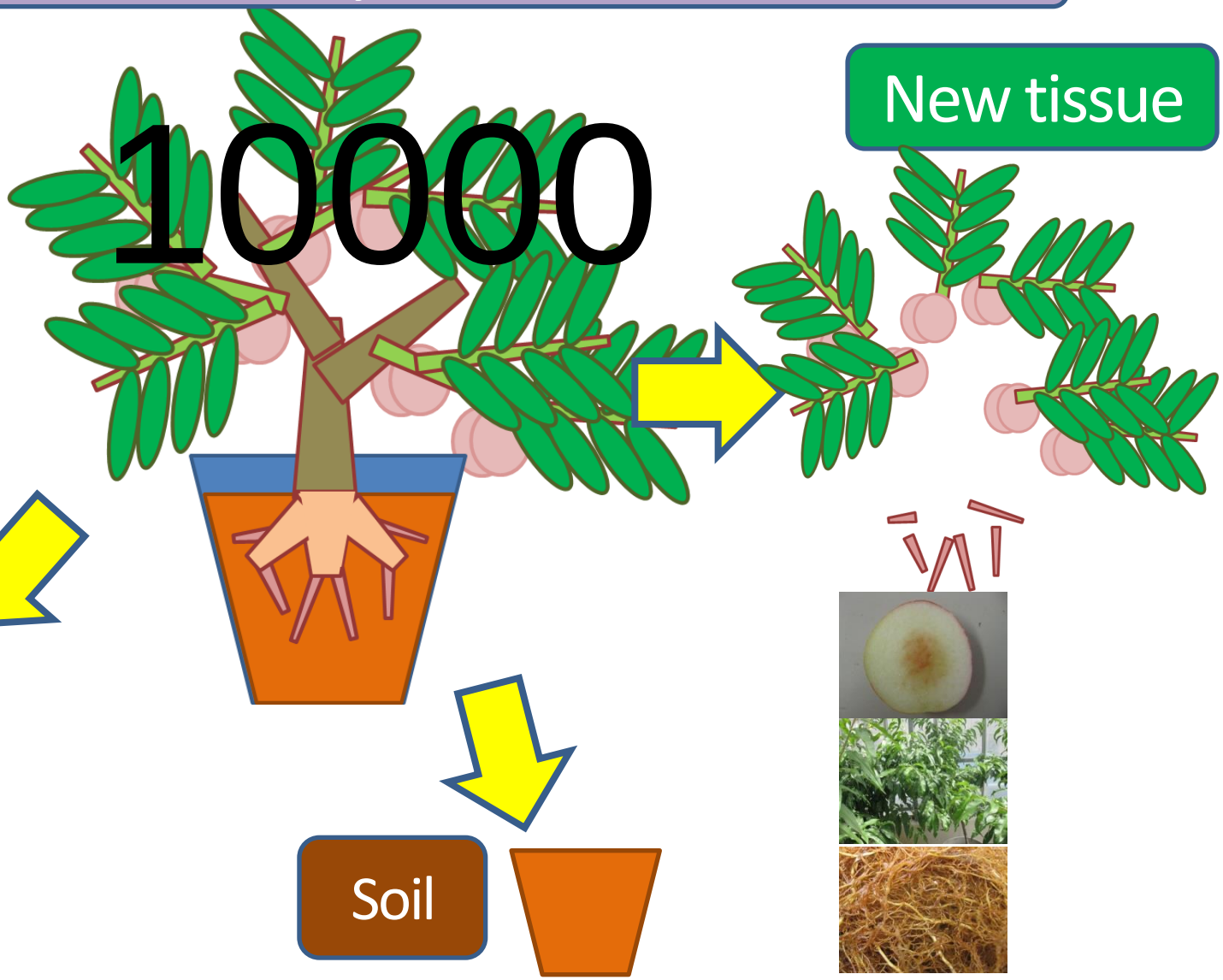
1.3m高

by S. Masumori

Environment: 1.8 μ Sv/h

*Cs movement in a tree

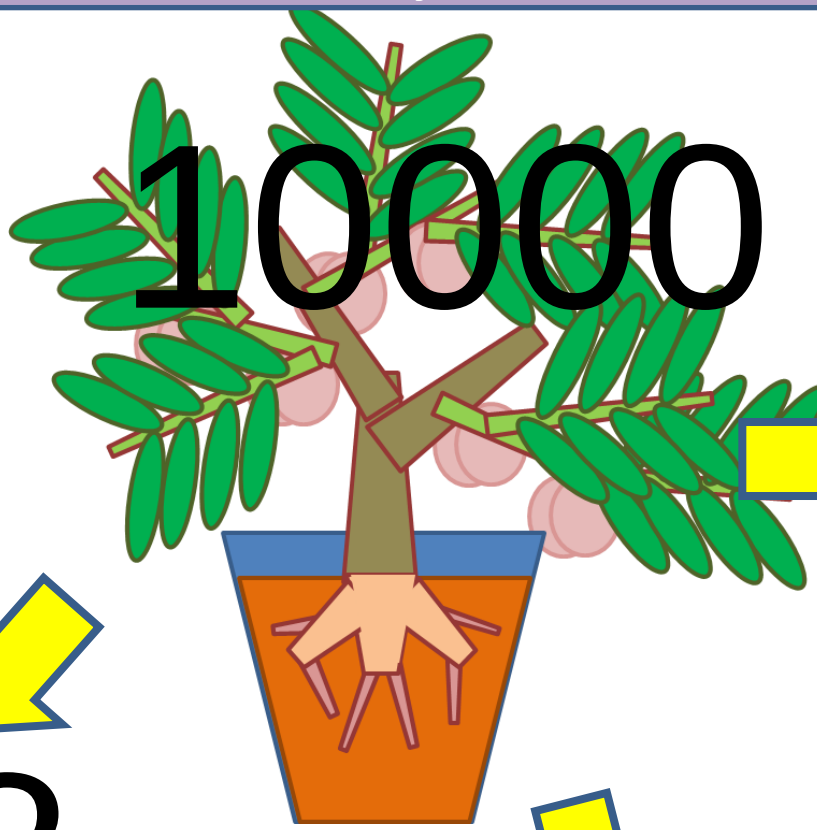
When the total activity within the tree is 10000



by D. Takada

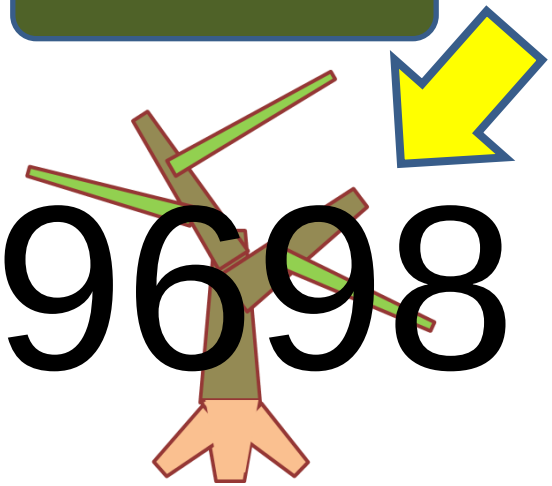
*Cs movement in a tree

When the total activity within the tree is 10000

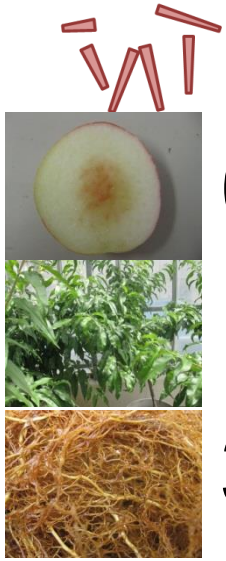


New tissue

Old tissue



Soil

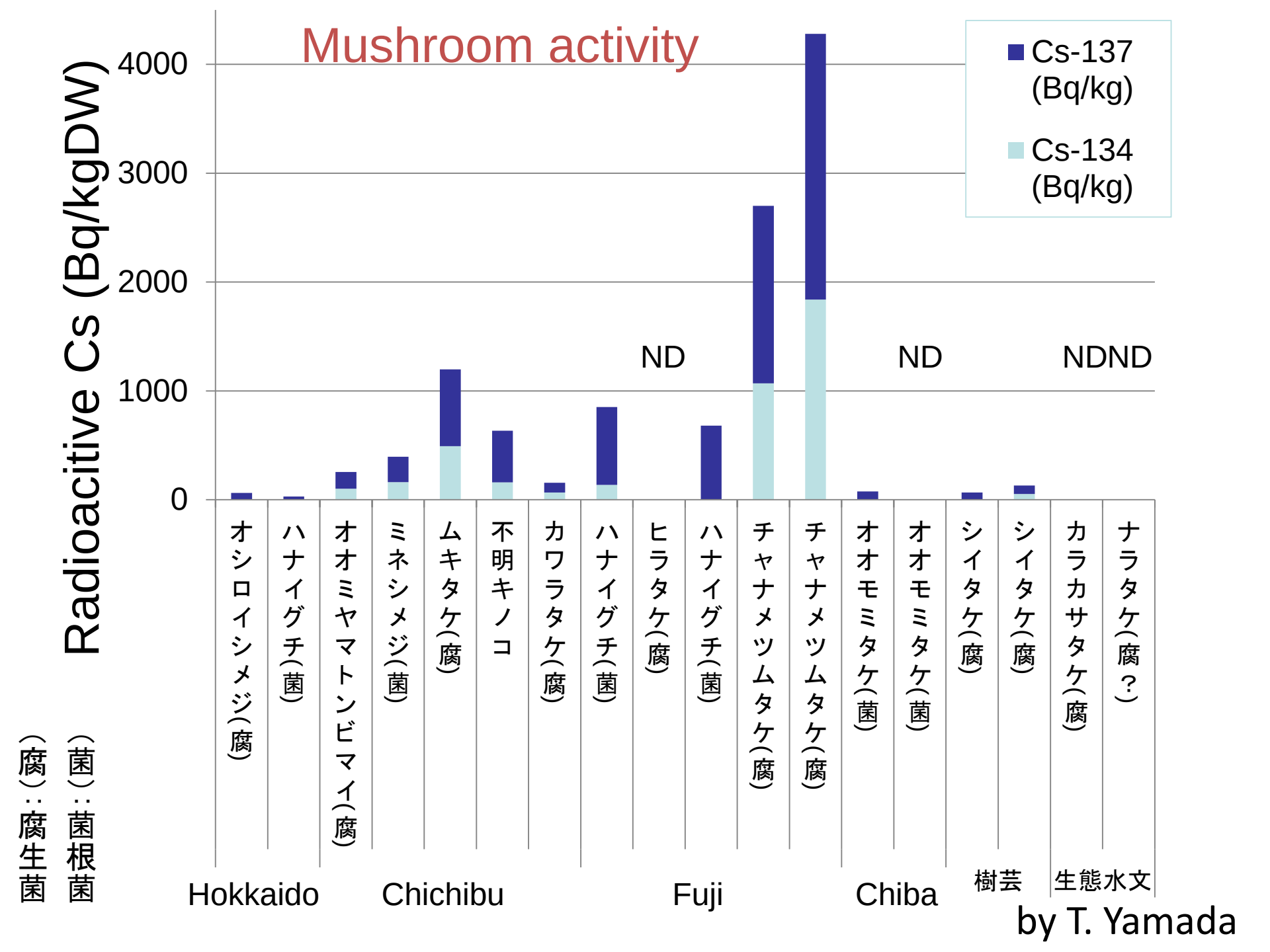


64

112

36

by D. Takada


Mushroom activity
Radioactive Cs (Bq/kgDW)
4000
3000
2000
1000
0
Cs-137 (Bq/kg)
Cs-134 (Bq/kg)
ND
ND
NDND
オシロイシメジ(腐)
ハナイグチ(菌)
オオミヤマトンビマイ(腐)
ミネシメジ(菌)
ムキタケ(腐)
不明キノコ
カワラタケ(腐)
ハナイグチ(菌)
ヒラタケ(腐)
ハナイグチ(菌)
チャナメツムタケ(腐)
チャナメツムタケ(腐)
オオモミタケ(菌)
オオモミタケ(菌)
シイタケ(腐)
シイタケ(腐)
カラカサタケ(腐)
ナラタケ(腐？)
Hokkaido
Chichibu
Fuji
Chiba
樹芸
生態水文
菌：菌根菌
腐：腐生菌

by T. Yamada

Representative fallout effects in agriculture

1. Soil
2. Plants
3. mountains
4. Animals and others

feather of the bird (*Cettia diphone*)

by K. Ishida

Bird's feather (*Cettia diphone*)

*Cs image by an IP

by K. Ishida

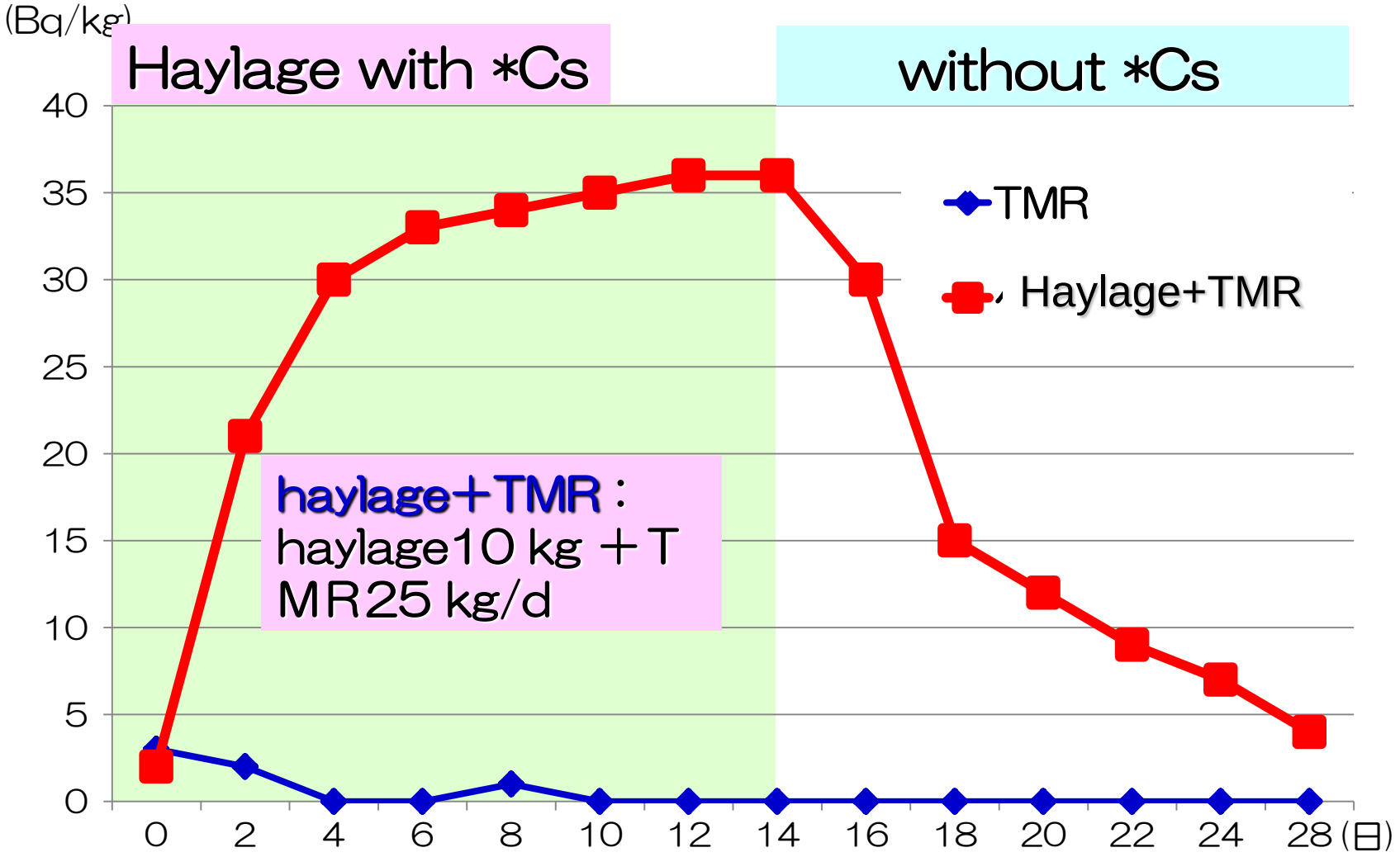
Experiment

TMR 14 d	TMR 14 d	TMR 14 d
TMR 14 d	haylage+TMR 14 d	TMR 14 d

- TMR：35kg/d
- haylage＋TMR：
  haylage10kg＋TMR
  25 kg /d
  （total 35 kg）

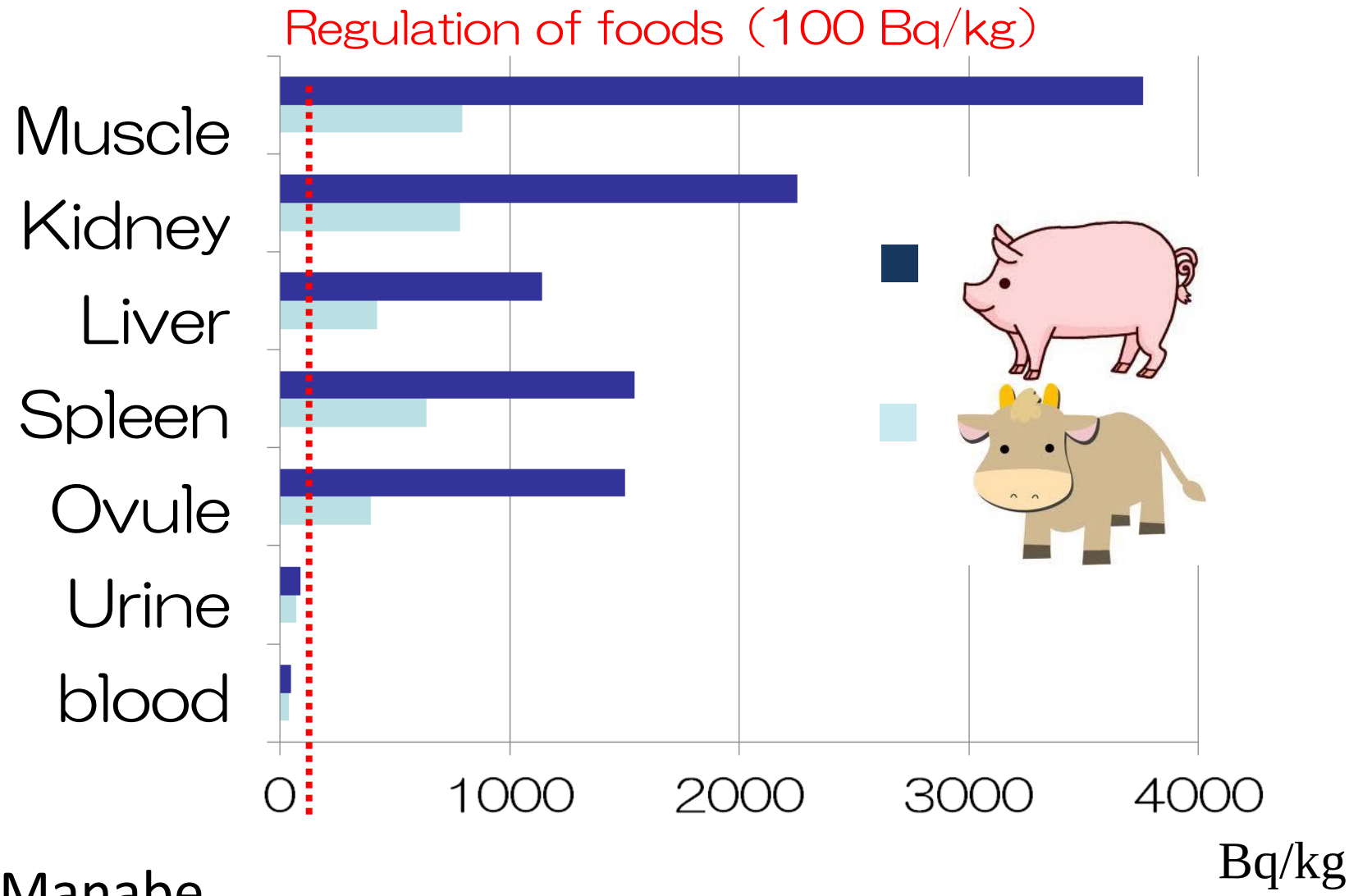
by N. Manabe

Radioactivity in milk



by N. Manabe

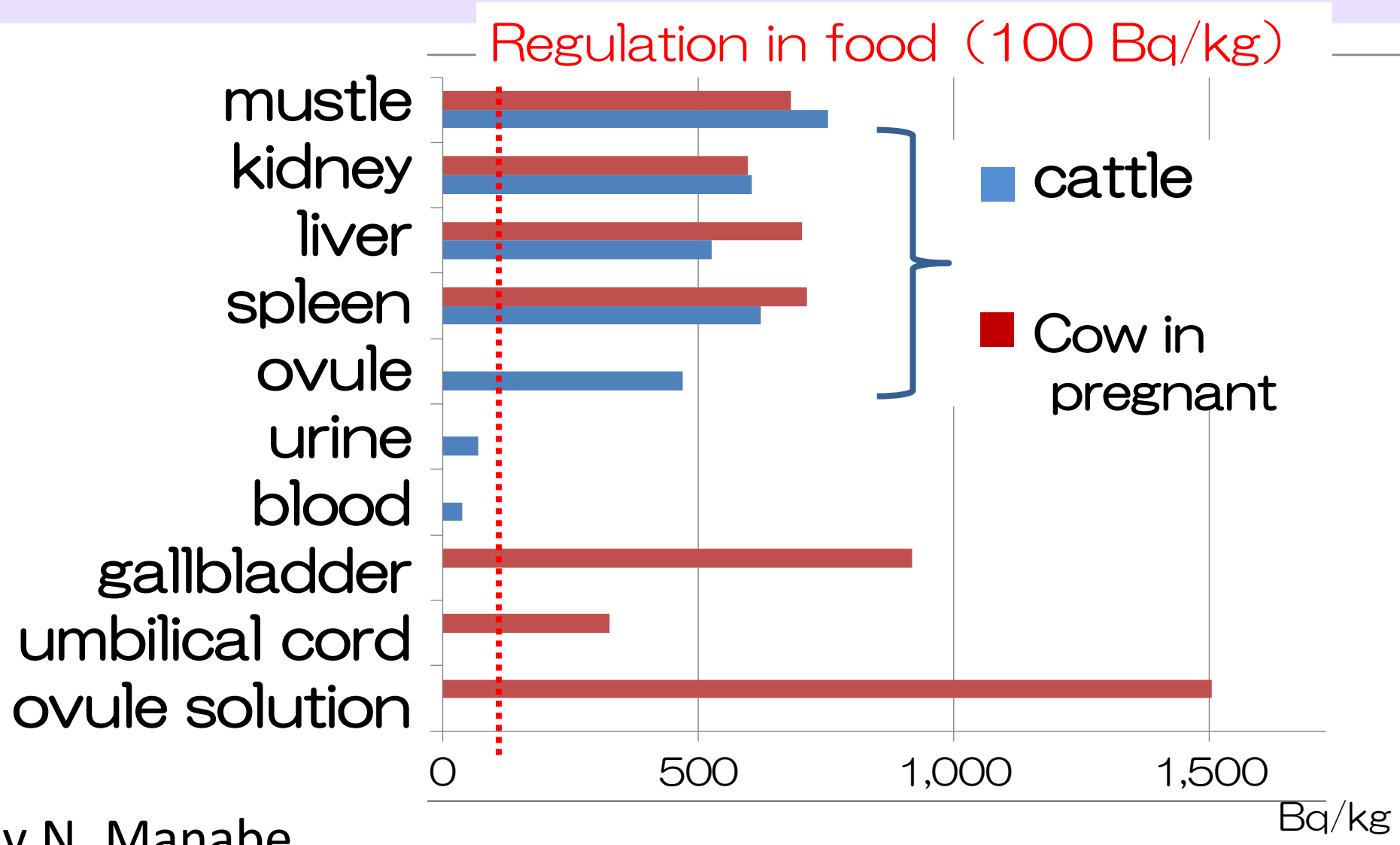
Contamination of animals



by N. Manabe

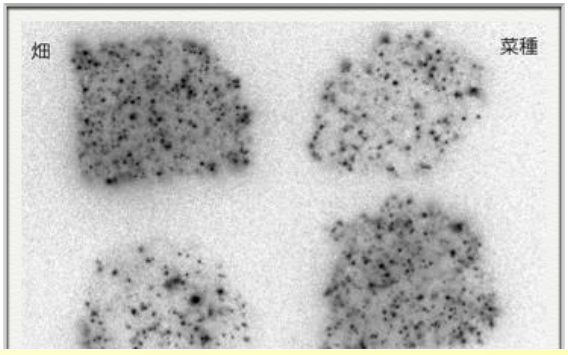
Animal contamination

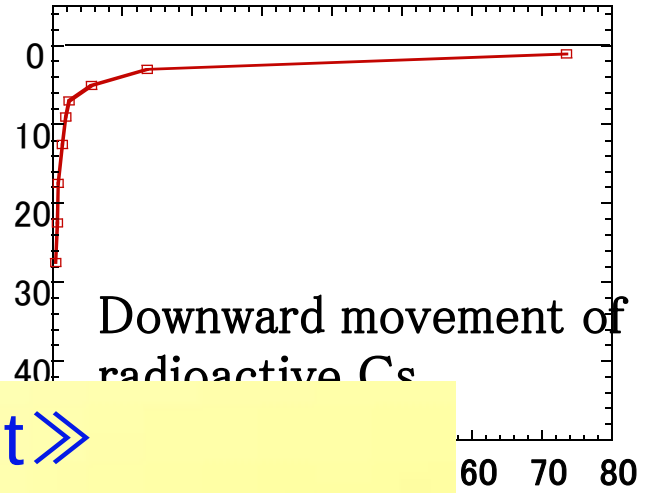
Transport to next generation



by N. Manabe

soils





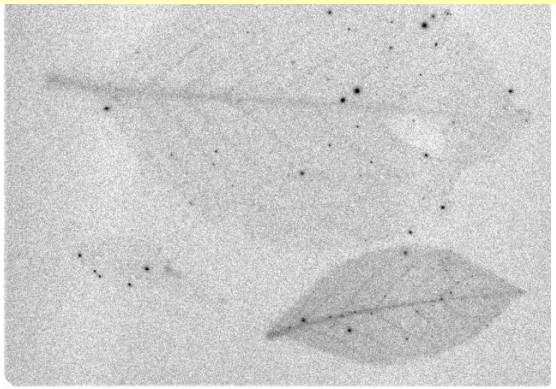
≪features of fallout≫

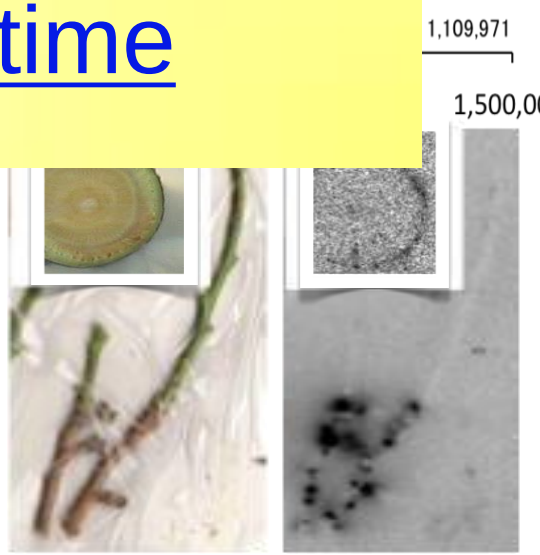
Spot-like adsorbtion at surface

Hardly move with time

crop

trees

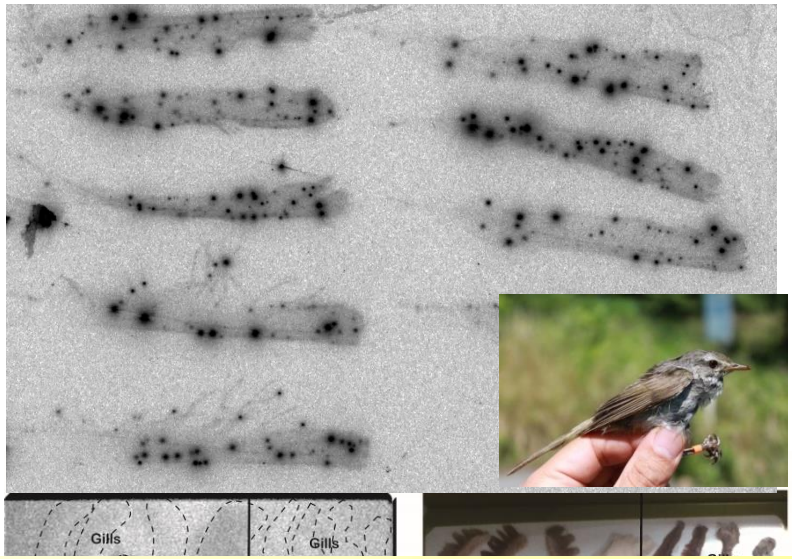




birds

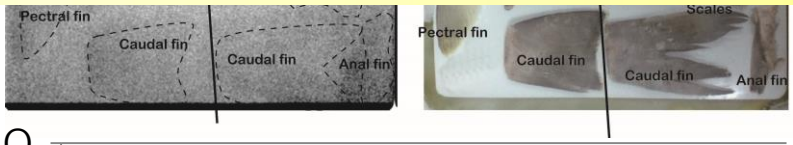
fish

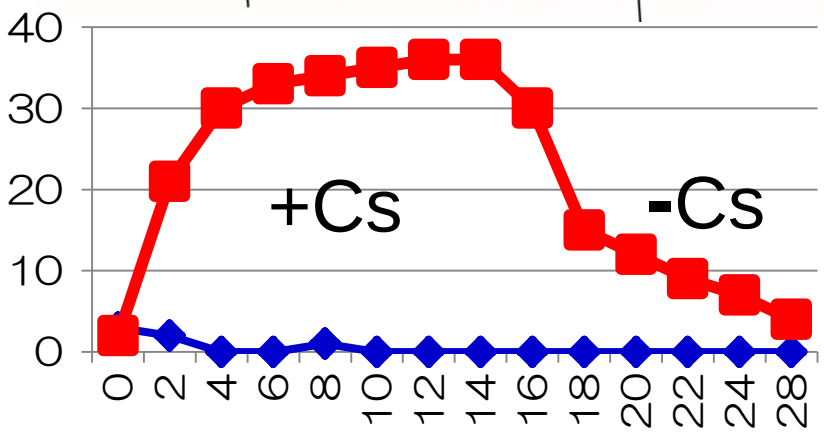
cow



≪living thing≫

metabolization





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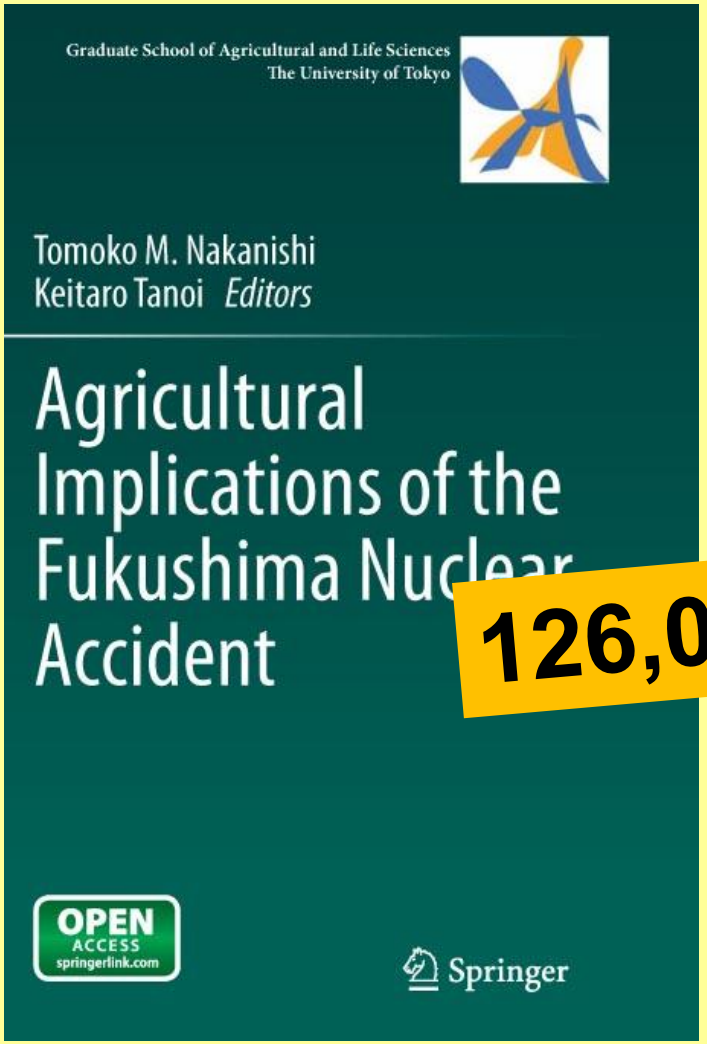

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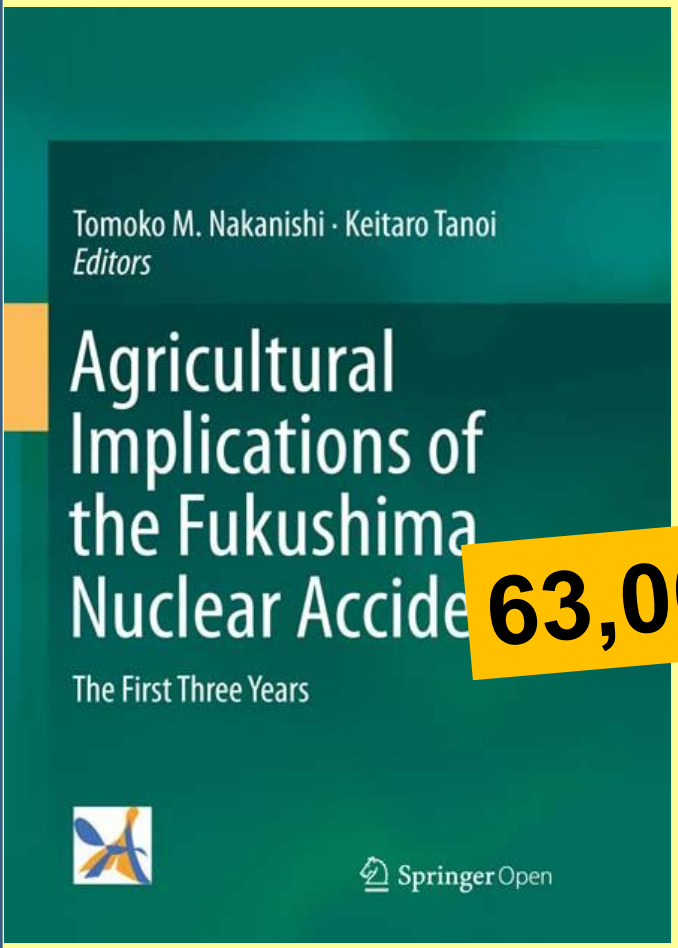

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land
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