LONG-TERM RADIATION MONITORING FROM CONTAMINATED SOIL BURIED IN PADDIES IN IITATE VILLAGE, FUKUSHIMA

東京大学 THE UNIVERSITY OF TOKYO

MASARU MIZOGUCHI

Department of Global Agricultural Sciences, The University of Tokyo

ABSTRUCT Since May 2014 we have conducted rice cultivation every year at a paddy field where soil contaminated with radiocesium was buried. As a result of measurement of soil radiation every year, the depth of the highest soil radiation has not changed for 4 years. This tendency was also the same as in the pasture of cattle where a contaminated paddy bank was buried. This result indicates that radiocesium is unlikely to leach from the contaminated soil buried in paddy fields. In addition, it was found from this study the soil radiation will decrease naturally obeying a theoretical equation.

INTRODUCTION Radiocesium (Cs) is fixed to clay minerals such as weathered mica in soils. On the other hand, when Cs is loosely adsorbed to organic matter in soil, there is concern that it will be released again due to decomposition of organic matter by microorganisms, absorbed from the roots of the crops. This study shows the results of soil radiation measured over 4 years at two paddy fields buried contaminated soil.

METHOD

(1) In-situ burial work of Cs-contaminated paddy bank

In the governmental decontamination work, paddy banks were not decontaminated. In the Matsuzuka of Iitate village, a side of a paddy bank was excavated (1 m wide, 10 m long, 0.7-1.0 m deep) in order to bury the contaminated bank and cover it with about 50 cm thick non-contaminated soil (*Photo.1*). As well as the in-situ experiment in Sasu [1], an observation well for a PVC pipe with a bottom and a lid was installed from a depth of 150 cm to 50 cm above the ground. Since 2016, this paddy field has been used as a cattle pasture although it has often submerged by heavy rain and snowmelt water due to poor drainage of the soil.

(2) Measurement of soil radiation

A radiation meter with a length of 1 meter with 10 Geiger–Müller tubes arranged at intervals of 10 cm is inserted into the observation well and radiation in the soil were measured every year from March 2015 to March 2019.

RESUTS AND DISCUSSION

(1) Distribution of soil radiation (Fig.1)

Soil radiation became Gaussian distribution with maximum value around 70-80 cm high. In addition, the maximum radiation decreased with time.

(2) Analysis of maximum value of radiation (CPM), its height (b) and the centroid height (c) (Table.1&Fig.2)

As in the previous year [1], the radiation was analyzed in the vicinity of the maximum value, and the height (b) at the maximum soil radiation and the centroid height (c) of fitting curves were determined using the EXCEL solver.

(3) Attenuation of maximum soil radiation (Fig.3)

Soil radiation dose decreases year by year due to natural attenuation of Cs-134 and Cs-137. Fig.3 shows attenuation curves calculated using Maximum CPM value of 2016/3/20 in Table.1, assuming that (1)the ratio of Cs-134 and Cs-137 released was 1:1 at the nuclear accident (2) half-life time are 2.1 and 30.2 years for Cs-134 and Cs-137, respectively. (3) the ratio of the effects of Cs-134 and Cs-137 on the soil radiation is 7.3:2.7. Fig.3 suggests that the soil radiation will decrease naturally obeying a theoretical equation.

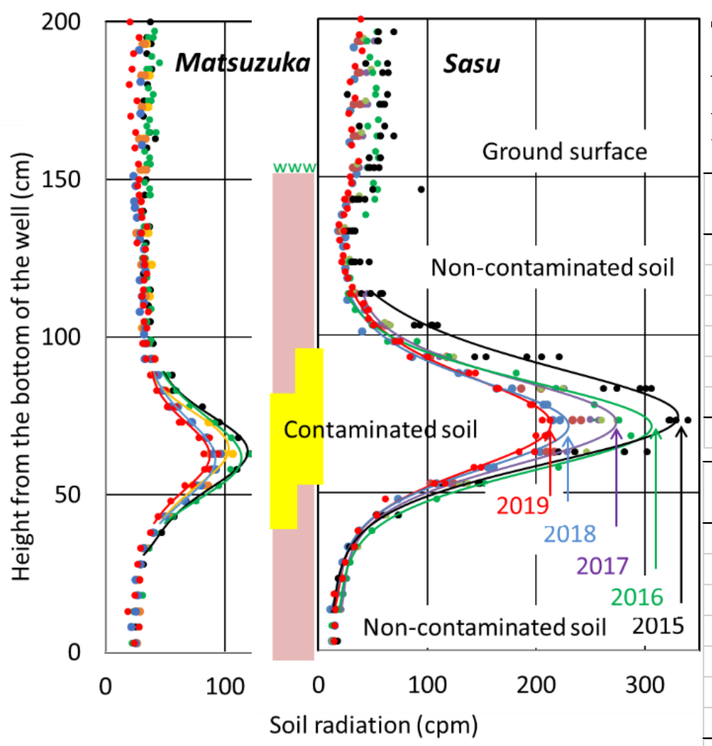

Fig.1 Profiles of soil radiation starting in March 2015. Note that Cs-contaminated soil was buried in the layer from around 40-100 cm high from the bottom of the well. The ground surface is at the height of 150 cm from the bottom of the well. The solid lines are fitting curves of data measured in 2015-2019.

Table.1 Analysis of maximum value of radiation (CPM), its height (b) and the centroid (c)

Date measured	Years after 2011/3/15	Height (cm) b	Height (cm) c	Maximum CPM
2015/11/21	4.7	63.9	64.7	119
2016/3/20	5.0	60.8	64.4	113
2017/3/12	6.0	64.2	65.3	103
2017/12/9	6.7	60.4	64.5	91
2018/3/11	7.0	60.0	64.1	92
2019/3/10	8.0	62.4	64.6	87
Gradient	1.0	-0.49	-0.07	-10

Date measured	Years after 2011/3/15	Height (cm) b	Height (cm) c	Maximum CPM
2015/3/21	4.0	72.2	73.7	328
2016/3/20	5.0	70.7	69.4	306
2016/11/6	5.7	70.8	70.7	274
2017/3/12	6.0	71.9	70.8	265
2017/12/9	6.7	69.7	71.1	243
2018/3/11	7.0	69.8	70.3	224
2019/3/10	8.0	69.8	70.7	210
Gradient	1.0	-0.61	-0.48	-32

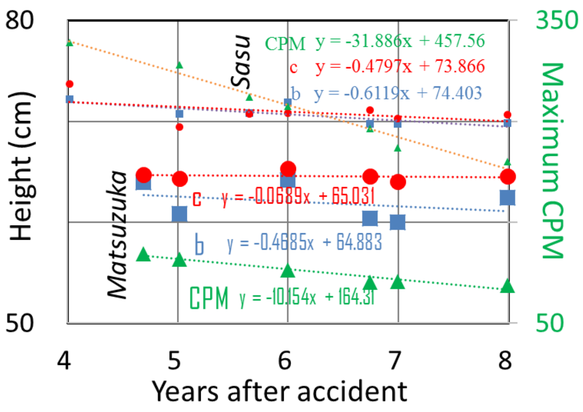

Fig.2 Maximum of radiation dose in soil and its heights

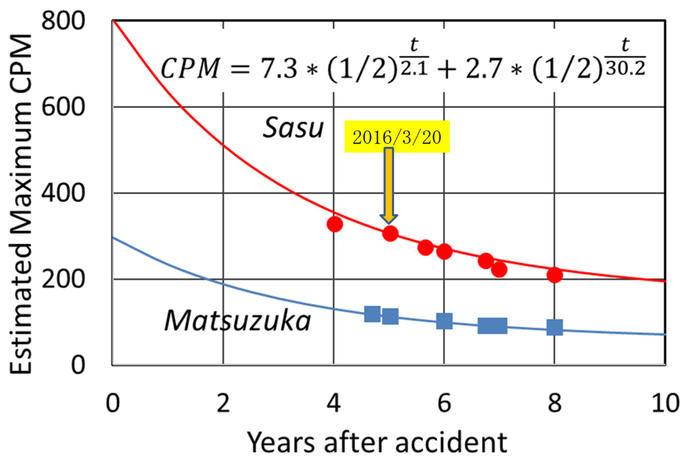

Fig.3 Estimation of radiation dose in soil.

Photo.1 In-situ burial work of contaminated paddy bank in Matsuzuka (2015.11.15)

CONCLUSION

From the 4 year's measurement of soil radiation, it was reconfirmed that Cs hardly moved in the soil at two paddy fields that Cs-contaminated soil were buried. It was also found that the soil radiation will decrease naturally obeying a theoretical equation derived from three assumptions.

ACKNOWLEDGMENTS I would like to thank the NPO members (President: Mr. Yoichi Tao), and the local farmers (Mr. Muneo Kanno, Mr. Kinichi Okubo, Mr. Takeshi Yamada, Mr. Keiichi Kanno) in Iitate Village.

REFERENCES [1] M. Mizoguchi: Monitoring of soil radiation doses from contaminated soil buried in a paddy field in Iitate Village, Fukushima, Paddy and Water Environment, pp 1-4 (2019)

Email: amizo@mail.ecc.u-tokyo.ac.jp

PAWEES2019, Korea

More information →