Welcome Workshop for Tondel-san's visit in Osaka
April 21, 2019
Maru-biru Bekkan, Shin-Osaka

Various effects observed on animals and plants around Fukushima after the FDNPP accident

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Basic motivation for presentation

- Various effects on birds and wild mice *etc* have been reported around Chernobyl.
- However, it seemed to be difficult to conclude something from ecological observations.
- Several studies at the early stage after the Fukushima accident indicated something shocking to me on animals.
- Anyway, we have to collect data and record what occurred in the environment after the Fukushima NPP accident.

Today's topics

1. Mutation/modification of blue butterfly, *SHIJIMICHO*.
   - Research by a group of Ryukyu University.
2. Mutation/modification of aphid, *WATAMUSHI*.
   - Research by a group of Hokkaido University.
3. Mutation/modification of fir trees, *MOMINOKI*.
   -Research by a group of NIRS.
4. Mutation/modification of Japanese monkeys.
   -Research by groups of Veterinary Univ and Tohoku Univ.
5. Our experiment using rice, *NIPPONBARE*.

Blue butterfly, YAMATO-SHIJIMI

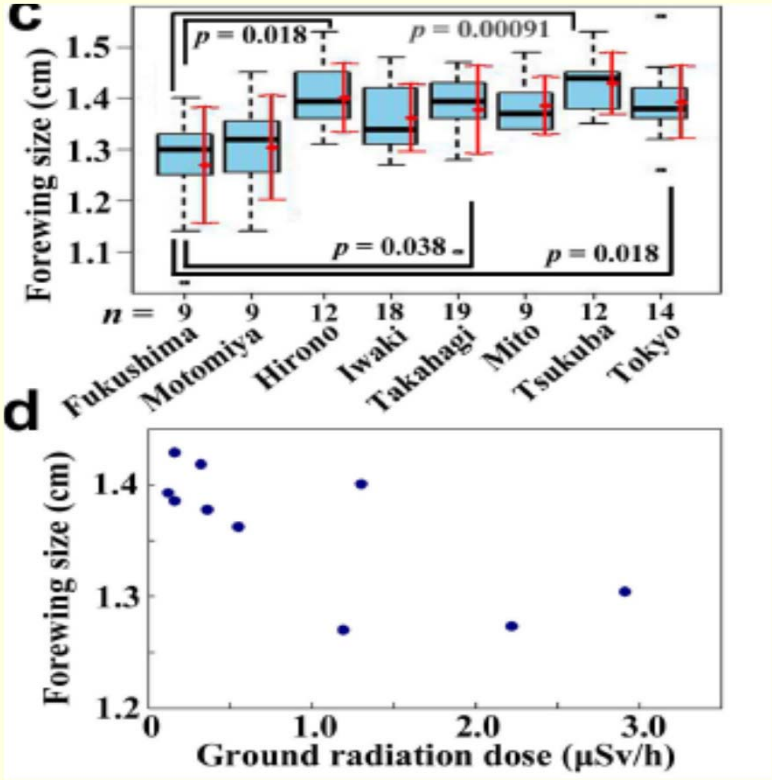
Scientific Reports 2012

OPEN

SUBJECT AREAS:
ENVIRONMENTAL SCIENCES
ECOLOGY
BIODIVERSITY

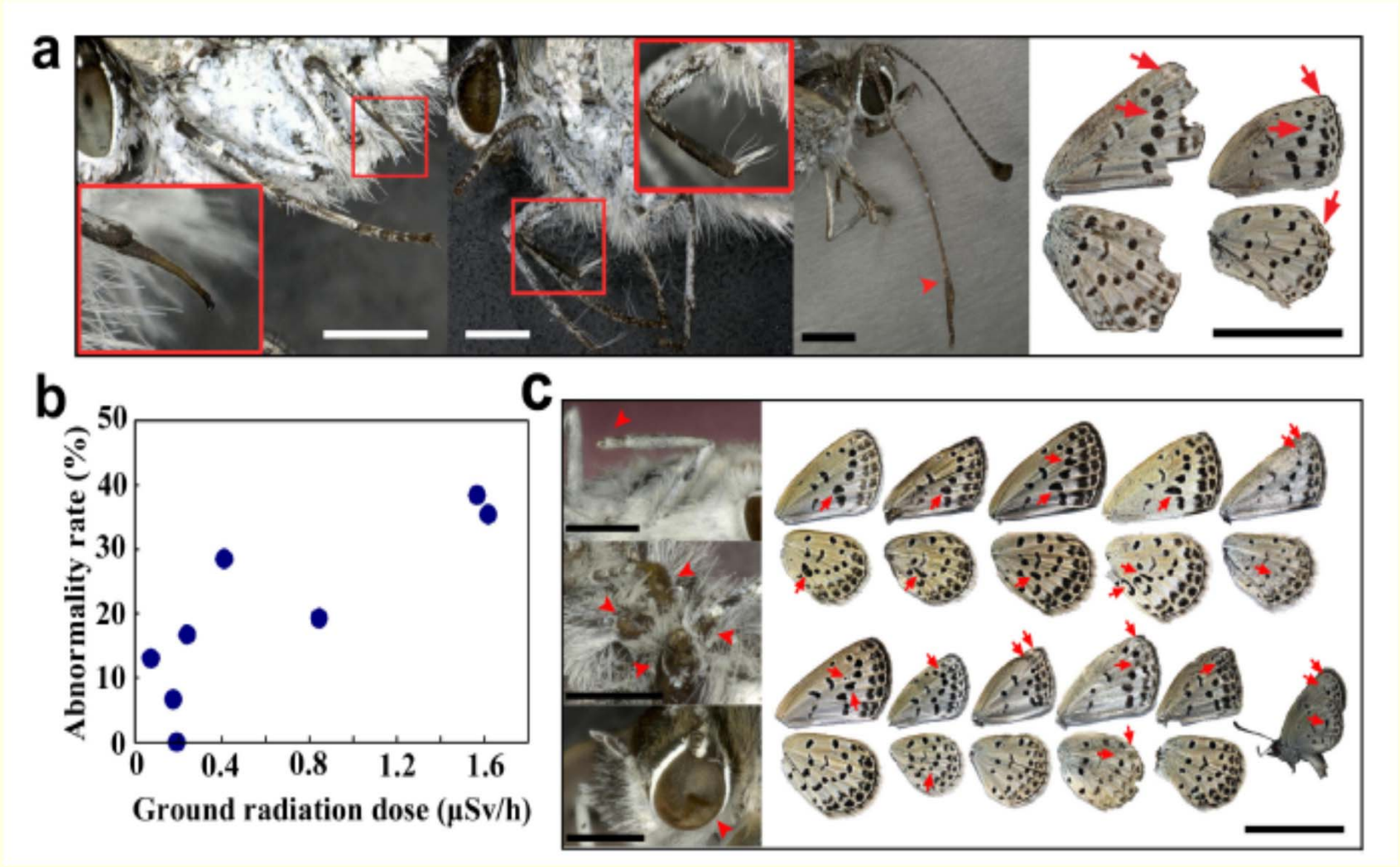
The biological impacts of the Fukushima nuclear accident on the pale grass blue butterfly

Atsuki Hiyama[1]*, Chiyo Nohara[1]*, Seira Kinjo[1], Wataru Taira[1], Sinichi Gima[2], Akira Tanahara[2] & Joji M. Otaki[1]



Observation in May 2011

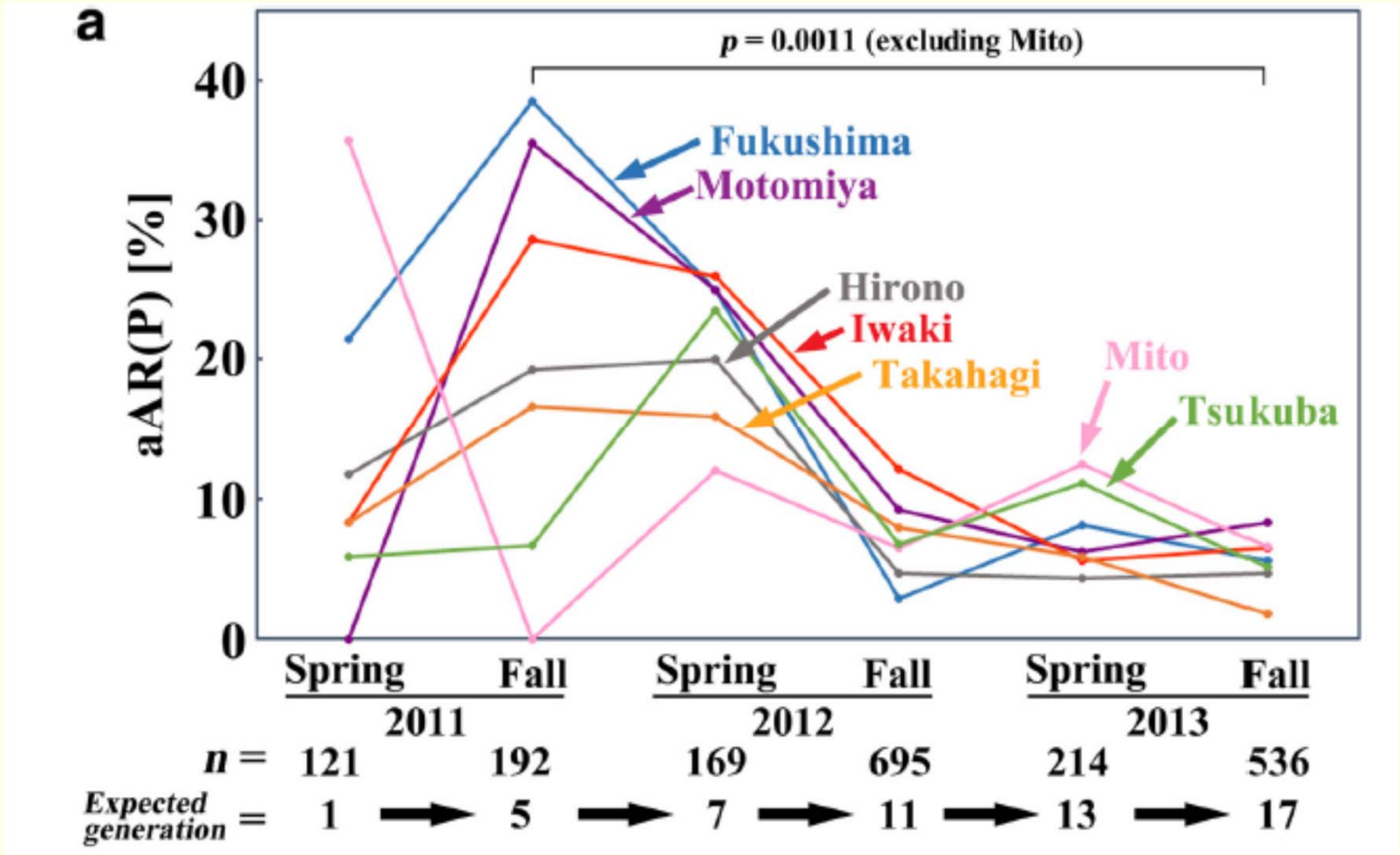
Hiyama et al, Scientific Reports 2012



Observation of abnormality in May 2011

Hiyama et al, BMC Evolutionary Biology 2015

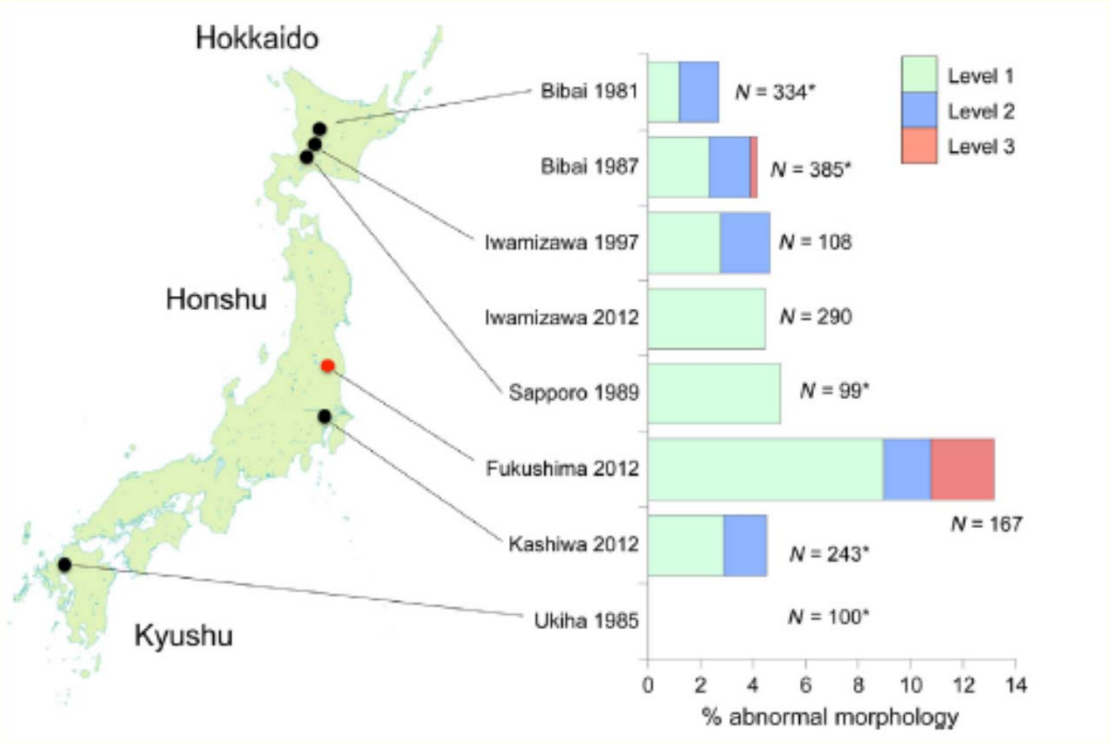
Abnormality tends toward normal after two years later

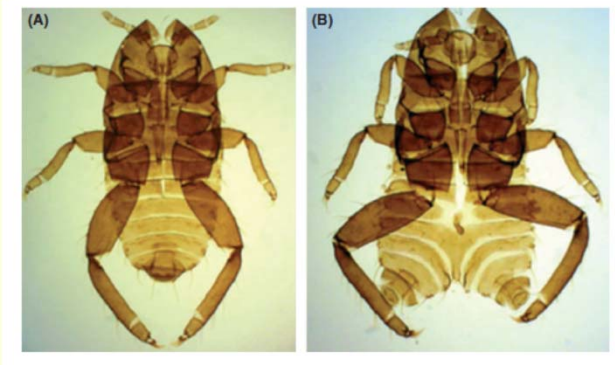


Morphological abnormalities in gall-forming aphids in a radiation-contaminated area near Fukushima Daiichi: selective impact of fallout?

Shin-ichi Akimoto

Department of Ecology and Systematics, Graduate School of Agriculture, Hokkaido University, Kita-ku, Sapporo, 060-8589, Japan





Abnormality of aphid in 2012

Akimoto et al, J Heredity 2018

Effects of Radiation From Contaminated Soil and Moss in Fukushima on Embryogenesis and Egg Hatching of the Aphid *Prociphilus oriens*

Shin-ichi Akimoto, Yang Li, Tetsuji Imanaka, Hitoshi Sato, and Ken Ishida

Experiment at my lab, irradiating aphid eggs for three months in winter 2015.

A small earlier hatching was observed for the irradiated group of eggs.

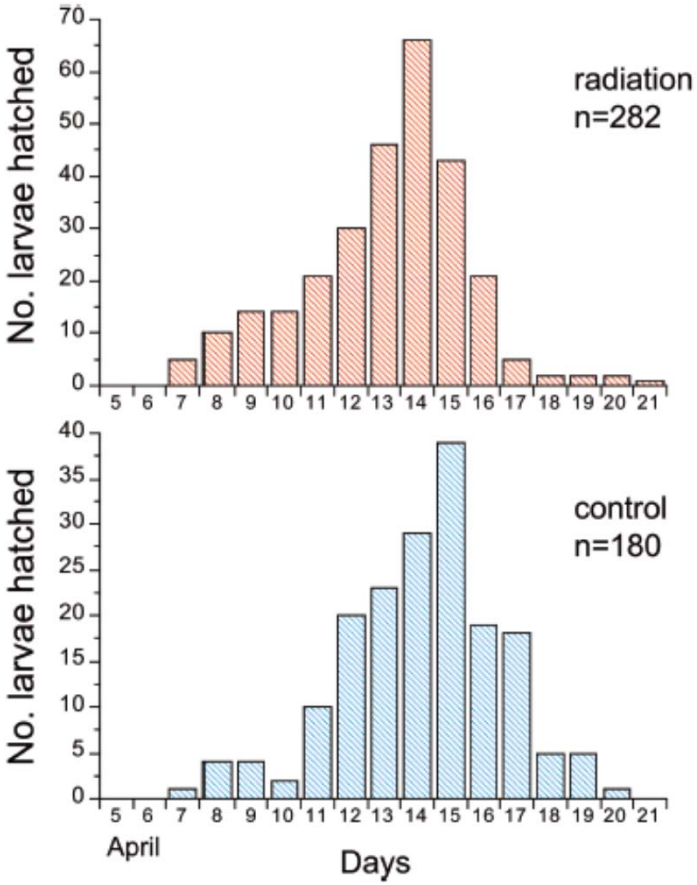


Figure 2. Hatch date distribution of eggs in the 4-month moss experiment. The number of larvae hatching each day is indicated for the radiation treatment and the control.

Ochiai et al,
Scientific Reports 2014

Low blood cell counts in wild Japanese monkeys after the Fukushima Daiichi nuclear disaster

Kazuhiko Ochiai[1], Shin-ichi Hayama[1], Sachie Nakiri[1], Setsuko Nakanishi[2], Naomi Ishii[1], Taiki Uno[1], Takuya Kato[1], Fumiharu Konno[3], Yoshi Kawamoto[4], Shuichi Tsuchida[1] & Toshinori Omi[1]

Table 1 | Hematological values of Japanese monkeys captured in Fukushima and Shimokita

	Fukushima											
	10,000–100,000 Bq/m² in soil						100,000–300,000 Bq/m² in soil					
	Immature			Mature			Immature			Mature		
Hematological values	n	Mean	SD	n	Mean	SD	n	Mean	SD	n	Mean	SD
WBC (×10²/μL)	13	65.3	45.4	11	87.6	42.6	11	71.7	34.0	16	84.3	51.1
RBC (×10⁴/μL)	14	432.6	90.4	10	484.6	72.4	10	476.7	88.8	14	443.8	99.1
Hb (g/dL)	13	10.6	1.9	10	12.0	2.0	10	11.7	2.1	14	11.2	2.5
Ht (%)	14	33.4	6.8	10	38.7	6.2	10	36.3	6.4	14	35.5	8.3
Pt (×10⁴/μL)	12	40.6	33.8	7	23.3	13.5	6	16.3	9.5	13	29.9	12.9
Lymphocytes (%)	15	62.1	3.7	15	61.6	2.9	14	62.1	3	17	59.2	15.4
Guranulocytes (%)	15	36.2	3.8	15	36.7	3.1	14	36.7	3.2	17	33.8	9.1
Monocytes (%)	15	1.7	1.1	15	1.1	0.8	14	1.2	0.9	17	1.2	1.1
Fat index	15	9.0	5.9	15	13.2	7.8	14	12.7	5.4	18	10.2	8.6
Cs (Bq/kg)	14	430.3	341.6	15	291.2	257.1	14	560.4	242.6	18	908.3	501.4

WBC, white blood cell count; RBC, red blood cell count; Hb, hemoglobin; Ht hematocrit; Pt, platelets; Cs, Muscle radiocesium concentration; ND, not detected; n, number of i
*Nigi et al [Ref. 14].

Monkeys were captured around Fukushima city between April 2011 and June 2012.

Decreasing tendency of WBCC was observed with increasing radio-caesium concentration in muscle.

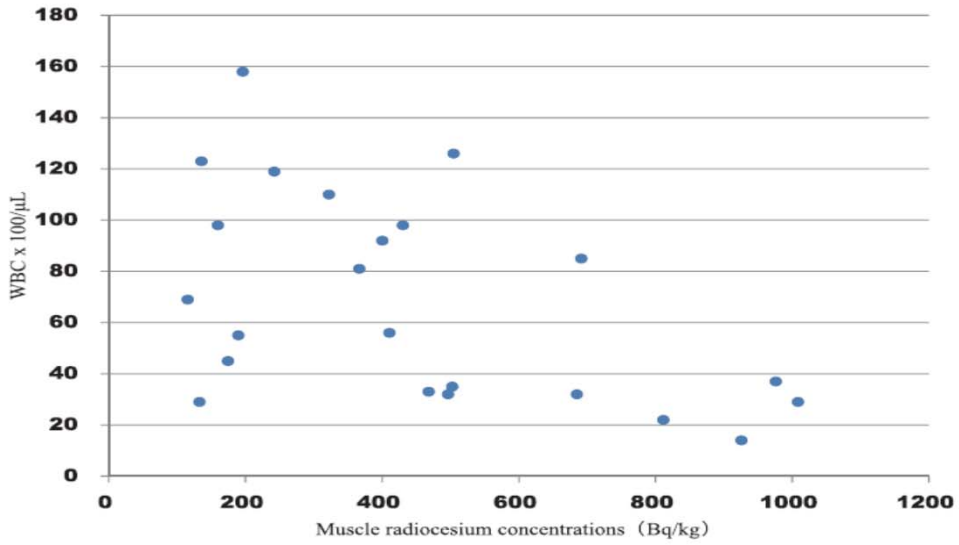


Figure 2 | White blood cell counts and muscle radiocesium concentrations in immature Japanese monkeys captured in Fukushima.

Hayama et al,
Scientific Reports 2017

Small head size and delayed body weight growth in wild Japanese monkey fetuses after the Fukushima Daiichi nuclear disaster

Shin-ichi Hayama[1], Moe Tsuchiya[1], Kazuhiko Ochiai[1], Sachie Nakiri[1], Setsuko Nakanishi[2], Naomi Ishii[1], Takuya Kato[1], Aki Tanaka[1], Fumiharu Konno[3], Yoshi Kawamoto[4] & Toshinori Omi[1]

Slower development of monkey fetuses was observed after the accident than observed before.

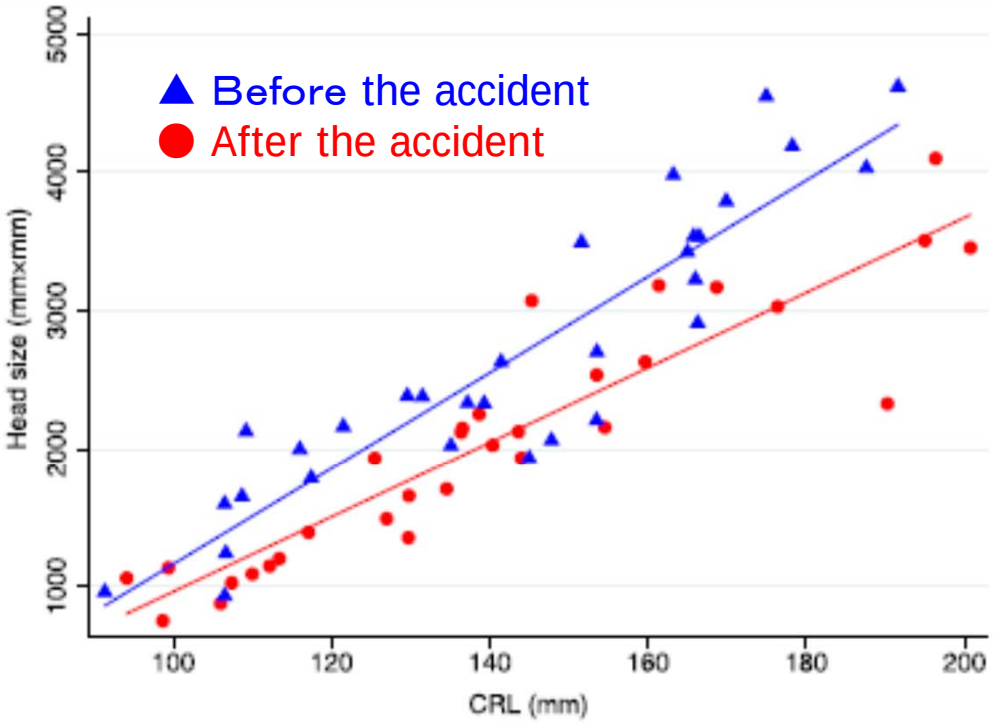
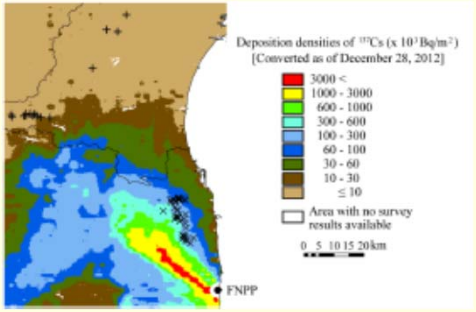


Figure 2. Head size (mm^2) as a function of CRL (mm) in Japanese monkey fet
(n = 62). The figure shows regressions between head size and CRL in pre- and p
triangles were pre-disaster monkey fetuses with the blue line representing the fi
Red circles were post-disaster monkey fetuses with the red line representing th

Urushihara et al,
Scientific Reports 2018

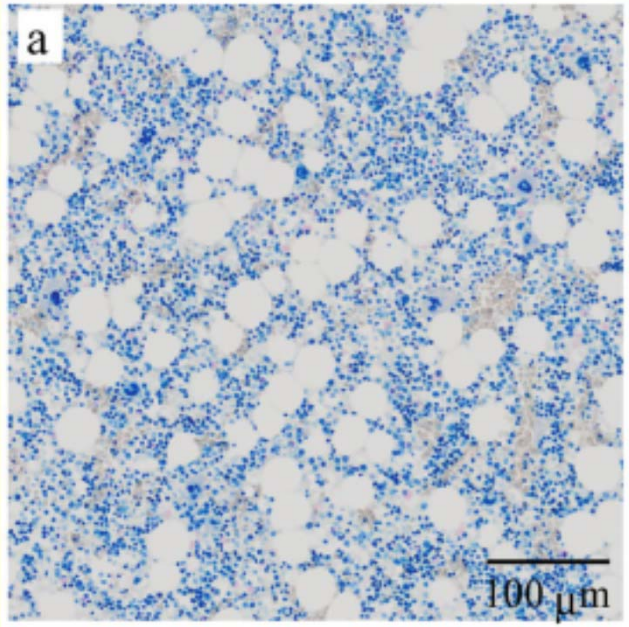


Haematological analysis of Japanese macaques (*Macaca fuscata*) in the area affected by the Fukushima Daiichi Nuclear Power Plant accident

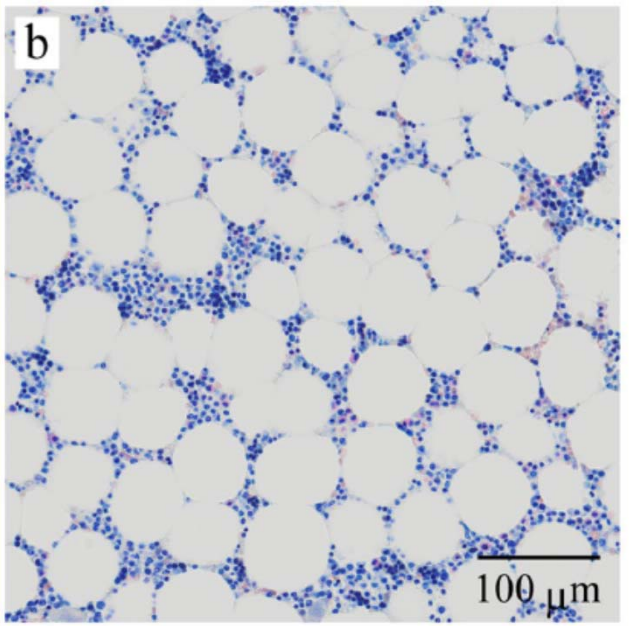
Yusuke Urushihara[1,2], Toshihiko Suzuki[3], Yoshinaka Shimizu[3], Megu Ohtaki[4], Yoshikazu Kuwahara[5], Masatoshi Suzuki[6], Takeharu Uno[7], Shiori Fujita[3], Akira Saito[8], Hideaki Yamashiro[9], Yasushi Kino[10], Tsutomu Sekine[11], Hisashi Shinoda[3] & Manabu Fukumoto[1,8]

Histological image of bone marrow

Extraordinary degeneration of born marrow was observed in the right highly-contamination case.



Male, 9 yr old.
Captured in Aug 2013
Cs134+137 in muscle: 479 Bq/kg



Female, 8 yr old.
Captured in Jan 2014
Cs134+137 in muscle: 11,400 Bq/kg

Watanabe et al, Scientific Reports 2015

Morphological defects in native Japanese fir trees around the Fukushima Daiichi Nuclear Power Plant

Yoshito Watanabe[1,*], San'ei Ichikawa[2,*], Masahide Kubota[2], Junko Hoshino[3], Yoshihisa Kubota[1], Kouichi Maruyama[1], Shoichi Fuma[1], Isao Kawaguchi[1], Vasyl I. Yoschenko[4] & Satoshi Yoshida[1]

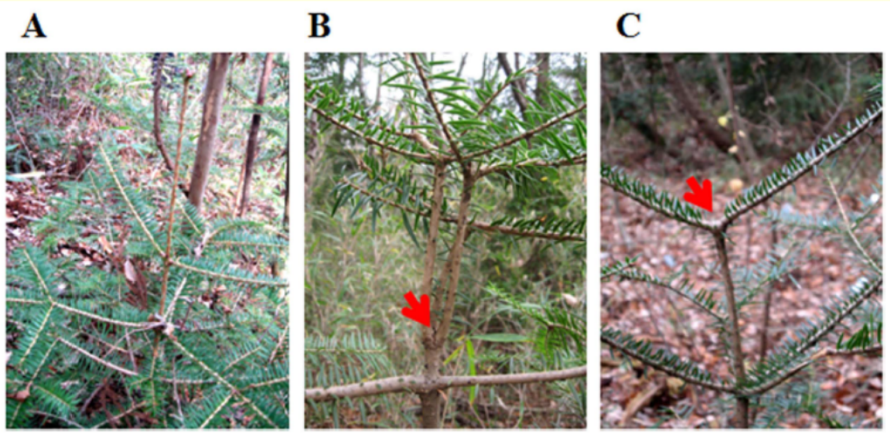
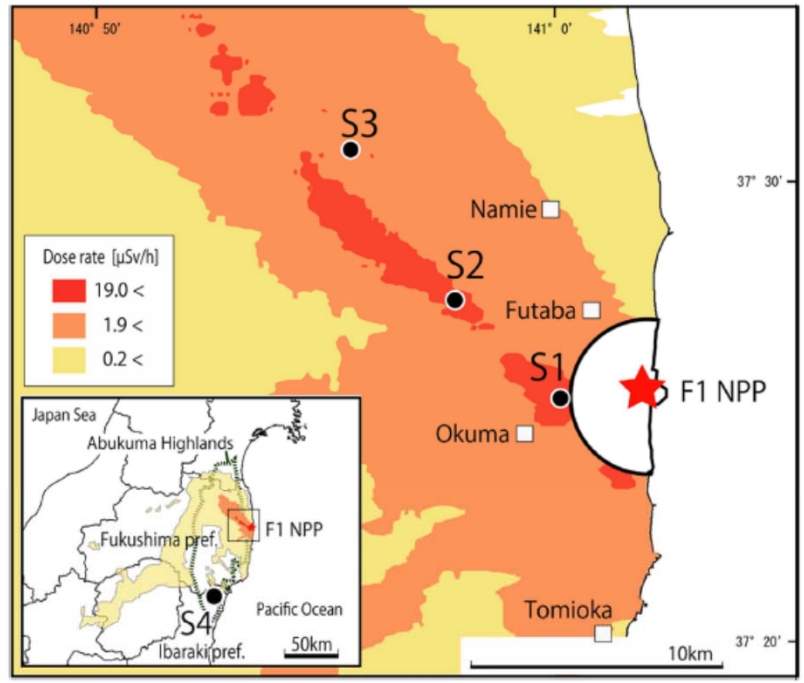
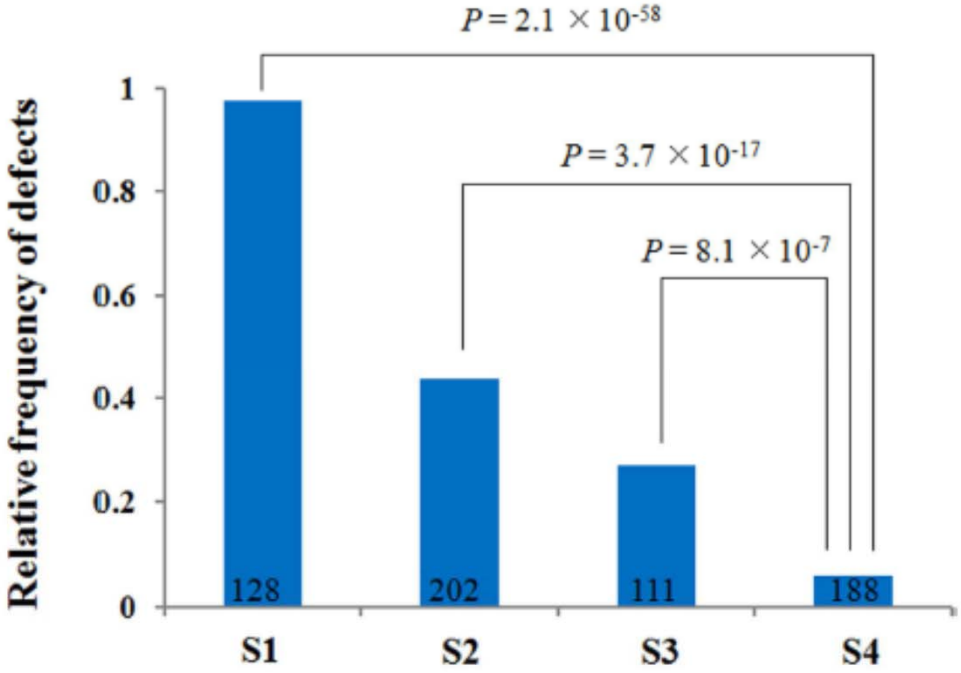


Figure 3. Representative morphological defects in Japanese fir trees. Arrowheads indicate the position of deleted leader shoot. (A) normal tree (S3), (B) defected tree (vertical forking, S1), (C) defected tree (horizontal forking, S2).





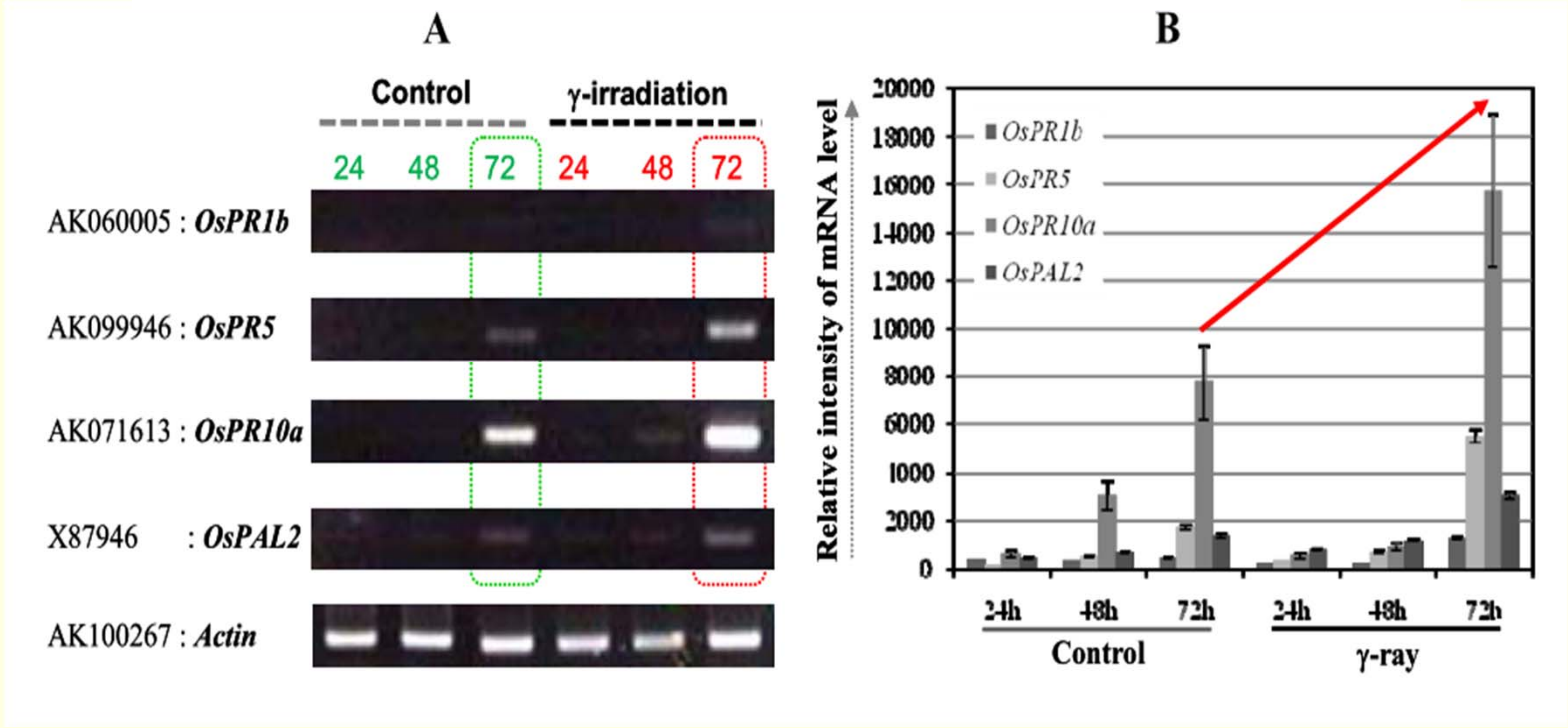
Abnormal frequency increased with the level of contamination.

Our previous experiment observing gene expression in rice leaves after exposing low level gamma-ray from Cs-137 of 40 μGy/day

Int. J. Mol. Sci. **2009**, *10*, 1215-1225; doi:10.3390/ijms10031215

Ultra Low-Dose Radiation: Stress Responses and Impacts Using Rice as a Grass Model

Randeep Rakwal [1,2,*], Ganesh Kumar Agrawal [2], Junko Shibato [1], Tetsuji Imanaka [3], Satoshi Fukutani [3], Shigeru Tamogami [4], Satoru Endo [5], Sarata Kumar Sahoo [6], Yoshinori Masuo [1] and Shinzo Kimura [7]



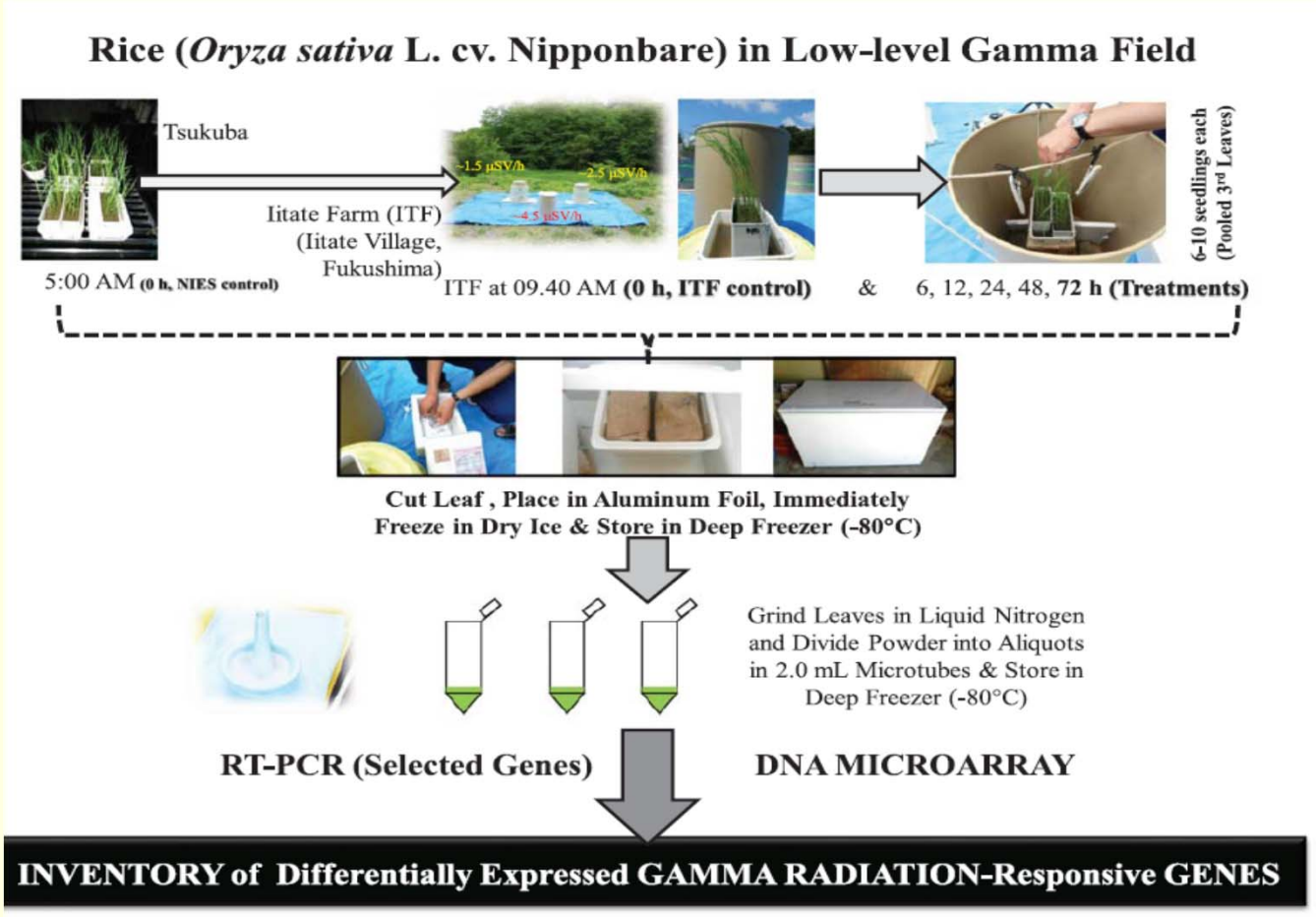
Expression of stress-related genes significantly increased after 72 hr Cs-137 gamma-ray exposure of 40 μGy/day.

After the Fukushima accident, we did experiment using Iitate village as artificial gamma-ray field for rice gene expression

Hayashi et al,
J Heredity 2014

Unraveling Low-Level Gamma Radiation–Responsive Changes in Expression of Early and Late Genes in Leaves of Rice Seedlings at Iitate Village, Fukushima

3 levels of exposure rate:
H: ～100 μSv/day
M: ～60 μSv/day
L: ～40 μSv/day



Temporal expression pattern of 22 genes

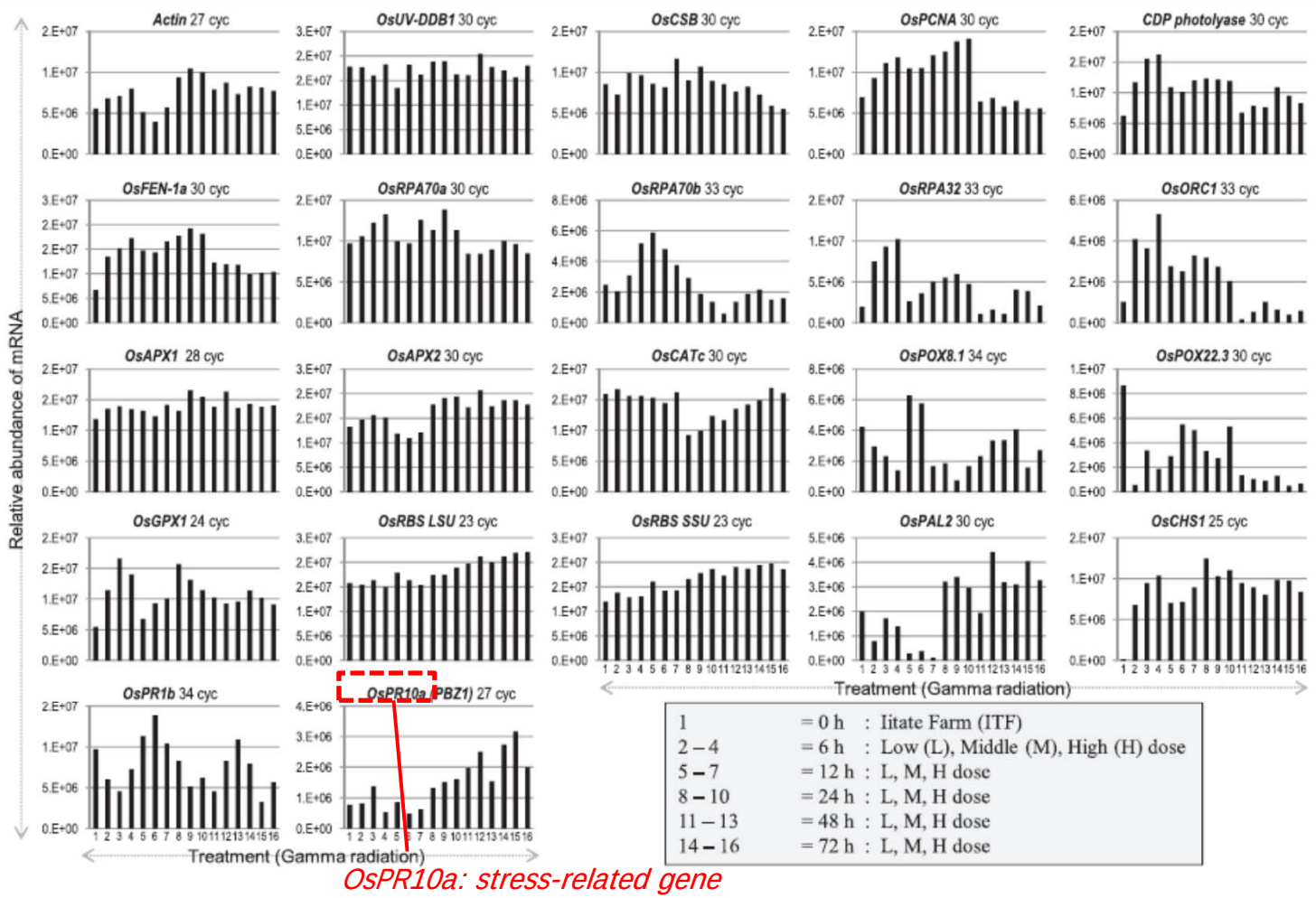


Figure 6. Gene expression analysis of 22 selected genes. Beta-actin gene was used to check the quality of cDNA and as a positive control. Relative abundance of gene expression calculated from the bands on agarose gels (see Materials and methods and Supplementary Figure 6 for further details) were plotted against treatment (gamma radiation) time and dose. Details are mentioned in the text.

Gene expression is very sensitive and complicated being affected by various environmental factor. It seems to be a difficult task to draw something conclusive from one or two experiments.

Anyway, we have to continue our works to record what is happening around Fukushima

-1st workshop. August 10-11, 2014. KUR Kumatori

-2nd workshop. August 10-11, 2015. KUR Kumatori
https://www.rri.kyoto-u.ac.jp/PUB/report/04_kr/img/ekr004.pdf

-3rd workshop. August 3-4, 2016. KUR Kumatori
https://www.rri.kyoto-u.ac.jp/PUB/report/04_kr/img/ekr015.pdf

-4th workshop. August 2-3, Tokusyu-kai, Narita

-5th workshop. August 3-4, Tokyo Univ, Tokyo

●Special issue of J. Radiation Research, 2015
https://academic.oup.com/jrr/issue/56/suppl_1

●Springer book “Low-Dose-Rate Radiation Effects on Animals and Ecosystem -Long-Term Study on the Fukushima Daiichi Nuclear Power Plant Accident” (to be published on-line soon)