Impact of Effective Microorganisms on the Activity of ^{137}Cs in Soil from the Exclusion Zone of Chernobyl NPP

#Aleksander Nikitin[1], Shuichi Okumoto[2], Galina Gutzeva[1], Masaki Shintani[2], Galina Leferd[1], Teruo Higa[3]
[1]Institute of Radiobiology of the National Academy of Sciences of Belarus, Republic of Belarus
[2]EM Research Organization Inc., Japan
[3]International EM technology center, Meio University, Japan
Email: nikitinale@gmail.com

During the development of a method for using effective microorganisms (EM) to reduce soil–plant transfer of ^{137}Cs on land contaminated with radioactive Cs, an unexpected effect of EM on the change in ^{137}Cs activity in soil samples was observed. Laboratory experiments to evaluate the impact of EM and fermented organic fertilizer (EM-bokashi) on ^{137}Cs activity in soil samples were then conducted to investigate this observation.

Sod-podzolic soil samples from the Chernobyl exclusion zone were used in the experiment. The soil samples were placed in 0.1-L containers and mixed with EM or EM-bokashi in different concentrations. Each treatment was repeated 15 times. Soil samples were kept at room temperature (20—24°C). EM is a mixture of microorganisms such as lactic acid bacteria, photosynthetic bacteria, and yeast. EM-bokashi is an anaerobic fermentation product made from solid agricultural byproducts inoculated with EM. The activity of ^{137}Cs was measured before and after an 18-month exposure to the microbiological preparations. At the time of measurement, water was added into samples to bring the solutions up to same weight as at the time of first measurement.

Loss of ^{137}Cs activity in soil samples in percent to the initial activity (mean ± SD)

Treatment	% of decreasing
Dry soil	0.81 ± 4.20
Wet soil	3.10 ± 1.59
Wet soil + molasses	2.91 ± 1.28
EM 1% + molasses	4.75 ± 1.62*
EM 5% + molasses	2.67 ± 2.77
EM 10% + molasses	4.50 ± 4.19
EM-bokashi 1%	4.71 ± 2.60*
EM-bokashi 5%	4.55 ± 2.19*
EM-bokashi 10%	3.08 ± 2.66
EM 10%	1.55 ± 2.24

Note: * – the differences from physical decay rate for loss of ^{137}Cs on 18 months is significant at the 5% significance level

After the 18 months, the activity of ^{137}Cs in the samples was decreased by 0.81–4.75%. Loss of ^{137}Cs due to the radioactive decay should be about 3.39% ($T_{1/2}$ = 30.17 years). Most of the soil samples did not differ significantly from this value. However, a significant difference ($p < 0.05$) with the radioactive decay rates was observed in the samples treated with EM (1%) and EM-bokashi (1% and 5%). The differences with the radioactive decay rates slightly exceed 1% (table).

The activity of radioactive isotopes is not affected by operations such as heating, addition of water, or addition of organic matter. It decreases only according to the law of radioactive decay. However, according to the hypothesis of bio-transmutation [1–3], some microorganisms may alter the rate of radioactive decay. The results of the experiments indicate that effective microorganisms accelerate the radioactive decay of ^{137}Cs.

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