

Radioactivity in fertilizers

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Fertilizers are produced from organic materials or mineral deposits. Varying concentrations of radionuclides are found in these raw materials. During industrial processes, radionuclides may concentrate in the product, side product or waste. Therefore, fertilizers in the Finnish market were investigated as a part of Finland's environmental radioactivity surveillance programme. The previous survey on radioactivity in fertilizers was carried out in 1982–1983.

Potential exposure routes

1. Radioactivity in fertilizers may transfer from soil to agricultural produce either directly to edible crops or via feed cultivation to livestock → *internal exposure* to consumers
2. Gamma radiation from radioactivity in fertilizers may cause *external exposure* to those who handle them professionally (manufacture, wholesale, farmers).

Materials and methods

We measured radioactivity in 45 fertilizers intended for both kitchen gardens or commercial farms.

32 inorganic fertilizers	4 soil amendments
7 organic fertilizers	2 substrates

The samples were collected by Finnish Food Safety Authority – Evira for their control analyses of fertilizer products. The fertilizers originated from Finland, Russia, Germany, Estonia, Israel, Sweden and Belgium, and were collected in 2012.

Gamma spectroscopic measurements were performed on all samples in our accredited testing laboratory (T 167 by Finnish Accreditation Service – FINAS). The principles of the method are described in standard IEC 61452: 1995.

Results

		Inorg. fertil.	Organic fertil.	Soil amend.	Substr.
U-238 (Bq/kg)	N _s / N _a	32 / 32	7 / 7	4 / 4	2 / 2
	N _{<LOD}	30	7	2	0
	LOD range	10–50	22–40	20–20	–
	Min–Max	56–120	–	22–38	14–14
Ra-228 (Bq/kg)	N _s / N _a	32 / 32	7 / 7	4 / 4	2 / 2
	N _{<LOD}	22	2	0	0
	LOD range	0.6–5	0.7–0.7	–	–
	Min–Max	1.0–34	0.67–6.2	5.8–15	14–21
Ra-226 (Bq/kg)	N _s / N _a	32 / 32	7 / 7	4 / 4	2 / 2
	N _{<LOD}	13	2	0	0
	LOD range	0.4–2	0.3–0.6	–	–
	Min–Max	0.52–41	0.36–3.8	4.0–15	12–15
Pb-210 (Bq/kg)	N _s / N _a	32 / 19	7 / 4	4 / 3	2 / 1
	N _{<LOD}	15	2	2	1
	LOD range	2–10	2–2	10–10	10
	Min–Max	3.4–12	5.7–5.9	28	–
K-40 (Bq/kg)	N _s / N _a	32 / 32	7 / 7	4 / 4	2 / 2
	N _{<LOD}	1	0	0	0
	LOD range	3	–	–	–
	Min–Max	358–11400	330–2310	31–150	410–530
Cs-137 (Bq/kg)	N _s / N _a	32 / 32	7 / 7	4 / 4	2 / 2
	N _{<LOD}	31	3	0	0
	LOD range	0.1–0.9	0.2–1.5	–	–
	Min–Max	0.82–0.82	0.26–8.5	27–76	2.0–3.5

N_s - number of samples

N_a - number of analyses

N_{<LOD} - number of samples below limit of detection (LOD)

Min–Max - minimum and maximum of samples above LOD

Discussion

We assume 70 kg_N/ha/y, 18 kg_K/ha/y and 6 kg_P/ha/a. For an increase of 10 Bq/kg in soil in 20 years time, the fertilizer should contain 1000 Bq/kg of respective U- and Th-series nuclides. All measured concentrations were significantly lower.

Cs-137 concentration was <1 Bq/kg and <8.5 Bq/kg in inorganic and organic fertilizers, respectively.

Radioactivity in soil amendments and substrates were on the same level as in soils in general.

The maximum excess dose rate at 1m distance from fertilizer piles was assessed as 0.16 μSv/h (⇔ <0.3mSv/a).