

## Cadmium and lead in soils and crops from allotment gardens in the Netherlands

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**Abstract.** Soils and crops from 57 allotment gardens in possibly contaminated areas were analysed for Cd and Pb. The median Cd and Pb concentrations in the soil samples were higher than those in normal Dutch soils used for arable farming and horticulture. Cd and Pb concentrations in the crops were rather normal.

**Key words:** vegetable garden, Cd, Pb, soil, crop, Netherlands, contamination.

**Introduction.** There are about one million vegetable gardens in the Netherlands. They are in use by 30 % of the families in the country (Anon., 1985). Mostly the vegetable gardens either belong to private houses or are situated in groups on allotments. The products of these gardens constitute an important part of the diet of many people. It is therefore important to know if these products present any health hazard to consumers.

Increased Pb contents were observed in crops from gardens in a number of towns in England (Jones & Thornton, 1983; Davies et al., 1983), in the USA (Spittler & Feder, 1979), in Germany (Alt et al., 1982) and in gardens adjacent to highways in the Netherlands (Projectgroep Lood in Volkstuinen, 1982). In urban areas (England) contamination of the soil with metals seems to originate from soot emission by chimneys resulting from burning coal (Purves, 1985). Pb-containing exhaust gases from motorized traffic increased Pb contamination in these areas in the 20th century.

To obtain some idea about possible contamination with Cd and Pb of vegetable gardens in the Netherlands, soils and crops from 57 allotments, situated in possibly contaminated areas, were analysed for these elements.

**Materials and methods.** The investigation was conducted in the period 1981-1984 on 57 allotments which were assumed to be contaminated with Cd and/or Pb because of their position near highways or metal-emitting industries or because of previous use of the land on which the allotments are situated. Some allotments were investigated for more than one year. The growers were asked to grow crops for the investigation in about 20 randomly distributed gardens per allotment. In 1981 lettuce and sometimes endive were cultivated, and in 1982-1984 lettuce, carrots, curly kale and sometimes endive. In principle all crops were grown on all gardens. In each allotment samples of the soil, layer 0-20 cm, and crops were taken in duplicate. Some-

times one sample was taken when the crops to be sampled were lacking in quality and quantity. The soil samples were taken from the same spots as the crop samples (mostly lettuce). The edible parts of the crops were rinsed with tap water and analysed for Cd and Pb. The total Cd and Pb contents of the soil samples were also determined.

**Results.** The respective median Cd and Pb concentrations in the soil samples (Table 1) were 1.5 and 2.5 times as high as those found by Wiersma et al. (1986) in normal Dutch soils used for arable farming and horticulture. In normal Dutch peat soils and loess soils the mean Cd concentrations are higher than in clay soils and the mean Pb concentration in peat soils is higher than in sandy soils and clay soils (van Driel & Smilde, 1982). An increase of the median Cd and Pb concentrations in the soils of the allotments was mainly found in sandy clay and clay soils. In 14 % and 30 % of the investigated allotments a substantial increase in soil Cd and Pb was found, respectively (Cd and Pb concentrations higher than  $1 \text{ mg kg}^{-1}$  and  $100 \text{ mg kg}^{-1}$ , respectively). Median Cd concentrations in lettuce, carrots, curly kale and endive, grown in market gardens were  $0.04$ ,  $0.03$ ,  $0.02$  and  $0.02 \text{ mg kg}^{-1}$  fresh weight, respectively (Wiersma et al., 1986). Median Pb concentrations amounted to  $0.09$ ,  $0.04$ ,  $0.54$  and  $0.07 \text{ mg kg}^{-1}$  fresh weight, respectively. Median Cd concentrations in lettuce, carrots and curly kale and median Pb concentrations in lettuce and carrots (Table 1) were comparable to those found on market gardens. Median Cd concentration in endive was 4 times as high as that in commercial crops and median Pb concentrations in curly kale and endive were 2 and 2.5 times as high, respectively. Only in one sample of endive was the tentative maximum acceptable Cd concentration in commercial crops (Klitsie, 1983) exceeded and that for Pb in one sample of curly kale. In establishing the tentative maximum Cd and Pb concentrations for commercial crops one of the considerations was that a product with a possibly high

Table 1. Cd and Pb concentrations in soils and crops from allotment gardens in possibly contaminated areas.

Soil or crop	Number of sampled allotments	mg Cd per kg dry soil or per kg fresh weight crop				mg Pb per kg dry soil or per kg fresh weight crop			
		min.	max.	mean	median	min.	max.	mean	median
Sand	13	0.15	0.75	0.33	0.30	15	326	49	25
Sandy clay	27	0.19	2.61	0.79	0.63	17	274	101	79
Clay	7	0.34	3.17	1.18	0.77	64	325	138	140
Loess	6	0.43	1.00	0.63	0.58	28	105	47	37
Peat	4	0.56	0.98	0.82	0.88	22	85	47	40
All soils	57	0.15	3.17	0.72	0.61	15	326	85	61
Lettuce	51	0.01	0.18	0.05	0.05	0.05	0.20	0.09	0.08
Carrot	39	0.02	0.17	0.06	0.04	0.01	0.24	0.06	0.05
Curly kale	26	0.02	0.08	0.04	0.03	0.24	2.54	1.03	0.91
Endive	15	0.03	0.23	0.09	0.08	0.06	0.29	0.16	0.19

Cd or Pb concentration – but still lower than the tentative maximum concentration – is counterbalanced by a product with a low Cd or Pb concentration in the diet. However, when the Cd or Pb concentration of one crop in a garden is raised, the concentration will generally also be higher in other crops in this garden. This should be taken into account when the tentative maximum acceptable Cd and Pb concentrations for commercial products are applied to vegetable garden products.

**Conclusions.** The median Cd and Pb concentrations in soils of allotment gardens in possibly contaminated areas were higher than those in normal Dutch soils used for agriculture and horticulture. Median Cd and Pb concentrations in the crops from these allotments were rather normal. Only the median Cd concentration in endive and median Pb concentrations in curly kale and endive were higher than those found in commercial farming. Because crops from allotments in possibly contaminated areas have rather normal Cd and Pb concentrations it is reasonable to assume that in general Cd and Pb concentrations in crops from vegetable gardens in the Netherlands are normal. However, alertness for exceptional cases is required.

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