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Accumulation and distribution of ^{137}Cs in tropical plants

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Abstract. The accumulation and distribution of ^{40}K and ^{137}Cs in several tropical plant species were studied through measurements of gamma-ray spectra, focusing on establishing the suitability of using radiocaesium to trace the plant uptake of nutrients such as potassium.

Keywords: ^{137}Cs and ^{40}K distributions; Tropical trees.
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The present knowledge on the transport and distribution of salts in plants shows that potassium and caesium can be similarly absorbed by plant roots from soil and can be translocated to the aboveground plant parts, such as twigs, leaves, flowers and fruits [1,2]. Therefore, we present measurements of the concentration levels of ^{137}Cs and ^{40}K in several tropical plants. Table 1 shows mean values of such concentrations in compartments of plants contaminated by caesium, and suggests that tissues with low K concentrations (on a dry weight basis) have also low Cs concentrations. Particularly, the results indicate that only for wood trees the younger parts have simultaneously higher concentrations of ^{137}Cs and ^{40}K than the older parts and this implies that the ^{137}Cs could be a good tracer of plant nutrients for such plant species.

Figure 1 shows the radial distribution of ^{137}Cs and ^{40}K within the tree rings in the main trunk of a guava tree. This measurement was obtained from the analysis of a disk of the main trunk located 100 cm above the ground (Figure 1a). From the one-dimensional distribution (Figure 1b) it can be seen that they have similar behavior, both concentrated inside the trunk. The error bars take into account the variability between samples of each tree ring. However, by slicing each tree ring of the disk in several samples [1], a bi-dimensional diagram of ^{137}Cs radial distribution can be plotted (Figure 1c), showing that radiocaesium can be more mobile, migrating within the rings, and tending to the side most exposed to sunlight,

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while for potassium this pattern is not observed. These results suggest that although Cs and K show similar behavior in wood plants, there are subtle differences between them that should be taken into account if radiocaesium is to be used to trace the plant uptake of nutrients such as K^+.

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Table 1 Mean values of ^{137}Cs and ^{40}K concentrations (in kBq.kg^{-1}) for the younger and older parts of the tropical plants contaminated by caesium. Values in parentheses represent the standard deviation from the mean, which take into account the variability between samples of the same tissue or compartiment.

Tree	Sample	^{137}Cs	^{40}K
Guava	Roots	0.8(0.1)	0.4(0.1)
	Main trunk	0.9(0.2)	0.4(0.1)
	Leaves	2.1(0.3)	0.7(0.1)
	Fruits	2.0(0.4)	0.9(0.1)
Mango	Main trunk	1.0(0.1)	0.15(0.02)
	Leaves	1.9(0.6)	0.32(0.05)
	Fruits	3.2(0.4)	0.27(0.04)
Avocado	Main trunk	1.8(0.4)	0.23(0.04)
	Leaves	2.3(0.2)	0.4(0.1)
Chili pepper	Roots	2.1(0.2)	0.24(0.04)
	Main trunk	1.1(0.1)	0.21(0.03)
	Leaves	6.1(0.5)	0.93(0.01)
	Fruits	2.5(0.3)	0.48(0.13)
Papaya	Roots	1.0(0.4)	2.0(0.5)
	Main trunk	0.6(0.2)	1.4(0.5)
	Leaves	0.4(0.1)	1.6(0.2)
	Fruits	0.5(0.3)	1.7(0.5)
Manioc	Roots	0.12(0.04)	0.22(0.02)
	Main trunk	0.21(0.06)	0.14(0.22)
	Leaves	0.36(0.09)	0.15(0.03)

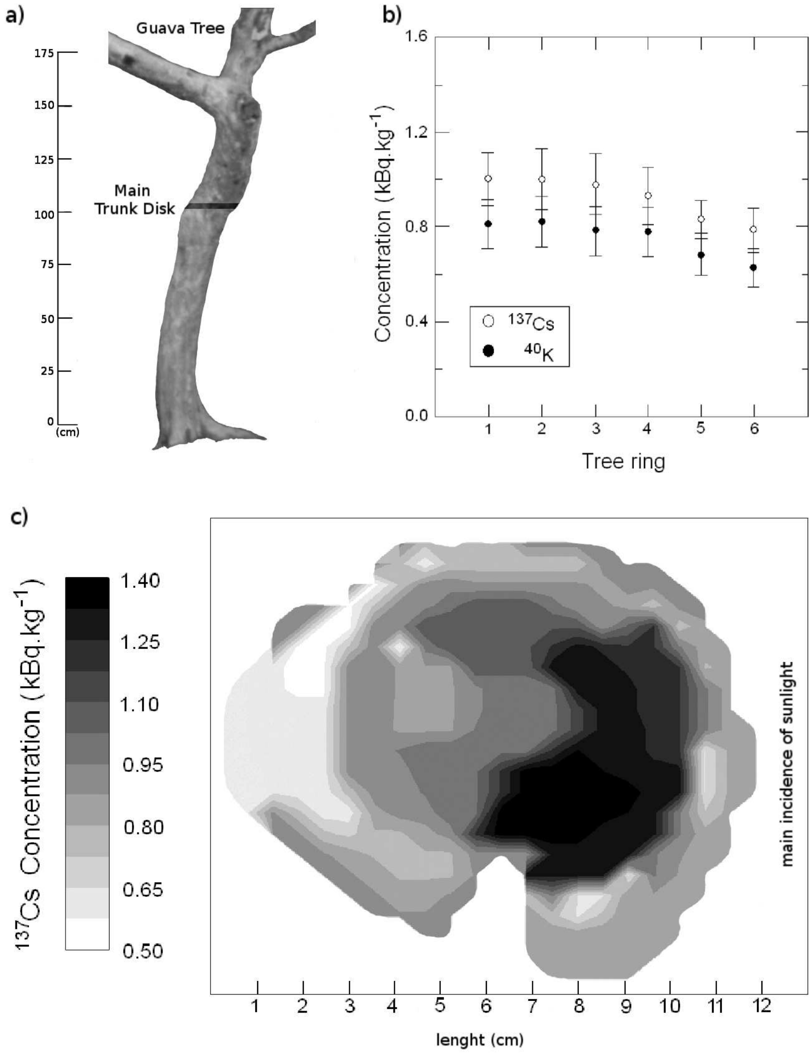

Fig. 1. Radial distributions within the tree rings in main trunk of the guava tree: a) illustration of the sampling position of the disk in the main trunk ; b) one-dimensional distribution of mean values of ^{137}Cs and ^{40}K concentrations and; c) bi-dimensional diagram for ^{137}Cs concentration.