Can elemental composition data of crop leaves be applied to tree leaves and wild grass?

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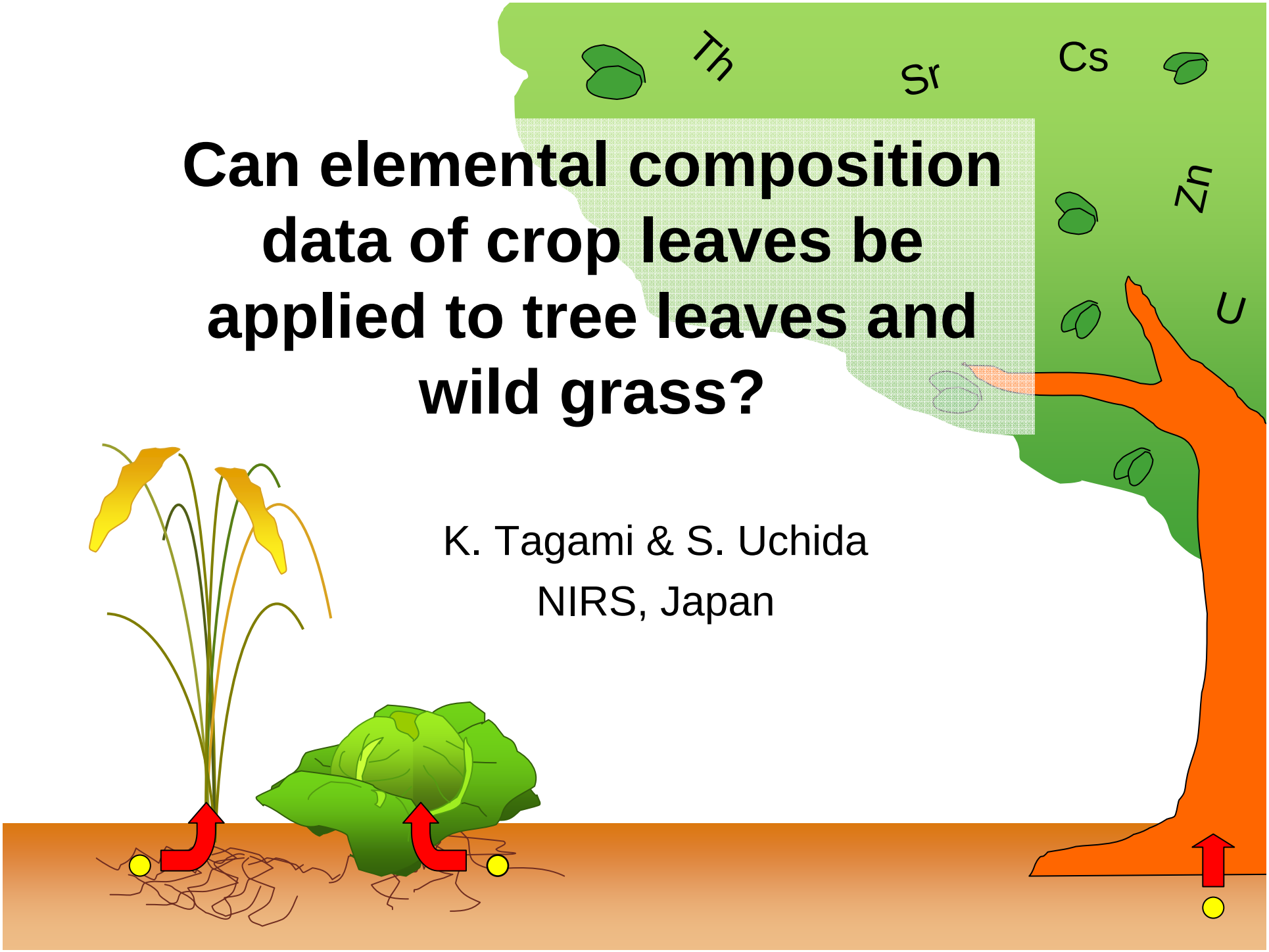
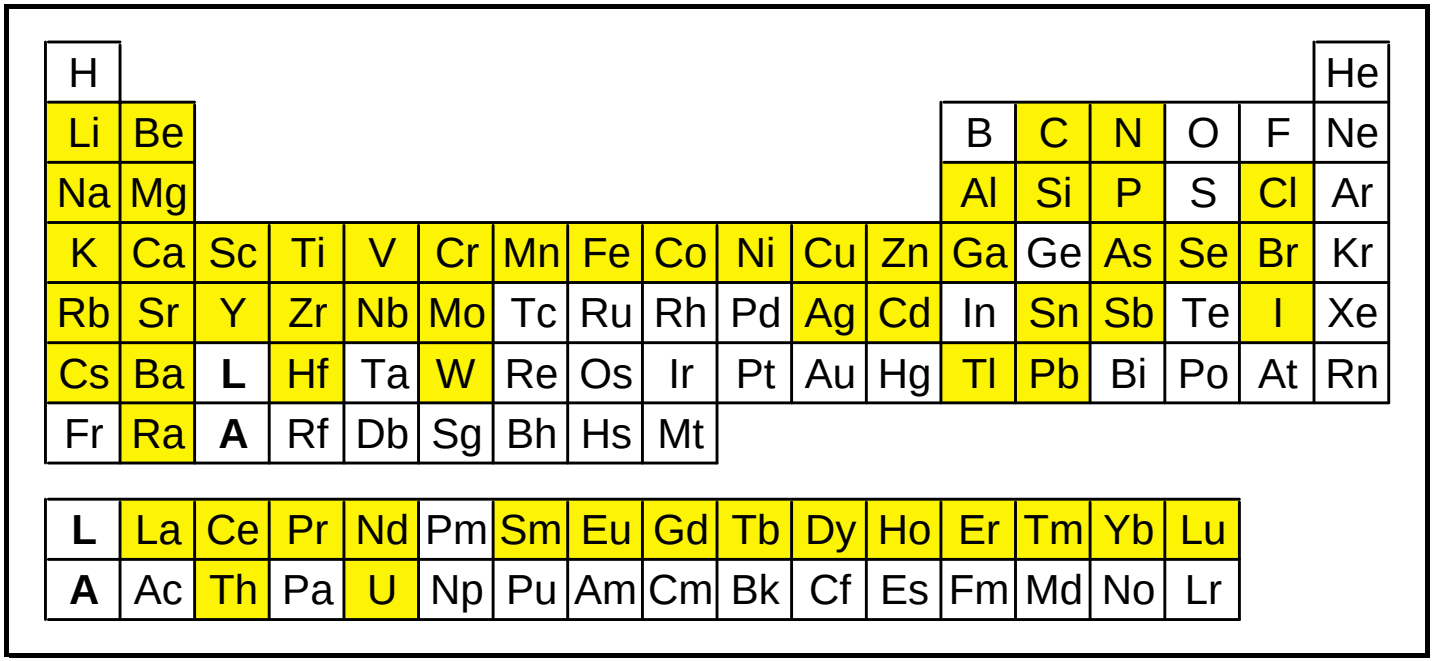
NIRS, Japan



Elements measured in 18 leafy vegetable samples collected in Japan

(Associated field soil samples were also measured)

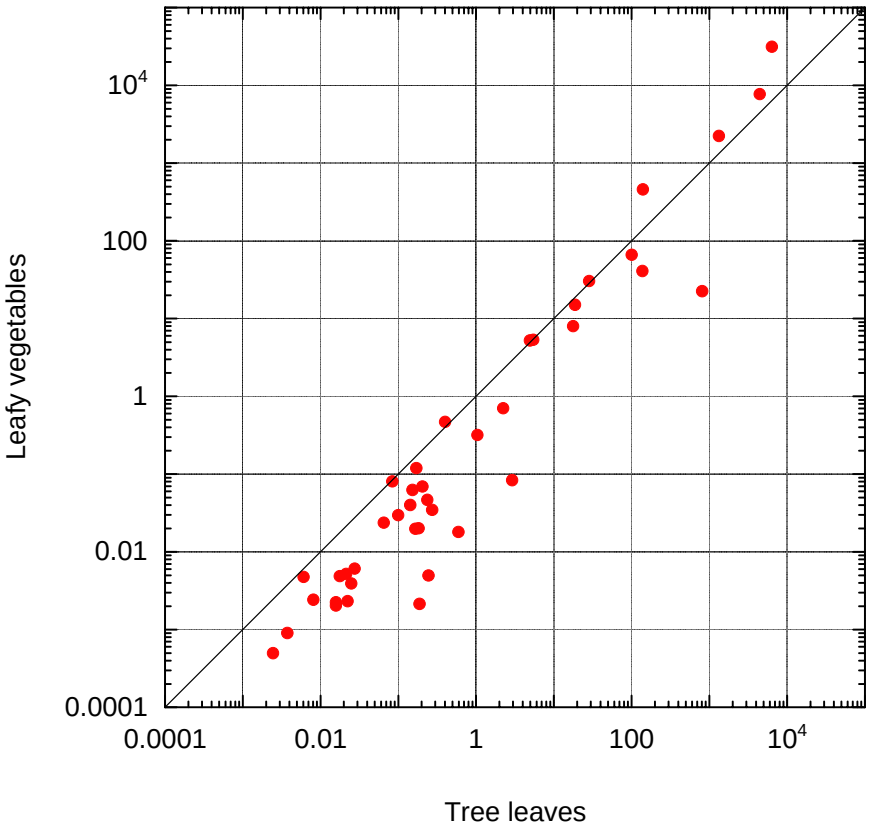


60 elements

July ‘09 meeting…

Comparison of elemental concentrations in leafy vegetables and tree leaves

Leafy vegetables’ data were from Cabbage, Chinese cabbage, and Lettuce *etc.* collected in Japan



Not too bad…
But how about with other tree’s data?

Tree leaves data were from B. Markert, “Instrumental element and multi-element analysis of plant samples” (1996)

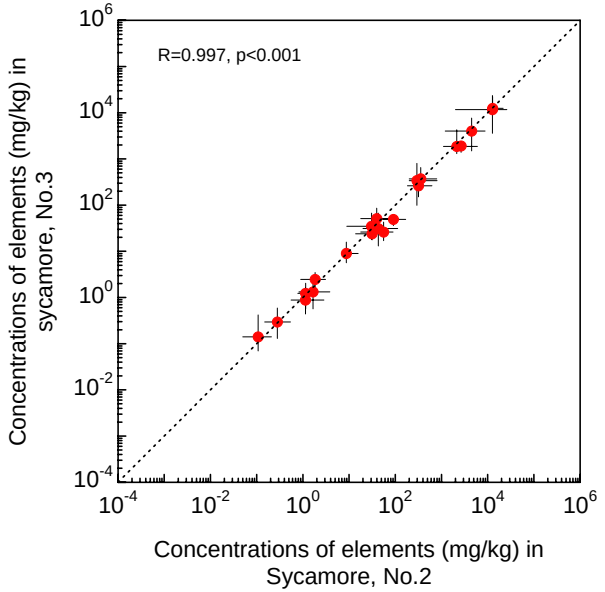
Other literature data

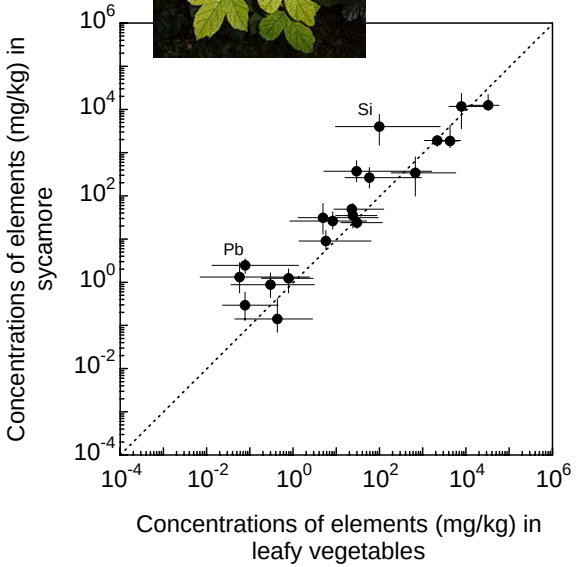
- Guha MM, Mitchell RL (1966) The trace and major element composition of the leaves of some deciduous trees. *Plant Soil* **24**: 90-112.
- Sheppard SC, Evenden WG (1990) Characteristics of plant concentration ratios assessed in a 64-site field survey of 23 elements. *J Environ Radioactiv* **11**: 15-36.
- Takada J, Takamatsu T, Satake K, Sase H (1994) Data on elemental concentration in land plants by neutron activation analysis. F-58-‘93/NIES, National Institute for Environmental Studies, Tsukuba
- Markert BA (1996) Instrumental element and multi-element analysis of plant samples: methods and applications. John Wiley & Sons Ltd., West Sussex

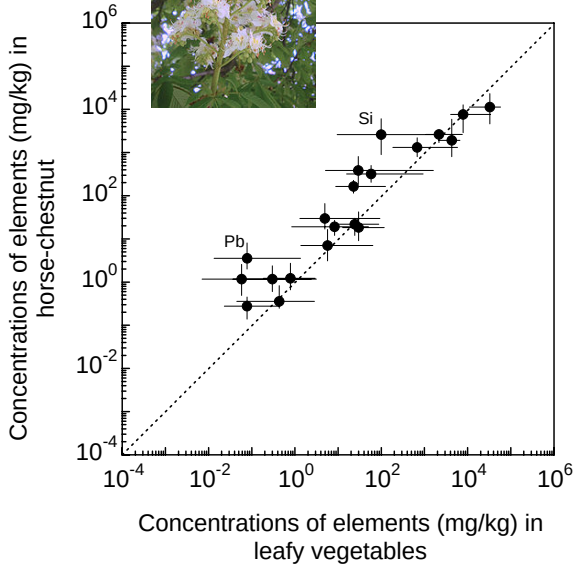
Guha MM, Mitchell RL (1966)

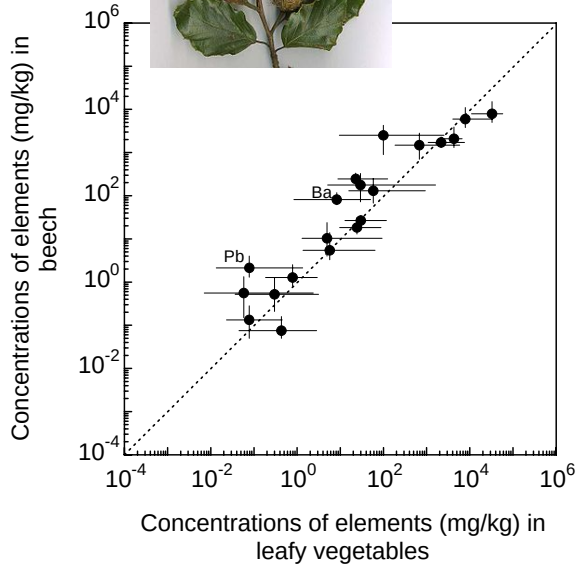
- Tree names: sycamore, horse-chestnut and beech.
- Soil type: granitic soil at Aberdeen, Scotland.
- Leaves of trees were collected several times of a year in 1959.
- Samples were also taken from bottom, middle or top of crown.
- Twenty-one elements were measured: Co, Ni, Fe, V, Ti, Cr, Pb, Al, Mn, B, Si, Ca, Sr, Ba, Mg, Cu, Mo, Zn, P, K and Na.

Elemental concentrations v.s. Leafy vegetables





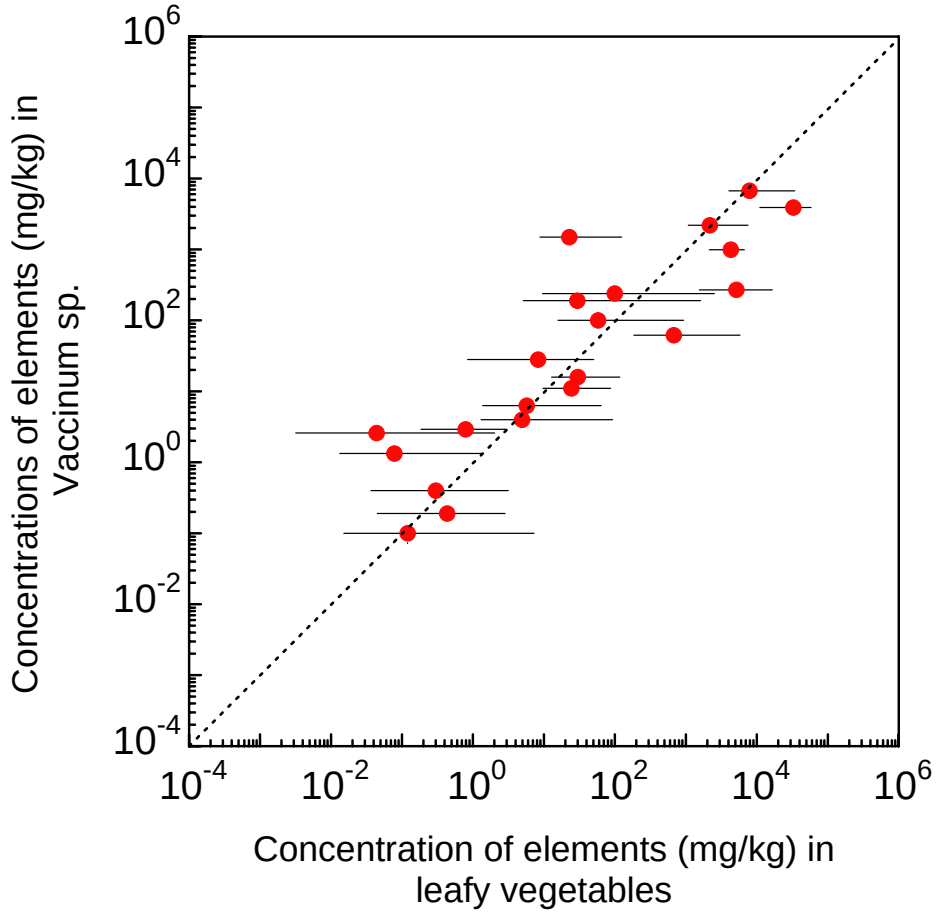




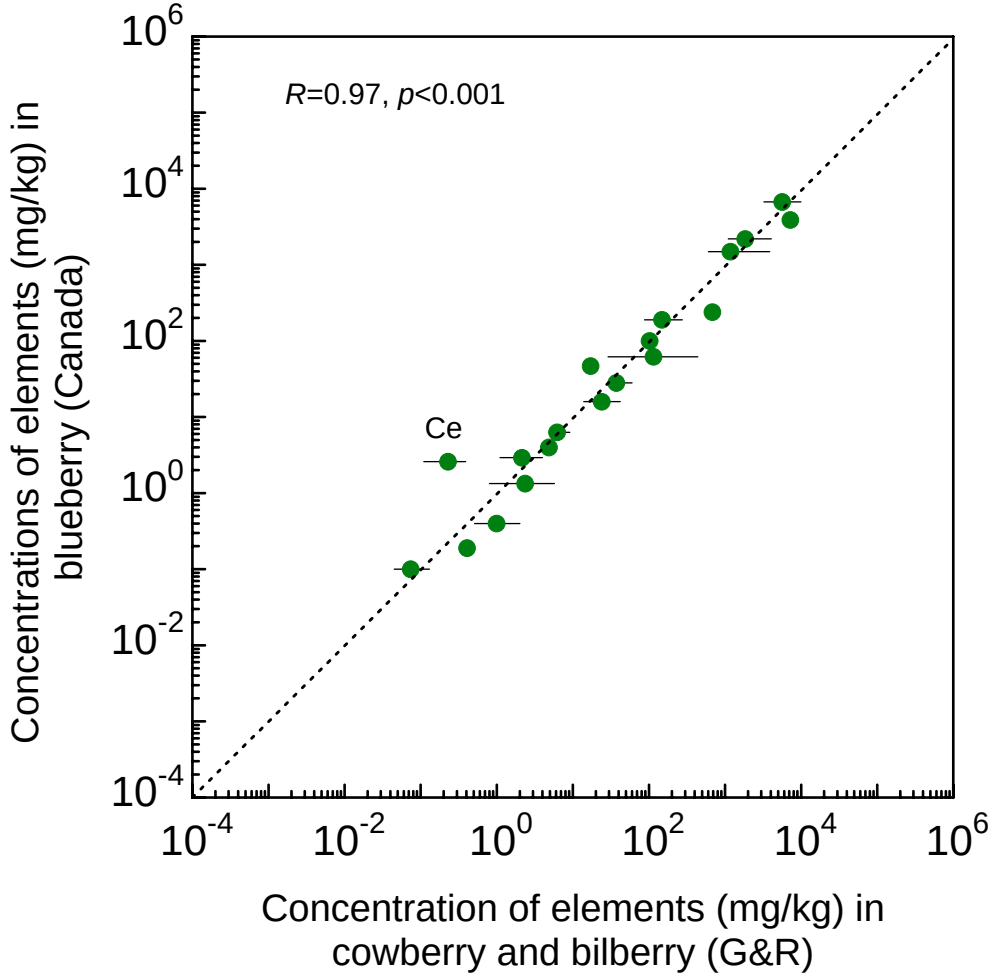
Sheppard SC, Evenden WG (1990)

- Tree names: blue berries (*Vaccinium angustifolium*)
- Collection sites: 64 fields in Canada
- Leaves of trees were collected at June - July 1983.
- Twenty-three elements were measured: Ni, Fe, Ti, Cr, Pb, Al, Mn, B, Si, Ca, Sr, Ba, Mg, Cu, Mo, Zn, Zr, Ce, P, S, Cl, K and Na.

Elemental concentrations



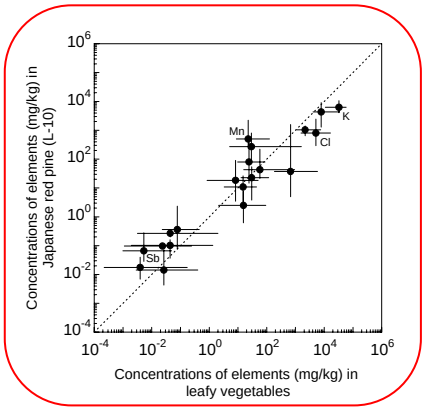
Vaccinum angustifolium (Canada) v.s. *Vaccinum sp.* (Germany & Russia)

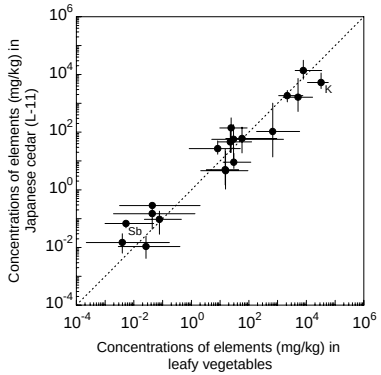


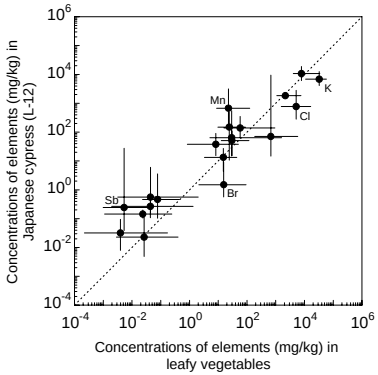
Takada J., *et al*. (1994)

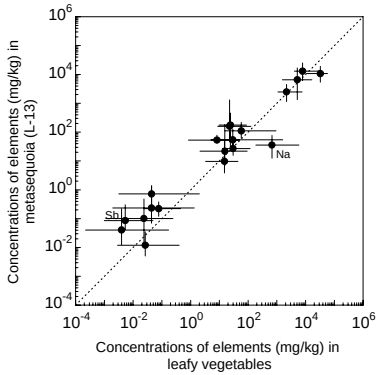
- Tree names: Japanese red pine, Japanese cedar, Japanese cypress, Metasequoia, Japanese cherry, *Shiraki, Hisakaki*, Tea plant, *Sakaki*, Japanese clethra, Javanese bishopwood*, Ryukyu pine* (12 species).
  *collected from subtropical area in Japan.
- Collection sites: Japan
- Leaves of trees were collected at Mar.-Nov., 1980-1981.
- Twenty elements were selected by setting the criterion to select elements for which the element concentration was detected in 1/3 or more of the measured samples: Co, Fe, Al, Mn, Ca, Rb, Sr, Ba, Mg, Zn, Sb, Cs, Sc, Ce, La, Sm, Cl, Br, K and Na.

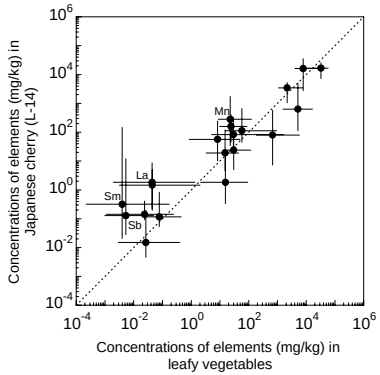
Comparison of elemental concentrations

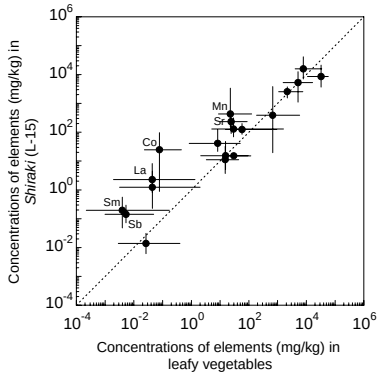


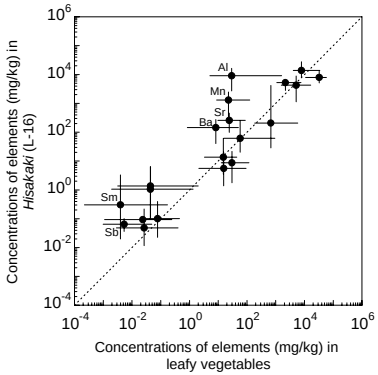


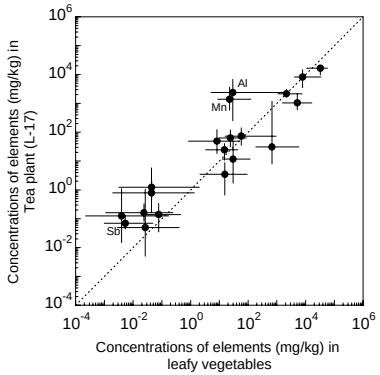


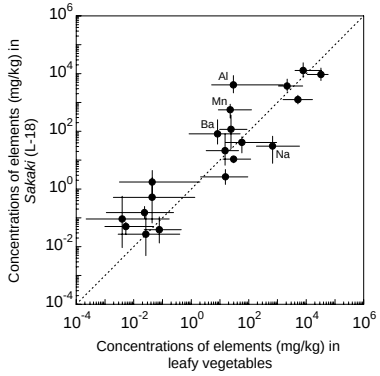


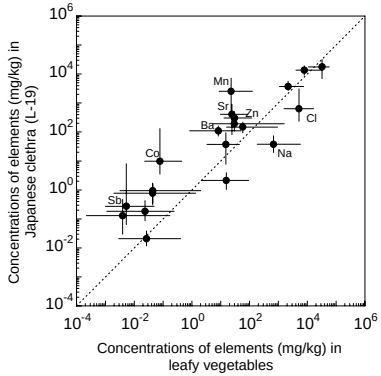


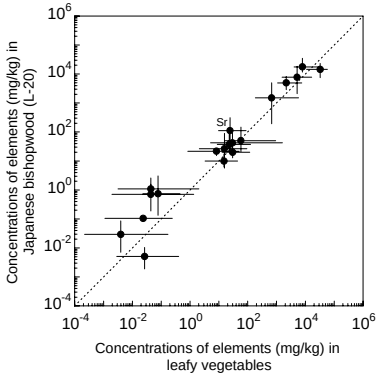


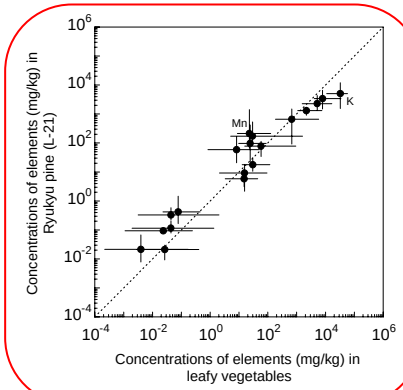




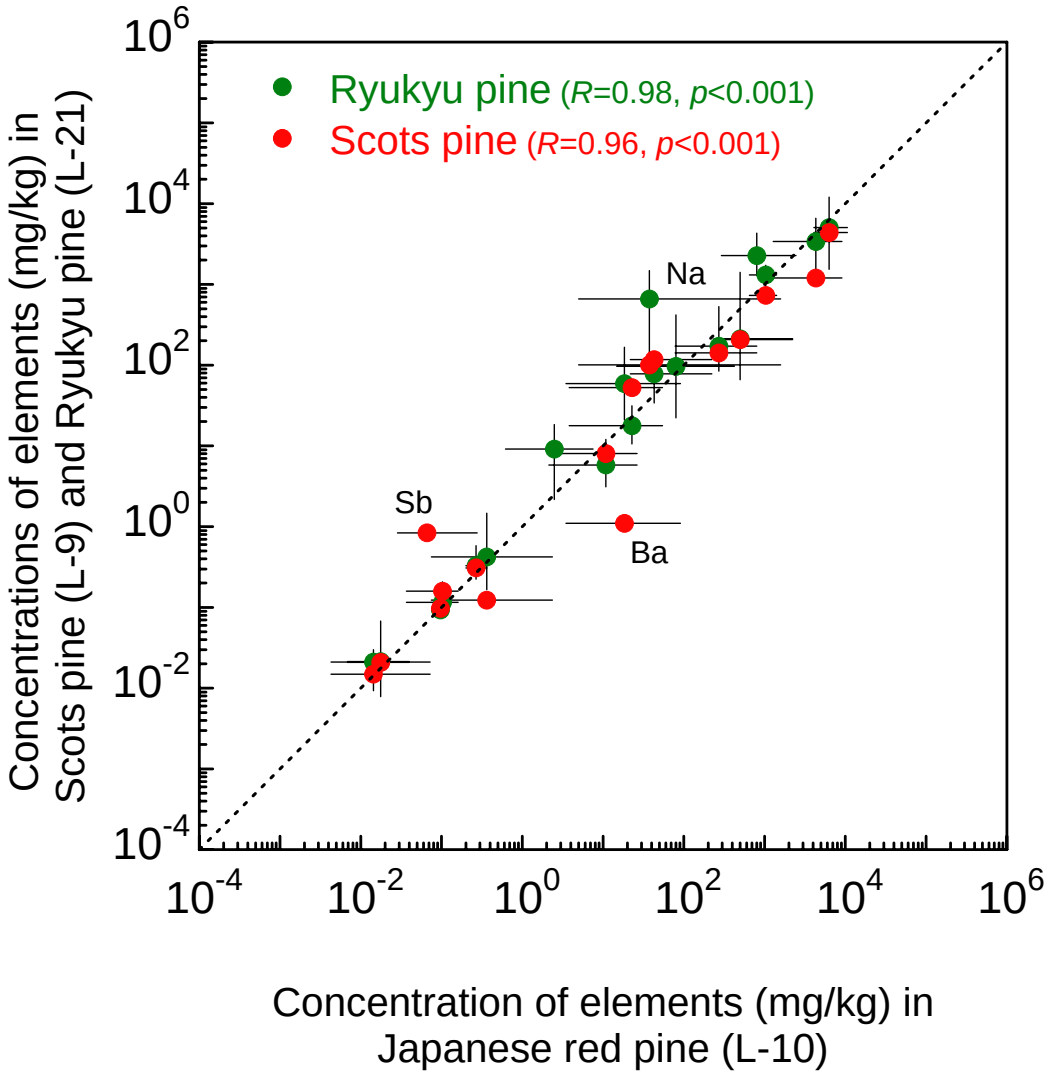




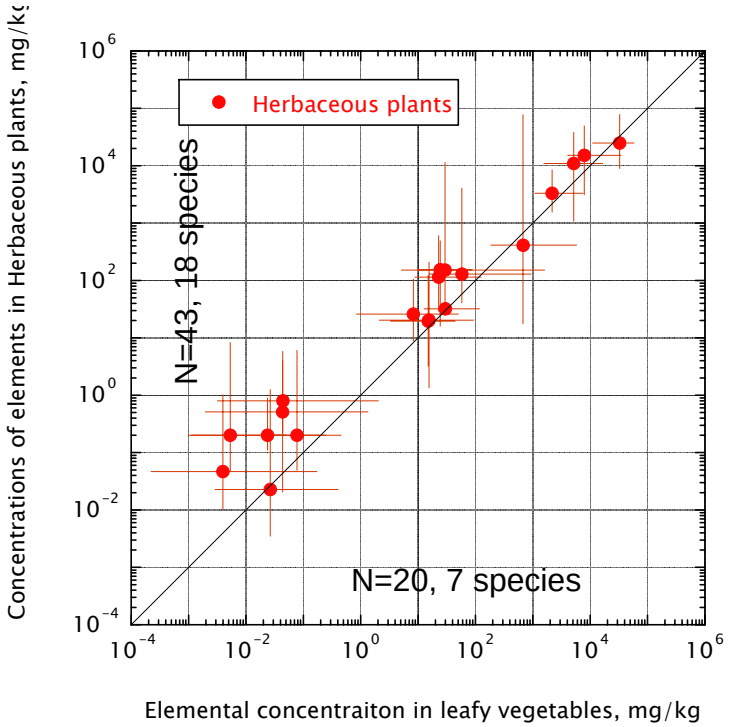


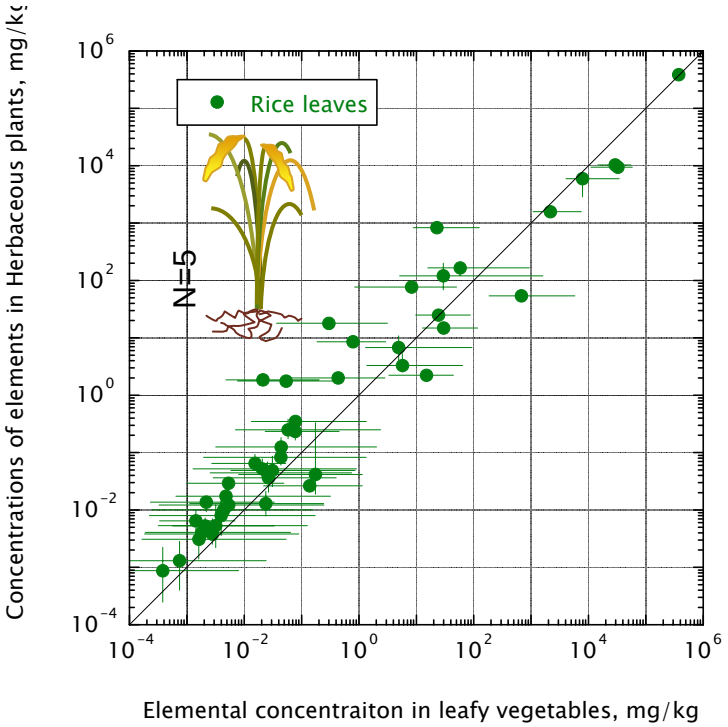


Among pine trees



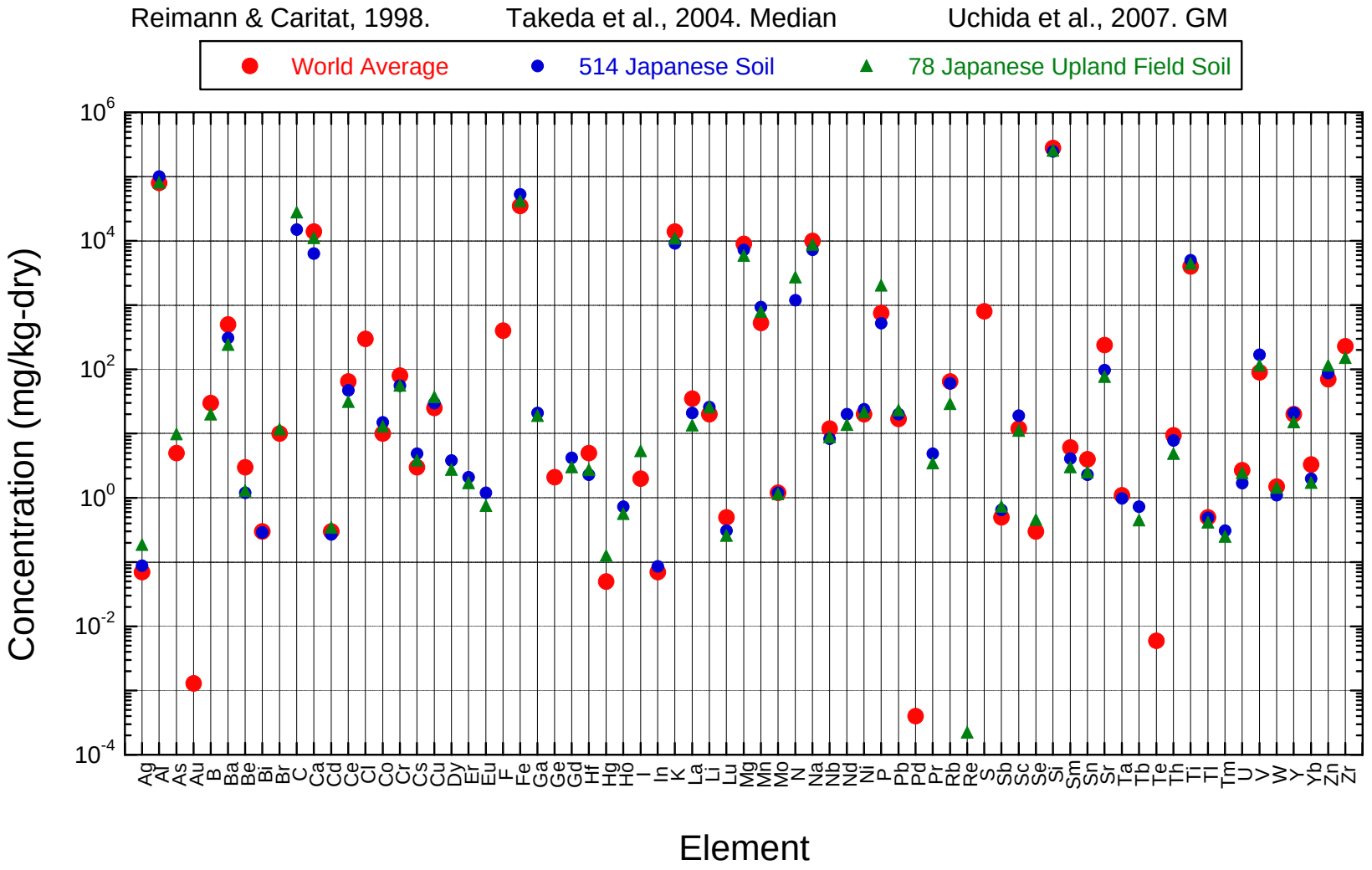
Leafy vegetables v.s. leaves of Herbaceous plants (Takada et al., 1994) or Rice (not published)



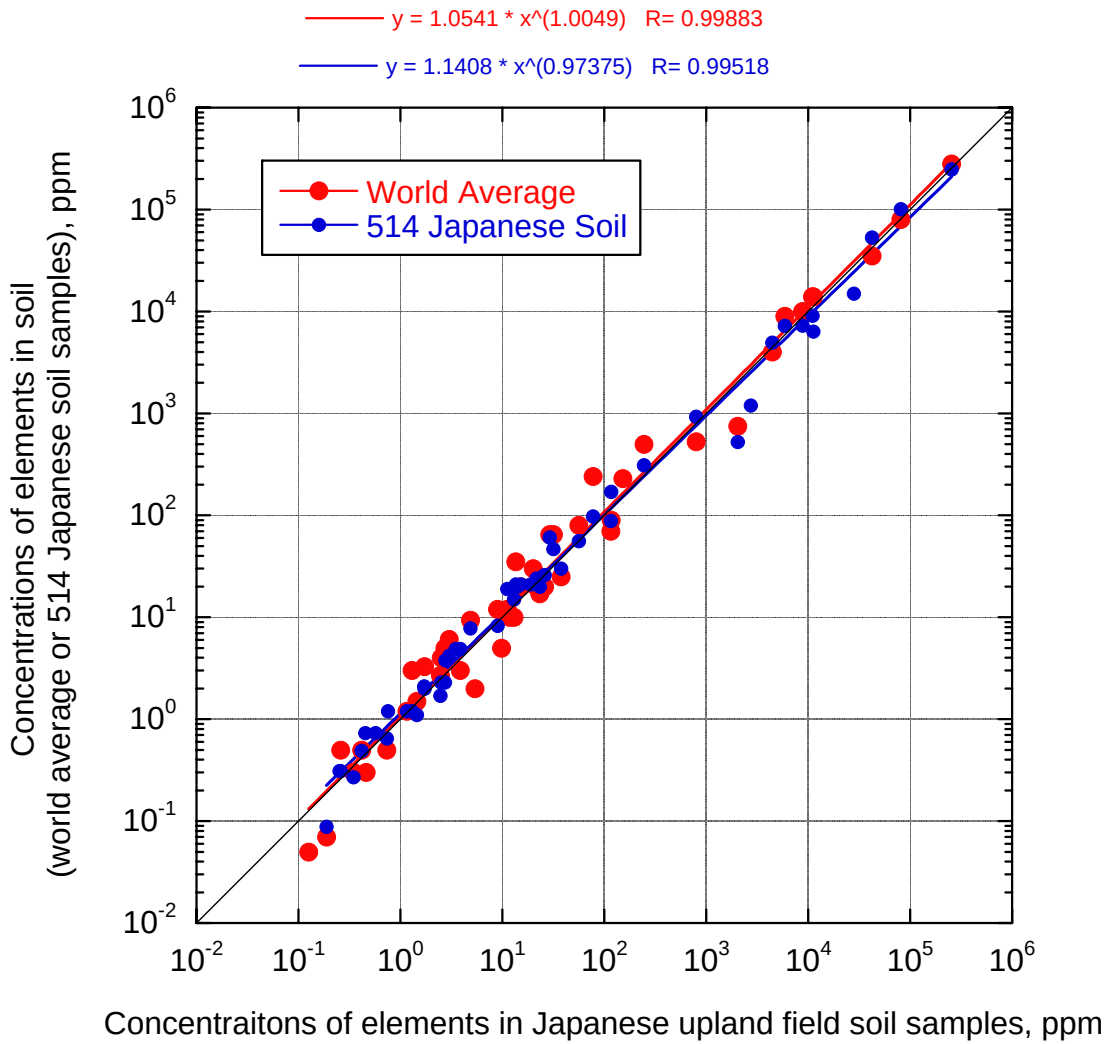


The data for leafy vegetables would also be applicable to “Wild Grass” in RAP if there are no suitable data

Elemental concentrations in soil



Comparison of the elemental concentrations in soil



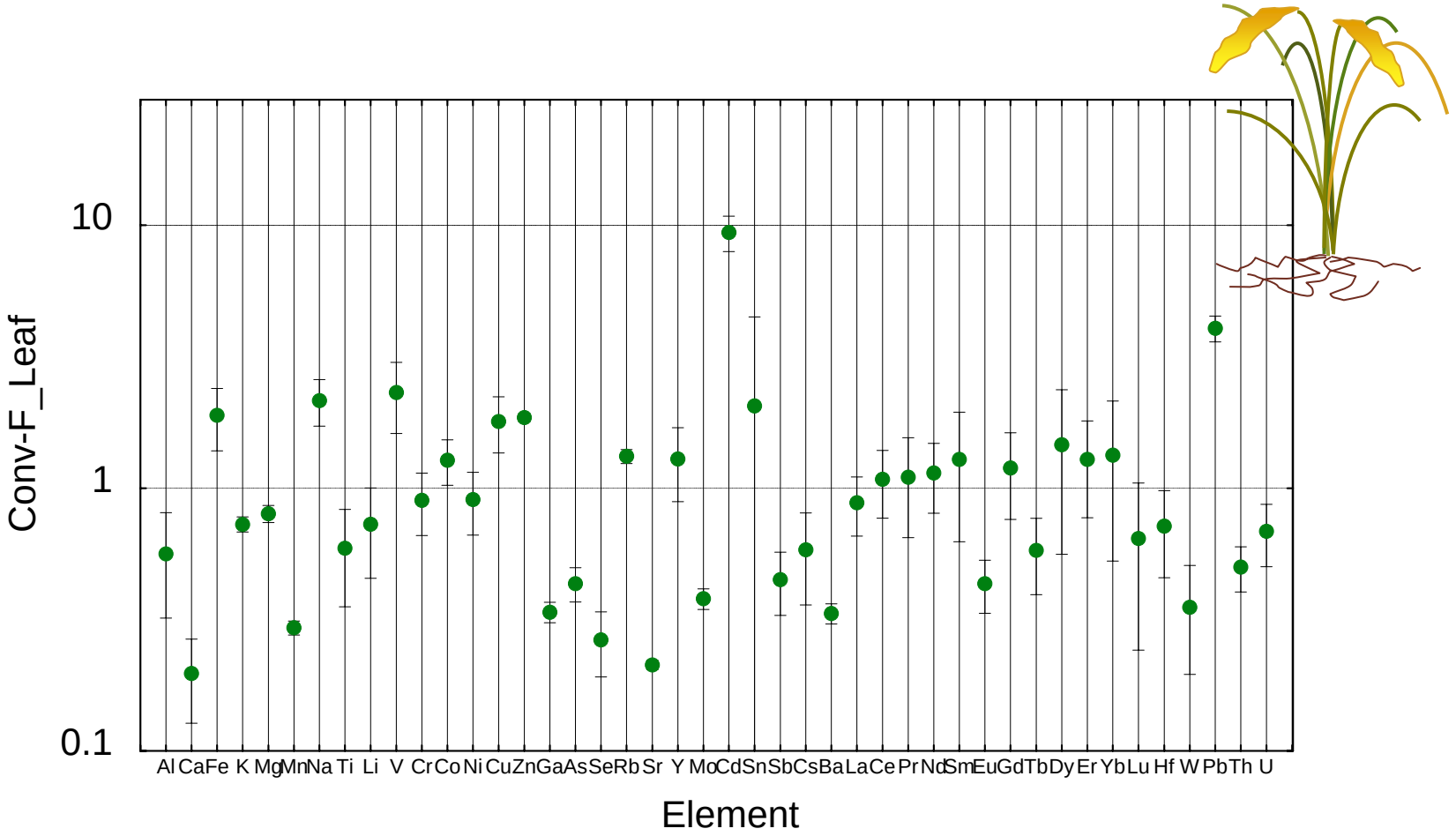
Potential CR values for leaves of higher plants

C: 1.0

Ag	3.1E-02	Gd	1.2E-03	Rb	2.9E-01
Al	3.4E-04	Hf	4.3E-04	Sb	8.5E-03
As	2.9E-03	Ho	1.1E-03	Sc	1.9E-03
Ba	2.4E-02	I	2.4E-02	Se	3.6E-02
Be	1.1E-03	K	2.9E+00	Si	3.8E-04
Br	1.4E+00	La	1.9E-03	Sm	9.0E-04
C	1.7E+01	Li	1.3E-03	Sn	5.9E-02
Ca	7.5E-01	Lu	1.1E-03	Sr	1.8E-01
Cd	4.5E-01	Mg	3.0E-01	Tb	1.2E-03
Ce	9.2E-04	Mn	3.0E-02	Th	6.5E-04
Cl	1.7E+01	Mo	3.7E-01	Ti	1.1E-03
Co	6.1E-03	N	1.5E+01	Tl	6.8E-02
Cr	4.7E-03	Na	7.8E-02	Tm	1.2E-03
Cs	6.0E-03	Nb	8.2E-04	U	1.2E-03
Cu	1.9E-01	Nd	1.2E-03	V	4.7E-04
Dy	9.8E-04	Ni	3.6E-02	W	1.1E-02
Er	9.6E-04	P	3.9E+00	Y	1.4E-03
Eu	2.2E-03	Pb	3.9E-03	Yb	6.9E-04
Fe	1.3E-03	Pr	1.3E-03	Zn	3.3E-01
Ga	2.7E-03	Ra	1.1E-02	Zr	6.3E-04

Concentration in leafy vegetables / concentration in soil (average)

Conversion factor
(from leaves to whole plant data)



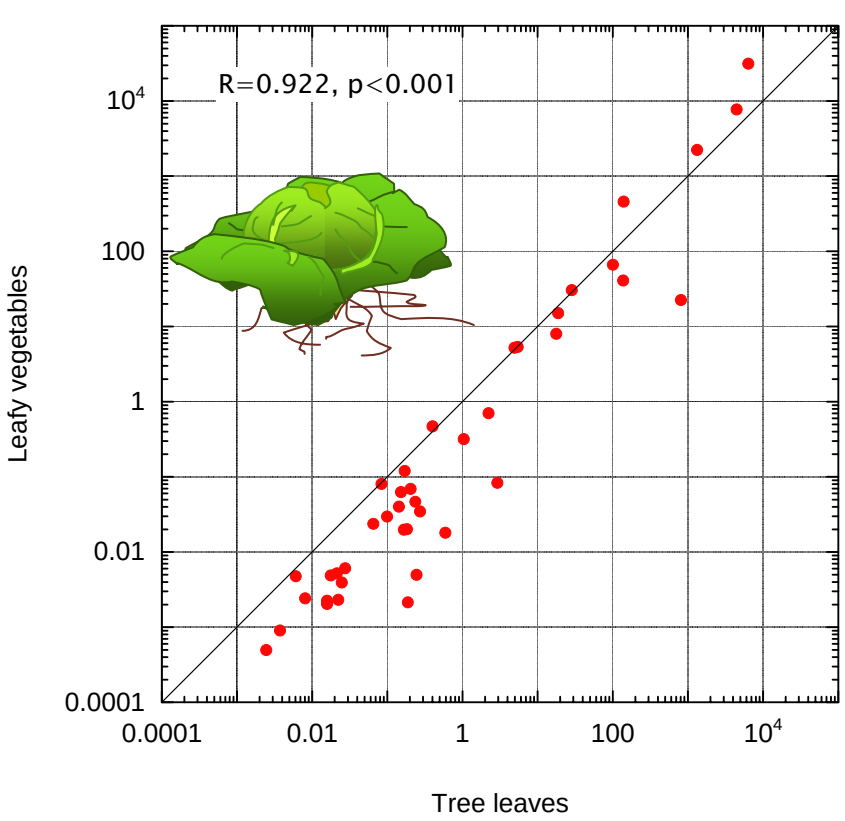
Thank you for your attention!

Conclusions (for paper)

- There are elemental composition data for many more elements in leafy vegetables than in wild tree leaves.
- The correlation coefficients were high between elemental compositions of leafy vegetables and those of various tree leaves.
- From these results, we concluded that elemental composition data for leafy vegetables would be applicable for wild tree leaves if there were no data for that tree.
- However, leaves of some trees have a tendency to accumulate some elements such as Al, Co and Mn.
- Thus to obtain more precise data for each element in each tree type, further data must be collected.
- It should be noted that the data of leafy vegetables are only applicable to leaves of trees so that to estimate element transfer to a whole tree body, elemental components in other tree parts, such as trunks and branches, should be measured.

Which is better?

Leafy vegetables (NIRS)
vs
Tree leaves (Markert, 1996)



Rice leaves (NIRS)
vs
Tree leaves (Markert, 1996)