Supplementary Information: "Factors that influence the absorption of uranium by indigenous plants on the spoil tip of an abandoned mine in western Spain"

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Abstract

This file contains supplementary information for the paper 'Factors that influence the absorption of uranium by indigenous plants on the spoil tip of an abandoned mine in western Spain'.

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Appendix A1. Plant species.

A1.1. Plant species in the study area

Table A1.1. Plant species in the study area.

Plant Specie
Aira elegantíssima Schur
Capsella bursapastoris (L.) Medik.
Chamaemelum nobile (L.) All (Anthemis nobilis L.)
Ctenopsis delicatula (Lag.) Paunero (Vulpia delicatula (Lag) Dumort.)
Erodium cicutarium (L.) L´Her.
Juncus bufonius L.
Lepidium heterophyllum Benth.
Molineriella laevis (Brot.) Rouy (Periballia laevis (Brot.) Asch. & Graebn.
Parentucellia latifólia (L.) Caruel in Parl.
Plantago lagopus L.
Plantago lanceolata L.
Poa bulbosa L.
Rumex acetosella L. subsp. angiocarpus (Murb.) Murb.
Rumex induratus Boiss. & Reut.
Spergularia purpúrea (Pers.) D.Don. var. rubra.
Spergularia rubra (L.) J.Presl & K. Presl. var rubra
Trifolium. micranthum Viv. (Trifolium filiforme L.)
Trifolium tomentosum L.
Trifolium arvense L.
Trifolium cernuum Brot.
Trifolium glomeratum L.
Trifolium micranthum Viv.
Trifolium strictum L. (Trifolium laevigatum Poir.)
Trifolium subterraneum L. subsp. subterraneum.
Trifolium cernuum Brot.
Vulpia bromoides (L.) Gray

A1.2. Plant species considered in this study

The following figures show the plant species selected for this study.

Fig. A1.1. Trifolium arvense L.

Fig. A1.4. Trifolium cernuum Brot.

Fig. A1.2. Trifolium glomeratum L.

Fig. A1.5. Vulpia bromoides L.

Fig. A1.3. Trifolium micranthum Viv.

Fig. A1.6. Spergularia rubra (L.) J. Presl & C. Presl.

Fig. A1.7. Aira elegantissima L.

Appendix A2. Soil physical–chemical properties

Table A2.1. Soil physical-chemical properties: pH, organic matter (%) and particle size (µm).

Nº	Reference	pH	Organic Matter (%)	Biodisponibility (%)	Particle size (µm)	Coordinates	
1	VP-1a-ES	6.21	2.37	26.2	11.89	735312	4547087
2	VP-1b-ES	6.28	2.89	36.6	11.96	735316	4547088
3	VP-1c-ES	6.18	3.25	24.2	12.03	735313	4547084
4	VP-2a-ES	5.96	2.47	72.6	12	735298	4547120
5	VP-2b-ES	5.82	3.69	31.4	12.14	735294	4547123
6	VP-2c-ES	6.02	1.96	30.2	12.56	735292	4547127
7	VP-3a-ES	6.56	2.35	39.2	12.78	735274	4547147
8	VP-3b-ES	6.41	1.87	39.6	13.03	735272	4547147
9	VP-3c-ES	6.36	1.62	28.7	13.12	735277	4547151
10	VP-4a-ES	6.14	2.36	43.2	12.61	735273	4547155
11	VP-4b-ES	6.09	2.94	85.3	12.81	735273	4547156
12	VP-4c-ES	6.03	3.25	75.2	13.12	735274	4547155
13	VP-5a-ES	5.86	1.98	63.5	12.05	735267	4547154
14	VP-5b-ES	5.75	1.85	35.5	12.09	735268	4547154
15	VP-5c-ES	5.83	1.75	46.3	12.13	735269	4547153
16	VP-RI-SUBa-ES	5.83	1.83	83.4	12.21	735278	4547139
17	VP-RI-SUBb-ES	5.94	2.11	71.3	12.23	735275	4547139
18	VP-RI-SUBc-ES	6.02	2.36	53.8	12.45	735280	4547137
19	VP-RI-SUBd-ES	5.93	2.42	47.6	12.96	735287	4547131
20	VP-RI-SUBe-ES	5.86	2.65	65.3	13.11	735288	4547129
21	VP-RI-SUBf-ES	5.98	3.26	56.2	12.56	735285	4547130
22	VP-RI-VULa-ES	6.25	3.45	72.3	12.19	735284	4547133
23	VP-RI-VULb-ES	6.47	1.26	41.6	12.36	735240	4547174
24	VP-RI-VULc-ES	6.12	1.15	59.3	12.48	735241	4547174
25	VP-RI-VULd-ES	6.23	2.26	56.8	12.25	735243	4547174
26	VP-RI-VULe-ES	6.17	2.57	69.4	12.96	735244	4547171
27	VP-RI-VULf-ES	6.08	3.12	81.1	12.58	735238	4547168
28	VP-RI-PERa-ES	5.42	2.54	75.3	12.01	735241	4547168
29	VP-RI-PERb-ES	5.69	2.87	65.4	12.09	735276	4547163
30	VP-RI-PERc-ES	5.96	2.45	52.2	11.98	735280	4547164
31	VP-RI-PERd-ES	5.89	1.87	28.3	12.57	735278	4547164
32	VP-RI-PERe-ES	6.11	1.82	37.7	12.35	735282	4547165
33	VP-RI-PERf-ES	6.25	2.84	42.3	12.47	735275	4547162
34	VP-RI-SPEa-ES	5.68	2.55	39.2	12.23	735285	4547165
35	VP-RI-SPEb-ES	5.72	2.36	36.6	12.36	735251	4547163
36	VP-RI-SPEc-ES	5.49	2.41	28.4	12.43	735248	4547163
37	VP-RI-SPERd-ES	6.41	1.94	39.2	12.56	735246	4547169

Nº	Reference	pH	Organic Matter (%)	Biodisponibility (%)	Particle size (µm)	Coordinates	
38	VP-RI-SPERe-ES	6.24	1.55	42.1	12.45	735244	4547168
39	VP-RI-SPERf-ES	6.12	2.62	43.2	11.98	735248	4547171

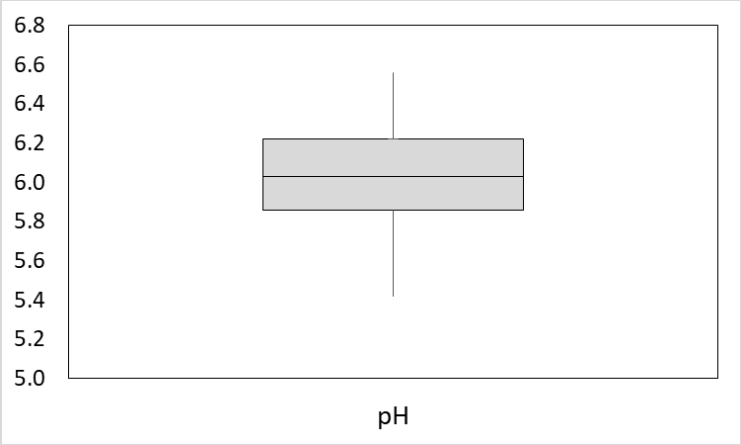

Fig A2.1. Box-and-whisker plot for the soil pH in the study area.

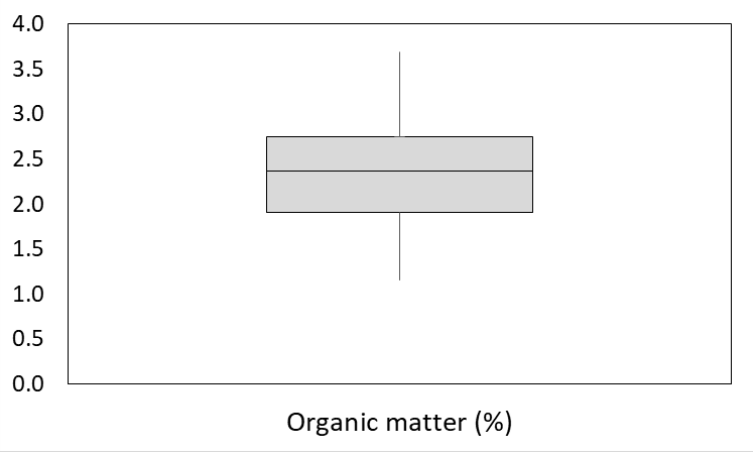

Fig A2.2. Box-and-whisker plot for the soil organic matter (%) in the study area.

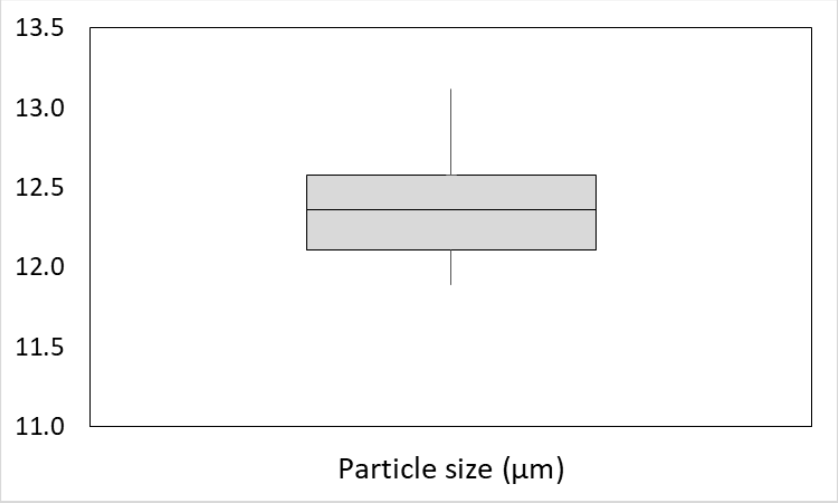

Fig A2.3. Box-and-whisker plot for the soil particle size (µm) in the study area.

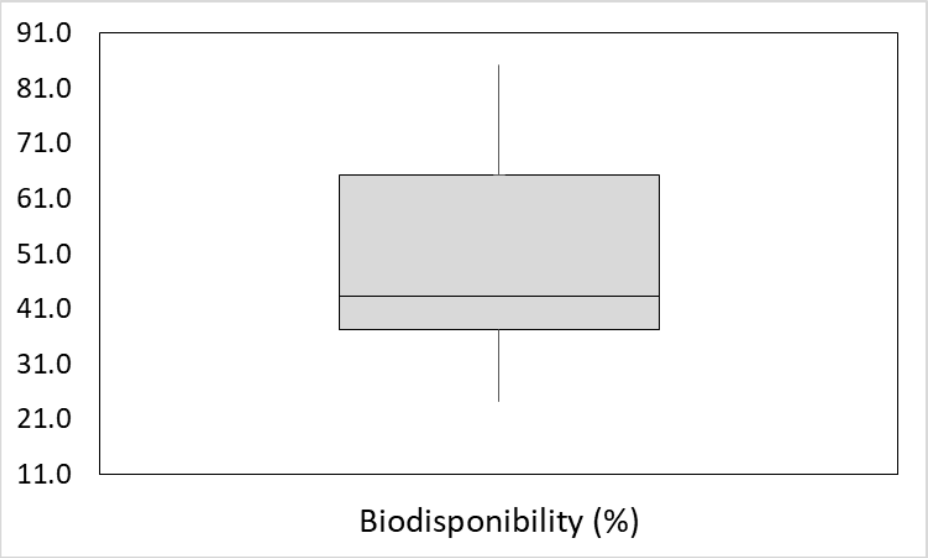

Fig A2.4. Box-and-whisker plot for the soil biodisponibility (%) in the study area.

Appendix A3. Uptake of Uranium by plants

A3.1. CR versus soil concentration

A hypothetical relationship for the CR for essential and non-essential elements over a range of substrate concentration is shown in Fig. A3.1. [1].

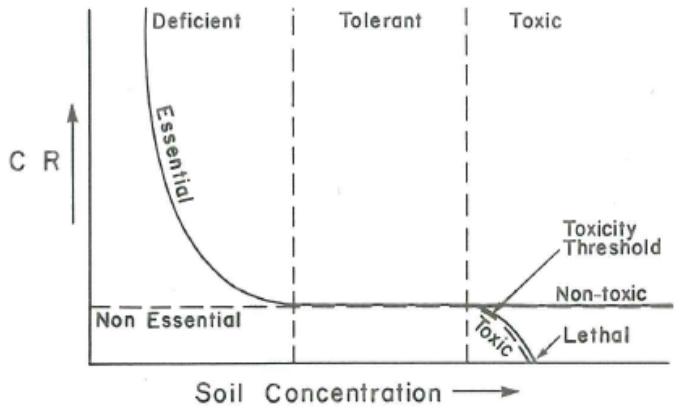

Fig A3.1. Diagrammatic representation of CR versus soil concentration for both essential and non-essencial elements through the deficient to toxic soil-concentration range.

A3.2. CR versus soil concentration, Uranium concentration in soil as a function of annual rainfall and Uranium concentration in the plant species as a function of annual rainfall

A3.2.1. Trifolium cernuum Brot.

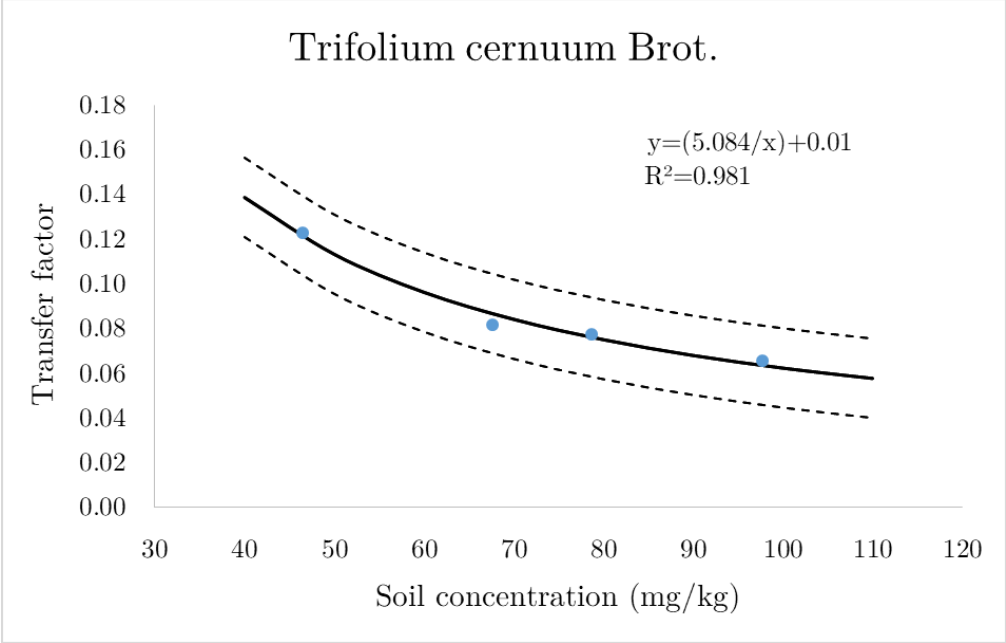

Fig A3.2. Transfer factor as a function of U soil concentration (mg kg^{-1}) for Trifolium cernum Brot.

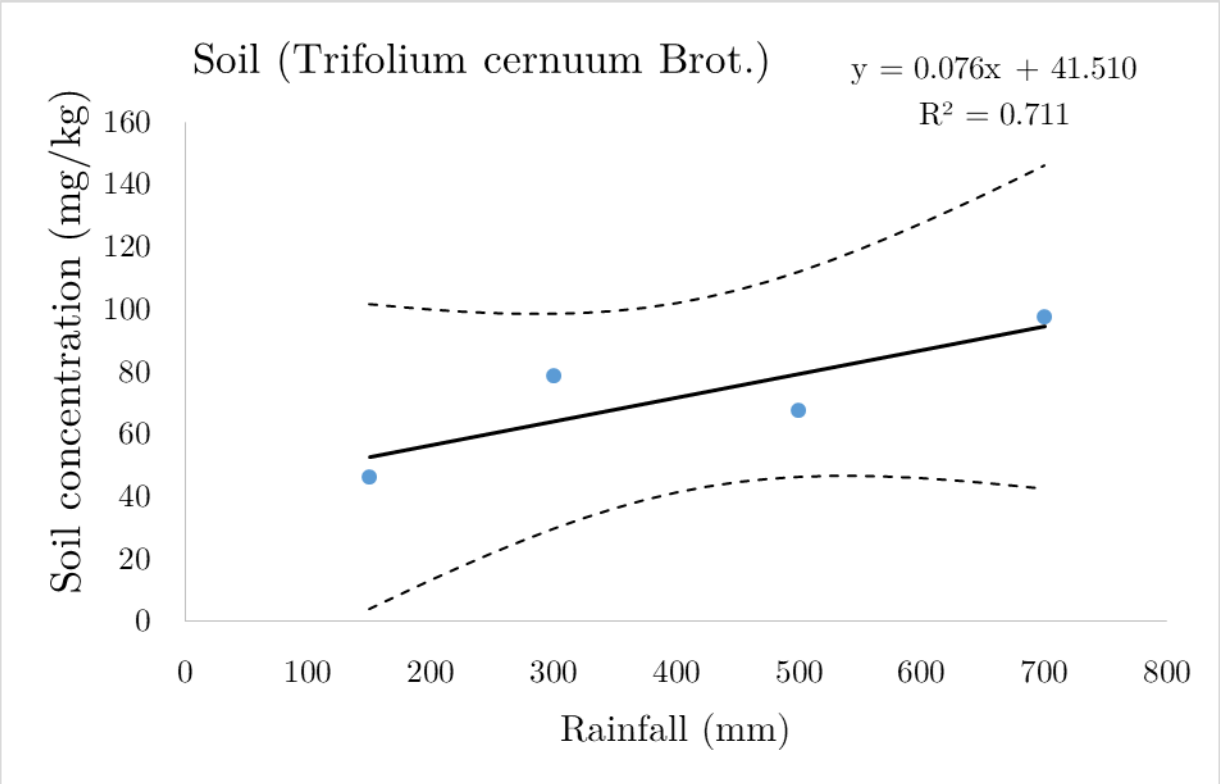

Fig A3.3. U soil concentration as a function of rainfall for Trifolium cernum Brot.

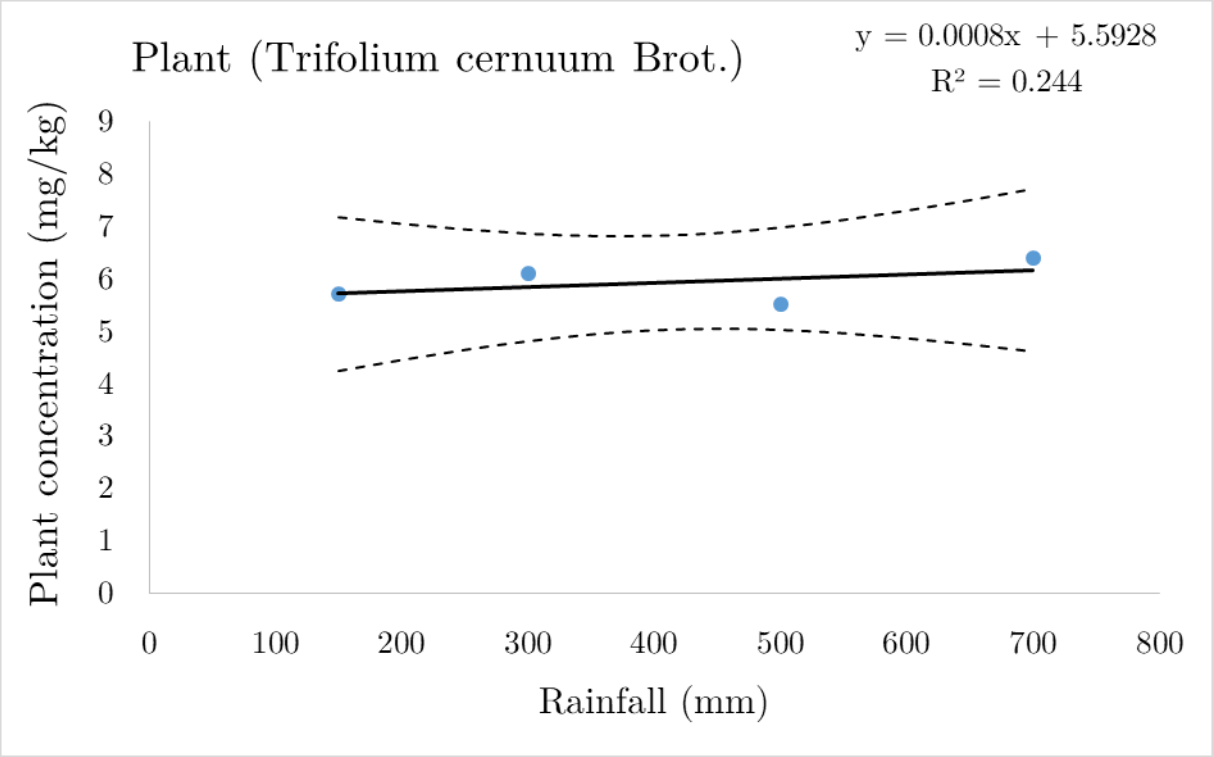

Fig A3.4. U plant concentration as a function of rainfall for Trifolium cernum Brot.

A3.2.2. Trifolium micrantum Viv.

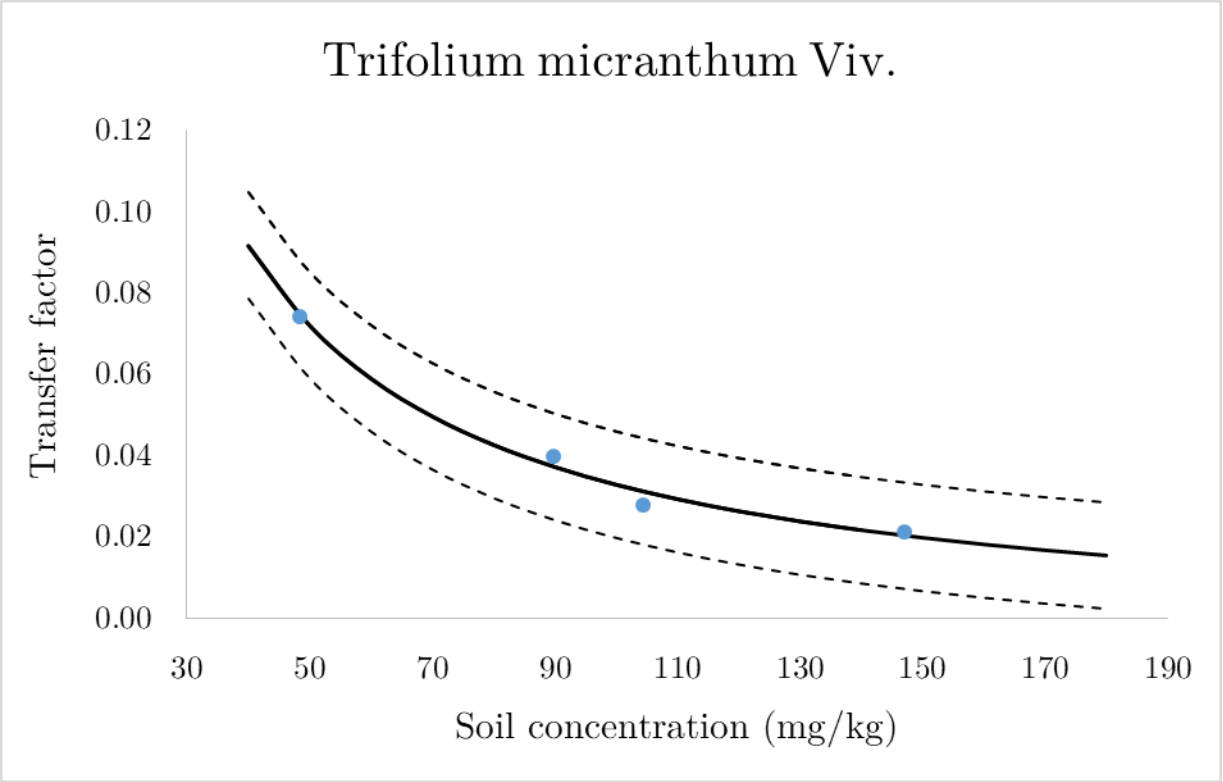

Fig A3.5. Transfer factor as a function of U soil concentration (mg kg^{-1}) for Trifolium micrantum Viv.

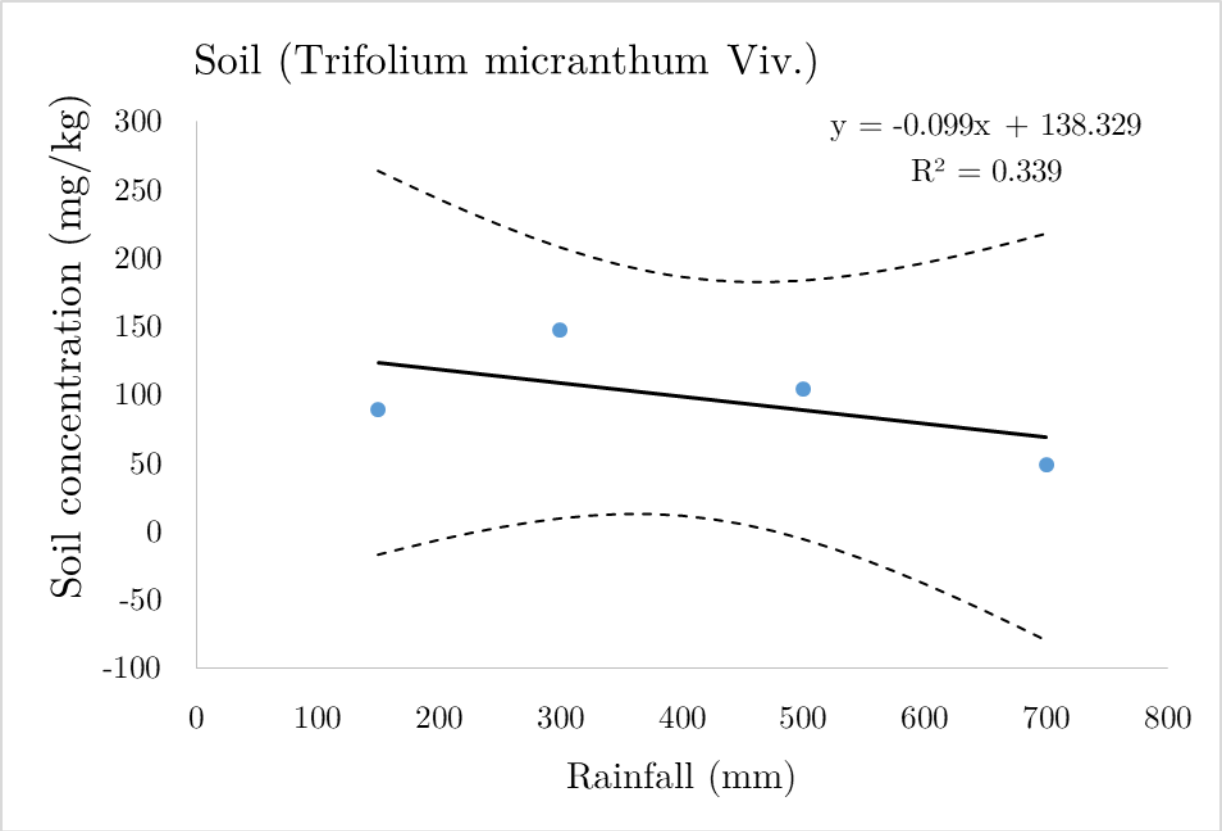

Fig A3.6. U soil concentration as a function of rainfall for Trifolium micrantum Viv.

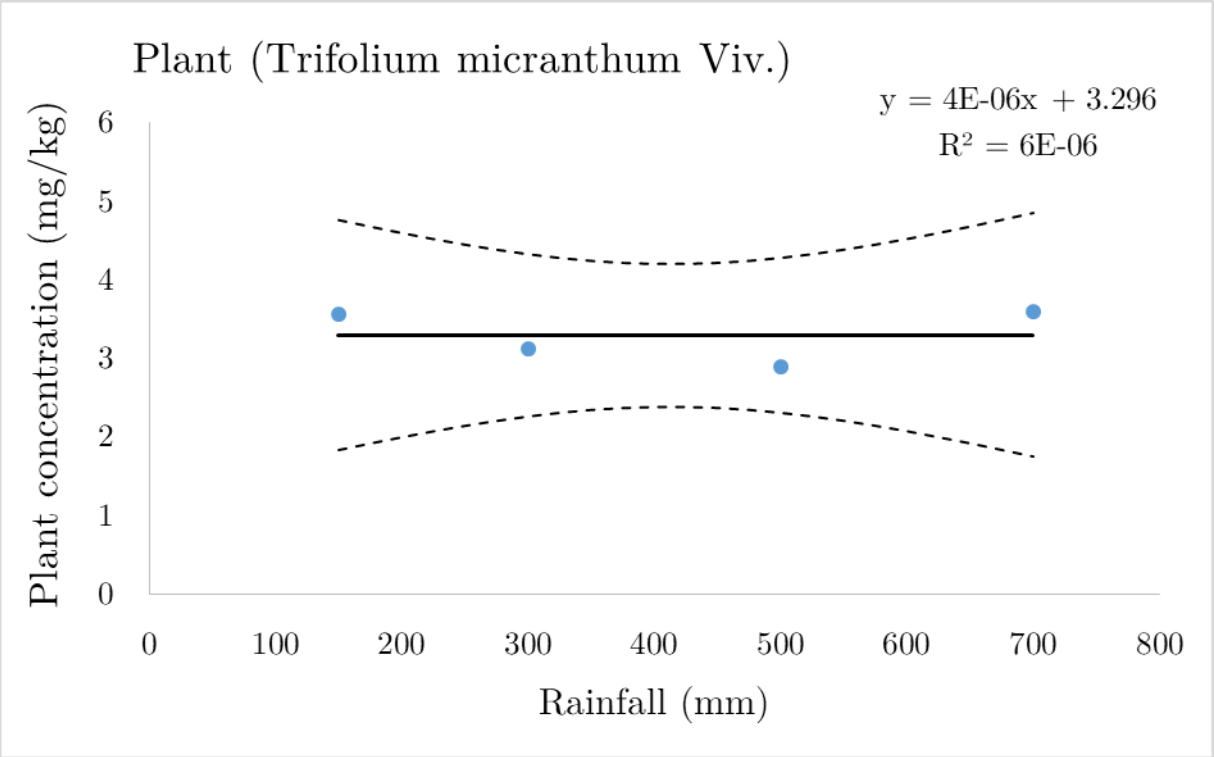

Fig A3.7. U plant concentration as a function of rainfall for Trifolium micrantum Viv.

A3.2.3. Trifolium glomeratum L.

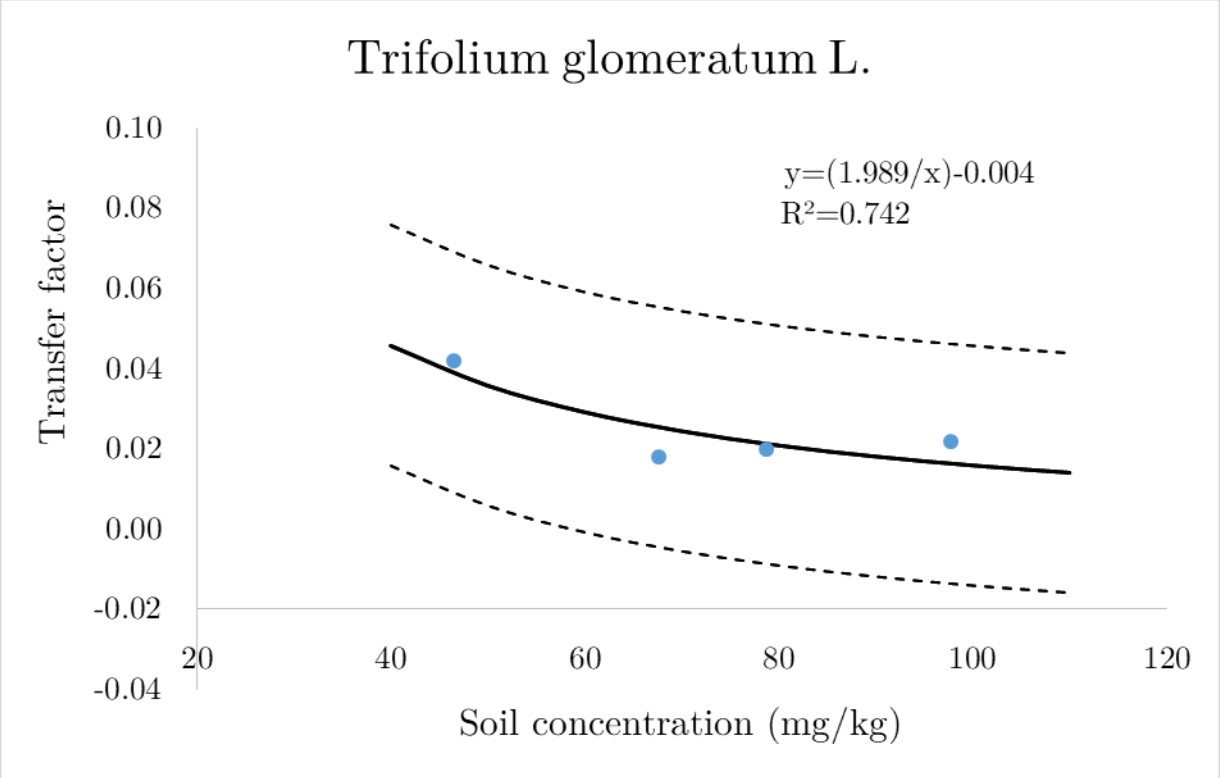

Fig A3.8. Transfer factor as a function of U soil concentration (mg kg^{-1}) for Trifolium glomeratum L.

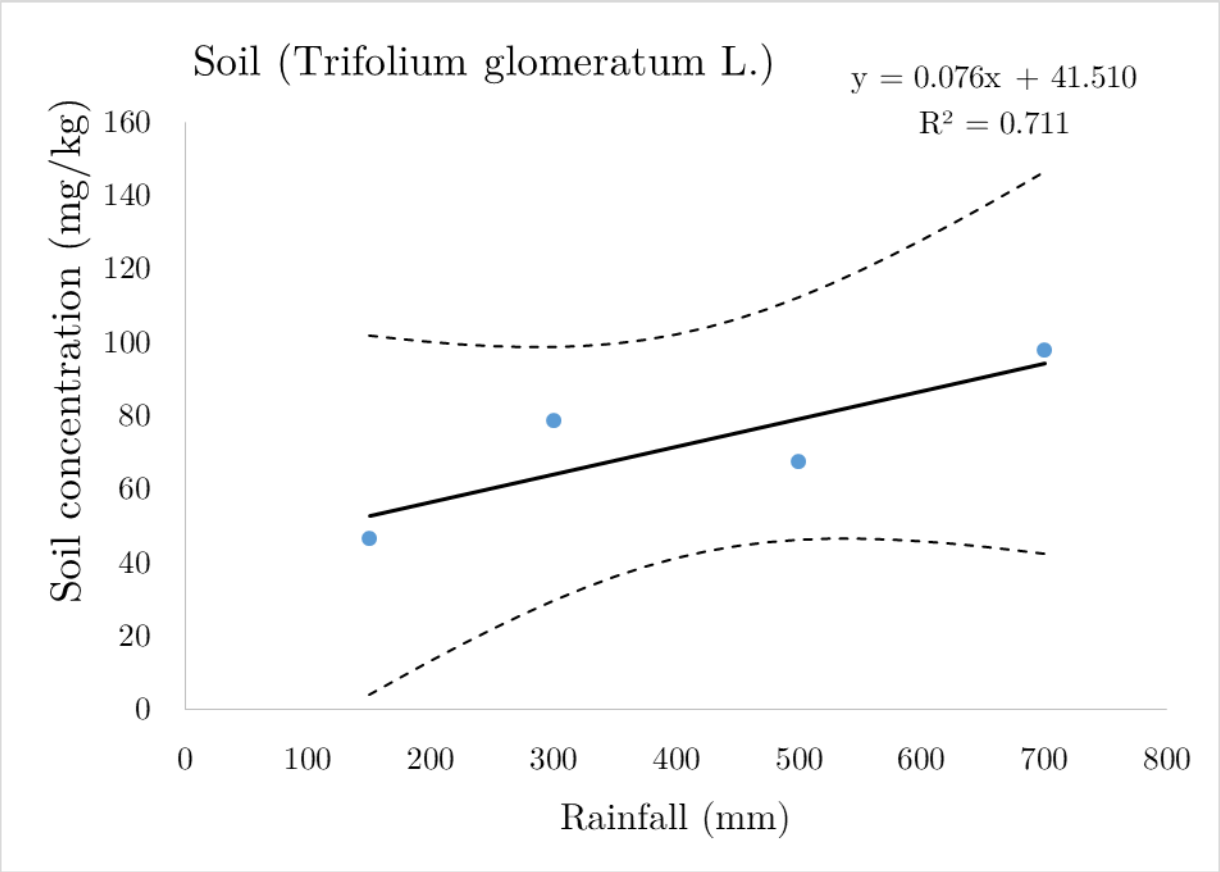

Fig A3.9. U soil concentration as a function of rainfall for Trifolium glomeratum L.

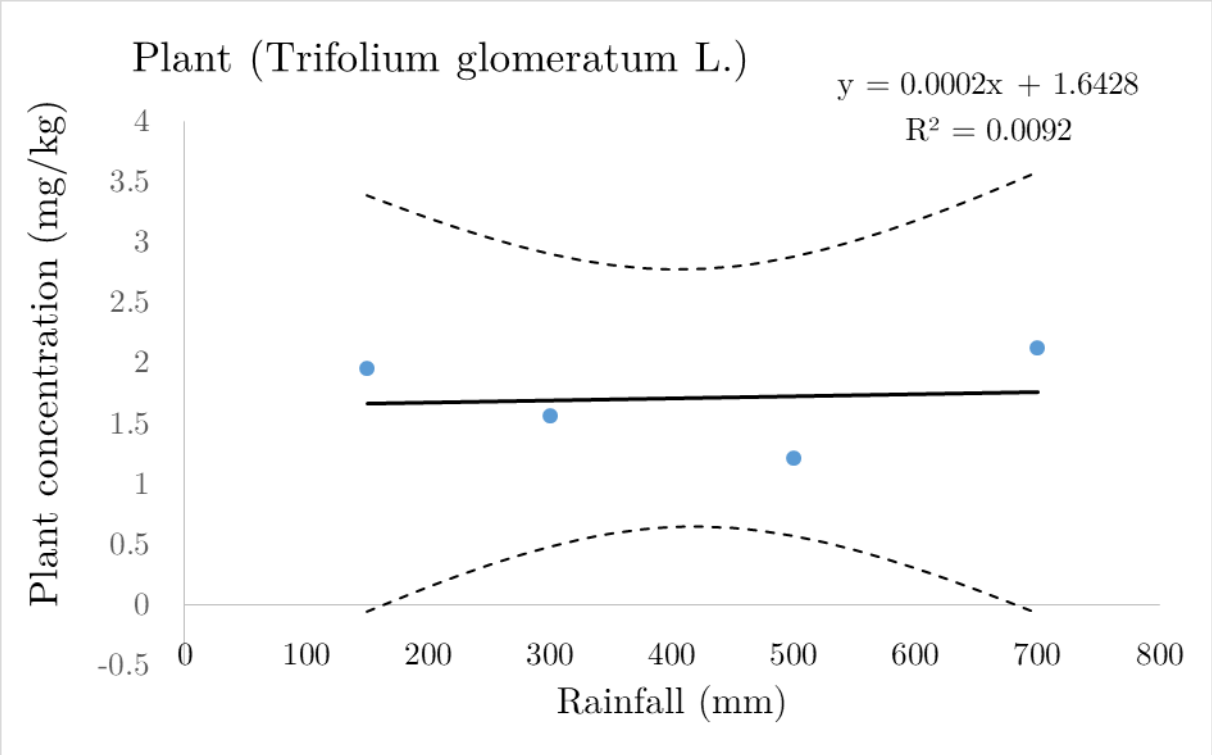

Fig A3.10. U plant concentration as a function of rainfall for Trifolium glomeratum L.

A3.2.4. Trifolium arvense L.

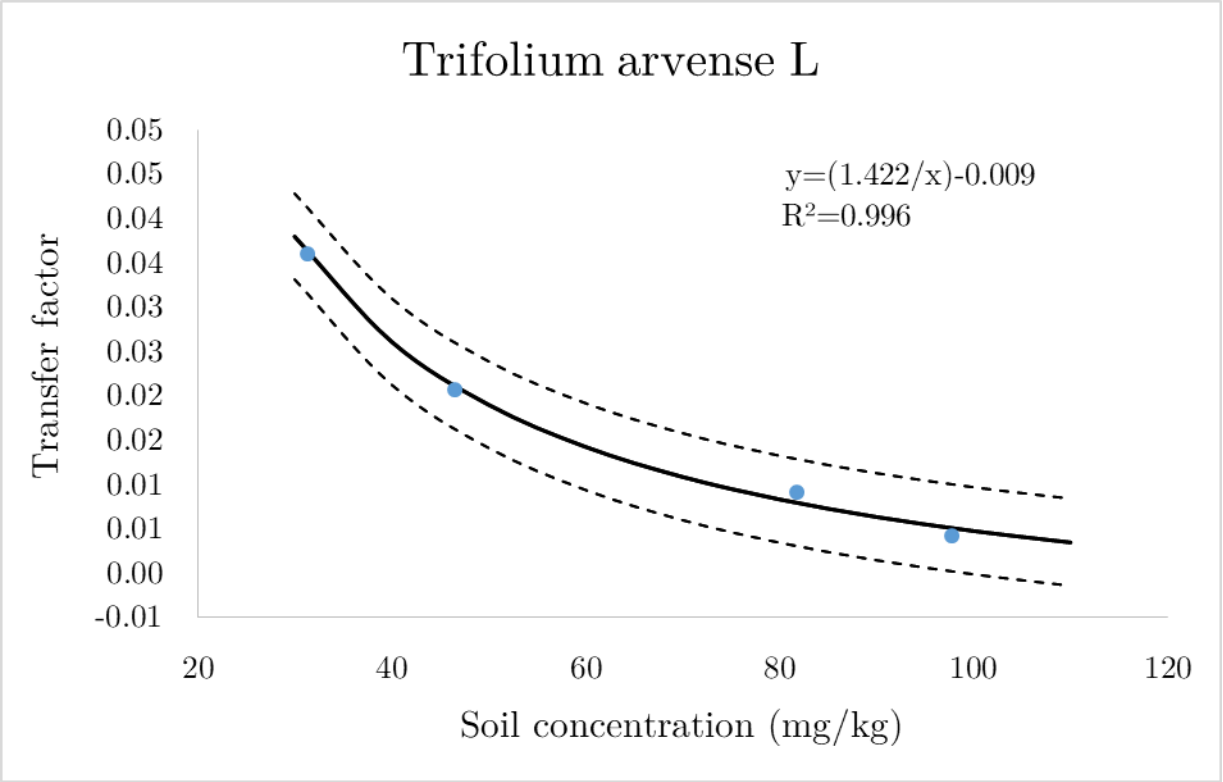

Fig A3.11. Transfer factor as a function of U soil concentration (mg kg^{-1}) for Trifolium arvense L.

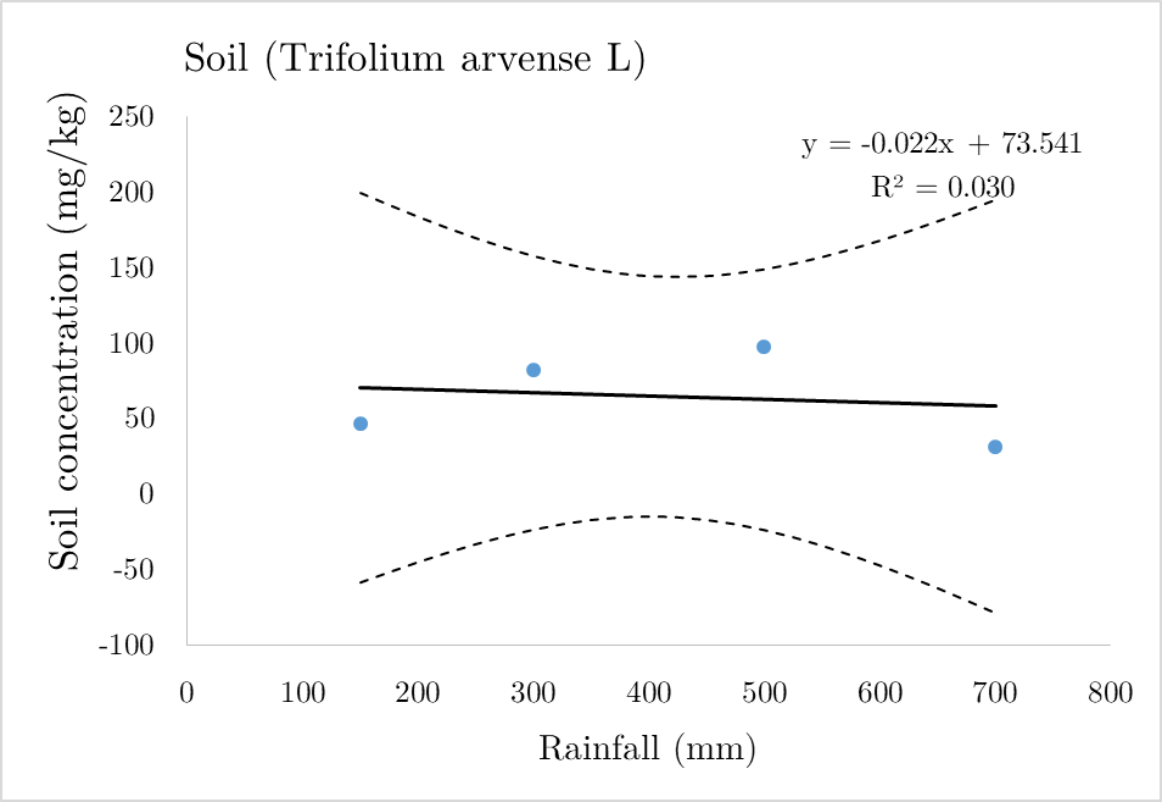

Fig A3.12. U soil concentration as a function of rainfall for Trifolium arvense L.

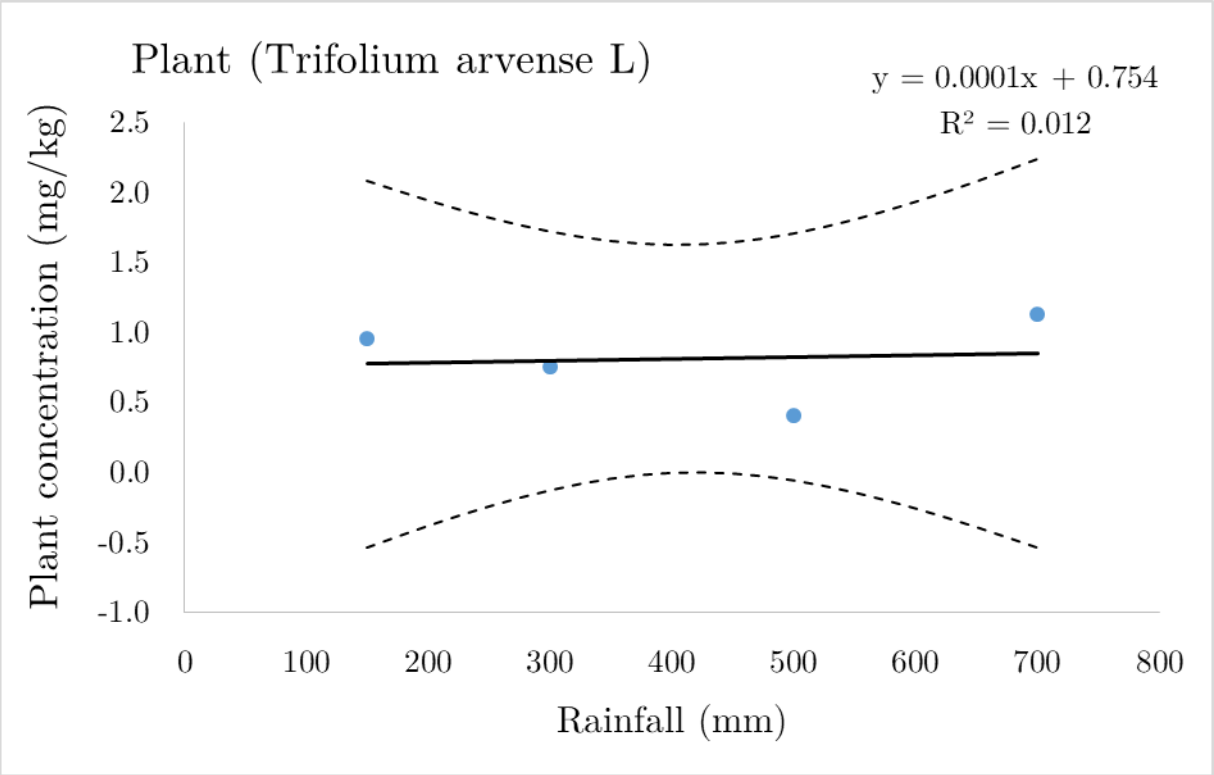

Fig A3.13. U plant concentration as a function of rainfall for Trifolium arvense L.

A3.2.5. Aira elegantissima Shur.

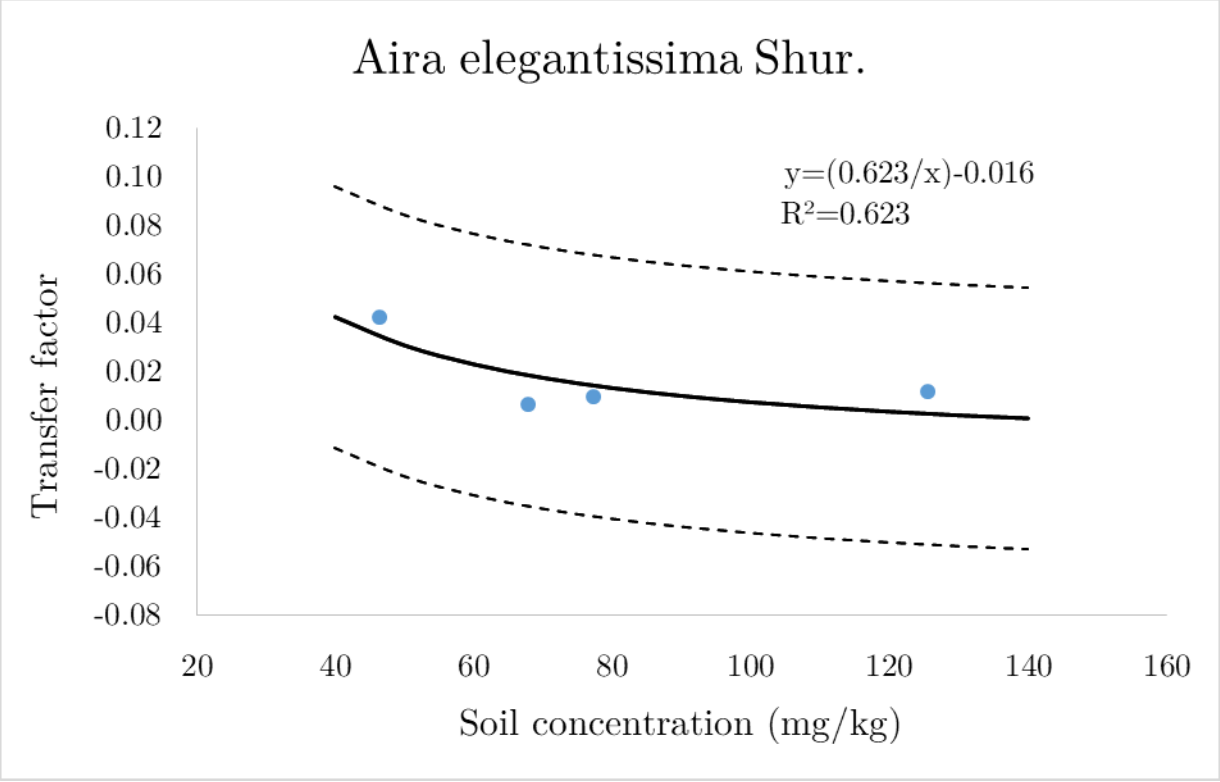

Fig A3.14. Transfer factor as a function of U soil concentration (mg kg^{-1}) for Aira elegantissima Shur.

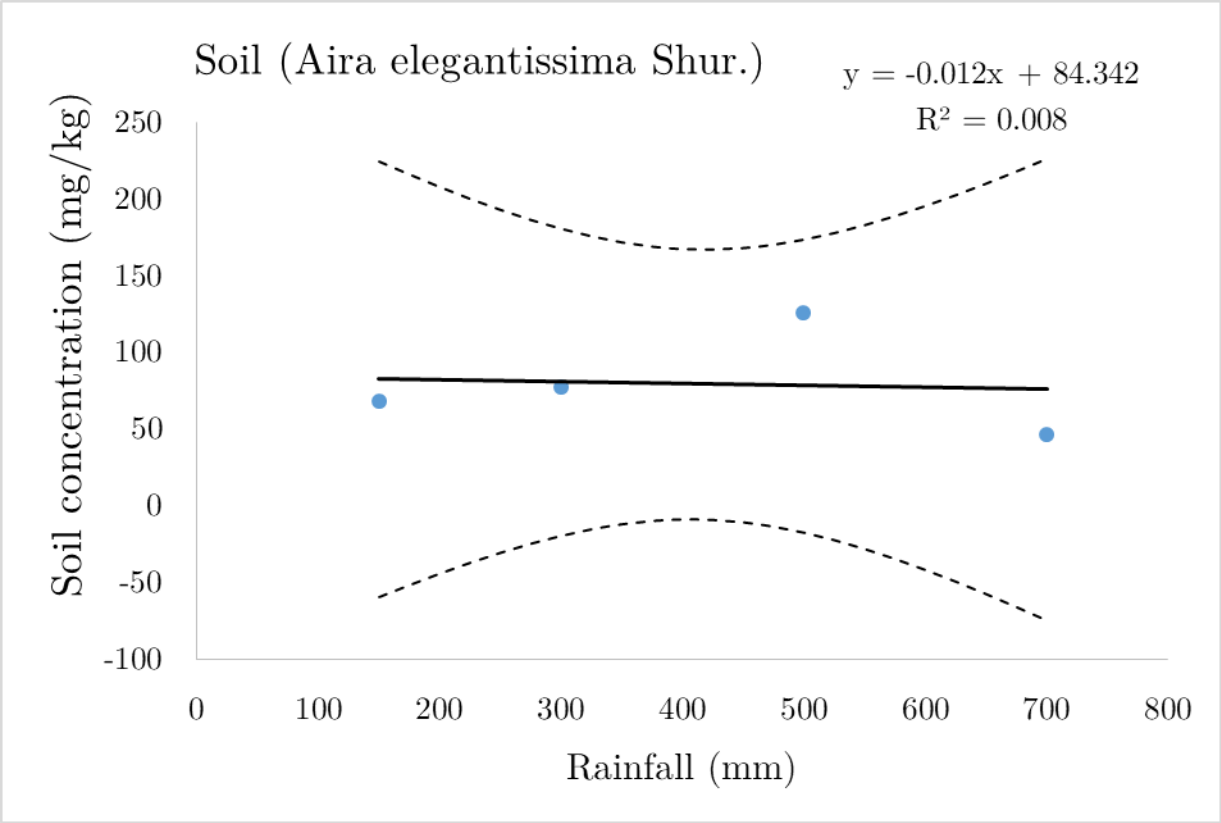

Fig A3.15. U soil concentration as a function of rainfall for Aira elegantissima Shur.

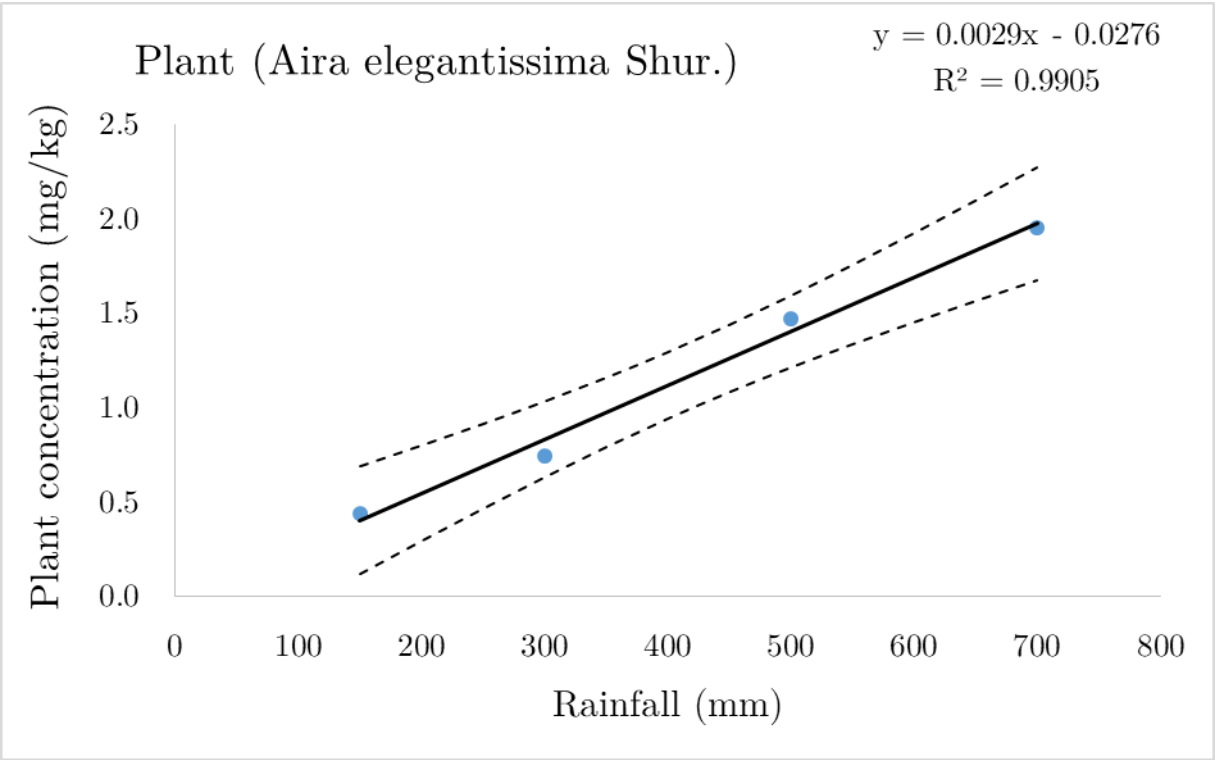

Fig A3.16. U plant concentration as a function of rainfall for Aira elegantissima Shur..

A3.2.6. Spergularia rubra (L.) J.Presl & C.Presl

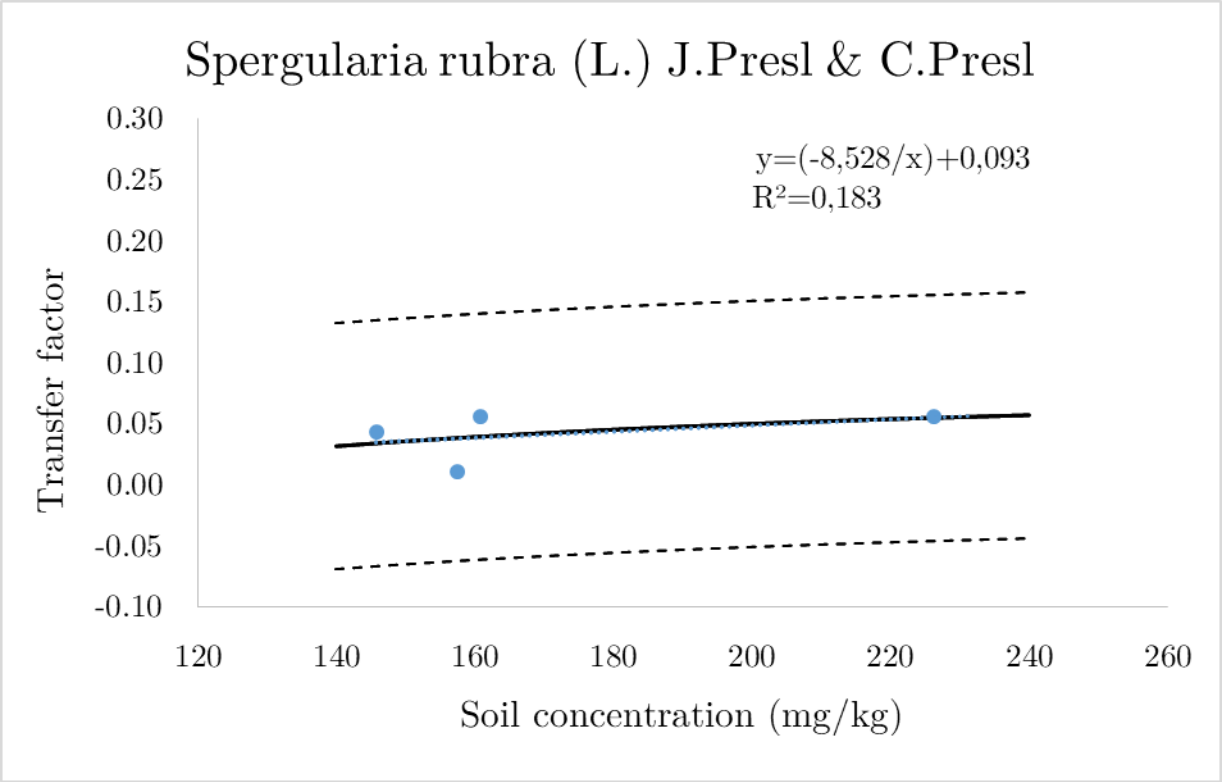

Fig A3.14. Transfer factor as a function of U soil concentration (mg kg^{-1}) for Spergularia rubra (L.) J.Presl & C.Presl

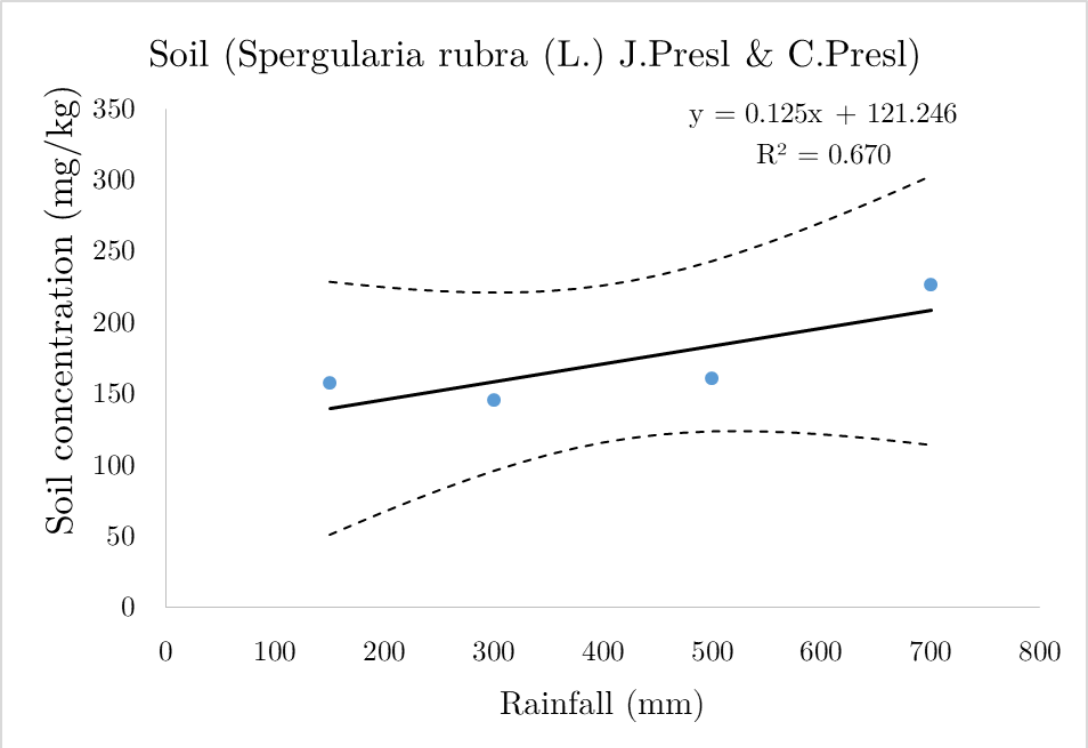

Fig A3.15. U soil concentration as a function of rainfall for Spergularia rubra (L.) J.Presl & C.Presl.

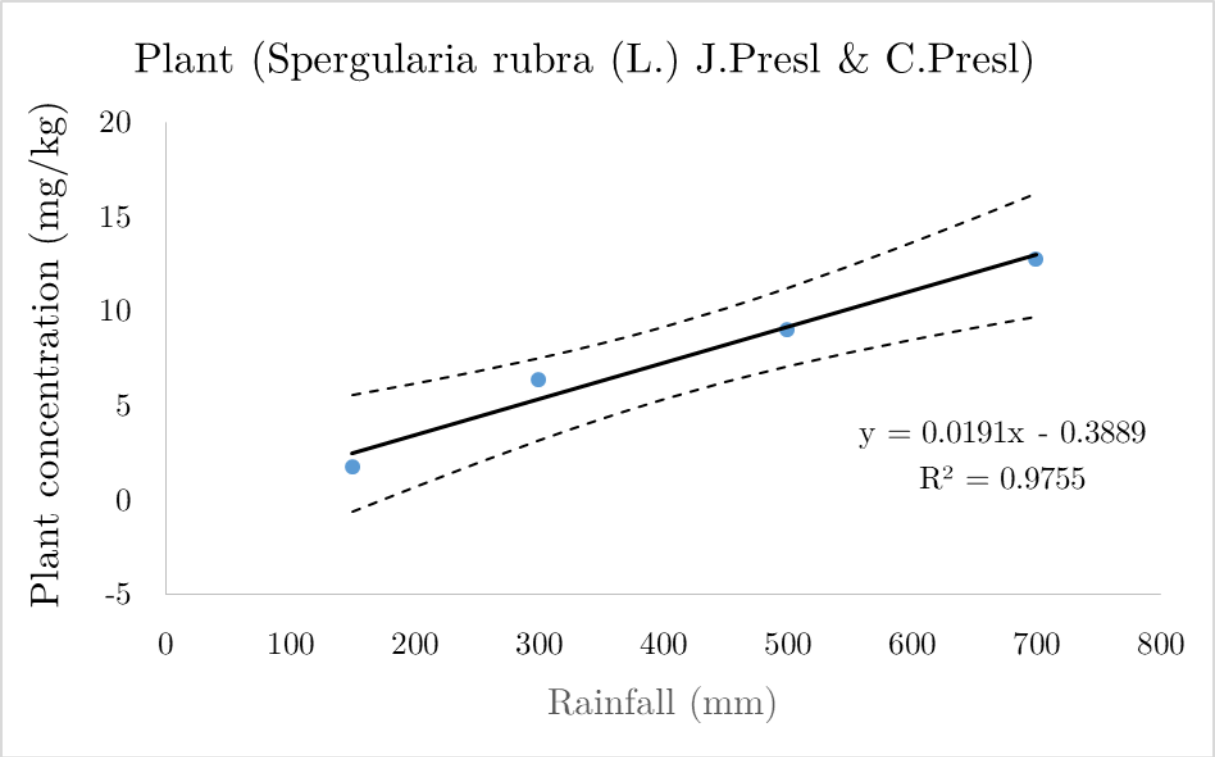

Fig A3.16. U plant concentration as a function of rainfall for Spergularia rubra (L.) J.Presl & C.Presl.

A3.2.7. Vulpia bromoides (L) Gray.

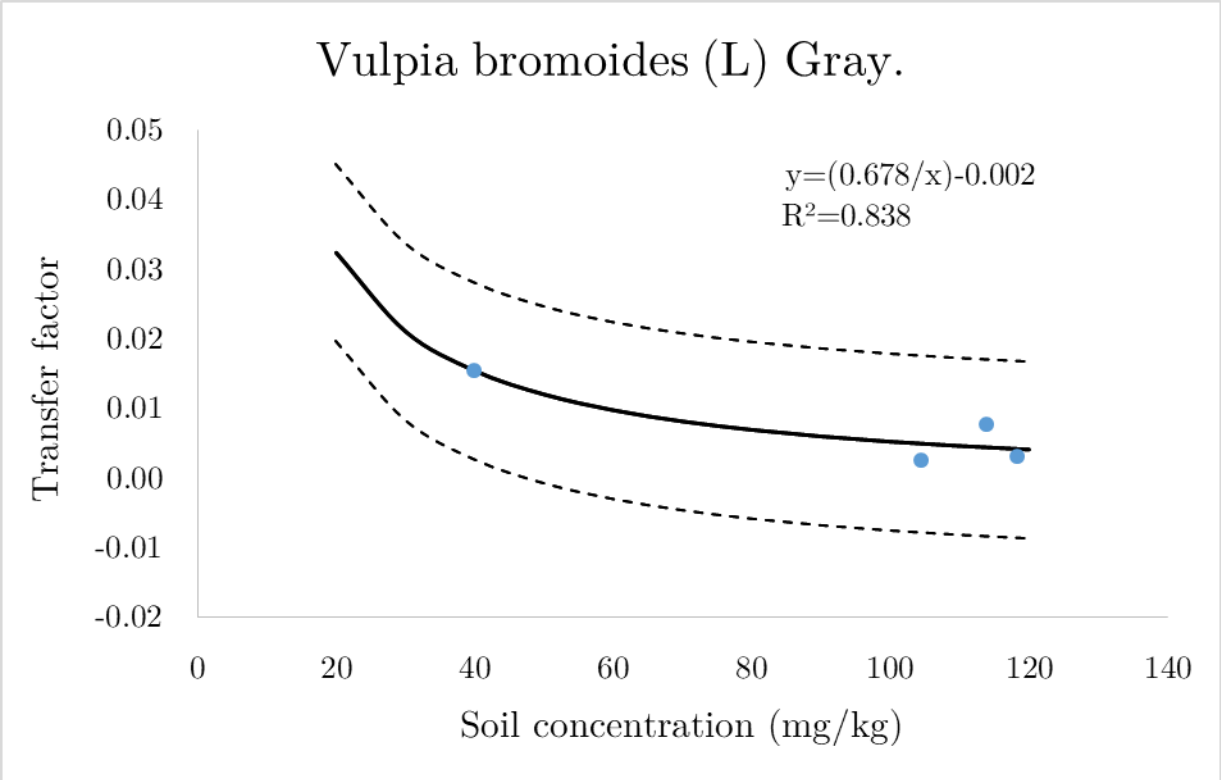

Fig A3.14. Transfer factor as a function of U soil concentration (mg kg^{-1}) for Vulpia bromoides (L) Gray.

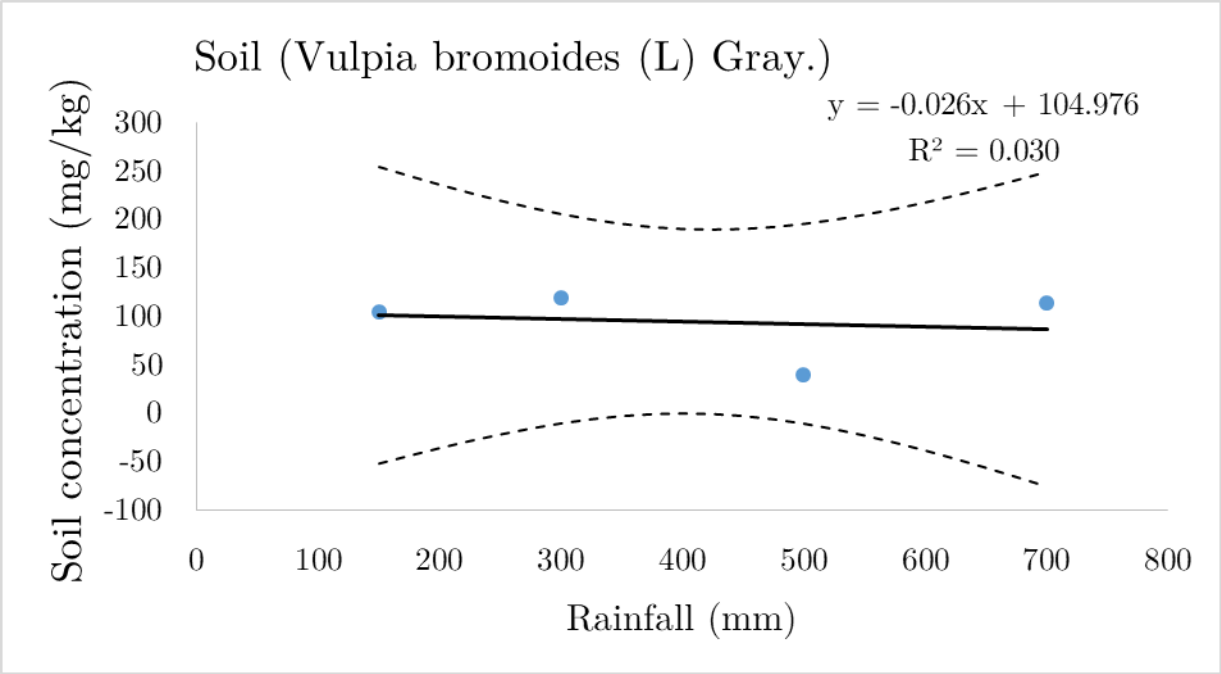

Fig A3.15. U soil concentration as a function of rainfall for Vulpia bromoides (L) Gray.

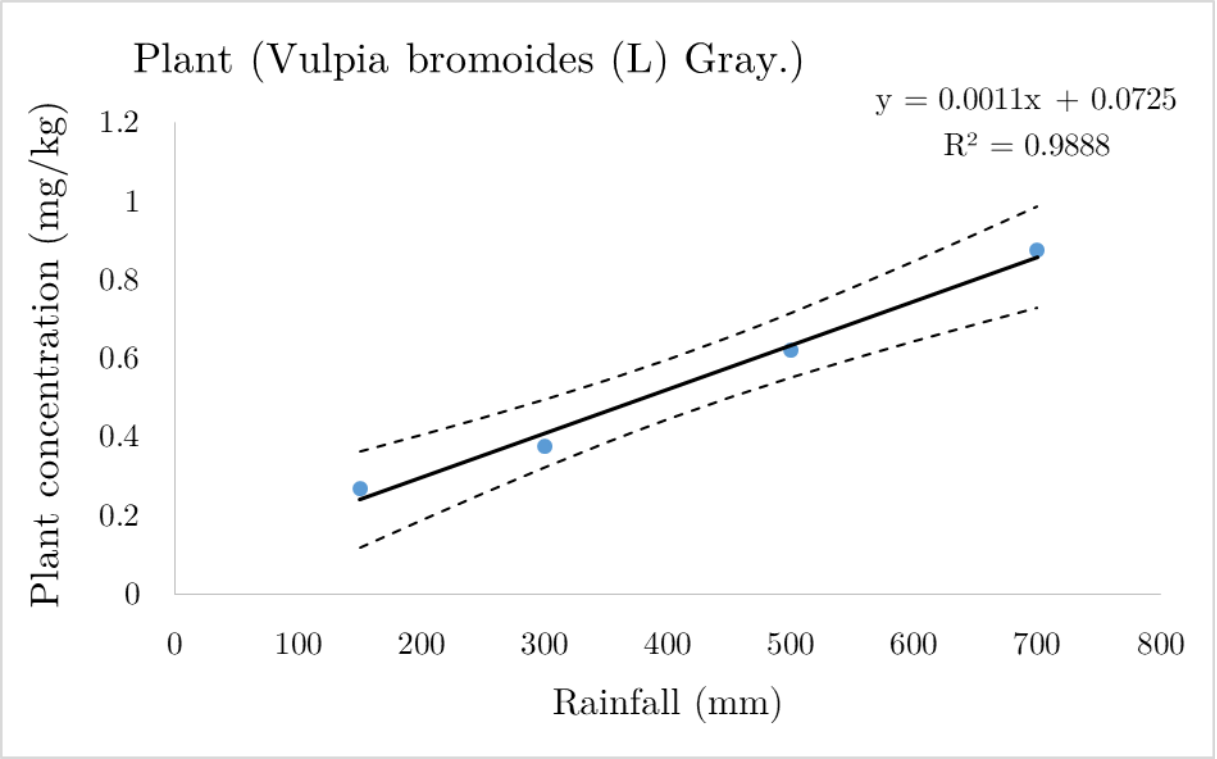

Fig A3.16. U plant concentration as a function of rainfall for Vulpia bromoides (L) Gray.

Appendix AC. Supporting Information references

[1] M. Sheppard, S. Sheppard, The plant concentration ratio concept as applied to natural U, Health Phys 48(4) (1985) 494-500.