Universidad de Alcalá

Influence of the substitution of a grass cover by a mulch on infiltration rate (irrigation with reclaimed water in city parks of Madrid)

Antonio Sastre-Merlín; Silvia Martínez-Pérez; Ramón Bienes-Allas; Eugenio Molina-Navarro and Loreto Martínez de Baroja

Department of Geology, School of Sciences, University of Alcalá. Ctra. Madrid-Barcelona Km. 33,6. Alcalá de Henares (Madrid, Spain) E-mail: antonio.sastre@uah.es

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1. INTRODUCTION

Most urban parks in the city of Madrid have been irrigated with reclaimed water since 2002, replacing the urban water supply used for that mission. This has released a substantial volume of drinking water to supply the city. However, to date has not been made systematic analysis of the effects of use of these waters on soil and vegetation and even the groundwater.

Such monitoring has being conducted since 2009. one of the most important is the replacement of some stands of prairie by mulching in order to reduce evapotranspiration.

This paper analyzes the results of that experience comparing various soil properties of both location within a year.

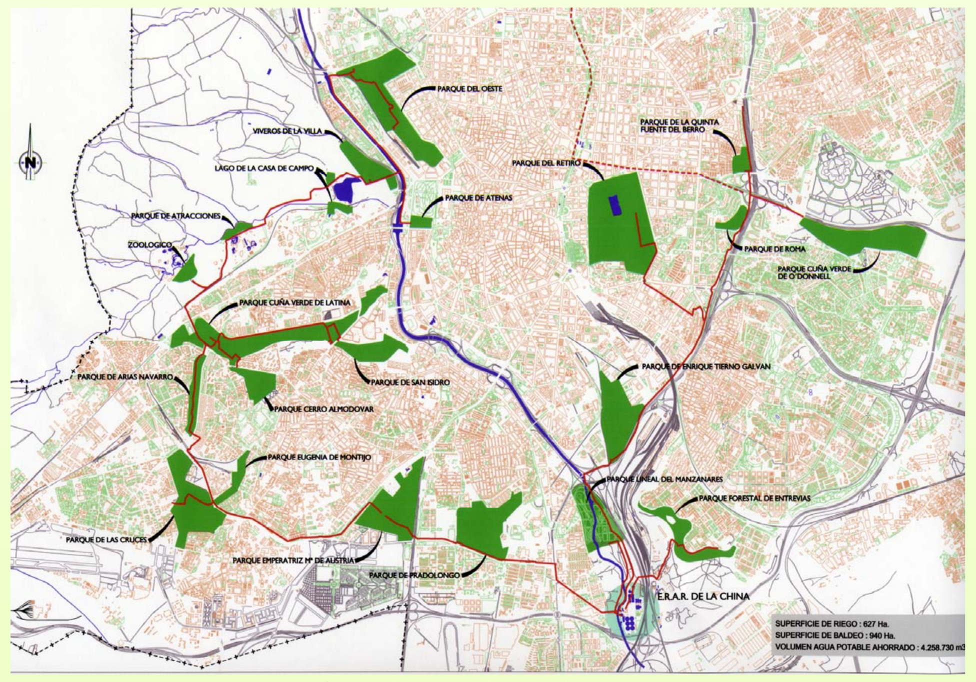


Figure 1. Location of parks with reclaimed water irrigation.

2. STUDY SITE AND WATER QUALITY.

The experience was developed in the "Parque del Oeste", an emblematic park of Madrid. Its prairies are irrigated entirely with reclaimed water since 2002.

It have been installed a set of moisture, electrical conductivity and temperature sensors, performed the physical characterization and took the soil samples.

Figure 2 shows the location (grass and mulch) in which experience has been performed.

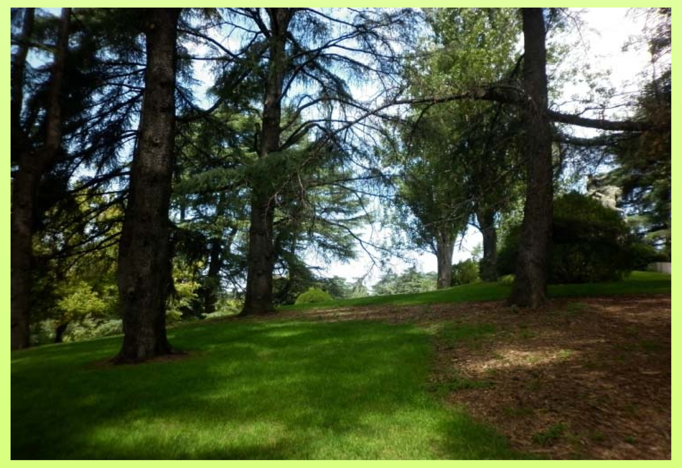


Figure 2. Grass and mulch ("Parque del Oeste").

The irrigation water quality is good as shown the S-B Diagram –except in nitrate concentration- and some of the most commonly used indexes (Scott, Eaton and electrical conductivity) (figure 3).

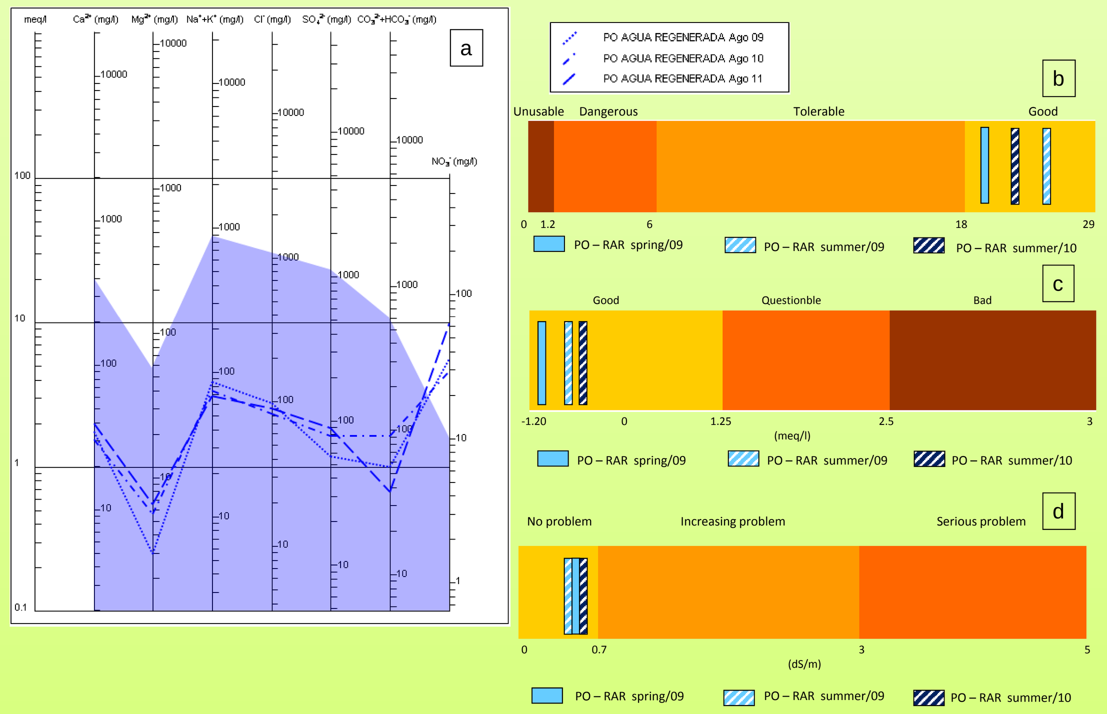


Figure 3. Reclaimed water of irrigation quality (a: phisico-chemical characteristics (Schoeller-Berkaloff diagram); b: Scott Index; c: Eaton Index; d: Electric Conductivity)

3. METHODOLOGY

- ➢Infiltration test (Müntz method; fig.4): 3 tests for each place.
- ➢Measure of porosity in undisturbed samples collected in both places.
- ➢Soil compaction measurement (penetrometer).
- ➢Bulk density measurement.
- ➢Soil samples at 0, 20, 40 and 60 cm depth (figure 5) are taked and analyzed (saturation extract) in autumn 2010 and 2011 (at the end of each irrigation season).
- ➢Install moisture sensors, electrical conductivity and temperature at 20, 40 and 60 cm depth in pasture and mulch.
- ➢Interpretation of results.

Figure 4. Müntz infiltrometer

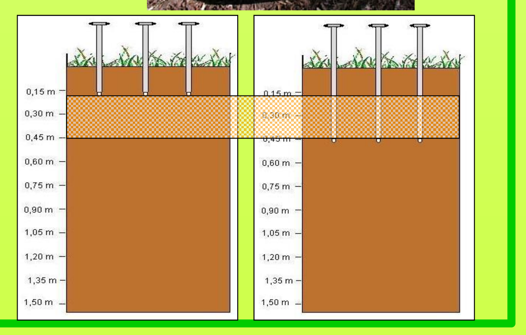


Figure 5. Sampling soils scheme

4. RESULTS AND DISCUSSION

➢Bulk density (Table 1): No significant differences in this parameter have been found, althought is slightly higher in themulch in the prairie

Table 1. Average bulk density ($t.m^{-3}$), standard deviation and number of repetitions.

Depth (cm)	Prairie	n	Mulch	n
0-5	1,09 ± 0,04	3	-	-
8-13	1,13 ± 0,07	3	1,16 ± 0,22	4
±15-20	1,13 ± 0,09	3	1,22 ± 0,18	3

➢Total porosity is similar in both, prairie and mulch. However, macroporosity is greater in prairie and microporosity is greater in mulch (Table 2).

Table 2. Porosity (%) and standard deviation. Number of repetitions n=3.

Treatment	Depth (cm)	Total porosity (%)	Macroporosity (%)	Mesoporosity + microporosity (%)
Prairie	0-5	62,46 ± 3,32	28,54 ± 2,92	43,24 ± 3,66
	8-13	52,24 ± 1,39	25,96 ± 4,53	20,16 ± 4,03
	15-20	52,36 ± 1,66	27,21 ± 3,63	19,66 ± 3,44
Mulch	8-13	52,74 ± 6,46	20,81 ± 3,21	28,57 ± 7,92
	15-20	50,50 ± 4,39	23,24 ± 4,68	23,17 ± 8,47

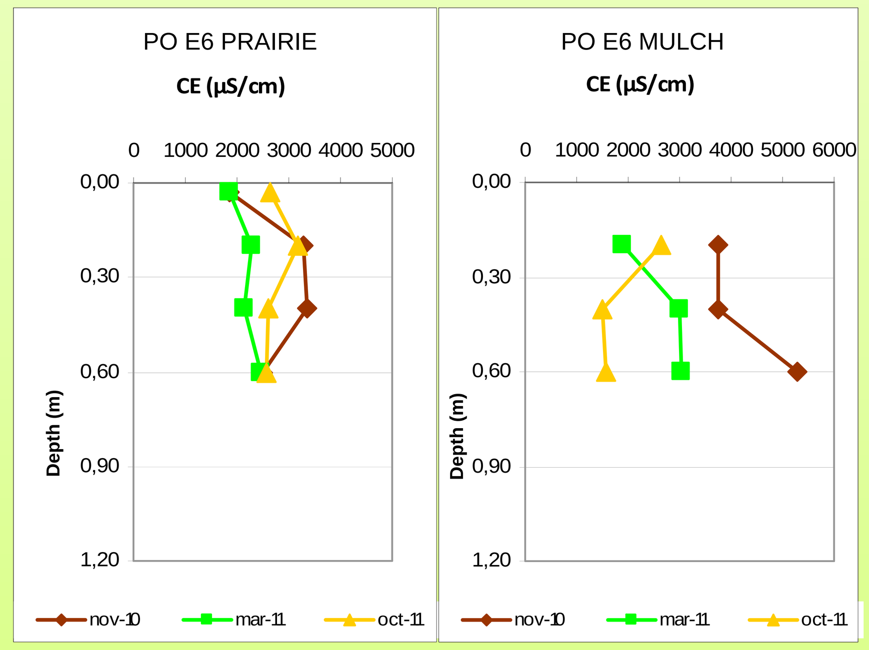
➢Infiltration rate is higher in the meadow in mulch, due to the existence of preferential channels generated by the roots of the prairie (Table 3)

Table 3. Average infiltration velocity

Treatment	All test (n=3) (mm/h)	outliers removed(n=2) (mm/h)
Prairie	16,2	18,9
Mulch	7,76	8,4

➢Electrical conductivity in mulch shows a continuous declining trend, in contrast to the lower changes observed on the Prairie (fig. 7)

Figure 7. Electrical conductivity vs depth



➢There is a marked difference between prairie and in mulch in response to rainfall events (fig.8).

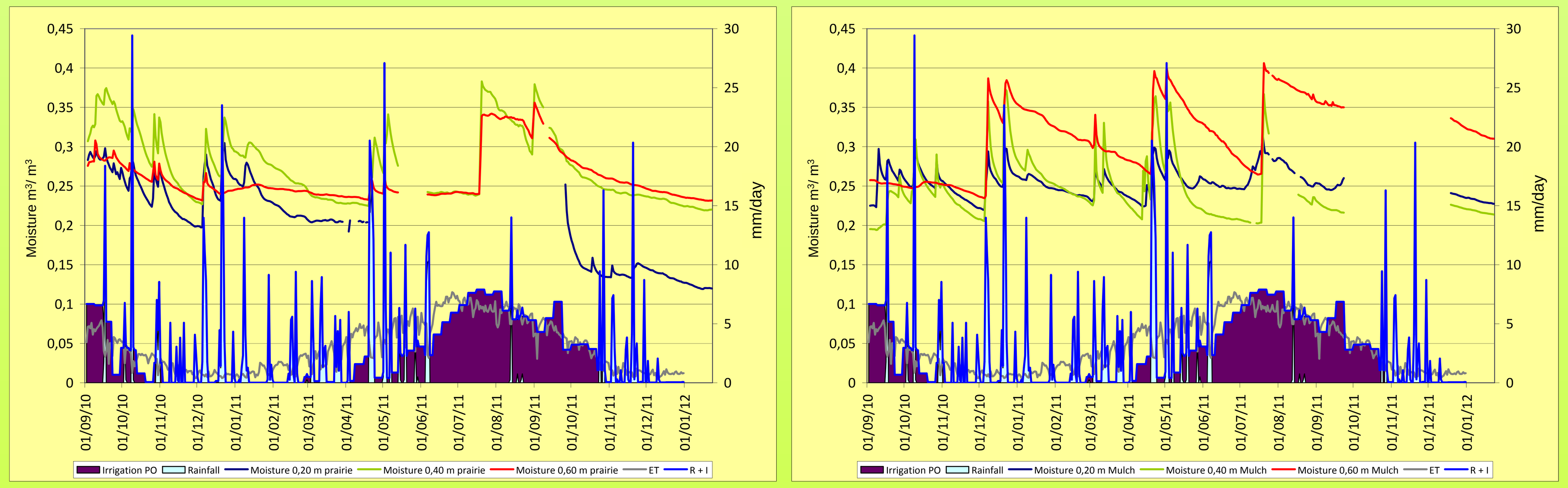


Figure 8. Records of moisture in sensors placed on prairie and mulch

5. CONCLUSIONS

➢The continuous decrease in conductivity of mulch could be related to soil demineralization. This is not observed in prairie.

➢There is a clear response of soil moisture -both prairie and in mulch- to strong rainfall events (fig.8).

➢At 40 cm depth moisture is higher in the prairie, while at 60 cm depth moisture is higher in the mulch.This suggests a longer advance of wetting front in mulch than in prairie

➢The replacement of prairie by mulching have significant consequences on soil characteristics, and should be undertaken carefully

7. REFERENCES

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