AVAILABLE WATER MODIFICATIONS BY TOP-SOIL TREATMENTS UNDER MEDITERRANEAN SEMIARID CONDITIONS: AFFORESTATION PLAN

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Introduction:

During dry periods in the Mediterranean area, the lack of water entering the soil matrix reduces organic contributions to the soil.

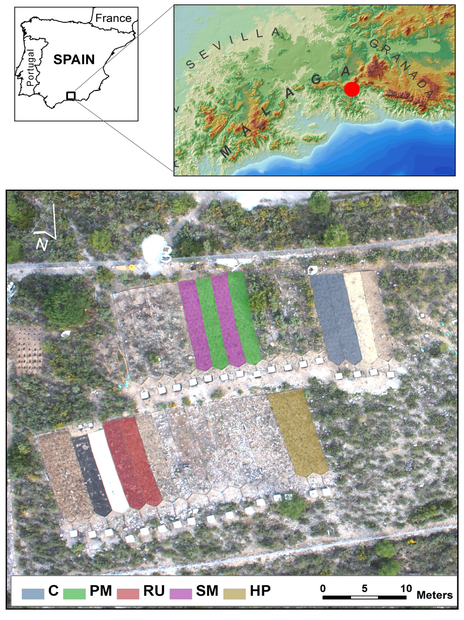
Restoration of native vegetation is the most effective way to regenerate soil health, and control runoff and sediment yield.

In Mediterranean areas, after a forestry proposal, it is highly common to register a significant number of losses for the saplings that have been introduced.

It has been proven as the addition of an external source of extra-carbon to soil is a powerful strategy to combat soil degradation process under uncovered areas.

The aim:

In this study we investigated the hydrological effects of five soil treatments in relation to the temporal variability of the available water for plants.



Study area:

The study area is located in Málaga (Andalusia, Spain), There, the mean annual temperature is around 18 ºC and the mean annual precipitation of 589 mm.

The geological substrate consists mainly of Triassic marbles with interbedded schists of Alpujarride Complex. The types of soil are lithic Leptosols and eutric Leptosols, with sandy-loam texture (60% sands, 32% silt, 8% clay).

Plots:

An experimental paired-plot layout was established in 2010 October. The initial vegetation cover was removed in all of the experimental area to avoid differences in vegetation cover.

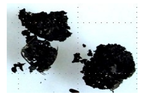
Different management treatments were applied in 2011 May with two replicate plots per treatment (24 m^2 = 2 m width x 12 m length).

Plots were afforested following the same spatial pattern, and amendments were mixed with the soil at the rate 10 Mg ha^{-1}.

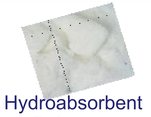
Amendments :


Pinus mulch


Staw mulch

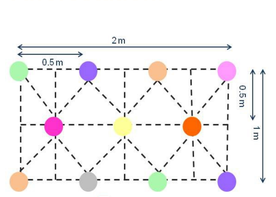

Sewage sludge


Manure


Hydroabsorbent Polymers

In 2011 May, five organic amendments were added at the rates 10 Mg ha^{-1}.

Afforestation:

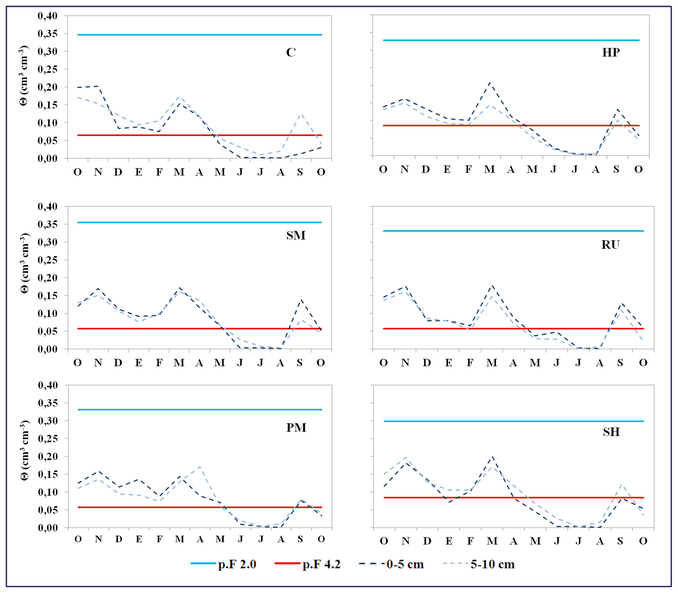


Material and methods:

- The sampling strategy involved a collection of 4 disturbed soil samples per plot (0–10 cm depth).
- The retention water capacity was measured by Pressure Plate Extractor (5 and 15 Bar).
- Soil water content was measure in field by S-SMC-M005 probes (5 cm and 10 cm depth).

RESULTS

In control plots, during June, July, August and September, soils were registered below the wilting point, and therefore, in the area of water unusable by plants. These months were coinciding with the summer mediterranean drought. This fact justifies the high mortality found on plants after the seeding plan.

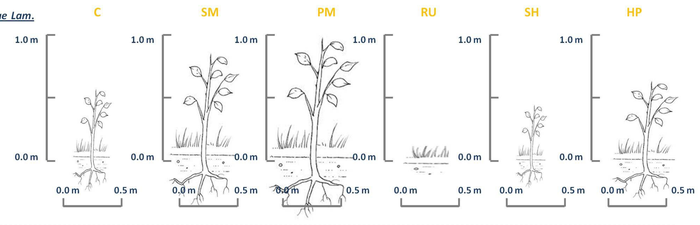


Soil moisture trends under different treatments and their relations with water retention capacity. Where: pF 2.0, Field capacity; pF 4.2, Wilting point ; C, control; SM, Straw mulch; PM, Chipped branches of *Aleppo pine*; RU, Sewage sludge; SH, Cattle manure; HP, Terracottem Hydroabsorbent polymers.

Survival rates four years after the afforestation plan (%). Where: C, control; SM, Straw Mulch; PM, Chipped branches of Aleppo pine; RU, Sewage sludge; SH, Cattle Manure; HP, Terracottem Hydroabsorbent polymers.

SURVIVAL RATE (%)	C	SM	PM	RU	SH	HP
***Chamaerops humilis* L.**	0,0	0,0	0,0	8,3	0,0	0,0
***Lavandula stoechas* Lam.**	75,0	100,0	75,0	25,0	75,0	100,0
***Lavanda multifida* Lam.**	100,0	100,0	100,0	0,0	100,0	100,0
***Lavandula dentatae* Lam.**	33,3	100,0	100,0	0,0	50,0	100,0
***Rhamnus alaternus* L.**	0,0	0,0	66,7	0,0	0,0	33,3
***Rhamnus oleoides* L.**	0,0	0,0	0,00	0,0	16,8	16,8
***Pistacea lentiscus* L.**	0,0	0,0	0,0	0,0	0,0	0,0
***Rosmarinus officinalis* L.**	75,0	100,0	100,0	0,0	75,0	100,0
***Thymus capitatus* L.**	66,6	100,0	100,0	100,0	15,5	100,0

Lavandula dentatae Lam.

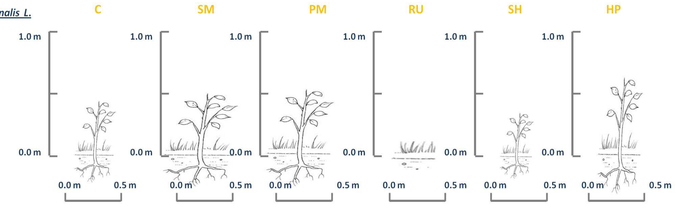


		C	SM	PM	RU	SH	HP
Apical sprout length (cm)	Average	52.1	88.3*	96.4*	lack	41.8	67.7
	SD±	10.1	6.9	5.4	lack	12.4	14.2
Canopy diameter (cm)	Average	32.7	49.5	54.6	lack	29.1	41.1
	SD±	20.6	9.0	12.1	lack	21.5	11.3

Average growth rate (cm) for *Lavandula dentatae Lam.* Where: C, control; SM, Straw Mulch; PM, Chipped branches of Aleppo pine; RU, Sewage sludge; SH, Cattle Manure; HP, Terracottem Hydroabsorbent polymers. Four years after the afforestation plan.

Similarly, soils have never exceeded the field capacity value measured for control plots. Conversely, in the straw and pinus mulch, soils were above the wilting point during a longer time than in control plots.

Rosmarinus officinalis L.



		C	SM	PM	RU	SH	HP
Apical sprout length (cm)	Average	45.3	44.7	51.8	lack	32.4	67.7
	SD±	29.6	10.0	14.2	lack	23.6	14.2
Canopy diameter (cm)	Average	31.2	51.5	40.2	lack	23.3	36.2
	SD±	18.5	20.2	11.3	lack	8.7	2.2

Average growth rate (cm) for *Rosmarinus officinalis L.* Where: C, control; SM, Straw Mulch; PM, Chipped branches of Aleppo pine; RU, Sewage sludge; SH, Cattle Manure; HP, Terracottem Hydroabsorbent polymers. Four years after the afforestation plan.

Sludge, manure and polymers showed a water retention capacity slightly more limited than straw and pinus mulch. This situation was especially sharpened in plots amended with manure. In this treatment, the upper part of the soil profile was below the wilting point for six months per year (from April to August).

CONCLUSIONS

In conclusion, from a land management standpoint, the pinus and straw mulch treatments have been shown as effective methods reducing water stress for plants.

In this research, mulching has been proved as a significant method to reduce the mortality sapling rates during the Mediterranean summer drought.