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Abstract. The root environment is characteristic for each species, soil type and environmental condition. Interactions may be established between the roots and its environment, which influences the mineral nutrition and the relationship soil / plant. The importance of environmental characterization of Atlas pistachio root rhizosphere under arid climate is our primary objective in this work. The knowledge of the arid climates and their water and soil resources, that lead to vegetation in severe conditions, suggests the implementation of serious measures in plantations development in drylands. Our results confirmed these assumptions and revealed the presence and the extent of poor soils in these regions likely with arido-soils type, unsalty, limestone with very low organic matter content and low phosphorus rates. The richness of these soils in nitrogen, especially their rhizospheric fraction, may be explained by the root activity and the microbial biomass in the soil / root interface.

Keywords. *Pistacia atlantica* – Rhizosphere – Chemical analysis – Soil type.

Caractérisation de la rhizosphère de Pistacia atlantica sous climat aride

Résumé. *L'environnement de la racine est caractéristique pour chaque espèce, le type de sol et de l'environnement. Les interactions peuvent s'établir entre les racines et leur environnement, ce qui influe sur la nutrition minérale et la relation sol / plante. L'importance de la caractérisation environnementale de la rhizosphere de la racine du pistachier de l'Atlas sous climat aride est notre objectif principal dans ce travail. La connaissance des climats arides et de leurs ressources en eau et des sols qui mènent à la végétation dans des conditions sévères suggère des mesures sérieuses dans le développement des plantations dans les zones arides. Nos résultats confirment ces hypothèses et révèlent la présence et l'étendue de sols pauvres de cette région, de type arido-sols, non salés, calcaires à très faible teneur en matière organique et des taux de faible teneur en phosphore. Leur richesse en azote, en particulier la zone rhizosphérique, est dû essentiellement à l'activité des racines et de la biomasse microbienne dans l'interface sol / racine.*

Mots-clés. Pistacia atlantica – Rhizosphere – Analyses chimiques – Type de sols.

I – Introduction

Intense germplasm erosion is underway in the semiarid, arid and Saharian areas due to human activities (Quezel and Santa, 1963). Initiatives have been taken to conserve and propagate pre-Saharian and Saharian genetic resources. The Atlas pistachio (*Pistacia atlantica* Desf.) is one of the species considered in this initiative, but very little information is available about the ecological adaptation of this species. Due to the lack of information, intraspecific variation is poorly understood and there is also limited knowledge about distribution of characters within the wide-ranging populations (Belhadj *et al*., 2007). *Pistacia atlantica* (Anacardiaceae) is a dioecious tree, widely distributed in Algeria from the Mitidja plains to the Saharian regions (Monjauze, 1980). This droughttolerant tree, with an extensive root system, has been the subject of several studies aimed at selecting ecotypes best-adapted to present weather and soil conditions (Belhadj, 2007).

Rhizosphere is the most important chemically, biologically and ecologically microactive location in the soil (Toal *et al*., 2000). The rhizosphere is also defined as the volume of the soil under the influence of living roots (Lucas, 2002). It is the obligatory pathway of all minerals from the soil to plants, and a place of strong interactions between plants and soil microorganisms (Walter *et al*., 2005). The root environment is characteristic for each species, soil type and environmental condition. Interactions may establish between the roots and their environment, which influences the mineral nutrition and the relationship soil/plant. The importance of environmental characterization of *Pistacia atlantica* root environment under arid climate is our primary objective in this work. The knowledge of the arid climates and their water and soil resources, that lead to vegetation in severe conditions, suggests the implementation of serious measures in plantations development in drylands and areas.

II – Material and methods

Soils were collected randomly under twenty individuals from a natural *Pistacia atlantica* orchard located at Messaad site in Djelfa district (Algeria) which is characterized by an arid climate with a fresh winter (Fig. 1). Five soil samples were collected from each individual, three under soil vegetation (SSV) and two from soil without soil vegetation far from the rooting system (SHC) (Fig. 2). Physical and chemical analyses (Tables 1 and 2) were then performed and the data were statistically analysed using Stat-Box software.

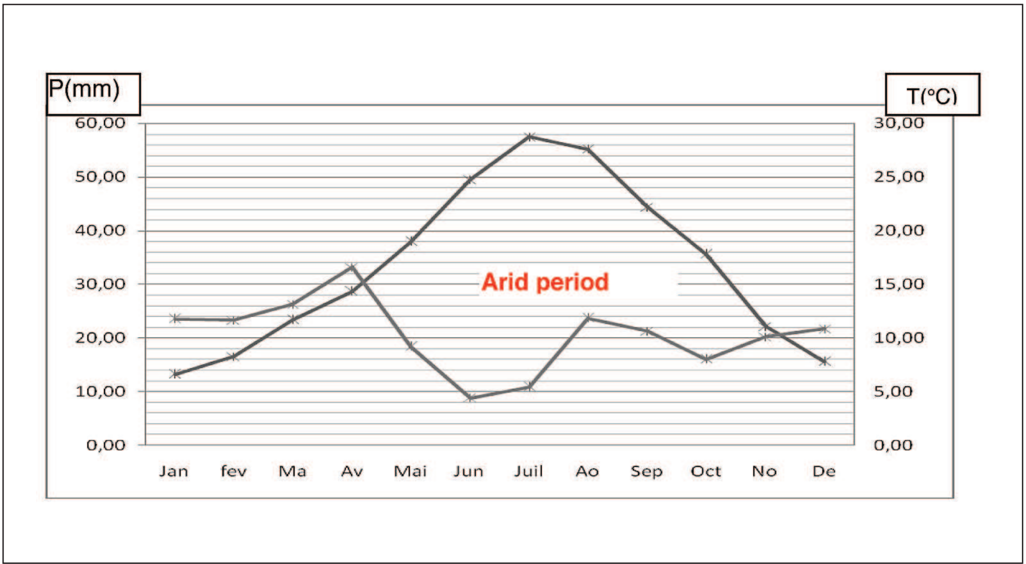

Fig. 1. Ombrothermic diagramm of Messad site.

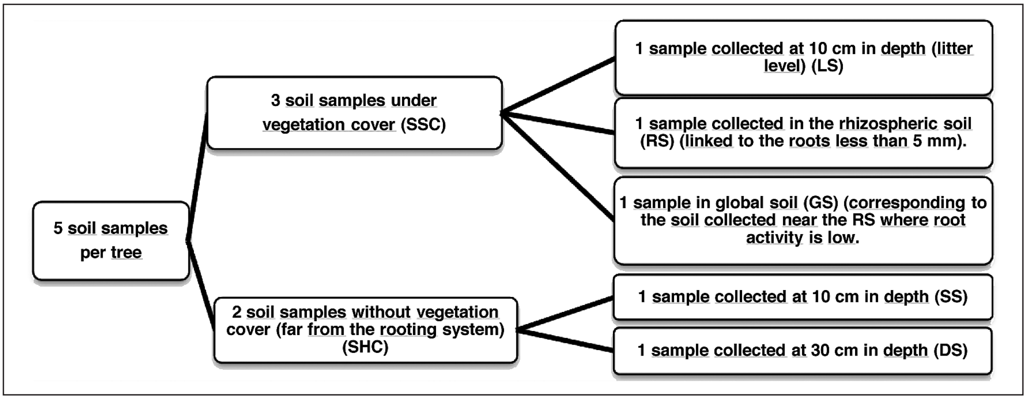

Fig. 2. Sampling scheme and soil collection.

III – Results and discussion

Atlas Pistachio root environmental characterization under arid climate revealed that the soils in this area are aridosoils type mainly with a sandy to sandy-silty texture (Tables 1 and 2). Their pH is slightly alcaline to alcaline in the samples without vegetation. The soils are limestony (calcareaous), with very low rate of organic matter. Under the trees, the amount of limestone in global soils is higher than in the rizospheric fraction. More organic matter is registered in soils under tree cover than in nude soils. The soil samples are non salty. Concerning the phosphorus, the amount is lower whenever we get closer to the vegetation layer.

ANOVA showed significant differences in pH and organic matter rate between the different soil samples, while significant differences were noticed among individuals for organic matter and phosphorus amounts (Table 3).

Table 1. Physical properties of sampled soils in *P. atlantica* orchad in Messad area

Soil samples	Soil fraction (%)					Soil texture
	Clay (%)	Thin silty (limons) (%)	Large silty (limons) (%)	Thin sand (%)	Large sand (%)	
SSCRS	1.60	7.20	34.34	1.85	55.01	Sandy-silty
SSCGS	0.23	3.43	46.10	9.36	40.88	Silty-sandy
SSCLS	1.03	9.40	59.19	1.67	28.71	Silty-sandy
SHCSS	1.90	3.23	61.70	9.44	18.72	Silty-sandy
SHCDS	2.13	0.27	35.05	2.79	59.76	Sandy-silty

Table 2. Chemical properties of sampled soils in *P. atlantica* orchad in Messaad area

Soil samples	pH	$CaCO_3$ (%)	Organic matter (C) (%)	Total Phosphorus (ppm)	Olsen Phosphorus (ppm)	†Electrical conductivity (Ms/cm)	†Total Nitrogen (%)
SSCLS	7.57	11.67	0.36	117.92	11.80	0.22	0.07
SSCRS	7.74	10.98	0.38	137.52	12.28	0.20	0.08
SSCGS	7.73	12.08	0.38	104.53	11.56	0.21	0.06
SHCSS	7.91	10.83	0.32	164.94	13.72	0.26	0.05
SHCDS	7.76	10.00	0.30	132.35	12.04	0.26	0.05

†: Measures performed under one tree.

Table 3. ANOVA for the chemical data of sampled soils in *P. atlantica* orchad in Messaad area

		S.C.E	DDL	M. S	TEST F	PROBA	Sig.
pH	TOTAL VAR.	2.62	59	0.04			
	VAR. individuals (1)	0.002	1	0.002	0.07	0.79516	NS
	VAR. soil (2)	0.99	4	0.25	9.45	0.00001	***
	VAR. 1*2	0.33	4	0.08	3.11	0.02311	*
	Residual VAR.	1.31	50	0.03			
$CaCO_3$ (%)	TOTAL. VAR.	832.68	59	14.11			
	VAR. individuals (1)	1.35	1	1.35	0.09	0.76701	NS
	VAR. soil (2)	22.42	4	5.60	0.36	0.83657	NS
	VAR. 1*2	32.07	4	8.07	0.52	0.72704	NS
	Residual VAR.	776.85	50	15.54			
Organic matter (C) (%)	TOTAL VAR.	11.52	59	0.19			
	VAR. individuals (1)	1.13	1	1.13	6.81	0.0115	*
	VAR. soil (2)	1.88	4	0.47	2.82	0.0342	*
	VAR. 1*2	0.2	4	0.05	0.30	0.87606	NS
	Residual VAR.	8.31	50	0.17			
Total Phosphorus (ppm)	TOTAL VAR.	98742.67	59	1673.61			
	VAR. individuals (1)	10820.84	1	10820.84	7.58	0.00803	**
	VAR. soil (2)	11941.36	4	2985.34	2.09	0.09483	NS
	VAR. 1*2	4616.21	4	1154.05	0.81	0.52775	NS
	Residual VAR.	71364.26	50	1427.29			
Olsen Phosphorus (ppm)	TOTAL VAR.	387.24	59	6.56			
	VAR. individuals (1)	211.56	1	211.56	72.08	0.....	***
	VAR. soil (2)	12.03	4	3.01	1.03	0.40442	NS
	VAR. 1*2	16.90	4	4.23	1.44	0.23387	NS
	Residual VAR.	146.74	50	2.94			

This work shows the effect of *Pistacia atlantica* rooting system on the soil properties. After Dambrine and Tessier (2001), alcaline soils are common under arid climates with very low rainfall and high evapotranspiration, such as our sampling site, which is characterized by a very long arid period (more than 7 months) (Fig. 1).

IV – Conclusions

Our results revealed the presence of poor soils in the steppic area, likely with arid soils type with very low organic matter content and low phosphorus rates. The soils are unsalty and calcareous (limestone). Their richness in nitrogen, especially the rhizospheric area, is the result of the root activity and the microbial biomass in the soil/root interface.

Atlas pistachio remains, potentially, a very interesting species for the development and the conservation of such arid areas hence, the protection and the preservation of this tree, in its natural ecosystems, is a sinequanone condition.

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