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WATER REPELLENCY IN MACCHIE SOILS AND ITS RELATION TO PLANT SPECIES, SOIL PROPERTIES AND FIRE

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A b s t r a c t

Being the dominant plant cover in the Mediterranean climatic region, the macchie has a great potential to produce hydrobhobic subtances which create water repellency problem in soils. The macchie soils developed on different parent materials, under four macchie species showed a water repellency with varying degrees from moderate to extreme. The soils derived from granite parent material in which the sand contents are high, have a great sensitivity to occurrence of the water repellency than the soils derived from metamorphic schist parent material with lower sand contents. When the sand fraction contents of the soils reach to 80 percent or more, the occurence of the extremely water repellency begins. The clay contents of the soils have also affect the soil wettability, especially in sandy soils.

Infiltration trials in field conditions showed that, infiltration rates 5 - 33 times higher in normal wettable soils than in water repellent soils under same plant cover.

INTRODUCTION

One of the major factors that create the suitable environment for the erosion process is the increase in the amount of surface run - off due to prevention of the water infiltration through the soil profile. Studies done in recent years showed that, the hyrobhobic substances produced by plant species create the problem of water repellency in soils, and that the surface run - off is much encouraged, because the infiltration of water through this water repellent soil layer is largely prevented.

Two of the major vegatation types that create the property of water repellency in soils are the chaparral and evergreens (DeBano 1969, Holzhey 1969).

Soil wettability and the occurrence of the water repellent soils have been studied most intensively in the Western coast of the United States (DeBano and Rice 1973). A lot of studies carried out in chaparral soils have indicated that,

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naturally and fire induced water repellency are acute problems in these areas, and this vegetation type has a great potential for hydrobhobic substances.

On the other hand, water repellent soils have been reported as a problem in sandy soils covered with shrubs and range vegetation in Australia Pastures (Bond, 1969).

The macchie cover with varying species can be seen in all countries in the Mediterranean climatic region. This vegetation type is very similar to chaparral, expect species. Soils developed under macchie cover like chaparral soils in many aspects. The soils are very shallow and fire causes many management problems in these areas. Further more, some times fire is used as a site preparation tool for the new plantations.

Studies done on water repellency and fire effects on this problem in macchie soils are scant. It can be easily said that, macchie vegetation cover has a great potential to create water repellency in soils as in the chaparral. It has a high resistance to drought and sensitivity to fire. A mosaic appearance consisted of different species is common. Wildfire is a main driwing factor in this ecosystem. One part of these areas is subjected to fire every 20 - 25 years. This vegetation can also be seen as a understory in *Pinus brutia* and *Pinus nigra* stands in the Mediterranean climatic region in Southern and Southwestern parts of Turkey.

This study is concerned with seven basic questions, a) is the water repellency a problem in macchie soils in Turkey, b) Does surface soil wettability differ among upper soil zones under four machie species, c) How fire affects the soil wettability, d) is soil wettability related to amount of organic matter in the surface zones of the soils before and after fire, e) does soil wettability differ in soils derived from two different parent materials under macchie cover, f) does soil texture affect the degree of water repellency in soils, g) how water repellency affects the infiltration rates and soil moisture?

MATERIAL AND METHODS

The study area chosen is the Armutlu Peninsula in the Eastern Marmara Geographic Region of Turkey. The general location of the area is between the 28° 49' - 28° 54' East Longitudes and 39° 29' - 39° 33' North latitudes. The mean elavation is 350 m above sea level. Dominant plant covers are the macchie and two pine species on the peninsula. Macchie cover consists of mainly *Arbutus unedo, Erica sp., Cistus sp.,* and *Quercus coccifera.* These are also common macchie species in those area which are in the Mediterranean climatic region in Turkey.

The soils of the peninsula were developed on two different parent materials of the Paleozoic Age. These Paleozoic formations are represented by a large granite batholite and metamorphic schists in the study area. This schist parent material consists of chloride schist and schistic diabases. The granite parent material is alkaline granitic rocks.

Soils, on both of these parent materials are very shallow and show a weak profile development.

The annual mean precipitation is 713.1 mm according to Bursa meteorogical station near the peninsula.

The macchie cover shows a mosaic structure in the study area. Each of these mosaics is almost purely covered by a certain macchie species. Sampling plots were chosen, for each species, in the centre of these pure mosaics (20×20 m). Three surface mineral soil zones, at fifteen sampling points in each sampling plot of the four macchie species, were sampled to a depth of 7.5 cm as below.

1 — 0.0 - 2.5 cm mineral soil
2 — 2.5 - 5.0 cm » »
3 — 5.0 - 7.5 cm » »

In addition to these samples, two sampling plots for two pine stands were chosen and soil samples were collected at the same depths. To show the fire effects on naturally existing water repellency, 60 hectares of burned macchie area was included to the study. The fire was developed on the granite parent material and on a small area on metamorphic schist parent material, while we were working in the area, in 1980's summer. So, the opportunity of comparison of the fire effects on soil wettability has arisen. For all purposes mentioned above 675 soil samples were taken in total (Table 1). One liter disturbed samples were collected for laboratory analysis. The samples were air - dried, ground to pass a 2 mm sieve.

Table 1. Sampling desing with respect to factors of species, parent material and fire.

Burned sampling plots on granite parent mat.	Unburned sampling plots on granite parent mat.	Unburned sampling plots on M. schist parent mat.
Arbutus unedo	Arbutus unedo	Arbutus unedo
Erica sp.	Erica sp.	Erica sp.
Cistus sp.	Cistus sp.	Cistus sp.
Quercus coccifera	Quercus coccifera	Quercus coccifera
	Pinus brutia	
	Pinus nigra	Pinus nigra

↙ ↘

Variation of the wettability between burned and unburned areas	Effect of parent materials on soil wettability

Variation of the soil wettability under different plant species and among the sampling depths.

Soil wettability was determined by using the «Capillary - Rise Method» (Letey et al. 1962 a). The drop test was also used to determine the stability of water repellency in field and laboratory. Readily oxidizable organic matter was determined by the Walkley - Black's method, and the soil fractions were determined by the «Hydrometer Method».

RESULTS AND DISCUSSION

The Variations of the Soil Wettability by the Plant Species

According to the results of the wetting angle measurements as a wettability criteria, soils developed on granite parent material under four macchie species and

Table 2. The maximum, minimum and the mean wetting angle values of soils developed on granite and metamorphic schist materials in burned and unburned areas:

Species	Granite Parent Material (Unburned)									Granite Parent Material (Burned)									Metamorphic Schist Parent Material (Unburned)								
	0-2.5			2.5-5.0			5-7.5			0-2.5			2.5-5.0			5.0-7.5			0-2.5			2.5-5.0			5.0 - 7.5		
	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.
Arbutus unedo	68.[illegible]	75.17	[illegible]	63.[illegible]	76.0[illegible]	[illegible].13	67.[illegible]	75.[illegible]	[illegible].91	80.19	75.37	87.57	74.77	84.[illegible]	87.80	70.93	78.60	83.89	69.57	73.06	77.03	64.49	70.48	75.23	66.18	70.86	74.78
Erica sp.	69.84	78.12	84.69	70.50	74.54	78.92	71.55	75.23	79.96	52.81	65.62	74.90	77.72	82.35	89.92	69.15	77.29	87.81	63.72	72.50	79.56	56.62	69.11	79.05	58.48	69.02	73.80
Cistus sp.	61.08	72.32	79.79	65.02	71.15	73.65	56.66	66.46	73.65	65.05	73.01	81.41	69.22	71.65	74.97	66.52	72.36	75.35	66.66	69.06	72.24	64.35	68.35	70.52	66.38	68.12	69.32
Quercus coccifera	66.01	68.48	71.12	50.42	66.20	69.77	62.84	67.37	69.74	52.81	66.76	70.06	68.68	70.08	71.47	62.04	67.61	70.48	68.65	66.76	70.48	62.12	67.35	71.16	58.48	66.65	70.94
Pinus nigra	66.12	75.93	89.82	62.57	71.97	80.30	66.20	73.40	80.01	-	-	-	-	-	-	-	-	-	66.66	75.43	87.43	62.18	73.60	82.13	62.88	69.40	77.84
Pinus brutia	68.35	80.05	88.48	56.82	74.21	85.13	68.79	74.08	80.77	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

two pine species have shown important water repellency problem, naturally. The results of variance analysis showed that, soils under six different plant cover varied in wettability at a 0.01 significance level (Table 3). Taking into consideration the measured maximum wetting angles, the soils under *Pinus nigra, Pinus brutia, Arbutus unedo,* and *Erica sp.,* were found extremely water repellent (Wetting angle>80°). Soils under *Cistus sp.,* were moderate water repellent, under Q. coccifera water repellency was not in a level to create problem (Table 2). The soils tested under six plant species for wettability were ranked as in Table 2.

Table 3. Results of analysis of variance for the wetting angle of soils developed on granite parent material under six plant species:

Source of variation	Degree of freedom	Sum of squares	Mean squares	F - ratio
Species	5	3247.896	649.58	29.950***
Depths	2	406.057	203.02	9.414***
Species X Depth	10	592.158	59.21	2.730**
Error	252	5465.474	21.68	
Total	269	9711.586		

The variation in soil wettability among three surface zones were tested by the analysis of variance. The results have shown that, the soils at three sampling depths were different in wettability at a 0.01 significance level. According to the results of the Duncan test used to compare the depths each other, the soils of the

Table 4. Results of Duncan test for the wetting angles of top soils at three sampling depths.

Sampling depths (cm)	Wetting angles mean (degree)	Differences	
0—2.5	75.02	2.52**	
2.5—5.0	72.50	2.65**	0.15^{NS}
5.0—7.5	72.35		

depth of 0 - 25 cm were found more water repellent than the other sampling depths with a 0.01 significance level (Table 4). These results led us to conclude that the water repellency problem in soils on the granite parent material was severe at 0 - 2.5 cm of the surface soil layers, naturally.

When the wetting angles of the soils sampled at the depth of 0 - 2.5 cm under six plant species (15 samples for each depth of the sampling plots) are considered; 47 percent of the soil samples under *Pinus brutia* were found extremely water repellent (Wetting Angle>80°) 46 percent of them are moderately water repellent. Under *Erica sp.,* 40 percent of the soils were extremely water repellent and 53 percent were moderately water repellent (80°>Wetting angle>70°). These results show that, naturally occuring water repellency is a very important problem in these areas. This can be clearly seen in Table 5 for other species.

Table 5. Distribution of the soils into wettability classes at three sampling depths.

Species	Depths (cm)								
	0–2.5			2.5–5.0			5.0–7.5		
	A	B	C	A	B	C	A	B	C
	%								
Pinus brutia	47	46	7	27	53	20	—	80	20
Erica sp.	40	53	7	—	100	—	—	100	—
Pinus nigra	20	67	13	6	53	41	—	73	27
Arbutus unedo	13	73	14	20	67	13	—	27	73
Cistus sp.	—	80	20	—	67	33	—	23	77
Q. coccifera	—	30	70	—	100	—	—	27	73

Wettability classes : A = Extremely water repellent
B = Moderately water repellent
C = Slightly water repellent

The Variation of the Soil Wettability In Soils Derived From Different Parent Materials

To determine, the parent material's effects on the soil wettability, soils developed on granite parent material under four macchie species were compared with soils developed on metamorphic schist parent material under the same vegetation cover. For the comparative analysis of the soils, 360 soil samples were taken into consideration. 180 of them were from granite parent material, the rest was from metamorphic schist parent material. The results of the variance analysis of the wetting angles showed that, soils developed on granite parent material were more water repellent than soils developed on metamorphic schist parent material at a 0.01 significance level.

In the light of this finding, soils developed on granite parent material having 85 percent average sand content were found as highly sensitive to occurrence of natural water repellency than soils developed on metamorphic schist parent material in which average sand content is 67 percent.

This result also supports that, coarse textured soils creating a suitable environment, affect the degree of water repellency as suggested in some studies concluded on this problem.

When maximum wetting angles of the soils developed on granite parent material are compared with wetting angles of soils developed on metamorphic schist parent material, none of the wetting angles of soils sampled on schist parent material was found extremely water repellent under the same plant cover (Table 2).

Fire Affects on Soil Wettability

To show fire affects the soil wettability, the soils of unburned area were compared with the soils of burned area under the same plant covers on the granite parent material. According to the Analysis of variance results soils in burned areas were more water repellent than the soils in unburned areas under macchie cover with a 0.01 significance level. Comparing the mean wetting angles of the soils at three sampling depthe in burned areas showed that, there were big differences between the sampling depths for wettability with a 0.001 significance level. The results of the Duncan test indicated that soils from the depth of 2.5 - 5.0 cm were more water repellent than the soils from the depths of 0 - 2.5 and 5.0 - 7.5 cm respectively with 0.001 and 0.05 significance levels.

In unburned areas, under *Erica sp.,* 40 percent of the soil samples at the depths of 0 - 2.5 cm were found extremely water repellent, conversely, soils from burned plots at the same sampling depth were almost normal wettable. Under other three macchie species in burned areas, the soil wettability also showed an increasing at the same sampling depths. On the other hand, in burned areas at the depth of 2.5 - 5.0 cm under *Erica sp.,* and *Arbutus unedo,* 60 percent of the soil samples were found extremely water repellent. These results indicated that, during the fire, in the soils at the depth of 0 - 2.5 cm soil wettability was increased. At that time, the soils underlying this layer turned into extremely water repellent.

In soils examined under *Cistus sp.,* and *Q. coccifera* in burned plots, soil water repellency slightly increased at all sampling depths. These results came from moderate burning conditions due to litter material consumed by the fire were scant and existing hydrophobic subtances in the litter layers were transfered only to mineral soil surface. Where the upper soil layers are exposed to very intense heating, water repellence property has been transfered to depths of 2.5 - 5.0 cm. At some points at this soil layer were completely nonwettable.

Effects of Some Soil Properties On Soil Wettability
Organic Matter

Relationships between total organic matter and the soil wettability have been subjected to some studies but the results found have contradictions (School 1971, Bond 1969). In this study, for this purpose, 180 soil samples from unburned plots 90 soil samples from burned plots on granite parent material and 105 soil samples from unburned plots on metamorphic schist parent material were tested with simple correlation analysis.

In soils developed on granite parent material have no correlation between total organic matter and the wetting angles of the soils. In soil collected from burned plots on the same parent material, there was a weak negative correlation ($r=-2744$). On the other hand, this relationship showed a good positive correlation ($r=0.6139^{***}$) in soils developed on metamophic schist parent material under the same plant cover (Fig. 1).

Soil Fractions

It is suggested that water repellency is a common problem where soils are coarse textured (Bond 1965) or degree of water repellency is affected by soil

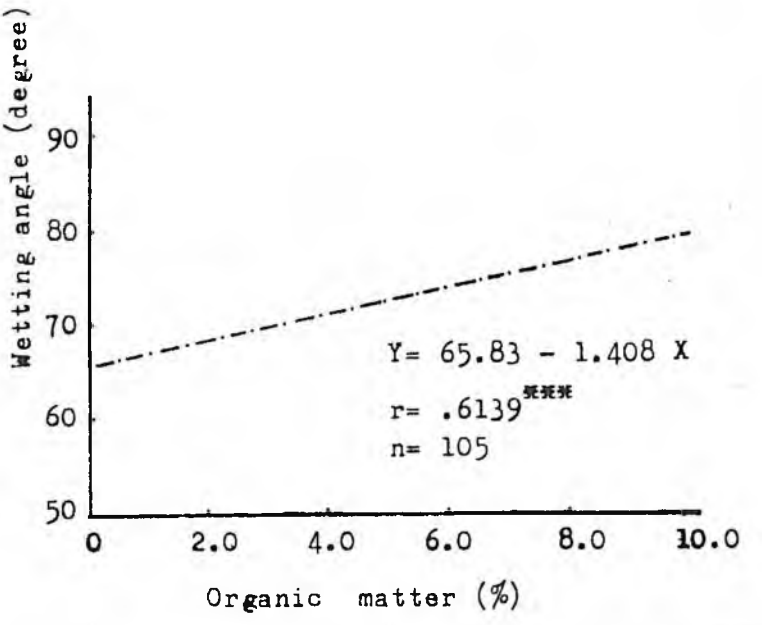

Fig. 1. The Relation Between Organic Matter and Wetting Angles of Soils Developed on Metamorphic schist Parent Material.

texture (DeBano 1981). Our results showed that, there are positive correlations between the sand content of the soils and the wetting angles. Correlation coefficients in soils developed on granite parent material in burned and unburned areas and in soils developed on metamophic schist parent material were respectively .5283***,

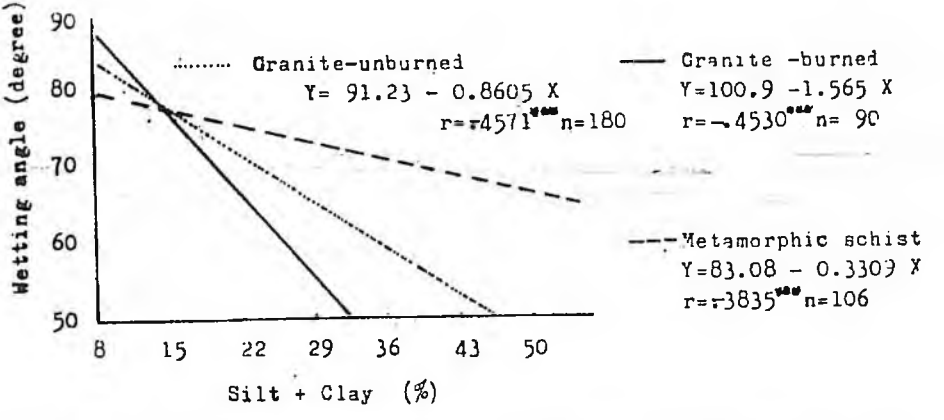

Fig. 2. Relations Between Silt + Clay Fractions and Wetting Angles of Soils Developed on Two Different Parent Materials.

4215*** and .3284***. When the silt contents of the soils are compared with their wetting angles, negative correlations occured. The correlation coefficients are; —.3364*** in soils on metamorphic schist parent material and —.4069*** in burned soils on granite parent material. This trend can also be seen in relations between the wetting angles and silt+clay contents of the soils on both parent materials (Fig. 2).

According to these results, when the sand contents of the soil reach to 80 percent or more, the occurrence of the extremely water repellency begins. The increase amount of the silt and clay fraction contents of the soils the decrease wetting angles of the soils. This findings is also supported by the correlation between the clay contents and the wetting angles in soils developed on granite parent material with the r value of —.6617*** as shown in Fig. 3.

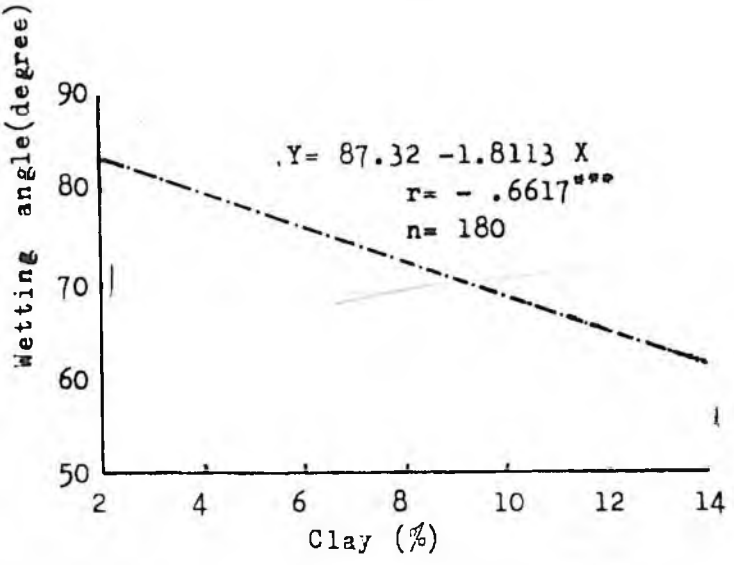

Fig. 3. The Relation Between Clay Contents and Wetting Angles of Soils Developed on Granite Parent Material.

In the light of these findings it can be said that the lower clay contents in soils have a great effect on the occurrence of the soil water repellency, especially in soils having high sand fraction content. But this effect was not so important in soils in which clay fraction contents are 14 percent or more.

Affects of Water Repellency on Soil Moisture and Infiltration

Traditionally, soil water has been characterized by the soil moisture constants. To show how the soil wettability affects the soil moisture constants; 45 soil samples from burned plots and 60 soil samples from unburned plots were tested. Although

the correlation coefficients were weak, general trend occured was the wetting angles increased the moisture contents decreased in all samples for two tensions levels (Field Moisture capacity, Permenant wilting Point). In some of them, water repellency was so strong that it was not possible to wet them for measurements. The relation between the available water dontents and the wetting angles was given in Fig. 4.

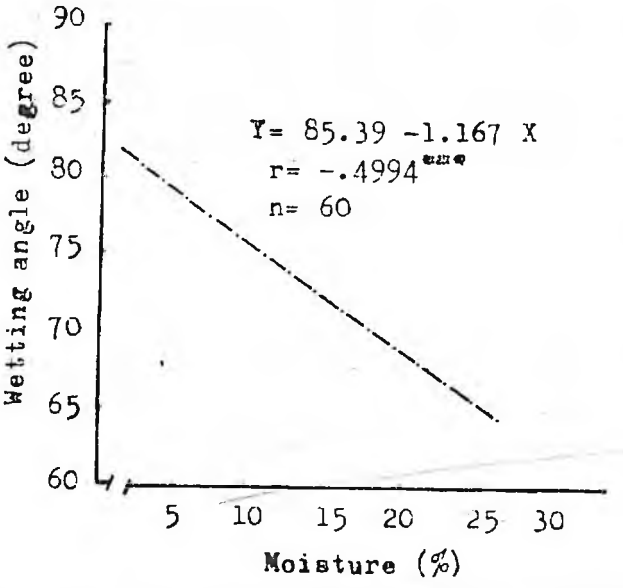

Fig. 4. The Relation Between Wetting Angles and Available Water Percentages of Soils Developed on Granite Parent Material.

Infiltration trials were made by using the ring infiltrometer in field. The measurements were carried out at three different soil conditions on granite parent material and two different conditions on metamorphic schist parent material. The burned area was classified as heavily burned and lightly burned on the granite parent material. On the other hand, the fire caused a light burning on the metamorphic schist parent material covered with macchie species.

According to the results of the calculated initial infiltration rates for first 30 minute (Table 6). In heavily burned places the initial infiltration rates were two times lower than the rates of unburned places. Comparing the initial infiltration rates between the lightly burned and heavly places, the infiltration rates showed 2 times incresing in lightly burned places. When, these infiltration rates of unburned places were compared with the rates of lightly burned places, this increasing was also apperently higher in lightly burned areas than in unburned areas, especially on metamophic schist parent material this can be explained by the loosing of the surface soil after the fire.

Table 6. Calculated initial infiltration rates of soils under macchie species.

Species	Soils developed on granite parent material			Soils developed on metamorphic schist parent material	
	Lightly burned	Unburned	Heavily burned	Lightly burned	Unburned
	mm/minute				
Erica sp.	22.0	18.1	10.7	16.1	14.7
Arbutus unedo	15.8	11.7	6.0	28.5	16.4
Cistus sp.	16.8	16.3	—	28.5	19.7
Q. coccifera	15.0	14.0	—	36.0	24.6

When the infiltration rates of the water repellent soils are compared with the rates of normal wettable soils under *Pinus brutia* and *Pinus nigra,* the effects of water repellency on water infiltration sharply occured (Table 7). The results showed that, the infiltration rates are 33 times higher in normal wettable soils than in water repellent soils under *Pinus brutia* and 5.8 times higher under *Pinus nigra.*

Table 7. Calculated initial infiltration rates of soils developed on granite parent material under Pinus nigra and Pinus brutia stands.

Species	Normal wettable soils	Water repellent soils
	mm/min.	
Pinus brutia	13.18	0.41
Pinus nigra	27.02	4.63

SUMMARY

As it was pointed out in many studies, the resistance to wetting in soils can be fodnd a variety of vegetation types. Comparison of the results between this study and the others concluded on the intensity of water repellency in soils, it may be said that water repellency problem is most severe in macchie soils than the soils under other vegetation cover. Laboratory measurements showed that approximately, 50 percent of the soil samples from a sampling plot were found extremely water repellent. This huge percentage can clearly explain the severity of water repellency in macchie soils.

Although there were some correlations found between the total organic matter and the soil wettability in some studies, the effect of organic matter on the water

repellency problem is very complex. When the upper surface soil zones are compared each other, total organic matter can give a relation with the soil wettability. Conversely, when individual soil samples taken at the same soil layer are compared each other, this relation may not be found. Because, in the occurrence of the soil water repellency, soil texture and the organic matter must be considered together.

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MAKİ İLE KAPLI ALANLARDAKİ TOPRAKLARDA GÜÇ ISLANMA SORUNU VE BUNUN TOPRAK ÖZELLİKLERİ VE YANGINLA İLİŞKİLERİ

Doç. Dr. Kamil ŞENGÖNÜL

Kısa Özet

Ülkemizde geniş alanlarda yayılışı görülen maki vejetasyonun topraklarda güç ıslanma sorunu yaratan hidrofobik maddeler bakımından oldukça zengin olduğu görülmektedir. Dört maki türü altında iki farklı anamateryalden gelişmiş topraklarda orta şiddetten ekstrem dereceye kadar değişen güç ıslanma özelliğinde topraklar belirlenmiştir. Kum oranı yüksek granit anamateryalden gelişmiş toprakların, daha az kum içeren metamorfik şist anamateryalden gelişmiş topraklara oranla güç ıslanmanın oluşumuna daha duyarlı oldukları bulunmuştur.

Arazi koşullarında yapılan infiltrasyon ölçmeleri sonuçlarına göre, güç ıslanan toprakların bulunduğu yerlerde infiltrasyonun normal ıslanabilen yerlere oranla 5 - 33 kere daha yavaş olduğu görülmüştür.

GİRİŞ

Suyun toprağa girişinin engellenmesi, bunun sonucunda yüzeysel akışın artması, erozyon oluşumunda önemli etkenlerden biridir. Son yıllarda yapılan araştırmalar çeşitli bitki örtüsü tarafından üretilen hidrofobik organik maddelerin, topraklarda bir güç ıslanma sorunu oluşturduğu, bunun sonucunda da güç ıslanan topraklarda suyun toprağa girişi (infiltrasyon) engellenerek, yüzeysel akışın arttığı saptanmıştır.

Topraklara güç ıslanma özelliği kazandıran bitki türlerinin başında maki (Chapparal) vejetasyonu türleri ve iğne yapraklı ağaç türleri gelmektedir. Bu nedenle ülkemizdeki Pseudomaki türleri ile kaplı alanlar ile karaçam ve kızılçam türleri ile kaplı alanlardaki topraklarda güç ıslanma sorununun bulunup bulunmadığı sorusuna cevap bulmak yanında güç ıslanmanın oluşumunda toprak faktörünün etkisini ortaya koymak amacıyla bir araştırma yapılmıştır.

MATERYAL VE YÖNTEM

Araştırma alanı olarak Marmara bölgesinin doğusunda yer alan Armutlu yarımadası seçilmiştir. Genel mevki olarak araştırma alanı 28° 54′ - 28° 49′ doğu

boylamları ile 39° 29' - 39° 33' kuzey enlemleri arasında bulunmaktadır. Ortalama yüksekliği 350 m dir.

Yukarıda açıklanan amaca yönelik olmak üzere kızılçam, karaçam ve dört Pseudomaki türü (Arbutus unedo, Erica E. arborea + E. verticillata, Cistus C. creticus + C. salvifolius, Quercus coccifera) ile kaplı alanlarda farklı iki anamateryalden gelişmiş topraklar üzerinde örnekleme parselleri alınmıştır. Ayrıca, yangınların güç ıslanmanın oluşumu üzerinde etkilerinin araştırılması amacıyla, Pseudomaki türleri ile kaplı yangın geçirmiş alanlarda da örnekleme parselleri alınarak bu örnekleme parselleri üzerinde, üst toprağın üç ayrı derinlik kademesi (0 - 2.5, 2.5 - 5.0, 5.0 - 7.5) örneklenmiş toplam 675 adet toprak örneği alınarak değerlendirilmiştir.

Toprak örnekleri üzerinde kapilar yükselme yöntemi kullanılarak toprakların ıslanma açıları saptanmış, ayrıca arazi ve laboratuvar koşullarında damla testi (Water - drop Penetration Time) uygulanarak toprakların nisbi ıslanabilirlikleri belirlenmiştir.

Diğer taraftan topraklarda güç ıslanmanın oluşumunda önemli yeri olan bazı toprak özellikleri ile ıslanma açısı arasındaki basit korelasyon ilişkileri üzerinde durulmuş, toprak örnekleri üzerinde saptanan organik madde, kum, toz, kil gibi bazı toprak özellikleri birer bağımsız değişken olarak ele alınarak ıslanma açısı bağlı değişkeni arasında basit korelasyon ve çoğul regresyon analizleri yapılmış ve regresyon denklemleri belirlenmiştir.

Islanabilirliğin, toprakta tutulan nem miktarı üzerindeki etkisinin görülmesi amacıyla, topraklarda nem konstantlarında tutulan su miktarları ile ıslanma açıları arasında sayısal ilişkilerin belirlenebilmesi için korelasyon analizleri yapılmış ve korelasyon katsayıları saptanmıştır.

BULGULAR VE TARTIŞMA

Laboratuvar ve arazi çalışmaları ile saptanan bulgular aşağıdaki gibi özetlenebilir.

Araştırmaya konu edilen bazı pseudomaki türleri ile kaplı alanlarda granit anamateryalden gelişmiş Arbutus unedo ve Erica (E. arborea + E. verticillata) ile kaplı alanlardaki topraklarda ekstrem derecede güç ıslanma problemi oluştuğu saptanmıştır. Diğer taraftan kızılçam (P. brutia Ten.) altında yine granit anamateryalden gelişmiş topraklarda da ekstrem derecede güç ıslanan toprakların oluştuğu görülmüştür. Kızılçam ile kaplı alanlarda sahanın % 47'sinin, Erica ile kaplı alanlarda % 40'ının, Arbutus unedo il ekaplı alanlarda ise sahanın % 46'sının güç ıslanan özellikte olduğu saptanmıştır. Doğal durumda güç ıslanma sorununun toprak profilinde en şiddetli olduğu yer 0 - 2.5 cm lik derinlikteki üst toprak tabakası olduğu bulunmuştur. Buna karşın yangın geçirmiş koşullardaki topraklarda Arbutus unedo ve Erica (E. verticillata + E. arborea) ile kaplı alanlarda yüzey altında 2.5 - 7.5 cm lik derinlikler arasında ekstrem derecede güç ıslanan toprakların oluştuğu görülmüştür.

Araştırma alanı üzerinde granit ve metamorfik şist anamateryalden gelişmiş toprakların aynı bitki türleri altında karşılaştırılması sonucunda granit anamateryalden gelişmiş toprakların metamorfik şist anamateryalden gelişmiş topraklardan 0.01 düzeyde önemli olarak güç ıslanmanın oluşumuna daha duyarlı oldukları saptanmıştır.

Bazı toprak özellikleri ile toprakların ıslanma açıları arasında saptanan korelasyon ilişkilerine göre;

— Granit anamateryalden gelişmiş topraklarda ıslanma açısı ile kil miktarı arasında ($r=-0.6617^{***}$) negatif bir korelasyon saptanmış buna karşılık metamorfik şist anamateryalden gelişmiş topraklarda kil miktarı ile ıslanma açısı arasında bir ilişki görülememiştir.

— Metamorfik şist anamateryalden gelişmiş topraklarda organik madde miktarı ile ıslanma açısı arasında ($r=0.6139^{***}$) pozitif bir korelasyon saptanmıştır.