

Relationship Between Soil Structure and Botanical Composition of The Flat Pastures in Costal Region of Samsun Province

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This study was conducted in 14 different flat pastures representing Samsun Coastal region. The relationships among the soil structure with plant covered area, botanical composition and distribution of the plants according to their families were inspected in these pastures. Average altitudes of these pastures were about 4 m. Observations and measurements were done between 26th April and 17th May 2005 and transect method was used for measurements. Considering each pasture zone, soil samples were analyzed to determine the general soil characters. Silty, sandy clay and different soil textures with different compositions of these soil characters were determined in the pastures. Generally, organic matter contents were high in the clay soil pastures, moderate in the silty soil pasture and moderate and low in the sandy soil pastures. Nitrogen contents of the pasture soils were between 0.007 and 0.043 %, pH values varied from 7.2 to 8.7. Phosphorous contents of the soil samples were between 1.846 and 23.080 ppm; lime content were between 0.20 and 12.82 %; salt contents were 146.2-974.4 μ mhos/cm; C/N ratio was 12.14 and 48.4. Plant covered areas of the pastures changed between 35.62 and 84.80 %. Generally clay soil pastures had higher plant covered area values than other pastures. Considering the plant families, it is observed that silty soil pastures had more legumes and sandy soil pastures had the plants belonging to the other families. However, any other relationship could not be determined between soil structure and the grass family-plants.

Key Words: Pasture and range, Vegetation, Soil structure, Wetland.

INTRODUCTION

Meadow and pastures are the kinds of ecosystems that realizing a lot of functions at the same time. They supply food source for animals and are significant environments for biological diversity as well. However, in Turkey, although meadow and pastures had multiple functions, public opinion focused on the stockbreeding function.

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As pasture stockbreeding consists of the 70 % Turkey's stockbreeding system, naturally this function is the matter of priority¹. Overgrazing for years and inconsiderable utilization of native pastures have caused extinction of high quality plant species in the pastures and continual decrease of the biodiversity. It is inevitable to take improvement cautions for pastures which have lost their productivity and become potentially erosion source.

Regarding plant cover of meadow and pastures in Samsun province, vegetation was adequate in some pastures, whereas, low vegetation density was observed in some part of pastures. However, Meadow and pasture quality is low as they were a lot of non-nutritious plant species having low yield. Moreover, soil gets tight when it is wet because of the overgrazing, sufficient aeration can not be supplied for plant root region. Most of the flat pastures flood or water level is too close to surface between December and May as water level is high in this period.

It is highly significant to determine the degree of the vegetation damage and to take cautions before starting pasture improvements. Firstly, plant cover and soil relations should be determined in any part of the pasture. Furthermore, determination of the soil characters of a pasture, plant cover rate and contribution of the species to the botanical composition is main application to find out the damage degree and precautions. There is a significant correlation among the plant-soil and water. Wrong usage causes the weak plant vegetation and soil and water losses depending on the applications². Bell³ reported that soil, main environment for pasture plant growing, is storage for many effects of dominant environmental factors. The researcher also reported that the factors which determine plant vegetations in present conditions of the pasture are way (vector), slope, soil deepness, texture and structure, water and nutrients holding capacity and some physical and chemical characters. Mannatje⁴ reported that different vegetations occurred as a consequence of different environmental variations such as climate, topography, soil, grazing, irrigation, fertilization and occurrence of new plant species. Plant vegetation situation is generally a pasture evaluation criteria as plant growing depends on environmental conditions such as climate, soil and topography⁵, *etc.* Plant covered area gives reliable data on general situation of pasture vegetation^{6,7}. Kroel-Dulay *et al.*⁸ determined the species ratio of botanical composition in meadows, soil type differences and special characters of the dominant species in a research conducted in New Mexico. Moreover, researchers reported special life forms and species compositions for specific soil textures. But this general structure shows variations depending on local conditions. Insufficient soil aeration limits the nutrient converts to available forms for plants depending on water quantity. Micro-organisms, important factors to intake of these nutrients, are generally not able to continue their life in airless conditions. Bacteria, supplying the nitrogen fixation and organisms, helping for organic matter decompositions, are the most significant complements. So, the colour of the plants on the pastures

with close water level to surface is yellowish as an indicator of nitrogen shortage². Another value effecting micro-organism activities is carbon-nitrogen ratio (C:N). This value should be about 20 for micro-organism survival. C:N ratio increase limits the organic matter decomposition. Decrease of C:N ratio is evidence for nitrogen usage ability increase of the plants⁹.

This study was conducted in 14 different flat pastures representing Samsun Coastal Region. Considering each pasture zone, soil samples were analyzed to determine the general soil characters. Plant covered area *i.e.*, botanical composition and distribution of the plants according to their families were inspected in these pastures. Moreover, the relationships among the soil structure-botanical composition and plant distribution designs were discussed as well.

EXPERIMENTAL

This study was conducted in 14 different flat pastures (Terme Town-Sakarli settlement, Miliç village and Ahmetbey village, Çarsamba Town-Akçatarla village, Kumtepe village, 19 Mayıs Town-Engiz village and Yörükler village and Bafra Town-Doganca settlement, Fener village, Koruluk village, Sariköy, Üçpinar village) representing Samsun Coastal Region.

Average altitudes of these pastures were about 4 m. Observations and measurements were done between 26th April and 17th May 2005. Transect method, recommended by many researchers¹⁰⁻¹² was used for measurements. Considering each pasture zone, plant covered area was determined using at least 10 transect measurements. Problem areas on pastures were observed and photographed.

Samsun province has generally moderate climate. But, climate shows difference towards transit zones. Moderate climate in coastal region (hot weather in summers, warm and rainy in winters) and terrestrial climate is observed (cold and rainy in winters; cool in summers) in transit zones effected by Akdag (2000 m altitude), Canik (1500 m altitude), Nebyan (1399 m altitude) mountains. Annual mean temperature was 14.2 °C. The hottest months according to long-term mean temperatures were July (23.1 °C) and August 23.2 °C. The coldest months were January (6.9 °C) and February (6.6 °C). Long term mean precipitation of Samsun province was 666.4 mm. Precipitation percentage was 24 % in spring, 17 % in summer, 32 % autumn and 27 % in winter months.

Considering each pasture zone, soil samples were analyzed to determine the general soil characters. Organic matter content (Walkley-Black method), phosphorous content, (Olsen), lime content (Calsimetric method) were determined in soil¹³. Texture analysis was done according to Bouyoucos Hidrometre method¹⁴. pH values of soil samples were measured with 1:1 soil-water rated pH meter having glass electrode¹⁵. Electrical conductivity values of the soils were found out with 1:1 soil-water rated electrical conductor¹⁶. Total nitrogen was calculated according to Kjeldahl method¹⁷.

RESULTS AND DISCUSSION

Some soil characters, plant cover areas, plant species belonging to legumes, grasses and other families of flat pastures in coastal region of Samsun province is presented Tables 1-3. Different soil textures such as sandy, silty clay and different mixture types and different values and ratios were determined concerning organic matter, nitrogen, lime, salt contents and pH. Different ratios of plant species belonging to legume, grass and other families were obtained as well.

TABLE-1
SOIL CHARACTERS AND PLANT DESIGNS OF FLAT PASTURES WITH SANDY TEXTURES IN COASTAL REGIONS OF SAMSUN PROVINCE

Character	Locations				
	Terme-Sakarli	Bafra-Doganca	Terme-Miliç	Çarsamba-Kumtepe	Ondokuzmayis-Engiz
Texture	Sandy	Sandy	Sandy-Loamy	Sandy-Clay-Loamy	Sandy-Clay-Loamy
Organic matter (%)	1.90	0.38	5.54	1.30	2.98
Carbon (%)	0.424	0.085	1.236	0.290	0.665
Nitrogen (%)	0.012	0.007	0.037	0.009	0.027
C/N	33.33	12.14	33.40	32.22	24.62
pH	8.7	8.7	7.3	8.5	8.0
Phosphorus (ppm)	2.308	7.847	2.769	6.001	5.077
Lime (%)	3.92	6.15	0.99	7.97	2.88
Salt (μ hos/cm)	182.7	146.2	475.0	274.0	493.3
Legume rate (%)	41.00	22.98	23.33	28.16	28.16
Grass rate (%)	24.49	43.25	39.10	33.86	33.88
Other Fam. rate (%)	34.51	33.77	37.56	38.98	38.96
Plant covered area (%)	49.27	35.62	58.30	70.20	69.90

Considering the organic matter contents of soil samples, generally clay soils had high organic matter contents, silty soils had moderate and sufficient organic matter contents, whereas, sandy soils had moderate and insufficient organic matter content. The lowest organic matter content was found in the sandy soil sample obtained from Bafra-Doganca pasture (0.38 %), while the highest organic matter content was determined in the clay soil sample obtained from Çarsamba-Akçatarla pasture (8.07 %).

Nitrogen contents of the soil samples varied from 0.007 (Bafra-Doganca) to 0.043 % (Terme-Ahmetbey). Therefore, all soil samples had poor nitrogen contents.

Phosphorus contents of the soil samples were between 1.846-23.080 ppm. Only the soil sample obtained from Terme-Ahmetbey have sufficient phosphor content. Other soil samples had moderate and low phosphorus content.

TABLE-2
SOIL CHARACTERS AND PLANT DESIGNS OF FLAT PASTURES WITH CLAY
TEXTURES IN COASTAL REGIONS OF SAMSUN PROVINCE

Characters	Locations			
	Çarsamba-Akçatarla	Ondokuzmayis-Engiz	Bafra-Fener	Bafra-Üçpınar
Texture	Clay	Clay	Clay	Clay
Organic matter (%)	8.01	5.16	5.09	4.99
Carbon (%)	High	High	High	High
Nitrogen (%)	1.788	1.151	1.136	1.114
C/N	0.043	0.042	0.033	0.029
pH	Very low	Very low	Very low	Very low
Phosphorus (ppm)	41.60	27.40	34.42	38.41
Lime (%)	7.2	7.8	8.4	8.5
Salt (µmhos/cm)	Neutral	Slightly alkali	Slightly alkali	Slightly alkali
Legume rate (%)	3.231	1.846	1.846	11.540
Grass rate (%)	Low	Low	Low	Moderate
Other Fam. rate (%)	0.20	1.19	3.48	2.09
Plant covered area (%)	low	Moderate	Moderate	Moderate
	499.4	560.3	718.6	487.2
	Moderate	Moderate	Moderate	Moderate
	37.50	37.81	15.61	26.79
	26.63	33.59	66.11	50.19
	35.89	28.42	18.27	23.02
	84.80	78.20	60.20	53.00

Certain differences were determined among the soil samples concerning lime and salt contents. Lime contents of the soil samples changed between 0.20 and 12.82 (moderate and limy soils). Soil samples, neutral pH characters, obtained from Terme-Miliç and Çarsamba-Akçatarla pastures had low lime content. Salt contents of the soil samples were between 146.2-974.4 µ mhos/cm. Sandy soil samples obtained from Terme-Sakarlı and Bafra-Doganca pastures had low salt content, others were slight, moderate and excessive salty.

Another character in the study was C/N. It varied from 12.14 to 48.4. C/N ratio is required about 20 for micro organisms⁹. High C/N ratio decreases the soil productivity. According to obtained data, C/N ratio was below 20 in the soil samples obtained from Bafra-Doganca (12.14) and Bafra-Sariköy (14.81) pastures, whereas, other soil samples of 12 pastures were highly over 20.

Plant covered areas of the pastures were determined between 35.62 and 84.80 %. The highest value concerning plant covered area was found in Çarsamba-Akçatarla pasture with clay soil character (84.80 %), while the lowest value found in Bafra-Doganca pasture with sandy soil (35.62 %). Generally, the pastures with clay soil had higher plant covered area ratio. Considering the plant families, the pastures with silty soils had rich plant species of legumes, whereas, pastures with sandy soils had rich plant species of other families. However, any relation was not able to determine between grass plants and soil structures. Both plant covered area

TABLE-3
SOIL CHARACTERS AND PLANT DESIGNS OF FLAT PASTURES WITH SILTY
TEXTURES IN COASTAL REGIONS OF SAMSUN PROVINCE

Character	Locations				
	Ondokuzmayis- Yörükler	Bafra- Sarıköy	Bafra- Doganca	Bafra- Koruluk	Terme- Ahmetbey
Texture	Silty-Clay	Silty-Clay	Silty-Clay - Loamy	Silty-Clay - Loamy	Loamy
Organic matter (%)	2.86 Moderate	4.48 High	1.52 Moderate	4.39 High	6.67 High
Carbon (%)	0.603	0.385	0.339	0.980	1.489
Nitrogen (%)	0.017 Very low	0.026 Very low	0.007 Very low	0.029 Very low	0.043 Very low
C/N	35.50	14.80	48.42	33.80	34.63
pH	8.4 Slightly alkali	8.2 Slightly alkali	9.0 Slightly alkali	8.3 Slightly alkali	7.9 Slightly alkali
Phosphorus (ppm)	3.231 Low	11.079 Moderate	4.616 Low	6.466 Moderate	23.080 High
Lime (%)	1.34 Moderate	2.95 Moderate	12.82 High	5.98 Moderate	2.73 Moderate
Salt (μ hos/cm)	974.4 High	767.3 Moderate	791.7 Moderate	6.557 Moderate	974.4 High
Legume rate (%)	42.43	46.01	28.37	30.42	32.12
Grass rate (%)	48.22	38.18	41.13	38.12	50.65
Other Fam. rate (%)	9.35	15.81	31.13	31.46	18.69
Plant covered area (%)	67.40	62.60	59.90	76.60	61.00

ratio and plant species distribution of families affect the pasture usage situation. Untimely and inconsiderably overgrazing the pastures decrease the plant covered area and quality plant species. Furthermore, these pastures flood in winter times (*ca.* 3-4 months) because of high water level. So it affects the plant covered area ratio and plant distribution design.

Considering plant species besides the plant families, *Medicago hispida* L., *Trifolium subterraneum* L., *Trifolium hybridum* L., *Trifolium resupinatum* L., *Lotus corniculatus* L. species as legumes; *Lolium perenne* L., *Paspalum paspaloides* L., *Cynodon dactylon* L., *Poa annua* L., *Agrostis castellana* Boiss., *Alopecurus mysoruoides* Hudson., *Lolium multiflorum* L. as grasses; and *Plantago lanceolata* L., *Geranium rotundifolium* L., *Bellis perennis* L., *Holosteum umbellatum* L., *Carex divisa* Huds., *Taraxacum hypernum* L., *Anagallis arvensis* L. as other families were determined in the pastures with sandy soil.

Trifolium resupinatum L., *Trifolium hybridum* L., *Trifolium repens* L., *Medicago hispida* L., *Trifolium meneghinianum* Clem as legumes; *Poa annua* L., *Alopecurus mysoruoides* Hudson., *Cynodon dactylon* L., *Paspalum paspaloides* L., *Lolium perenne* L., *Agrostis castellana* Boiss as grasses; and *Bellis perennis* L., *Plantago lanceolata* L., *Ranunculus muricatus* L. as other families were determined in the pastures with silty soil.

Trifolium resupinatum L., *Trifolium repens* L., *Medicago hispida* L., *Trifolium hybridum* L., *Lotus corniculatus* L. as legumes; *Alopecurus mysoruoides* Hudson., *Agrostis castellana* Boiss., *Lolium perenne* L., *Cynodon dactylon* L., *Paspalum paspaloides* L. as grasses; *Plantago lanceolata* L., *Bellis perennis* L., *Taraxacum hypnorum* L., *Ranunculus muricatus* L., *Cirsium arvense* L. as other families were determined in the pastures with clay soils.

Medicago hispida L. and *Trifolium hybridum* L.; *Lolium perenne* L., *Cynodon dactylon* L. and *Paspalum paspaloides* L.; *Plantago lanceolata* L. and *Bellis perennis* L. species were highly common in all 14 pastures.

Conclusion

The relationships among the soil characters and plant species-families were not clear in the study areas. This situation shows that climate factors and pasture grazing factors are also effective on plant species design. Most of the pastures flood or water level gets close to surface between December and January. Determination of pasture grazing time is very important in these kinds of pastures. Soil gets tight when it is wet because of the overgrazing, sufficient aeration can not be supplied for plant root region. Therefore, roots can not strongly grow and vegetation remains short and weak. During the year, animals are grazed in the pastures. Sheep, cattle in winter and sheep and cattle in some pastures are grazed together. This situation accelerates the pasture degeneration. Especially in the sandy soil and wet pastures, grass species are pulled up by sheep. Improvement of the flat pastures and sustainability can be supplied evaluating soil-plant and grazing relations.

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REFERENCES

1. Anonymous, <http://www.cedgm.gov.tr/cevreatlasi/dogalkaynaklar.pdf> (2005).
2. M. Altin, A. Gökkuş and A. Koç, Pasture-Rangeland Improvement. T.C. Agriculture and Rural Ministry, Pasture-Rangeland, Forage Crops and Basin Improvement Presidency, Ankara, ISBN 975-407-188-8 (2005).
3. H.M. Bell, Rangeland Management for Livestock Production, University of Oklahoma Press, Publishing Division of the University, USA (1978).
4. L. Mannatje, <http://www.date.hu/acta-agraria/2002-08i/mannetje.pdf> (2008).
5. N. Uluocak, *J. Forest Fac.*, **30**, 52 (1980) (In Turkish).
6. M.S. Gençkan, *J. Agric. Fac. Ege Univ.*, **4**, 53 (1966) (In Turkish).
7. Ö. Bakir, *A.U. Fac. Agric. Annual Press*, **19**, 550 (1970) (In Turkish).
8. G. Kroel-Dulay, P. Odor, D.C. Peters and T. Hochstrasser, *J. Veget. Sci.*, **15**, 531 (2004).
9. A. Harasimiuk and M. Cyrczak, Soil-Plant Relations on Sandy Grassland in the Middle Vistula River Valley, *Miscellanea Geographica, Warszawa*, Vol. 11, pp. 41-50 (2004).
10. F. Tosun, The Research on Determination of Optimum Sample Intensity in Rangeland Vegetation Study Using With Transekt Method, Atatürk U., Agriculture Faculty, Agricultural Res. Enst. Pub. No: 27, Erzurum (1968).

11. A. Koç and A. Gökkus, Comparison of Some Canopy Characters of the Rangelands Under Grazing with Partly Protected and Used as Skiing Ground in Palandöken Mountains, 3th Pasture-Rangeland and Forage Crops Congress of Türkiye, June 17-19, Erzurum, pp. 162-170 (1996) (In Turkish).
12. H. Kendir, *J. Agri. Sci.*, **5**, 104 (1999) (In Turkish).
13. B. Kacar, Chemical Analysis of Soil and Plant, III. Soil Analysis. A.U. Agriculture Faculty Education Research and Improvement Foundation Press. No. 3, Ankara (1994) (In Turkish).
14. I. Demiralay, Physical Analysis of Soil, Atatürk U. Faculty of Agriculture Press No. 143, Erzurum (1993) (In Turkish).
15. F. Bayraklı, Analysis of Soil and Plant, OMU Faculty of Agriculture Press No. 17, Samsun (1987) (In Turkish).
16. L.A. Richard, Diagnosis and Improvement of Saline and Alkali Soils, U.S. Dept. Agr. Handbook, Vol. 60, pp. 105-106 (1954).
17. J.M. Bremner, Methods of Soil Analysis Part 2, Chemical and Microchemical Properties, Ed. C.A. Black, A.M. Soc. of Agric. Inc., Publisher Agronomy Series, No. 9, Madison, Wisconsin, USA (1965).

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