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PROBLEMS MEASURED AND EVALUATED OF IRRIGATED AGRICULTURAL AND NON-IRRIGATED AGRICULTURAL SOILS

Ahu Alev Abaci-Bayan*

Ahi Evran University, Faculty of Agriculture, Soil Science and Plant Nutrition of Department, Kirsehir

ABSTRACT

Healthy and balanced nutrition of a country's population as well as its future generations is possible by ensuring sustainable economic development through protecting the environment and biological diversity. In this study, the areas where two different agricultural systems applied were determined and soil samples were taken from 0-30 cm depth and soil analyses were carried out for ecological and agricultural evaluation.It was found that the saturation percentage of the soils varied between 41.80-84.70%, its pH varied between 7.27-8.19, the total amount of $CaCO_3$ varied between 2.55-21.24%, total salinity ratio 0.003-0.040%, organic matter content varied between 1.25-3.86%, the amount of beneficial P_2O_5 varied between 1.92-9.00 kg da^{-1} and the amount of available K_2O was found so high. In the study, it was concluded that the application of phosphorus and potassium fertilizer should be taken into account since the P_2O_5 level is high in irrigated soils and the soils are clay loam and the amount of K_2O is at an adequate level in both cultivated soils.

KEYWORDS:
Kirsehir, soil charactesitic, irrigated agricultural, non-irrigated agricultural

INTRODUCTION

It has been stated that 3200 million hectares of land in the world are potentially suitable for agriculture; however, only 1450 million hectares of them are still cultivated and that the majority of the remaining land of 1750 million hectares is less suitable for agriculture and environmentally sensitive soils. In the world, non-irrigated farminghas been carried out in 1200 million hectares, whereas irrigated agriculture has been carried out in 250 million hectares (17%). It is estimated that the total area, in which drainage is conducted, 150-200 million hectares (10-14%), and 100-150 million hectares of theseare located in rainy areas while 25-50 million hectares are located in irrigated areas [1].

It has been determined that the ecological conditions determine which of the agricultural systems, including irrigated, non-irrigated and moist agriculture will be put into practice in a region where the most effective factor in the field agricultural system is water. Irrigated agriculture is an agricultural system which has been applied in places where water cannot be met by natural rainfall but can be provided through irrigation, which is necessary for the normal development and crop production of plants. The quantity and quality of the products decreases and salinity-desertification problems soon begin if proper quality water is not used in irrigation no matter how efficient the soil is, how well modern irrigation methods are used. The quality of irrigation water is determined by the amount of dissolved salts in the waterand irrigation water mostly contains sodium, magnesium and calcium salts. Soil-plant-water relationships in irrigated farming lands and their effects on human and environment have not been considered thoroughly. Because of this, the producers tend to use excessive water because they could not be trained adequately, consequently they encounter many problems such as drainage, high groundwater, salinity and sodium. Among other agricultural systems, non-irrigated farmingis non-irrigated field farming, which is carried out in soilsan having annual rainfall of up to 500 mm or irregular rain distribution according to seasons. Non-irrigated farming is a mandatory method where rainfall is a limiting factor for plants. 60-65% of the total area in the world, while 81.7% of a total of 27.7 million hectares of cultivated land in Turkey, annual precipitation is less than 500 mm and non-irrigated farming has been applied. Fallow non-irrigated farming has been carried out in 74% of the non-irrigated farming areas, namely 16.8 million hectares. Because the water is limited in non-irrigated farming areas, the main purpose of non-irrigated farming is to maintain the water obtained from the precipitation as long as possible in the soil for a long time and to use the water most effectively [2].

The agricultural productivity of the soil and the content of plant nutrients are important for increasing agricultural production. The positive or negative physical and chemical properties of soils and the lack or excess of plant nutrients is among the factors that affect the yield and quality of agricultural crops. If there are not enough plant nutrients to grow the plants in the soil, the appropriate type and amount of fertilizer is given to the soil to cover the deficit. A good fertilization is achieved by determining the amount and type of the fertilizer that the plant needs, and giving this fertilizer to the soil in accordance with its technique at the right time. The type and amount of fertilizer required for soil in the laboratory are determined by obtaining various soil samples from a specific area. Thanks to soil analysis, the nutrients which are found in the soil structure and needed for soil can be determined accurately. Hence, which fertilizer, how and in what quantities will be applied are determined through soil analysis.

In this study, physical and chemical analyzes were performed on the samples taken in order to determine the soil structure of some non-irrigated and irrigated farming carried out in Kırşehir province. Additionally, soil analysis results have been examined in terms of productivity and some suggestions have been made.

MATERIALS AND METHODS

Soil samples taken from 0-30 cm depth of irrigated and non-irrigated agricultural land are dried under laboratory conditions and prepared for an analysis by being crushed with a wooden hammer and sieved with a 2 mm sieve. According to the basis reported by Demiralay (1993) [3], percentage of saturation with water, 100 g of soil samples sieved with a 2 mm sieve were taken and soil colloid surface areas were saturated with water. Soil reaction (pH) was measured potentiometrically in saturation sludge by using a pH meter [4]. Total salinity in the saturation sludge was measured by the electrical pH conductivity probe [4]. Total lime was determined on a volume basis using Scheibler calcimetre with 10% hydrochloric acid [5]. The organic material was determined titrimetrically by oxidizing the organic carbon with 1.0 N $K_2Cr_2O_7$ ve H_2SO_4 and 0.5 N $FeSO_4.7H_2O$ by the 'Walkley-Black' method of wet decomposition [6]. Exchangeable potassium was extracted as reported by Helmke and Sparks (1996) according to the Ammonium acetate method (NH_4OAc, 1.0 N, pH:7) and the amount of potassium passing through the solution was determined in a flame photometer [7]. Beneficial phosphorus was determined by using 0.5 M sodium bicarbonate ($NaHCO_3$) using a UV-VIS spectrophotometer at a wavelength of 880 nm coulometrically according to the method developed by Olsen et al. (1954) [8]. Statistical evaluation was done by calculating standard deviation, variance, skewness, kurtosis, coefficient of variation and correlation.

RESULTS AND DISCUSSION

The average water saturation percentage of the study area soil at 0-30 cm depth was found to be 54.55% for irrigated areas, while it was found to be 54.08% for non-irrigated areas andsome soil analysis results are given in Table 1 and Table 2. The coefficient of variation for watery saturation percentages of irrigated soils was determined to be 27.99 %, while 20.08 % for non-irrigated soils and these values were found to be moderately variable. Because, the coefficient of variation is considered to be slightly variable if it is <15 and to be intermediate-level variable and to be highly variable if it between 16-35 if it is >36 [9].

The saturating condition which is used to determine the soil structures is given in Table 3. When the soils of the study area are evaluated according to Table 3, it is stated that both areas generally have a clay loam structure. The soil structure is one of the important physical properties that determines the level of soil fertility and is of great importance in terms of fertilization [10]. In addition, the analysis results of the soils based on the agricultural system used in the study areas are given in Figure 1.

It was observed that the average soil pH was 7.87 in irrigated areas from the study area, while it decreased to 7.64 in non-irrigated areas. When the soil is classified according to pH values, soils with a pH of 7.4-7.8 are usually mildly alkaline and those with a pH of 7.9-8.4 are considered to be moderately alkaline [12]. The percentage of variation coefficient of soil pH was found less than <15 for irrigated and non-irrigated farming, which indicates that the pH value of these areas is slightly variable. Accordingly, as a result of the evaluation of the study area soil according to Table 4, the pH of non-irrigated soils were found slightly alkaline and the pH of irrigated soils exhibited a moderately alkaline reaction. Soil reaction is a soil feature that significantly influences plant growth and availability of plant nutrients. If the annual amount of rainfall is low, it causes the soil pH to be high. The variable H^+ ion is less common in arid regions. Due to the influence of the prevailing climate condition, the bases in the soil are prevented from being washed away and turned into acid-reactive state [10].

TABLE 1
Soil analysis of results in irrigated agriculture areas

Soil No	Product	Texturing class	Saturation percentage	pH	Total salt	Total lime ($CaCO_3$)	Organic matter	Available Phosphorus (P_2O_5)	Exchangeable Potassium (K_2O)
			%		%	%	%	kg da^{-1}	kg da^{-1}
1	Walnut	Clay loam	60.53	7.53	0.011	15.83	3.72	13.61	287.38
2	Walnut	Loam	35.50	7.87	0.003	6.73	1.55	14.77	121.00
3	Walnut	Clay loam	54.45	7.95	0.010	21.24	1.51	8.55	114.95
4	Walnut	Clay loam	53.79	8.19	0.009	20.18	1.26	8.02	96.80
5	Walnut	Clay loam	61.60	7.95	0.011	14.18	1.38	7.88	104.36
6	Sunflower seeds	Loam	44.00	7.81	0.018	4.34	2.01	16.96	1614.59
7	Sunflower seeds	Clay	84.70	7.83	0.033	7.64	3.22	3.16	427.28
8	Sunflower seeds	Loam	41.80	7.81	0.003	3.22	2.46	1.92	170.01
	Minimum	-	35.50	7.53	0.003	3.22	1.26	1.92	96.80
	Maximum	-	84.70	8.19	0.033	21.24	3.72	16.96	1614.59
	Average	-	54.55	7.87	0.012	11.67	2.14	9.36	367.05
	Variance		233.12	0.03	0.00	50.48	0.84	29.08	267327.41
	Standard deviation		15.27	0.18	0.01	7.11	0.92	5.39	517.04
	Skewness		0.95	-0.13	1.58	0.21	0.91	0.02	2.57
	Kurtosis		1.41	2.10	3.02	-1.83	-0.61	-1.22	6.81
	Coefficient of variation (%)		27.99	2.35	80.50	60.88	42.82	57.61	140.86

TABLE 2
Soil analysis of results in non-irrigated agriculture areas

Soil No	Product	Texturing class	Saturation percentage	pH	Total salt	Total lime ($CaCO_3$)	Organic matter	Available phosphorus (P_2O_5)	Exchangeable potassium (K_2O)
			%		%	%	%	kg da^{-1}	kg da^{-1}
9	Barley	Loam	46.75	7.56	0.020	2.55	1.25	2.16	143.54
10	Barley	Clay loam	63.80	7.49	0.018	7.56	1.95	2.85	540.72
11	Barley	Clay loam	53.90	7.60	0.011	6.81	1.66	2.70	510.47
12	Barley	Loam	46.20	7.78	0.011	6.37	1.37	2.78	186.04
13	Barley	Loam	47.30	7.83	0.013	8.24	1.28	5.41	453.75
14	Barley	Loam	44.00	7.81	0.011	6.66	2.08	1.92	160.33
15	Barley	Clay	75.68	7.77	0.040	13.40	3.86	2.54	546.39
16	Barley	Clay loam	55.00	7.27	0.011	3.31	1.85	9.00	70.18
	Minimum	-	44.00	7.27	0.011	2.55	1.25	1.92	70.18
	Maximum	-	75.68	7.83	0.040	13.40	3.86	9.00	546.39
	Average	-	54.08	7.64	0.017	6.86	1.91	3.67	326.43
	Variance		117.90	0.04	0.00	10.95	0.72	5.78	41542.16
	Standard deviation		10.86	0.20	0.01	3.31	0.85	2.40	203.82
	Skewness		1.31	-0.93	2.20	0.83	2.09	1.98	-0.03
	Kurtosis		1.16	0.19	5.11	1.78	4.97	3.66	-2.43
	Coefficient of variation (%)		20.08	2.57	58.76	48.23	44.35	65.51	62.44

TABLE 3
Percentage of saturation condition [11]

Percentage of saturation	Meaning class
<%30	Sandy
%31-50	Loam
%51-70	Clay loam
%71-110	Clay
>%111	Heavy clay

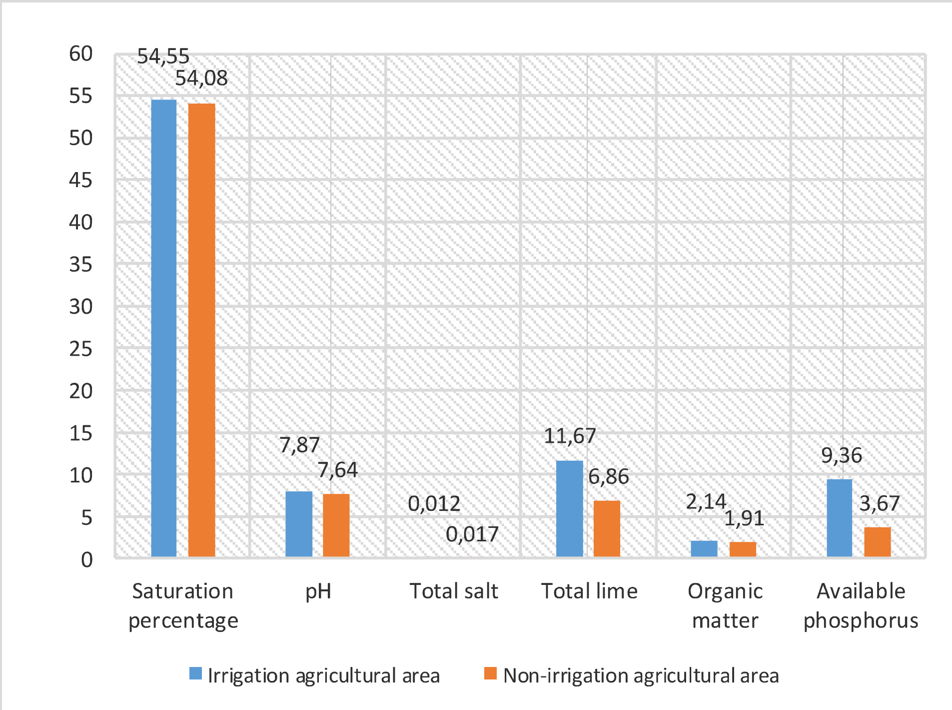

FIGURE 1
Analysis results of irrigation and non-irrigation agricultural soils

TABLE 4
According to the classification of soil pH [12]

pH values	Reaction
<4.5	Excess acid
4.5-5.0	Very strong acid
5.1-5.5	Strong acid
5.6-6.0	Medium acid
6.1-6.5	Light acid
6.6-7.3	Neutral
7.4-7.8	Light alkaline
7.9-8.4	Medium alkaline
8.5-9.0	Strong alkaline
>9.1	Very strong alkaline

TABLE 5
Total soil content of soils (%) [11]

Total soil (%)	Meaning class
<%0.15	Without salt
%0.15-0.35	Lightly salt
%0.35-0.65	Medium salty
>%0.65	Very salty

It was found that the average % salt content of the irrigated study soilwas 0.012%, while it was 0.017% for the non-irrigated soil. When the study area was classified according to total salt content percentage, it was determined that all of the soil contained less than 0.15%, which is the limit value for salinity and, it was determined that the soil was in the unsalted class when assessed according to Table 5. It was concluded that there is no problem in terms of salinity in the study area soils. The coefficient of variation of both study area soils is found >36, which means that the total salt content is highly variable.

The total lime content of the study area soil was found to be 11.67% for irrigated farming, while it was found to be 6.86% for non-irrigated farming soils. In order to determine the lime status of the soil in Table 6, % total lime contents are given and classified accordingly as medium lime when the average values of the field soils are taken into account. However, in some irrigated areas, the total lime content was found to be too high. The excessive amount of lime in the soil prevents plant nutrients such as phosphorus, iron and zinc from being taken up by the plant. The coefficient of variation of both study area soils is found >36, which means that the total lime content is highly variable.

Soil organic matter is the most important structural component of soil and consists of plant and animal wastes. When the research area is compared with respect to the content of organic matter, the average area of organic matter in irrigated areas was 2.14% and the amount of organic matter in dry areas was 1.91%. The classification of soils by organic matter content is given in Table 7. Accordingly, it was determined that the organic matter content of the study area soil is included in the moderate and low classes, respectively. In these areas, it was foundthat application of the barn, vermicompost barnyard manure application, green fertilization and application of organic matter content should be done. The coefficient of variation of both soil samples is >36, which indicates that the total organic matter content is highly variable.

Phosphorus is among the plant nutrients that are most needed by the plant. It was determined that the average amount of phosphorus (P_2O_5) content in the soil of the irrigated farming areawas 9.36 kgda^{-1}, while it was 3.67 kg da^{-1} in the soil of non-irrigated farming area. The classification of soils according to their phosphorus content is given in Table 8. Accordingly, the study area was determined to be a soil with high and low levels of phosphorus in terms of the available phosphorus content of the soil. It was found that the amount of phosphorus available is particularly high in irrigated areas, while it is low in non-irrigated areas. Considering the analysis results of the soil, phosphorous fertilizers can be applied if needed. The coefficient of variation of both study area soils was >36, which indicated that the beneficial phosphorus contents were highly variable. Figure 2 shows the exchangeable potassium contents of agricultural areas.

TABLE 6
Total lime contentof soils (%) [11]

Total lime (%)	Meaning class
<%1	Less lime
%1-5	Lime
%5-15	Medium lime
%15-25	Excess lime
>%25	Too much lime

TABLE 7
Total organic matter content of soils (%) [11]

Organic matter (%)	Meaning class
<%1	Very little
%1-2	Little
%2-3	Medium
%3-4	Good
>%4	High

TABLE 8
Available phosphorus content of the soil (kg da^{-1}) [11]

kg P_2O_5 da^{-1}	Meaning class
<3	Very little
3-6	Little
6-9	Medium
9-12	High
>12	Very high

Potassium element is among the plant nutrients that are widely found in the soil. Thin soils contain more potassium than coarse soils [10]. It was shown in Figure 2 that the average available potassium (K_2O) content of the irrigated area in the study was found to be 367.05 kg da^{-1}, while it was found to be 326.43 kg da^{-1} in non-irrigated farming soils. The classification of soils according to their

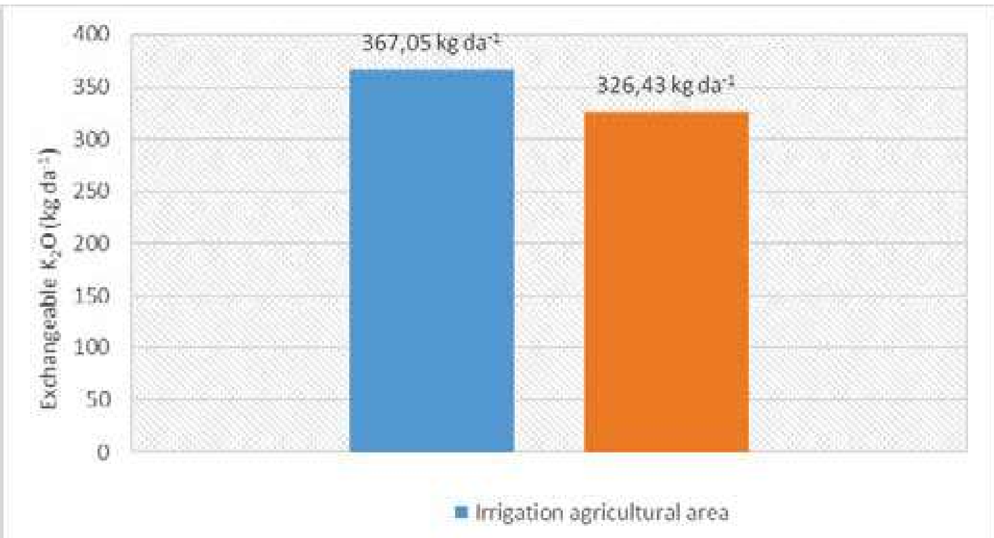

FIGURE 2
Exchangeable potassium status of irrigated and non-irrigation agricultural soils

available potassium content is given in Table 9, and according to this classification, the study area was determined to be sufficient in terms of available potassium content of the soils. Potassium fertilization is not needed since there is no difference in plant growth and yield as a result of potassium fertilization due to the sufficient amount of potassium in the soil of the region. The coefficient of variation of both study area soils was >36, which indicated that the beneficial phosphorus contents were highly variable.

TABLE 9
Exchangeable potassium content of the soil ($kg\ da^{-1}$) [11]

K_2O kg da^{-1}	Meaning class
<20	Very little
20-30	Little
>30	Adequate

As a result of the statistical analysis on the soil structure of the study area, it was found that there is a positive correlation between the water saturation percentages of irrigated agriculture soil and total salinity value at $p < 0.05$ significance level. It has been determined by [13] that the total salinity value is higher in the horizons where the saturation value is high in the Gavur Lake soil. It was observed that there was a negative correlation between pH value of field soils and organic matter content at $p < 0.05$ significance level. Similar findings were found in [13] and [14] have also been reported, and as the soil pH increases, the content of organic matter decreases.

Dry agricultural areas of research lands made correlation analysis total salinity values and percent saturation with water as a result of $p < 0.05$ significance level is positive, in percent saturation with water to the organic matter content $p < 0.01$ was found positive relationship cardinality. The organic matter content of soils causes the increase of the specific surface area of the soils and the soil becomes sature with higher moisture contents [13]. It has been observed by [15] that the percentage of saturation of the soil with water increases due to the dose rate increase of the hazelnut compost, which can be applied to the soil, [16] examined the physical and chemical relationships of 24 soil samples and found a positive relationship between organic matter and saturation value. Organic matter with a total salinity $p<0.01$ level of significance was found a positive correlation. The Golbasi Lakes horizon where the low total salinity of soil the soil is found to be low in organic matter content [13]. Total lime with between potassium $p<0.05$ level of significance was found a positive correlation. [17] by the application of lime soil pH of the soil, available phosphorus, potassium and can also in many research studies to increase the amount of calcium was determined [18-19-20-21-22].

CONCLUSION

It was found that hot and dry climatic conditions and high clay coverage lead soil to be rich in potassium plant nutrients and soil potassium excess has been observed in many study area soils rather than potassium deficiency. When the average values of the analysis results of the study area soils are taken into account, it was determined that the soil is clay loam, and the soil is unsalted and medium calcareous, and also available potassium element is sufficient. In irrigated areas, it was found that the amount of available phosphorus amount is high, the amount of organic matter is moderate, and the area soil exhibited a moderate alkaline reaction. In non-irrigated farming areas, it was concluded that the amount of available phosphorus and organic matter is low, and the soil is characterized by mild alkalinity. It was determined that the practices which increase of organic matter content, such as barnyard manure, vermicompost application, green fertilization, should be carried out in the study area soil. In conclusion, it was determined thatthe phosphorous fertilizer application should be reduced in the soil where the content of phosphorus is high, and fertilizer application should be done based on the plant nutrient needs by carrying out soil analyses regularly.

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CORRESPONDING AUTHOR

Ahu Alev Abaci-Bayan
Ahi Evran University,
Faculty of Agriculture,
Soil Science and Plant Nutrition of Department, Kirsehir

e-mail: ahuabaci@gmail.com