New Approaches and Applications in Agriculture

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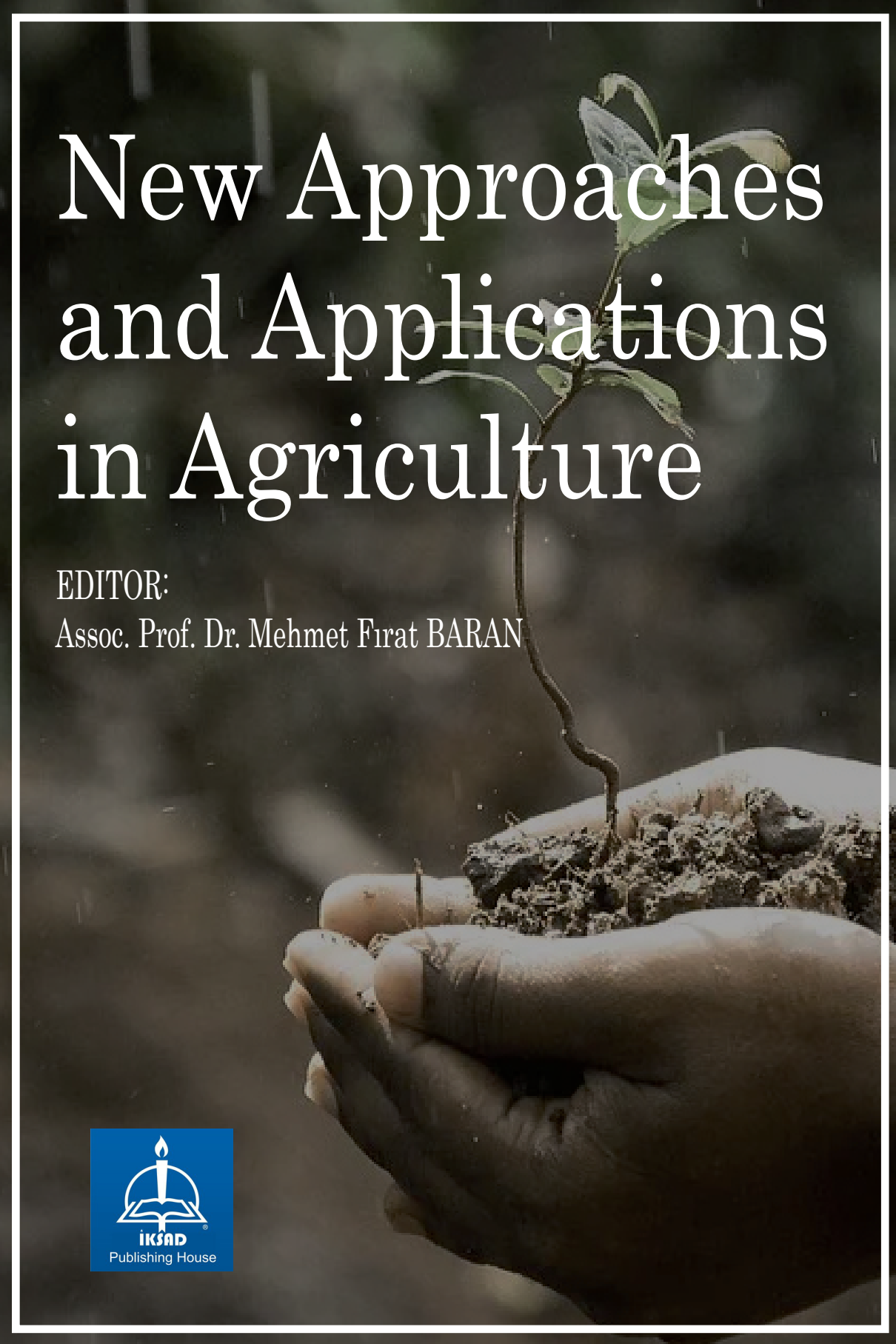

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(The Licence Number of Publicator: 2014/31220)
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ISBN: 978-625-7279-66-6
Cover Design: İbrahim KAYA
December / 2020
Ankara / Turkey
Size = 16 x 24 cm

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PREFACE

New generation agricultural models are needed to meet the rapidly increasing needs of the consumption society. In a sense, the economically sustainable development and development of countries at local, regional and global scale can be achieved by revealing, developing, producing and implementing new inventions and innovative differences.

The preparation of plans and programs in the agricultural sector generally focuses on the resources needed for agriculture such as soil and water, as well as socio-economic factors such as investment potential, food chain economy and level of knowledge.

Within this period, it is vital to deliver the information to the target audience faster and efficiently to create society of knowledge and allow these Technologies to be applied and become wide spread. In increasing agricultural production, the selection and use of inputs such as water, fertilizer, seed, plant protection and mechanization is important, the more important it is to use the work and machine power that will ensure the application of these inputs in an appropriate and economical way. As in every field and every stage of crop production, developments in terms of mechanization in animal production have reached a promising level in using our country's agricultural potential more effectively. In this book section, studies on new approaches and applications in agriculture are included.

The studies presented in this book, will benefit the agriculture sector development and sustainability practitioners also will make a very important contribution to Turkey's agriculture.

Best regards
Assoc. Prof. Dr. Mehmet Fırat BARAN
EDITOR

CHAPTER 12

EVALUATION OF PRODUCTIVITY STATUS OF DRY FARMING SOILS IN MARDIN PLAIN USING GEOGRAPHICAL INFORMATION SYSTEM ANALYSES

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INTRODUCTION

Soil fertility is among the most basic criteria for obtaining quality and abundant products in agricultural production. The physical and chemical properties of soils, the scarcity or abundance of plant nutrients are important factors affecting the yield and quality of agricultural products, and the nutrient concentrations in soils can be determined by soil analysis. In addition, depending on the physical and chemical properties of the soil, knowing the relationships between these properties and the nutrients in the soil is important in terms of providing the highest benefit of fertilisation for the plants to be grown according to the land conditions (Taban et al., 2004; Başaran and Okant, 2005; Tümsavaş and Aksoy, 2008). The product yield and quality of the grown plants are closely related to the nutrient content of the soils to meet the needs of the plants (Zengin et al., 2003; Belliturk et al., 2019). The formation of agricultural lands is the only resource that takes thousands of years, and cannot be produced or renewed. The sustainability of soils, though, is possible by examining and monitoring soil resources as adequately as possible and defining the characteristics of agricultural areas better (Özyazıcı et al., 2016).

Mardin province has lands that can be processed very easily in terms of agriculture with high yield values in the Mardin plain, where important cereal products are grown in our country, which has a high agricultural potential in the Southeastern Anatolia Region (Eren, 2019). The climate of Mardin is similar to the Mediterranean climate; summers are hot and dry, while winters are rainy and cold. In the winter season, snowfalls

are seen in mountainous areas from time to time, while less and non-permanent snowfalls are seen in the plain (Mercan and Arpağ 2020). In this study, it was aimed to determine the fertility status, physical and chemical properties of soils taken from two different depths in some dry farming villages in the province of Mardin.

MATERIAL AND METHOD

In the study, SRTM data and soil maps of the General Directorate of Rural Services (Anonymous, 1997) were used to create maps of the study area. Maps were digitised using "Global Mapper 18" and "ArcGIS 10.3" programs. From these maps created; aspect, slope and digital elevation maps were drawn. A database was created in GIS for all maps drawn. Thematic maps such as land use map, classification of agricultural lands, large soil groups and land use capability were created from the data. In 2019, soil material was collected from 10 different villages of Mardin province (Yukarı Azıklı, Göllü, Çiftlik, Gökçe, Ortaköy, Yolbaşı, Emirli, Ilıcak, Kumlu and Çınarcık) and from each land; a total of 60 soil samples were taken from 3 different points at 0-30 and 30-60 cm depth according to the principles stated by Jackson (1958) to represent the land. Sampled villages are shown in Figure 1; and GPS coordinates of the samples are included in Table 1. Soil samples taken from the fields, plant residues and stones were crushed with a wooden mallet and passed through a 2 mm sieve, and then made ready for physical and chemical analysis. In soil samples, organic matter was modified by Bouyoucous hydrometer method (Bouyoucous 1951), pH saturation sludge according to Jackson (1958), % salt

saturation sludge according to Richard (1954); and it was determined with the Walkley Black method as reported by Walkley and Black (1934). Available P (Olsen et al., 1954); available K, according to Richards (1954); and the useful Fe, Cu, Zn and Mn were determined by DTPA as reported by Lindsay and Norvell (1978).

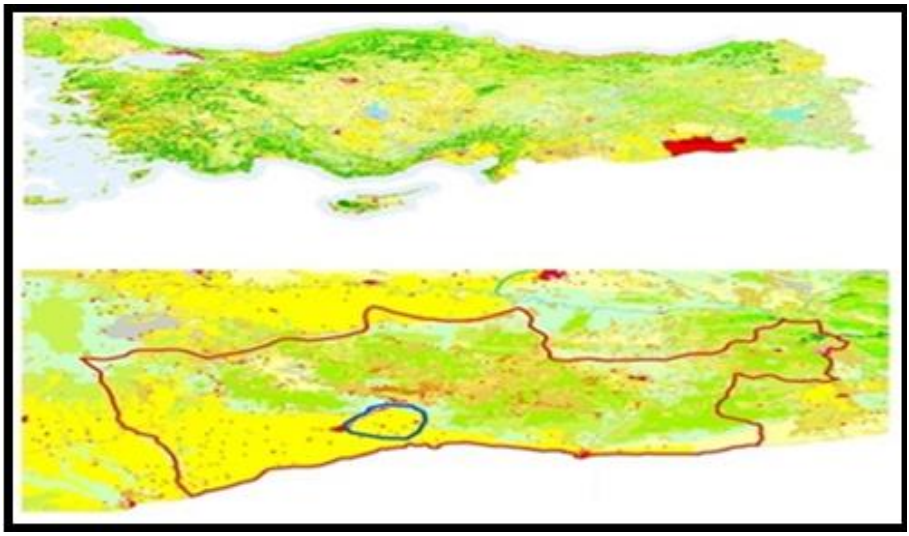

Figure 1. Location map of the study area

Table 1. GPS coordinates of soil samples

Villages	**Coordinates (UTM, m)**	
Yukarı azıklı	648612	4126128
Göllü	652088	4123562
Çiftlik	653071	4127968
Gökçe	650341	4118041
Ortaköy	657734	4120296
Yolbaşı	657870	4125365
Emirli	650105	4114633
Ilıcak	643884	4116133
Kumlu	653083	4114760
Çınarcık	642987	4119847

RESULTS AND DISCUSSION

The altitude of the sampling sites from different villages is between 503-554 metres in Kumlu, Eymirli, Ilıcak, Çınarçık and Gökçe villages, 555-599 metres in Ortaköy and Göllü villages, 600-659 metres in Yolbaşı and Yukarıazıklı villages; with the highest study area determined varying between 660-740 metres in Çiftlik Village. It was determined that the slope of Çitlik and Yolbaşı villages varied between 7.4-13%, and between 0.0-1.1% in the other sampled areas (Figure 2).

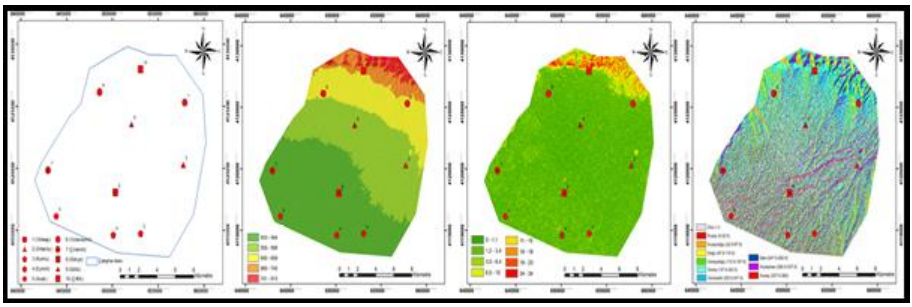

Figure 2. Village names, elevation, slope and aspect maps of the study area

In the sampled areas, Çiftlik village's soils seem to be close to the brown forest soils group; and it has been determined that Yolbaşı, Ortaköy, Yukarıazıklı and Göllü villages are in the other areas group, while Kumlu, Eymirli, Ilıcak, Çınarcık and Gökçe villages are in the reddish brown soil group. When the land use capability maps are examined, Yolbaşı and Çiftlik village soils are in 3rd class; soils in Ortaköy and Çınarcık are in 2nd class; and Kumlu, Eymirli, Ilıcak, Yukarıazıklı, Gökçe and Göllü village soils are determined to be 1st class (Figure 3). Among the soil types in Mardin, two different soil types can be

mentioned; the first is brown forest soils covering 46.65%, and the second is dry agricultural areas that make up 22.68%. 16.48% of the lands in Mardin is first class, 9.73% is 2nd class, and 2.68% is 3rd class, which can be evaluated as fertile land (Mercan and Arpağ 2020).

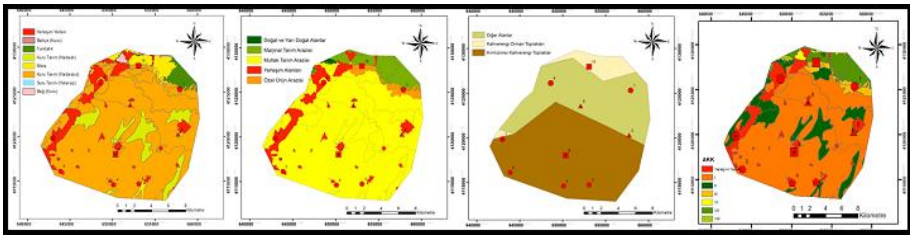

Figure 3. Land use, land classification, land use capability and major soil groups maps of the study area

The pH values of the soils range between 7.36-8.08 and the average pH was determined as 7.70. When classified according to the limit values reported by Kellogg (1952), it was determined that 55% of the soil pH was "slightly alkaline" and 45% was "neutral". When the sampled lands are classified according to the limit values reported by Tüzüner (1990) in terms of salt, it is determined that they are in the "salt free" class, the soils vary between 0.10-0.35% and the average is 0.23%. Organic matter contents vary between 0.54-2.38%, and the average was determined to be 1.39%. When classified according to the limit values reported by Ülgen and Yurtsever (1995), it was determined that the organic matter content of 65% of the soils is in the "low", 20% in the "very little" and 15% in the "middle" class. It has been determined that 70% of the soils are in the "clay-loam" and 30% are in the "loam" class according to their constituent classes (Tables 2 and 3).

In a study conducted by Eren (2019) on soil fertility in some villages of Kızıltepe district of Mardin, it was reported that approximately 67.4% of the soils were at "low" and 32.6% were at "moderate" level in terms of organic matter amounts. It has been stated that the total salt (%) amounts of the village soils used in the study are in the "salt-free" class. As a result of the analysis performed on 25523 soil samples of the South East Anatolia Region, it was stated that 47.5% of the soils has "clay-loam" structure (Güçdemir 2006).

Table 2. In soil samples, pH, salt, organic matter and constituent classes

Villages	Depth (cm)	pH	%					Texture class
			Salt	O.M.	Sand	Silt	Clay	
Yukarı azıklı	0-30	7.41	0.11	1.26	35.21	28.12	36.67	CL
	30-60	7.30	0.19	0.54	38.28	29.01	32.71	CL
Göllü	0-30	7.36	0.18	2.38	39.15	31.13	29.72	CL
	30-60	7.76	0.23	1.25	42.18	35.71	22.11	L
Çiftlik	0-30	7.41	0.10	1.78	41.32	30.26	28.42	CL
	30-60	7.96	0.13	1.06	44.22	35.91	19.87	L
Gökçe	0-30	7.52	0.18	2.04	37.15	30.73	32.12	CL
	30-60	7.93	0.25	1.29	37.97	39.09	22.94	L
Ortaköy	0-30	7.49	0.14	2.26	36.17	31.74	32.09	CL
	30-60	8.01	0.19	1.45	38.57	39.98	21.45	L
Yolbaşı	0-30	7.51	0.30	1.74	39.10	29.54	31.36	CL
	30-60	7.82	0.32	1.02	22.36	41.15	36.49	CL
Emirli	0-30	7.48	0.34	1.45	33.15	37.25	29.60	CL
	30-60	7.25	0.35	0.73	40.79	26.87	32.34	CL
Ilıcak	0-30	7.58	0.15	1.56	39.36	29.75	30.89	CL
	30-60	8.08	0.30	0.84	38.10	43.46	18.44	L
Kumlu	0-30	7.44	0.29	1.89	29.15	39.38	31.47	CL
	30-60	7.97	0.33	1.17	40.22	34.85	24.93	L
Çınarcık	0-30	7.41	0.21	1.37	28.36	35.36	36.28	CL
	30-60	7.94	0.22	0.65	41.17	28.85	29.98	CL
	Min.	7.36	0.10	0.54	28.36	26.87	18.44	
	Means	7.70	0.23	1.39	37.10	33.91	28.99	
	Max.	8.08	0.35	2.38	44.22	43.46	36.67	

Table 3. PH of soil samples, salt, organic matter, constituent classes and sample numbers

Physical and chemical analysis	Limit values	Class	Number of samples	References
pH	<4.5	Very strongly acid	-	(Kellogg, 1952)
	4.5-5.5	Strongly acid	-	
	5.5-6.5	Moderately acid	-	
	6.5-7.5	Neutral	9	
	7.5-8.5	Slightly alkaline	11	
	>8.5	Strongly alkaline	-	
% Salt	0-1,5	Non-saline	20	(Tüzüner, 1990)
	1.5-3.5	Very slightly saline	-	
	3.5-6.5	Slightly saline	-	
	> 6.5	Strongly saline	-	
% O.M.	<1.0	Very little	4	(Ülgen and Yurtsever, 1995)
	1.0-2.0	Little	13	
	2.0-3.0	Middle	3	
	3.0-4.0	Sufficient	-	
	>4.0	High	-	
Texture		C	-	(Bouyoucus, 1952)
		CL	14	
		L	6	
		LS	-	
		SCL	-	
		SL	-	

The macro and micro-element concentrations of soils vary between P 8.13-44.3 mg kg^{-1} and 45% (8.0-25 mg P kg^{-1}) is "sufficient", while 25% (25-80 mg P kg^{-1})'is "high"; and K ranges between 432-734 mg kg^{-1} and it has been determined to be generally "high" in terms of K. Zinc ranges from 0.18-0.56 mg kg^{-1}; 5% (<0.2 mg kg^{-1}) is "very little" and 95% (0.2-0.7 mg kg^{-1}) is "little"; it varied between 2.69-5.26 mg kg^{-1}in terms of Mn; 55% (<4 mg kg^{-1}) is "very little" and 45% (4.0-14 mg kg^{-1}) is "little" (Table 4 and 5). In the study conducted by Eren (2019), in 86 soil samples taken from some villages where wheat farming is carried out, 52.3% of the soils are low, 30.2% are medium,

and 9.3% are high in terms of P_2O_5, while 5.8% very low and 2.3%, it was determined to be very high. He stated that the K_2O amounts of soil samples are very high. In order to determine the general condition of the extractable soil in terms of Fe, Cu, Zn and Mn in Turkey, as a result of the analysis of 1511 soil samples taken to represent the country lands; it was stated that 49.83% Zn deficiency, 26.87% Fe deficiency, and 0.70% Mn deficiency was observed, while deficiency in the Cu element was not observed.

Table 4. P, K, Zn, Mn, Fe and Cu concentrations of soil samples.

Villages	Depth (cm)	mg kg^{-1}					
		P	**K**	**Zn**	**Mn**	**Fe**	**Cu**
Yukarı azıklı	0-30	12.7	523	0.33	5.07	19.9	0.61
	30-60	11.7	486	0.26	5.01	15.5	0.45
Göllü	0-30	13.3	518	0.24	5.26	20.7	0.54
	30-60	8.13	495	0.25	5.12	16.2	0.36
Çiftlik	0-30	15.4	639	0.39	3.42	12.9	0.46
	30-60	9.38	607	0.22	3.56	19.2	0.48
Gökçe	0-30	16.0	677	0.47	3.53	13.4	0.69
	30-60	9.75	638	0.36	2.69	11.6	0.65
Ortaköy	0-30	46.1	691	0.35	3.59	13.7	0.53
	30-60	28.1	657	0.26	2.74	10.8	0.34
Yolbaşı	0-30	44.3	727	0.38	3.72	14.1	0.49
	30-60	27.0	692	0.21	2.81	14.3	0.31
Emirli	0-30	21.3	589	0.43	3.91	14.9	1.05
	30-60	13.0	561	0.31	2.95	9.8	0.67
Ilıcak	0-30	21.5	453	0.56	4.01	15.4	0.65
	30-60	13.1	432	0.32	4.02	12.0	0.41
Kumlu	0-30	25.6	643	0.42	4.13	16.0	0.57
	30-60	15.6	629	0.18	4.12	13.2	0.58
Çınarcık	0-30	24.6	734	0.46	4.09	15.7	0.51
	30-60	15.0	543	0.33	3.95	15.4	0.32
	Min.	8.13	432	0.18	2.69	9.80	0.31
	Means	19.6	597	0.34	3.89	14.7	0.53
	Max.	44.3	734	0.56	5.26	20.7	1.05

Table 5. Classification of soil samples in terms of some macro and micro elements and sample number

Chemical analysis	Limit values	Class	Number of samples	References
P (mg kg^{-1})	< 2.5	Very low	-	(Sillanpää, 1990)
	2.5-8.0	Low	-	
	8.0-25	sufficient	15	
	25-80	High	5	
	> 80	Very high	-	
K (mg kg^{-1})	< 50	Very low	-	(Sillanpää, 1990)
	50-140	Low	-	
	140-370	sufficient	-	
	370-1000	High	20	
	> 1000	Very high	-	
Zn (mg kg^{-1})	< 0.2	Very low	1	(Lindsay and Norvell, 1978)
	0.2-0.7	Low	19	
	0.7-2.4	sufficient	-	
	2.4-8.0	High	-	
	> 8.0	Very high	-	
Mn (mg kg^{-1})	< 4	Very low	11	
	4.0-14	Low	9	
	14-50	sufficient	-	
	50-170	High	-	
	> 170	Very high	-	
Fe (mg kg^{-1})	< 2.5	Few	-	
	2.5-4.5	middle	-	
	> 4.5	High	20	
Cu (mg kg^{-1})	< 0.2	Few	-	
	> 0.2	sufficient	20	

RESULTS

As a result, when Mardin province is classified according to the adequacy of some dry farmed soils in terms of nutrients and productivity; it is in the "salt-free" class, soils varied between 0.10-0.35%, the average being 0.23%, soils were generally low in terms of organic matter, and the average pH values were determined as 7.70. It

has been determined that 65% of the organic matter contents are in "little", 20% in "very little" and 15% in "middle" class. Some macro and micro element concentrations, 45% of soils are sufficient in terms of P amount and 25% is high; in terms of K, it was determined to be generally high. It has been determined that 5% of zinc is "very little" and 95% is "little", and 55% of Mn is "a little" and 45% is "a little". No deficiency in terms of Fe and Cu was detected in soil samples.

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ISBN: 978-625-7279-66-6