

# Agroecological Estimation of the Soils Good for Grape in the Lenkoran Region of Azerbaijan Republic

Mahluga M. Yusifova<sup>1, \*</sup>, Kamala G. Nuriyeva<sup>2</sup>

<sup>1</sup>Faculty of Ecology and Soil Sciences, Baku State University, Baku, Azerbaijan

<sup>2</sup>Institute of Soil Science and Agrochemistry of ANAS, Baku, Azerbaijan

## Abstract

Changing of the natural condition and analysis of the reasons of the dangerous ecological states formation show that all these occur practically as a result of antropogen process effect. An intensification of the ecological problems requires the works over ecological condition estimation at present. From this point of view, the researches which are carried out in the direction of the agroecological estimation of the soil cover on the basis of grape plant possess vital importance for vine-growing development which is considered the most perspective areas in agriculture of the republic. The research consequences in a direction of the agroecological evaluation in the Lenkoran region soils were reflected in the presented article. Initially, a present soil-ecological condition of the investigative region was learnt, the bonitet scores of the Lenkoran region soils of the Azerbaijan Republic were defined. The main limiting factors were determined for the grape and cotton plants being grown in the zone soils at the following period, the ecological value scales were used for it. The Lenkoran region soils evaluation was performed using from the ecological appraisal scales and conducting scientific analyses of all the collected research materials. It was determined that the best soils of the Lenkoran region are ecologically *mountain grey-brown and typical mountain-brown soils*.

## Keywords

Agroecological Estimation, Under Grape Soils, Limiting Factors, Indicators of Fertility, Lenkoran Region

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## 1. Object and Method of the Research

The soils good for grape of the north part in the Lenkoran region are taken as a research object. Total area of the district is about 220000 h. The physical-chemical analyses over the total received methods of the soil samples taken during field-soil researches. Have been conducted D. I. Bulgakov's [1], G. Sh. Mammadov's [5,6], S. Z. Mammadova's [7] and other methods [3,13] are used while conducting an ecological estimation of the soils good for grape in the Lenkoran district.

## 2. Analysis and Discussion

The Lenkoran region is a south zone of Azerbaijan, it borders on the Kur-Araz lowland from the north, on the Caspian Sea from the east and south-east, on Azerbaijan-Iran borderline from the east and south-east, on Azerbaijan-Iran borderline from the west and south-west. Lenkoran is considered from one of the regions where important agricultural products are produced. Lenkoran are divided into two parts according to the relief and geological structure; mountain and lowland zones. Two thirds part of the zone consists of mountains, but one third consists of lowlands. Unlike mountain ranges, a geological age of the Lenkoran lowland is young. This zone

\* Corresponding author

E-mail address: mehluqe\_yusifli@mail.ru (M. M. Yusifova), nuriyevakamala@rambler.ru (K. G. Nuriyeva)

consists of the third period deposits remained under rocks of the present and ancient fourth period. The clayey-delluvial and loamy-delluvial and delluvial-alluvial deposits are represented very well. Their density (thickness) reaches some metres in some places. The sea deposit rocks spread widely. The Lenkoran lowland joins the Kur-Araz in the north of the region [4].

It is possible to separate two different districts according to the relief features in the Lenkoran lowland: the first, district, called "zero" terrace placed at a height of 0-50 m from the sea level, the fifth abrasion-accumulative terrace; the second district is a terrace- beginning from "o" hypsometric height, 28 m below sea level. Some researches [4,12] note that there is "foothill zone" on the border of the mountain and lowland zones. The upper border of the region passes from 500-600 m of height in the west, but passes from 50 m of height in the east. Soil cover of the Lenkoran region had been learnt by some investigators for a long time [4-9, 11,12]. We have learnt summarizing of the reference and fund materials and field researches carried out in the fields good for grape of the north part of Lenkoran and present soil-ecological condition of the zone investigated as a result of the analysis and give soil-ecological character of the mountain-brown, brown, grey-brown and meadow grey-brown soils.

Mountain-brown soils are formed on the low mountainous north end of Alashar-Burovar mountain range, in little warmer and humid condition of the semi-humid subtropic zone of the foothill slopes, on the clayey carbonatic weathering crusts and delluvial carbonatic clays. The fertile layer density reaches 120 sm, humus quantity is to an enough degree – 3,25-3,72% in mountain-brown soils (table 1). A change of the humus quantity is gradual along the profile and goes till deep layers. Total nitrogen quantity changes to 0,18-0,21% correlating well with humus. Phosphorus quantity forms 0,15-0,18%, Potassium quantity is 2,5-2,7%. As a result of leaching of Carbonates deeply carbonatic illuvial horizon is situated under-humus layer in typical mountain-brown soils, but deeper than it in the leaching mountain-brown soils [7].  $\text{CaCO}_3$  quantity is 4,0-16,8% in 0-100 sm layer. A quantity of the absorbed bases is high in these soils, but it is 34,2-34,7 mg-ekv. in 0-50 sm of the layer. The soils environment reaction is neutral characteristic: pH 7,0-7,5. Agrophysical parameters are satisfactory. Profile of the mountain-brown soils is clayey, sometimes low layers are skeletal and form deep fissures in a dry case.

Brown soils: leaching brown soils spread in the southern and central part of the zone, but typical brown soils spread in the northern part. The humus quantity is more in typical brown soils (3,05-4,18%) than leached soils (2,96-3,58%). It reduces gradually till 0-100 sm (1,86-2,35%), a quantity of total nitrogen and phosphorus changes corresponding to

humus ( N 0,18-0,25% in 0-50 sm of layer, P 0,15-0,20%). Carbonateness is observed either in upper layer or little deeper, totally carbonatic illuvial layer is always observed in the soil, simply it is in the different depth according to the leaching degree (11,8-15,6%). These soils are mainly heavy loamy and clayey characteristic (54,48-61,85%) according to mechanical structure [7]. The low layers of the soils developed on deposit rocks are skeletal and little clayey. Because of changing of a quantity of the absorbed bases is more (26,29-40,15 mg-ekv. 100 g. soil) in middle horizon than in upper and low horizons depending on silt fraction quantity.  $\text{Ca}^{+2}$  cation (75-80%) is more in the absorbed bases,  $\text{Mg}^{+2}$  -20%. These soils are solonchaks because of little absorbed  $\text{Na}^+$  quantity (2%). An environment of the leached brown soils is neutral (7,1), typical brown soils are weak alkaline characteristic (7,5-7,9) because an environment reaction depends on absorbing degree with bases and  $\text{CaCO}_3$  quantity. Dry remnant quantity is little (0,05-0,1%), bicarbonate, Ca, Cl and sulphates are more in salts structure. According to the soils agrophysical parameters aggregating character in these soils is weak, it inclines to hardened crustformation having weak structure [4]. Brown soils are used under grape and high profitable heat-loving plants. To develop dry vine-growing is very desirable and profitable.

Grey-brown soils are in the passage from semi-humid climate to arid one, develop in the subtropic dry steppe bushes zone, their soilforming rocks are carbonatic delluvial and proluvial-delluvial clays and loams. The mechanic structure of these soils is middle and heavy loamy (42,8-57,5%), silt particles are met in humus layer. The mechanic structure in the low layers of the profile in the soils developed on hard rocks is very light and skeletal. Agrophysical characters are mainly satisfactory, it is explained by their bad aggregating and heavy mechanic structure [4]. Because of its bad structural composition after rain the sowing layer hardens and forms crust. The low layers of the soil profile possess the highest density and lowest porosity. The humus quantity in the grey-brown soils isn't much-2,23-2,78%, the total nitrogen quantity is correspondingly 0,16-0,24%. The absorption capacity of these soils is high (27,6-35,4 mg-ekv.) but reduction is observed towards low layers. Reaction of the soil environment is alkaline characteristic (pH 7,9-8,3), carbonate quantity is at average level (10,0-14,6%).

Meadow grey-brown soils. These soils develop in the seaside lowlands on debris cones consisting of Bolgarchay horizontal proluvial-alluvial clayey and loams. The humus quantity in the sowing horizon is little more than in the grey-brown (chestnut) soils (2,44-3,12%), it reduces gradually towards low layers and it is 1,21-1,96% in 1 m of the layer. Total nitrogen, phosphorus and potassium quantity

accordingly changes: N 0,19-0,29%, P 0,18-0,24%, K 2,5-3,5%. These soils are carbonatic: 9,2-13,8%, carbonatness is observed along the profile, the most quantity is found in illuvial-horizon. The salts are found along the soil profile, 0,1% in the first half-metre, its quantity rises in the second half-metre, remnant salinization is observed deeply. Salts are sulphatic structural, sometimes chlorides are met. Meadow-grey-brown soils are heavy loamy and clayey according to the mechanical structure (47,24-60,01%). The environment reaction is clayey (7,9-8,4). Alkaliness is very little in the saline soils. These soils become saturated with the bases. A quantity of the absorbed bases is high (25,3-34,61 mg.ekv.100 g. of soil), it can be explained by a clayey character of soils.  $Ca^{2+}$  cation is superior in the absorbed bases structure (70-80%),  $Mg^{2+}$  quantity is 15-20%. The salinization signs are felt in connection of the nearness of subsoil waters with the surface in meadow-grey-brown soils.

The latest research materials over soil, climate and relief parameters of the soils good for grape in the Lenkoran region are gathered, mathematic-statistic scientific analysis is carried out, ecological estimation on the bases of [5,7] the corresponding methods by applying special evaluation scales

according to the separate signs appearance degrees (table 2) has been carried out. As is obvious from the table 7 types and subtypes of the soils good for grape spread in the research zones. Initially on the basis of fertile parameters of these soils bonitet marks are found, at this time as standard soil the mountain-brown soils having the highest fertility are taken (100 marks) (table 3). But having heavy mechanic structure (70 marks) and being of of satisfactory aggregate structure (70 marks) reduced an agroecological mark of these soils (93 marks). The environment factors, pH parameter and carbonate quantity is in optimum, level for these soils. Bonitet mark of the mountain-brown soils (91 marks) decreased (ecological mark-88 marks): the soil parameters take place as limited factors: pH indication (90 marks), carbonate quantity (70 marks), granulometric structure (70 marks) and waterstable aggregates quantity (70 marks). As is obvious the environment factors are in optimum level for vine-growing in mountain-brown soils. The high marks got over the environment and soil parameters as a result of the complex valuation of the ecological condition raises a total ecological mark and it forms 93 marks (bonitet mark -81 marks).

**Table 1.** Agroecological characteristics of soils of the Lenkoran region for winegrowing.

Soil characteristics	Soils			
	Mountain-brown	Mountain-grey-brown	Grey-brown	Meadow-grey-brown
Particle size data (%) 0-100 cm				
<0.01 mm	64,8-68,2	54,1-68,5	42,8-57,5	47,2-60,0
<0.001 mm	30,7-36,0	28,7-34,9	18,3-24,9	20,5-29,8
Humus, %, 0-20 cm	3,25-3,72	2,34-3,12	2,23-2,78	2,44-3,12
0- 50 cm	2,10-2,85	2,55-2,78	1,55-2,32	1,92-2,68
0- 100 cm	1,76-2,17	1,35-1,96	1,12-1,45	1,21-1,96
Nitrogen,%,0- 20 cm	0,21-0,25	0,17-0,23	0,19-0,27	0,22-0,30
0- 50 cm	0,18-0,21	0,15-0,22	0,16-0,25	0,19-0,29
Phosphorus,, %, 0- 20 cm	0,18-0,21	0,15-0,20	0,17-0,23	0,22-0,27
0-50 cm	0,15-0,18	0,14-0,17	0,15-0,21	0,18-0,24
Adsorbed bases, meq/ 100 g				
0-20cm	32,5-33,1	30,1-37,9	27,6-35,4	25,3-34,6
0- 50cm	34,2-34,7	30,5-37,4	27,1-33,5	21,7-31,3
pH, 0-100 cm	7,0-7,5	7,8-8,0	7,9-8,3	7,9-8,4
CaCO <sub>3</sub> , %, 0-100 cm	4,0-16,8	12,4-19,0	10,0-14,6	9,2-13,8

**Table 2.** The bonitet scale of the soils good for grape in Lenkoran region.

Names of the soils	Humus, t/ha mark			Nitrogen, t/ha mark		Phosphorus, t/ha mark	
	0-20	0-50	0-100	0-20	0-50	0-20	0-50
Typical mountain-brown	94,75	191,18	296,4	6,5	15,73	5,6	12,71
	100	100	100	100	100	100	100
Leached mountain-brown	88,70	163,95	260,0	5,82	14,52	4,93	11,50
	94	86	88	90	92	88	90
Mountain-grey-brown	72,54	155,55	213,53	5,15	11,59	4,45	9,76
	77	81	72	79	74	79	77
Typical brown	83,34	172,42	282,1	5,38	12,71	4,70	10,89
	88	90	95	83	81	84	86
Leached brown	72,80	127,05	228,8	4,70	10,89	4,03	9,08
	77	66	77	72	69	72	71
Grey-brown	67,44	131,04	174,2	6,0	13,86	5,04	11,34
	71	69	59	92	88	90	89
Meadow grey-brown	66,35	139,37	217,1	6,73	15,63	5,57	13,12
	70	73	73	103	99	99	103

Table 2. (Continue).

Names of the soils	Potassium, t/ha mark		Sum of the absorbed bases, mg-ekv.		Bonitet mark
	0-20	0-50	0-20	0-50	
Typical mountain-brown	82,88	205,7	35,51	34,70	100
	100	100	100	100	
Leached mountain-brown	76,16	187,5	33,16	34,25	91
	92	91	102	99	
Mountain-grey-brown	74,88	170,8	35,49	35,07	81
	90	83	109	101	
Typical brown	67,29	163,3	31,76	32,25	89
	81	79	98	93	
Leached brown	62,72	151,2	32,12	33,43	77
	76	73	99	96	
Grey-brown	64,80	144,9	32,67	31,84	75
	78	70	100	92	
Meadow grey-brown	74,24	181,2	30,50	27,16	84
	90	88	94	78	

Table 3. Estimation of ecological condition of the soils good for grape in Lenkoran region.

Names of the soils	Height, m	Rainfalls, mm	Md	$\Sigma T > 100S$	Bonitet mark	CaCO <sub>3</sub> , %
Typical mountain-brown	400-700	500-700	3600-4200	0,25-0,35	100	14,0-18,5
	90	100	95	100		100
Leached mountain-brown	400-700	500-700	3600-4200	0,25-0,35	91	2,0-4,0
	90	100	95	100		70
Mountain-grey-brown	200-500	300-700	3800-4400	0,20-0,30	81	12,4-19,0
	100	100	100	100		100
Typical brown	100-200	300-500	4100-4400	0,15-0,25	89	11,8-15,6
	100	90	100	90		90
Leached brown	100-200	300-500	4100-4400	0,15-0,25	77	2,3-5,1
	100	90	100	80		70
Grey-brown	0-100	200-400	4300-4450	0,10-0,20	75	10,0-14,6
	100	80	100	70		90
Meadow grey-brown	-20-0	200-400	4300-4450	0,10-0,20	84	9,2-13,8
	100	80	100	70		90

Table 3. Continue.

Names of the soils	pH	<0,01 mm, %	>0,25 mm, %	Dry remnant, %	Agroecological mark
Typical mountain-brown	7,4-7,6	60,1-67,6	36,7-45,82	-	92
	100	70	60	100	
Leached mountain-brown	6,7-7,3	65,4-70,8	35,51-43,61	-	87
	90	70	60	100	
Mountain-grey-brown	7,8-8,0	54,2-68,5	42,12-49,80	-	93
	100	80	70	100	
Typical brown	7,5-7,9	54,4-59,2	39,6-50,9	0,05-0,10	91
	100	80	70	100	
Leached brown	6,8-7,4	56,2-61,8	31,4-42,3	0,05-0,08	85
	90	80	60	100	
Grey-brown	7,9-8,3	42,8-57,5	31,9-38,2	0,10-0,16	85
	100	90	60	80	
Meadow grey-brown	7,9-8,4	47,2-60,0	26,5-33,2	0,12-0,20	84
	100	80	60	80	

We see that the agroecological marks are higher than bonitet mark in other soil types and subtypes. The bonitet marks of the brown soils increase from 89 and 77, they became 91 and 85 marks. The height parameters, active temperature sum, pH index and dry remnant quantity are in optimum level for these soils, the rainfalls quantity (90 marks), Md index (90 marks), Carbonate quantity (90-70 marks), granulometric structure (80 marks) and water-stable aggregates quantity (70 marks) make limitation in vine-growing. Though bonitet mark of the grey-brown soils increases from 75 marks till 85

marks, a mark of the meadow grey-brown soils remains constant (84 marks). From the environment parameters for grey-brown and meadow-grey-brown soils - rainfalls quantity (80 marks), Md index - (70 marks), from soil parameters - Carbonates quantity (90 marks), granulometric structure (80 marks) and water-stable aggregates quantity (60 marks) take place as limited factors [2]. Generally, the typical mountain-brown and mountain-grey-brown soils got the highest agroecological mark according to the fitness for grape over the zone.

According to the carried out agroecological researches in order to produce desert, weak and strong wines and cognac wine productions in the vineyards of the foothill plain part of the Lenkoran region: to grow Hamashara, Rkasiteli, Bayanshira, Khindogni, Madrasa-technical grape sorts and Ag (White) xalili, Black raisins, Ag (white) Shani-table grape sorts; strong desert, table wines, cognac vine products, grape juice in the low mountainous- foothill part: Izabella, Bayanshira, Rkasiteli, Khindogni, Madrasa from technical grape sorts for table grape production: Ag (White) Khalili, Ag (White) Shasla, Gara (Black) Shani, Tabrizi grape sorts [10] are advisable to grow.

### 3. Consequences

1. The main bonitet scale has been composed by carrying out qualitatively estimation of the Lenkoran region soils on the basis of studying of the temporary soil-ecological condition of the zone which is investigated as a result of the analysis and generalization of the reference and fund materials; the typical mountain-brown soils (100 marks) having the highest fertility over the zone as a model soil are taken; enough fertilite soils are typical leached mountain-brown (91 marks), typical brown (89 marks), meadow grey-brown (84 marks), mountain grey-brown (81 marks) soils. The relative fertility concerns leached brown (77 marks) and grey-brown (75 marks) soils of the plain zone.
2. As a result of the investigations the main limited factors of the vine-growing in the low mountainous and foothill zone in the Lenkoran district- possessing mechanical structure (70 marks) and being insatisfactoriness of the aggregate structure (60-70 marks), for plain zone soils: climate aridity (Md parameter-70 marks), rainfalls quantity (80 marks), granulometric structure (80-90 marks), water-stable aggregates quantity (60 marks) and soils salinization (80 marks) are defined. The mountain grey-brown and typical mountain-brown (93 marks) soils are the most useful for grape on agroecological side.

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