SUITABILITY FOR VINE PLANTATIONS OF SOIL RESOURCES FROM VINIFRUCT COPOU COMPANY OF IASI

Cristian HUŢANU[1], Feodor FILIPOV[1], Octavian TOMIŢĂ[1]
E-mail: hutanucrst@yahoo.com

Abstract

The favorability establishment of soil resources for vine plantations was done for four representative soil units (US_1, US_2, US_3, US_4) from Vinifruct Copou Company of Iasi. Soil units belong to the second class of favorability for vines for wine production and to the third class of favorability for vines for production of consumption grapes. Restrictive factors of grapes production are represented by deep groundwater, terrain slope, corrected annual average temperature, the humus reserve and the water excess manifested only in the middle part of soil (US_4). The lowest favorability of evaluation notes was obtained for the vine plantations for production of consumption grapes. The lower favorability of evaluation notes is due to the necessity of higher temperatures for plantations of vine for production of consumption grapes. The lowest suitability for vine was recorded for the unit of soil US_3 and is due to average terrain slope that is higher, which favors the soil surface erosion by water flow, decreasing the humus and the nutrients supply. Area occupied by these units is small and therefore the weighted average of evaluation note has higher values.

Key words: favorability, soil resources, plantations of vine

Knowledge of soil resources is useful for a wide range of activities such as:

- inventory and systematization of surfaces (parceling, tracing the roads and others) taking into account soil and terrain conditions;
- establishing the most appropriate land use categories for efficient exploitation of the land while maintaining an optimal level of soil fertility;
- determining the degree of favorability of the soil for different species, varieties and hybrids of cultivated plants;
- adaptation of agricultural technologies for growing plants differently, depending on plant requirements, soil conditions and characteristics and others.

MATERIAL AND METHOD

The study and technical evaluation of soil resources was carried out in 97.9865 hectares of vineyard plantation of Vinifruct Copou Company of Iasi, located northwest of City of Iasi [Huţanu, Cr., 2011].

The studied territory is under the influence of observations made at weather station of Iasi (altitude H = 100 m; longitude λ_E = 27º 36'; up φ_N = 47º 10'), where the average annual temperature is 9.5ºC, solar radiation is between 114 and 128 kcal/cm^2, the average yearly rainfall is 580 mm, of which between April to October 421.4 mm (73% of total), during this period recording a total deficit of 223 mm and annual aridity index value is 29.7 ≈ 30. These parameters allow us to consider that the territory fall within the climate zone "II moderately warm – half-wet".

The main features of the landscape are surfaces slopes which can be highlighted on the case plan by three such categories of slope (*fig. 1* and *tab. 1*):

- from 2.0 to 5.0% on 14 parcels and the area of 4.5161 hectares (4.61% occupancy) with wavy relief;
- from 5.1 to 12.0% on 61 parcels and the area of 55.2442 hectares (56.38% occupancy) in low relief terrain;
- from 12.1 to 20.0% on 56 parcels and the area of 38.2262 hectares (39.01% occupancy) with moderately rough terrain.

Given the fragmentation density and energy of relief, according to the same indicator is considered that most of the area presents a slightly rough relief (55.2442 hectares, 56.38% occupancy) in moderately fragmented hill area of the south of Moldova Plain.

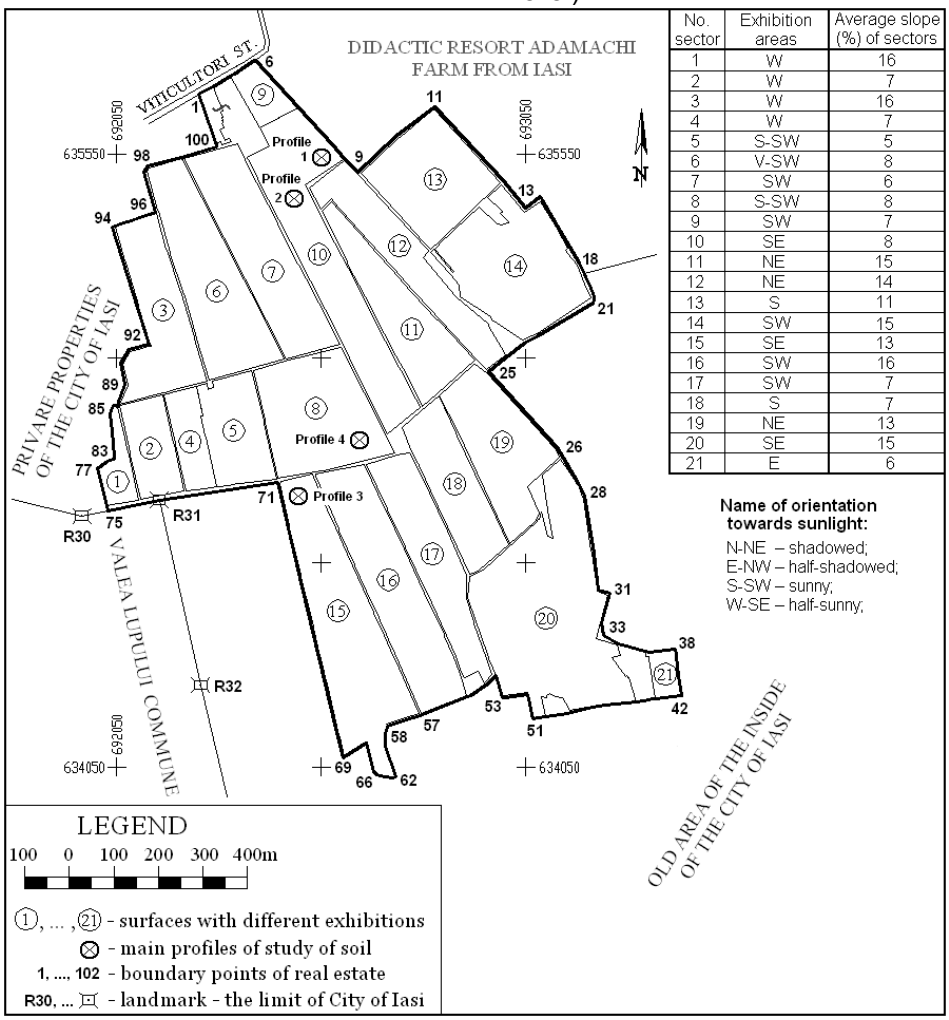
For the framing in 3C indicator, regarding the corrected annual average temperature, are taken into account the temperature corrections according to the slope and exposition. The correction value is 9.8ºC, which changes the annual average temperature class, in which is framed the area under study.

To characterize the annual average precipitations will take into account the group and class of slope and exhibition of land class shown in figure 1 by areas (sectors) worked with mechanized technology. For evaluation of land

[1] University of Agricultural Sciences and Veterinary Medicine Iasi

surfaces was calculated the average slope of sectors, as the arithmetic average of the average slope of cadastral parcels that are composing mechanized worked surfaces.

The average slopes of mechanized worked sectors (tab. 1) have values between 4.98% (technological sector 5) and 16.12% (technological sector 3), and the average slope of the entire area owned by vineyard unit is 10.52% (slightly rough relief).



No. sector	Exhibition areas	Average slope (%) of sectors
1	W	16
2	W	7
3	W	16
4	W	7
5	S-SW	5
6	V-SW	8
7	SW	6
8	S-SW	8
9	SW	7
10	SE	8
11	NE	15
12	NE	14
13	S	11
14	SW	15
15	SE	13
16	SW	16
17	SW	7
18	S	7
19	NE	13
20	SE	15
21	E	6

Figure 1 **The sketch of the sectors worked with mechanized technology, with various exhibitions, of Vinifruct Copou Company of Iasi**

Table 1

Distribution of slope categories on agricultural plots from the agricultural total

Slope category (%) *	Plots number	Area in hectares of slope category	Percentage of occupancy (%)	Color	Landforms name
2.0 – 5.0	14	4.5161	4.61	yellow	Corrugated relief
5.1 – 12.0	61	55.2442	56.38	green	Slightly injured relief
12.1 – 20.0	56	38.2262	39.01	ocher	Moderately injured relief
AGRICULTURAL TOTAL	131	97.9865	100.00	–	–

** According to the indicator no.1 on the annex no.3, from The Methodology of Elaboration of Soil Studies, 3rd Part, 1987*

To achieve the cartogram of these technological sectors, in figure 1 were delimited these areas, enrolling in a joined table the slopes exposition and average slope. By allocation on land exhibition class (indicator 34), shown in *figure 1,* on mechanized worked sectors, we see that the location of vineyard unit is favorable to vine plantations with a sunny exhibition of 45.94% and half-sunny of 39.58% (tab. 2).

RESULTS AND DISCUSSIONS

In the vine plantation of Vinifruct Copou Company of Iasi were characterized four representative units of soil: mezocalcaric aric cambic chernozem, regradat aric cambic chernozem, weakly eroded aric cambic chernozem and weakly water excess coluvic aric cambic chernozem.

Table 2

Distribution on exhibition class of the land on the sectors worked with mechanized technology at Vinifruct Copou Company of Iasi

Exhibition classes of land from sunlight	Plots number	No. of mechanized worked sectors	Area in hectares of mechanized worked sectors	Percentage of occupancy (%)
N – NE (shadowed)	11	3	13.5230	13.80
E – NV (half-shadowed)	5	1	0.6632	0.68
S – SW (sunny)	55	10	45.0126	45.94
W – SE (half-sunny)	60	7	38.7877	39.58
AGRICULTURAL TOTAL	131	21	97.9865	100.00

The **unit of soil US_1** is located on low sloping ground with an average slope of 6%. According to morphology, soil was diagnosed as mezocalcaric aric cambic chernozem, consisting of the following pedogenetics horizons: plowed layer, Apd; A molic sloppy, Amd; (A+B) sloppy and B cambic with accumulations of calcium carbonate by the regradare process (Romanian System of Soil Taxonomy, 2003).

Cambic chernozem is a soil with a large and useful edaphically volume and good aerohidric regime. Relatively uniform color of soil matrix indicates that the soil is not affected by stagnant moisture excess. The soil is relatively loose except tamping areas of agricultural machinery used in soil works and maintenance of the plantation. Soil compaction is evidenced by massive structure, lower frequency of plant roots and their uneven distribution. From an agronomic point of view, the soil presents no major restrictions for noble vine plantations.

Mezocalcaric aric cambic chernozem has a fine texture (loamy clay – TT), total porosity between 46.64 and 51.71%, slightly acid reaction to slightly alkaline (tab. 3). Calcium carbonate appears from 40 cm depth.

Table 3

Some physical and chemical properties of mezocalcaric aric cambic chernozem (US_1) from Vinifruct Copou Company of Iasi

Depth (cm)	Pedogenetic horizon	Texture	PT (%)	DA (g/cm^3)	$CaCO_3$ (%)	pH	Humus (%)	Humus reserve t/ha (0 – 50 cm)
0 – 16	Apd	TT	51.71	1.27	-	6.2	3.37	177.98
16 – 40	Amd	TT	49.05	1.34	-	6.7	2.65	
40 – 56	(A+B)d	TT	47.02	1.42	1.3	7.6	1.71	
56 – 71	Bvk	TT	46.64	1.43	5.3	8.3	-	-

Mezocalcaric aric cambic chernozem (US_1) falls into 2nd class of favorability for vine plantations for wine production. Favorability of the soil limiting factor is represented by the great depth of the groundwater, the evaluation coefficient being only 0.8 (tab. 4).

Table 4

Evaluation notes of ground unit US_1 of vine plantations of Vinifruct Copou Company of Iasi

Culture	Coefficients of evaluation for:									Evaluation notes
	Tc (ºC)	Pc (mm)	Ground-water	Texture Ap	Slope (%)	PT (%)	$CaCO_3$ (%)	pH Ap	Humus reserve	
VV*	1	1	0.8	1	1	1	1	1	1	80
VM**	0.8	1	0.8	1	0.9	1	1	1	1	58
VN***	0.9	1	0.8	1	0.95	1	1	1	1	68

*VV – wine vineyard, **VM – consumption grapes vineyard, ***VN – vineyard (two varieties: VV and VM)

The unit of soil US_1 has a lower favorability for plantation of vines for consumption grapes production, the limiting factors being represented by groundwater located at great depth and corrected annual temperature average values.

We are mentioning that in some years, during the phase of exploitation of the plantations, can be obtained both higher productions than the corresponding evaluation average notes and under average productions, depending on the climate features of the year.

In the situations where the vine hubs for the production of wine grapes and consumption grapes occupies about equal surfaces, the average value of the evaluation note is estimated as an arithmetic average of the two types of plantations.

The **unit of soil US_2** is located on the terrain with an average slope of 9.5% (slightly inclined). Following the morphological description, the soil was diagnosed as regradat aric cambic chernozem (proxicalcaric).

The soil profile has the following pedogenetic horizons: plowed layer (Apd); D_1(A+B)k, D_2(A+B)k in alternation with Bvk; Cca (horizon of accumulation of earth alkaline carbonates).

The regradat aric cambic chernozem, is a soil with large useful edaphically volume and good aerohidric regime. Although the soil has a fine texture (loamy clay – TT), it is intensely drained due to the terrain tilt favoring rapid flow of rainwater. The weak to medium tilt of the terrain determines the manifestation of surface hidric erosion process, a fact evidenced by the less thickness of the sloppy soil layer.

The main weed species identified in the spring season are represented by *Stellaria media, Taraxacum officinale, Veronica hederifolia* and others. The roots highest frequency is recorded in soil material with a darker color and higher content of humus.

From an agronomic point of view, the soil presents no major restrictions for noble vine plantations, but soil degradation by erosion occurs gradually and continuously with different intensities, according to rain characteristics, length of drainage on the slope and its inclination.

Regradat aric cambic chernozem has a fine texture (loamy clay – TT), total porosity of between 43.66 and 47.75%, slightly acid reaction in Apd horizon and weak alkaline underlying horizons (*tab. 5*). Except for the superficial layer (0 – 8 cm) there is a secondary accumulation of calcium carbonate in the upper soil profile by regradare processes.

Table 5

Some physical and chemical properties of regradat aric cambic chernozem (US_2) from Vinifruct Copou Company of Iasi

Depth (cm)	Pedogenetic horizon	Texture	PT (%)	DA (g/cm^3)	$CaCO_3$ (%)	pH	Humus (%)	Humus reserve t/ha (0 – 50 cm)
0 – 8	Apd	TT	47.75	1.38	-	6.5	2,94	149.44
8 – 30	D_1(A+B)k	TT	46.39	1.41	1.87	7.4	2,21	
30 – 45	D_2(A+B)k+Bvk	TT	45.90	1.45	2.63	7.9	1,67	
45 – 60	Cca	TT	43.66	1.51	5.76	8.1	-	-

The unit of soil US_2 fits in the same classes of favorability for vine plantations as previous soil unit (*tab. 6*). Secondary accumulation of calcium carbonate does not limit the growth and development of the vine, knowing that it is a plant that tolerates calcium carbonate sediments.

Table 6

Evaluation notes of ground unit US_2 of vine plantations of Vinifruct Copou Company of Iasi

Culture	Coefficients of evaluation for:									Evaluation notes
	Tc (ºC)	Pc (mm)	Ground-water	Texture Ap	Slope (%)	PT (%)	$CaCO_3$ (%)	pH Ap	Humus reserve	
VV*	1	1	0.8	1	1	1	1	1	1	80
VM**	0.8	1	0.8	1	0.9	1	1	1	1	58
VN***	0.9	1	0.8	1	0.95	1	1	1	1	68

**VV – wine vineyard, **VM – consumption grapes vineyard, ***VN – vineyard (two varieties: VV and VM)*

The **unit of soil US_3** is located on terrain moderately inclined with a slope average of 10.6%. Following the morphological description, the soil was diagnosed as aric cambic chernozem, slightly eroded. Soil profile consists of the following pedogenetic horizons: plowed layer (Ap); D(A+B) in alternation with B_V; transition horizon BC and horizon C of accumulation of calcium carbonate (Cca). Weakly eroded aric cambic chernozem is a large useful edaphically volume and good aerohidric regime. In principle, the inclination of the terrain favors the flow of rain water causing the amplification of the negative effect of drought. The weak to moderate inclination of the terrain determines also the manifestation of surface hidric erosion process, as evidenced by the less thickness of the layer of sloppy soil.

The weak eroded aric cambic chernozem fits in the group of soils with fine texture (loamy clay – TT). The humus reserve is small because a part of the humus material was removed through processes of surface erosion (tab. 7). Restrictive factors of soil fertility are represented by lower reserves of humus and nutrients and by the greater slope of terrain that favors the surface water flow and the decrease of the amount of water that infiltrates into the soil.

Table 7

Some physical and chemical properties of weakly eroded aric cambic chernozem (US_3) from Vinifruct Copou Company of Iasi

Depth (cm)	Pedogenetic horizon	Texture	PT (%)	$CaCO_3$ (%)	pH	Humus (%)	Humus reserve t/ha (0 – 50 cm)
0 – 12	Apd	TT	53.23	1.23	6.2	2.92	104.53
12 – 34	D(A+B)k	TT	51.12	1.31	6.7	1.56	
34 – 50	Bv	TT	46.64	1.43	6.7	0.72	
50 – 65	BC	TT	44.03	1.50	7.2	-	-

The unit of soil US_3 has a reduced favorability for vine plantations due to a lower humus reserve and due to terrain slope. Although in the upper side of soil profile (0 – 12 cm) it is recorded 2.92% of humus, because of the reduced thickness of the layer of humus accumulation, the humus reserve expressed in t/ha on a reference thickness of 50 cm is only 104.5 t/ha (*tab. 7*). Other restrictive factors of soil favorability for vine growing are the big depth of groundwater and the terrain slope (*tab. 8*). The unit of soil US_3 has the lowest evaluation notes for plantations of grapes vine for consumption, because these varieties have the biggest heat requirements.

Table 8

Evaluation notes of ground unit US_3 of vine plantations of Vinifruct Copou Company of Iasi

Culture	Coefficients of evaluation for:									Evaluation notes
	Tc (ºC)	Pc (mm)	Ground-water	Texture Ap	Slope (%)	PT (%)	$CaCO_3$ (%)	pH Ap	Humus reserve	
VV*	1	1	0.8	1	0.9	1	1	1	0.9	65
VM**	0.8	1	0.8	1	0.8	1	1	1	0.9	46
VN***	0.9	1	0.8	1	0.85	1	1	1	0.9	55

**VV – wine vineyard, **VM – consumption grapes vineyard, ***VN – vineyard (two varieties: VV and VM)*

The **unit of soil US_3** is located on terrain moderately inclined with a slope average of 10.6%, in the middle third of the slope, the terrain having a linear-convex slope after water flow direction and with south-eastern exposition. As regards the external drainage this is satisfactory. The soil was formed on colluvial deposits formed by gradual accumulation of eroded material from the slopes surface from the immediate vicinity.

Weakly water excess coluvic aric cambic chernozem is a soil with a large and useful edaphically volume and good aerohidric regime. Although it has a relatively uniform color is affected by stagnant moisture excess coming from the drains of slope sides. Only in areas where are passing the agricultural machinery used for the execution of the soil works and the maintenance of the plantation, the soil it is not relatively loose. Therefore, in this area the frequency of roots of plants and often their uneven distribution is lower due to soil compaction as evidenced by a massive structure. From an agronomic point of view, the soil presents moderate restrictions for noble vine plantations. Temporary manifestation of moisture excess causes the decrease of resistance from frost. In depression areas where there is a water excess from adjacent lands leakage appeared more goals in the plantation.

Since calcium carbonate is within the 5 and 100 cm depth, the soil is mezocalcaric (tab. 9).

Table 9

Some physical and chemical properties of weakly water excess coluvic aric cambic chernozem (US_4) from Vinifruct Copou Company of Iasi

Depth (cm)	Pedogenetic horizon	Texture	PT (%)	$CaCO_3$ (%)	pH	Humus (%)	Humus reserve t/ha (0 – 50 cm)
0 – 16	Apd	TT	52.99	1.26	6.1	3.40	191.61
16 – 28	Am	TT	50.00	1.34	6.3	2.85	
28 – 61	Dw(Am)	TT	51.12	1.31	6.5	2.68	
61 – 90	Bv_1	TT	47.02	1.42	7.5	-	-

The unit of soil US_4 it is well supplied with humus and nutrients. The humus reserve is high, being revealed in terrain by the dark color of the upper side of soil profile and thickness of humus horizon. The thickness of the dark horizon is due to gradual accumulation of eroded material and deposited by waters flowing from the terrains in the immediate vicinity. As a result of the exploitation of vine plantations was created a slightly wavy micro relief with small crests and small gutters, those favoring water infiltration into the soil and drainage to the slope basis.

Weakly water excess coluvic aric cambic chernozem (US_4) has a lower favorability for vine plantation due to terrain slope and due to temporary stagnation of water in the deposit area of eroded material by flowing waters from the lands in the immediate vicinity (tab. 10).

Table 10

Evaluation notes of ground unit US_4 of vine plantations of Vinifruct Copou Company of Iasi

Culture	Coefficients of evaluation for:										Evaluation notes
	Tc (ºC)	Pc (mm)	Ground-water	Texture Ap	Slope (%)	PT (%)	$CaCO_3$ (%)	pH Ap	Humus reserve	Water excess	
VV*	1	1	0.8	1	1	1	1	1	1	0.9	72
VM**	0.8	1	0.8	1	0.9	1	1	1	1	0.9	52
VN***	0.9	1	0.8	1	0.95	1	1	1	1	0.9	62

**VV – wine vineyard, **VM – consumption grapes vineyard, ***VN – vineyard (two varieties: VV and VM)*

The water stagnation is also favored by the anthropic micro relief, which is a result of the annual maintenance works of the plantation. The surface of the land is slightly wavy, alternating the micro areas from the row of plants and with higher elevation of land with gutters formed on the spacing between the rows of plants.

The main weed species identified in the spring season are represented by *Stelaria media*, *Cirsium arvense, Achilea setacea, Rumex crispum.* The low favorability for vine plantations is also confirmed by the existence of holes in the territorial unit of soil US_4. The holes appeared in the plantation in the years when were recorded less favorable climatic conditions for the growth and development of the vine (low temperatures during the winter, atmospheric and soil drought in summer).

In these years the hubs of vine from the unit of soil US_4 were more vulnerable and were dry. The evaluation notes determined on the basis of evaluation coefficients are presented in table 10.

CONCLUSIONS

The framing of the territory studied, based on the most representative soil units, in the second class of favorability for vines for wine production and to the third class of favorability for vines for production of consumption grapes production is due to the following restrictive factors: deep groundwater, terrain slope, mean corrected annual average temperature, the humus reserve and the water excess.

The lowest favorability of evaluation notes was obtained for the vine plantations for production of consumption grapes (between 46 and 80 evaluation points) because of the bigger requirements of heat.

BIBLIOGRAPHY

Huţanu, Cr., 2011 – *The cadastral changes that occurred in time over the parcels of the vineyard unit Vinifruct Copou Company – limitrophe to the inside of the City of Iasi*, Scientific Works, The 54 volume, Horticulture Series, U.S.A.M.V. Iasi.

Munteanu, I., Florea, N., 2009 – *Guide for the description in the field of the soil profile and specific environmental conditions,* SITECH publishing, Craiova.

*****, 1987** – *The Methodology of Elaboration of Soil Studies, 3rd Part – Ecopedologics Indicators*, elaborated by Institute of Pedology and Agrochemistry Bucharest.

*****, 2003** – *Romanian System of Soil Taxonomy*, elaborated by Institute of Pedology and Agrochemistry Bucharest.