THE EFFECTS OF VITICULTURE ON THE SOIL QUALITY STATUS IN THE REPUBLIC OF MOLDOVA

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Abstract

There were identified the causes that led to the worsening situation and land deterioration in the vineyards: the irrational parceling of vineyard plantations by privatizing former household; the considerable decrease of soil fertility in vineyards due to the lack of funds to combat erosion and losses of nutrients; the abandonment of over 50 000 hectares of vineyards due to low yields (2.0 to 2.5 t ha^{-1} of grapes); the lack of funds for clearing the old vineyards; the excessive spread the species of weeds, crop diseases and pests harmful to the vines due to the lack of pesticides; relocation of the new plantations from slops typical for viticulture (occupied with the old vineyards) on the inadequate land (dales, vales, meadows, etc.); the soil pollution of vineyards with residues of pesticides and plant protection products; the soil salinity hazard in the saplings planted vineyards. In this context, a soil protection system of vineyards was developed and proposed, based on the organizational, agro-, phyto- and hydro-technical measures.

Key words: protection measures, soil degradation, vineyards

Development of viticulture in Republic of Moldova knows several stages of development. The first stage - since ancient times until the 80's of XIX century, is characterized by the accumulation of production experience and knowledge about the role of soil and other environmental factors in the development of the viticulture. The second phase since the end of XIX century until the 50's of XX is characterized by scientific research on soil properties, on the quality and quantity of vine production, in terms of genetic pedology, applying research methods in field and laboratory. The main feature of this period is the transition of viticulture to grafted culture. The third stage - contemporary, characterized by database development of ampelology science as separate branch of agricultural pedology. An interest becomes on the research of ecological system "*soil – vines"*, determination of capacity and intensity of biological cycle of nutrients, development of soil fertilization systems of planted vines (Унгureану В., 1979). Thus, the soil becomes an important object of viticulture study in Moldova.

MATERIAL AND METHOD

For this study we used the literature on viticulture and national data base. The results are presented as graphs charts formulas interpretations.

RESULTS AND DISCUSSIONS

On January 1st, 2014 Moldova's total area constitutes 3384.6 thousand ha, including: 1960.8 thousand ha (58%) of agricultural land, of which 1651.1 thousand ha (84.2%) - arable land, 244.3 thousand ha (12.5%) - perennial plantations, including vineyard – 113.6 thousand ha (5.5%). From total area of vineyard, in the private ownership are 4.4%. Irrigate plantations constitute 1037 ha, in the private ownership – 737 ha (71.1%). The young vines of 1-4 years are 10 percent of the total area of vines (Cadastru Funciar, 2014).

The last agrarian reform in Moldova, in the result of inappropriate strategies, has not created conditions for increasing soil fertility in vineyards, sustainable land use, increasing agricultural production, exerting therefore a negative impact on the viticulture. The causes leading to decreased in viticulture consequences are:

- irrational fragmentation of agricultural land and liquidation of techniques units by privatizing former household;
- significant decreased of soil fertility in the vineyards due to lack of funds to combat soil erosion and compensate the losses of nutrients;
- abandonment of over 50 thousand hectares of vineyards due to low yield (2.0 - 2.5 t ha^{-1} of grapes) and lack of funds, state subsidies for their deforestation (about 4-5 thousand lei ha^{-1});

• excessive spread of many species of herbs harmful vine culture, as a result of unsatisfactory work of plantation land, shortage of manpower, financial resources to purchase herbicides;

• relocation of new industrial plantations (over 20 thousand ha) from the typical vine slope to land of valleys, meadows, alluvial soils with clay texture;

• soil pollution from plantations of vines with pesticide residues;

• increasing soil salinization of vine nurseries (over 22 licensed businesses in this area) as a result of use the water high mineralization, excessive use of sprinkler irrigation method;

• diminishing soil fertility in vine plantations due to land unclogging without fertilization included in projects to create new ones;

• frequent loss of multiples areas of land, once used successfully to create plantations of perennial crops (including vines) due to the occurrence the process of swampy (recurrence of coastal springs, surface water, reed bushes, etc.)

• Deforestation of protection forest belts on the considerable land surface, leading to increase the wind erosion on cultivated lands vine plantations (Leah T., 2012).

Land reform has radically changed the structure and use of land ownership, to ensure land solvency, the increased number of participants in land relations, led to a variety of forms of land ownership and management (*figure 1, 2*).

However, these land changes have not created conditions for increasing soil fertility and agricultural production volume, which decreased during the agrarian reform 2 times (*table 1*).

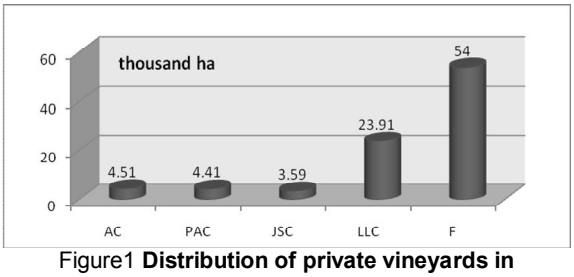

Figure1 **Distribution of private vineyards in accordance to type of activity (AC - agricultural cooperative, PAC – production agricultural cooperative, JSC - joint stock company, LLC - limited liability company, F - farm)**

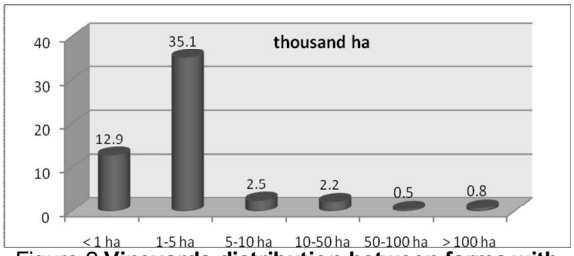

Figure 2 **Vineyards distribution between farms with different surface**

Table 1

Comparison of land use of Moldova in 1989 (up to land reform) and 2004-2012 (after the land reform)

Land category	1989		2004		2011		2012	
	Thousand ha	%	thousand ha	%	thousand ha	%	thousand ha	%
Total land	2578,9	76,4	2528,3	74,9	2498,3	73,8	2450,2	72,4
Arable	1819.7	53,8	1845,4	54,5	1812,7	53,6	1651,0	48,8
Perennial plantation, including:	410,4	12,1	298,0	8,8	298,8	8,8	244,3	7.2
Vineyards	**182,1**	**5,4**	**153,0**	**4,5**	**149,6**	**4,4**	**113.6**	**3,4**

Massive land clearing of vineyards in the Soviet Union period after approval of anti-alcohol laws in the 1980 and EU measures, which have stimulated grubbing up, led to decrease of vineyards surface in the Republic of Moldova. During 2000-2012, the situation has improved slightly and the surface of vineyard plantations showed modest stability (*figure 3*).

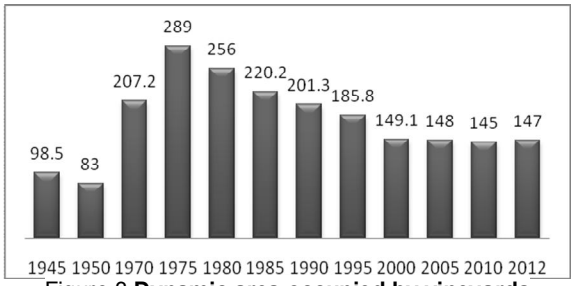

Figure 3 **Dynamic area occupied by vineyards**

Erosion resistance of soils as a result of sloppy removing on the surface the clays is very small. Soil cover in vineyards located on sloping land, during spring - summer period is unprotected status of black field and in the early years is subject of the very intensive processes of erosion.

Therefore, preparation of land for the establishment of vineyards on slopes should be made on the general direction of the contour. Currently about 70% of the vine plantations are located on the eroded soils (*figure 4*).

To antierosion organization of vineyards on the arable slopes, the relief conditions are often ignored. Roads, fields and sectored areas are located along the slopes, in the result is formed trenches and ravens. Often, conditions for focusing leaks are created as various irregularities of the soil surface - pits, improper leveling of longitudinal roads, cross plowing along the upper litter of forest

strips, divided furrows, that comprising water runoff from areas located further up and we headed for a second trench at a distance of 300-400 m, which then formed ravens.

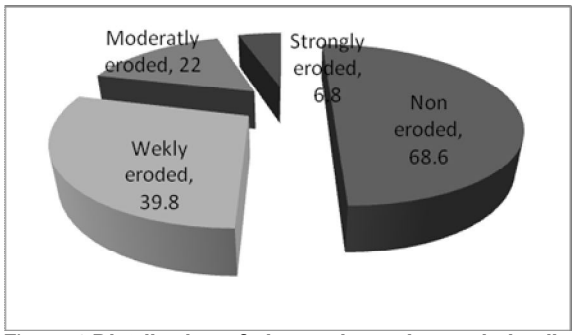

Figure 4 **Distribution of vineyards on the eroded soils**

In vineyards need permanent monitoring on soil surface in order to carry out the appropriate order to avoid concentrating runoff and reduce their fertility. Also be made uniform dispersion of water flow without damage by forest belts, bands – buffer, grass strips to discharge the water and other protective plantations. Surface runoff during rainfall should be regulated during and after heavy rains, preventing formation of preventing the formation of trickles, rills, gullies leading to the initiation of ravens. Weighted average annual yield losses from eroded land in vineyards with an area of 113.6 thousand ha are 30%. Damage caused by erosion, in cash, on land occupied by plantations is - 1350 lei ha^{-1} (Eroziunea solului, 2004).

Degradation of arable layer In the foundation process of vineyards were unclogged at the depth of 50-60 cm - 550 thousand ha of land, which led to the disruption of natural stratification of genetic horizons and surfacing the underlying weak humus horizons with high carbonates content. Soil fertility of sloppy land used for field crops is lower on average by 10-20% compared to similar non damaged soil fertility. Anthropogenic soil surface increases from the expense of damaged abandoned old vine plantations (*figure 5*).

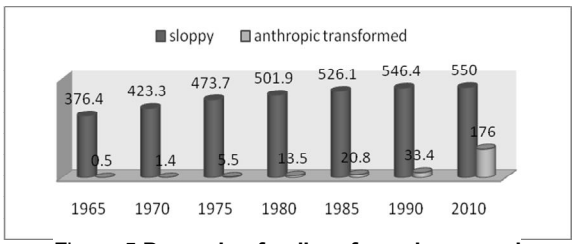

Figure 5 **Dynamic of soil surface sloppy and anthropic transformed, thousand ha**

Soil compaction. Shunting capacity of agricultural machinery in vineyards is reduced, leading to their release on one and the same way, forming areas with increased soil compaction as a result of reduced water permeability, while increasing soil erosion and water flow on the slopes. The deterioration process of soil structure and secondary compaction extends over the entire area of intensive agro-technical tillage covered by vineyards.

Dehumification and soil properties modification. Soils on the slopes are very different content of humus; the physical, chemical and biological properties depending on type of soil and origin of horizons. Content in different particle size fractions (sand, dirt, clay), humus, nutrients, pH values, density, etc. appear as weighted averages values of the characteristics of mixed types or subtypes horizons status. To assess the conditions and status of slopes and damaged anthropic soils of vineyards need to perform special investigations to establish rational exploitation and mitigation measures of their fertility under the system of pedological monitoring. Soils damaged by unclogging are not announced in the inventory lists. This fact do not permit to be estimated the losses of soil organic matter, secondary processes of soil compaction and deterioration of structure.

Creditworthiness note. To assess the creditworthiness note of vineyards soil, and location of these plantations a scale of evaluation was developed , taking into account the reaction of vines at different soil properties. The clay loam calcareous chernozem is considered as standard soil (100 points). According to this scale of evaluation the soil quality status for location of vines is satisfactory. Creditworthiness weighted average note of soils used in vineyards is 60 points.

The main factors limiting the founding vineyards are: the 10-15% of the vine plantations now is located in depressions places (valleys, meadows); the high content of carbonates in the soil, more than 17%; the soil high apparent density more than 1.5 kg cm^{-3}; the high clay content greater than 60%; the pH less than 6.5; the presence of groundwater nearer than 1.5 m from the soil surface; the soil or marshy with NaCl salt concentration of greater than 0.6; if the slope exceeds 12° inclination it is necessary to founded the terraces; on the highly eroded soils is necessary to apply organic fertilizers and composts to improve the fertility and structure status.

Suitability of pedoclimatic zones for vine. The vine is a highly productive perennial crop. Period of intensive exploitation of commercial grape vines are on average 20-25 years. Therefore vineyard productivity and longevity largely depends on the soil type and climatic zone suitability. Soil resources of Moldova in terms of pretability for vineyards in perspective extends to

755 thousand ha or 31% of the surface. The territory of Moldova is divided in tree agropedoclimatic zones: North, Central and South (Monitoringul, 2010).

Northern zone: subzone I - includes North Moldavian Plateau. Main zonal soils are gray soils, clay-alluvial and leached chernozems. Soils are characterized by high fertility, but *are not suitable to vine*; ***Subzone II*** - comprises the Moldavian Northern Plain and Dniester Hills. Mainly zonal soils are typical and leached chernozem, grey soils with clay-loamy texture. Relief fragmentation leads to natural vertical setting of the soils. On the terraces of rivers Dniester and Prut, located less than 150 m attitudes are spread the ordinary chernozem areas with clay or clay-loamy texture. These lands are suitable for irrigation vineyards (Găină B., Leah T., 2012). Factors limiting production of soil capacity in Northern zone are erosion, coastal swamps, degradation of structural stability and secondary compaction of arable layer (0-25 cm) and post arable (25-35 cm) as a result of agro-technical tillage. Most favorable zones for vine growth are the Center and South (*table 2*).

Table 2

The characteristic of agropedoclimatic zones suitable for vineyards in Moldova

Indexes	Central Zone, *Warm semi-humid*		South Zone, *Warm-droughty*
	Subzoe 1.	Subzone 2.	
Suitability for main crops	Vineyards, orchards, nuts, etc.	Vineyards, orchards, nuts, winter cereals, sunflower, irrigation vegetables	Vineyards, orchards, winter cereals, irrigation vegetables, oils plants
Restrictions for some crops	Hoeing crops (intensive erosion)	Sugar beets, soybeans, spring cereals	Sugar beets, soybeans, spring cereals

In Moldova only last 15 years the surface of grape vine varieties decreased by 8 thousand ha (from 28 to 20 thousand ha), decreased yield per hectare and total production of grapes. Thus, perfecting the measures complex related to ensuring population with fresh grapes (18-20 kg person/year) and export needs is an actual acute problem. For Moldova the restoration of this economic branch has a significant importance in relation to the difficulties incurred in the marketing of wine products and to ensure rural population with jobs. Since 2006, in Moldova is given greater attention to the development of grapes viticulture. It was elaborated a draft of Government decision on restoration and development of vines for grapes to 2020 years. Calculations show that Moldova is able to produce 135-136 thousand tons annual consumption of fresh grapes, including 115-116 thousand tons of grapes - merchandise, of which about 30 thousand tons for sale after storage (Nicolaescu G. et al, 2007).

CONCLUSIONS

The geomorphologic conditions of Moldova determines location of vines plantations on sloping land, after their suitability for these cultures are, in most cases, higher plane upper land. In these conditions it is necessary to develop measures to protect soil against erosion and deterioration. To achieve this goal the most effective protective measures were developed and implemented, that favors water retention and soil fertility conservation of the upper layers. Developed erosion protection system is based on the application of organizational, agro-, phyto- and hydrotechnical measures. The direct effect of this system is reflected by reducing leakage and erosion, increase soil water reserve and increase productivity of vineyard perennial plantations.

REFERENCES

Găină B., Leah T., 2012 - *The state land quality in the vineyards of the Republic of Moldova.* Scientific Paper. Series Agronomy, Vol. LV, UASVM. Bucharest., pp.47-53.

Leah T., 2012 - *Aspecte ale degradării solurilor şi de protecţie în plantaţiile viticole*. Revista Agricultura Moldovei. Nr.9-10, pp. 14-18.

Nicolaescu Gh., Apruda P., Perstinov N., Tereşcenco A., 2007 - *Ghid pentru producătorii de struguri pentru masă.* Chişinău: "IUNIE PRIM", 128 p.

Унгурян В.Г., 1979 - *Почва и виноград* / В.Г. Унгурян. - Кишинёв: Штиинца, 180 с.

*** - *Eroziunea solului. Esenţa, consecinţele, miimalizarea şi stabilirea procesului* / MAIA, ARFC, IPAPS N.Dimo. Ch.: Pontos (Tip.Centrală). 2004, 476 p.

*** - *Monitoringul calităţii solurilor Republicii Moldova (baza de date, prognoze, concluzii, recomandări).* Coord. V. Cerbari. Chişinău: Pontos, 2010, 476 p.

*** - *Cadastru funciar.* 2012.05.07. http://www.arfc.gov.md /transparenta/proiecte.