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THE MANAGEMENT OF SOILS FROM VITICULTURAL PLANTATIONS

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Abstract

Wine plants are cultivated on different types of soils with different degrees of fertility, from sandy ones up to clay ones. Consequently, the technology for maintaining viticulture plantations must improve their fertility state and the soil's productivity. The large number of works and the repeated crossings with tractors and viticulture equipment in vineyards negatively influences the soil's characteristics: structure degradation, surface and depth compaction, the decrease of humus content, reduction of biological activity, that can finally led to a decrease of the soil's natural fertility. In this paper are presented different solutions for: preventing soil erosion; capitalization of viticulture fields in the conditions of applying a sustainable viticulture, remaking the water-air percentage and improving the soil's biological activity.

Key words**:** *management, soil, grassing, grapevine, mulching*

INTRODUCTION

Through their specificity, viticulture plantations occupy for a long time the fields, so that their emplacement is especially done on soils that are improper for other cultures. This includes fields under erosion (field slopes higher than 10%) that cause a permanent deterioration action of the soil's physical-chemical properties with a final result – a weak infiltration of precipitations in soils and a a water supply in the soil much diminished over time.
The climatic changes from the last period have led to a randomized distribution of precipitations with frequent torrential rains framed by long drought periods [4, 5, 16, 17]. Related to the effects of erosional processes and to the reduced capacity of the affected soil's regeneration, it is much more important to apply soil erosion prevention measures than to fight against them [3, 6, 7, 13,18].
Soil erosion is a physical process that occurs at the soil's surface or in its depth that transports by water or wind important soil masses together with their fertility at distances that can sometimes reach thousands of kilometers [1, 2, 8, 12, 14]. Often, soil erosion aggravates soil properties and definitely contributes to decreasing their productions. The loss of the fertile layer from the soil's surface is unequalled and sometimes irreversible, with high financial restoration efforts.
The grapevine's needs towards water are mostly satisfied from precipitations left over in the superior soil layers. Phreatic waters can also have a part only if they are not too deep.

A lack of precipitations and their inadequate distribution in the vegetation phase can create critical periods for grapevines from a physiological point of view that is later reflected in the production of grapes [16].

MATERIALS AND METHODS

The present paper presents different solutions for: preventing soil erosion; capitalization of viticulture fields by applying a long-lasting viticulture; remaking the water-air percentage and improving the soil's biological activity. These solutions are the results of studies realized at Research and Development Station for Viticulture and Winemaking (SCDVV) Bujoru and National Institute for Research and Development for Biotechnology in Horticulture (INCDBH) Stefanesti.

The observations were realized during 2012-2018 at SCDVV Bujoru where three experimental parcels were created: green fertilizer plants were used for the 10% slope inclination; the 18-20% field slope has large terraces with 5-6 rows of grapevine fertilized at soil with composted grape marc, barn manure; the field slope larger than 20% has narrow terraces with 1-2 rows of grapevines fertilized at soil with composted grape marc and barn manure. The observations and tests referred to: determining the soil's hydro physic indexes; soil content in NPK, humus and PH; the mobility of nutritive elements from soil; the dynamic of soil humidity on the 0-100 cm profile; recording the grapevine's behavior during the vegetation phase; the content of microorganism/1g sol; the soil's biological activity; monitoring climatic factors; controlling useful entomofauna and establishing the biologic reserve of pathogen factors.

For INCDBH Stefanesti, the studies were realized during 2012-2018 and consisted in applying more systems for maintaining the soil: permanent soil natural grassing (obtained by leaving the strip between the rows with the weeds that grow spontaneously); artificial grassing in strips with *Trifolium repens* var. silvestris (10 kg/ha) (obtained by grassing the area between the rows); artificial grassing in strips with *Lotus corniculatus*, Bull variety (18 kg/ha) (obtained by grassing the area between the rows); black field (conventional non-organic system).

RESULTS AND DISCUSSIONS

Solutions for preventing soil erosion

- Orienting grapevine rows on the level curves;
- Realizing ridges on slopes with gentle and uniform inclination in order to retain water;
- Creating coast channels with evacuation outlets for pluvial waters;
- Creating terraces with embankments from stone or cement walls;
- Maintaining the optimal level of organic matter in soil and ensuring its biodiversity [15];
- Ploughing on the level curves in slopes;
- Natural or artificial grassing, total or only for the intervals between the grapevine rows. This can be done by seeding gramineae and/or leguminous species (*Lolium perene, Poa pratensis, Agrostis stolonifera, Festuca rubra, Bromus inermis* Leyss. - Orfeu, *Trifolim pratense, Trifolium repens*);
- Creating bands with forest species on slope fields (cherry, locust, honey locust, cherry plum, walnut, hazelnut, blackthorn, oak, holm and others).

Solutions for capitalizing viticulture fields in the condition of applying a long-lasting viticulture [9]

- For fields with a slope <10%: using green fertilizer plants (a borceate made of 120 kg/ha vetch and 60 kg/ha oat), planted in early spring from two to two intervals (end of March-beginning of April) and mowed when are in blooms (June). After mowing, it remains as mulch on the soil's surface until it dries being then incorporated in the soil with the disk or milling machine. This process stimulates the soil's microbiological activity. In addition, it has a similar effect with applying a large quantity of barn manure. In comparison with barn manure, green fertilizer offers a plus of nitrogen and a minus of phosphor and potassium. Green fertilizers improve the mobility of nutritive elements in the soil-plant system. By incorporating them

under the furrow, the nutritive elements are fixed by humus and are no longer lost.
- For fields with a slope of 18-20% large terraces can be realized with 5-6 rows of grapevine, fertilized at soil with composted grape marc, barn manure and foliar fertilizer based on the phenophase moment and necessity.
- For fields with a slope >20%, situated in narrow terraces with 1-2 rows of grapevine, soil fertilization with composted grape marc (4.5 to/ha) / barn manure (15-20 to/ha) is also recommended. Foliar fertilizers can also be applied based on the phenophase and necessity (NPK 2:1:0 for sprout growing and NPK 0:1:1 for grapes ripeness). Foliar fertilization is recommended simultaneously with phytosanitary treatments in order to reduce the number of aggregates passages and for avoiding soil compactation.
- Reducing soil compactation by limiting the crossings with the tractor by using phytosanitary products that combat simultaneously more pathogen agents and pests.
- Realizing the superficial soil maintenance works by applying a reduced number of works and profound soil aeration.
- Avoiding soil works when it has a high humidity in order to prevent the compaction and to maintain/increase the soil water infiltration.
- Supplementing the nutritive input in viticulture plantations by using grass mowed as mulch, by applying foliar fertilizers and using a composted grape marc. This contributes to increasing the plants' longevity and to decreasing secondary effects caused by some climatic factors (prolonged drought, high temperatures, attack of different phyto-pathogen agents).

Solutions for restoring water-air percentage and for improving the soil's biological activity:

- Soil scarification preferably when it has a medium humidity of 50% IUA (active humidity interval). The recommended depth is of 55-60 cm so that it creates optimum conditions for depth water soil penetration.
- Applying agro-phyto-technical methods for preventing hydric stress: annual depth aeration - in order to ensure a maximum interception of precipitations, realizing a harrowing in April with mobilizing the soil at 5-8 cm (in order to level the plow, to reduce water evaporation and to favor soil surface heating); avoiding soil yielding by realizing spring ploughing at an optimum soil humidity level; realizing superficial soil maintenance works without turning over the furrows, in order to reduce soil water evaporation at a minimum during scarce rainy periods; if during the winter the sum of precipitations presents a pronounced scarcity, the spring ploughing must be replaces with soil aeration at the depth of 12-16 cm, without turning over the furrow.
- Partial mulching on the interval of grapevines with composted marc mulch (Fig. 1) in a minimum 10 cm depth layer; maintaining the grapevine row through post-emergent weed killing (applying two weed killings with products based on glyphosate in a dosage of 3-5 l/ha), and by limiting the rod load at 18 eye/but/m^2. This method capitalizes precipitation waters and limits its evaporation from soil.

Fig. 1 Mulching with composted marc
Source: [10,11].

- Total mulching with vegetal remains (straw, chopped strings etc.) in intervals and on rows with a depth of 10 cm that is redone from two to two years; fertilization with N, P, K in optimum dosage by limiting the rod loading at

18 eye/but/m^2 (Fig. 2). Mulching as soil maintenance method is also benefic in heat periods when the vegetal cover causes a lower temperature of the soil's superficial horizons in comparison with maintaining the soil as black field or through herbicides. Using the mulch or organic materials such as straws or vegetal remain for ensuring a physical barrier on the soil's surface.

Fig. 2 Mulching with vegetal remains
Source: [10,11].

- Applying adequate viticulture works for burying vegetal remains and accelerating their decomposition.
- Maintaining the soil through minimum tillage - Fig. 3 (autumn ploughing, deep mechanic hoeing in spring, total post emergent weed killing, 2-3 herbicidation).

Fig. 3 Minimum tillage
Source: [10,11].

- Temporary grassing – sowing species such as oatmeal, pea, clover, birdsfoot trefoil, lupine, soya, vetch etc (Fig. 4).

- Maintaining the natural grassing soil (Fig. 5) in order to regulate water content, to increase the organic matter content and to reduce erosion processes.

Fig. 4. Temporary grassing
Source: [9].

Fig. 5 Natural permanent grassing after mowing
Source:[15].

CONCLUSIONS

Reducing soil erosion as well as favoring water soil infiltration and preventing surface water leakage can be achieved by executing different works at the soil's level. In order to practice a safe viticulture that takes into account its effects on the environment as well as the consumers' safety, certain grapes production systems must be applied. As a consequence, the technologies for cultivating

grapevines must be remodeled and optimized in order to streamline natural resources. Thus, a long-lasting viticulture involves the proper application of soil works in order to avoid soil degradation by compaction (the least number of crossings by viticulture equipment); the use of organic fertilizers such as bran manure and green fertilizers; the application of the chemical fertilizers in small quantities for completing the necessary of grapevine plants.

The water and air content influence soil heating through the water/air percentage due to specific heath and their different thermic conductibility. The temperature is high in a dry soil, while a humid soil has a low temperature as water heaths harder due to the high caloric capacity.

The soil's water-air percentage as well as thermic regime can be optimized by applying soil works based on the area's microclimate where the viticulture plantation exists.

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