THE COMPACTNESS STATE OF THE SALINE SOILS ON THE WESTERN SLOPE OF THE BEJENEASA FARM – COTNARI

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Abstract

The state of compactness is a complex characteristic of soil resulting from its textural characteristics and bulk density values. It is influenced both by the natural processes that contributed to the formation of the soil and by the agricultural works carried out. Our studies concern the compactness state of saline soils on the Bejeneasa Farm, Cotnari Vineyard, from the northeast part of Romania. The studied area is about 11.6 hectares in six vineyard plots. It is situated on the upper part of the slope. The absolute altitude ranges between 152 m and 172.5 m. The average annual precipitation and annual temperature values are 508.9 mm and 10.9°C, respectively. To highlight the causes of weak growth of the vine on the slope with a slope of 8% and with the western exposure, five soil profiles were made in representative locations following the cutting clearing of the vine plantation. The soil profiles were made after cutting the vine stems due to the growing stagnation and the small yields obtained from the grapes. The soil profiles were located in the upper and lower parts of the slope, both in the part with a uniform slope and on the diluvial–colluvial glacis located in the contact area with the land with a lower slope. From each soil horizon, soil samples were collected for laboratory analysis. The analytical data showed that the state of compactness of the saline soils was influenced by both soil formation processes and agriculture during the growing season and in the cold season. The range of values of the bulk density for the tracks of the wheels of agricultural machines was wider compared to those recorded on the row of vines.

Keywords: compactness, saline soils, vines

INTRODUCTION. The modernisation of viticulture to increase productivity and increase the quantities of wine products for consumption has led to a multitude of worrying negative effects on the environment and especially on the soil, influencing the production and quality parameters of the vine (*Vitis vinifera* L.).

Recently established vineyards require more agricultural operations than older ones. These practices, which are necessary for the growth and development of the vines (e.g., application of pesticides, fertilisers, installation of the support system), involve the continuous use of heavy machinery and consequently cause changes in the physical properties of the soil. Intensive agricultural activities cause the degradation of soil structure, compaction and the formation of surface crusting, which in turn reduces water infiltration. If soil infiltration capacity is lower than rainfall intensity, the potential risks of runoff and soil erosion are increased (Alagna V. *et al,* 2018).

Due to the intensification and extension of degradation processes, it is necessary to study agricultural activities in vine plantations because these activities lead to soil quality changes. The soil in vineyard plantations under vine training is subject to frequent tractor traffic associated with tillage, carrying out phytosanitary treatments, mechanised grape harvesting, manual dry, and green tillage works throughout the viticultural year. The increase in the number of mechanical works on the soil, as well as the use of heavy machinery and equipment, lead to soil compaction and partial destruction of the soil's structure (Robescu Valentina-Ofelia *et al,* 2008). These processes also decrease the soil's fertility by reducing the amount of organic matter in the soil and increasing the risk of erosion. Increased tillage also leads to damage to vine roots and the directional spread of pests and pathogens (Buesa I. *et al,* 2021). Compactness is a complex property of soil resulting from its textural characteristics and bulk density values.

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Soil degradation directly affects agroecosystems through high losses of soil and water, depletion of organic matter, and reduction of soil biota. The use of modern machinery in highly mechanised viticulture can influence soil compaction, which is also dependent on the amount of soil water.

Soil compaction is also relevant for understanding the life cycle in the soil system so that sustainable farming systems can be adopted, systems for soil improvement can be developed and adopted, and soil can be conserved and utilised in a superior way by establishing sustainable cropping technologies and adopting conservative tillage systems (Jităreanu G., 2015).

Soil management practices of vineyard plantations with sustainable objectives can be considered a first step to establishing a protective strategy to improve grape quality and reduce the effects of climate change (Cataldo Eleonora *et al,* 2020).

Soil compaction is one of the major causes of soil degradation in modern agriculture, and when operations are carried out in wet soil conditions, the risk of soil compaction is amplified (Marinello F. *et al,* 2017).

Unfavourable soil compaction in the path of tractors and machinery can be eliminated by using tillers appropriate to the wheel gauge. Controlled traffic practices, deep ripping and conservation tillage are recommended to increase the soil's physical condition. Another suggestion would be the application of organic mulch to reduce erosion without decreasing yields (Țopa D. *et al,* 2013).

MATERIALS AND METHODS

The study regarding the state of compaction of dewatered soils was carried out on the slope of Bejeneasa Farm, Cotnari Vineyard, in northeastern Romania. The studied area is about six vineyard plots. It is located in the upper part of the slope (*figure 1*).

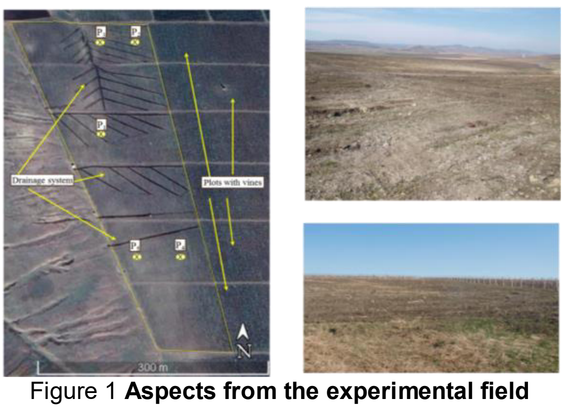

Figure 1 **Aspects from the experimental field**

To determine the main physical properties of the soil from the five soil profiles, soil samples were collected using numbered stainless-steel cylinders with dimensions of 5.1 cm in height and 5 cm in diameter (volume of 100 cm³), with walls 0.8–1 mm thick and pointed at one end. To determine the moisture regime, samples with a mass of about 20–25 g were placed in ampoules of aluminium.

The soil samples taken from the vine plantation were processed and analysed in the laboratory of the Research Institute for Agriculture and the Environment, Iași, according to the standardised methodology developed by the National Research Development Institute for Pedology, Agrochemistry and Environmental Protection (ICPA).

Several soil profiles were opened in the field, and the soil samples were analysed in the laboratory, where both the physical and chemical properties of the soil were determined *(figure 2).*

Figure 2 **Aspects from soil profiles in the field**

RESULTS AND DISCUSSIONS

The soil within the studied area was formed on texturally inhomogeneous diluvial and diluvial–colluvial deposits. The clay content ranged between 36% and 55%. The highest content was recorded in the middle part of the soil profile, which constituted a barrier for water infiltration into deeper layers.

The bulk density values in the soil profile on the vine row ranged from 1.21 to 1.66 g/cm^3. It is worth noting that bulk density values were higher than those on the vine row only in the 0–80 cm depth interval between rows *(figure 3).*

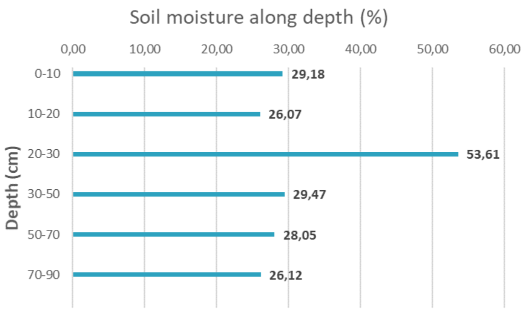

Figure 3 **Soil moisture along depth**

The soil was heavily loamy, starting from a depth of 60 cm, both on the vine row and on the tractor wheel tracks. The high DA values recorded at the base of the soil profile were due to natural soil compaction processes. The moderately compacted soil layer on the tractor wheel tracks was thicker than that on the plant row.

The compaction of the middle part of the soil profiles was due to pedogenetic processes of CTSS salinisation, which was also noted by pH values close to 9 and weak and moderate alkalinisation within the soil profile. The more pronounced compaction of the upper part of the soil on the tractor wheel tracks was a limiting factor for the lateral development of the root system of the vine. The lack of vine roots at depths greater than 35–40 cm was another indicator of severe limitations for vine growth due to salinisation and salinisation processes.

The determination for the same soil profile of the values of momentary moisture content and bulk density (Figure 4) revealed that the salty soil layer, with a clay content of approximately 55%, prevented water infiltration into the soil. The soil layer located above the clay layer recorded a high water content of 50% and approached flow consistency. Lower values of bulk density recorded on the depth interval of 30–65 cm, compared to those determined in the previous year, highlighted the presence of smectitic clay minerals that increase their volume greatly in the presence of water.

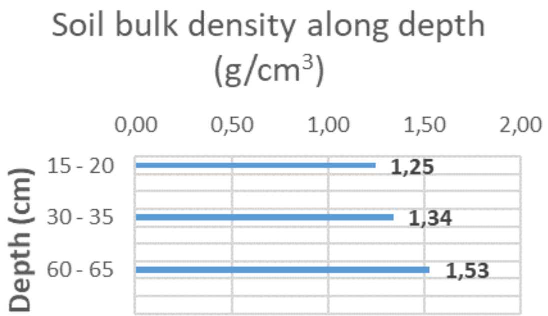

Figure 4 **Soil bulk density along depth**

The presence of these minerals was evidenced in the field by the oblique-slip faces in the layer with maximum clay content.

Penetration resistance values of more than 3 MPa were recorded starting from a depth of 45 cm, which confirmed the existence of other chemical limitations for root penetration (*figure 5).*

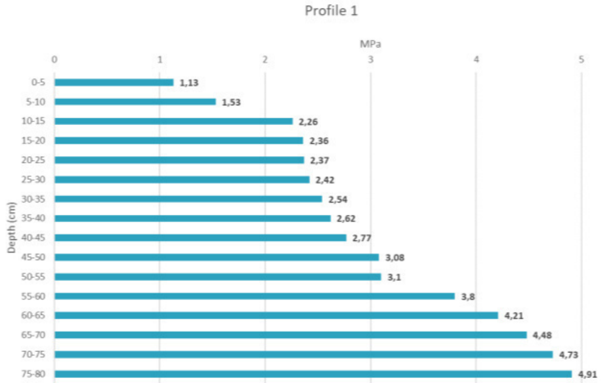

Figure 5 S**oil penetration resistance long depth**

The results obtained on soil compaction and other soil profiles confirmed that the development of the root system of the grapevine was restricted both by moderate or strong soil compaction and soil salinisation.

CONCLUSIONS

The state of compaction of depleted soils was influenced by both pedogenetic processes and the agricultural works carried out.

The range of variation of bulk density values was wider in the tracks of agricultural machinery than in the vine rows

The extension of the root system of the vine was limited due to both soil compaction as a result of the maintenance works carried out on the plantation and pedogenetic processes of depletion (salinisation and sodisation).

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