

THE COMPARISON OF SEVERAL SOIL CULTIVATION METHODS IN THE TOKAJ-WINE REGION

SROVNÁNÍ NĚKOLIKA PŮDNÍCH KULTIVAČNÍCH METOD VE VINAŘSKÉM REGIONU TOKAJ

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ABSTRACT

Our results show that the different cultivation methods have higher effect on the yield than on the grape quality. The several cultivation methods have effect on the nitrate +nitrite content and the compaction of the soil. The mechanical cultivation helps to decompose the organic matters in the soil, but in some cases the nutrients infiltrate in the deeper layers and became unavailable to the grapes. This cultivation method causes soil compaction only in the subsoil. In this point of view, the straw mulch proved to be the best solution, but the results indicate, that it has to be renewed regularly. In 2008 the straw mulch proved to be the best solution regarding the yield. As it appears from the results, the soil cultivation method has an effect also on the temperature and relative humidity in the foliage, influencing the ratio of noble rotted berries.

Key words: straw mulch, barely cover crop, erosion, soil compaction, noble rot

INTRODUCTION

Soil cultivation is one of the most important questions of the agriculture. It has an effect not only on the soil, but indirectly on the plants as well. Therefore it is really relevant to choose the proper cultivation method. Also in case of integrated farming is advanced to apply these environment friendly methods. In case of vineyards is the soil cultivation also important, especially when the plantation is located in steep slopes. Such kind of erosion, which can be caused by heavy rainfalls or also by frequent mechanical soil cultivation, is a major problem. So soil cultivation method has to be chosen considering this.

LITERARY SURVEY

A suitable soil cultivation method improves the soil structure: compaction, erosion, nutrient losses can be reduced. It makes better conditions in the soil environment for the existing soil organisms, as follows it increases soil biological activity and the organic matter content of the soil can be preserved. The moisture content of the soil depends also on the cultivation method. The preservation of soil moisture is especially important, in that kind of areas where the precipitation is less than 500 mm / year and principally from June to August, when the evapotranspiration is greater than the precipitation, like in Hungary (Bauer et al., 2004). The growth of the roots is influenced by the structure of the soil; hereby the growth of the grape is related to the compaction and to the moisture content of the soil, too. The looser the soil is the longer the roots of the vine are (Wheaton et al., 2007). Nutrient uptake of the grape is affected by the soil compaction, the moisture content and the soil temperature. For example between the high soil temperature and N, K, Ca, Mg uptake is a positive correlation (Bogoni et al., 1995). Several abnormal circumstances in the soil, for example lack of water can cause stress on the plants, which influences the growth and the yield of the plants negatively (Fardossi, 2001).

One of the most often used soil cultivation methods in vineyards is mechanical cultivation. But when it is used too often or inadequate negative effects can be observed: decaying soil structure, erosion, nutrient losses, dry soil affected by greater evapotranspiration (Bauer et al., 2004). Mechanical soil cultivation results -through the long term traffic- topsoil and subsoil compaction below the frequent tillage depth (Ferrero et al., 2005).

Covering methods are ecological soil management techniques. As soil covering several materials or cover crops can be used.

Straw mulch is a relatively cheap and easy available material. Application of mulch has a lot of agronomic advantages, including the control of weeds and erosion, improvement in soil physical structure. The presence of mulch eliminates the need for frequent soil tillage in agroecosystems. It prevents the soil like an umbrella by heavy rainstorms (Schuch, 1981). The prevention of the soil is important, because the soil moisture in the whole profile depend primarily on the intensity of rainfall, not on the total amount of it. At high intensities soil moisture increases only in the surface layer, but no significant increases were observed in

deeper layers, where most of the roots are found. Under low intensity rainfalls, the increase in soil water content occurred in the whole profile (Ramos et al., 2006). The water budget of the soil improves due to the better structure and the straw reduces water loss by evaporation. It enhances the soil environment for existing soil organisms by improving soil nutrient availability and reducing soil temperature fluctuations (Jacometti et al., 2007). When the straw decays it adds nutrients to the soil, but because its C: N ratio is wide, additional N is needed. Otherwise the lack of N causes pentosan effect (Fox, 1981).

Beside straw or other mulch materials, several crops can be used. Permanent or only in certain seasons covering crops, legumes or non legumes are appropriate to cover the soil between the rows. Cover crops compete with weeds, prevent erosion and soil compaction and in addition, they increase the complexity of agroecosystems. The soil structure and soil biological activity will improve. They facilitate to filter the water into the soil. It has an effect on the nutrient content of the soil, especially when a leguminous plant is used, because of the biological fixation of atmospheric N (Bauer et al., 2004). Cover crops have also negative effects on the vine performance; compete for water and nutrients in the soil with vine. Places, where precipitation is not high enough are not suitable for permanent cover crops, because of the great use of water. In this cases grapes are stunted, lower wine performance can be observed. The vegetative growth is reduced, but it can have also positive effects. Because of the lower canopy density, the microclimate of the plantation will change, the vapor content of the air will be lower, and because of this the infection of the grape with fungal diseases, for example *Botrytis cinerea*, is reduced (Monteiro et al., 2007). In some cases it can be disadvantageous, for example in the Tokaj wine region of Hungary, where the noble rot of the berries caused by *Botrytis cinerea* is important to gain Aszú wine. Infection of *Botrytis* requires moist conditions, but later for the rotting period, it needs drier climate. If the weather stays wet, grey rot of the bunches can be observed (Lehoczky, 1968). There is an increased light penetration in the thin canopy, so the titratable acidity of the berries can be reduced and the sugar content will improve (Ingels et al., 2005).

MATERIALS AND METHODS

The experiment was set up in the Tokaj-wine region in 2007. Three soil cultivation methods were compared: mulching with straw, barely cover crop (*Hordeum vulgare L. convar. vulgare MSF.*) and mechanical cultivation. The straw mulch was laid down in May 2007, in the case of the Hárslevelű variety it was renewed in 2008 July. The barely cover crop was sown in March, after a seed-bed preparing. The process of the mechanical cultivation contains a deep ploughing in autumn, and two cultivator treatment in a vegetation phase. In case of the Furmint variety the soil was cultivated in the first decade of July. The study was carried out on Royat cordon vines (with 1x1,8 m row and vine spacing). The investigated varieties were: 'Furmint' clone T.85 and 'Hárslevelű' clone K.9 grafted in Teleki 5.C. rootstocks. Every treatment is located in five rows, in four replications per treatment. The plantation is settled in a steep-slope area on loess soil in the site of Hétszőlő (Hárslevelű) and Nagyszőlő (Furmint), where the prevention of erosion is especially important.

In 2008 the NO_2+NO_3 content of the soil was measured. The soil samples were collected in the last pentad of every month from March to July, from the 0-30 cm and the 30-60 cm soil layers. The compaction of the soil was measured in June and July of 2008 with a penetrometer to the 45 cm depth in the soil. The yield and the ratio of noble rot within one bunch were recorded in case of case of both cultivars. The temperature and the relative humidity were observed in the foliage under the ripening period, from 1st July to 28th September.

RESULTS

The NO_2+NO_3 content of the soil was measured in the most cases in the soil samples from the mechanical cultivated rows, because this cultivation method helps to decay the organic mater in the soil. (Fig.1.) The minor values on the straw mulched and on the barely covered grapes can be explained with the pentosan effect, resulted by the decaying straw and the nutrient uptake on the barely, respectively. In case of the Hárslevelű variety can be observed that the higher nitrate+ nitrite values in the upper layers in June appeared in the 30-60 cm layer in July. The reason of it can be, that the mechanical cultivation in the beginning of July, and the big amount of precipitation in the month (68,7 mm), helped the nutrients getting down to the lower layers. Because the availability of the N in this layer for the grapes is not so advantageous, the over frequent use of mechanical cultivation in the vegetation season is not recommended.

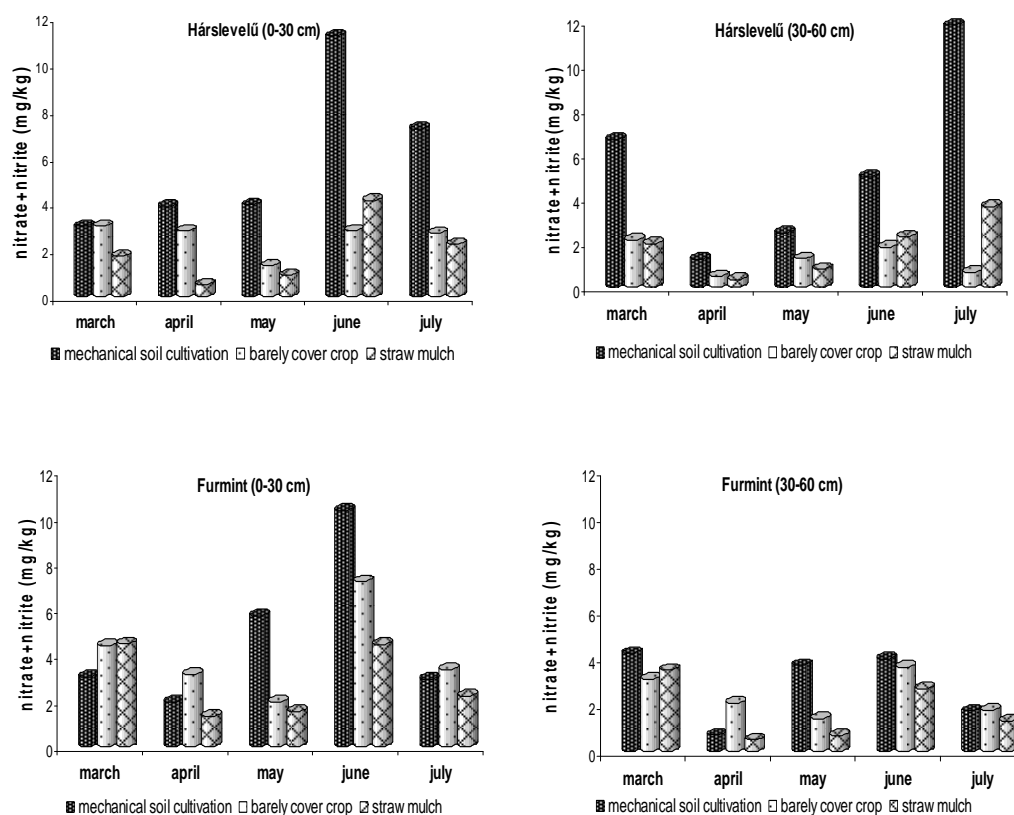


Figure 1. Nitrate and Nitrite content of the soil (Tokaj, 2008)

The measurements of the soil compaction in the last pentad of June and July have shown that in the upper (5-15 cm) cultivated layer of the soil is less compacted than the subsoil. In the 15-45 cm layer is a hard (in some cases 3000-3500 kPa) compaction, most likely caused by the tractor traffic.

In case of the Furmint variety was not found greater differences, because the straw mulch was laid down in May of 2007 and until then it was not renewed and the other vines were not cultivated until March. At the same time, in case of the Hárslevelű variety, because of the mechanical cultivation in the beginning of July and the refreshed straw mulch, differences can be observed among the treatments. The more hard compaction was measured in case of the barely cover crop and by the mechanical cultivation was the soil the less dense. In the barely covered rows makes the clipping the soil harder contrary to the straw mulched rows, where because of the weed depressing effect of the mulch, no cultivation or clipping is needed. However in the subsoil aren't greater differences between the treatments (Fig. 2.).

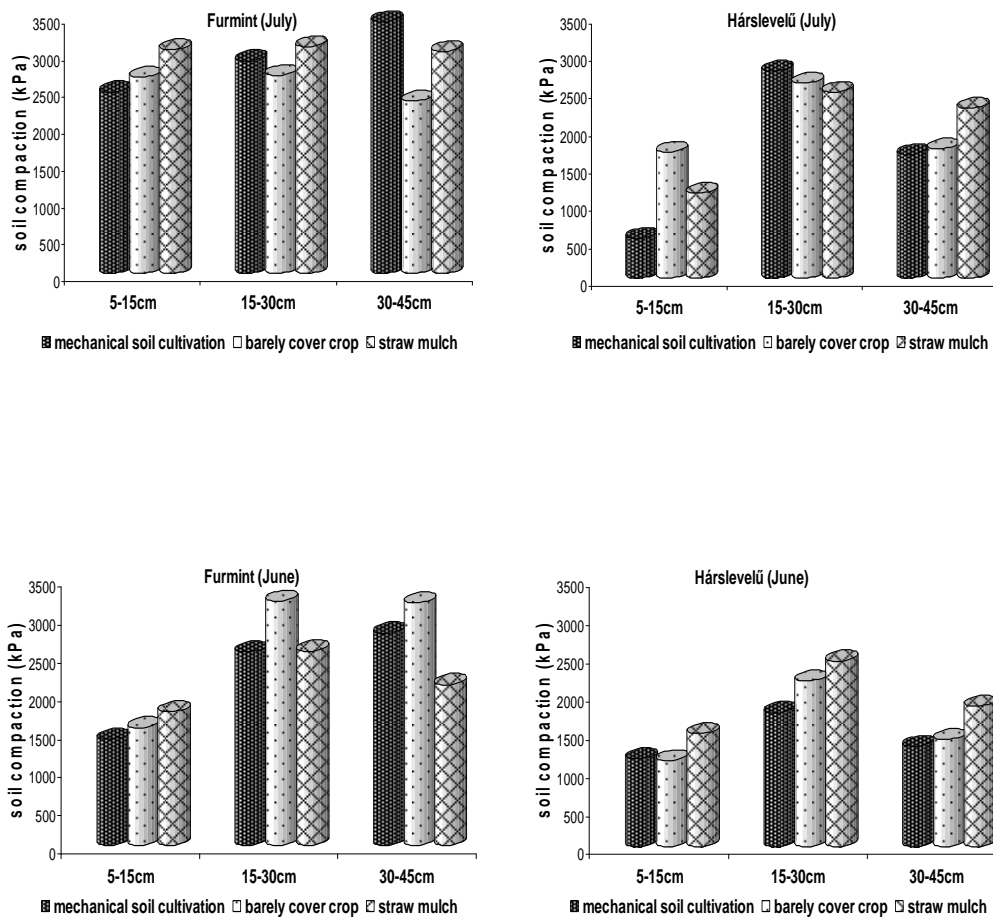


Figure 2. Compaction of the soil (Tokaj, 2008)

Comparing the yield and the average bunch weight on the plots, significant differences could be observed in case of both varieties. The highest average bunch weight was measured

in case of the straw mulched grapes, while the minor average bunch weight was measured on the barely covered grapes. The greater yield on straw mulched grapes the less on the barely covered plots was measured in case of both varieties. (Fig. 3.)

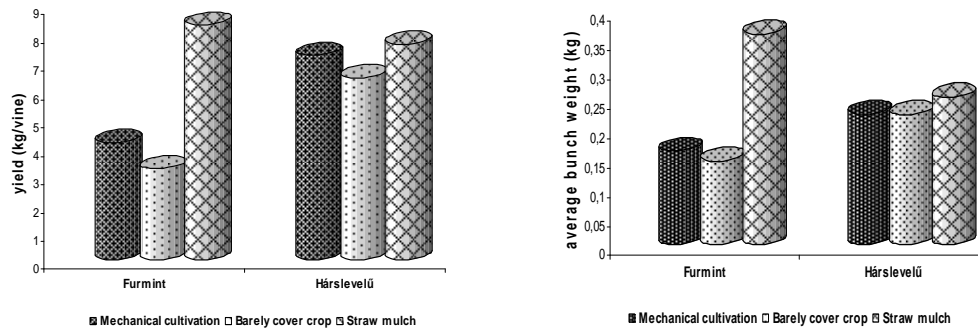


Figure 3. Average bunch weight and yield of Furmint and Hárslevelű (Tokaj, 2008)

The temperature and the relative humidity in the foliage were different in case of the several cultivation methods. The temperature was in the barely covered plots the higher. In the foliage of the mechanical cultivated and the straw mulched vines was the average temperature lower under the ripening period. The higher relative humidity was measured in case of the straw mulched plots, in case of both varieties. (Fig. 4.)

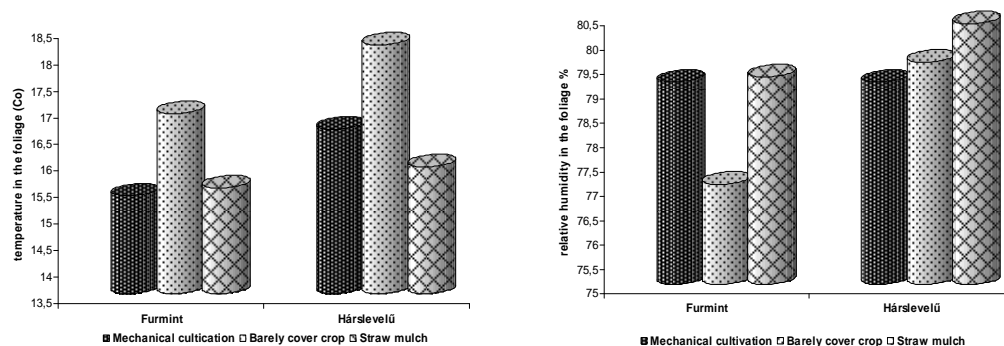


Figure 4. Temperature and relative humidity in the foliage in case of Furmint and Hárslevelű (Tokaj, 2008)

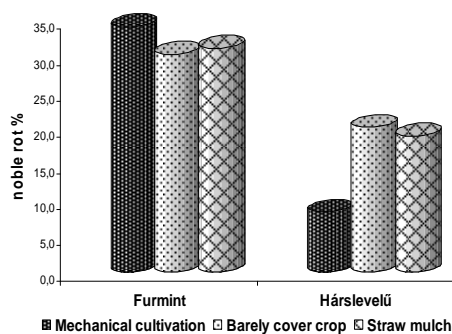


Figure 5. Ratio of noble rot within one bunch

From every treatment 100 randomly selected bunches were observed in four replications per treatment. The percentage of the rotted, Botrytis infected berries was counted within the bunches. In case of the Furmint variety more infected berries were counted. (Fig.5.)

Comparing the temperature and relative humidity in the foliage, goes to show, that they have an effect on the Botrytis infection.

DISCUSSION

Our results show that the different cultivation methods have higher effect on the yield than on the grape quality.

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