The impact of conservative soil maintenance practices in vineyards on soil microbial diversity and on the biodiversity of useful and harmful entomofauna

Şerdinescu Adrian*, Ion Marian*, Fîciu Lidia*, Brînduşe Elena*
*Research and Development Institute for Viticulture and Enology, ValeaCălugărească, Valea Mantei street, no.1,107620, Prahova district
* Autor corespondent: e-mail: serdinescuadrian@yahoo.com

INTRODUCTION

In the context of actual climatic changes, which led to an increase of soil hydric stress in many wine regions of the world, new conservative soil maintenance practices were experimented, in order to ensure a good preservation of water in soil and of its fertility. These included the mulching systems (total or partial) using as mulch materials the cereal straws, the marc compost or the shredded wood wastesand and also the cover crops, based on the artificial grassing of the interval between rows with small plants (such as ornamental clover) or honey plants.

The studies conducted worldwide have highlighted that the use of the new soil maintenance systems caused a change of the microbial activity in soil (in case of the mulching systems) and of the biodiversity of useful and harmful entomofauna present in vineyards (in case of the use of cover crops) as compared to the classical black furrow system. These modifications were the result of changes occurred in soil water regime, soil temperature and on soil fertility determined by the use of new soil maintenance.

In this respect, our researches aimed to experiment some new soil maintenance systems suitable for viticulture in case of drought conditions, establishing the impact that these systems have on soil microbial activity (as microbial mass and biodiversity) and on the biodiversity of vineyard entomofauna, as an indicator of natural biological balance in viticulture ecosystem.

MATERIALS AND METHODS

The researches were performed during a drought period in two experimental plots located in two vineyards from Valea Călugărească viticultural center. In the first experimental plot was studied the influence of soil maintenance systems on soil microbiological diversity. There were studied two variants of soil mulching, namely the total mulching (rows and interval between rows) with cereal straws applied in a layer of 10 cm and the partial mulching (interval between rows) with marc compost applied in a layer of 10 cm. As control was considered the classical black furrow system. In the second experimental plot was studied the impact of the cover crops (as soil maintenance system), on the biodiversity of useful and harmful entomofauna. There were studied two variants, namely the artificial grassing with ornamental clover Nano and the artificial grassing with *Melilotus officinalis* (a honey plant), applied on the interval between rows. As control was considered the classical black furrow system. There were performed determinations concerning the soil water regime during the growing season of grapevine, the microbiological activity of the soil and the presence of useful and harmful entomofauna on soil surface.

The impact of conservative soil maintenance practices in vineyards on soil microbial diversity and on the biodiversity of useful and harmful entomofauna

MATERIALS AND METHODS

The soil water regime was establish monthly, between April and September, on the depth of 0-100 cm, taken samples from 20 to 20 cm with an agrochemical bore.

For the determination of soil microorganisms were collected samples from three different locations of the experimental plot in paper bags by using a tubular bore. All materials and instruments were sterilized before use by steaming at a temperature of 180°C for one hour. The soil samples were collected at the end of August in sterile conditions from 0-20 and 20-40 cm depth, sieved through a 2 mm sieve mesh and then scattered and homogenized in a sterile mortar. The total number of soil viable microorganisms was achieved by inoculation on solid culture media using the method of serial dilution. Each serial dilution was inoculated in three Petri dishes. The number of microorganisms per gram of soil was calculated according to the following formula:

N = m x c x 10, where:

N = the number of living microorganisms per gram of soil;

m = the average number of the colonies developed on the three Petri dishes;

c = inverse of the dilution used for inoculation;

10 = the coefficient for reporting the results to 1 gram of soil.

In order to identify the microbial colonies, selective culture media for each systematic group of microorganisms were used: Potato dextrose agar medium for bacteria, Glycerol yeast agar medium for actinomycetes, Sabouraud dextrose agar with streptomycin for fungi and Yeast extract peptone dextrose medium (YEPD) for yeasts.The inoculation was performed by the distribution of 0.1 ml of the selected homogeneous dilutions on the surface of solidified medium, previously distributed in plates. The cultures were then incubated at 28°C. The determination by microscopy of the number of bacterial colonies was achieved after 24 hours and the number of fungi after 5 days.

In the second experimental plot the determinations of the useful and harmful entomofauna were achieved in June and September. To collect the biological material were used different methods appropriate to the target groups, such as the Barber traps, the leaf samples and the typing technique. The identification of the insect species was performed in the laboratory using specialized instruments.

The impact of conservative soil maintenance practices in vineyards on soil microbial diversity and on the biodiversity of useful and harmful entomofauna

RESULTS AND DISCUSSIONS

The experimental data obtained in the first experimental plot highlighted that in comparison with the classical maintenance system (black furrow), where the microbial load had a value of $7.7x10^6$ microorganisms/g of soil on the depth of 0-20 cm, a significant increase was observed in case of total and partial mulching, with values of $16.8x10^6$ and $22.1x10^6$microorganisms/g of soil. The same trend can be mentioned also for the depth of 20-40 cm, but in this case the differences between variants were smaller (Figure 1).

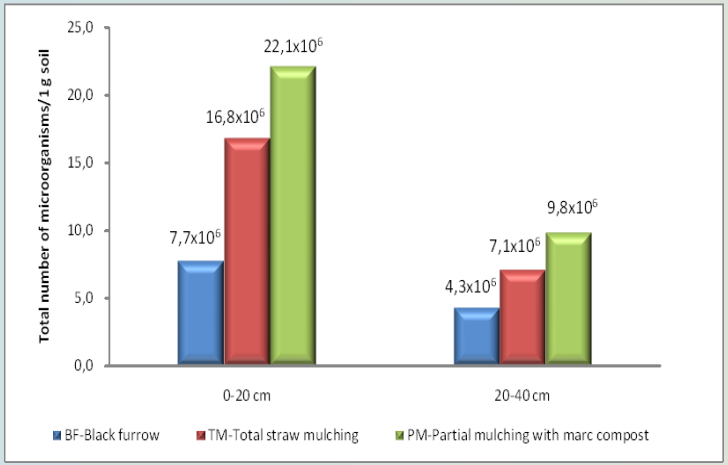

Figure 1. Influence of soil maintenance systems on soil microbial load

Not only the microbial load was influenced by the soil maintenance systems, but also the development of the main groups of microorganisms in soil (Figure 2).

Bacteria were the largest group of microorganisms, representing an average from the total viable microorganisms of 60.1% for the depth of 0-20 cm and of 58.5% for the depth of 20-40 cm, fallowed by *Fungi* with 36.7% and 38.0% respectively, *Actinomycetes* with 3.2% and 3.5% respectively and *Yeasts* with 0.01%, highlighted only in the 0-20 cm depth.

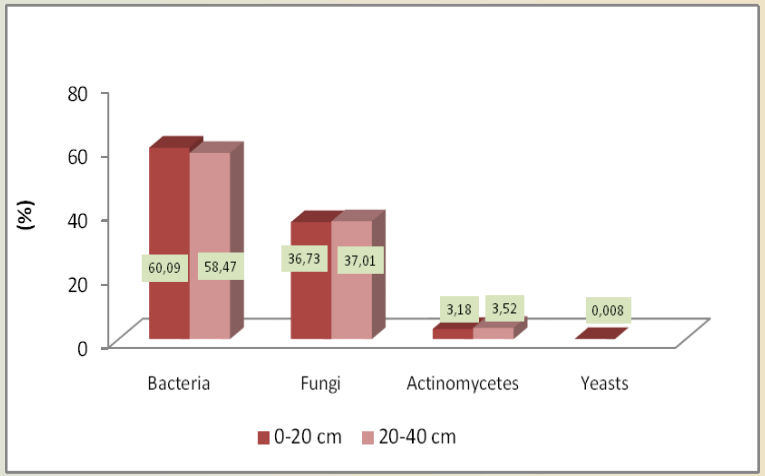

Figure 2. The percentage of the number of microorganisms in relation with systematic groups

The impact of conservative soil maintenance practices in vineyards on soil microbial diversity and on the biodiversity of useful and harmful entomofauna

RESULTS AND DISCUSSIONS

The ratio between *Fungi* and *Bacteria* was higher in case of the mulching systems, as compared to the black furrow system, this being a favorable factor for soil biological activity and for soil health (Figure 3).

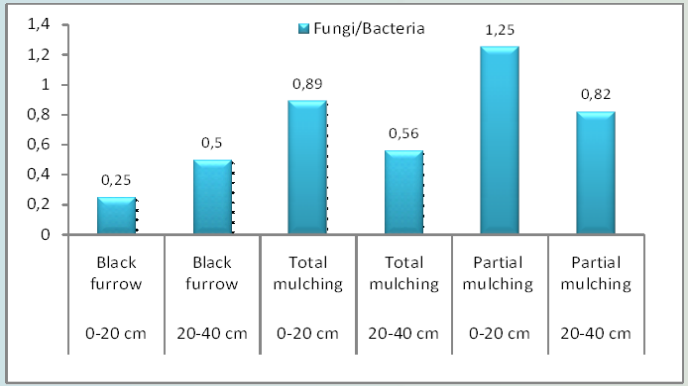

Figure 3. The fungi/bacteria ratio

The data obtained in the second experimental plot (where the impact of cover crops on the insects biodiversity was studied) highlighted that the number of insects collected had the highest value in case of the artificial grassing of soil with ornamental clover Nano and the lowest value in case of black furrow maintenance system, for all the studied groups of insects (Table 1).

Table 1. The load of the main groups of insects from soil surface during the growing season of grapevine depending on soil maintenance system (mean values)

Groups of insects	Month	Variant		
		Artificial grassing with ornamental clover Nano nr.	Artificial grassing with honey plants nr.	Black furrow nr.
Enchitreide	June	222	187	71
	September	154	107	56
	Mean value	**188**	**147**	**64**
Nematode	June	298	227	202
	September	298	192	110
	Mean value	**298**	**210**	**156**
Colembole	June	255	209	120
	September	234	175	64
	Mean value	**245**	**192**	**92**

The most representative group of insects was *Nematode*, followed by *Colembole* for all the variants. We can mention also that the number of insects was higher in June compared to September. Analysing the structure of the fauna captured by using the typing technique we can notice the existence of a larger number of useful insects species compared to the harmful insects in case of all the variants. From the useful species the high number was registered for the orders *Ortoptera*, *Coleoptera* and *Arahnidae*. A low number of harmful species has been recorded among those that belong to the orders *Homoptera*, *Hymenoptera*, *Diptera* and *Heteroptera* (Figure 4).

The impact of conservative soil maintenance practices in vineyards on soil microbial diversity and on the biodiversity of useful and harmful entomofauna

RESULTS AND DISCUSSIONS

Concerning the influence of the cover crops on the ratio between the useful and harmful insects we can mention that the number of useful species was higher in case of the artificial grassing of soil with ornamental clover Nano, this aspect being favorable for grapevine protection against the harmful insects.

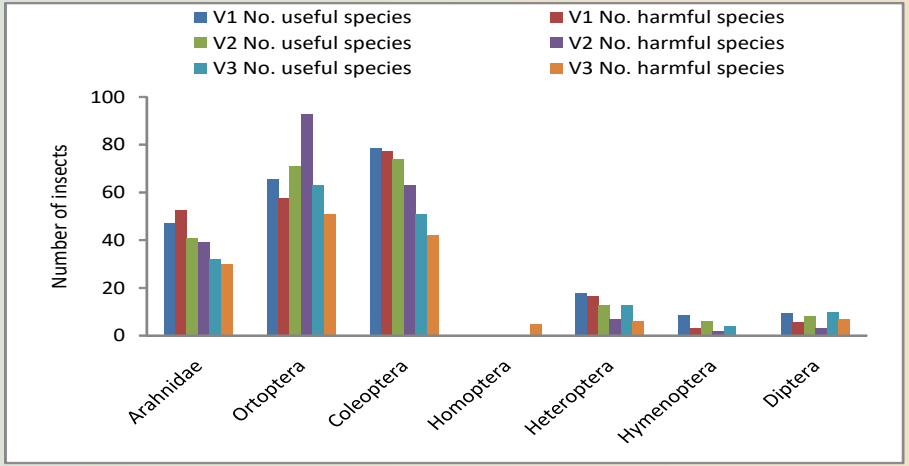

Figure 4. The structure of the entomofauna captured by using the typing technique (mean values)

CONCLUSIONS

The experimental data obtained showed that the use of conservative soil maintenance systems caused changes (quantitatively and qualitatively) on the biodiversity of soil and vineyard organisms, as a result of the modifications occurred in soil water regime, soil temperature and also on soil fertility induced by these systems.

Concerning the soil microbial biodiversity it was found a significant increase of the total number of microorganisms in case of the mulching systems (especially in case of partial mulching with marc compost) as compared with the classical black furrow system. Bacteria was the largest group of microorganisms, followed by fungi, actinomycetes and yeasts.There was a good correlation between the microbial load and the soil humidity. The ratio between fungi and bacteria was higher in case of the use of mulching systems, this being a favorable factor for soil health and for its biological activity.

The use of the artificial grassing of soil between the rows with ornamental clover or honey plants caused a change of the number of insects present in vineyard and of their diversity. The useful species of insects, especially from the orders *Ortoptera*, *Coleoptera* and *Arahnidae* registered the highest values in case of the artificial grassing of soil with ornamental clover Nano, this being favorable factor for grapevine protection against harmful insects.