Micromycetes in ampelocenosis soil under different keeping system

A A Lukyanov

Anapa Zonal Experimental Station of Viticulture and Wine-making, Branch of Federal State Budgetary Scientific Institution, North-Caucasus Federal Scientific Center of Horticulture, Viticulture, Wine-making, 36, Pionersky prospect, Anapa, 353456, Russian Federation

E-mail: lykaleks@mail.ru

Abstract. As a result of 2019 research it was found that the largest number of micromycetes colony-forming units in the soil was observed in the variant with sod formation. The number of CFU in 1 gram of absolutely dry soil in the variant with sod formation in May exceeded the variant with black fallow fivefold and in August twofold. Species diversity was represented by 11 species belonging to 8 genera: Mucor, Trichoderma, Penicillium, Aspergillus, Fusarium, Alternaria, Cladosporium, Verticillium. In the complex of isolated micromycetes in the variant with sod formation during spring period the p. Trichoderma species predominated. Its occurrence frequency was 80%. On the black fallow in this period the dominant position was occupied by r. Penicillium species (30.4%). During summer period in sod formation variant the genera species Fusarium, Alternaria, Cladosporium, Verticillium were isolated with a higher occurrence frequency, while the dominant position was occupied by p. Penicillium species (27.4%). In the variant with black fallow soil keeping system p. Penicillium and Aspergillus species predominated.

1. Introduction

Micromycetes are an essential ecosystems component occupying various ecological niches. Moreover, fungi absolutely predominate in soil microbial community. So, according to T.G. Dobrovol’skaya, D.G. Zvyagintsev, I.Y. Chernov et al. (2015) soil fungi make up from 50 to 90% of soil microorganisms total biomass and it is they which create plant material destruction [1].

Nowadays much attention is paid to the study of microscopic fungi complex in soils since soil microbial community is a sensitive indicator of anthropogenic load degree on the ecosystem [2–4]. Constant anthropogenic load on soil leads to its degradation degenerating soil properties [5 - 9]. Such phenomena are observed as: soil structure disturbance, overconsolidation, water-physical properties degeneration and meanwhile soil biological activity also decreases. Thus, soil microbiological activity suppression as a result of intensive anthropogenic impact associated with soil organic matter supply decrease is mentioned in the works of researchers T.N. Vorobyeva (2016), A.A. Lukyanova (2019), O.E. Klimenko et al. (2019) [10 - 12]. In this regard, the purpose of our research was to study soil micromycetes composition under different soil maintenance systems on vine plantations.
2. Materials and research methods

Agrochemical indicators of soddy-carbonate thick, low-humus, heavy loamy granulometric composition formed on the eluvium of marl and carbonate shale soils were determined according to generally accepted methods [14-18]. The sampling was carried out at industrial vine plantations site with different maintenance system using the envelope method. The number of micromycetes was assessed by plating soil on hungry alcoholic agar suspension according to the method of G.D. Easten (1969) described in detail in the works of V.S. Gorkovenko (2006) [19]. The number of colony-forming units in the soil sample was counted according to the formula of T.G. Mirchink (1988) [20].

3. Research results

Under generally accepted system of black fallow type soil keeping negative changes in soil properties occur on vine plantations [21]. To be exact the imbalance arises between the inflow and removal organic matter from the soil. This is quite often mentioned in the works of researchers T.N. Vorobieva, V.S. Petrova, A.S. Belkova, A.V. Ashes [22, 23]. Such system of soil keeping does not ensure soil fertility reproduction and deprives of self-regulation ability. Therefore, in order to prevent soil degradation processes in amelioration it has recently been increasingly recommended to use biologized soil keeping systems while taking into account the precipitation and terrain amount.

As part of the study an agrochemical research of soddy-calcareous soil was carried out and soil micromycetes quantitative composition was studied under a biologized and traditional (black fallow) soil system keeping (sod formation).

An agrochemical soil research showed that this type of soil is characterized by a humus containing varying from 1.8% to 2.8% in the upper soil horizon (0-30 cm), and from neutral soil reaction (pH 7.1) to slightly alkaline (pH 7.2). The amount of water-soluble salts does not exceed permissible limits. The presence of calcium carbonates varies from medium to high increasing with depth. The content of nitrate nitrogen in soil layers of 0-20 cm and 20-30 cm cultivated with the use of sod formation was 2.8 and 6.1 mg / 100 g of soil respectively which is 0.3 and 4.0 mg / 100 g. higher than similar layers in black fallow version. Mobile phosphorus containing in soil layers 0-20 cm and 20-30 cm in sod formation variant exceeded black fallow keeping system variant by 5.2 and 4.0 mg / 100 g. of soil respectively. Humus-carbonate soil parent rock material is quite rich in potassium therefore there is no potassium deficiency on this type of soil.

Quantitative and qualitative soil micromycetes composition of sod-calcareous soil with different types of soil keeping is shown in the table 1.

Table 1. The number of micromycetes in sod-calcareous soil with different types of soil keeping.

| Micromycetes                  | sod formation      | black fallow      | sod formation | black fallow | sod formation | black fallow | sod formation | black fallow | sod formation | black fallow |
|-------------------------------|--------------------|------------------|---------------|--------------|---------------|--------------|---------------|--------------|--------------|--------------|
|                               | 20.05.2019         | 02.08.2019       |               |              |               |              |               |              |              |              |
| Trichoderma spp.              | 19232.5            | 4287.5           | 19232.5       | 4287.5       | 19232.5       | 4287.5       | 19232.5       | 4287.5       | 19232.5      | 4287.5       |
| Penicillium spp. (3 types)    | 3185               | 1960             | 3185          | 1960         | 3185          | 1960         | 3185          | 1960         | 3185         | 1960         |
| Mucor spp.                    | 245                | 490              | 245           | 490          | 245           | 490          | 245           | 490          | 245          | 490          |
| Verticillium spp.             | 0                  | 1225             | 0             | 1225         | 0             | 1225         | 0             | 1225         | 0            | 1225         |
| Fusarium spp. (2 types)       | 1348               | 1103             | 1348          | 1103         | 1348          | 1103         | 1348          | 1103         | 1348         | 1103         |
| Cladosporium spp.             | 0                  | 0                | 0             | 0            | 0             | 0            | 0             | 0            | 0            | 0            |
| Aspergillus spp.              | 0                  | 1348             | 0             | 1348         | 0             | 1348         | 0             | 1348         | 0            | 1348         |
| Alternaria spp.               | 0                  | 1225             | 0             | 1225         | 0             | 1225         | 0             | 1225         | 0            | 1225         |
| Total                         | 29400.0            | 5635.0           | 29400.0       | 5635.0       | 29400.0       | 5635.0       | 29400.0       | 5635.0       | 29400.0      | 5635.0       |

The greatest number of micromycetes colony-forming units in the soil was observed in sod formation variant. Thus, the number of CFU in 1 gram of absolutely dry soil in sod formation variant in May exceeded black fallow variant fivefold and in August twofold. Their maximum number was revealed in late spring (May 20) and amounted to 29,400 CFU per 1 g. of soil. With depth, the number of CFU in 1 gram of absolutely dry soil decreased only in sod formation variant. From the 0-20 cm layer in sod
formation variant from 9555.0 to 22662.5 CFU per 1 g. of soil was isolated, in black fallow variant 1960.0-4410.0 CFU. From 20-30 cm horizon 6737.5 - 8330.0 CFU per 1 g. were isolated on sod formation and 3675.0 - 3797.5 CFU per 1 g. on black fallow.

Micromycetes composition analysis isolated from soil in the experimental plot showed that the species diversity is represented by 11 species belonging to 8 genera: *Mucor, Trichoderma, Penicillium, Aspergillus, Fusarium, Alternaria, Cladosporium, Vertecillium*. The indicators of their occurrence frequency are shown in figure 1.

![Figure 1](image-url)

**Figure 1.** Micromycetes occurrence frequency in sod-calcareous soil with different types of soil keeping, 2019.

In spring period *r. Trichoderma* species (80%) followed by *Penicillium* species (17.5%). Occurrence frequency of *p. Mucor, p. Vertecillium* and *p. Alternaria* was not high at 1.7%, 0.4% and 0.4%, respectively. On the black fallow in this period the dominant position was occupied by species of *p. Penicillium* (30.4%), further: *p. Aspergillus* - 23.9%, *p. Trichoderma* - 21.7%, *p. Mucor* - 17.4%. With the lowest occurrence frequency the species of *p. Alternaria* (4.3%) and *Cladosporium* (2.2%) are.

In summer species of the genera *Fusarium, Alternaria, Cladosporium, Vertecillium* actively colonize dead parts of grasses with a sodding system of soil keeping which is why these micromycetes were isolated with a higher occurrence frequency in summer. Suppressive fungi of the genera *Penicillium* (27.4%) and *Trichoderma* (1.4%) were isolated at the same time. Species *p. Trichoderma* did not take up dominant position transformation at this stage. Under soil keeping system of black fallow species *Penicillium and Aspergillus* retained a dominant position.

4. Conclusion

Thus, when using a biologized soil keeping system which is sod formation the number of soil micromycetes was distinguished by large values. The number of CFU in 1 gram of absolutely dry soil in sod formation variant in May exceeded black fallow variant fivefold, and in August twofold. When
studying the soil micromycetes composition of soddy-calcareous soil with different soil keeping systems in vine plantations 11 species of micromycetes belonging to 8 genera were identified: *Mucor, Trichoderma, Penicillium, Aspergillus, Fusarium, Alternaria, Cladosporium, Verticillium*. There was a regrouping of the species composition depending on the soil keeping system and the season. In our opinion decrease in the number of *Trichoderma* is due to seasonal dynamics the main factor of which was the lack of precipitation in summer.

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