Streszczenie rozprawy doktorskiej w języku angielskim

Apple Replant Disease (ARD) commonly occurs in orchards, mainly with apple-trees, and in fruit nurseries. The disease is mostly caused by the lack of balance in the structure of the soil microbiota and mycobiota and due to the accumulation of harmful microorganisms. The negative effects of ARD can be reduced through biofumigation, which leads to the production of volatile biocidal compounds in the soil.

The aim of the study conducted between 2019 and 2021 was to assess the influence of selected phytosanitary plants, i.e. the French marigold (*Tagetes patula* L.), white mustard (*Sinapis alba*), and oil radish (*Raphanus sativus* var. *oleifer*) on: the composition of the soil microbiome and mycobiome, the number of nematodes, the physicochemical properties of the soil after nursery cultivation, the growth of apple trees and the biometry of their leaves.

The study was conducted in a production nursery. Apple trees were planted into the soil from two sites. The soil from the first site had not been used for the production of nursery material (crop rotation soil). The soil from the other site had been used for the production of apple trees (replanted soil). Three species of plants were used as forecrops: French marigold (*Tagetes patula* L.), white mustard (*Sinapis alba*), and oil radish (*Raphanus sativus* var. *oleifer*).

The analyses of taxonomic and functional diversity of bacterial communities showed that biofumigation changed the structure and abundance of the microbiome in the replanted soil in the fruit tree nursery. The abundance of operational taxonomic units (OTUs) (*Proteobacteria, Bacteroidota, Patescibacteria, Chloroflexi, Fatescibacteria, Verrucomicrobiota*) and bacterial genera (*Flavobacterium, Massila, Sphingomonas, Arenimonas,* and *Devosia*) increased. Biofumigation improved the physicochemical properties of the soil (bulk density and humus) and increased the abundance of operational taxonomic units (OTU) of the fungi kingdom. Apart from that, biofumigation with French marigold and oil radish reduced the abundance of the *Fusarium* genus, which includes several species of plant pathogens.

After biofumigation the number of phytopathogenic nematodes in the replanted soil decreased significantly. The greatest decrease was observed in the soil where French marigold (*Tagetes patula* L.) was used for biofumigation. It is particularly important that the population of *Pratylenhus penetrans* – a nematode species considered to be the main cause of ARD, was completely eliminated.

The biofumigants applied as forecrops to the replanted soil significantly increased its enzyme activity and respiration. In consequence, selected growth parameters of the apple trees

in the nursery improved. In comparison with the soil where no phytosanitary plants were used, as a result of biofumigation, the height of the trees growing on the replanted soil increased by over 50%. The area of the leaves and their mass, as well as the total length of lateral shoots were also significantly greater.

The results of our study let us conclude that phytosanitary plants can be successfully used as an alternative to chemical soil fumigation in nursery production. The French marigold (*Tagetes patula* L.) seems to be one of the most promising species.

Keywords: biofumigation, microbiome, nematodes, enzyme activity, tree growth

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