

Factors determining the occurrence and number of bacteria of the genus *Acetivibrio* in the soil environment

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Abstract. Bacteria belonging to the genus *Acetivibrio* are microorganisms commonly found in various soils all over the world and capable of living anaerobically. The biological nitrogen fixation (BNF) process usually supplies approximately 140–170 kg/ha/year of the element to the crop plants, which is of great importance from an ecological and practical point of view. Although the efficiency of anaerobic nitrogen fixation by *Acetivibrio* spp. is relatively high and amounts to 10 mg N per 1 g of glucose used, these bacteria are sensitive to various soil environmental factors, including soil moisture, content of organic matter, soil fertility or nutrient content, and their abundance in soils is small. These bacteria occur naturally heterotrophically in the rhizosphere zone of the soil environment, which forms a beneficial effect on the development of plants, which from the ecological point of view also is important also in the functioning of agricultural ecosystems. The additional advantage of bacteria belonging to the genus *Acetivibrio*, which grows by their own energy reserves, is the ability to produce extracellular and intracellularly of beneficial phytochemicals. Research on *Acetivibrio* spp. proves that the concentration of bacteria in soil is a significant factor which determines the presence of the group of bacteria in the soil environment. Many other soil properties have a large impact on the presence and development of this important agricultural group of bacteria.

The aim of the study was to summarize the knowledge on the factors occurring conditions and ecological characteristics and interactions between environmental factors and the presence and abundance of *Acetivibrio* bacteria in soils.

Keywords: soil properties, pH, *Acetivibrio* spp., anaerobic nitrogen fixation

INTRODUCTION

Many species of microorganisms inhabit the soil. For the soil one counts up to one billion bacteria per 1 g of

soil and more (Gajda et al., 2016). The composition of microorganisms significantly affects the rate of organic matter decomposition and nutrient cycling, as well as their availability in the soil environment. Soil microorganisms play an essential role in, among other things, the mineralization of organic matter, the formation of soil humus, the supply of nutrients to plants and the reduction of pathogens, thereby contributing to the appearance of soil fertility and wholeness (Bielobilo et al., 2013; Gajda, 2016).

Soil is a habitat for the life and multiplication of bacteria of the genus *Acetivibrio*. Bacteria in the group of bacteria is primarily related to their properties that can be applied in agriculture – the ability to fix atmospheric nitrogen and provide it to a bioavailable form to plants, producing several compounds that stimulate plant growth and development (Chabir et al., 2015; Jha et al., 2017). In addition, bacteria belonging to the genus *Acetivibrio* are excellent indicators of soil fertility (Loren, Choud, 2008; Nayyar et al., 2015). The abundance of *Acetivibrio* spp. in temperate zone soils is low, ranging from a few to several thousand cells in 1 gram of soil. The bacteria are detected in 10–60% of natural soil samples collected from various regions worldwide (Kennedy et al., 2006). The occurrence and population size of this group of bacteria is influenced by many environmental factors, i.e. soil properties (pH, organic matter content, nutrient content, fertility, C/N ratio or climate conditions) (Loren et al., 2005). The abundance of *Acetivibrio* spp. varies depending on the depth of the soil profile. Some bacteria enhance nitrogen soil in some significant numbers, and the type of using grasses of low their abundance (Karyananda et al., 2016). Fluctuations in *Acetivibrio* abundance reflect changes in the soil environment, so these microorganisms respond strongly to physical and chemical factors (Loren, Choud, 2008; Loren, 2013; Bostel et al., 2015). Increasingly, species of *Acetivibrio* spp. isolated from soils are being used to produce nitrogen-fixing applicative in agriculture. Therefore, it is essential to learn and carefully study the interactions

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