# MICROBIAL FUNCTIONALITY AND SPECIFICITY IN GRASSLANDS

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***Abstract***

*Grasslands are ecosystems with a high dynamic of population and matter flow. Climate change and the intensification of applied management act to produce strong alteration in microbial communities of this ecosystem. Microbial diversity provides realistic clues on the response of ecosystem to disturbances. Rhizosphere microorganisms are designed to control the flows of matter, enhancing grasslands stability and maintaining the balance of plant diversity. The emergence of dominant species in the canopy acts to reduce microbial diversity and to achieve a high level of specificity. The report fungi: bacteria is correlated with the amount of matter present in the ecosystem, defining transformation mode and path of transfer in nutrient flow. Symbiotic partnerships are present as stabilizing mechanisms for ecosystem at rhizosphere level, acting both for carbon and nitrogen storage and to reduce susceptibility of arhizospheric microbial groups to ecopedological momentary conditions. Microorganisms have the role of providing balance and stability in grasslands, either by maintaining plant diversity, either by stimulating the emergence of new paths for the transfer of matter.*

**Keywords:** bacteria, microbial, grassland, functionality.

## INTRODUCTION

Grasslands ecosystems are scattered in all ecoregions, characterized by high dynamics of matter transformation processes. Plant diversity in the canopy is complemented by an infinitely greater variety of microorganisms, with an active role in mediating the flow of information and matter between plants and soil (LAUENROTH and PRESTON, 2013; LEMAIRE *et al*., 2000). The adaptation of plants rhizospheric potential to microbial functional groups led to a selection of the organisms focused to a temporal balance and stability of grasslands (COOPER and RAO, 2006; LEMAIRE *et al*., 2011). Starting with agricultural period of humanity, grasslands were subjected to a constant anthropogenic pressure, stimulating the evolution of microbial flora but also the selection of different groups with high functionality. The analysis of microbial diversity and functionality of microorganisms present in grasslands is a section with a dynamic and a high potential for the exploration of self-control mechanisms in this type of ecosystems (LORE *et al*., 2002; WALL, 2004). The large number of individuals present in the microbial populations raises the level of exploration complexity of trophic processes and interactions, providing a wide variety of results.

**Microbial functionality**

The presence of microorganisms in the functional processes of terrestrial ecosystems offers the perspective of an orientation phenomenon of plant diversity toward values correlated with transfer processes. Meanwhile, plant diversity is an activator of microbial diversity by increasing the diversity of nutritional resources through the export of root exudates in soil and vegetal resources for decomposition (PROBER *et al*., 2015). Connecting α- and β-diversity of plants and microorganisms present in an ecosystem allow the establishment of realistic assumptions in evaluating possible changes due to climate change or the increase of human pressure (DE DEYN and VAN DER PUTTEN, 2005; LARKIN, 2003). While γ is a concept applicable at ecoregion level, the mechanism for assemblage of α- and β-microbial diversity can be connected to a single grassland ecosystem. α-microbial diversity, located at a low spatial scale, floristic survey level, can be analyzed within a complex extrapolation to achieve an average of β-diversity at a whole grassland and correlate it with the diversity of plant (BURNS *et al*., 2015; MITCHELL *et al*, 2010; VERESOGLOU *et al*., 2011; WANG *et al*., 2016). For the fungal component, capable of symbiotic associations with rhizosphere of plants, diversity is directly correlated with the number of species present in the ecosystem (DOLL *et al*., 2013). The response of microorganisms to external factors is visible primarily in the use, conversion and transfer of principal nutrients necessary for plants (LIEBISCH *et al*., 2013; MÜLLER-STÖVER *et al*., 2011), carbon, forms of nitrogen and phosphorus having fluctuations correlated with the activity of microbial functional groups. Rhizodeposition of carbon falls into the first conversion of this element by fungi, with a high diffusion in microbial community, but accessible after a longer period for actinomycetes and bacteria (BALASOORIYA *et al*., 2012). Increasing the level of nitrogen from external inputs is manifested through a higher sensitivity of microbial communities to soil conditions, but also with an increase in the capacity for degradation of organic matter derived from plant residues (ZEGLIN *et al*., 2007). Coordinated activity of fungi and bacteria leads to a stabilization of soil microaggregates: mechanical trapping of soil particles by fungal mycelia and along with bacteria fulfilling the binding process of soil particles using extracellular polysaccharides (PERES *et al*., 2013). Overall, the physico-chemical properties of the soil act in complex with floristic diversity and management of areas occupied by grasslands (ROONEY and CLIPSON, 2008) changing the structure of microorganisms populations and stimulating the occurrence of spontaneous intermediate successional stages in microbial communities. Residues derived from microbial metabolism have lower values in grasslands (MURUGAN *et al*., 2014) compared to agroecosystems, diversity of grassland flora being completed by a high diversity of microbial communities, which stimulates the processes of continuous conversion of matter present in soil. The reduction of microbial diversity is visible in the functionality of organic matter decomposition process, which causes a malfunction of all processes at the scale of entire ecosystem (BAUMANN *et al*., 2013).

**Microbial specificity**

Interaction with microorganisms is one of the crucial components for the presence of a plant in an ecosystem. From the plant perspective, dominant species tend to apply a high selection pressure on microorganisms, stimulating the emergence of a microflora highly functional for its own requirements; from the perspective of microbial community the pressure applied in rhizosphere is balanced split between species and stimulate the conservation of plant diversity degree (HOSANNA *et al*., 2013). Characteristics of dominant species, in terms of reducing floristic diversity, act in complex with its own microbial component and create negative changes in the functioning of grasslands; at the opposite pole are located synergistic interactions between microbial component and high diversity of plants, which lead to a stimulation of biomass production and efficient use of resources (MASSACCESI *et al*., 2014). An increase in the level of $CO_2$ in the atmosphere act to produce powerful changes of microbial specificity, altering the functioning of related processes in soil. Diazotrophic microbial communities in areas with higher levels of $CO_2$ react to attract and stimulate the activity of non-symbiotic $N_2$ fixers, leading to a change in the natural ratio between these two types of functional groups (TU *et al*., 2015). Grazing act to increase the abundance of microorganisms associated to nitrification processes, as an immediate response for the presence of manure, but is reduced as a group in the community immediately after the end of this type of activity (WANG *et al*., 2016). Microbial diversity decreases with an increase in altitude, especially soil fungi (LUGO *et al*., 2007), but increase as specificity in ecosystems located at high altitudes. The increase of altitudinal gradient stimulate the installation of autotrophs as dominant group in soil microflora, a phenomenon positively correlated with the caption of higher levels of $CO_2$, visible in alpine grasslands (GUO *et al*., 2015). The less amount of biomass produced by plants and its origin from a reduced range of species acts for a restriction in the abundance of microorganisms than to reduce their diversity (LIU *et al*., 2007), which means that latitude and longitude gradients have less effect than altitude in the composition of soil microbial community. The installation of certain microbial taxa as dominant in grasslands is correlated with the local climate and soil pH, while species richness is correlated with annual rainfall, which imprints to this parameter a microbial filter character (CAO *et al*., 2016). Under the dominance of a small number of plant species, mycorrhizal microflora may reduce its diversity, but without affecting the symbiotic potential and the stimulation of plant growth (ZALLER *et al*., 2011).

The fertility of the soil is a more restrictive parameter for mycorrhizal fungi than for bacteria in the rhizosphere, and the reduction of diversity acts to lower the quality of available substrate for saprophytic fungi and produce a decrease in their diversity (MILLARD and SINGH, 2010). An excess of nutrients in soil leads to a change in the community oriented to population highly tolerant for this phenomenon (DE VRIES *et al*, 2011; KNAPP *et al*., 2016), masking the ephemeral distribution of microorganisms in relation to the stressor, but highlighting the complexity of community (REGAN *et al*., 2014). A change in the ratio C:N, particularly in grassland ecosystems converted into arable land spreads in the transformation and accumulation of amino acids processes, lowering the efficient functionality of the microbial populations complex (REDMIRE-GORDON *et al*., 2015). The duration of maintenance for a management type imprints a selective dynamic for microbial groups present in grasslands – in stable systems microbial biomass having higher values, while short-term changes acting to reduce this parameter; fungal biomass decreases after a period of 10 years with an increase in total bacterial biomass (OATES *et al*., 2016). An associate increase in biomass of vesicular-arbuscular fungi and gram negative bacteria indicates the intensification in the cycle of nutrients and stability of microbial mediated processes. At the microbial community level, taxa with low abundance are more spaced than those abundant, indicating their subsequent appearance in the ecosystem (YOUSSEF *et al*., 2010, YOUSSEF *et al*., 2015).

**CONCLUSION**

The intensification of human pressure on grasslands leads to a selection of rhizospheric microflora and a high specificity of this community. Microorganisms can act to restrict the extension of dominant species, regulating nutritional flows and balancing the ecosystem.

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