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Short Communication

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Agroecological transition in the integration of bioproducts

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Short communication

Bioproducts are considered appropriate biotechnologies for agricultural production, mainly for the control of populations of harmful organisms, crop nutrition, improvement of soil properties and the conservation of associated biodiversity, among other functions that have been promoted with the rise of Organic Agriculture and the emergence of Agroecology.

The synergistic integration of microbiological biopesticides, biofertilizers, biostimulants and mycorrhizal inoculants is in high demand and puts scientific pressure on the methodological innovations necessary to achieve their sustainable use, mainly to determine the compatibility between the microorganisms used to make them and their interactions with populations that cohabit in the rhizosphere and phyllosphere of cultivated plants, as well as to develop appropriate technologies for their integration into crop technologies and transform the design of the agroecosystem as a quality habitat for these microorganisms.

The scientific base that is accumulating on the biotic interactions of microorganisms is profuse, showing that plants influence the microbial communities of the rhizosphere by secreting various metabolites, which in turn are important in plant growth and health.[1] Symbiotic mycorrhizal fungi, such as arbuscular mycorrhizal fungi form a key component of the microbial populations influencing plant growth and uptake of nutrients.[2]

Likewise, the microbiota that inhabits the phyllosphere depends on the metabolites emitted by the leaves for its nutrition, while protecting them from infection by airborne pathogens,[3] a function that could be mediated by the production of antimicrobial compounds, the competition between microorganisms or the activation of the defense mechanisms of the plant;[4] in turn, due to the influences of many other aspects related to plant nutrition,[5] adaptation to abiotic stresses such as drought, ultraviolet rays or frost[6,7] and with various metabolic functions of plants related to photosynthesis.[8]

Biofertilizers contain microorganisms such as bacteria, blue-green algae (cyanobacteria), microalgae, mycorrhizal fungi, which promote growth by increasing the supply or availability of nutrients to the host plant;[9] biostimulants facilitate functions for plants to regulate/modify physiological signaling, metabolism, uptake and transport processes, leading to increased plant growth, nutrient use efficiency, mitigating stress-induced limitations and increase the yield and quality of crops[10] and microbiological biopesticides are products based on bacteria, fungi, cyanobacteria and microalgae, whose isolated active compounds have antimicrobial, antiviral, cytotoxic, insecticidal or phytotoxic properties.[11]

Access by farmers to these bioproducts is diverse, because they are offered and distributed like any other product for agricultural use; also, local laboratories have been created that obtain them in a semi-industrial way, for their direct commercialization; and, even, there are artisan elaboration techniques from the local biodiversity. All these options have led to their being considered decentralized biotechnologies,[12] because their production and use coexist in the context of the territory.

The agroecological transition in the use of bioproducts begins with the substitution of chemical inputs for biological ones, continues with the diversification in the supply and use of different types of bioproducts, at the same time that these are integrated into the management of farming systems, contributing with various agronomic, economic and ecological functions; while, the greatest sustainability in its use is achieved when synergies between bioproducts are promoted (Figure 1).

During the agroecological transformation of agroecosystems, farmers begin to use microbiological biopesticides, organic fertilizers, biofertilizers and mycorrhizal inoculants, a situation that encourages their participation in transdisciplinary co-innovation processes, which also contribute to the agroecological transition of technologies of use of this type of inputs,[13] mainly on: (a) decision system (crop stages, bioproduct efficacy); (b) integration to crop technology (plant organs, crop development stage, cultural tasks, irrigation system, harvest); (c) preparation of the broth for the applications (compatibility of the mixtures); (d) application techniques (palletizing, inoculation, immersion, spraying, irrigation system); (e) mechanisms of action (microorganisms that comprise it); (f) agroecosystem quality (microclimate, structural complexity).

The quality of the agroecosystem as a habitat facilitates the functions of the associated biodiversity and the synergies in the use of bioproducts, which is evidenced in its capacity for ecological self-regulation, due to the occurrence of cumulative multi-effects that contribute to the regeneration and conservation of the biota in the soil, recovery and conservation of the associated biota (rhizosphere, epiphytic, natural enemies, pollinators) and higher quality of food, with less environmental impact, among others.[14]

Several ecological theories argue that the efficient functioning of agroecosystems does not depend only on the elements of biodiversity that are introduced and inhabit it,[15] because the quality of the habitat is essential,[16] as well how to favor interactions that contribute to the ecological services of functional biodiversity.[17]

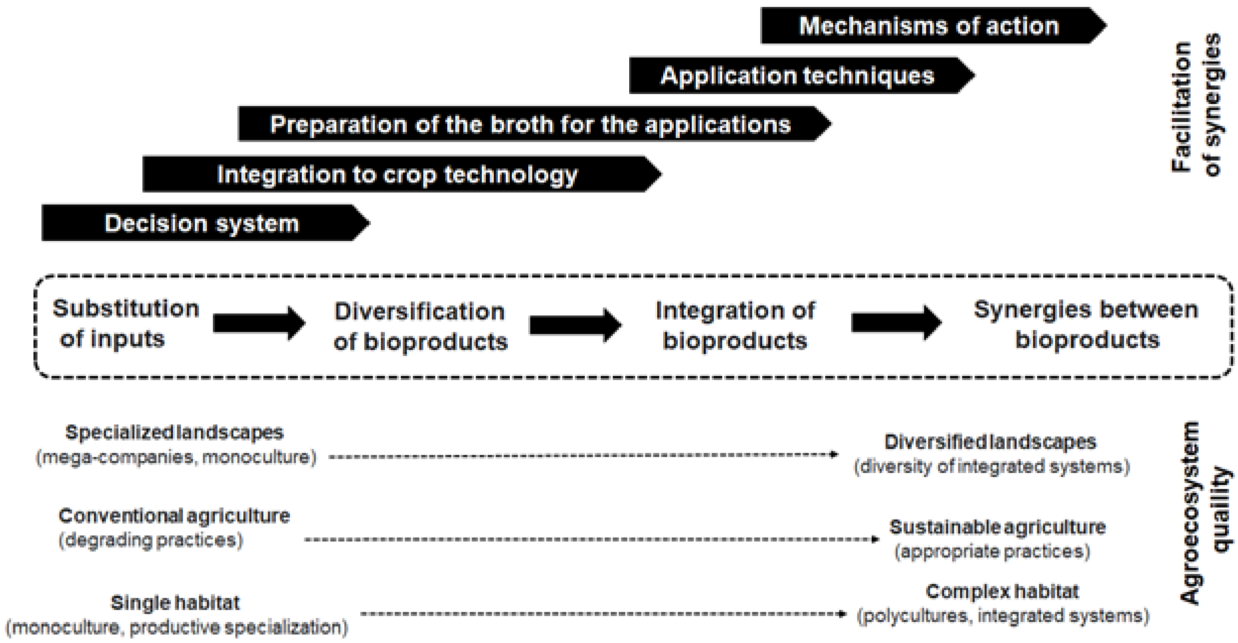

Figure 1 Representation of the agroecological transition process in the use of bioproducts.

It has been shown that certain consortia of microbial populations that influence plant growth and promote plant health,[18] can contribute to more sustainable agricultural practices.[19] These microbial populations can interact with each other, and exert a positive effect, not only on plants, but also on the soil, in such a way that they contribute to the stability and productivity of agricultural systems.[20]

The complexity of plant-soil-microorganism-environment interactions are varied and a complete understanding of all the relationships in question is unlikely; however, the beneficial effects of biological interactions that stimulate crop yields and improve plant health can be evaluated and some general strategies of interaction can be evidenced,[21] as well as some cultural practices. , such as mechanization, crop rotation, the use of irrigation, among others, modulate the interaction.[22]

Modern agroecosystems require systemic change, but new redesigned farming systems will not emerge from simply implementing a set of practices (rotations, composting, cover cropping, etc.) but rather from the application of already well defined agroecological principles. These principles can be applied using various practices and strategies, each having different effects on productivity, stability and resiliency of the target farming system. By breaking the monoculture nature of farming systems, agroecological diversification aims at mimicking ecological processes leading to optimal nutrient cycling and organic matter turnover, soil biological activation, closed energy flows, water and soil conservation and balanced pest-natural enemy populations. All these processes are key maintaining the agroecosystem's health, productivity and its self-sustaining capacity. By enhancing functional biodiversity, a major goal of the conversion process is achieved: strengthening the weak ecological functions in the agroecosystem, allowing farmers to gradually eliminate inputs altogether by relying instead on ecological processes and interactions.[23]

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Conflicts of interest

The author declared there is no conflict interest.

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