AUCTORES
Globalize your Research

Journal of Clinical and Laboratory Research
Luis L. Vázquez *

Open Access

Mini Review

Decentralized Biotechnologies in The Transition Towards Sustainable Agriculture

Luis L. Vázquez *

Invited Researcher, Center for Latin American Agroecological Research (CELIA).

***Corresponding Author:** Luis L. Vázquez, Invited Researcher, Center for Latin American Agroecological Research (CELIA).

Received Date: August 15, 2023 | **Accepted Date:** September 05, 2023 | **Published Date:** September 15, 2023

Citation: Luis L. Vázquez, (2023), Decentralized Biotechnologies in The Transition Towards Sustainable Agriculture, *Journal of Clinical and Laboratory Research*. 6(3); **DOI:**10.31579/2768-0487/114

Abstract

Biotechnology has the potential to play a significant role in developing more productive and nutritious crops. However, at the same time, it is essential to ensure that these technologies are developed in a responsible manner and that their benefits are distributed equitably across communities and regions.

Biotechnology has the potential to play a significant role in developing more productive and nutritious crops. However, at the same time, it is essential to ensure that these technologies are developed in a responsible manner and that their benefits are distributed equitably across communities and regions.

Key words: biotechnology; nutritious crops; microorganisms

Introduction

Biotechnology is a traditional research and development area in agriculture, which has evolved according to scientific advances in different disciplines related to the massive multiplication of plants, animals and microorganisms, becoming an emerging sector.

Biotechnology has the potential to play a significant role in developing more productive and nutritious crops. However, at the same time, it is essential to ensure that these technologies are developed in a responsible manner and that their benefits are distributed equitably across communities and regions (Das et al 2023).

The biological technologies used in agriculture are known as "agricultural biotechnology" or "agrobiotechnology", terms that refer to a set of different techniques (procedures and resources) that can be used to contribute to the solution of some of the agricultural problems (Alarcon and Artunduaga 2005).

The generation of biotechnological products considers the upward scaling during the development process of a new product or technology, based on the results of a smaller scale (Stamenković et al., 2018); while, in decentralized biotechnologies (DB) the production process and the use system have a scale in the territories (Vázquez 2021).

The sustainable production of fresh food is moving towards contextual self-management, a process that demands the decentralization of appropriate biotechnologies; in turn, to facilitate interactions between actors who obtain and use these products, aspects that are briefly addressed in this article, with examples of decentralized agrobiotechnologies in Cuba.

Decentralization of agrobiotechnologies: Agricultural biotechnologies are anchored in a scientific paradigm rooted in experimental biology, while sustainable agriculture is based on a biological paradigm that is best described as ecological. Both biotechnology and sustainable agriculture are associated with particular social science paradigms: biotechnology has its foundation in neoclassical economics, but sustainability is framed by an emerging community-focused and problem-solving perspective (Lyson 2002).

The decentralized biotechnologies (DB) strategy for the transition towards sustainable agriculture and food means that the processes for obtaining and systems for using these products, are appropriate for the different socioeconomic and ecological-environmental contexts where they are going to be used, so that it is feasible to create capacities for these agrobiotechnologies to be integrated into local value chains.

These can be obtained through industrial, semi-industrial and artisan processes, in decentralized facilities at different levels in the territory. Adopting agrobiotechnologies has various logistical, legal, financial, knowledge management, innovation, and biosafety implications, among others; in turn, the territorial scaling for its obtaining and use must be designed as an incremental transition process, in which three levels can be considered (Figure 1):

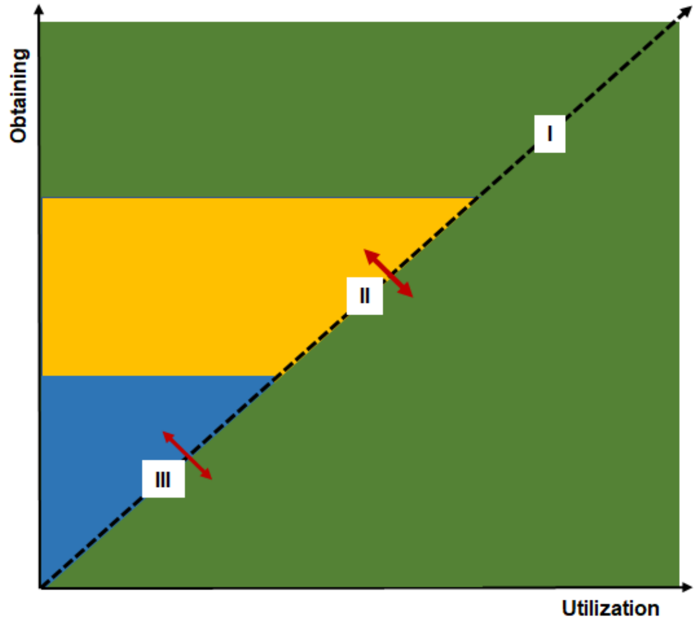

Figure 1: Territorial scaling of decentralized biotechnologies. Escalation level: III-territory; II-locality; I-production system.

III-territory: The obtaining process is carried out in facilities with territorial or municipal scope. The interaction between biotechnologists and farmers is limited to exchanges in the facilities when the latter go to buy them directly; Although, there is generally a specific system for its commercialization.

II-locality: The obtaining process is carried out in facilities with scope to localities, zones or productive organizations, for their local use; although, some productions can also be marketed in nearby towns. The interactions are facilitated because the units that obtain these products are closer to the properties or farms and are not only limited to acquiring them, but also contract quantities according to the moment of use, they achieve exchanges on types, strains or ecotypes, doses and delivery system. use, according to crops and seasons of the year, efficacy assessments, among others.

I-Agricultural production systems: Obtaining biotechnological products is achieved in production systems (property, farm, orchard, etc.), managed by the farmers themselves. At this level, farmers acquire skills to plan, obtain and use agrobiotechnologies. Some productions could be marketed locally, according to production levels.

Various agrobiotechnological products are valued as appropriate for the agroecological transition towards sustainable food systems, because synergies are facilitated in their use and functional interactions in agroecosystems, which as a whole contribute to the conservation of natural resources and the safety of fresh foods (Vazquez 2021).

Territories appear as “places” where strategies are elaborated, decisions are made, conflicts or at least tensions are managed; in that sense they are very close to organizations. The territories would thus be new forms of organizations-spaces in the piloting of territorial development (Vazquez and Chía 2020).

Innovation for the adoption of agrobiotechnologies requires a holistic approach in their integration into agricultural production systems, so that synergies and functional interactions are facilitated that also contribute to the economic rationality of the transition towards sustainable systems. Knowledge management that integrates education or training with innovation makes it easier to adapt or adjust the process of obtaining it and the system of use to local characteristics, as well as the interactions between actors who work in both processes.

Some agrobiotechnological products are imported or obtained by national entities, so that access by local agricultural production depends on various external actors; however, the DB means an approach to the places where primary agricultural production is carried out, whose main advantages are: (a) facilitation of access by farmers; (b) greater possibilities of exchange between biotechnologists and users; (c) production planning according to crops and seasons of the year; (d) possibilities of using elements of the local biota in some bioproducts (example: microbiological biopesticides); (e) feedback on effectiveness to improve product quality; (f) greater contribution to the transition process towards sustainable systems.

The development and scaling of bioprocesses has made significant progress (Xia et al 2014). It can be considered as a solid scientific-technical base to innovate in the generation of decentralized semi-industrial and artisanal production processes. Although the latter could be of lower quality and stability, the proximity of biotechnological facilities to agricultural production systems would facilitate access and planning according to growing seasons. Of course, the combination of need or demand, existing scientific and innovation capacities, access to funding sources, and the behavioral perception of decision-makers are decisive in this.

Agrobiotechnologies appropriate for the sustainability of agriculture: The DBs facilitate the agroecological transition towards sustainable agriculture, because they contribute to the circular economy of the value chains of the farm and the territory. In Cuba, for example, various agrobiotechnologies have been decentralized to the territories, some with technological adjustments to scale up their production in localities and production systems (Table 1).

Purposes	**Main types**	**Descentralization**		
		III	**II**	**I**
Multiply crops	Botanical seed.[2]	x		x
	Agamic seed (roots, tubers, cuttings, cuttings, buds)[2].	x		x
	Seedlings (vegetables, fruit trees, ornamentals, fodder)[3]	x	x	x

	In vitro seedlings (tissue culture)[4]	x		
Improve soil properties	Traditional compost[5]			x
	Technified compost (Indore method)[5]		x	x
	Worm humus[5]		x	x
Crop nutrition	Biofertilizers (*Bradyrhizobium*, *Rhizobium*, *Azotobacter*, *Azospirillum*, *Pseudomonas; Glomus* y *Acaulospora*)[6]	x		
	Native efficient microorganisms			x
Crop health	Entomopathogenic microbiological biopesticides (*Bacillus thuringiensis, Beauveria bassiana, Metarhizium anisopliae, Verticillium lecanii, Heterorhabditis spp.)*[6]	x	x	
	Antagonist microbiological biopesticides (*Trichoderma harzianum, Trichoderma viride)*[6]	x	x	
	Pathogenic nematodes microbiological biopesticides (*Paecilomyces lilacinus, Trichoderma viride, Tsucamurella paurometabola, Pochonia chlamydosporia*)[6]	x	x	
	Botanical biopesticides (nim and others)			x
	Entomophagous arthropods (*Lixophaga diatraeae*, Trichogramma spp)[6]	x	x	
Post harvest value addition	Processing of fresh produce (conservation, others)[7]	x	x	x
	Transformation of fresh agricultural products (pulps and others)[7]	x	x	x

Table 1: Purposes and types of decentralized agrobiotechnology bioproducts in Cuban agricultural territories. Decentralization scale: III-territory; II-locality; I-production system.

(1) Production in specialized units (seed farms) and on farms; (2) various research institutes offer the basic seed for decentralized productions; (3) screen houses or greenhouses; (4) facilities known as biofactories, which produce quality seedlings, free of phytopathogens; (5) Organic Matter Centers (OMC) that reside in towns and farms; (6) facilities (industrial and semi-industrial); (7) mini-industries (semi-industrial processes).

The products (worm humus and compost) have been widely used for different purposes in solid and liquid form, with very good results and in most crops, contributing decisively to the sustainability of agricultural production in the country, especially in the areas committed to the Urban, Suburban and Family Agriculture system (Martínez and García 2016).

For several years, 22 biofertilizer products for agricultural use have been developed from isolating, characterizing, producing and inoculating native soil microorganisms, mainly of the bacterial genera and orbicular mycorrhizal fungi, alone or combined with very advantageous effects on growth and production. of plants (Gómez and Martínez-Viera 2016) and native microorganisms (Blanco et al 2016).

The biofactories of vitroplantulas constitute a technological innovation with respect to the traditional seed production systems in Cuba, which has made it possible to achieve important benefits and impacts in the country, in which the following stand out: the production up to the year 2004 of 179,191,500 plants in vitro of high genetic and phytosanitary quality in species of agricultural, forestry and ornamental interest (Agramonte et al 2006).

Post harvest value addition (mini-industries) have emerged in agricultural territories as new biotechnologies, mainly as innovative initiatives of farmers. Its adoption is considered successful, because it adds value to fresh agricultural products, while they can be marketed throughout the year.

An example of sustainability in decentralized biotechnologies is the massive multiplication of biological control agents in the Cuban territories, which dates back to the middle of the last century in the cultivation of sugarcane and continued during the 70s-80s with the rest of the agriculture, with a reinforcement since the 1990s (Pérez and Vázquez 2001), benefiting annually 2.4 million hectares with bioproducts obtained in a network of 175 laboratories known as CREE (Centro Reproductor de Entomófagos y Entomopatógenos) and four Biopesticide Plants (Marquez et al 2000).

The decentralization strategy towards the territories of the production of biological control agents (ACB), led to the appropriation of these technologies by local actors, consolidating a system with high self-sufficiency for planning according to demands of agricultural production (Vázquez and Chía 2020).

During the transition of agriculture towards sustainable systems, agrobiotechnological productions are intended for production systems with different types of technological approaches (traditional, conventional, organic, in agroecological transition), regardless of the size of their surface. This is particularly important because it is necessary to adapt these new technologies, while building the capacities of local actors to understand their characteristics and contribution to sustainability.

The emergence of agricultural biotechnology was dependent on advances in our understanding of the basic biochemistry, genetic and physiological processes of biological systems and has led to the development of products that have provided farmers with new tools to increase productivity and lessen the impact environmental impact of agricultural practices (Ridley 2003).

References

1. Agramonte D, Orellana P, Suárez-Castella M, Jiménez MA, Santana I, et al. (2006). Biofábricas para la micropropagación de especies vegetales. Memorias VII Simposio Internacional de Biotecnología Vegetal (17-21 de abril de 2006), Biotecnología Vegetal 6 (4): 219-224.
2. Alarcón E. y Artunduaga R. (2005). América Latina y el Caribe: Nuevas agrobiotecnologías, desafíos, tendencias y consideraciones institucionales. Comunica, Edición Nº 2, II Etapa, 11p.
3. Blanco D, Suárez J, Donis F, González. (2016). Biodigestores y microorganismos nativos, pp. 159-168. En: Funes F, Vázquez LL (eds.), Avances de la Agroecología en Cuba. Estación experimental de Pastos y Forrajes Indio Hatuey. Matanzas. 605p. ISBN: 978-959-7138-21-1
4. Das S, Ray MK, Panday D, Mishra PK. (2023). Role of biotechnology in creating sustainable agriculture. PLOS Sustain Transform 2(7): e0000069.
5. Gómez LA y Martínez-Viera, R. (2016). Inoculantes microbianos y estimulantes, pp.41-153. En: Funes F, Vázquez LL (eds.), Avances de la Agroecología en Cuba. Estación experimental de Pastos y Forrajes Indio Hatuey. Matanzas. 605p.

6. Lyson TA. (2002). Advanced agricultural biotechnologies and sustainable agriculture. Trends in Biotechnology, 20 (5-1): 193-196.
7. Márquez ME, Vázquez LL, Rodríguez MG, et al. (2020). Biological control in Cuba, pp: 176–193. In: Van Lenteren JC, Bueno VHP, Luna MG, editors. Biological control in Latin American and the Caribbean. Its rich history and bright future. CABI Invasive series.
8. Martínez F y García C. (2016). Abonos orgánicos, pp. 109-122. En: Funes F, Vázquez LL (eds.), Avances de la Agroecología en Cuba. Estación experimental de Pastos y Forrajes Indio Hatuey. Matanzas. 605p. ISBN: 978-959-7138-21-1
9. Pérez N, Vázquez LL. (2001). Manejo ecológico de plagas. En: Transformando el campo cubano. Avances de la Agricultura Sostenible. Ed. ACTAF. La Habana. 191-223.
10. Ridley WP. (2003). Introduction to Agricultural Biotechnology: Challenges and Prospects, pp. 3-17. In: Agricultural Biotechnology. Ed. Bhalgat MK, Ridley WP, (Editor), Felsot AS. CS symposium series – 866, 218p.
11. Stamenković S, Beškoski V, Karabegović I, Lazić M, Nikolić N. (2018). Microbial fertilizers: A comprehensive review of current findings and future perspectives. Spanish Journal of Agricultural Research 16(1): e09R01.
12. Vázquez LL. (2021). Decentralized biotechnologies in production-use networks of biological control agents. Journal of Applied Biotechnology and Bioengineering, 8(2):65–66.
13. Vázquez LL y Chía E. (2020). Innovación y auto-gobernanza territorial del control biológico en Cuba. Agroecología (Murcia, España), 14 (1): 69-79.
14. Xia J, Wang G, Lin J, Wang Y, Chu J, et al. (2014). Advances and Practices of Bioprocess Scale-up Adv Biochem Eng Biotechnol.

DOI:10.31579/2768-0487/114