

Training for the production and use of bioinputs in the state of Hidalgo: an analysis of the actors

Espinosa-García José A.¹, Vélez-Izquierdo Alejandra^{1*}

¹ Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias-CENIDFyMA, Ajuchitlán, Colón, Querétaro, México, C.P. 76280

* Correspondence: velez.alejandra@inifap.gob.mx

ABSTRACT

Objective: The excessive use of synthetic fertilizers and pesticides has had negative effects on agricultural biodiversity. Recently, an alternative that has been suggested is the use of bioinputs, such as biofertilizers, biostimulants and biopesticides, coupled with the need to train agricultural technicians in topics related to the preparation and use of these bioinputs. In response, SADER in collaboration with INIFAP, designed a Training Program of 10 topics related to this subject, aimed at the technical staff of the Agricultural Representations.

Design/methodology/approach: In Hidalgo, approximately 40 participants attended the sessions. Each participant completed both pre- and post-topic evaluations, as well as evaluations of the course and the trainers. This information was compiled into a database and formed the basis of the present document, which aims to describe the program's results with a focus on capacity development (CD) and sustainable agriculture. Capacity development was measured by assessing the change between the initial and final evaluation scores.

Results: The capacity development of the technical staff from the SADER Representation in Hidalgo was low, with an average improvement of only 1.0 point over the 10 courses.

Findings/conclusions: Therefore, it is considered important to reinforce the training by implementing the bioinput production processes presented.

Keywords: Capacity building, sustainable agriculture, soil fertility.

INTRODUCTION

The increase in the human population has been accompanied by a growing demand for food, driving the development of agricultural technologies aimed at increasing productivity. This was the case with the Green Revolution in the mid-20th century, which was based on the use of high-yielding varieties, primarily cereals, as well as the massive application of synthetic fertilizers and pesticides (Mamani & Filippone, 2018). These practices have led to negative effects on agricultural biodiversity, triggering an escalating cycle of ecological and social degradation, resulting in risks and threats (Molina, 2021). In response to these adverse effects, the concept of sustainable agriculture has emerged, promoting agricultural production while conserving natural resources such as soil, water, and biodiversity (Badgley *et al.*, 2007). This shift has been primarily driven by the increasing demand for agricultural and livestock products free of agrochemical residues, necessitating changes in traditional production methods.

An alternative that has gained relevance is the use of bioinputs, such as biofertilizers, biostimulants, and biopesticides, which represent economically attractive and environmentally sustainable options (Mamani & Filippone, 2018). A bioinput is a product based on compounds and/or extracts from microorganisms or plants, or on living microorganisms, capable of improving crop productivity, quality, and/or health without causing negative impacts on the agroecosystem (Gerwick & Sparks, 2014). Throughout

Citation: Espinosa-García, J. A., & Vélez-Izquierdo, A. (2025), Training for the production and use of bioinputs in the state of Hidalgo: an analysis of the actors. *Agro Productividad*. <https://doi.org/10.32854/agrop.v18i2.3264>

Academic Editor: Jorge Cadena Iñiguez

Associate Editor: Dra. Lucero del Mar Ruiz Posadas

Guest Editor: Daniel Alejandro Cadena Zamudio

Received: November 27, 2024.

Accepted: January 07, 2025.

Published on-line: March XX, 2025.

Agro Productividad, 18(2). February. 2025. pp: 201-207.

This work is licensed under a Creative Commons Attribution-Non-Commercial 4.0 International license.



history, these bioinputs have been used in traditional agriculture based on farmers' empirical knowledge. However, most of them do not have a defined author and have not been incorporated into agronomy curricula. This situation highlights the need to train technicians who advise producers on the production and use of bioinputs, particularly those focused on soil nutrition and fertility.

To address this need, the Secretariat of Agriculture and Rural Development (SADER), in collaboration with the National Institute of Forestry, Agricultural, and Livestock Research (INIFAP), designed a Training Program covering ten key topics on the production and use of bioinputs and their benefits for soil conservation and fertility (Reyes *et al.*, 2023). This program was aimed at technical staff from the Agricultural Representations in most federal entities of the country, as well as other professionals in the sector.

One of the states that participated in this training was Hidalgo, where INIFAP researchers delivered the ten topics to SADER technical staff during the last quarter of 2022. On average, 40 people participated, each of whom completed an initial and final evaluation for each topic, as well as assessments of the course and trainers. This information was compiled into a database, which served as the basis for this study. The objective of this document is to describe the results of the Training Program for the Production and Use of Bioinputs for Plant Nutrition and Soil Fertility Conservation in the State of Hidalgo, with a focus on capacity development and sustainable agriculture.

MATERIALS AND METHODS

Data compilation

Data from the initial and final evaluations completed by 40 participants from the state of Hidalgo were compiled in an Excel[®] spreadsheet. These evaluations covered the ten topics included in the Training Program: 1. Nutritional needs of plants and soil as a source of nutrients. 2. Biogeochemical processes in soil and their role in nutrient availability. 3. Interactions between microorganisms, plants, soil, and the environment. 4. Tools for determining plant nutritional needs and the use of organic and synthetic fertilizers. 5. Contribution of organic inputs to soil nutrition and quality. 6. Improvement of agricultural crop productivity and health through the use of biological products. 7. Preparation and use of bioles. 8. Production and use of compost. 9. Production and use of vermicompost. 10. Production and use of leachates.

The responses from the satisfaction surveys completed by the 40 participants for each of the 10 topics covered were also integrated, reflecting their opinions regarding the course:

- Were the objectives and content of the training covered?
- How was the relationship between the explanations and the activities performed?
- Do you consider the content of the topics to be appropriate and up-to-date?
- The provided training materials.
- What was learned will be useful in my work activities.
- Are you satisfied with the course?

And their opinion regarding the instructor(s):

- The treatment towards the participants.
- He/she presented the objectives and the work program.
- He/she fulfilled the objectives and the work program.
- Demonstrated mastery and knowledge of the topics.
- Promoted, supervised, and strengthened group integration.
- Conveyed the knowledge clearly.

Analysis of the Initial and Final Evaluation Responses

For each topic, a test with 10 questions was designed and applied at the beginning and end of the topic presentation. The scores from the responses were compiled into an Excel[®] spreadsheet, assigning a value of 1 for correct answers and 0 for incorrect ones. The correct answers were summed, and the total was converted into a grade on a scale from 1.0 to 10.0. The grades for all participants were then averaged to obtain the overall average for each topic.

Analysis of the Course and Instructor Evaluation Responses

To analyze the responses from participants for each topic, a Likert scale (Ospina *et al.*, 2003) was applied. For each question, participants could select from four options: excellent (value of 4), very good (value of 3), good (value of 2), poor (value of 1), and very poor (value of 0). The average value for each participant and for all the questions was calculated to obtain an overall average for each course.

Evaluated Variables

To measure capacity development, the value of the final evaluation was subtracted from the value of the initial evaluation for each course. Additionally, the average, maximum, and minimum percentages of the evaluations for each course and each instructor were calculated.

RESULTS AND DISCUSSION

Based on the topics presented in the 10 courses, the first four address conceptual aspects of the soil-plant-environment relationship (Reyes *et al.*, 2023). Therefore, as shown in Table 1, the initial scores obtained are the lowest, indicating limited mastery of these topics by the participants. The following six topics have a practical orientation, so the participants' prior knowledge was greater, which is reflected in the scores obtained, particularly in the production and use of leachates, where the initial score was 9.0 on a scale of 1 to 10.

In the same Table 1, the values that participants obtained at the end of each course are presented. It can be observed that the courses with greater practical application, such as the preparation and use of bioles, composts, vermicomposts, and leachates, are the ones with the highest scores. This shows the current importance of training and disseminating these topics to transition from conventional agriculture to sustainable agriculture, especially the last three inputs, due to their role as fertilizers and soil enhancers (Aramendis *et al.*, 2023).

Table 1. Average values of the initial and final scores for the 10 courses taught in the state of Hidalgo.

Courses	Initial evaluation			Final evaluation		
	Mean ^a	Max	Min	Mean	Max	Min
1. Nutritional needs of plants and soil as a source of nutrients.	5.0	9.0	1.0	7.0	10.0	2.0
2. Biogeochemical processes in soil and their role in nutrient availability.	5.0	10.0	0.0	7.0	10.0	3.0
3. Interactions between microorganisms, plants, soil, and the environment.	6.0	10.0	3.0	9.0	10.0	5.0
4. Tools for determining plant nutritional needs and the use of organic and synthetic fertilizers.	6.0	10.0	10.0	8.0	10.0	2.0
5. Contribution of organic inputs to soil nutrition and quality.	7.0	10.0	5.0	7.0	10.0	4.0
6. Improvement of agricultural crop productivity and health through the use of biological products.	6.0	10.0	3.0	8.0	10.0	6.0
7. Preparation and use of bioles.	8.0	10.0	4.0	8.0	10.0	4.0
8. Production and use of compost.	7.0	10.0	10.0	8.0	10.0	3.0
9. Production and use of vermicompost.	7.0	10.0	4.0	9.0	10.0	3.0
10. Production and use of leachates.	9.0	10.0	3.0	9.0	10.0	4.0
Promedio general	7.0	10.0	3.0	8.0	10.0	4.0

^aMean=Average. Source: Prepared by the author using data from participant evaluations.

Composts, vermicomposts, and leachates are the most commonly used organic and foliar fertilizers due to their high content of free amino acids or humic and fulvic acids. Some of these inputs are produced by the farmers themselves (Mamani and Filippone, 2018). Therefore, training the technicians who support the farmers has positive effects, and understanding the processes involved in their preparation will improve the efficiency of these inputs, thereby enhancing production.

When analyzing the effect of the 10 courses on the skills acquired by the participants, it is observed in Figure 1 that the topic with the greatest difference between the average initial and final exam scores was related to “nutritional needs of plants and the soil as a source of nutrients.” As mentioned earlier, this is a theoretical topic, and while most participants are agronomists, not all are specialists in Soil. Therefore, the diagnostic evaluation was low, but upon receiving the training, they absorbed the concepts presented, as reflected in the final evaluation. There are other topics that did not show improvements, such as “contribution of organic inputs to soil nutrition and quality,” which had an initial and final score of 7.0, and “production and use of leachates,” which maintained an initial score of 9.0.

When analyzing Figure 1, it is observed that the effect of the training was not significant. The average score across the 10 courses was 1.0, which is a low value. This can be attributed to the fact that capacity development is the result of a combination of resources, practices, knowledge, and relationships (González, 2021). It can be deduced that a short training course is not sufficient to improve the participants' skills. The topics taught, especially

those with practical application, need to be put into practice. These topics explain how to produce and use inputs and demonstrate the impact on soil improvement or performance. This can only be achieved through direct contact with the producers, which is the main role of most of the course participants. Only then can it be said that the individual has acquired experience, knowledge, and technical competencies (González, 2021).

Another aspect that can be observed in Figure 1 is the training gap. In the case of the production and use of compost, this topic needs to be reinforced, as the average final evaluation score was 7.0. This result represents an area for improvement (González, 2021), because compost is a bio-input that can be produced from manure, a widely available ingredient in the state of Hidalgo, such as in the Tizayuca and Valle de Tulancingo dairy basins (Poméon *et al.*, 2006).

A determining factor for capacity development is the instructor. Participants' opinions regarding these actors were evaluated on a scale from 0 to 4, where zero is very poor and four is excellent. The average of the six questions is shown in Figure 2, which includes the evaluation of: the treatment towards participants, the communication and fulfillment of course objectives, as well as the instructor's command and delivery of the course content. In this figure, it is observed that the instructor with the lowest score was the one who taught the course on the production and use of compost, with participants indicating that they perceived less mastery and knowledge of the topic, as well as difficulty in transmitting it clearly. Although this instructor received the lowest score, they averaged a rating of 3.4, which places them in the "very good" category according to the scale used. On the other

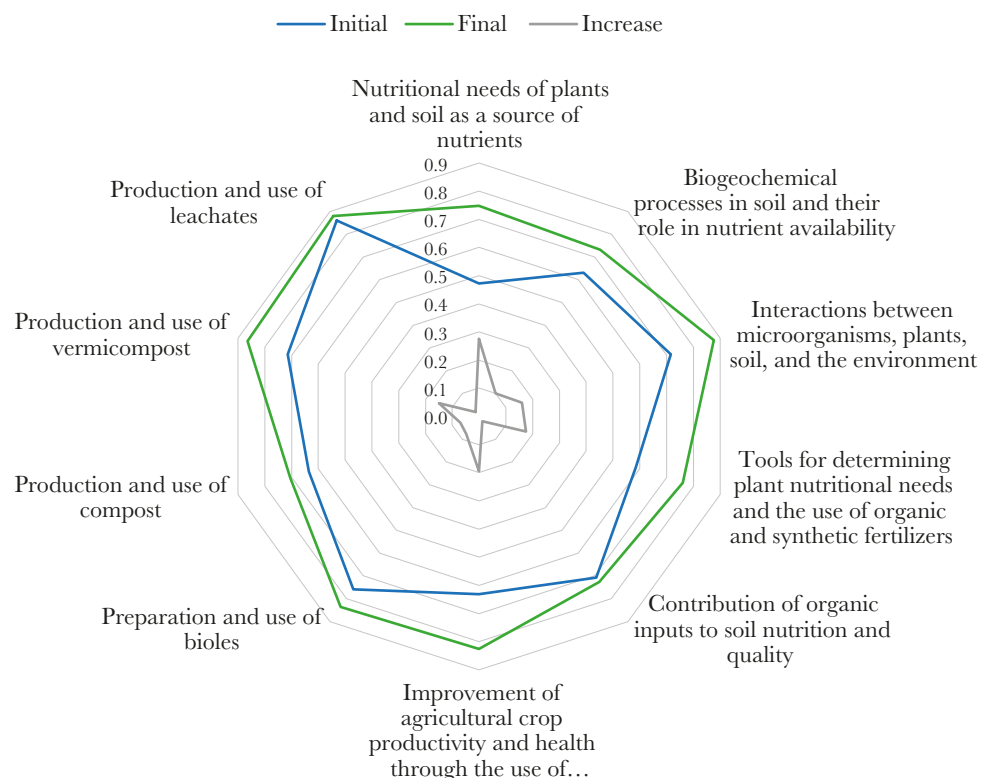


Figure 1. Effect of the training received by participants in 10 courses held in the state of Hidalgo.

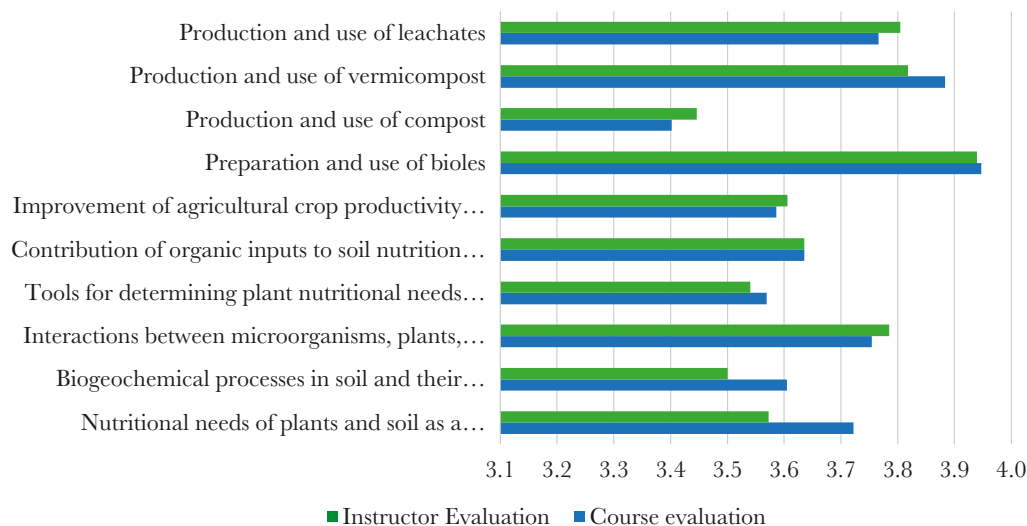


Figure 2. Evaluation of the instructors and the 10 courses held in the state of Hidalgo. Source: Author's elaboration based on the participants' satisfaction survey data.

hand, the instructors who received the highest ratings were those who taught the courses on “preparation and use of bioles” and “production and use of vermicompost.” Analyzing the ratings given to all the instructors, it is clear that all instructors received ratings above 3.4, indicating that participants rated them as very good or excellent.

In the same Figure 2, the average rating of the 10 courses provided by the participants is shown, regarding each course. Their opinions were based on whether the stated objectives were met, if the topics were appropriate and up-to-date, if the provided materials were useful and adequate, if what was learned was applicable to the participants' activities, and how satisfied they were with the course. In this figure, it is observed that the course with the lowest rating was “Biogeochemical Processes of the Soil in Nutrient Availability,” with the question regarding the provided materials receiving the lowest score. Although this course received the lowest rating, it still averaged a score of 3.5, which places it in the “very good” category.

In contrast, the course with the highest rating was the “Preparation and Use of Bioles.” For the six questions that asked for the participants' opinions, it received an excellent rating, with an average of 3.95. Upon analyzing the ratings for all the courses, they all scored higher than 3.5, indicating that the participants rated all 10 courses as very good to excellent.

CONCLUSIONS

The results presented from the participants in the Training for the Production and Use of Bioinputs for Plant Nutrition and Soil Fertility Conservation in the state of Hidalgo show that the capacity development was low, with an average change in the final evaluation score compared to the initial score of only 1.0 on a scale from 1.0 to 10.0 in the knowledge acquired. The initial average score across the 10 courses was 7.0, and at the end, they obtained 8.0. Even in the topics of “Contribution of organic inputs to soil nutrition and

quality” and “Production and Use of Leachates,” the scores obtained in both evaluations were the same.

The participants’ ratings regarding the performance of the instructors, as well as the quality, relevance, and applicability of all the courses, were above 3.4 on a scale of 4, indicating that both the instructors and the courses were rated as very good and excellent by the participants. However, the difference between the initial knowledge of the topics versus the knowledge acquired by the end of the training was low.

REFERENCES

- Aramendis, R., Mondaini, A. y Rodríguez, A. 2023. Bioinsumos de uso agrícola: situación y perspectivas en América Latina y el Caribe, Documentos de Proyectos (LC/TS.2023/149), Santiago, Comisión Económica para América Latina y el Caribe (CEPAL).
- Badgley C., Perfecto I. y Cassman K. 2007. Can organic agriculture feed the world? *Renewable Agriculture and Food Systems* 22(2): 80-85.
- Gerwick B.C. y Sparks T.C. 2014. Natural products for pest control: an analysis of their role, value and future. *Pest Management Science* 70(8): 1169-85.
- González B., H.A. 2021. Capacidades: (otra vez) un análisis conceptual y metodológico. *Intersticios sociales*, 21:9-43.
- Mamani de M., A. y Filippone, M.P. 2018. Bioinsumos: componentes claves de una agricultura sostenible. *Rev. Agron. Noroeste Argent.*, 38(1): 9-21.
- Molina Z., J.E. 2021. La revolución verde como revolución tecnocientífica: artificialización de las prácticas agrícolas y sus implicaciones. *Revista Colombiana de Filosofía de la Ciencia* 21(42):175 -204.
- Ospina BE, Sandoval JJ, Aristizábal CA y Ramírez MC. 2005. La escala de Likert en la valoración de los conocimientos y las actitudes de los profesionales de enfermería en el cuidado de la salud. *Antioquia. Invest Educ Enferm.*, 23(1):14-29.
- Poméon, T.; Boucher, F.; Cervantes E., F.; Fournier, S. 2006. Las dinámicas colectivas en dos cuencas lecheras mexicanas: Tlaxco, Tlaxcala y Tizayuca, Hidalgo. Memoria del III Congreso Internacional de la Red SIAL: “Alimentación y Territorios”. Universidad de Andalucía, España. 28 p.
- Reyes C., A.; García S., R.; Zetina L., R.; Espinosa R., M.; Reveles H., M.; Aguado S., G.A.; Camas G., R.; Báez P., A. y Patishtan P., J. 2023. Producción y uso de bioinsumos para la nutrición vegetal y conservación de la fertilidad del suelo. Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias. Centro de Investigación Regional Pacífico Centro. Campo Experimental Tecomán. Tecomán, Colima. México, Libro Técnico No. 3. 494 p.

