

### Training course

## "Biological control and the production of arthropods as natural enemies for pest management in agriculture"

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### 1. Background

In Ecuador and Latin America, there is interest in applying biocontrol to various crops for food security and economic importance, but there are few or no local companies that provide parasitoids / predators for agricultural use. For this reason, we took the initiative to organize a training course in biocontrol with special attention to the mass rearing of beneficial arthropods.

Recently, we hosted two congresses, the I Congress of Applied Biocontrol (4th to 6th of October, 2018) and the II (28th – 29th of October and 4th – 5th of November 2020), in which 32 (first congress) and 30 (second congress) experts presented talks and with the participation of more than 220 (first congress) and 2000 (second congress) people of 28 nationalities and with speakers of 11 nationalities. The broad international participation in these two congresses shows the growing interest in biocontrol to reduce the use of agrochemicals in Ecuador and South America.

## 2. Results

At the end of 2020, we submitted a financial proposal for a grant of the IOBC <https://www.iobc-global.org/> for training courses in biocontrol for young students and professionals interested in biological control. The course was held in November 2021 and focused on the mass rearing of natural enemies such as parasitoids and predators. Due to the circumstances of the pandemic, the event was held online with the participation of 25 national and international experts who provided their experiences in biological control. The 25 instructors came from Colombia, Peru, Uruguay, Chile, Argentina, Brazil, Mexico, Spain, Italy, the Netherlands, and Ecuador. In addition, for the opening and closing we had the presence of the current president of IOBC, Dr. Martin Hill (Rhodes University, South Africa), the previous president Dr. George Heimpel (University of Minnesota, United States) and the president of the neotropical regional section (NTRS) of IOBC Dr. Germán Vargas (Cenicaña, Colombia).

The event was organized by the National Institute of Agricultural Research (INIAP, Dr. Carmen Castillo), Technical University of the North (Spanish acronym UTN, Dra. Julia Prado) and the San Francisco de Quito University (USFQ, Dr. Antonio León) of Ecuador. The IOBC granted scholarships to 70 Ecuadorian and regional students with the delivery of the book "Biological Control in Latin America and the Caribbean, its Rich History and Bright Future" edited by Prof. Joop van Lenteren (WUR) et al. [https://www.editorialacribia.com/libro/control-biologico-en-america-latina-y-el-caribe\\_130523/](https://www.editorialacribia.com/libro/control-biologico-en-america-latina-y-el-caribe_130523/). The McKnight Foundation, with its Collaborative Crop Research Program [https://www.mcknight.org/es\\_pe/programs/international/collaborative-crop-research/](https://www.mcknight.org/es_pe/programs/international/collaborative-crop-research/), sponsored the event with the digital platform and simultaneous translation of the English talks. In addition, its website will host the lectures of this course.

The event lasted 5 days (November 8<sup>th</sup> – 12<sup>th</sup>, 2021), with five hours a day. About 2,200 people signed up (Table 1.) from 26 countries (Fig. 1). As a general public, an average of 456 people attended per day (Table 2, Fig. 2); also the participants by gender can be seen in Table 3.

Table 1. Number of people enrolled and country in the biological control course organized by Ecuador, 2021.

Pais	No. Inscritos
Andorra	1
Argentina	78
Bolivia	150
Brasil	8
Canadá	2
Chile	9
Colombia	163
Costa Rica	23
Cuba	2
Ecuador	1277
El Salvador	5
España	4
Guatemala	70
Honduras	11
Mexico	160
Mozambique	1
Holanda	1
Nicaragua	12
Panamá	2
Paraguay	2
Perú	224
República Dominicana	4
Tunisia	1
Uruguay	22
USA	2
Venezuela	4
<b>Total</b>	<b>2238</b>

Figure 1. Number of people registered by country in the biological control course. The value of Ecuador was excluded from the figure. Ecuador, 2021.

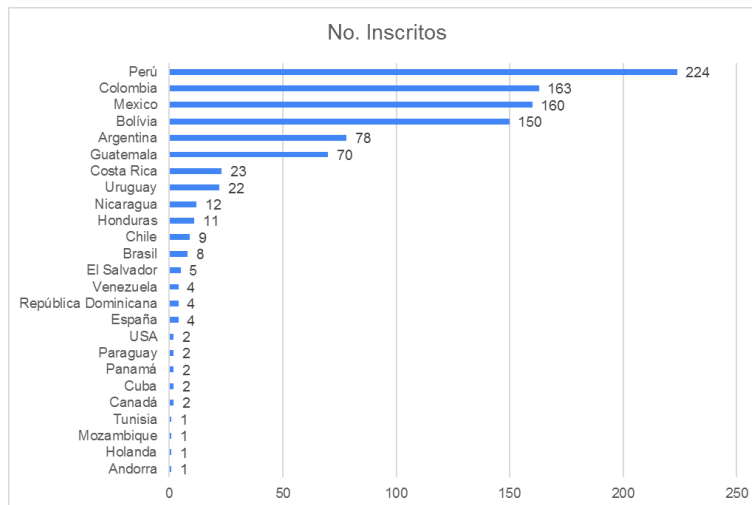


Figure 2 and Table 2. Number of participants per day in the biological control course. Ecuador, 2021.



Date	Participants
08/11/2021	490
09/11/2021	440
10/11/2021	485
11/11/2021	443
12/11/2021	383
<b>Promedio</b>	<b>456</b>

Table 3. Number and percentage of participants by gender.

Gender	Participants	Percentage %
Men	564	50,13
Women	561	49,87
<b>TOTAL</b>	<b>1125</b>	<b>100</b>

Among the granted students and young professionals, women participated in 61% and men in 39%. The granted students belong to 13 universities located in 10 provinces of Ecuador (Imbabura, Pichincha, Cotopaxi, Tungurahua, Chimborazo, Loja, Los Ríos, Guayas, Napo, Pastaza). Eight universities are located in the highlands, three in the Coast and two in the rain forest of Ecuador.

The objective of the course was to train young people, joined in agronomy or biology studies, in biocontrol in the use of arthropods as biological control agents, both predators and parasitoids of agricultural pests. This event is an important training tool to strengthen the use of biocontrol in agriculture in Ecuador and the South American region, especially on multiplication methodologies, research-experimentation and application of biocontrol programs. The participation of national and international experts on these issues allowed an enriching exchange of experiences and specific knowledge in different agricultural systems. The application of biological control in agriculture is beneficial to the environment and the production of healthy foods, in such way, its promotion is essential today.

#### Course objectives

1.To analyze the scope of biocontrol in agricultural production in Latin America.

2. To present arthropod multiplication techniques and quality control methods for mass-produced natural enemies.

3. To know the national and international regulations for the use of biocontrol agents and international exchange of natural enemy species.

### 3. Instructors and agenda

Instructor	Affiliation	Country
Martin Hill	Rodhes University; president IOBC-Global	South Africa
George Heimpel	University of Minnesota; former president IOBC-Global	USA
Joop van Lenteren	Wageningen University and Research Centre; secretary IOBC-Global	Netherlands
Julia Prado	Universidad Técnica del Norte	Ecuador
Antonio León	Universidad San Francisco de Quito	Ecuador
Santin Gravena	UNESP-Jaboticabal-SP (retired)	Brazil
Piedad Linganco	Universidad Central del Ecuador	Ecuador
Jorge Espinoza	Productor independiente	Ecuador
Vanda Bueno	Universidad de Lavras	Brazil
Javier Calvo	Koppert	Spain
Danilo Pedrazzoli	Koppert	Brazil
César Basso	Universidad de la República	Uruguay
Guillermo Cabrera	Fundación para el estudio de especies invasivas FuEDEI	Argentina
Jan van der Blom	Servicio de extensión de Almería	Spain
María Manzano	UNAL Palmira	Colombia
Yolanda Gutiérrez	Ingenio del Cauca	Colombia
Yelitza Colmenárez	CABI; former president IOBC-NTRS	Brazil
María Luisa Dindo	University of Bologna	Italy
Takumasa Kondo	Agrosavia	Colombia
Regiane Oliveira	Universidad Estatal Paulista Julio de Mesquita Filho	Brazil
Carmen Salcedo	SENASA	Peru
Gonzalo Martínez	INIA	Uruguay
Marta Rodríguez	Biobichos	Chile
Julio Velázquez	Koppert	Mexico
Germán Vargas	Cenicaña; president IOBC-NTRS	Colombia



Agenda

Noviembre

Hora (Ecuador)	Lunes 8	
	Moderadora: Carmen Castillo (INIAP)	
8h00 - 8h20	Bienvenida y opening	Dr. Raúl Jaramillo, subdirector del INIAP. Dr. Martin Hill, Rhodes U. South Africa y Dr. George Heimpel, UoFM, USA. Presidente actual y presidente anterior, IOBC
8h20 - 8h50	Visión del CB a nivel mundial	Dr. Joop van Lenteren, U. Wageningen, Holanda
8h50 - 9h00	Preguntas	
9h00 - 9h40	Evaluación inicial Qué es el control biológico (CB)	Dra. Julia Prado, U. Técnica del Norte, Ecuador
9h40 - 9h55	Preguntas	
9h55 - 10h00	Receso	
10h00 - 10h40	Historia del CB en Ecuador	Dr. Antonio León, U. San Francisco de Quito, Ecuador
10h40 - 10h55	Preguntas	
10h55 - 11h00	Receso	
11h00 - 11h40	Preservation and augmentation of natural enemies in the Brazilian citriculture - present status	Dr. Santin Graevna, Prof. retirado UNESP- Jaboticabal-SP, Brasil Consultor en GCDNCl y KOPPERT
11h40 - 11h55	Preguntas	
11h55 - 12h00	Receso	
12h00 - 12h40	El control biológico de <i>Ioerya purchasi</i> en las Islas Galapagos y los pasos necesarios para garantizar un programa exitoso	Dra. Charlotte Causton, F. Charles Darwin y Dra. Piedad Linoango, U. Central del Ecuador
12h40 - 12h55	Preguntas	
12h55 - 13h00	Fin de la jornada	

Hora (Ecuador)	Martes 9	
	Moderadora: María José Romero (UTN)	
8h00 - 8h40	Producción de parasitoides y predadores para control biológico en hortalizas en Ecuador	Ing. Jorge Espinoza, productor independiente, Ecuador
8h40 - 8h55	Preguntas	
8h55 - 9h00	Receso	
9h00 - 9h40	Insectos depredadores en el control biológico aumentativo de plagas: riesgo o realismo?	Dr. Vanda Bueno, U. Lavras, Brasil
9h40 - 9h55	Preguntas	
9h55 - 10h00	Receso	
10h00 - 10h40	Desarrollo y comercialización de agentes de control biológico	Dr. Javier Calvo, Koppert, España
10h40 - 10h55	Preguntas	
10h55 - 11h00	Receso	
11h00 - 11h40	How to position biocontrol agents into the Brazilian extensive agriculture	Dr. Danilo Pedrazzoli, Koppert, Brasil
11h40 - 11h55	Preguntas	
11h55 - 12h00	Receso	
12h00 - 12h40	Antecedentes y realidad del Control biológico aumentativo en Uruguay. Producción masiva de <i>Trichogramma</i> spp.	Dr. César Basso, Universidad de la República, Uruguay
12h40 - 12h55	Preguntas	
12h55 - 13h00	Fin de la jornada	

Hora (Ecuador)	Miércoles 10	
	Moderador: Antonio León (USFQ)	
8h00 - 8h40	Desafíos de la cría de agentes de control biológico de malezas	Dr. Guillermo Cabrera, fundación para el estudio de especies invasivas (FuEDEI) Argentina
8h40 - 8h55	Preguntas	
8h55 - 9h00	Receso	
9h00 - 9h40	Detalles en producción masiva y control de calidad del parasitoide de mosca blanca, <i>Encarsia formosa</i>	Dr. Joop van Lenteren, U. Wageningen, Holanda
9h40 - 9h55	Preguntas	
9h55 - 10h00	Receso	
10h00 - 10h40	Adaptaciones agroecológicas para favorecer el control biológico de las plagas principales en cultivos hortícolas	Dr. Jan van der Blom, Servicio de extensión de Almería, España
10h40 - 10h55	Preguntas	
10h55 - 11h00	Receso	
11h00 - 11h40	Importancia de las plantas en el control biológico: casos de estudio en moscas blancas y áfidos en Colombia	Dra. María R. Manzano, UNAL Palmira, Colombia
11h40 - 11h55	Preguntas	
11h55 - 12h00	Receso	
12h00 - 12h40	Producción masiva de enemigos naturales de plagas en caña	Dra. Yolanda Gutierrez, Ingenio del Cauca,
12h40 - 12h55	Preguntas	
12h55 - 13h00	Fin de la jornada	

Hora (Ecuador)	Jueves 11	
	Moderadora: Julia Prado (UTN)	
8h00 - 8h40	BioProspección versus regulación y su influencia en la utilización del control biológico en América Latina	Dra. Yelitza Colmenárez, CABI, América Latina
8h40 - 8h55	Preguntas	
8h55 - 9h00	Receso	
9h00 - 9h40	Mass rearing of Tachinid parasitoids, antagonist of herbivorous pest insects	Dra. María Luisa Dindo, U. de Bologna, Italia. Grupo de multiplicación de enemigos naturales IOBC
9h40 - 9h55	Preguntas	
9h55 - 10h00	Receso	
10h00 - 10h40	Experiencias en el control biológico de <i>Diaphorina citri</i> y <i>Cryptosepsa multicristatus</i> : Cría de parasitoides y depredadores	Dr. Takumasa Kondo - AGROSAVIA, Colombia
10h40 - 10h55	Preguntas	
10h55 - 11h00	Receso	
11h00 - 11h40	Biological control strategies with parasitoids in integrated pest management	Dra. Regiane Oliveira, U. E. Paulista Julio de Mesquita Filho, Brasil
11h40 - 11h55	Preguntas	
11h55 - 12h00	Receso	
12h00 - 12h40	Crianza de los principales insectos benéficos utilizados en Perú para el control de plagas	Dra. Carmen Salcedo, SENASA, Perú
12h40 - 12h55	Preguntas	
12h55 - 13h00	Fin de la jornada	

Hora (Ecuador)	Viernes 12	
	Moderadora: Carmen Castillo (INIAP)	
8h00 - 8h40	Oportunidades y desafíos para el control biológico aumentativo de plagas forestales en América Latina	Dr. Gonzalo Martínez, Instituto Nacional de Investigación Agropecuaria (INIA), Uruguay
8h40 - 8h55	Preguntas	
8h55 - 9h00	Receso	
9h00 - 9h40	Logros y posibilidades para el control biológico aumentativo en América Latina, visión de la industria	Dra. Marta Rodríguez, Biobichos, Chile
9h40 - 9h55	Preguntas	
9h55 - 10h00	Receso	
10h00 - 10h40	Control biológico en México	Dr. Julio Velazquez, Koppert, México
10h40 - 10h55	Preguntas	
10h55 - 11h00	Receso	
11h00 - 11h40	Control Biológico de los barrenadores en caña de azúcar: presente y desafíos futuros	Dr. Germán Vargas, CENICAÑA, Colombia, Presidente IOBC-NTRS
11h40 - 11h55	Preguntas	
11h55 - 12h00	Receso	
12h00 - 12h30	Normativa para el registro de bioplaguicidas	Ing. Sara Barriga, Agrocalidad, Ecuador
12h30 - 12h40	Clausura	Dr. Germán Vargas, presidente IOBC-NTRS
12h40 - 12h55	Evaluación final	Dra. Julia Prado, UTN, Dra. Carmen Castillo, INIAP
12h55 - 13h00	Fin del evento	

Traducción de inglés a español

#### 4. Flyer



Control Biológico y la producción de artrópodos como enemigos naturales para el manejo de plagas en agricultura.

Aprender la multiplicación masiva de enemigos naturales para el control biológico de plagas agrícolas

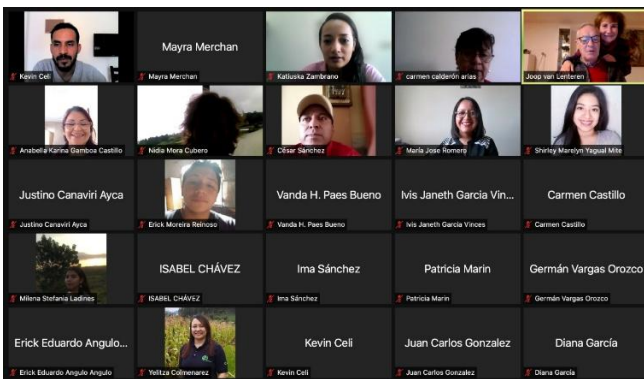
**8 al 12**  
Noviembre 2021  
8H00 A 13H00 (Ecuador)  
**Evento gratuito**  
→ Registro: [bit.ly/3btcdxu](https://bit.ly/3btcdxu)

PROGRAMA COOPERATIVO DE INVESTIGACIÓN SOBRE CULTIVOS  
INIA  
INIA  
COLEGIO DE INGENIERÍAS  
USFQ

Instituto Nacional de Investigaciones Agropecuarias

República del Ecuador  
Gobierno del Encuentro | Juntos lo logramos

## 5. Screen shots



## 6. Testimony of IOBC granted students

The International Organization for Biological Control awarded 70 students from Ecuador and Latin America with the delivery of the book "Biological Control in Latin America and the Caribbean, its Rich History and Bright Future" [https://www.editorialacribia.com/libro/control-biological-in-latin-america-and-the-caribbean\\_130523/](https://www.editorialacribia.com/libro/control-biological-in-latin-america-and-the-caribbean_130523/). Below the testimony of the granted student and young professionals. Their comments about the course and gratitude about receiving the book.



### Studentes and jounq professionals from Latin America

Candela Barakat, PhD student at CONICET (Centro de Estudios Parasitológicos y de Vectores, CEPAVE), Universidad Nacional de La Plata, Argentina.



"I really liked the course. I found the experience of being able to listen to speakers from other parts of the world, but especially from different Latin American countries, super nutritious. I was not particularly aware that there were so many successful biological control programs applied in our continent, and it was very encouraging to me. I also consider that it is vitally important to know what the situation in other Latin American countries is and to keep up to date on this, since there are issues of distribution and pest management (which can be shared), which we must know and keep in mind. Therefore, getting in touch with peers, whether in the interior or abroad of the country, is something that we should not stop doing and this course was perfect for it. Thanks a lot"

Eduardo Cadet Piedra, young professional. LAICA, Costa Rica.

"The course seemed very updated and complete to me, it accomplished many of my expectations and I am grateful to have participated. I hope that this type of activities will continue to be given and very soon I hope we will be able to return to face-to-face"

### Students and jounq professionals from Ecuador

**Universidad Técnica de Ambato (UTA). Ambato, Tungurahua, Ecuador**

Carmen Marisol Garcés, undergrad.



The course "Biological Control and the production of arthropods as natural enemies for pest management in agriculture" in which I participated, seemed captivating and emotional to take other measures for the control of pests in staple crops. I would like to participate in more events similar to this. Glad to have participated and grateful for the extensive and information received in each conference and for the book"

Nereyda Ruíz, undergrad. Universidad Técnica de Ambato, Tungurahua, Ecuador.



"The course seemed very interesting and important to me to strengthen the knowledge we have on this subject, the focus and importance given to biological control really catches my attention since nowadays the use of chemicals is prioritized in crops, but these have adverse effects on both human health and the farmer's economy since the prices of chemicals are increasingly higher and do not generate profitability. For this, the use of biological controls to care the crop is very effective and less expensive. The course was very well organized and run normally. I am very satisfied with the course I have received. Additionally, it is very important that these types of courses continue to be carried out since it helps us as students a lot in the reinforcement of knowledge and teaches us new techniques of pest management and control of which many times we are not aware of. Thanks to IOBC for the book"

**Universidad Central del Ecuador (UCE). Quito, Pichincha, Ecuador**

Luis Felipe Jácome, undergrad student.



"I thank the IOBC for the training on biological controllers not only in Ecuador but in Latin America and how this can be an important tool in the future for sustainable agriculture. I also thank for giving us the book" Biological Control in Latin America and Caribbean"

Luis Fernando Quishpi, undergraduate student. Universidad Central del Ecuador, Quito.

"I thank the IOBC for the training received where different aspects of biological control were shared, as well as different results of various investigations that promoted the exchange of knowledge and allowed us to learn what pest and disease management actions are carried out. Not just locally, but internationally. In the same way, I appreciate the delivery of the book "Biological Control in Latin America and the Caribbean" which is a great complement to the information received in the training course"

Gloria Nathaly Aguilar Moncayo, undergraduate student. Universidad Central del Ecuador, Quito.

“It seemed to me a course with high quality of information and various lectures that reinforce the biological control theme by exposing experiences and real data. I appreciate the opportunity to hear from experts on the subject”

Anahí Mejía, undergraduate student. Universidad Central del Ecuador, Quito.

“I thank the IOBC for the excellent training and delivery the book, I consider that interesting topics were planned, each of the talks contributed with different knowledge that will help me throughout my professional career. It was an interesting training, having speakers from different places the knowledge provided was expanded considerably. Trainings such as biological control are important and necessary to disseminate this topic which is interested by a large number of people. I hope to be able to participate in more courses, without more to say, thank you very much”



Picture: Luis Felipe Jácome, Anahí Maylin Mejía, Luis Fernando Quishpi and Roberto Isaac Cesén.  
Universidad Central del Ecuador, Quito.

**Pontificia Universidad Católica del Ecuador (PUCE). Quito, Pichincha, Ecuador**

Francisco Villacís, undergrad. Pontificia Universidad Católica del Ecuador, Quito.



"The course on biological controllers was impressive, I had no idea about all that work is being done in the region, it motivated me a lot to know that there is more and more alternative ways for pest control that do not harm the environment. I would like to be able to go deeper into these issues in the future. Thanks for the book! "

Diego Mina, young professional, Master's student. Pontificia Universidad Católica del Ecuador.



"Personally I think the course had a good level starting with a variety of content. Current issues were addressed and the dynamics of having national and international experts was very interesting. I think it was a fairly complete package since topics such as the use of parasitoids, predators, plants and other controlling pathogens were discussed, as well as talks that focused on opportunities and challenges to establish biological control in Latin America. Additionally, the evaluations carried out helped the attendees' reflection. Finally, I think it was important to include local universities as organizers of the event, this stimulates students who are

interested in this branch of agronomy"

**Universidad Nacional de Loja (UNL). Loja, Loja, Ecuador**

Marjory León, undergrad.



"First of all I want to thank in a special way the International Organization for Biological Control for the webinar called " biological control and the production of arthropods as natural enemies for pest management in agriculture ", since this control method encourages us to use new natural techniques taking preventive measures for pests and diseases. In this way over time it will be obtained good results avoiding environmental impact. It must be added the greater environmental awareness that citizens have and that, as consumers, demand quality products without chemical residues that harmful health. Thank you. The course seemed very good to me since as future professionals it is important to know how to do good control of pests and diseases in crops. As a control method, biological control has many advantages since it does not harm crops, the environment and humans. On the contrary, the use of this method helps agriculture to reduce the use of chemical products"

**Universidad Técnica de Babahoyo (UTB). Babahoyo, Los Ríos, Ecuador**

Cristian Fernández, undergrad student.



"The first impression that I had in this course and it caught my attention, is to see how insects can eliminate others, how an insect can destroy weeds, which greatly benefits those who work with organic and healthy agriculture. I am very grateful to the IOBC for this great learning opportunity, which helped me to gain new knowledge"



Rosa Castillo, undergrad. Universidad Técnica de Babahoyo, Los Ríos, Ecuador.



"The biological control of pests allows us to fight against them without having to use insecticides or pesticides, products that are toxic and harmful to both human health and the environment. Among the natural enemies that were learned, it is possible to distinguish predatory and parasitoid arthropods, and other entomopathogenic organisms (bacteria, fungi, nematodes and viruses). Thanks for the opportunity"

Erika Mendoza, undergrad student. Universidad Técnica de Babahoyo, Los Ríos, Ecuador.



"Biological control is a key tool to reduce the pressure of virus vector insects and minimizing their possible damage, it involves the mass production and release of natural enemies, such as parasitoids and predators to combat insects that cause pests in a way that respects the environment. Thanks for the opportunity to participate and to receive the book!"

### Universidad ECOTEC. Guayaquil, Guayas, Ecuador

Oscar Navia, undergrad student.



"The training course held from Monday, November 8 to 12, was quite complete and I would like to know more about the process of breeding parasitoids in laboratories in Ecuador and how they are integrated into the different crops after passing the process of parenting and what are the problems that may arise during these processes. In addition, I would like to know more about the commercialization processes of biological control agents in other countries, to see how they could be applied in different ways and if there is any way that the quality of a good biological control can be determined"

Eduardo Orellana, undergrad student. Universidad ECOTEC, Guayaquil, Ecuador.



“In general terms, the course was very interesting because the contents presented had clear scientific basis. In addition, the trainers gave talks that clarified all kinds of doubts related to the subject, relying on easy-to-grasp presentations. The platform always worked properly, which further enhanced the experience. Very interesting topics such as the increase of natural enemies or very useful aspects such as the necessary steps to guarantee a successful biological control program were among the most important and notable. ”

Jeremy Muñoz, undergrad student. Universidad ECOTEC, Guayaquil, Ecuador.



“Regarding the course given on biological control, it seemed to me a very interesting topic because of the way in which some pests that affect crops can be controlled. A particular case, the ladybug used in a biological control of aphids. This type of control helps to reduce the use of certain agrochemicals that affect the environment in the long term, thus tending to a more ecological agronomic management ”.

Lisseth Pérez Zambrano, undergrad student. Universidad ECOTEC, Guayaquil, Ecuador.

“The biological control course seemed very interesting to me, especially I was able to learn more about classical biological control and to identify the process of agent development. I learned about how to conserve biological agents. I also found it interesting about pests and what agent should I use to control them, how to control moths, thrips, aphids. The most important thing is to learn how to feed our biological agents to be able to conserve them”



Picture: Lisseth Pérez, Oscar Navia, Eduardo Orellana and Jeremy Muñoz. ECOTEC, Guayaquil, Ecuador.

**Universidad Regional Amazónica IKIAM. Tena, Napo, Ecuador**

Tanya Camalle, undergrad student.



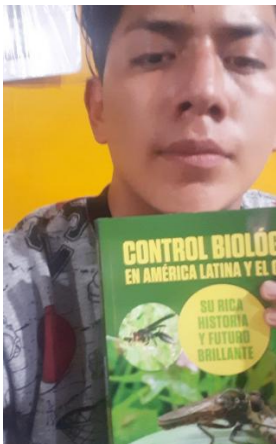
“As for the biological control course, I wanted to tell you, I found it very interesting. I also learned a lot, and above all, is the knowledge that I will put into practice as a student and later in my professional career. All the investigations that have been carried out by the researchers who generously shared with us are of the utmost importance. It encourages their practice. I thank in advance the organization and the treatment. It was a real pleasure to have participated in this event”

Milena Ladines, undergrad student. Universidad Regional Amazónica Ikiam.



"The biological control course was very enriching for me because using sustainable and ecological management techniques in the biological control of pests is part of an ecological agriculture such as Agroecology. The diversity of topics that were presented were very well explained in a language that was very understandable to me, which made it easier for me to learn many new terms. In addition, each topic was complemented by the experience of each researcher or producer. The experience of having participated as a listener within the course gave me a broad knowledge of concepts and terms that are helpful in my pest and disease management class, as well as in my agricultural entomology class that I am studying in this semester. Therefore, not only I was part of the course, but also it served as a complement in my professional training within my field of study, Agroecology. I am grateful for having had the opportunity to participate in this great course”

Santiago Montes, undergrad student. Universidad Regional Amazónica Ikiam.



"My name is Santiago Montes, I belong to IKIAM University. I study Agroecology and it was a pleasure for me to have participated in the course on " Biological Control ". Interesting and appropriate topics were taught for me in at this instance. Because of this course, I have understand many concepts that I haven't have the chance to solve by my self. Now, I would like to learn more about the experiences in our territory with our micro and macro organisms. Without any other particular, let me thank you for the welcome and I appreciate your attention and organization”



**Universidad Técnica de Cotopaxi (UTC). Latacunga, Cotopaxi, Ecuador**

Martha Isabel Chávez, undergrad student.



"I participated in the course of biological control and mass rearing of natural agents for pests in agriculture. It seemed very interesting to me because I was able to learn that in Ecuador biological control of pests that generate economic losses in agriculture is applied. Then it seemed to me a very interesting and very important topic for agriculture. Thank you very much for giving me the book on biological control!"

Roberto Taco, undergrad student. Universidad Técnica de Cotopaxi, Ecuador.



"As a result of the course, I feel the need to have this book for reaching greater knowledge and perhaps in the future to be able to develop my thesis based on this topic. Maybe to be able to research for new pest control methods that be more environmental friendly and thus put aside the use of chemicals that are so carcinogenic to humans. Thanks for the biological control book, it is a good source of information"



Pictures: Left, Carmen Castillo and Emerson Jácome (teacher at UTC). Right, Nataly del Rocío Changoluisa, Martha Isabel Chávez, Emerson Jácome (teacher), Wendy Isabel Vasco and Roberto Alexander Taco. Universidad Técnica de Cotopaxi, Ecuador.

**Universidad Técnica Estatal de Quevedo (UTEQ). Quevedo, Los Ríos, Ecuador**

Jorge Luis Espinoza Loor, undergrad student.



“Over the years, I have been able to participate in various congresses as a spectator, but the event held by the IOBC-NTRS in terms of the organization level, the themes and trainers, for me, it was one of the best I have been able to appreciate. I congratulate the organizers and experts of the event, hoping in the future to be able to learn more from this sea of knowledge. Knowledge that is gathered in a single moment. I hope to be able to learn

more and be more productive in our long journey that awaits us as future professionals. I am infinitely grateful for having been able to participate in such a beautiful event. Greetings from Quevedo-Ecuador”

Keneth Carlos Zambrano Aroca, undergrad student. Universidad Técnica Estatal de Quevedo, Ecuador.



“The course on biological control and the production of arthropod natural enemies for pest management in agriculture has been an excellent opportunity that allowed me to have more knowledge about biological control and broaden my interest in this area, which has inspired

me to continue my studies focusing on this branch of Agricultural Sciences”

Ketty Vanessa Arellano Ibarra, undergrad student. Universidad Técnica Estatal de Quevedo, Ecuador.



"As an Agronomy student, I was interested in the course and what I learned in it since the technologies focused on agriculture are being updated and even more related to biological control, which is the future for the control of pests and diseases. The information presented and the topics were in accordance with the requirements that are currently needed and encouraging participants to research more about the topics. I am grateful for the opportunity to be a participant in this event and I congratulate the organizers for organizing and encourage us to use these technologies"

Mariana Maricela Burgos Matamoras, undergrad student. Universidad Técnica Estatal de Quevedo, Ecuador.



"As a future agricultural professional, I can state that what I learned in the Biological Control course to have a more sustainable perspective for pest control through biological control agentes. I was able to realize the great potential that parasitoids and predators have to control insects-pests and how these can be used more frequently in crops in Ecuador. Events like these allow us, students, to train with new technologies that are environmental friendly and to contribute to change the traditional pest management with chemical products. Thanks to the IOBC for the opportunity to participate in this important course and form the scholarship to receive the biological control book"

**Universidad Técnica del Norte (UTN). Ibarra, Imbabura, Ecuador.**

Jorge Solano, undergrad student.



science"

"The course was excellent. It accomplished its objective of showing a sustainable alternative for pest and disease control in crops such as tomato, sugar cane, potato, among others. Usually, contemporary agriculture uses pesticides is used excessively. Most of the chemical used in agriculture destroy the health of farmers and consumers. Biological control is presented as an innovative and efficient alternative for pest control, so it is important to further investigate in this important area of

Alexandra Calpa, undergrad student. Universidad Técnica del Norte, Ecuador.



"The biological control course seemed excellent to me, due to the knowledge imparted on the different characteristics of each controller and influence on important pests, especially each speaker in socializing their studies that enrich our education and to be able to apply as professionals in the future"

Mishel Sevilla, undergrad student. Universidad Técnica del Norte, Ecuador.



"The course seemed quite interesting to me because it encourages the inclusion of sustainable agriculture through the use of biological control within an integrated pest management program. The biocontrol allows greater diversity within an agroecosystem, in this way, reduce the environmental impact caused by pesticides. To potentiate the use of biological control agents counteract pests and diseases, and preserve the integral health of the soil and the environment"

Karina Salazar, undergrad student. Universidad Técnica del Norte, Ecuador.



"The new methods in the control of pests and diseases promote sustainable production in pro of the environmental conservation and consumers' health. Biological control agentes have the ability to combat pests and diseases that affect crops, and to generate large economic resources for the population. The course helped to know these agentes and to put them into practice in our professional lives"



Dayana Dueñas, undergrad student. Universidad Técnica del Norte, Ecuador.



“The biological control course seemed very important to me in our academic training, since each of the talks showed us the different characteristics that each beneficial agent possesses and its effect on important pests in crops. They showed their studies that serve as motivation to venture into this wonderful research field”

Zhazha Mendieta, undergrad student. Universidad Técnica del Norte, Ecuador.



“The biological control course allowed me to know a sustainable way and strategies for pest control. For which, I congratulate al the trainers. It remains for me as a lesson that biological control offers a balance to conserve the agrobiodiversity of an ecosystem and allows healthy food to be produced, contributing to the sovereignty and food security of the population”

Mishel Ruiz, undergrad student. Universidad Técnica del Norte, Ecuador.



“Through this Biological Control Course, I was able to soak up valuable information about beneficial insects, their habitat and acting against pests, in addition to generating knowledge, it helped me to raise awareness about of how much more we should be working on these biological control issues in order to reduce the aggressive use of chemicals and the destruction of the environment and the habitat of our natural enemies”



**Foto: 13 granted students from UTN (Imbabura province).**

**Universidad San Francisco de Quito (USFQ), Quito, Pichincha, Ecuador**

Sebastián Díaz, undergrad student.



"A practical course, essential and updated to the needs of producers. With an emphasis on promoting and training on the biological control methodology, fundamental for the change towards a more sustainable agriculture"

Alejandra Sánchez, undergrad student. Universidad San Francisco de Quito, Ecuador.



"Personally, it is a pleasure to attend the courses on biological control. I believe that progress on this topic is rapid. It is important and necessary that the expert researchers share their experience in events like this one. Additionally, I think that being a virtual event, more people had access to it and help to reach more people. Thanks to the organizers and the sponsoring institutions for carrying out this event"

**Universidad Estatal Amazónica (UEA), Puyo, Pastaza, Ecuador**

Marcia Alexandra Vaca, undergrad student.



"My name is Alexandra Vaca and I work with invertebrates. My interests led me to take the course of biological control and production of arthropods as natural enemies for the management of pests in agriculture that was carried out from November 8<sup>th</sup> to the 12<sup>th</sup> of this year. It has been an extremely interesting experience. In this course, we had access to works of renowned researchers who have dedicated themselves to studying specific pests for their integrated management in large areas of cultivation. For some of us, who live in areas where

agriculture is the the main source of income, it has been very valuable information presented during the course. I have been able to learn interesting facts about specific pests in crops in tropical areas. I am very grateful to the organizers of this event and hopefully more of these initiatives will come to generate knowledge about pests and biological control. In these difficult times this is necessary for a sustainable agricultural production"

Yarina Tapuy Avilés, undergrad student. Universidad Estatal Amazónica, Ecuador.



"The biological control course has clarified certain doubts that I had as a biology student, since my main interest was to learn about studies in which biological control agents are used in ecological reserves or national parks and it was a great pleasure to hear the presentation by the representative of the Charles Darwin Foundation who had worked with *Rodolia cardinalis* to control the scale. In addition to expanding my knowledge, I learned about different pests and their controllers produced under commercial mass rearings and especially about those used in research"

Jocelyne Román, undergrad student. Universidad Estatal Amazónica, Ecuador.



"The biological control course seemed interesting to me, especially because it addressed important issues that perhaps some of us were unaware of, such as the case of breeding biocontrol organisms for sale. Another important point to address is the lack of implementation of biocontrol agents in Latin America, perhaps due to the lack of information or the lack of resources to produce them. I believe that these courses should continue to inform more people and perhaps in the future replace chemicals with pest control organisms. It should be emphasized that these chemicals used in agriculture are the cause of much of the soil and water contamination. I thank the event organizers for the information provided and I hope that these courses continue to be taught"

Edy Marlon Mendoza, undergrad student. Universidad Estatal Amazónica, Ecuador.



"Having participated in the Biological Control course gave me the opportunity to learn about sustainable alternatives in terms of ecosystem services where pests are reduced by the presence of beneficial organisms in nature or in agroecosystems. An example of this is the vampire fly (*Philornis downsi*) which parasitizes finch offspring in the Galapagos Islands and is a highly endemic problem; therefore, working on control alternatives such as parasitoids provides the opportunity to preserve endemic species such as finches"

**Escuela Politécnica de Chimborazo (ESPOCH), Riobamba, Chimborazo, Ecuador**

Luis Fernando Chuquiana, undergrad student.



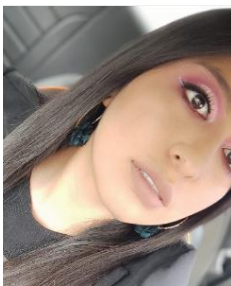
“Although biological control has been used in agriculture for millennia, it is a relatively new practice in modern agriculture. These courses nourish us with knowledge and encourage us to be more aware with the use of pesticides and give this alternative of healthy management to farmers. The same natural enemies, so many parasitoids, predators, etc., keep pest populations in balance. It caught my attention how they carried out the massive rearing of natural enemies of some pests, since for each pest insect there are one or more insects as natural enemies. Very grateful to the IOBC for the course, for the biological control book and the knowledge that I will acquire every day”

Ana Micaela Sáez, undergrad student. Escuela Politécnica de Chimborazo, Ecuador.



“This course was really excellent, as an agronomy student and with a particular interest in biocontrol agents, biological control technology seems to be the future of agriculture, because it offers to deal with the pest problems in production, leaving aside the chemical methods that pollute and make the environment sick and consequently affect the human kind. This course was very complete and the speakers were very clear, in particular I liked the interventions on biological control in Latin America and Ecuador. As a professional I would like to work in this area of agronomy and bring this technology to the communities of Chimborazo province. I just have an observation, I would like training about microbial biological control agents and the schedule to be more accessible for the students”

Katy Alexandra Aushay Lliquin, undergrad student. Escuela Politécnica de Chimborazo, Ecuador.



“I belong to the Forest Engineering career. The course personally has served me as a great teaching on something as important as biological control since this technique consists of improving the harmful impact of pests on crops. Through the use of natural enemies, agriculture does not be invasive with the nature and the environment without chemicals that damage the soil environment and alter ecosystems. This technique is used in some countries such as Europe and Latin America for its great results since producers have realized that this technique is cheaper than using chemical products. It is for this reason that the course gave me the motivation to continue researching and learning on this topic which is of great importance in the present and future. I can help and encourage medium-sized producers to use this different but effective technique. Farmers do not know about biocontrol most often and it is important to motivate them to use biocontrol. They fear to lose



their crops so usually do not deal to innovate. This is the change that the world needs in order to face the environmental contamination”

Karol Susana Ruiz Tello, undergrad student. Escuela Politécnica de Chimborazo, Ecuador.



“The biological control course focused on the massive production of natural enemies, was personally quite beneficial since as a student of Agronomy I was interested in learning about the use of beneficial organisms or natural enemies, recognizing their usefulness in improving the quality of agricultural products. To know the management of these organisms for the control of agents that cause damage and also to know the mechanisms that can be used to apply biological control”

### Young professionals, Ecuador

Lucia Verónica Suquillo, young professional. Teacher, Universidad Central del Ecuador, Quito.



“I really loved the course, the information provided was very helpful for people who are starting to breed arthropods, speaking from my experience. The talks provided here have helped me to strengthen and expand techniques for the mass rearing of arthropods and use them as biological control. I hope that there will continue to present more events like these. Many thanks to the IOBC for the book, great job!

María Esmeralda Cuzco, young professional. Teacher, Universidad ECOTEC, Guayaquil, Ecuador.



“The content of the course was quite interesting and above all it allowed us to keep up to date with the latest research carried out in Ecuador and Latin America. I encourage the IOBC to organize more events like this and especially, on different parasitoid breeding methodologies and their potential as a control agent. We are infinitely grateful to the International Organization of Biological Control for giving us the book, which will undoubtedly contribute to the development of students' knowledge. As a university we are grateful for making us part of this great community and it is the beginning of carrying out great research with our students”

Katiuska Zambrano, young professional. Independent. Quevedo, Los Ríos, Ecuador



“I really enjoyed the course, the exposed materials opened up a new perspective for me on how to handle biological control. I am deeply grateful to all of you, and I greatly appreciate the work you do, in providing us with your knowledge and research with each of the given presentations and making them available to all, the new acquired knowledge will serve to continue shaping ourselves and making this a better world. A huge hug!”

Christian Pilco, young professional. Independent. Ambato, Tungurahua, Ecuador.



“I am a young professional. I am an Agricultural Engineer graduated from Universidad Estatal de Bolívar, Ecuador. I really like biological control and I am currently working on biol with beneficial microorganisms such as *Trichoderma* spp. I really liked the biological control course, the information was very interesting since it shows us how it is possible to manage a crop without the use of pesticides, and maintaining care for the environment and human health with ecological practices. I am grateful for the book that was given to me, as it helps me a lot to continue acquiring more knowledge. Thank you very much and greetings”

**7. List of the granted students by IOBC for the biological control course. Ecuador, 2021.**

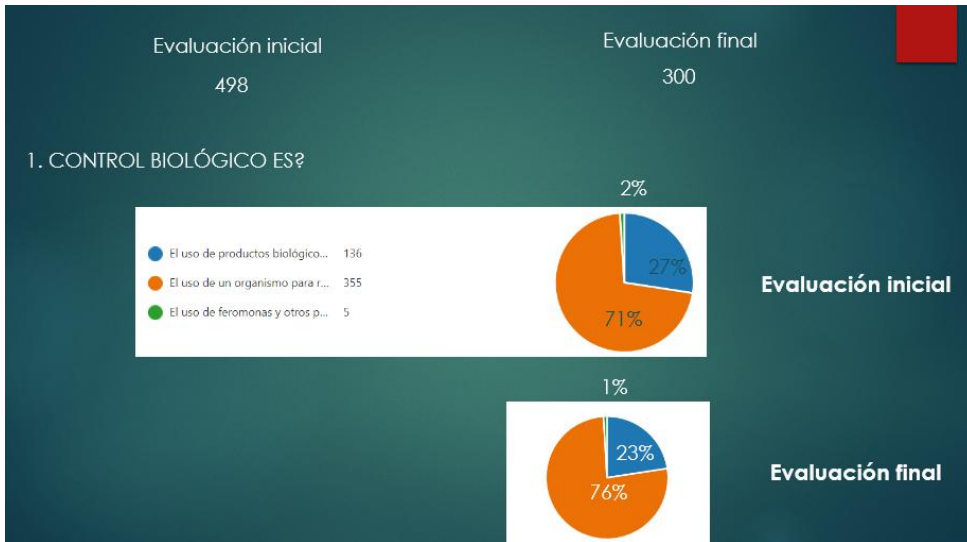
1	Eduardo Andrés Orellana	Estudiante pregrado, ECOTEC, Ecuador
2	Jeremmy Muñoz Mendoza	Estudiante pregrado, ECOTEC, Ecuador
3	Lissett Yaritza Pérez Zambrano	Estudiante pregrado, ECOTEC, Ecuador
4	Oscar Javier Navia Pesante	Estudiante pregrado, ECOTEC, Ecuador
5	María Esmeralda Cuzco	Profesora ECOTEC, Guayaquil, Ecuador
6	Dayana Dueñas	Estudiante pregrado, UTN, Ecuador
7	Jorge Solano	Estudiante pregrado, UTN, Ecuador
8	Karina Salazar	Estudiante pregrado, UTN, Ecuador
9	Mishel Sevilla	Estudiante pregrado, UTN, Ecuador
10	Mishell Ruíz	Estudiante pregrado, UTN, Ecuador
11	Zazha Mendieta	Estudiante pregrado, UTN, Ecuador
12	María Alejandra Calpa	Estudiante pregrado, UTN, Ecuador
13	Danny Alexander Flores	Estudiante pregrado, UTN, Ecuador
14	Elvis Abraham Cepeda	Estudiante pregrado, UTN, Ecuador
15	Bryan Vinicio De la Cruz Inuca	Estudiante pregrado, UTN, Ecuador
16	Estefania Karolina Morillo	Estudiante pregrado, UTN, Ecuador
17	Roberto Carlos Factos	Estudiante pregrado, UTN, Ecuador
18	Sherlay Mishel Hernández	Estudiante pregrado, UTN, Ecuador
19	Milena Ladines	Estudiante pregrado, IKIAM, Ecuador
20	Tanya Camalle	Estudiante pregrado, IKIAM, Ecuador
21	Santiago Montes	Estudiante pregrado, IKIAM, Ecuador
22	Gloria Nathaly Aguilar	Estudiante pregrado, UCE, Ecuador
23	Luis Felipe Jácome	Estudiante pregrado, UCE, Ecuador
24	Anahí Maylin Mejía	Estudiante pregrado, UCE, Ecuador
25	Roberto Isaac Cesén V.	Estudiante pregrado, UCE, Ecuador
26	Luis Fernando Quishpe	Estudiante pregrado, UCE, Ecuador
27	Lucía Verónica Suquillo	Profesional, UCE
28	Luis Fernando Chuquiana Guano	Estudiante pregrado, ESPOCH, Ecuador
29	Katy Alexandra Aushay Lliquin	Estudiante pregrado, ESPOCH, Ecuador
30	Ana Micaela Sáenz Paguay	Estudiante pregrado, ESPOCH, Ecuador
31	Karol Susana Ruíz Tello	Estudiante pregrado, ESPOCH, Ecuador
32	Carla Jasmín Miranda	Estudiante pregrado, ESPOCH, Ecuador
33	Lady Nathaly Maygualema	Estudiante pregrado, ESPOCH, Ecuador
34	Sandra Lucrecia Paltan	Estudiante pregrado, ESPOCH, Ecuador
35	Madison Aracelly Chango	Estudiante pregrado, ESPOCH, Ecuador
36	Diego Armando Muñoz	Estudiante pregrado, ESPOCH, Ecuador
37	Diego Mina	Profesional, IRD. Estudiante de posgrado PUCE
38	Francisco Villacís	Estudiante pregrado, PUCE, Ecuador
39	Carmen Garcés	Estudiante pregrado, UTA, Ecuador
40	Nereyda Ruíz	Estudiante pregrado, UTA, Ecuador
41	Roberto Taco	Estudiante pregrado, UTC, Ecuador

42	Martha Chávez	Estudiante pregrado, UTC, Ecuador
43	Nataly Changoluisa	Estudiante pregrado, UTC, Ecuador
44	Wendy Vasco	Estudiante pregrado, UTC, Ecuador
45	Sebastián Díaz	Estudiante pregrado, USFQ, Ecuador
46	Alejandra Sánchez	Estudiante pregrado, USFQ, Ecuador
47	Edy Mendoza	Estudiante pregrado, UEA, Ecuador
48	Jocelyne Román	Estudiante pregrado, UEA, Ecuador
49	Tapuy Avilés	Estudiante pregrado, UEA, Ecuador
50	Marcia Alexandra Vaca	Estudiante pregrado, UEA, Ecuador
51	Ketty Arellano	Estudiante pregrado, UTEQ, Ecuador
52	Mariana Burgos	Estudiante pregrado, UTEQ, Ecuador
53	Keneth Zambrano	Estudiante pregrado, UTEQ, Ecuador
54	Jorge Espinoza	Estudiante pregrado, UTEQ, Ecuador
55	Erika Mendoza	Estudiante pregrado, UTB, Ecuador
56	Cristian Fernández	Estudiante pregrado, UTB, Ecuador
57	Rosa Carrillo	Estudiante pregrado, UTB, Ecuador
58	Marjory León	Estudiante pregrado, UNL, Ecuador
59	Katiuska Zambrano	Profesional independiente, Quevedo, Ecuador
60	Christian Pilco	Profesional independiente, Ambato, Ecuador
61	Candela Barakat	Estudiante de doctorado, La Plata, Argentina
62	Eduardo Cadet Piedra	Profesional, LAICA, San José, Costa Rica

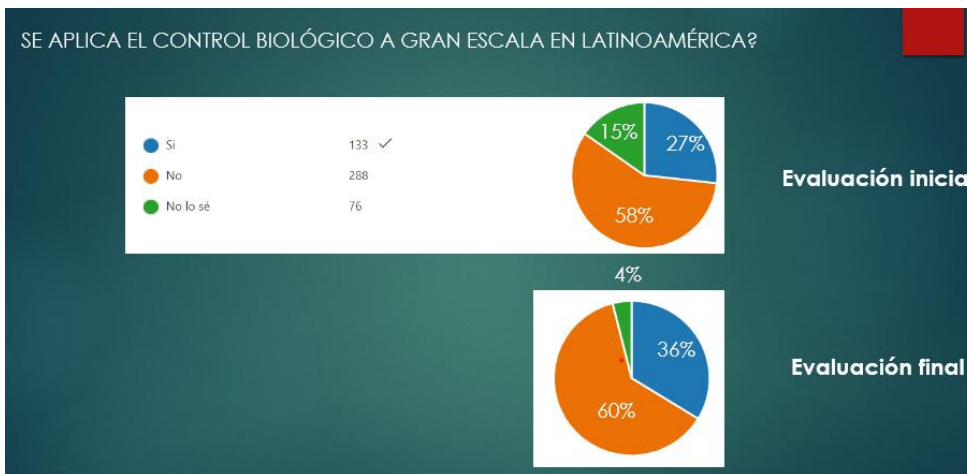
## 8. Initial and final evaluation of the course

During the first day, this survey was carried out with ten questions in which 498 course attendees participated. During the final two days, we asked to participants to answer the same questionnaire, in which 300 people participated. At the end, the results of the initial evaluation were compared with the final answers. The results were analyzed and presented by Dr. Julia Prado from the UTN.

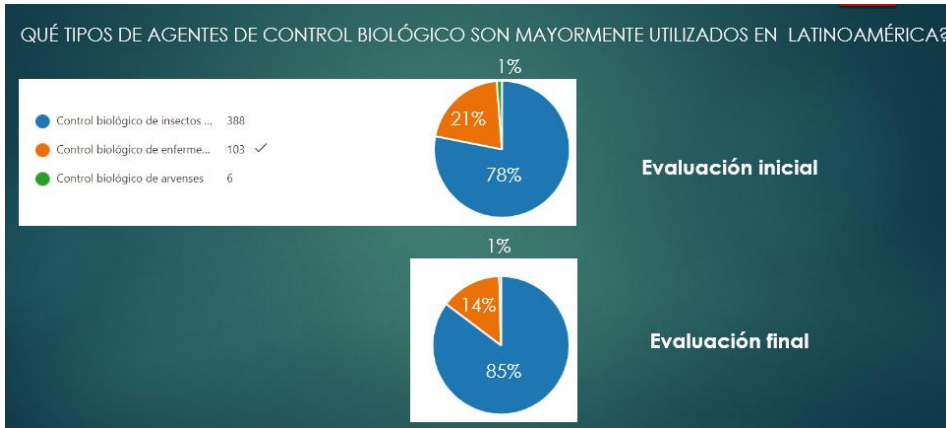
Pregunta 1. Control biológico es...?



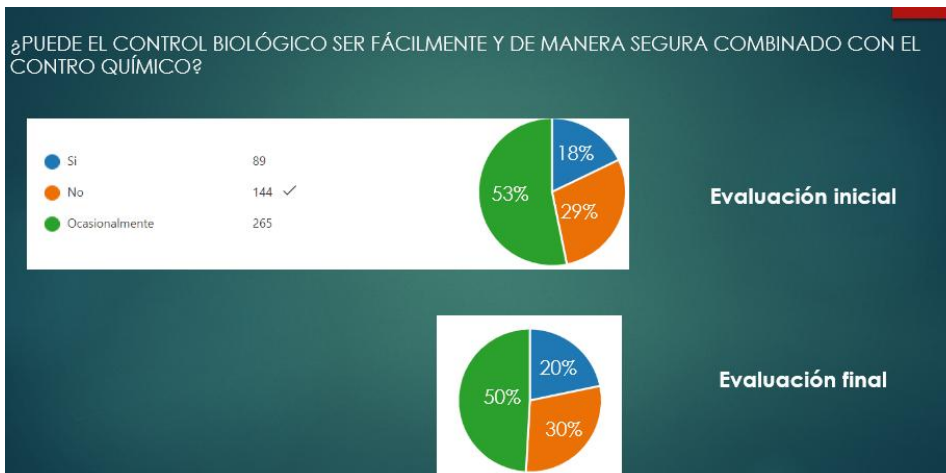
Pregunta 2. Se aplica el control biológico a gran escala en Latinoamérica?



Pregunta 3. Qué tipos de agentes de control biológico son mayormente utilizados en Latinoamérica?

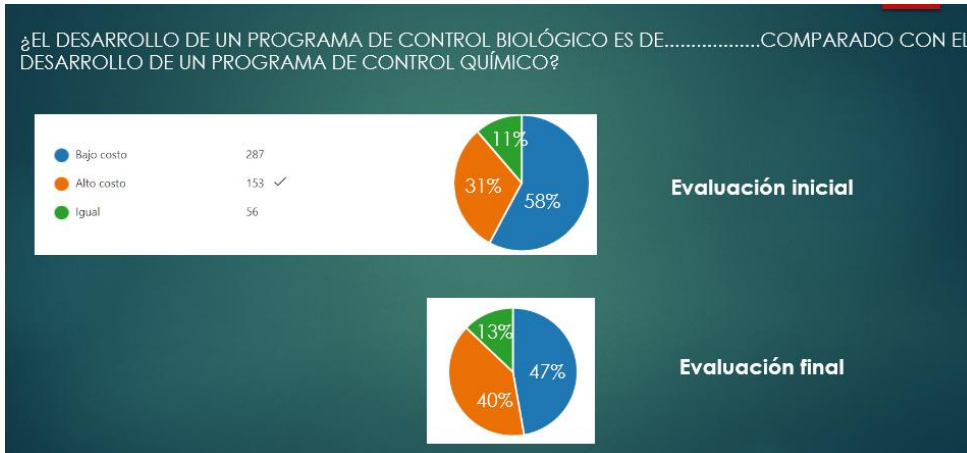


Pregunta 4. Puede el control biológico ser fácilmente y de manera segura combinado con el control químico?

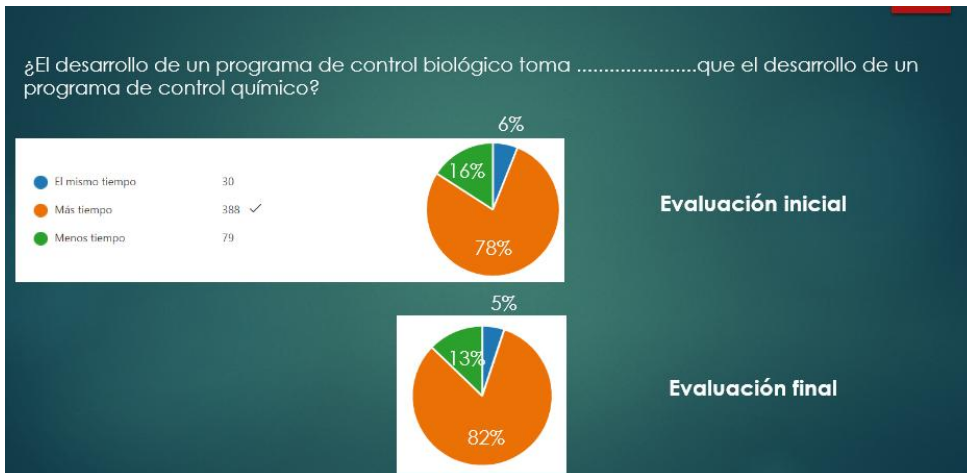




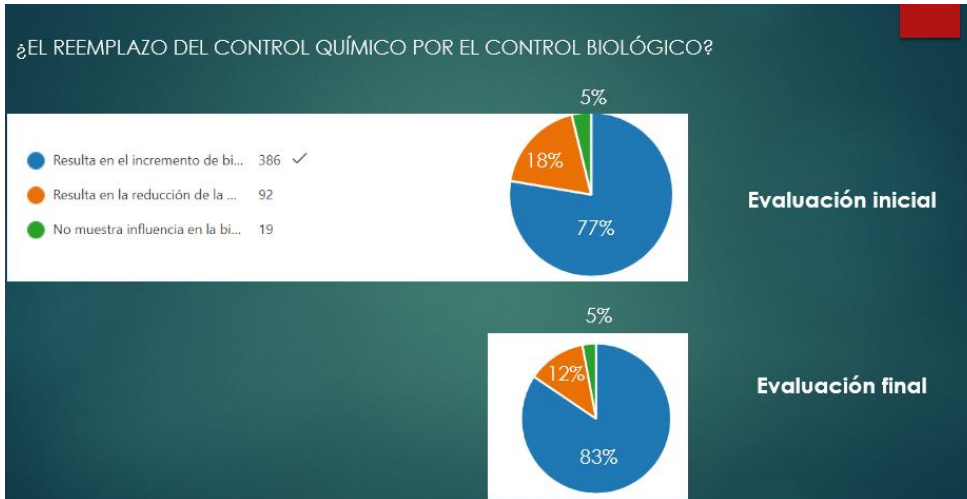
Pregunta 5. El desarrollo de un programa de control biológico es de .... Comparado con el desarrollo de un programa de control químico?



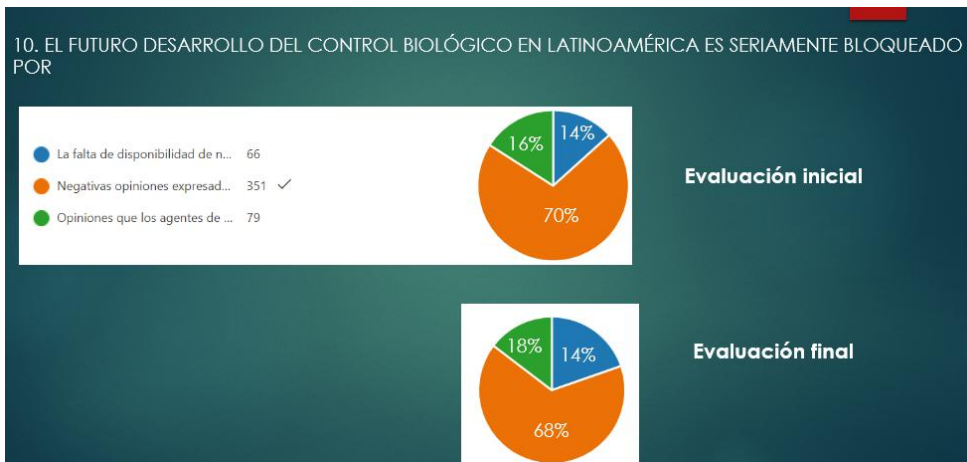
Pregunta 6. El desarrollo de un programa de control biológico toma... que el desarrollo de un programa de control químico?



Pregunta 7. El reemplazo del control químico por el control biológico resulta en el incremento de/reducción de/no muestra influencia en/ la biodiversidad dentro y fuera del cultivo?



Pregunta 10. El futuro desarrollo del control biológico en Latinoamérica es seriamente bloqueado por... a) la falta de disponibilidad de nuevos agentes de control biológico, b) las opiniones negativas expresadas por las industrias de pesticidas químicos a nivel de gobiernos y agricultores, c) la opinión de que el biocontrol generalmente falla?





Opiniones del público sobre el curso.

## EVALUACIÓN GENERAL DEL CURSO

- ▶ Excelente curso para conocer sobre organismos para control biológico y leyes para su implementación
- ▶ Totalmente instructivo y práctico
- ▶ Excelente curso, actualización de los últimos estudios respecto del Control Biológico en Latinoamérica y otros países.
- ▶ Charlas muy específicas y claras, además de excelentes expositores y sus ponencias.
  
- ▶ Es importante seguir con las capacitaciones de control biológico en los otros grupos de enemigos naturales y otras plagas, así como protocolos de control de calidad.
- ▶ Resumen de las ponencias o un libro de memorias.