Validation and Diffusion of Models for Integrated Pest Management (IPM) of Potato in the Carchi and Bolívar, Ecuador

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Abstract

The research is being carried out jointly between the IPM-CRSP, Ecohealth-IDRC, Fortipapa-COSUDE, FAO and Croplife from Ecuador.

The methodology utilized for this research is the Field Schools for Farmers (FSs), based on participatory research and training. The methodology is developed through an entire potato crop cycle, where farmers perform experiments and practices. The purpose of the FSs is to improve the ability of the farmers so they are able to make better decisions, based on more complete knowledge of the system.

The study has been performed in 16 participating communities, based on the criteria of the different projects. Twelve communities were identified in the province of Carchi: Santa Martha de Cuba and Santa Martha de Cuba Colegio (Tulcán), San Pedro de Piartal Alto, San Pedro de Piartal Bajo, San Francisco de Piartal, Pioter and Monteverde (Montúfar), San Francisco Alto, San Francisco Bajo and San Isidro (Espejo), and Las Lajas and Pueblo Viejo (Bolívar); and four communities in the province of Bolívar: Pucarapamba, Culebrillas, Larcaloma and Qunidigua Alto (Guaranda). The headquarters of activities were the INIAP offices in San Gabriel and Guaranda, respectively. Preliminary baseline studies were done in each community, providing information on pesticide use practices, potato crop management and the activities of women at home.

The IPM components of the training curriculum are: IPM Andean weevil (*Premnotrypes vorax*), IPM late blight (*Phytophthora infestans*), IPM central american tuber moth (*Tecia solanivora*) and IPM miner fly (*Liriomyza huidobrensisi*). An average of 17 training sessions was provided for the communities, with a total of 302 participating farmers. Participants observed significant reductions in the number of applications of pesticides as well as in expenses due to IPM.

Other farmers and technical personnel from governmental institutions and NGOs have also been trained. Forty-eight participants, including technicians and agricultural promoters from 25 institutions that normally work in the north and central zones have been trained in IPM. As a result, we estimate that approximately 1150 potato growers in Carchi and 360 potato growers in Bolívar are now using at least one IPM component.

Objectives

1. To validate and diffuse models of integrated pest management of potato in communities of Carchi and Bolivar.
2. To incorporate integrated management components generated in the different projects for integrated pest management of potato in Ecuador.

Research Methods

INIAP, through its Validation and Technology Transfer Units of Carchi and Bolívar, with the support of the Nucleus of Technical Support and Training, the Plant Protection Department of Santa Catalina Experimental Station of INIAP, and the International Potato Center (CIP), has accumulated wide experience about the implementation, validation, and diffusion of models of IPM on potatoes. This information has been produced using the FS approach, based on learning via discovery. To build the field schools, the following steps were taken: a) selection of location and communities, b) a base-line study of the communities, c) conformation and organization of the FSs, d) development and implementation of the training curriculum, and e) selection and implementation of the IPM components.

Sixteen communities in the province of Carchi have been identified: 2 in Tulcán county, 5 in Montúfar county, 3 in Espejo county and 2 in Bolívar county. In the province of Bolívar, 4 communities were identified, all in Guaranda county (Table 1).

Base-line study of the communities

The base-line study used two forms of data. The first one, through a producer questionnaire, combined closed and open questions about the management of the potato crop. In addition, a Participative Rural Diagnosis (PRD) was

conducted with key groups of producers. In Carchi, 97 participants were identified and in Bolivar, 39 participants were identified for the field school.

Organization of the FSs

Complementary to the primary data taking, farmer groups were organized in the FSs, using the following:

Promotion: Initially, governing leaders of communities and organizations were contacted; they supplied the first data. Subsequently, invitations were made to all the people in the community. The objectives, obligations and the goals of the project were presented at this meeting.

Motivation: Two meetings were held in each community. During these meetings, agricultural problems related to diseases, insect pests and the indiscriminative use of pesticides to control them were discussed. Presentations about alternatives generated by INIAP and CIP were given to the farmers. The cost-reducing impact of IPM alternatives was discussed.

Selection of participants: Participants were selected according to the following criteria: a) Interest in participating; b) potato is the principal crop; c) willingness to share and diffuse experiences; and d) creativeness and innovation.

Organization of the working groups: Groups were formed in each FS (Table 1). Each working group had a speaker in charge of coordination with the technical facilitator and for the training events and themes.

Development and implementation of the curriculum

With the objective of evaluating the knowledge changes of the participants, tests were taken at the beginning, intermediate, and at the end of FS training. A practical tool called The Box Test was used. Once the FSs were organized, and starting knowledge was evaluated, a training curriculum was elaborated. IPM components developed by INIAP were included. These components covered the principal pests and diseases of the potato crop: andean weevil, late blight, Central American tuber moth, and miner fly (Table 2).

The training curriculum covered themes related to soil fertility levels through chemical analysis to determine the fertilizer quantities required by the crop. Tests were made of missing plant nutrients to show deficiency symptoms and the importance of each nutrient for plant growth. The FSs in San Francisco elaborated an organic fertilizer based on fresh manure and incorporation of plants with insecticide properties. An important aspect of the FSs was knowledge of the agro-ecology and biology of the principal diseases and pests, and their relationship to the potato crop.

Selection and implementation of the IPM components

The potato crop in Carchi is managed with acceptable technology. This is not the case for the province of Bolívar, and for this reason IPM alternatives should offer improvements on traditional agriculture.

IPM andean weevil: traps and leaf application of insecticides of low toxicity were used at 40, 60, 80 days following planting. The traps consisted of potato stems sprayed with insecticide and covered with paperboard or other materials to protect it from rain. They were placed in a proportion of 100 per hectare. Depending on the state of the potato stems, traps were renovated every 8 to 10 days, with 2 or 3 renovations before and after sowing, respectively.

IPM late blight: As an alternative to lowering costs of control of late blight, the variety INIAP-Fripapa99 was used. This variety has vertical resistance and high yields. During the five months of the crop cycle, four applications were made using systemic and contact fungicides in different mixtures according to the incidence of late blight. As a preventive alternative, the first control was done at the 45^{th} days, using Mancozeb as 0.5Kg/200L of water. The following controls were done according to incidence of 2% in late blight: Curathane (Cimoxanil) and Dithane M45 (Mancozeb) as 0.5kg plus 0.5kg/200L of water respectively. At the FSs, the INIAP-Fripapa99 was evaluated compared to the local variety Superchola in Carchi, and with INIAP-Gabriela in Bolívar.

Table 1. Field School participants and training meetings done at the provinces of Carchi and Bolívar, Ecuador.

Community	Canton-Province	Number of Meetings	Number of Participants
Santa Martha de Cuba (2000, 2001)	Tulcán, Carchi	17	22
San Pedro de Piartal Alto (2000, 2001)	Montúfar, Carchi	15	25
San Francisco Alto (2000, 2001)	Espejo, Carchi	15	20
San Pedro de Piartal Bajo (2001)	Montúfar, Carchi	17	16
San Francisco Bajo-Carchi (2001)	Espejo, Carchi	16	14
Santa Martha de Cuba Colegio (2002)	Tulcán, Carchi	18	18
San Francisco de Piartal (2002)	Montúfar, Carchi	16	12
Pioter (2002)	Montúfar, Carchi	23	25
Las Lajas (2002)	Bolívar, Carchi	20	23
Pueblo Viejo (2002)	Bolívar, Carchi	15	17
San Isidro (2002)	Espejo, Carchi	16	28
Monte Verde (2002)	Montúfar, Carchi	15	10
Pucarapamba (2000, 2001)	Guaranda, Bolívar	16	24
Culebrillas (2001)	Guaranda, Bolívar	17	15
Larcaloma (2002)	Guaranda, Bolívar	15	18
Quindigua Central (2002)	Guaranda, Bolívar	15	15
Total		266	302

Source: INIAP, CIP, IPM CRSP, Virginia Tech, FAO, Croplife.
() Crop cycle: 2000 (October 1999 – September 2000)
2001 (October 2000 – September 2001)
2002 (October 2001 – September 2002)

IPM miner fly: Fixed traps were set at edges of the field starting at the 45th day until flowering, yellow fixed traps, sized 0.4 m x 0.4 m, in a proportion of 45 per hectare. They were sprayed every 3 to 5 days with cooking and motor oil in a 1 to 1 proportion. Spraying occurred every eight days starting at the 45th day until flowering stage, and yellow mobile traps were passed around, covering two furrows, over the crop.

IPM tuber moth: Two monitoring traps were installed at the edges of the crop; these traps consisted of a thimble impregnated with a chemical compound that attracts the male moths, to deter mating and reduce the laying of fertile eggs.

Results

Results of the implementation of the FSs

In total, in the potato FSs, 266 training sessions have been conducted, with 302 participating farmers. Eight field days were also conducted, 4 in Carchi and 4 in Bolívar. Some 1700 persons have participated. Interchange field trips were organized with farmers from the zone and those of the FSs, so they could share experiences.

Field school participants have shared their experiences with 1510 farmers from the communities under study. Other farmers have recognized the benefits of the IPM approach and have begun to form FSs groups.

The first groups that were trained through the FSs have continued working as a Local Agricultural Research Committees (LARCs). The methodology has demonstrated some propensity to be self-sustaining

Results of the implementation of the IPM components on farmers' fields

Results show excellent control of adults of the Andean weevil, before and after planting, by using traps; control of the leaf miner using the fixed and mobile yellow traps, starting 45 days after planting up to the flowering stage; and control of late blight by means of the use of the potato variety INIAP-Fripapa 99. These components have contributed to the reduction of potato production costs as well as less use of pesticides.

Preliminary analyses show that in Carchi (Table 2) the number of phytosanitary controls has been reduced. In the case of insecticides, controls were reduced from 5 to 4 controls with IPM. The amount of chemical products utilized is reduced by 61%, since the 9 liters of insecticide per hectare commonly used by the farmers has been reduced to 3.5 liters per hectare under IPM. The same happened with fungicides, where it has also been possible to reduce the number of applications and the amount of product. Number of controls was reduced from 8 to 4, and the amount of utilized product has been reduced by 58%. Regarding expenditures, IPM in Carchi reduces costs from $ 430 per ha. to $ 257 per ha, a reduction of costs in pesticides of 40%. For the Bolívar case similar reductions in numbers of controls, amount of pesticide applied and total costs resulted (Table 3). For insecticides, the controls have been reduced from 3 to 2; the amount of insecticides is reduced by 58%. In Bolívar, total costs were reduced from $ 291 per ha to $202, a cost reduction of 30%.

Networking Activities

Workshops

In April 2002, in Santa Martha de Cuba, Montúfar county, Carchi, the third field day was held to demonstrate the FSs advances. 300 visitors, both national and international, participated; 30% were women.

In December 2001, and June and July of 2002, in Larcaloma, Pucarapamba and Quinua Corral, Guaranda county, Bolívar, field days were also held. 500 people attended, 40% were women.

From April 2002, in the province of Imbabura, the First Course of Training to Trainers in IPM implementation and FSs methodology was held. This course included 51 students (45% women) of the final grade of the Agronomy Schools of the Technical University of the North and the Catholic University of Ibarra.

Research Investigator Interchanges

Jovanny Suquillo of INIAP, since November of 2001, is pursuing his Masters Degree in Biological Control, in the Army Polytechnic School (APS).

Luis Escudero of INIAP, during November of 2001, was trained in Lima-Perú, on the evaluation of IPM impacts.
Víctor Barrera of INIAP, during June of 2002, had the opportunity to interchange experiences in Brasilia-Brasil, with technicians from other countries on methodologies of participatory training.

Luis Escudero, Jovanny Suquillo, Víctor Barrera, María Crizón, Richard Sandoval and José Romo are participating as Facilitators of the Course of Training to Trainers in IPM, aimed to students of the final grade of the Agronomy Schools of the Technical University of the North and the Catholic University of Ibarra.

Between May and September of 2002, Luis Escudero, Víctor Barrera, José Romo, Rosa Chulde, Richard Sandoval, Jovanny Suquillo and María Crizón, trained 50 children, 30 housewives, 40 applier farmers, 30 agrichemical sellers and 30 high school students, about IPM and the safe use of pesticides on potato.

Angel Rea participated in the Course on Training to Trainers, in integrated management of crops and the methodology of Field Schools for Farmers, and also in the Course about the methodology of the Local Agricultural Research Committees (LARCs), organized by the IPM-CRSP and FAO in the provinces of Carchi and Chimborazo.

Research Information and Product Exchange

In November 2002, 500 CDs were published with the experiences in Ecuador of the FSs, from its conformation up to this moment.

In March 2002, 500 copies of the Technical Bulletin about "Economic evaluation of the application of the technology of integrated management of plagues and diseases (IPM) in the potato crop in the highlands of Ecuador" were produced.

Table 2. Phytosanitary products, rates and costs per hectare utilized for the control of pests and diseases in potato. Carchi, Ecuador, 2002.

	IPM			Conventional		
Controls	**Product**	**Rate/ha**	**Cost ($/ha)**	**Product**	**Rate/ha**	**Cost ($/ha)**
1	Carbofuran (l)	0.5	8	Carbofuran (l)	1	16
2	Acefato (l)	1	40	Carbofuran (l)	1	16
	Mancozeb (kg)	2	10	Profenofos (l)	1	18
	Cymoxanil (kg)	1	12	Cymoxamil (kg)	1	12
				Mancozeb (kg)	2	10
				Azufre (kg)	2	6
3	Acefato (l)	1	40	Carbofuran (l)	1	16
				Metamidofos (l)	1	14
				Cymoxamil (kg)	1	12
				Mancozeb (kg)	2	10
				Azufre (kg)	2	6
4	Profenofos (l)	1	18	Carbofuran (l)	1	16
	Cymoxamil (kg)	2	24	Carbosulfan (l)	1	16
	Mancozeb (kg)	2	10	Metalaxil (kg)	1	13
				Cymoxamil (kg)	1	12
				Mancozeb (kg)	2	10
5				Carbosulfan (l)	1	16
				Profenofos (l)	1	18
				Cymoxamil (kg)	2	24
				Mancozeb (kg)	2	10
				Azufre (kg)	2	6
6	Cymoxamil (kg)	3	36	Cymoxamil (kg)	2	24
	Mancozeb (kg)	3	20	Propineb (kg)	3	18
				Azufre (kg)	2	6
7				Cymoxamil (kg)	2	24
				Azufre (kg)	2	6
				Mancozeb (kg)	2	10
8	Cymoxamil (kg)	2	24	Cymoxamil (kg)	2	24
	Azufre (kg)	3	15	Azufre (kg)	2	6
				Mancozeb (kg)	2	10
9				Cymoxamil (kg)	1	12
				Mancozeb (kg)	2	10
				Azufre (kg)	1	3
TOTAL COST ($/ha)			**257**			**430**

Table 3. Phytosanitary products, rates and costs per hectare utilized for the control of pests and diseases in potato. Bolívar, Ecuador, 2002.

	IPM			Conventional		
Controls	**Product**	**Rate/ha**	**Cost ($/ha)**	**Product**	**Rate/ha**	**Cost ($/ha)**
1	Acefato (l)	1	40	Profenofos (l)	1	18
	Mancozeb (kg)	2	10	Mancozeb (kg)	3	15
2	Acefato (l)	1.5	60	Profenofos (l)	2	36
	Cymoxamil (kg)	3	36	Mancozeb (kg)	3	15
3	Propineb (kg)	4	56	Metamidofos (l)	3	42
				Cymoxamil (kg)	3	36
				Mancozeb (kg)	3	15
4				Propineb (kg)	3	42
				Mancozeb (kg)	4	20
5				Propineb (kg)	2	28
6				Cymoxamil (kg)	2	24
TOTAL COST ($/ha)			**202**			**291**

Publications and Presentations

Víctor Barrera, David Quishpe, Charles Crissman, George Norton and Stanley Wood. 2002. "Economic evaluation of the application of the technology of integrated management of plagues and diseases (IPM) in the potato crop in the highlands of Ecuador". Technical Bulletin No. 91. INIAP-CIP-IPMCRSP-IFPRI. 62p.

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Training Output

On a weekly basis the farmers of the Field Schools receive training. During a period of six months, the Field Schools provide them abilities for the improvement of productivity as well as in the integrated management of the potato crop, with emphasis on the integrated management of the Andean weevil, late blight, central american tuber moth and miner fly.

Every month, during three days, the participants of the Course of Training to Trainers, receive training. During a period of six months, the participants acquire abilities in the integrated management of the potato crop, safe use of pesticides and the FSs methodology.

Every fifteen days, Carlos Monar broadcasts Radio Programs for the period of one hour, to transfer the knowledge about the FSs and the LARCs with the IPM approach, on the Radio of the Bolívar State University.

Project Highlight

Sixteen FSs in potato crop were established: 12 in the province of Carchi and 4 in the province of Bolívar.

302 farmers directly trained in the FSs know and apply IPM on their potato plots.

1510 farmers know and apply at least one IPM practice on their potato plots.

Mixed systems of PROMSA, FSs-FAO, ECOHEALTH INIAP-CIP, and FSs-CROPLIFE, are complementary projects that contribute to the FSs conformation and the IPM research in potato.

In Carchi and Bolívar, according to the initial analyses of the information, it is evident the reduction in production costs, as well as the number of applications and amount of pesticides when IPM is used.

It is also evident that the participatory training by means of the FSs may become a valid alternative to multiply the knowledge in IPM, not only in the potato crop but also in other crops, where the indiscriminate use of pesticides constitutes a serious problem.

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