Combating potato pests safely in Bolivia

RIU

Validated RNRRS Output.

Potato farmers in Bolivia, and their children, are learning about biological controls and integrated pest management. The potato is the staple food in Andean countries as well as the main cash crop. But pests and diseases cause huge losses each year. So, farmers use more and more pesticides, threatening human health and damaging the environment. Books for farmers, teachers and children introduce the ideas of integrated pest management. Children help in the potato fields, so raising their interest at an early age could pay off later. Farmers are also testing traps baited with natural extracts. These could help safely control the Andean potato weevil. Locally made traps intercept weevils heading for the potatoes. Other farm communities are keen to test the traps so demand could grow significantly.

Project Ref: **CPP57:**
Topic: **1. Improving Farmers Livelihoods: Better Crops, Systems & Pest Management**
Lead Organisation: **PROINPA, Bolivia**
Source: **Crop Protection Programme**

Document Contents:

Description

CPP57

Research into Use
NR International
Park House
Bradbourne Lane
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Geographical regions included:

Bolivia,

Target Audiences for this content:

Crop farmers,

A. Description of the research output(s)

1. Working title of output or cluster of outputs.

IPM of potato pests in Hillside systems in Bolivia

2. Relevant RNRRS Programme:

Crop Protection Programme

3. Relevant project R numbers:

R8044, R8443

Institutional Partners:

Lead Institution: Fundación PROINPA, Cochabamba, Bolivia (Ing. Rayne Calderón & Dr. Javier Franco)

Principal Collaborator: Natural Resources Institute (NRI), Chatham, UK (Prof. D. Hall, Dr M. Downham, D. Grzywacz)

Centro Internacional de la Papa (CIP), Lima, Perú (Dr J Kröschel, Dr.Oscar Ortiz, Ing. J. Alcazar)

*4. Describe the RNRRS output or cluster of outputs being proposed and when it was produced. **(max. 400 words)**.*

Andean potato is the staple food and major cash crop in several Andean countries. In **Bolivia** it is grown by 400,000 poor rural families, typically in hillside production systems where yields are low due to a complex of weeds, nematodes, pests and diseases, as well as poor soils and erosion. Within this complex, insect pests have a substantial impact on farmers' livelihood. The most important are **potato tuber moths** (**PTM**s), ***Phthorimaea operculella*** and ***Symmetrischema tangolias*** and **Andean potato weevils** (**APW**s) ***Premnotrypes*** spp. and ***Rhigopsidius piercei***, which each cause losses of up to 500 US$/ha/year. Farmers have used increasing amounts of pesticides, resulting in abuse and overuse in a vain attempt to improve productivity.

The project aimed to develop, produce and promote a novel formulation of the *P. opercullela* **granulosis virus** (**PoGV**) as a **microbial pesticide** for farm-store use; to develop a new viral control agent for *S. tangolias*; to develop **attractants** for trapping and controlling APWs; and to promote and assess uptake of IPM technologies by farmer. Outputs were:

1) A new liquid formulation of PoGV was developed. The formulation achieved high levels of infection of PTMs in farm stores in Bolivia, but there was little reduction in damage, because the virus was thought to be too slow-acting.

2) Several thousand samples of potentially virus infected larvae of *S. tangolias* were collected from potato fields in Peru and Bolivia. Despite this, no virus specific for *S. tangolias* was found.

3) Laboratory and field bioassays and chemical analyses showed no evidence for production of a pheromone by APWs. However, strong attraction to volatiles from potato leaves was demonstrated. Two components of these volatiles, **(*E*)-2-hexenal** and **(*Z*)-3-hexenol**, were shown to be attractive to APWs, and slow-release dispensers were developed. **Pitfall traps** baited with these were developed from locally-available plastic containers. In field trials bottle traps baited with (*Z*)-3-hexenol were more attractive than un-baited traps and of equal attractiveness to potato leaves. The trap is set at field margins to intercept weevils immigrating into fields at the start of the season.

4) Following base-line surveys of farmers' perceptions of potato pests and diseases, training of adult farmers took place in three communities, with emphasis on control of APW and PTM and on the rational use of pesticides. Materials for teaching schoolchildren about IPM of potato pests were developed and evaluated with 15 rural school teachers in 4 basic education schools.

5) A workshop on IPM in potatoes was held at CIP in Peru and was attended by technical staff from Peru, Bolivia, Colombia and Ecuador.

5. What is the type of output(s) being described here?
Please tick one or more of the following options.

Product	*Technology*	*Service*	*Process or Methodology*	*Policy*	*Other Please specify*
	X		X		

6. What is the main commodity (ies) upon which the output(s) focussed? Could this output be applied to other commodities, if so, please comment.

Potato (*Solanum tuberosum ssp. andigena*) is the target commodity.

7. What production system(s) does/could the output(s) focus upon?
Please tick one or more of the following options. Leave blank if not applicable

Semi-Arid	*High potential*	*Hillsides*	*Forest-Agriculture*	*Peri-urban*	*Land water*	*Tropical moist forest*	*Cross-cutting*
		X					

8. What farming system(s) does the output(s) focus upon?
Please tick one or more of the following options (see Annex B for definitions). Leave blank if not applicable

Smallholder rainfed humid	*Irrigated*	*Wetland rice based*	*Smallholder rainfed highland*	*Smallholder rainfed dry/cold*	*Dualistic*	*Coastal artisanal fishing*
				X		

*9. How could value be added to the output, or additional constraints faced by poor people addressed, by clustering this output with research outputs from other sources (RNRRS and non RNRRS)? (**max. 300 words**).*

Project outputs could be clustered with those of CPP projects R8485 and R8182 ("Strengthening technical innovation in potato based agriculture") which also operated in Bolivia. The APW traps and farmer training methods are new developments which could be tested through the systems of farmer evaluation of technical innovations which these projects helped to develop.

Validation

B. Validation of the research output(s)

*10**. How** were the output(s) validated and **who** validated them? Please provide brief description of method(s) used and consider application, replication, adaptation and/or adoption in the context of any partner organisation and user groups involved. In addressing the "who" component detail which group(s) did the validation e.g. end users, intermediary organisation, government department, aid organisation, private company etc... This section should also be used to detail, if applicable, to which social group, gender, income category the validation was applied and any increases in productivity observed during validation **(max. 500 words)**.*

The liquid formulation of the *P. operculella* granulosis virus was developed by NRI in UK and evaluated in replicated, small-scale storage trials by PROINPA in Bolivia.

Collections of larvae of *S. tangolias* were made by staff from CIP and PROINPA in Peru and Bolivia and evaluated by microscopic examination and ELISA tests at CIP.

For APW attractants, collections of natural volatile compounds were made from weevils and host plants at PROINPA, NRI and CIP laboratories, then analysed and identified at NRI using standard gas chromatography-mass spectrometry (GC-MS) and gas chromatography-electroantennography (GC-EAG) techniques. Putative attractant compounds identified were bio-assayed against adult APWs (both sexes of both species) using replicated tests with 2- or 3-choice pitfall chambers in PROINPA and CIP laboratories.

Researcher-led field trapping tests were carried out in farmers' fields in Bolivia by PROINPA and NRI staff. These used standard randomised-block methodologies with traps set just inside field margins to trap immigrating weevils.

The base-line survey of farmers' perceptions of pests and diseases was carried out in three communities in Bolivia – Cebada Jichana, Lope Mendoza Alto and Candelaria in 2003 by PROINPA staff. This was instrumental in identifying farmers' training needs. In each community 30 farmers were interviewed, of approximately equal numbers of both sexes. More than 60% of the population were 12 - 25 years old. The majority had received education to primary and intermediate levels.

During 2004 eight training days were carried out in the three communities in the local Quechua language. Based on the baseline study, and following requests by farmers, these targeted different IPM components with emphasis on biological control of APW and PTM and on the rational use of

pesticides. The activities were aimed at the younger age groups and were attended by 168 men, 64 women as well as children. Farmer training was supported by slides, videos and live samples and for future training several leaflets on the biology and integrated management of APW and PTM were prepared. To provide technical material to field technicians a potato pest handbook was published.

Training activities within the rural schools were conducted in four communities (Huajllapujru, Cebada Jichana, Caña Kota and Boqueron k'asa), near PROINPA'S Toralapa Centre in 2005. Children are often involved in potato cultivation and the schools provide an untapped opportunity for introducing large numbers to the concepts of IPM at an early age and, indirectly, to parents. For this purpose a teachers' guide and a student notebook were prepared. Materials were prepared for students from fifth and sixth grade (ages 10 – 12). These were tested with 131 students and their teachers before a final version was developed.

*11. **Where and when** have the output(s) been validated? Please indicate the places(s) and country(ies), any particular social group targeted and also indicate in which production system and farming system, using the options provided in questions 7 and 8 respectively, above **(max 300 words)**.*

Small-scale field trials with the liquid formulation of the *P. operculella* granulosis virus were carried out in Bolivia during 2003-2004.

Larvae of *S. tangolias* were collected in Peru and Bolivia during 2002-2004 and evaluated at CIP in Peru.

APW attractants were collected in Bolivia and Peru and identified in the NRI laboratories in UK during 2001-2004. Laboratory bioassays were performed in the PROINPA laboratories in Bolivia during 2001-2004.

Field trapping tests were conducted in potato fields, mostly at PROINPA's field station in the Cochabamba region of Bolivia and nearby in farmers' fields, but also in the Chuquisaca region, during 2002-2005.

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Current Situation

C. Current situation

*12. **How and by whom** are the outputs currently being used? Please give a brief description **(max. 250 words**).*

Currently, there is no independent use of the APW traps by farmers, in part because their technical development could not be completed under the DFID-CPP project. However, in October 2005 PROINPA, with NRI collaboration, a two-year World Bank Development Marketplace funded project began. This aims to further develop the APW traps as an IPM component, and to achieve pilot-scale commercial production and farmer uptake in the Cochabamba region.

During the first year aspects of trap design, lure dose or trap placement approach for successful mass-trapping were addressed in researcher-led on-farm trials in five communities. For the first time, evidence was gathered suggesting that tuber infestations could be reduced. Pilot-scale production of traps and lures was commenced by PROINPA and training of farmers in the use of traps was undertaken in a further seven communities. In the second year farmers will manage trapping activities in the 12 communities now trained. Costs of traps and lures will be met by the project. Assuming successful outcomes this year, commercial sales to farmers will be possible subsequently.

Following their validation in 2005, the use of finished training materials for schools was continued in 2006. Separate textbooks with interactive exercises had been developed for grades 5 and 6. In total, around 360 were distributed to six schools in the Toralapa area along with 60 complementary teaching books intended for teacher use. Informal feedback from the schools is very positive, with teachers reporting that levels of student interest in the books and activities have been without precedent.

*13. **Where** are the outputs currently being used? As with Question 11 please indicate place(s) and countries where the outputs are being used **(max. 250 words).***

During 2006, mass trapping of APWs has been evaluated in five communities in the Toralapa region of Bolivia and farmers have been trained in seven other communities. Trapping will be managed by farmers in all 12 communities during 2007.

IPM training material for schools was used in six schools in the Toralapa area of Bolivia during 2006.

*14. What is the scale of current use? Indicate how quickly use was established and whether usage is still spreading **(max 250 words).***

During the 2006 – 07 season traps will be deployed in approximately 15-20 fields, in 12 communities, in the farmer-led trials of mass-trapping control of APWs forming part of the WB-DM project. It is anticipated that this will involve around 1000 traps. In addition, requests have come from a few other (as yet untrained) farm communities around Cochabamba for the traps, as well as from some University researchers in Potosí and another branch of PROINPA in La Paz where they will be deployed for population monitoring purposes. Thus it is anticipated demand could increase significantly in future.

The training materials for schools are currently being used by about 360 students in six schools. Uptake by the schools was enthusiastic and followed on directly from the previous year´s validation of the materials. Around 3000 textbooks were printed by PROINPA and the remainder will be used to extend the scheme to schools in other regions of Bolivia in 2007, with initial support provided by PROINPA staff in those areas. In November 2006 a representative of the Ecuadorian

Ministry of Agriculture will visit to see the use of the school textbooks and teaching methods, with a view to expanding the scheme to Ecuador. This will take place with the support of the "*Papa Andina*" project, managed by CIP.

15. In your experience what programmes, platforms, policy and institutional structures exist that have assisted with the promotion and/or adoption of the output(s) proposed here, and in terms of capacity strengthening what do you see as the key facts of success? ***(max 350 words).***

The enthusiastic uptake of the school training materials and the limited uptake, to date, of the APW traps is very largely due to PROINPA's previous good relations and network of contacts with farming communities, extension agents and other researchers, within Bolivia and in other Andean countries. PROINPA's established training methods and training fora are, and will in future continue to be, important determinants of the ultimate success of uptake. The dissemination workshop held in June 2005, at CIP, as part of the final phase of the CPP project, was particularly helpful in spreading awareness of the outputs to other organisations in the Andean region.

Current Promotion

D. Current promotion/uptake pathways

16. ***Where*** *is promotion currently taking place? Please indicate for each country specified, in detail what promotion is taking place, by whom and indicate the scale of current promotion* ***(max 200 words).***

Active promotion of the APW traps is currently taking place within the Cochabamba region of Bolivia, specifically in 12 farming communities centred on the PROINPA station at Toralapa. It is focussed on training in the use of traps of farmers in the context of community farmer associations; it is allied to the practical demonstrations that the season-long trials provide. Furthermore, technical training materials – posters and leaflets in Spanish and Quechua – will soon be provided to supplement these promotional activities.

PROINPA's network of contacts with Bolivian and other Andean country research and extension organisations provide avenues of promotion for all its activities - as evidenced by requests for APW traps from University researchers in Potosí and another branch of PROINPA in La Paz, and interest in the IPM training materials for schools from Ecuador.

17. What are the current barriers preventing or slowing the adoption of the output(s)? Cover here institutional issues, those relating to policy, marketing, infrastructure, social exclusion etc. ***(max 200 words)****.*

An obvious limitation to the potential uptake of traps and lures is the dearth of local, private sector specialist producers and distributors of such materials within the Andean countries where the APW trap outputs could potentially be taken up. This has necessitated PROINPA undertaking pilot-scale production of traps and lures in the hope that another organisation might eventually take this on. Although PROINPA has previous experience of commercial sale of agricultural inputs, they may find it hard to cater to high rates of demand. There appear to be no governmental policy or regulatory issues that would adversely affect commercial production of the traps and lures.

One constraint to the further adoption of the school training materials is a financial one, once the current print run of 3000 textbooks and teaching materials is exhausted. At present, the political environment, at a regional level within Bolivia, is favourable to the approach of using IPM teaching in schools. However, this could change. PROINPA has sought to minimise and avoid such difficulties by working as far as possible a very local level and developing effective friendly relations.

18. What changes are needed to remove/reduce these barriers to adoption? This section could be used to identify perceived capacity related issues ***(max 200 words).***

Assuming a successful technical validation of the mass-trapping approach to control of APW, large-scale demand could rapidly develop, in Bolivia, Peru and Ecuador, where APWs are also a signficant problem. In order to interest a potential supplier a suitable marketing study and economic analysis will be needed. One specialist supplier of semiochemical products does exist in Costa Rica, and they might conceivably take on a role in future.

For the traps, the necessary plastic bottles are produced locally and the producers are willing to supply, cheaply, those bottles deemed sub-standard for normal use as water or soft drink containers. The bottles require modification for use as traps, which is labour intensive. Alternatively, production of a customised model or template for the trap has been investigated but is expensive; a future project might undertake to fund this.

Local lure production is technically feasible. If a potential private sector supplier can be found, funds could be made available to invest in the equipment or initial purchase of materials necessary for very large-scale production. Small grants could be made available to farmer organisations as loans for the purchase of lures (and traps).

Further funds may eventually be needed to continue promotion of the school materials.

19. What lessons have you learnt about the best ways to get the outputs used by the largest number of poor people? ***(max 300 words).***

The base-line survey of farmers' perceptions of pests and diseases showed that farmers' awareness of the biology of pests, of the best methods of conventional pesticide application and of alternative approaches is generally poor. A large proportion of the farming population is young; many of these are of school age and these can be reached with suitable training materials developed specifically to fit in with the school curriculum. Students receive this kind of training very well. Training on APW traps could be readily incorporated into this approach, as well as using existing, effective conventional approaches to farming communities.

Impacts On Poverty

E. Impacts on poverty to date

20. Where have impact studies on poverty in relation to this output or cluster of outputs taken place? This should

include any formal poverty impact studies (and it is appreciated that these will not be commonplace) and any less formal studies including any poverty mapping-type or monitoring work which allow for some analysis on impact on poverty to be made. Details of any cost-benefit analyses may also be detailed at this point. Please list studies here.

No impact studies, formal or informal, have yet taken place concerning either the APW traps or the farmer training methods.

21. Based on the evidence in the studies listed above, for each country detail how the poor have benefited from the application and/or adoption of the output(s) ***(max. 500 words):***

Currently, there is not yet any independent use or uptake of the APW traps by farmers. Consequently no poverty impact can yet be attributed to them.

Farmer and schools training in IPM approaches and awareness of pests is continuing and this will have had some impact on the effectiveness of pest control by farmers within several communities already. This will very probably expand geographically, but at present this is difficult to quantify.

PROINPA has plans for assessing impact at several levels: through formal tests of children at the end of the courses of study, surveys of households whose children have received training as well as checks on the field practices of the relevant farmers and their relatives.

Environmental Impact

H. Environmental impact

24. What are the direct and indirect environmental benefits related to the output(s) and their outcome(s)? ***(max 300 words)***

This could include direct benefits from the application of the technology or policy action with local governments or multinational agencies to create environmentally sound policies or programmes. Any supporting and appropriate evidence can be provided in the form of an annex.

Both the use of traps for controlling APWs and uptake of IPM training through schools should lead to a reduction in the use of conventional pesticides. Indirectly therefore, environmental benefits will accrue in terms of reduced toxic effects on non-target species.

25. Are there any adverse environmental impacts related to the output(s) and their outcome(s)? ***(max 100 words)***

No adverse outcomes are foreseen for either the APW trap technology or the school IPM training materials, other than the potential for broken or used traps and lures to litter the environment if not cleared away after use.

26. Do the outputs increase the capacity of poor people to cope with the effects of climate change, reduce the risks of natural disasters and increase their resilience? ***(max 200 words)***

Neither the APW trap technology nor the IPM training of school children offer any direct protection or mitigation of climate change or natural disaster other than through their potential to improve food security.