Method, creativity and CIALs

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Abstract: CIALs (Committees For Local Agricultural Research) are community level organisations for helping agricultural scientists and farmers to collaborate on adaptive research. Although CIALs have been used mainly for testing new crops and varieties, an unorthodox project in Peru and Bolivia recently used CIALs with a range of research techniques: formal trials, participatory research and farmers' own experiments. It is also combining CIALs with farmer field schools (FFS). The result is many new, chemical free technologies for managing an introduced disease that is difficult to observe and hard to manage.

Keywords: CIALs; farmer creativity; plant pathology; bacterial wilt; participatory research; Peru; Bolivia.

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Biographical notes: Jeffery W. Bentley is an agricultural anthropologist. He received his PhD degree from the University of Arizona in 1986. He has worked his whole career with smallholder farmers and has also spent a year in Portugal, living with craft farmers (1983–1984). After teaching for a semester at New Mexico State University, he spent seven years in Honduras

(1987–1994), at Zamorano, an agricultural college, helping IPM (integrated pest management) researchers and smallholders create appropriate technology. In 2002, he published a *Manual for Collaborative Research with Smallholder Coffee Farmers*, co-authored by Peter Baker (Egham, UK, CABI). Bentley has lived in Bolivia since 1994, and is an international consultant.

Sylvie Priou is a plant pathologist. He obtained his PhD degree from University of Agriculture, Rennes, France in 1992. After spending about three-and-a-half years at CIP's Regional Office for Middle East and North Africa in Tunisia working on storage diseases of potato, she moved to CIP Headquarters, Peru, in November 1996 as Head of the Bacteriology Unit. Since then she has been leading the team of integrated management of potato bacterial wilt. Her research has focussed primarily on improving sensitivity and user-friendliness of detection techniques for seed quality testing and research in developing countries. She and her team have also been working with farmers to test and validate cultural control options to manage this disease while improving soil health and increasing availability of self-supplied seed, and they produced multimedia training materials for various type of users.

Pedro Aley is an agronomist and plant pathologist and he received his MSc from the National Agricultural University of Lima, Peru in 1997. He joined CIP in 1987 and surveyed bacterial and fungal diseases of sweet potato for three years. In 1991 he started working with the bacterial wilt project and is currently a research assistant in the integrated management of potato bacterial wilt team.

Javier Correa is an agronomist and he received his BSc from the National Agricultural University of Lima, Peru in 1998. He has specialised in seed production while he worked for three years with the MSP project of the Peruvian Export Association (ADEX) in Andauaylas department. He joined the CIP-DFID Bacterial Wilt project for three years to support seed producers and farmer–researcher groups in Huánuco department.

Roger Torres is an agronomist and he received his BSc from the National University of Cajamarca, Peru in 2001. He has worked for three years at SENASA Cajamarca in the potato seed certification program before joining the CIP-DFID project as research assistant and trainer for Cajamarca Department for three years.

Hermeregildo Equise is an agronomist. He graduated from the Universidad Mayor de San Simón, Cochabamba, Bolivia in 1998, specialising in plant science. From 1990 to 1999 he conducted conventional and participatory research on plant pathology. Since then he has used farmer field schools and CIALs to study bacterial wilt with farmers. He has been an IPM expert with the PROINPA Foundation for over 15 years.

Jose Luis Quiruchi graduated from the vocational agricultural school Instituto Politécnico Tomás Katari (IPTK) in Ocurí, Potosí, Bolivia in 1994, specialising in food security and human development. He was an extension agent in Potosí with Ricerca e Cooperazione (1995–2009), and in Chuquisaca with the PROINPA Foundation (2001–2004). He now works in Northern Potosí with Ricerca e Cooperazione.

Oscar Barea Montellano is an agronomist and specialist in Integrated Pest Management (MSc). He has been working for 15 years in Research and Technology transfer in IPM and is leading the Integrated Bacterial Wilt Management Project at the PROINPA foundation, Cochabamba, Bolivia.

1 Introduction

The setting

CIP, the International Potato Centre in Lima, was home to some of the earliest participatory research (e.g., Rhoades and Booth, 1982; Horton 1984), although there was a lull for several years. Graham Thiele and colleagues suggest that in fact, participatory research was never integrated into the mainstream CIP programme (Thiele et al., 2001). That began to change in 1997, when CIP plant pathologist Rebecca Nelson and her colleagues adapted farmer field schools for research in late blight in Peru, inspired by a previous experience in Vietnam (Nelson et al., 2001). Participatory research is now being used at CIP by other, mainstream agricultural scientists. The PROINPA Foundation (Promotion and Research of Andean Products) evolved out of a CIP programme with the Bolivian Ministry of Agriculture after 1989 and fills much of the breach left by the sudden death, in 1997, of the Bolivian government's Institute of Agricultural Technology (IBTA).

Bacterial wilt: worthy opponent

Bacterial wilt is a serious disease caused by a bacterium, *Ralstonia solanacearum*, which can be transmitted through the seed, soil or even irrigation water. There is no known cure for the disease. It is prone to latent infection: the seed shows no symptoms (e.g., oozing pus) but it can still transmit the disease. Some potato varieties may seem to be resistant, only later to prove susceptible. As it is a new disease in the Andes (introduced to Bolivia in 1984), farmers have no traditional knowledge about managing it.

The Integrated Bacterial Wilt Management Project (2001–2004) is carried out by CIP and PROINPA in Peru and Bolivia, in the valleys of the Andes, in areas where potato is the daily staple diet on family farms and among the urban poor. The Project works in four departments:

- Cajamarca, in northern Peru
- Huánuco in the central Peruvian Andes
- Chuquisaca, south central Bolivia
- the low valleys of Santa Cruz, eastern Bolivia.

This paper discusses the first three areas.

The Project seeks solutions to this disease using several methods, including laboratory techniques, formal field trials, and participatory research, especially the CIAL and similar methods. The CIAL (local committee for agricultural research) is a method for organising smallholder farmers, teaching them scientific methods and giving them solutions to test on their own farms; it is now being widely adopted, especially in the Andes and Central America (Ashby et al., 2000).

2 Method: FFS, CIAL and formal seed

Before they had a CIAL, most or all of the collaborating communities had a FFS (farmer field school) on bacterial wilt, which helped prepare farmers to work on this 'difficult to observe' disease (see Braun et al., 2000; van de Fliert et al., 2002). PROINPA had worked with some communities since 1992, and the staff knew many local people well. The first year of the project, staff planted onfarm trials with the CIALs. Some of these were frankly participatory, where the agronomist and community members designed the trial in a meeting, where local people were encouraged to suggest treatments (experimental variables). For example, PROINPA agronomist Herme Equise would start by asking CIAL members to describe what they had tried on their own to control bacterial wilt, and then ask the group if they would like to test that method. The agronomists would tell CIALs about things that other communities were trying, and often the CIALs accepted those ideas. So the trial designs repeated certain themes from one CIAL to the next, and from Cajamarca to Huánuco to Chuquisaca. CIP called their Peruvian CIALs 'CAMES' (farmer committees to manage soil borne diseases), but there were few differences between how the Bolivian CIALs and the Peruvian CAMES worked.

CIP and PROINPA knew that the key to solving the disease was to plant healthy seeds in clean soil. So they worked with seed certification agencies to start or strengthen groups of smallholder farmers as formal seed producers in the high country (usually above 3,000 metres) for sale to other smallholders in the 'low' country (between about 2,000 and 2,500 metres). These seem to have been quite successful in Huánuco, less so in Cajamarca and the verdict is still out in Chuquisaca, although that is another story. See Table 1 for a list of some of the places where the Project was implemented and the methods they used. In Chuquisaca, the Project held FFS or community workshop training on bacterial wilt in over 20 other communities as well. PROINPA also produced radio programmes on the disease in Spanish and Quechua, broadcast from two different towns, to reach a large audience (see Bentley et al., 2003), and wrote a manual to help others lead an FFS or CIAL on managing bacterial wilt (Priou et al., 2004).

3 Results

Even before they started with the CIALs, some of the farmers who took FFS invented things. For example, Rafael Vargas was a young widower with children and a few small plots of land in El Astillero, Chuquisaca. In his FFS, Vargas learned that he should rotate crops to manage bacterial wilt, but he only had one irrigated potato field, and he had no choice but to plant potatoes every year. As the bacteria built up in his soil, he began losing most of his crop to bacterial wilt. But in the FFS he also learned that he should rogue (uproot and destroy) diseased potato plants. So he combined the two ideas, roguing and rotation. Mr Vargas uprooted the diseased plants and then planted a handful of wheat in the hole. The first year Vargas tried his invention, he had to replace 'almost all' his potatoes with wheat (Figure 1). But in the second year it was only 20%, the third year 15% and the fourth year, just 7%.

Table 1 Places and methods

Chuquisaca, Bolivia			*Cajamarca, Peru*			*Huánuco, Peru*		
Community	*CIAL*	*Organised to grow formal seed*	*Community*	*CIAL*	*Organised to grow formal seed*	*Community*	*CIAL*	*Organised to grow formal seed*
Lampasillos	Yes	Yes	Yamobamba		Yes	Illongococha		Yes
Tapial	Yes		Curgos		Yes	Santa Rosa de Monte Azul		Yes
Rosal	Yes	Yes	Tayanga		Yes	Rayancancha		Yes
T'ola Q'asa		Yes	La Encañada		Yes	Ramosragra		Yes
Astillero	Yes		Baños del Inca		Yes	Huamally		Yes
T'iyu Mayu	Yes		Chucmar		Yes	Yaurán		Yes
Pampas del Tigre	Yes		Cañafisto		Yes	Nauyán Rondos		Yes
Río Grande	Yes		Salabamba	Yes		San Juan de la Libertad		Yes
			Cruz Roja	Yes		Nueva Independencia	Yes	
			Nuevo Luarel	Yes		Huaguin	Yes	
			El Verde	Yes		Mayobamba, Cancejos	Yes	
			Sumidero	Yes		Pullanpampa	Yes	
			San Felipe	Yes		San José	Yes	
			Huangashanga	Yes		Shishiuniyoj	Yes	
			Rodiopampa	Yes		Molino	Yes	
			Cachacara	Yes		Tambillo	Yes	
			Tacabamba	Yes		San Marcos	Yes	
						Umari	Yes	

Actually, Yamobamba, Curgos and Tayanga are not in Cajamarca, but nearby, in the neighbouring department of La Libertad.

Figure 1 Bolivian smallholder Rafael Vargas plants wheat after he rogues potatoes, an invention of his own, tested in his own folk experiments

However, some of the best inventions were not made by farmers, but by agronomists, often based on something they learned from farmers. There is a touch of serendipity in many of these. One of farmers' greatest demands was for a technology that would rapidly clean the soil of the bacteria. The following three technologies all do that.

Bleach

In the 1990s, PROINPA agronomist Herme Equise worked with CIP plant pathologist, Enrique Fernández-Northcote, and learned to wash potatoes in a bleach solution before cutting them open in a lab. Fortunately, Equise noticed that the lab samples could still sprout; he concluded that the bleach did not damage them. After years of working with farmers, Equise knew that they often could not afford to wait through a five year crop rotation. Equise suggested to several CIALs that they either soak seed potatoes in a simple solution of laundry bleach, or else spray it onto the furrow as they plant. Either way it seemed to work. CIAL members were astonished to find that all of the potatoes they planted with bleach turned out healthy. At least two CIAL members in Chuquisaca tried bleach on their own.

Ash

We asked Peruvian farmers to dig little depressions at the gates to potato plots and fill them with powdered lime, to avoid tracking diseased soil between fields. On a visit to a group in Cajamarca, the plant pathologist, Sylvie Priou, was surprised to see that one group was using wood ash instead, because they did not have any lime. Priou was intrigued and tested the idea in her greenhouse in Lima. She found that wood ash in soil killed Ralstonia bacteria in two days. One of the CIP agronomists began designing trials of wood ash in Cajamarca. In the village of Salabamba, three CIAL members told us that they tried ash at the recommendation of an FFS from a previous FAO project, but as a fertiliser. They also noticed that it helped control bacterial wilt (Figure 2).

Figure 2 Domingo Quintos Cubas, Cornelio Chilcón Chuquicahua and David Goicochea Guevara, three of the seven CIAL members of Salabamba, Peru, who are participating in trials with humus and ash

Rotation

One of the plant pathologists, Pedro Aley, knew that Peruvian smallholders rotated their crops, but that they needed rotations that cleaned soil faster. CIP agronomists noticed a native Andean tuber, arracacha (*Arracacia zanthorrhiza*), being grown along canal banks in Huánuco. On a steep field belonging to CIAL leader Laura Cuchilla in Nueva Independencia, Huánuco (Figure 3), Aley designed a formal trial of three seasons of rotations, including arracacha. The field had a high incidence of bacterial wilt, but in 18 months, Three rotations with arracacha, lupine, sweet potato or cabbage eliminated so much of the disease-causing bacteria from the soil that potatoes could thrive there.

Figure 3 Laura Cuchilla Clemente, CIAL leader and owner of the parcel where the authors did a formal crop rotation trial

4 A tool box of methods

After the ‘eureka’ moment of thinking of a new disease-fighting tactic, there was a lot of systematic experimentation with each of them, and in each case it involved CIALs. Project agronomists selfconsciously used two styles of experiments, that they called ‘formal trials’ and ‘participatory research’. The following Sections discuss some of the pros and cons of each style.

Formal trials

The agronomists choose the treatments, usually six or seven, and test them in random blocks with three or four replicates. An individual farmer provides the land and labour, but he or she is nearly always a member of a CIAL. The agronomists share the results with the community in a meeting in the field at harvest time.

We mentioned above, the trial of crop rotations in Huánuco. The agronomists did not think of the trial as a formal part of the CIAL, although it was planted in the leader’s field, and the researchers hired CIAL members to harvest it. They dug up the seven treatments of the different rotations, stacking the potatoes neatly in their 21 little squares. With a dozen people working, it could have been chaos but the plant pathologist choreographed the data taking perfectly. They weighed the tubers from each square, healthy and diseased ones separately, and then moved on to the next replicate. When the agronomists had finished with their harvest of numbers, they wanted to help the community members to see the results. They carried the potatoes from each of the three replicates to a single place, so there were seven piles of bagged potatoes, instead of 21. The difference was obvious; the people could see immediately that yields of the potatoes from the rotated plots, especially the ones with arracacha and sweet potato, were much higher than the control group, which had been monocropped (Figures 4 and 5).

Figure 4 As soon as they saw the bags, CIAL instantly understood the order of each treatment in weight, without doing the numbers first

Figure 5 Plant pathologist Pedro Aley shows the results of a formal trial to the CIAL members. Front row, potato grown following potato, following potato. Upper rows. Two treatments of potato grown in rotation

Participatory experiments

These are designed with CIAL members and are simpler, with three or four treatments and two or three replicates. But like the formal trials, the blocks are still randomised and the individual treatments are still small, (2 × 5 m at the most). The agronomists help CIAL members take numerical data.

In Salabamba, Cajamarca, CIAL members described their experiment to compare humus with ash, (and with chemical fertiliser as a control group, besides a treatment that blended chemicals with humus). The CIAL members confused the treatments a bit when they explained them to us. Later, the agronomist who works with them explained that anyone can get confused with the randomised blocks of four treatments and three replicates. When they were planting the trial they put humus in a square which belonged to chemical fertiliser and they had to dig it out and replace the soil. They made a similar mistake again and decided to change the design (Figure 6).

Figure 6 Domingo Quintos (rt) shows potatoes fertilised with earthworm humus to agronomist Héctor Vargas. Mr. Quintos and his neighbours are experimenting on their own and in their CIAL with techniques they learned from agronomists

This is not a criticism of the agronomist or the farmers. There was confusion in most project sites whenever local people used randomised blocks of replicates. When we asked CIAL members which treatment was which, they usually could not remember it offhand. In one community in Chuquisaca a CIAL ran out of seed when planting a trial, so they skipped one of the rows (not one of the replicates), which meant that they had two replicates of some treatments and three replicates of others. We are not trying to be hypercritical. The point is that anyone can get confused with these trial designs. The agronomists themselves have to keep maps of the designs to keep the treatments straight.

The farmers understand the *philosophy* behind random blocks. When we have asked them why agronomists plant trials that way, the campesinos smile and say that not all land is the same, even within a small field. Still, participatory, randomised block trials are frustrating, at least some of the time, for both agronomists and farmers (Figure 7). As we will see in the section below on folk experiments, farmers learn from participating in trials with agronomists, and apply some of the principles in their own work.

Figure 7 Farmers in Cruz Roja, Cajamarca, Peru plant a formal trial of potatoes. Farmers who participate in trials like this understand the method involved, although they may later not recall all of the details of the trial design exactly. Later, when they experiment on their own, local people are much more likely to adopt the topics of formal research than the methods

Folk experiments

These are designed and conducted by the farmers. They may involve two or more experimental variables, usually mixed together in the same treatment. Farmers often use folk experiments to test ideas they have learned from agronomists, who frequently know about them, and sometimes take them seriously.

We mentioned above that two CIAL members in Chuquisaca, Bolivia, tried laundry bleach. Farmers tend not to separate their fields into treatments while experimenting. Ríder Rodas simply tried bleach on his whole field. Ariel Plata probably would have done the same. Instead, he sprayed bleach until he ran out of it. Then he planted a row of maize to mark the spot and kept planting potatoes without bleach. His treatments were *ad hoc*, but he was keen to show us that there was only bacterial wilt in the furrows without bleach (Figures 8 and 9). In the case of bleach, and in Rafael Vargas' wheat-in-the-hole experiment, the farmers tested an idea that they learned from agronomists, combined of course with their own knowledge of running a farm. However, sometimes farmers also try new experimental methods that they learn from agronomists.

Figure 8 Ariel Plata easily found plants with bacterial wilt symptoms in the part of his field where he did not use bleach. Observe the pus oozing from the vascular ring of the tuber

Figure 9 But where he did use bleach, all the potatoes were healthy

For example, Cornelio Chilcón in Salabamba, Cajamarca experimented with earthworm humus, which he learned to make in an FFS. He planted two sacks of seed with 15 sacks of humus, and three sacks of seed with 20 sacks of manure, which is what he usually uses. In other words, as a result of his training in a CIAL, Chilcón used an experimental variable (humus) and a control group (manure). There may be parts of the scientific method that local people find useful for their own research. In turn, scientists can learn from farmers' qualitative description of the results. In this case, Mr Chilcón said that the soil treated with earthworm humus did not have less wilt, but fewer *white grubs*. A scientist may not have thought to even notice the grubs, but the farmer added a further detail: grubs do little damage to the potatoes, but they attract skunks, which ruin the potatoes while digging for grubs.

Farmers often combine two variables in a single treatment (Saad, 2002). For example, Oscar Molocho in Cruz Roja, Cajamarca is a CIAL member who also hosts a formal trial run by the agronomists. CIP agronomists gave Mr Molocho a bag of certified seed potato, which he planted in a forest remnant on the edge of a potato field, but he carefully left all the mature trees standing, and only cut out the brush and saplings. He valued the trees, and told us the names and uses of each of the six species, including one with inner bark so sticky it was once used to repair the bladders of soccer balls (Figure 10). This was a typical folk experiment, with no control group. The layout was simple, but it involved at least three goals

- verify the agronomist's notion that 'virgin' soil is disease free
- learn if potatoes can be grown under a light shade of forest trees
- rear the seed.

This third goal is worth mentioning, because scientific trials usually are for harvesting numbers. Researchers are usually happy to give the crop to the farmer, after measuring the results. But for the farmer, harvesting the crop is always the main goal. Numbers are easily sacrificed if they get in the way of the crop.

Figure 10 Peruvian farmer Oscar Molocho in his trial where he intercropped potatoes with forest trees. Agronomists could pay just a bit more attention to experiments like this

5 Discussion

We have seen that formal, non participatory trials can be housed in a CIAL; the local people can learn the results of even a complicated trial and scientists get the quantitative data they need as well. Somewhat simpler, participatory trials with blocks and replicates are still complex enough to be confusing to farmers and anthropologists, but the farmers still learn from them. Folk experiments are often creative trials of topics from more formal trials including CIALs, and agronomists should pay them just a bit more attention (e.g., researchers should test 'wheat in the hole' formally). Folk experiments occasionally make use of bits of the scientific method (e.g., testing different treatments in separate subplots), but in general, farmers find the *topics* of scientific research much more useful than the *methods*.

Franzel and Coe (2002) observed that experiments designed and conducted entirely by farmers, conflict with the CIAL idea. That may be true, but as we have seen here, CIALs and FFS stimulate farmers to do folk experiments. The agronomists on our team felt that trials of seven or more treatments in seven replicates were too complicated for a CIAL. And they were probably right, since we have seen here that farmers were confusing the treatments of even simpler trials. Still, we did plant several formal trials with CIAL members (although not formally as a part of the CIAL), because the agronomists and the CIAL members knew and trusted each other. By the end of the formal trials, the CIAL members understood the results.

The designers of the original CIAL method actually recommend doing even more complicated trials of up to ten treatments in three or four replicates (Ashby et al., 2000, p.32). However, it is easier said than done. Based on experience in Mexico, Mauricio Bellon (2001) encourages researchers to consider having replicates between farms, not necessarily on the same farm (Bellon, 2001, p.71). It is a thoughtful idea, and may be appropriate in some cases, but when each farm is a replicate, farmers change the treatments enough so that each one is unique; there are many treatments, but no replicates (Bentley, 2003). One solution might be to have a large number of farmers, each doing one replicate, measure fewer variables and analyse them statistically as though they were questionnaire data. Sieg Snapp recommends the mother and baby trial of a formal trial with treatments and replicates (the mother) and several trials of one replicate on each farm (Snapp, 2002; Snapp and Heong, 2003).

We look at the CIAL more as a method of organising people than as a trial protocol. It is flexible enough to combine with various experimental methods, if we do not become too orthodox about it (Biggs, 1995). The main point is that the Project used CIALs to create many appropriate technologies for controlling bacterial wilt. They tested more options than we had space to describe in this paper (see Table 2).

Table 2 Some of the project's participatory research

Place	*Sample of research and innovations (chosen to represent some of the better ideas)*
Chuquisaca, Bolivia	
Tapial	The CIAL did trials for two years on additives that may kill Ralstonia bacteria in the soil, including bleach, detergent, lime, horse urine. One member, Ariel Plata, tried bleach on his own. The CIAL planted a trial of intercropped maize and potatoes. PROINPA did a formal trial of potato clones with one CIAL member, to test for resistance to bacterial wilt
El Rosal	The CIAL designed and conducted trials in crop rotation and fallow. They also tried boiling water, wood fire and chicken manure to sterilise the holes left after roguing potatoes. The CIAL tested ten potato varieties for disease resistance, and is now raising the best six
El Astillero	CIAL member Rafael Vargas invented 'wheat in the hole'. The CIAL tested boiling water, live fire and chicken manure to clean bacterial from the craters of rogued potatoes
T'iyu Mayu	The CIAL is studying bleach, laundry detergent, chicken and cow manures for their ability to kill soil bacteria
Lampasillos	The CIAL is studying bleach etc. and one member, Ríder Rodas, has tried bleach (and also chicken manure) on his own, with good results
Pucará	After receiving training in bacterial wilt, farmer Eleuterio Plata invented kerosene fires (mixed with ash, using a bottomless pot as a chimney) to sterilise roguing holes. He concluded that the fires rage like a flaming oil well, but are too much work. He also experimented with lime, which he found, controlled bacterial wilt and other soil-borne diseases
Río Grande	The CIAL compared chicken manure and various plant extracts as soil additives for managing wilt. CIAL members have tried multiplying clean seed. One member, Ramiro Guzmán, did a trial on his own with chemical and organic fertilisers
T'ola Q'asa	The Project has a formal trial with a FFS to compare six treatments of chemical and organic fertilisers. One FFS graduate, Valentín García (who grows certified seed), experimented with bleach in roguing holes. He also did an experiment, with three treatments, to compare chemical foliar fertiliser with fertiliser made with water and chicken manure

Table 2 Some of the project's participatory research (continued)

Place	*Sample of research and innovations (chosen to represent some of the better ideas)*
Cajamarca, Peru	
Baños del Inca	Smallholder farmers, organised as a group, continue to rear and sell certified seed, clean of bacterial wilt, even after they no longer receive visits from Project staff
Chucmar	Smallholders, growing certified seed. Rearing plantlets in greenhouses etc.
El Verde	The CIAL has done an experiment with cow and chicken manure applied at planting, and one with ash and guano in roguing holes. One CIAL member, Santos Ochoa has tried ash to kill soil bacteria
Salabamba	The CIAL and individual members, are doing experiments with worm humus and ash at planting time
Rodiopampa	Testing effect of cow manure; earthworm humus and ashes at planting; effect of roguing diseases plants and putting ashes in the hole
Cruz Roja	One CIAL member, Oscar Molocho, is experimenting with planting certified seed planted in the shade of forest trees. The CIAL has participatory trials on roguing, organic fertilisers, application of chalk at planting and soil preparation. The Ministry of Agriculture has a participatory trial with the CIAL & Project on lime & other soil additives at planting
Cachacara	An FFS is comparing organic and chemical fertilisers
Huánuco, Peru	
San José	The CIAL tried crop rotation trials, unsuccessfully. Using formal lab techniques, the Project learned that the problem was that their irrigation water was contaminated with bacterial wilt pathogen
Shishiuniyoj	Similar experience with crop rotation and contaminated irrigation water
Pullanpampa	Also had a bad experience with crop rotation due to bacteria in the water. The Project has a formal trial of advanced clones to screen for disease resistance. CIAL did participatory trial with clean seed
Nueva Independencia	Formal trial of Andean crops in rotations. Participatory trials of clean seed. One CIAL member, Manuel Buendía, did a trial on his own of wheat in crop rotation and another, Reinaldo Cuchilla, planted cabbage in the holes of rogued potatoes
Umari	The CIAL did a participatory trial of lime, bleach and cow dung applied with seed at planting. They also did a trial with additives in the roguing holes of diseased potatoes, including an idea of their own: agua de chocho (water used to remove the bitter taste from grains of edible lupines)
Molinos	After the CIAL did a participatory trial of clean seed, several members began spending their own money on formal potato seed
Rayancancha	The group of smallholder seed producers is doing a participatory trial with the project on planting densities to regulate seed size. They are testing several varieties and renovate their nucleus stock by planting costly prebasic seed from the formal system

6 Conclusion

Most CIALs still test new crop varieties (Tripp, 2001). But they can be used for the more difficult task of creating technologies for introduced, difficult to observe diseases. Participatory research is back at CIP (see Thiele et al., 2001), and PROINPA uses it in

Bolivia. One reason is that the researchers want to find techniques that farmers will actually use. We adopted the CIAL method because it seemed reasonable, but like the farmers who adapt instead of adopting, we changed the CIAL as we went along. The CIAL is a useful tool box, compatible with technology generation and different research styles.

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