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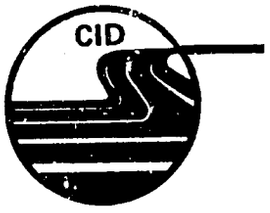

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04/82

END OF TOUR REPORT

Name	: Robert W. Hoopes
Date of Appointment	: September 25, 1978
End of Tour	: June 30, 1982
Job Title	: Plant Breeder

Period covered : September 25, 1978 - June 30, 1982

1. Position Description

"An agronomist will be assigned to the Toralapa station in Cochabamba to assist in the development of an overall potato research program. His primary responsibility will be to supervise the potato breeding program at the station and to train Bolivian counterparts assigned to him. He will also assist the station director in developing a potato seed program. In addition, he will give advice to the National Directors of the corn, wheat, and rice programs relative to plant breeding problems. He will also collaborate with members of the Agronomy Faculty at San Simón University in teaching and research problems, and advising student theses."

Discussion: Although the above description appears in the original CID contract, by the time I arrived on the scene in September of 1978, it was understood that the position was for a potato breeder only. Furthermore, the 'supervisory' role of all CID team members had been eliminated. Plans had been made for a technical assistance program funded by the Swiss Government with the responsibility of improving the seed program.

2. The Situation upon Arrival

When I arrived to begin work as potato breeder to advise and work with the IBTA program, potato breeding work in Bolivia had just begun. Considerable work had been done to identify varieties in the Bolivian germplasm collection which were resistant to the false rootknot nematode (Nacobbus aberrans) and some of these resistant varieties had been crossed with commercial varieties. The Toralapa station had a large germplasm collection in the form of native varieties. Many of these had been evaluated for certain characteristics. Some variety testing had been done on two sets of clones sent by the International Potato Center (CIP)--one set of

clones was being tested for late blight resistance and another group of clones for frost resistance. Two greenhouses were just being completed on thestation to make it possible to grow seedlings on a fairly large scale (around 10,000 per year), which is essential to a breeding program.

3. Establishing Goals for the Program

There are many potential improvements which could be made in potato varieties which would be desirable, since all potato varieties have many weaknesses. But it is not feasible to make all possible changes at once. We selected certain characteristics which, if incorporated into new varieties, would constitute important improvements for certain areas of the country.

A) Resistance to the false rootknot nematode: Work in this area was begun before my arrival. This nematode is thought to reduce yields considerably and is very widespread in Bolivia. Recent work by Victor Otazú and some becarios confirms that infestations by this pest may lower yields by 40%. Chemical controls exist, but they are expensive, toxic to humans, and only temporarily effective. The fact that Israel Avilés and Carlos Alarcón had identified native varieties with a high degree of resistance gave the program a good source of material with which to begin.

B) Resistance to late blight: This disease, which caused the Irish Famine of the 1840's, is caused by the fungus Phytophthora infestans, and is favored by high humidity and moderate temperatures. Although much of the highland area of Bolivia is too dry and cold for this disease to be a significant problem, there are many important production zones which are favorable to late blight, which can be devastating when it occurs. Sorata, Morochata, Independencia, Colomi, and Escalante are

several important potato producing zones affected by late blight. Chemical controls exist. They must be applied properly to be effective. The rising cost of imported pesticides makes it more and more desirable to combat the disease with resistant varieties rather than chemicals.

C) Resistance to Potato Virus Y: A major factor in the low potato yields produced in Bolivia is the fact that good seed potatoes are not usually available to the grower. The big reason for the low quality of the seed is the presence of virus diseases which are perpetuated in the seed tubers every year. If we could obtain varieties resistant to any of the major viruses, it would make it much easier to produce good seed and yields would increase. In Bolivia, we believe Potato Virus Y (PVY) is the most important of the viruses which attack potatoes. It is very widespread and causes severe yield losses. There is a single gene which confers inmunity to PVY which makes it relatively easy to incorporate resistance into new varieties. Dr. R. L. Plaisted of Cornell University kindly provided us with many progenies from crosses in which one parent was resistant.

D) Resistance to frost: Frost is one of the most severe and least controllable hazards of potato production in the highlands of Bolivia. There are several native varieties which are very frost-resistant but they have two disadvantages: they are quite low yielding and they are bitter. Most of them are good only for making chuño. In the process of freeze-drying, the glycoalkaloids, which produce the bitter flavor and are toxic, are expressed with the juices, making the potatoes edible. A non-bitter, frost-resistant variety would be extremely valuable for the highlands. Unfortunately frost resistance is a very difficult trait to breed for. Instead of starting from scratch, we chose to take advantage of the large

breeding program of CIP. Drs. Nelson Estrada and Juan Landeo brought over 200 clones to Bolivia to be tested here for frost resistance and other traits.

E) Yield and quality: These are the ultimate objectives of the program. The resistance traits mentioned above are means to these ends. Any new variety must have reasonable high yields and good quality to be acceptable, regardless of whether it has resistance to anything. Therefore, it is necessary to evaluate the clones being tested in all categories for yield and quality. In addition, there are some breeding lines under consideration which are not chosen for resistance to anything, but simply for high yield and acceptable quality.

4. Progress Made in Approaching These Goals

A) Resistance to the false rootknot nematode: Israel Avilés and I managed this work for the first few months of my time in Bolivia. In January of 1979, Carlos Alarcón returned from post-graduate training at La Molina, Perú, and took charge of breeding for nematode resistance. Since that time, I have not been involved in this aspect of the breeding program. Considerable progress is being made by Ing. Alarcón in the selection of clones resistant to Nacobbus and with good agronomic characteristics.

B) Resistance to late blight: This program has gone very well in the four growing seasons that I have been here. The screening site at Escalante was 'blessed' with severe late blight every year, which provided an excellent opportunity for selection. There are some very promising clones for blight-affected areas coming along in the breeding program. Several CIP clones, some clones which were selected from Cornell tuber families, and hybrids between these clones and native varieties are being

tested. One CIP clone, #575031, has consistently produced high yields with no protection from fungicides and also has good eating quality. Several of the Cornell clones have produced good yields, large attractive tubers, and have very high eating quality. If the Toralapa program will manage this material well, paying special attention to seed multiplication, some of these clones should be acceptable as new varieties within a few years. It should be possible to select even better varieties from among the progenies of the blight-resistant clones in the future.

C) Resistance to Potato Virus Y: Dr. Plaisted of Cornell shared with us a great deal of his breeding material to be tested for virus resistance, blight resistance, and adaptation to Bolivian conditions. We received some 4,000 tubers in the form of 'tuber families' and some 15,000 botanical seeds. In addition, 11 families of botanical seed were received from Dr. Hermsen at the Plant Breeding Institute at Wageningen, the Netherlands. All of this material was segregating for PVY resistance. A CID becario, Victor Alvarez, was given a thesis project which involved screening this material to produce a large number of clones with PVY resistance. These clones could then be screened in the field for desirable agronomic characteristics.

There have been a number of setbacks in the virus-resistance work. The techniques of handling the virus, inoculations, and evaluation for resistance are fairly difficult. We were delayed by the need to import equipment to do mass inoculations. A specialist from CIP who was asked to come to help get the program started had to cancel his trip. The Swiss program in potato seed program was withdrawn from Bolivia at a crucial point. Finally, Arturo Moreira, the Toralapa virologist, resigned from

IBTA. Victor was left without the technical assistance he should have received for this project.

In spite of many difficulties, Victor Alvarez has identified some 700 clones which are apparently PVY resistant. To make the screening process more efficient, I imported seed of a special indicator plant which produces local lesions in the presence of PVY. This has helped considerably in the evaluations. To make more positive evaluations, however, the technique of serology is much more sensitive than indicator plants. The station now has almost all the equipment needed for this process, but a few items are still lacking. CID is trying to equip the station more completely for this work before leaving Bolivia so that this important work in the breeding program can continue.

D) Resistance to frost: The first two seasons in which we planted a frost trial at 3500 m. at Koari there was no frost until so late in the growing season that it had no effect on production. We were, however, able to observe that several of the CIP varieties entered in the trials had considerable merit apart from any frost resistance they might have. Some of them produced, in every trial, significantly more than the local varieties Imilla blanca and Sani imilla in both good and bad years. This season we had a severe frost in late January and were able to observe the behavior of the same varieties under stress from frost.

Of all the CIP varieties, only one was highly frost resistant. This clone, unfortunately, does not have good agronomic traits. Several clones which had desirable agronomic traits were slightly more frost resistant than local varieties. More important, they tended to recover rapidly from frost damage and go on to produce higher yields than local varieties,

including the bitter frost-resistant lines. At this point, several CIP varieties look very promising from the standpoint of yield, some resistance to frost, and good eating quality. They are in the stage of seed multiplication as well as continuing evaluation. The farmers in the Koari area have been interested in these varieties and have planted tubers left over from our harvest in their fields. Some of these varieties may become successful even if the Toralapa program does nothing more with them.

We have also cooperated with the Belén station in evaluating more or less the same set of clones sent by CIP. The Belén technicians have done a good job of managing this material, but need to be more strict in their selections to reduce the number of clones they are keeping.

In summary, some of the CIP clones may be valuable new varieties for Bolivia, for areas with and without frost problems. Although none of them is highly frost resistant and high yielding, a number of them have enough resistance and recovery potential to offer a good alternative to farmers where frost is a problem and a non-bitter potato is needed.

E) Yield and quality: The success of breeding for resistance to various diseases and stresses will also bring about success in breeding for yield and quality. If we can prevent part of the crop from being lost to these hazards, the yields, tuber sizes, and quality, will also be improved. The clones being evaluated for Nacobbus resistance have not been evaluated for quality. Many of the virus-resistant, blight-resistant, and frost-resistant clones have been evaluated for specific gravity and entered in a taste preference panel. A good number of clones which were selected for other traits also have acceptable quality. Many are about

equal to Sani imilla, which is considered to have good quality, and a few equalled the very excellent Bolivian variety Imilla blanca in eating quality.

In addition to the breeding lines being evaluated for resistance to diseases or frost, a number of lines are being considered for selection not because they are highly resistant to anything, but simply for high yields and good quality. In this category are the progenies of crosses between local varieties, crosses between local and introduced varieties, and introduced material itself. In a unreplicated observation trial this year, around 50 clones were selected for their high yields and good tuber appearance. They are now being given specific gravity and taste evaluations. Some of these clones yielded more than double the local variety Sani imilla.

5. The CID Beca Program

The beca program was among the most gratifying aspects of our work in Bolivia. It gave us the opportunity to have a significant influence on many future agricultural technicians and it allowed us to undertake many projects that we could not have begun otherwise.

This is the list of the "becarios" I advised during my contract:

René Torrico - Species identification of populations of rootknot nematodes (Meloidogyne spp.) found in Bolivia, by means of differential host plants and morphology of females.
Ruth López - Determination of chromosome numbers of clones in the Bolivian Germplasm Bank.
Rosario Vargas - Determination of the incidence of several potato viruses in production zones of Cochabamba.
Victor Alvarez - Screening Bolivian germplasm and segregating families for resistance to Potato Virus Y.
Freddy Caballero - Physiological races of potato wart (Synchytrium edobioticum) present in the Cochabamba Department and Screening the Bolivian Germplasm Bank for resistance.

Fernando Rivas - Screening the Bolivian Germplasm Bank for resistance to the potato cyst nematode (Globodera rostochiensis).
Ignacio Huayta - Chemical soil treatments and their yield effects on potatoes in three locations in Cochabamba.

Of the seven becarios I advised, four are now IBTA technicians: two at Toralapa, one at Patacamaya, one at Belén; one works in the Faculty of Agronomy at UBMSS in Cochabamba; one is in Sanidad Vegetal in Santa Cruz; and one has gone into private business not related to agriculture. I believe this shows that the people we have assisted with the beca program will play a role in the future of agricultural work in Bolivia.

The slow pace of degree completion by the students has been disappointing. Only one of the seven students has completed her degree. One more student has authorization for scheduling the thesis defense, and two more are working on their final drafts. Three of the seven have not made much progress since the end of their scholarships.

I see three factors which help to bring about a low rate of degree completion:

a) The professors who must approve the thesis are usually not involved in the thesis research, since the university has very little research. The thesis would be more of a cooperative effort if professors did have research projects and the students could do their thesis in some area of those projects. It is a fact of life, however, that research tends to flee the Latin American universities because they are so susceptible to disruption because of political problems. During our time in Bolivia the universities were closed for almost one full year. This is something that must be considered in planning programs designed to strengthen the research capacity of the universities.

b) The students often cannot write well.

c) Once the student gets a job, there is very little financial incentive to finish the thesis, since the salary and status are about the same (low) whether or not he has the Ing. Agron. degree. Had we been able to offer becas for post-graduate training, however, there would have been an incentive for students to finish their Ing. Agron. degree to take advantage of this opportunity.

6. Specific Suggestions for the Bolivian Potato Breeding Program

A) Continue to put emphasis on it: A breading program is a very long-term effort which must have continuous support over 10-15 years to be productive. The advances of the initial years of the program are very promising. Most of the improvements which can be obtained through breeding will be free of cost to the farmer, will not require the use of increasingly expensive chemicals, special training, or special equipment. The farmer can continue to receive the benefit of the research work each year simply by planting new varieties.

B) The seed multiplication program must be improved: Both for the production of new varieties and the improvement of production of existing varieties, it is vital that the national seed production program be expanded and improved. Many new varieties fail simply because there is no adequate program of multiplying good seed of the variety. The improvement of the seed program should be the objective of a future program of international cooperation. There are three areas of seed production, all of which need improvement:

a) The Toralapa laboratory and greenhouse facilities for efficient indexing of basic seed stocks.

b) The field multiplication of seed at Toralapa. More roguing must be done to reduce the virus infection which is now very serious. Nematodes must be reduced to as low a level as possible so that the basic seed program for Bolivia is not distributing nematodes with its seed. This can be done through a combination of chemical controls, good rotations, and the control of the alternate hosts of the nematodes through the use of herbicides.

c) A group of farmers who have the desire and ability to specialize in seed production should be identified and the production of the Toralapa station should be sold only to recognized seed producers.

C) The establishment of national variety trials: Advanced clones from the breeding program at Toralapa should be sent to at least two other

stations each year--Belén and Chinoli. A standardized set of observations should be made at each site. At the end of each year, the technicians from the stations should meet to compare results and make decisions on which clones to select. These national trials should be the responsibility of the National Potato Program Coordinator.

D) Test everything for quality: All clones which have survived the third year of selection for agronomic or resistance traits should receive some evaluation for quality. Specific gravity and the results of taste preference panels are good indications. It would be a mistake to demand that all new varieties have the extremely high quality of some of the native varieties like Imilla blanca, but it is also a mistake to allow varieties which are of really inferior quality to remain in the program.

E) Consider wart and cyst nematode resistance as program goals: The past few years' observations have shown that wart disease is very important in Bolivia. There are no practical control measures other than resistant varieties. The work of CID becario Freddy Caballero, in which 42 potentially resistant native varieties were identified, should be followed by work so that resistance to this serious potato disease can be incorporated into new Bolivian varieties.

The cyst nematode is widespread in Bolivia and may become a more serious pest if the false rootknot nematode is brought under control. The preliminary work of CID becario Fernando Rivas in identifying resistance should be followed by further studies to determine what races of the nematode are present in Bolivia and to find sources of resistance to them.

F) Better communications: Some improvement in the work of the breeding program could be obtained through better communications among technicians,

among stations, and between IBTA and other organizations, such as CIP. If an organization such as CIP furnishes breeding material to the Bolivian program, CIP should be informed of the results obtained with the material as promptly as possible. Farmers' organizations should also be aware of the work of the breeding program, especially when advanced material is becoming available. Farmers who cooperate in conducting trials in their fields should be well informed of the purpose of the trial, the results, and the interpretation of the results.

7. Recommendations for Future Projects of This Type

A) Focus on well-defined objectives: This CID project was extremely broad in its scope, with a stated goal of "increasing production and marketing of basic food crops". Although the project had a 'team' member representing each of many disciplines, there were no clearly defined objectives or problems on which each technician was expected to bring his expertise to bear. Every technician simply went in any direction that seemed appropriate to him and worked on problems that seemed to need work.

The project not only had unrealistically broad objectives, but was spread very thin geographically, with technicians in two stations in Cochabamba, one station in Santa Cruz, and almost the whole administrative operation in La Paz.

I believe this project would have been more effective and future projects would be more effective if a coordinated effort were made to solve certain specific problems, with the whole team located in the same place. Logistical, transportation, and administrative problems would be simplified tremendously. There would be much more professional

stimulation, criticism, and teamwork if everyone were together and working on common or related problems. The 'critical mass' needed to make a significant impact could be accumulated by sharpening the focus of projects of this type.

B) Keep the beca program going: The beca program was a very positive aspect of the CID effort. It provided opportunities for many future agricultural technicians and increased our capabilities greatly.

C) Have the ability to send promising people for post-graduate training:

It was unfortunate that CID did not have a quota of post-graduate scholarships to send promising students, counterparts, or other associates for graduate training. This would have been very good for the institutions with which we worked and would also have given us a means of encouraging completion of the Ing. Agron. degree, better cooperation with our work, and demonstration of a higher level of professionalism among students and counterparts. It would be very desirable if post-graduate training could take place in Spanish-speaking countries as well as the United States, since many prospective students lack proficiency in the English language.

D) Everything necessary for the success of a project should be incorporated into the same contract: It was almost incredible that this contract was written with no provision for equipment or supplies. A separate USAID project was expected to complement ours by constructing buildings on the stations and equipping laboratories. The laboratory equipment arrived very late in the project and very little of it ever went to the Toralapa station. The building program at the Toralapa station was an embarrassing failure. Only by not staffing all of the allotted positions of the contract

was there any money to operate. It would have been much better to have all the necessary elements of the project together under a single contract.

E) Insist that the Bolivian Government support agriculture: With the amount of money that USAID was putting into rural development in the years before the breakdown of relations, it should have been accompanied by some pressure for the government to devote a reasonable share of its budget to rural development. It does not make sense to spend millions of dollars to provide advice to an organization that does not have the resources to carry out that advice.

F) Don't forget the farmers: It is very easy for groups of USAID officials, foreign technicians, and high Ministry officials to plan and execute rural development programs without remembering to involve any of the people who are supposed to benefit from those programs. None of the above administrators, technicians, and officials is likely to have very intimate knowledge of rural life in the country.

I believe that future projects should be developed in such a way as to involve farmers in some way from the beginning to the end. The projects are much more likely to be oriented in the appropriate direction, to proposed appropriate solutions, and to have those solutions accepted, if this is done.

G) The U.S. university should be deeply involved in the project. The lead university in a project like this one should be a school with (1) considerable interest and experience in international work, and (2) considerable expertise and interest in the areas covered by the project. This will encourage technical backstopping for the team members in the field, who are rather isolated from other members of their profession, the literature in their field, technical supplies, etc.

Although the consortium approach is designed to hire staff members from the member universities, in practice many of the project staff are people hired only for the duration of the project. If the U.S. university is to play a role other than as a sub-contractor on these projects, an effort should be made to support the work of these individuals in the field with resources of the U.S. university (information, literature, technical advice, small items of equipment, etc.), to recognize the work of these individuals, and to allow them opportunities to participate as staff members for the period in which they are employed on the university's overseas project.

Specific suggestions for closer university-employee relations:

- Invite the temporary staff member to the university campus when he is in the U.S. on home leave or other occasions. Time could be spent using the library facilities, bookstore, laboratories at the university. Have the project member give a seminar to his department on the work being done on the overseas project. Allow the individual to confer with staff members with common interests. Allow the overseas staff member an opportunity to meet with university staff in the planning of future overseas contracts.

- Provide an opportunity for the overseas staff member to contribute articles on his experience on the university project to the publications of the agricultural experiment station (Utah Science, for example).

- Be willing to pay publication charges for any technical articles the staff member is able to publish based on his work with the university overseas project.

Following these suggestions would benefit the overseas staff member as well as the lead university. The individual would receive more support to enable him to work more effectively on the university's overseas project and the university would take better advantage of the individual's experience.

8. Summary

The last years of this project coincided with very difficult times in Bolivia. Political and economic problems completely beyond the control of CID diminished our ability to contribute as much as possible to Bolivia's agriculture. In spite of this, a lot was accomplished in my area of potato breeding as well as other areas of CID involvement.

The years spent living and working in Bolivia were interesting, challenging and rewarding. It should be mentioned that CID made every effort to smooth the way for team members and their families on such matters as moving, housing, visas, and many other personal matters. This undoubtedly contributed to making this a good experience for the team members and their work, and was appreciated.