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ADMINISTRATIVE REPORT No. 05/80  
INFORME ADMINISTRATIVO No.

END OF TOUR REPORT

Name: Don C. Kidman

Date of Appointment: December 17, 1977

End of Tour: November 22, 1980

Job Title: Research Agronomist\*

\*Research Agronomist, Consortium for International  
Development, Santa Cruz, Bolivia.

November, 1980

LA PAZ, BOLIVIA

### Job Description

"The contract will provide an agronomist, with soils and irrigation specialization, assigned to the Santa Cruz area. His principal task will be to research critical problems related to the production of corn and oil seeds under irrigated and rainfall conditions and develop information and programs to extend this through and research demonstrations. He will also be required to advise MACA/CIAT counterparts and technicians in farming systems related to small farm agriculture and cooperate with the University Gabriel René Moreno in training students in related fields."

### Commencement

I arrived in Santa Cruz, October 25, 1977, as a short term consultant to participate in a seminar and make an assessment of my capability in fulfilling the above job description under the limitations of the available resources. It was apparent that the crops research programs were largely oriented toward variety studies with little or no emphasis being placed on soil moisture conservation, soil fertility studies, full year cropping opportunities, or supplemental irrigation investigations. Almost all of the resources were being placed in the programs of the International Crop Programs Sponsors leaving little for research other than variety trials. Anticipating that I could assist

CIAT to broaden their scope of research in Santa Cruz I accepted the invitation to join the CID Bolivia staff.

My tour of duty began December 16, 1977. I became acquainted with Ing. Carlos Vaca Diez, executive Director of CIAT Santa Cruz (Centro de Investigación Agrícola Tropical) and Ing. Gustavo Pereyra, Director of the Saavedra Experiment Station (now CIAT sub-director). A professional, cooperative, and friendly relationship was established with these two outstanding administrators and maintained throughout this tour of duty.

During this first period of time, I familiarized myself with the corn and oilseed crops and programs that had been planted in October, and prepared plans for some initial studies of crop growth factors under supplemental irrigation.

#### Oilseeds Program

My counterpart in the oilseeds program was Hebert Zurita. He conducts excellent investigations with good management. Harvest of the oil seed crops began about mid March, 1978 and I assisted Ing. Zurita with the analysis, evaluation and reporting of experimental results. The variety experiments were of three types: (1) variety introduction trials, which included new varieties being introduced, primarily from INTSOY, (2) variety comparison trials, from which

varieties could be selected for regional trials, (3) regional variety trials from which selections are made for commercial introduction. The program included insect control studies, and plant density studies.

I directed my attention in the oilseeds program to the areas described above. I also helped start a series of soil fertility studies for these crops. During the past two years soybean varieties UFB-1 and Bossier and peanut varieties Natal Common and Tarnash have been recommended by CIAT for seed increase for commercial production.

#### Corn Program

My counterpart in the corn program was Ing. Florina Rodriguez (now studying at New Mexico State University). The corn program was largely, if not entirely, the program recommended by CIMMYT. It was variety oriented, although it included some weed studies, insect investigations, and some farmer technology demonstrations on a regional basis. Besides being responsible for the corn program, Ing. Rodriguez was responsible for the sorghum program. The work load appeared to be too large for one technician, but with considerable help from CID vehicles, parts, and equipment the work was completed. I assisted with analysis, evaluation, and writing of reports of the research conducted.

The regional effort was affected by lack of CIAT/MACA support. Some experiments were lost, others yielded little or no information.

It was obvious after this year that CID technicians could have their greatest impact in strengthening quality instead of quantity, especially at the regional level.

Dr. D.W. James prepared a working paper (CID No. 011/79) "An Evaluation of the Quantity of Information Yield from Experiment Stations Saavedra, San Benito, and Toralapa 1976-77 and 1977-78." In his evaluation of the sorghum-corn program at Saavedra he states "only 6 percent of all experiments dealt with production practices, none of these being soil management". Also, "as a group, the regional trials and technology transfer trials were the poorest with only 3 percent of this group yielding any information worthy of note". By contrast, this last year (1979-80) regional studies in soybeans and corn consisted of soil fertility and variety comparison trials. There were seventeen experiments in six different regions. Two experiments were lost due to extreme drought in the Mairana region. Discounting this unavailable loss, the following is noted:

47 percent dealt with soil fertility and 53 percent with variety comparison studies. The average C.V.'s for the fifteen experiments was 14 percent with only two being greater than 20 percent (coefficient of variation is one of the criterion of his evaluation, stating that if the CV was higher than 20 percent the information yield was judged to be poor).

The overall corn program has improved by adding. Fertilizer studies some of which are under irrigation. Corn and rice compatibility studies have been made.

The varieties Tuxpeño, Sintético 10 líneas and Suwan have been released by CIAT for commercial projection during the last 3 years.

#### Irrigation Program

Ing. Erwin Ortiz was assigned as my counterpart to begin an irrigation research program for CIAT. Though irrigation was new to him he had the technical background and interest to begin to develop a research program.

Adequate facilities to carry on irrigation studies at the Saavedra Experiment station were not available. We, therefore, began to look for a private farm with the needed equipment that was willing to cooperate with us in some preliminary irrigation studies.

Hacienda Santa Clara that had a sprinkler irrigation system and Hacienda La Victoria that had gravity flow system. Both haciendas are located about 30 km northeast of Santa Cruz.

Experiments with water, plant densities and fertilizer nitrogen as variables were established at both locations during the winter season of 1978, with corn and wheat as crops.

The La Victoria experiment was continued during the summer 1978-79 with corn variety occupying the plant density plots. Soil samples were taken before this experiment was established to measure residual N from the N fertilizer treatment applies to the previous winter experiment and the effect from the three water application variables also of the previous winter experiment. No fertilizer was applied to the continued experiment and no irrigation was necessary. The results showed a high correlation between residual  $\text{NO}_3\text{-N}$  and fertilizers previously applied. There was also a high correlation between yield of corn and residual  $\text{NO}_3\text{-N}$ . There was a three-way interaction between corn varieties, previous water treatments, and previous N fertilizer treatments. This work served as an Ing. Agrónomo thesis for Margarita Cabrera. Results were presented at the III Seminario Nacional Agropecuario and are being published by them.

An experiment station circular No. 01/80 entitled "Resultados Preliminares del Estudio de Nitrato Residual" has also been published.

Neither rice nor winter wheat yielded well under irrigation on the heavy soil of La Victoria. With another year experience we may have been able to identify the reasons.

Strawberries did very well at La Victoria, planted in ridges between irrigated furrows. The plants multiplied very well and produced high quality berries.

The Santa Clara soils are sandy loam, and winter wheat did fairly well on these under irrigation. The 1978 moisture and fertility trials yielded about 1.2 ton/ha of variety Jaral. However, we found that the plant densities used were too low for this variety. The 1979 wheat trials consisted of 7 varieties with uniform supplemental irrigation and 2 nitrogen treatments. The best yields were about 3.5 tons/ha. This study served as a thesis project for student Rodolfo Aguilar who reported the results at the III Seminario Nacional Agropecuario, and is being published by them.

The Effect of Continuous Cropping on Soil Fertility in the Colonization Areas of Santa Cruz

During the winter season of 1979, my counterpart, Erwin Ortiz and I, assisted by CID economist Kendall Adams, conducted a study to determine the crop production and soil fertility decline on twenty four farms located in the areas of San Pedro, San Julián, Okinawa, Río Grande and Yapacaní. The study was made at the request of CIAT to provide an insight into the reasons for the farming system called "slash and burn".

Slash and burn is the term applied to a common land clearing and soil management system used in the agricultural frontier regions of Bolivia north and east of Santa Cruz. The process involves cutting

down all but the largest trees in a given area and setting fire to it when dry. The resulting field is planted by hand without further soil preparation. Since the partially burned tree trunks and stumps are not removed, machine cultivation and harvesting is impossible.

The typical procedure is to use the field for about three years after which the field is allowed to return to a state of natural growth called "barbecho". It remains in this condition for several years before again applying the slash and burn procedure. This second cutting is a little easier because the trees have not had time to grow large.

Crop yields are described as being best in the first year of slash and burn and declining each subsequent year. A new field is opened when yields no longer justify the cost of planting, cultivation and harvesting. A frequent explanation for the rapid decline in yields is that soil nutrients are depleted. It is thought that the nutrients are restored by allowing the land to return for a period of time to its natural state and later cutting and burning this growth before resuming cultivation. Another explanation of declining production is that weeds become so numerous that cultivated crops cannot compete after about three years. There was little data available to support one claim or the other, but the fact remains that clearing and re-clearing land is a costly farming operation. A survey was conducted

to see if a reduction in crop yield and soil fertility could be associated with years of crop production for given fields. Slash and burn is justified by the belief that such a reduction does occur.

The cooperators were chosen on the basis of their farms containing "monte" (forest land that was never cultivated), plus fields having continuous cultivation from one to several years.

Soil samples were taken from the fields under continuous cropping and from areas in "monte" at each farm. The samples were a composite of randomized cores of soil to a soil depth of 30 cm. These were analyzed for pH, electrical conductivity, organic matter, available phosphorous and available potassium by CIAT soils laboratory using standard analytical methods. The soil analysis data indicated that there was little or no decline in soil fertility from monte through five or more continuous cropping years.

An interview was conducted with each farmer to determine present crop production and sales returns. Of the twenty four farmers interviewed, fifteen were growing rice and nine were growing corn. The crops were used to determine present production levels in the study. According to the yield and crop sales data obtained from the farmers, yield and gross crop returns decreased very little with continuous cropping of fields.

As a check of the above data, regional fertilizer experiments designed to determine crop response to the application of fertilizers, nitrogen, phosphorous and potassium were established in the areas of San Pedro, Saavedra, Portachuelo, Yapacaní and Piray (Zanja Honda). The crops used in these experiments were rice and corn.

The regional fertilizer studies of rice and corn also showed no yield response to added N, P or K in seven regional locations. The experimental sites had been cropped continuously for periods of four to six years with the exception of one site which had been continuously cropped for fifteen years.

From the study it is concluded, therefore, that soil fertility decline within the area is not a valid reason for the use of the slash and burn system.

A report of this work is published as a Saavedra experiment station special bulletin No. 21.

#### Continued Soil Fertility Research

Soil fertility research is planned to continue as a three year program beginning in September, 1980. It will be conducted on a regional basis and includes San Pedro, Saavedra, Yapacaní and Okinawa.

Soil fertility will be studied in each area under full year cropping with three crops per year.

The objectives are: 1) to determine the correlation between soil analysis for phosphorous (P) and Potassium (K) and crop yield response. 2) to study, by soil analysis, the residual soil P and K through three cropping periods with the fertilizer all being applied to the soil at the time of planting of the first crop. 3) to determine maximum economic crop yields of three crops in a full year cropping sequence including three harvests and employing the crops corn, rice, soybeans, or wheat. 4) to compare the economic advantages between full year cropping sequence in chaqueado and soils under continuous cultivation for more than 10 years.

At my termination the experiments at each region have been established. The experiment at Saavedra will be duplicated with one cropping sequence receiving supplemental irrigation as needed and the other no irrigation.

Crop Yield and Net Benefit Estimates in the San Pedro and Yapacaní Regions Based on Farmer Estimates, Selected Field Samples and Regional Crop Production Trials.

It seemed important to me that we needed some measure of the value of improved farming practices at the farmer level. I discussed this

possibility with Dr. Kendall Adams, CID economist at Cochabamba and with the assistance of counterparts we decided to attempt such a study in connection with our 1979-80 regional soil fertility trials.

Regional crop production experiments are used for testing promising agronomic practices developed on experimental stations. In general the agronomic practices include improved crop varieties, soil preparation, time and density of seeding, insecticides, herbicides, fungicides, and fertilizers. Different regions have different soils, rainfall amounts and distributions, and different pest populations requiring evaluation of selected practices on a regional on-farm basis in order to adapt improved practices to actual farming conditions.

The purpose of this project was to expand the regional crop production experiments to include farms in close proximity to the regional trials in order to compare crop yields and economic benefits of on-farm crop management practices with so called improved technology.

Six farms were selected in collaboration with the Extension Service in November, 1979, on the basis of their proximity to the regional experimental sites in San Pedro and Yapacaní. An agreement to cooperate was obtained from each farmer after explaining the basic objectives and procedures of the study. A total of 10 fields of either

corn, rice or corn-rice intercropping were represented by these six farms. Several visits were made to each farm between planting and harvesting. The purpose of the repeated calls was to observe practices and obtain costs as they were occurring. Information was also obtained on the farming system in operation at each farm.

At the time of harvest, crop yield samples were taken from the ten fields. It was decided that these samples would be called "full-field samples". This sampling was done after first eliminating all problem areas in the field, such as those with intense weed competition, extremely low plant population densities and/or small flooded areas (pozos) that caused excessive crop damage and represented optimum production potential of the farms. Otherwise, samples were chosen on a basis that seemed most nearly to represent the field being sampled. This was done to provide an estimate of the effect of increased management over farm practices now being used by the farmers. Present farm technology was considered as, adequate soil preparation, planting of good seed of presently recommended crop varieties, the establishment of adequate plant densities, insect control measures now in use, and present harvesting methods. For the farmer this could have as much benefits as, or more benefit than, a new technology applied to his existing methods.

A basis was set up for estimating corn and rice crop returns comparing (1) present farm management practices, (2) improved present farm management practices and (3) the regional soil fertility experiments where all of the most promising farm management practices are employed.

The results of this study showed that improved present farm management practices could improve farm crop return by from 48 percent to 102 percent and that farm management practices employed in regional soil fertility experiments could improve farm crop returns by from 73 percent to 114 percent. There were no yield increases from the use of any fertilizer treatment applied.

This study is reported as Saavedra Experiment Station Bulletin No. 22, Santa Cruz 1978 "crop yield and net benefit estimates in the San Pedro and Yapacaní regions based on farmer estimates, selected field samples and regional crop production trials."

#### Irrigation System - Saavedra

An irrigation system designed to irrigate about 50 hectares of land at CIAT's experiment station in Saavedra was purchased by USAID for CIAT. A well to supply the system with water was also financed by USAID. The well is supposed to have a capacity of 25 liters/sec. Both the sprinkler irrigation system and the well are very good and

will provide Saavedra station with adequate water security for experimental purposes.

With the assistance of my counterpart, the experiment station director and station personnel I have set up a drainage system for the lands which will be irrigated. I have established the irrigation system so that any part of two 15 ha. fields, as well as two adjacent fields can be irrigated as desired. Initial use of the system indicates it is working as anticipated.

The principal purpose of the irrigation system is to furnish supplemental water needs for all crop experiments so that water will not be a limiting factor in field experimentation. The irrigation sprinkler lines are set up for the field experiments and tensiometers have been installed within each field experiment to assist in irrigation scheduling.

#### Comments

My tour of duty in Bolivia has been the most satisfying of my eleven years in Latin America with USU/USAID programs. This has been so because of the team approach and because the CID bolivian program has been directed by and staffed with outstanding administrators and technicians who have been dedicated toward the fulfillment of our contract with MACA to assist them in the development processes in the

generation and dissemination of information. I personally have received a great deal of cooperation, not only from CID staff, but from the Bolivians (administrators and technicians) as well. I am especially grateful for the very pleasant association I have enjoyed with my principal counterpart, Ing. Erwin Ortiz. I am pleased to learn that he has been accepted as a graduate student at Chapingo University, Mexico.

The team approach to the fulfillment of the contract with MACA has been attractive to me, and was one of the reasons for my joining the program. I believe that the team approach to the whole effort has been good and a great deal accomplished from it. However, I believe it can be substantially strengthened by CID team reviews and evaluations of itself, with follow-up collaboration and cooperation as needed. For instance, CID Bolivia has received evaluations and reviews of its program by USAID, CID, and USU as lead University. Perhaps more important is an evaluation by the CID Bolivian staff itself, occasionally, of its individual components of the whole program. As, with a review of a proposed publication, sometimes one is too close or too otherwise preoccupied over details to see all of the advantages and possibilities. This could help point out needed research effort, priorities and ways that more information might be obtained with little or no more effort or resources expended. CID technicians and counter-

parts could, with this kind of help, plan and carry out individual research programs with greater confidence.

Since I have been in Bolivia I have felt that CID could and should have more influence at the MACA direction levels, both at the IBTA-CIAT heads as well as the experiment station direction levels. This might be CID party chief or one designated as CID research Director. For one thing, he could help point out to the Directors research needs that have been recognized through the teams own evaluations of their own and counterpart efforts. He would serve the Directors more as a counterpart and thus help bring more coordination into the research plans of the experiment station technicians that could help bring about greater farm production impact. This would also give CID research technician support at a badly needed level. Dr. James in his evaluation of research reported at the various experiment stations demonstrated the need of this effort. He also made an approach to fulfill this need by writing to and by visiting with the various directors as occasion would permit.

#### Student Thesis Program

I have assisted the following students under CID's thesis assistance program. Their present progress is as indicated:

Jorge Navarro.- Calibración de la sonda neutrónica "503 Hydroprobe depth moisture gauge" para la determinación de la humedad del suelo en el área de Santa Cruz.

The thesis was completed according to his approved project outline. His committee asked for some additional work. He left with a 10 month beca to work on rice in Japan before the additional work was completed.

Margarita Cabrera.- Estudios de nitrógeno residual en los cultivos de maíz con riego.

Her thesis has been completed to acceptable form ready to submit to the committee. Universities are closed so she has not been able to get her degree.

Rodolfo Aguilar.- Efecto de cuatro niveles de fertilización en cinco variedades de maíz, bajo riego en invierno.

The research project was completed, the thesis is written to a rough draft form.

Alejandro Tejerina.- Determinación de épocas de siembra en soya Glycine Max (L) Merrill y espaciamiento entre surcos durante el período invernal, en Yapacaní.

His thesis has been completed to acceptable form ready to submit to the committee. The University is closed so he has not been able to get his degree.

Norberto Orosco.- Vivero Internacional de rendimiento y adaptación de frijol Phaseolus vulgaris L.

His thesis project has been completed and the evaluation and writing is in progress.

Leonor Castro.- Determinación de épocas marginales de siembra de frejol común (Phaseolus vulgaris) en dos localidades.

Her thesis project has been completed and the evaluation and writing is in progress.

Walter Guzmán.- Experimentos de fertilización en cultivo de maíz en Santa Cruz.

His thesis project has been completed and the evaluation and writing is in progress, and is nearly ready for presentation.

Julio Calancha.- Fertilización en cultivo de arroz en Santa Cruz.

His thesis project has been completed and the evaluation and writing is in progress.

Alberto Aguilera.- Evaluación de 23 variedades de arroz con tolerancia al frío.

His thesis project has been completed and the evaluation and writing is in progress.

Miguel Ramiro Aguilera.- Epocas de siembra en el cultivo de frejol.

His thesis project has been completed and the evaluation and writing is in progress.

Silvia Ribera.- Determinación de los efectos producidos por soluciones fertilizantes en suelos tropicales, mediante análisis químicos de elementos mayores, secundarios y menores para diagnosticar síntomas foliares de desórdenes minerales en raphanus sativus.

Her thesis project has been completed and the evaluation and writing is in progress.

It has been impossible for the students to continue with their projects because the Universities are closed and the advisor professors are not working.

Publications

Resultados Preliminares del Estudio de Nitrato Residual.

Circular No. 01/80. Erwin Ortiz, Don Kidman and Margarita Cabrera.

Manejo de nitrógeno del suelo para mejorar la eficiencia en la producción de cultivos. Boletín Técnico CIAT/CID No. 20. Don Kidman, Erwin Ortiz, and Rufo Angulo.

The effect of continuous cropping on soil fertility in the colonization areas of Santa Cruz. Special Bulletin No. 21. Don Kidman, Kendall Adams, Erwin Ortiz and Jorge Navarro.

Crop yield and net benefit estimates in the San Pedro and Yapacaní regions based on farmer estimates, selected field samples and regional crop production trials. Special Bulletin No. 22. Kendall Adams, Don Kidman, David Eding, Erwin Ortiz and Francisco Paz.

The following are being published by the Universidad Gabriel René Moreno:

Efecto de fertilización nitrogenada en variedades del trigo bajo riego en Santa Cruz - student Rodolfo Apuilar and Don Kidman.

Efecto del nitrato residual sobre el rendimiento del maíz - Student Margarita Cabrera and Don Kidman.

Estudio de épocas de siembra y espaciamento entre surcos en soya Pelicano en invierno en la zona de Yapacani - Student Alejandro Tejerina and Don Kidman.