IICA

PROCIANDINO

Informe de Consultoría sobre

"PUDRICIONES RADICULARES E
LEGUMINOSAS DE GRANO"

Dr. George S. Abawi
Cornell University

Octubre 3 - Noviembre 20, 198

PROGRAMA COOPERATIVO DE INVESTIGACION AGRICOLA PARA LA SUBREGION ANDINA

BID/IICA

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(Evento Técnico 2.3.7)

FINAL CONSULTANCY TRIP REPORT SUBMITTED TO IICA OFFICE IN QUITO, ECUADOR

Subprograma: Programa Cooperativo de Investigacion Agricola para la subregion Andina (PROCIANDINO).

Actividad: Pudriciones Radiculares en Leguminosas de Grano.

Codigo del Evento: 2 . 3 . 7

I. INFORMACION GENERAL:

A. Nombre del Consultor.- George S. Abawi, Professor of Plant Pathology and International Agriculture.

B. Institucion y Sede de Trabajo.- Department of Plant Pathology, New York State Agricultural Experiment Station, Cornell University, Geneva, N.Y., 14456, USA.

C. Instituciones Visitadas.- Institutions visited are listed in **appendix "A".**

D. Lugares a Los Que Viajo.- Areas visited are included in the trip itinerary (**appendix "B"**).

E. Nombre y Direccion de las Personas Contactadas.- People contacted are listed in **appendix "C".**

F. Fecha y duracion del Viaje.- 3 de Octobre hasta el 20 de Noviembre de 1987 (50 dias).

G. Fecha de Este Informe.- 5 de Diciembre, 1987.

II. OBJETIVOS ESPECIFICOS DE LA CONSULTORIA:

The main objective was to identify and determine the importance of root disease problems on food legume crops in the Andean subregion of south America (Bolivia, Peru, Ecuador, Colombia, and Venezuela). A secondary objective was to provide an informal training in the diagnosis, symptomatology, appropriate management strategies, and prioritizing research needs on these crops (Beans, Peas, Broadbeans, Lentils, Ckickpeas and others).

III. ACCIONES REALIZADAS, RESULTADOS Y RECOMENDACIONES:

A. Introducion.- Many root diseases have been reported to cause severe losses on food legume crops throughout the world **(appendix "D")**. Several species of the plant pathogenic fungal genera *Fusarium* , *Rhizoctonia* , *Macrophomina* , *Sclerotium* , *Pythium*, *Phytophthora* , and others have been reported to incite diseases on these crops. Also, species of the plant parasitic nematodes genera *Meloidogyne* , *Pratylenchus* , and others are known to infect and cuause damage to leguminous crops, specially in light-textured soils. Root rot diseases can be caused by any of these pathogens singly or in any possible combinaton with other pathogens or nonpathogenic soil organisms (microflora and microfuna) resulting in root disease complexes. In addition, severity of damage by root disease pathogens is influenced directly or indirectly by soil and environmental conditions, and specially during the early growth stages. Root diseases are most severe when soil conditions are poor such as inadequate drainage, poor structure, low level of organic matter, and high soil compaction. Furthermore, root diseases are most prevalent when the crop rotation in use is inadequate and consisting of susceptible crops that allow the build up of soilborne root pathogens.

Root diseases of leguminous crops are known to be wide spread and of significant impact on crop production in Bolivia, Peru, Ecuador, Colombia and Venezuela as has been identified in the PROCIANDINO document **(BID/IICA, 1987. Diagnostico de la Produccion e Investigacion: Leguminosas de Grano).** However, the exact etiology of the root diseases of these crops in each of the production areas was not specified. Information on the etiology of the major root rot diseases in each area are needed for the development and application of appropriate and effective control measures. Thus, the need to diagnose current disease problems and the reason for the involvement of the writer to cooperate with PROCIANDINO and scientists in each of the Andean subregion countries. Some of the acronyms used in this report are explaind in **appendix "E".**

The following are brief summaries of the observations and root rot diseases diagnosed in each of the five countries visited. Where possible, some conclussions, recommendations, and research needs are also listed. However, the information provided should not be

considered as complete or final. The time of this evaluation was not the most appropriate for each production area or for all leguminous crops grown in these areas. Thus, observations and visitations to commercial production areas were limited or not made as there were no plantings or the fields were just being prepared for seeding such as in the area of Santa Cruz, Bolivia; Cajamarca-Cajabamba, Peru; Pasto-Medellin, Colombia; and Merida-Barinas-Trujillos, Venezuela. Also, root disease problems may well be different among the several plantings made annually depending on the prevailing conditions. It appears that a visit in January-February or even latter would be more suitable to the majority of the production areas in the Andean subregion.

The writer is indebted to Dr. Guillermo Hernandez-Bravo, Coord. Internacional, Leguminosas de Grano, PROCIANDINO for planning and making all needed arrangements for this consultancy and for his continued concerns and help throughout the trip. The assistance and contributions of the national coordinators and the many scientists visited in each country are most appreciated and acknowledged here. This report would not have been possible and the visits to have been of any value without the cooperation, hard work, and genuine interests of the in-country scientists involved to whom I am deeply thankfull.

B. DESCRIPCION DETALLADA DE LA LABOR REALIZADA:

1. <u>BOLIVIA</u>: The major food legume crops grown in Bolivia are fababean (haba-*Vicia faba*), peas (arveja- *Pisum sativum*), beans (frijol- *Phaseolus vulgaris*), and chickpeas (garbanzo- *Cicer arietinum*). The areas planted to fababeans, peas, beans, and chickpeas in 1987 were 38571,15314, 9625, and 356 ha; respectively. Other leguminous crops that are consumed in the country, but with only limited or no local production, are lentils (lenteja- *Lens culinaris*) and lupines (tarwi-*Lupinus mutabilis*). It was interesting to learn that very little beans are consumed in Bolivia (approx. 600 gm/family/ year) with most of the beans produced are for the export market and principally for Brasil. Most varieties of these crops being grown by the farmers are native selections. However, improved varieties are being selected and introduced by IBTA and university scientists. Average yields being obtained in research plots are much higher than those obtained in commercial fields. For example, yield of fababeans range from 2000 to 2300 kg/ha (depending on the elevation of test sites) in research

plots, but average only 800 to 1000 kg/ha in grower fields. The latter suggest the need to introduce the improved varieties and also production packages that are appropriate and effective management practices.

Research activities with leguminous crops being conducted at the Pairumani Experiment Station (Centro de Investigaciones Fitogeneticas de Pairumani) include the maintenance, evaluation, and the selection of germplasm of beans, fababeans and lupines adapted to local production conditions. Work is also in progress to develop improved varieties, increase of improved seeds, and evaluation of selected production practices. An irrigated seed production field of beans and two research plots of fababeans were available for observation. Root rot diseases were not detected under the prevailing dry conditions. Actually, the bean field looked rather good and clean except for low incidence of rust (roya-*Uromyces phaseoli*) and insects injury(stem borers-Barrenadores). There was a severe stem borer injury in the fababean plots and considerable incidence of rust (*Uromyces viciae-fabae*), chocolate spot (mancha chocolate- *Botrytis fabae*), many viruses and some powdery mildew (mildeo pulvoso-*Microsphaera penicillata* var. *ludens*). However, the disease situation can be quite different during the rainy semester and root rot can be of major problem as suggested by Ing. Raul Rios and Ing. Mario Crespo. There is a need for the establishment of a plant pathology laboratory which the group is now working on. It is best if this laboratory is housed in an area with a minimum of dust sources to reduce the potential for contamination. If possible, it is best to locate the laboratory downstairs across from the seed storage room.

Several bean varieties and lines are being evaluated at the"La Jota" Experiment Station, Chapare. There was also a 3 ha seed increase field of the cv. ICA TUI and another small site for the mutiplication of few cowpea (Caupi-*Vigna unguiculata*) varieties. These plots were harvested or at a late maturity growth stage and under very dry conditions, and thus no root disease problem was evident. There was a sign of aluminum toxicity problem and there were no *Rhizobium* -nodules on the bean roots. Foliar disease symptoms observed were those of web blight (mustia hilachosa-*Thanatephorus cucumris*), Angular leaf spot (mancha angular-*Phaeoisariopsis griseola*), powdery mildew (mildeo polvoso-*Erysiphe polygoni*), and common bacterial blights (bacteriosis comun-*Xanthomonas phaseoli*). Some of the research being

conducted at the station and in the Chapare area is in cooperation with IBTA/ Experience,Inc. Project that deals with soil improvement and farming system research.

A severe incidence of **Sclerotium blight** (murcha de Sclerotium-*Sclerotium rolfsii*) was observed on cowpeas at the Experiment Station at Chipiriri. This disease is most common and damaging to cowpeas and other leguminous crops under wet and high temperature conditions. The fungus attack the tissues of the stem near the soil line. The point of attack become bleached in color and the lesion expand rapidly as this fungus produces large quantities of toxins and several enzymes that kill plant cells prior to fungal penetration. Under moist soil conditions, mycelial growth of the fungus can be seen by the naked eye on top of the soil around the stem areas with the characteristic production of the small round sclerotia. These sclerotia are light brown in color and are the surviving structures of this fungus. Severely infected plants show chlorosis, wilting, premature defoliation and eventually die. Yield evaluation of several bean varieties and lines were also conducted at the same station. The test was already harvested and the plants were being dried in preparation for shelling and weighting the seeds. The dried stems and pods exhibited symptoms of angular leaf spot and **ashy stem blight or charcoal rot** (Pudricion gris de la raiz y del tallo-*Macrophomina phaseolina*). Infected tissues have a light gray color and are covered with sclerotia and pycnidia of the fungus. Symptoms on young emerging seedlings appear as dark, irregular and sunken lesions of different sizes usually on the cotyledon tissues. On susceptible varieties these lesions expand into the stem tissues and progress downward and upword which may eventually reach the growing point and kill the plant. Dark, sunken lesions may also be found on the stem tissues below the soil line. There are many bean lines that are resistant to this disease and an Internatinal evaluation nursery is now available for testing and which can be obtained from CIAT in CALI, COLOMBIA.

The IBTA/GTZ irregation project is being implemented in the highland and valleys of Cochabamba. The project is using a farming system research approach with the objective to diversify production through the introduction of adapted varieties or alternative crops such as lentils, chickpeas and also vegetables. They are also working on the improvement of cultural practices including the possible use of fertilizers, herbicides, and others. The program has been operating in Bolivia for3 years. One student is now conducting

his thesis research within this project on the evaluation of lentil varieties, production of certified seeds, and other aspect of lentil production. Several fields of fababeans in the high velley production areas were visited. The main crop in this region is potatoes, but fababeans and barley or oats are the other crops used as rotational crops. Cutworms (trozadores /cortadores-*Agrotis* sp.), seed corn maggots (Musca de la semilla- *Hylemya* sp.) and stem borers (Barrenadores-*Elasmopalpus* sp.) injuries were severe. Limited damage and symptoms of *Fusarium*- rot (*Fusarium* spp.)and possibly *Rhizoctonia* - rot (*Rhizoctonia solani*) were observed in these fields. These pathogens may also be involved in the death of seedlings shortly after planting resulting in the reduced density of established seedlings. Other diseases observed on fababeans were rust, chocolate spot, and viruses.

It was interesting to learn of the considerable interest and research being conducted on leguminous crops at the Agronomy faculties of the Universidad major de San Simon in Cochabamba and the Universidad Autonoma Gabriel Rene Moreno in Santa Cruz. These activities should be encouraged and supported and hopefully to be coordinated with the activities of the regional and national research centers. Five graduate students are now conducting their thesis research on several aspect of crop production and pests of fababeans at the San Simon university campus in Cochabamba. The research and interests of the faculty and students at the Gabriel Rene Moreno University among leguminous crops is mainly with beans. Work being conducted on beans deals with the evaluation and selection of improved varieites, increase of certified seeds (40 - 80 ha), pest control, and other crop management practices. The group felt that bean production is not the problem, but rather the unpredictable market. Most of the beans grown in Santa Cruz and other parts of Bolivia are exported to Brasil. Fluctuation in the prices and demand of the export market, the lack of credit availability, and the limited financial support for research are the main problems on beans. The group is currently cooperaring with the Association of Cotton Producers (Asociacion de Productores de Algodon, Santa Cruz) to Improve export arrangement and to look for new markets. The research group thought that the most important foliar diseases on beans are angular leaf spot, rust and anthracnose. Sclerotium blight was thought to be most severe when organic manures are used. Other root disease problems mentioned were *Fusarium* and *Rhizoctonia* root rots. The University maintain a 70 ha experiment station which is close to the main campus. There is a plant

pathology laboratory at this station. The physical facility of this laboratory appear to be adequate and there are a number of essential equipments available. There is a need to organize the laboratory and to provide glassware, agar media, and other materials needed for routine pathological research. There were no bean plots available at the time of this visit to observe. A seed increase plot of several pea varieties showed a severe incidence of Fusarium-wilt (marchitamiento por Fusarium- *Fusarium oxysporum* f. sp. *pisi*). The plants showed considerable yellowing and necrosis symptoms and appeared to progress from the the base to the top of the plants. Also, there was considerable discoloration of the vascular tissues of the roots and lower stem when they were cut longitudinally. The discoloration was orange to dark red which suggests that the disease might been incited by race 2 (near wilt disease) of *Fusarium oxysporum* f. sp. *pisi.* Other diseases observed at this station were Root-knot nematode (nematodos de los nudos radicales- *Meloidogyne* spp.) and viruses on tomatoes, and black rot of cabbage (*Xanthomonas campestris*).

GENERAL OBSERVATIONS:

a. Major root diseases observed were **Fusarium-wilt** of peas, **Fusarium- rot** and **Rhizoctonia- rot** of fababeans, **Sclerotium blight** of cowpeas, and **Macrophomina- rot** of beans. However, only limited number of fields of leguminous crops were available for observations during this visit in early October which was also very dry. Thus, there is a need to visit the main production areas during the rainy season when the crops are at about the flowering growth stage before a definit conclussion can be made in regards to the diagnosis of the most prevalent and damaging root diseases on leguminous crops in Bolivia.

b. Insects are causing excessive damage to leguminous crops. There is a need to improve and to better time the application of chemical control measures available. Also, an educational program is needed to familiarize the growers with the effective and safe use of pesticides.

c. Soil conditions in a number of fields visited were rather poor as indicated by inadequate drainage, excess soil compaction, and low level of organic matter. Such conditions are known to increase stress on the plants, increase damage by soilborne pathogens and

reduce crop yield. Thus, there is a need for a program to improve soil conditions.

d. It appears that some of the practiced crop rotations are not adequate. For example, growing leguminous crops after potatoes or cotton is not good overall. Such a rotations are known to increase a number of root diseases such as Rhizoctonia rots and damage by plant parasitic nematodes including the root-knot nematodes. Growing a grain crop (Corn, Barley, rye, etc.) before the leguminous crops is best.

e. Providing disease resistant varieties (to root and foliar diseases) of leguminous crops may not result in the expected yield increases. It is important to control the excessive insect damage, to devise a program to improve soil conditions, advocate appropriate crop rotations, etc. Thus, there is a need to develop a technology package that is appropriate and effective in managing pest problems and increasing crop yield. Soil problems including root diseases and insect injuries are best controlled through the development of integrated control measures.

2. <u>PERU:</u> Beans, peas, fababeans, and lentils are the major legume crops in Peru with a total production area in 1985 of 57000, 26000,14500, and 4400 ha, respectively. Other leguminous crops grown or consumed in Peru include chickpeas, cowpeas, lupines, lima beans (pallar- *Phaseolus lunatus*), hyacinth beans (zarandaja- *Dolichos lablab*), pigeon peas (frijol de palo- *Cajanus cajan*), and mung beans (lactao-*Vinga radiata*). The average consumption of the major leguminous crops in Peru is about 6 kg/capita/ year. Considerable quantities of peas, lentils and at times also beans are imported annually. Legume crops are grown in three different production areas; the dry-arid coastal area, the high and cold andean area, and the tropical humid area. Cultural practices, production inputs used, and yields of crops grown among these regions vary considerably. Also, production constraints including pest problems are likewise different.

It was not possible to observe plantings of leguminous crops around Cajamarca as the rainy season was just getting started and many fields were being prepared for planting potatoes. It is best to visit this area during January-February or even later in the growing season. Observed one bean plot at the "Cajabamba" experiment

station. The plot was already harvested, but there were many plants left and many young seedlings had emerged from the newly produced seeds. The roots and stems of dug-up plants were rather free of diseases with only limited symptoms of **Fusarium dry root rot** (Pudricion seca de la raiz- *Fusarium solani* f. sp. *phaseoli*). Initial symptoms appear as narrow, long lesions that are bright red in color. These lesions continue to enlarge and with time coalesce and eventually can cover the total surface areas of the lower stem tissues and also the major roots. In the absence of other pathogens or the involvement of saprophytic microorganism, the infected tissues remain firm, dry and superficial. This pathogen causes only limited damage to beans when infected plants are growing vigorousely and are not subjected to stressfull conditions. However, it causes considerable damage to beans when plants are stressed by drought conditions, excess water, compacted soils, infection by other pathogens, etc. The only other disease symptoms observed in this bean plot was those of viruses. However, there was considerable damage of leafhoppers (lorito verde- *Empoasca* spp.) and severe damage of stem borers. The soil was rather loose but very dry. In a previous visit to Cajabamba in 1986, **Fusarium root rot** and low incidence of **root-knot nematodes** were observed on beans. The most improtant foliar diseases observed at that time were Ascochyta leaf spot (manch por Ascochyta-*Ascochyta phaseolorum*), anthracnosis (antracnosis-*Colletotrichum lindemuthianum*), gray leaf spot (mancha gris- *Cercospora vanderysti*), and viruses.

A pea field near the experiment station in Cajabamba showed symptoms of a severe incidence of **Fusarium- wilt** (marchitamiento por Fusarium- *Fusarium oxysporum* f. sp. *pisi*). Many plants in several spots in the field were chloratic, necrotic or had already died. Many of these plants had a rotted root and stem tissues. When the roots and stems of infected plants were cut open, the vascular tissues were found discolored and generally had a color of orange to dark red indicating the possible involvement of race 2 of this pathogen (the near wilt race). Some infected plants had symptoms of Fusarium root rot, whereas symptoms on others resumbled those of Ascochyta foot rot. Symptoms on other plants yet suggested the possiblity of Pythium root rot. It is not possible to diagnose the latter without the microscopic examination and/or isolation from infected tissues on agar media. Foliar diseases observed in this field were powdery mildew, Alternaria blight, and possibly Ascochyta or Mycosphaerella leaf spots.

Considerable research on fababeans is being conducted at the Estacion Experimental "Tahuaco". Many lines including those of ICARDA are being evaluated for their adaptability and usefullness as parental materials. The effect of several seed treatments are also being tested. Seed of few varieties of fababeans are being increased at this station as 5.2, 3.0, and 1.5 ha. of Verde de Anta, Blanka de Anta and Jegante Copacabana were in the early stages of growth. A severe incidence of **Rhizoctonia-root rot** (chancro por Rhizoctonia- *Rhizoctonia solani*) was observed at the station. This is not surprizing as fababeans is often planted after potatoes and both crops are susceptible to this pathogen. Early symptoms of Rhizoctonia appear as sunken, brown to black cankers on the stem and root tissues. In addition, this pathogen is capable of causing seed decay and damping off diseases when seedlings are infected shortly after germination. Severly infected older plants exhibit chlorosis, necrosis and stunting and usually die prematurely. Other root diseases observed at low incidence were **Furarium root rot** (*Fusarium* spp.), **Fusarium- wilt** (*Fusarium oxysporum* f. sp. *fabae*), **Ascochyta- foot rot** (*Ascochyta fabae*), and possibly *Pythium* or*Phytophthora* - root rots. Foliar diseases observed were Ascochyta blight (*Ascochyta fabae*) and viruses (possibly broadbean wilt and leaf roll and others). Only limited insect foliar feeding was observed at this high and cool location. A 3 ha. seed increase field of fababean at the Estacion Experimental "Potojani" was found to be rather clean. Only few plants showed symptoms of Rhizoctonia- rot and Fusarium root rot, but virus incidence was very severe as a high percentage of the plants were infected. This field was not planted with fababean before which illustrates the benificial effect of crop rotation in reducing root diseases.

In a previous visit to the coastal areas around Chincha and the experiment station (CIPA VI) in 1985, It was observed that root diseases were prevalent and causing serious losses to beans. The major pathogens diagnosed were ***Rhizoctonia solani*** and the **root-knot nematode** (*Meloidogyne* spp.). Beans were also found infected at lower frequency with ***Fusarium solani* f. sp. *phaseoli*** and ***Sclerotium rolfsii.*** Extensive research efforts were in progress to identify resistant and adapted bean germplasm to these pathogens and to incorporate such resistance into improved and adapted cultivars. The research group at Chincha was also working on cultural and chemical management measures for these pathogens.

The Plant Pathology and Agronomy facilities at both the "University Nacional Agraria la Molina" and "Universidad de Cajamarca" are good. Faculty members are very much aware with research needs on leguminous crops and are eager to be involved in cooperative research efforts. Thus, an excellent possibility exist for linking INIAP and university researchers in cooperative research, and specially through the direction of student thesis research to address important practical production problems such as diagnosing and effective management measures of root diseases.

GENERAL OBSERVATIONS:

a. The major root pathogens that were observed to occur in Peru included ***Rhizoctonia solani, Meolidogyne*** **spp.,** ***Fusarium solani*** **f. sp.** ***phaseoli,*** and ***Sclerotium rolfsii*** on beans; ***R. solani, F. oxysporum*** **f. sp.** ***fabae,*** and***Ascochyta fabae*** on fababeans; and ***F. oxysporum*** **f. sp.** ***pisi*** on peas. There is a need to diagnose and assess the severity of root diseases during the other parts of the growing season.

b. Excessive virus symptoms were observed on fababeans even in seed increase plots. There is a need to demonstrate and ecourage farmers in improving the selection of seeds for the following plantings. Virus infections may be reduced if seeds for subsequent plantings were harvested first and were selected from plants that are symptomless.

c. As a result of the severe incidence of *R. solani* on beans and fababeans, there might be a need to evaluate the effect of fungicide seed treatments for the control of this pathogen. Some of the effective fungicides are benlate, terraclor, demosan, vitavax or rizolex. It is best if these fungicides are applied as a slurry seed treatments and not as a dust treatments.

d. Where possible, there is a need to encourage the use of proper crop rotation as it is best to grow leguminous crops after grain crops.

3. ECUADOR: Beans are the major leguminous crop that is grown (39742 ha in 1985) and consumed in Ecuador(about 2.2 kg/capita/year). Fababeans and Peas are second in importance and

were grown on 4800 and 6700 ha in 1985, respectively. These crops are generally consumed as a fresh vegetable. Lentils are consumed considerably in Ecuador, however only 550 ha were planted to this crop in 1985. Estimated production areas of beans, fababeans, peas and lentils in 1987 were 45000, 10000, 5000, and 2000 ha, respectively. About 95% of the lentils consumed in Ecuador are imported annually, and thus the interest and need to increase its production. Chickpeas, cowpeas, pigeon peas and lupines are also produced or consumed in the country.

Investigations on food legume crops in Ecuador are being coodinated at the Estacion Experimental "Santa Catalina". The facilities at this station are good and the research team, although small, is experienced, enthusiastic and doing the needed adapted research. Germplasm collections of beans, fababeans, peas, lentils and lupines are being maintained and evaluated through annual plantings and incooperation with CIAT and ICARDA. Also, the station is involved in the production of clean seeds as 4 bean lines are now being increased for release to farmers. Research plots for fababeans and peas are carried out at the station land, whereas trials on other legumes are established in commercial production areas around the country.

Six fields of fababeans and one field of peas were visited in the areas of El-choupi, La Libertad, Romorillos and Jamubile in Pinchincha and Cotopaxi. **Fusarium- foot rot** (*Fusarium* spp.) was the only root disease observed on fababeans. However, severe incidence of stem borers (barrenadores del tallo) damage was evident and was always associated with symptoms and growth of Fusarium inside the stem tissues. The latter is not surprizing as parasitic and saprophytic *Fusarium* spp. are abundent in soil and on the surfaces of the stem and root tissues, and thus are probably functioning as secondary invaders. Thrips were found damaging fababean in one field. Chocolate spot (*Botrytis fabae*) was common and apparently is a serious problem on fababeans in this region. One fababean field had a high incidence of viruses resulting in considerable damage. Other foliar diseases observed were rust and leaf spots (*Ascochyta or Cercospora* spp.). Severe hail damage was observed in one fababean planting. The only pea field observed had a high incidence of **Fusarium- wilt** (*Fusarium oxysporum* f. sp. *pisi* , possibly race 2).

Light incidence of **Fusarium- root rot** (*F. solani.* f. sp. *phaseoli*) and root-knot nematodes (*Meloidogyn* spp.) were found on beans at a commercial farm near Tumbaco. Seeds of the improved bean lines INIAP 404 and 407 are being increased on this farm on a total of 1.5 ha. Soil conditions were very dry and the beans appeared to be stressed for lack of water. Incidence of rust and viruses was high and severe. Other diseases observed were gray spot, angular leaf spot, anthracnose, and powdery mildew.

Root-knot nematode, Fusarium- root rot and **Fusarium-wilt** were found on beans in a field near Guallabamba. Very severe incidence of root-knot nematode on INIAP line E 101 was found on another farm in the same area. The soil of this field was lighter in texture as compared to soils of other fields in the area. Other diseases observed on these farms were rust, gray spot, powdery mildew, angular leaf spot, and other leaf spots (*Alternaria* or *Ascochyta*). Insect damage was also evident on these farms.

A bean-pea intercropping in a field near Puellairo showed severe **Rhizoctonia-root rot** (*R. solani*) on both crops. Typical brown and sunken lesions were found on the stems of beans and peas. Also, severe **Fusarium-wilt** on peas (*F. oxysporum* f. sp. *pisi*) and beans (*F. oxysporum* f. sp. *phaseoli*) were evident. Plants showed wilting, chlorosis, necrosis and had the typical vascular discoloration which was brown in beans and orange to red in peas. Low incidence of leafminor (minadores) damage was found on beans. Infection of beans with *R. solani* was found in another field near Alchipichi. Gray spot and rust were also found in this field. In many of these fields it appears that the seeds were planted too deep, which is partly responsible to the higher incidence of the root rot diseases observed.

A one ha. field of beans, with some peas, was found to be rather clean in the area of Bolivar. Only few plants with *R. solani* lesions were found. The farmer was very knowledgable with proper production practices. He always rotated beans with corn and incorporated all the corn residues into the soil. The soil was dark, with good texture and with good mositure during our visit. The grower indicated that he used the fungicide maneb and the insecticide monitor only as needed. In contrast, severe incidence and damage of **Rhizoctonia-root rot** was evident in another field in the same area. The young plants were chloratic, wilting and had the characteristic brown sunken lesions on stem tissues below the

soil surface. The seeding rate appeared excessive (6 seeds /hill) which suggests the recognition of the problem by the grower in earlier plantings, and thus his attempt to compensate by increasing the seeding rate. The previous crop in this field was potato as there were volunteer potatoes among the beans. Beans after potatoes is not a good rotation as both crops are suceptible to *Rhizoctonia*. Seed treatment with fungicides may help in reducing root rot severity in such fields.

Two bean fields near Chulunhuasi area were found with average to severe incidence of ***R. solani***. No crop rotation was practiced by the grower as he grows only beans and onions. Furthermore, very severe incidence of *R. solani* and a low incidence of ***F. solani* f. sp. *phaseli*** and ***Sclerotium rolfsii*** were obsereved on beans in a field near Pimampiro. Pea plants in a field on the same farm had a severe infection by ***R. solani*** and ***F. oxysporum* f. sp. *pisi*** (Fusarium-wilt). Again, the farmer did not practice crop rotation. This farmer had recently applied a pesticide (it was not possible to determine the chemical) on these plantings on the suggestion of the local pesticide store operator. However, foliar application of even the appropriate pesticides are not effective in controlling soilborne pathogens at this late stage of infection.

Severe ***R. solani*** and low incidence of **root-knot nematodes**, ***F. solani* f. sp. *phaseoli***, and common bean mosaic virus were found on beans in a field near Chalguayacu. Low incidence of R. solani were found on beans and peas in a field near Ibarra, but both crops were under drought stress. In another field in the same area , bean growth was very uneven with chlorosis and necrosis of lower leaves. The symptoms suggested salinity, soil pH or mineral toxicity problems which is not surprizing on such margional type of soils.

Several plantings of beans were examined near San Antonio. One planting had a severe incidence of ***R. solani*** and damage by cutworm (cortadores). Leafhoppers (lorito verde) and seed maggots (gusano de la semilla) were also evident with some anthracnose on INIAP 400. In one location, stem borers (barrenadores) damage near the growing point was also found. The area just below the growing point become enlarged where the larvae were often found. The distal portion of the damaged branches become dark in color and eventually dry and die. Low incidence of Fusarium-root rot and probably bean yellow mosaic virus were observed.

Two bean fields in the Natabuela area had a severe injury from the stem borers attacking the tissues near the growing points. Other insects founds in these fields included leafhoppers and mites (aranita). Diseases detected included **Fusarium- wilt**, anthracnose, rust and bean common masaic virus.

Several bean fields were examined in the area of Quimiag. Only limited damage of **Rhizoctonia-root rot** , anthracnose, and bean chlorotic mottle virus were detected, but considerable injury from cutworms, stem borers, and leafminors were evident. Also, symptoms of mechanical damage were common in some fields suggesting the poor quality of the seeds used. One field of peas showed symptoms of **Fusarium-wilt** and powdery mildew, but also insect injury of leafminors and stem borers near the growing points.

Symptoms of **Fusarium-wilt** and **Fusarium- root rot** were detected in a field of fababeans near Urbena. The same field also showed a severe incidence of chocolate spot and insect damage. A pea field in the same area had **Fusarium-wilt**, **Fusarium-root rot** and lesions on the leaves and stems (*Aschochyta* or *Mycoshaerella*).

Severe incidence of **Rhizoctonia-root rot** was found on young volunteer lentil seedlings in a harvested field. These seedlings exhibited the typical sunken, brown lesions of *R. solani* on the stem tissues. Symptoms resumbling those of **soil line damping- off diseases** (possibly *Pythium* or *Phytophthora* spp.) were also observed on these seedlings. In addition, many palntings of several vegetable crops were visited. Plantings of cabbage, cauliflower, lettuce, and red beets looked rather good and disease free with only drought stress and some physiological breakdown of outer leaf tissues. Several diseases were detected in onions and garlic plantings including Fusarium basal rot (*F. oxysporum* f. sp. *cepae*), white rot (*Sclerotium cepivorum*), downy mildew (*Peronospora destructor*), and Botrytis leaf blights (*Bortytis spp.*).

GENERAL OBSERVATIONS:

a. Major root pathogens detected were **Rhizoctonia solani**, **Meloidogyne** spp., **F. solani f. sp. phaseoli**, and **Sclerotium rolfsii** on beans; **F. oxysporum f. sp. pisi**, **R. solani** and **F. solani** f. sp. **pisi** on peas: **Fusarium spp**. (Fusarium root rot), and **F. oxysporum** f. sp. **fabae** on fababeans; and **R. solani** on lentils.

b. Insect injuries are very severe resulting in severe losses on all leguminous crops. Insect control is essential and should be integrated with programs aimed at the control of other pests on these crops.

c. Programs to manage foliar diseases are needed and should be integrated with root disease and insect manegement programs. For example, chocolate spot, rust and viruses are very severe on fababeans.

d. It was observed that seeds of many of the food legume crops are planted too deep, which is undoubtly contributing to the severity of root diseases and other factors. There is a need to determine the reasons for this practice and to demonstrate the effectiveness and advantage of shallower planting depth.

e. An inadequate crop rotations are being used in several production areas. Such rotations are also contributing to the detrerioration of soil conditions. Inadequate crop rotations and poor soil conditions directly contribute to the prevalence and higher severity of root diseases. Research and demonstration trials in this area are warrented.

f. There is a need for research and education on the proper selection, time of application, methods of application and the safe use of pesticides for disease (root and foliar) and insect control.

g. Seed treatments with fungicides and insecticides may well be effective and practical for managing the severe root diseases and insect problems. Research on the efficacy of available fungicides and insecticides is needed and should be demonstrated under grower conditions.

h. The above indicate that the effective control of pests and increasing yield of leguminous crops will require the development of an integrated crop production management programs. The use of single management options such as the use of insect or disease resistant germplasm may not be effective unless the other limiting production factors are addressed.

4. <u>COLOMBIA:</u> Beans are the mojor food legume crop consumed in the country and grown on 138000 ha. in 1985. Peas are the second important crop with an average production area of 27000 ha. Fababeans are grown on about 4000 ha. Other crops produced or consumed in Colombia are lentils, chickpeas, cowpeas, and mung bean. Considerable amount of lentils, peas, beans, and other legumes are imported annually at the present time.

It was not possible to visit production fields in the Pasto area, but spend the time at the ICA/ OBONUCO station in Pasto discussing methodologies for research on soilborne pathogens, root disease problems on food legume crops and management strategies. Research on leguminous crops being conducted at the station deals with determining the causal agents for the major disease problems, evaluating the performance of selected germplasm and investigating the effectiveness of available control options such as the use of fungicide treatments and others. The group considered **Fusarium wilt** (*F. oxysporum* f. sp. *phaseoli*), **Rhizoctonia- root rot** (*R. solani*), web blight (mustia- *Thanatephorus cucumeris*), and white mold (moho blanco- *Sclerotinia sclerotiorum*) as the major disease problems on beans. **Fusarium- root rot** (Fusarium spp.) and stem borers were considered the main problems on fababeans. **Fusarium-wilt** (*F. oxysporum* f. sp. *pisi*), **Fusarium- root rot** (*F. solani* f. sp. *pisi*), stem borers, viruses, Ascochyta blight, downy mildew and powdery midew as the important pest problems on peas. In a previous trip to the Pasto-Funes-Ipiales production areas in 1985, the major root disease problem observed on beans was **Fusarium wilt**, but also low incidence of both **Sclerotium blight** (*S. rolfsii*) and **Fusarium-root rot**. Several bean lines that have performed well in the Pasto area and expected to have resistance to Frarium-wilt include TIB 3042, Frijolica 0-3.2 (E 605), ICA LLano Grande (E 1056), OBO-V-4, 8, 11, 16, 21, and other lines that are being tested now at OBONUCO.

A low incidence of **Fusarium-wilt** (*F. oxysporum* f. sp. *pisi*) was found in a pea field near Cajica. Peas in this field were grown in rows on a trellis and were very vigorous and with heavy pod load (it was estimated at 5 to 6 tons/ha.). Other diseases observed were downy mildew (*Peronospera pisi*), Ascochyta blight (*Ascochyta spp.*), and stem borers. Severe incidence of **Fusarium-wilt** was found in a 1.5 ha field near Susa-Bereda-punta de Cruz. The soil of this field was heavy and poorly drained. In addition, the grower did not practice a crop rotation in this field. Other diseases present

were Ascochyta blight and stem borers. Peas grown in association with potatoes and corn in a nearby field on the same farm looked rather good with no major problem. The soil of this field had a better texture and appeared with a better drainage. However, it is likely that the fertilizers, pesticides and other inputs used on potatoes have contributed to the vigorous growth and reduced disease incidence on peas grown in association with potatoes. The symptoms of Fusarium- wilt were also detected in two poorly growing peas in a field near Cacaita and another near Jenesano. The soils of both fields were heavy in texture and poorly drained. Insects damage was evident in both fields and there were symptoms that resumbled **Pythium-root rot** in the second field. Only limited symptoms of **Fusaium-root rot** were observed on fababeans in a field near Soraca and another near Jenesano. Rust, chocolate spot and stem borers injury were also observed on fababeans in these fields. A lentil field near Jenesano showed considerable chlorosis, necrosis but without a diagnostic symptoms of Fusarium-wilt. It was thought that this problem could be due to infection by *Pythium* or *Phytophthora* spp. The latter diagnosis need to be confirmed by attempting to isolate these fungi on agar media (e.g., on acidified water agar). Another lentil field near Tibana appeared to be free of root diseases, but had some insects (minadores) damage and a low level of rust.

A very severe incidence of **Sclerotium blight** (*S. rolfsii*) was found in a bean field near Garaqua. High percentage of the plants were chlorotic, wilted and exhibited the white mycelial growth of the fungus with the diagnostic small, round, and brown sclerotia on stem tissues near the soil line. A closeby pea field of the same grower had a very severe incidence of **Fusarium- will.** Another pea field on a different farm was found with a severe problems of both Sclerotium-blight and Fusarium-wilt. A planting of chickpeas on the same farm had a severe incidence of **Sclerotium-blight** and **Fusarium-wilt** (*F. oxysporum* f. sp. *ciceri*). A chickpea field near Huatica had a very severe problem of Ascochyta blight (*Ascochyta* spp.).

Fields of beans, peas, and a small planting of chickpeas were observed on several farms in the area of Pasca. A pea field had a severe incidence of **root- knot nematodes** (*Meloidogyne* spp.) and some **Fusarium- wilt,** and insect damage. A bean planting in the same field showed symptoms of root- knot nematode infections and severe incidence of anthracnose, Ascochyta- blight and leafminores.

Another bean field in the area had some plants with **Fusarium-wilt** symptoms and also a low incidence of Ascochyta- blight and anthracnose. A severe damage of white flies (mosca blanca) and some by leafminors were also present. White flies damage was detected in another bean field that also showed a severe Ascochyta-blight and low level of **Fusarium- root rot**. Root- knot infections, some symptoms of **Ashy- stem blight** (*Macrophomina phaseolina*) and Ascochyta blight ocurred in another field. This field was very wet and the seeds were planted excessively deep. Ashy- stem blight is severe and one of the major disease problems on beans grown in the Quilicho de Santander area.

Excellent germplasm evaluation and breeding trials of peas and beans were observed at the ICA research station (Centro de Investigacion "La Selva") in Rio Negro. These trials were extensive, well organized and maintained properly. The facilities at the station have been recently updated and appear adequate for the research being conducted. High incidence of **Fusarium- wilt** (*F. oxysporum* f. sp. *pisi* , possibly race 2) was present in the areas of the pea trials . The even and high severity of Fusarium- wilt at the station will makes it possible to evaluate pea lines without the need for artificial inoculations. **Root- knot nematodes** were also found on peas, but at a low density. Some plants exhibited symptoms resumbling those incited by *Pythium* spp., but this observation need to be confirmed by isolation to be made from infected tissues on selective agar media. Stem borers injury was severe on peas in these plots. The group also indicated that there is some Rhizoctonia-root rot (*R. solani*) on peas, but it was not possible to observe during this visit. Root disease problems observed in the bean trials included **Rhizoctonia-root rot, root-knot nematodes** (*Meloidogyne spp*) and infections with symptoms resumbling those of Pythium-root rot. Rhizoctonia- root rot is known to be of major importance to beans grown in the Popayan area. Ascochyta- blight was the major foliar disease problem. Damage by borers in the stem and near the growing points was observed as well as damage by cutworms. Bean fields of a farm near the station had a severe Ascochyta- blight in one field, very severe cutworm damage in a second planting, whereas the third planting had some anthracnose and Ascochyta- blight.

Very interesting research on peas and beans is being conducted or coordinated by the group at the Centro Nacional de Investigacion "TIBAITATA". It was interesting to see data demonstrating that

large pea seeds (7.1 mm in diameter) had better emergence, lower disease incidence, higher yield and thus higher profit return than small seeds (5.5 mm in diam.). Also, yield of plots planted with pea seeds that were discolored or with lesions was lower than plots planted with clean seeds of the same size. The most frequently isolated fungi from infected seeds were species of *Ascochyta, Rhizoctonia, Fusarium and Alternaria.* It was shown that the use of chicken or cow manures at 5 to 30 t/ha. reduced root disease infections in the greenhouse. The effect of these manures on root disease incidence and yield will be evaluated in the field. Growing peas on ridges that were 10 to 20 cm high resulted in reduced incidence of root rot and higher yield. Several fungicide seed treatments have been evaluated at rates of 1.2 to 2.4 gm/kg seeds with captan and benlate having the best effect on yield. In addition, considerable research has been conducted on the evaluation of lines for resistance to Ascochyta- blight, anthracnose, and powdery mildew. Several lines have been identified with a good level of tolerace to these diseases and will be used in the breeding program. Also, fungicides such as Bravo, and Benlate controlled Ascochyta-blight when first applied at 5% disease incidence and then repeated every 15 days. Many bean lines are being evaluated for resistance to Fusarium- wilt in the areas of Narino. Ancash and ICA Tundama are considered tolerant, whereas Sangre Toro as resistant.

GENERAL OBSERVATIONS:

a. Major root disease pathogens observed were ***Fusarium oxysporum*** f. sp. ***phaseoli, Rhizoctonia solani, Meloidogyne*** spp., ***Sclerotium rolfsii, Macrophomina phaseolina***, and ***F. solani f. sp. phaseoli*** on BEANS; ***F. oxysporum*** f. sp. ***pisi, R. solani, S. rolfsii, Meloidogyne*** spp, and ***F. solani*** f. sp. ***pisi*** on PEAS; ***Fusarium*** spp. and ***F. oxysporum*** f. sp. ***fabae*** on FABABEANS; **R. solani** on LENTILS, and ***F. oxysporum*** f. sp. ***ceciri*** and ***S. rolfsii*** on CHICKPEAS. Possible ocurrence of ***Pythium*** spp. was also suspected on several of these crops.

b. The prevalence and severity of root diseases observed in Colombia suggest the need for the development of integrated crop production management programs for reducing the impact of post problems on food legumes. There is a need to improve soil conditions, formulate better crop rotations, adjust planting depth, formulate effective fungicide and insecticide seed treatments, etc. as well as the use of resistant cultivars,where available.

Development of such programs is possible in the country as there are experienced researchers, adequate facilities, and other ongoing projects that are related such as the cultivos multiples project coordinated at TIBAITATA.

c. Although there are many root disease problems on leguminous crops and specially beans and peas, the incidence and severity of these problems vary considerably from one region of the country to another and thus the needed control programs will have to be specific for each area. For example; Fusarium- wilt, Rhizoctonia- root rot, Sclerotium- blight, charcoal rot, and root- knot nematodes are the major root disease problem on beans grown in the Pasto, Popayan, Quaraqua, Quilicho de Santander, and Pasca areas, respectively.

5. <u>VENEZUELA:</u> Beans (called caraota in venezuela) are the major legume crop grown over 39138 ha in 1984. However, the local production does not satisfy half of the needed tonage for in- country consumption which average about 5.6 kg/ capita/ year. Cowpeas (called frijol in Venezuela) is an important legume crop which was grown over 15240 ha in 1984. The local production apparently satisfy the consumption demand. Peas is second in importance after beans as it is consumed considerably. However, about 95% of the consumed tonages are imported as only 4125 ha were planted in 1985. pigeon peas are being produced in the country over some 5000 ha. and are consumed like beans as fresh or dry. Other leguminous crops consumed include lentils, chickpeas, and fababeans but they are not produced in Venezuela. The interest at the present time is to increase the production of beans and peas in the country to satisfy the local demand.

The national coordination of research dealing with leguminous crops is being conducted at CENIAP / FONAIAP in Maracay. It was very interesting to find out that CENIAP is housed together with the Agronomy Faculty of the Universidad Central de Venezuela. This association has promoted cooperation among the researchers at both institutions and also the involvement of graduate students in the projects through their thesis research. For example, three students in the Instituto de Genetica / Facultad de Agronomia are conducting their thesis research on legume crops. One student is investigating the resistance and inheritance to *Macrophomina phaseolina* in cowpeas, the other is illucidating the inheritance to cowpea severe

mosaic virus, whereas a third one is identifying the races of the rust pathogen and its resistance in beans. The facilities of the units at thiese centers are good and several experienced researchers from several units are involved in research on legume crops.

Observed An International Bean Yield Adaptation Nursery (IBYAN) and a regional trial of bean germplasm on a commercial farm near Quavavao. **Sclerotium- blight** (*Sclerotium rolfsii*), and **Ashy-stem blight** (*Macrophomina phaseolinia*) were very severe. In addition, a high incidence of **Fusarium- wilt** (*F. oxysporum* f. sp. *phaseoli*) and a low level of **root- knot nematodes** (*Meloidogyne* spp.) infections were also found. The weather conditions were dry and hot.

Root disease problems were not detected in the pigeon peas and soybeans trials that were observed at the Estacion Experimental Yaracuy. However, a considerable incidence of **Sclerotium- blight** was found in a pigeon pea trial established in a commercial field. Planting density, date of planting and pigeon pea varieties were being evaluated in this trial. A severe incidence of **Fusarium-wilt** in a pigeon pea planting was found at The Campo Experimental Quibor/ Estacion Experimental Lara. The soil of this plot was very heavy. There was also considerable borer damage to the pods and stems. A very severe attack of ***S. rolfsii*** was also found in a 10 ha field of beans in the same production area. A low level of attack by **root- knot nematode** was also found in this bean planting.

Several bean fields were visited in the extensive bean production area around Sanare in Lara. Only low incidence of **Fusarium- root rot** was evident and some symptoms suggesting **Fusarium-wilt** and **Rhizoctonia- root rot** were observed on few plants. However, anthracnose was very severe with symptoms on leaves, stems and pod tissues and were accompanied with considerable defoliation on severly infected plants. Rust incidence was also severe in these fields and some stem borer damage was also detected. Rust and anthracnose were also detected at low level in a field near Cubiro. The soils of all fields observed were shallow, rocky and dry at this time and bean roots were very shallow.

Potatoes are the major crop grown under overhead irrigation system in the Valle de Tucutunemo. Beans are planted after potatoes but are rarely irrigated. **Fusarium- wilt** symptoms were detected in a bean planting that was under water stress. This field

had a high incidence of viruses and severe injury from leafhoppers and stem borers activities. Another bean field in the same area that was irregated had a good plant population and the plants were growing vigorously. However, it had a high incidence of viruses (bean common masaic virus and symptoms resumbling those of cucumber mosaic virus, and others), some common bacterial blight, rust and leafhopper injury. The only symptom of root diseases observed on few plants was that of **Fusarium- root rot**. Beans are also planted in the Puerta Nigra area near Maracay, but the fields were just been prepared for planting when this area was visited.

GENERAL OBSERVATIONS:

a. Major root pathogens observed were ***Scleotium rolfsii***, ***F. oxysporum* f. sp. *phaseoli***, ***Meloidogyne* spp.**, ***Macrophomina phaseolina***, ***F. solani* f. sp. *phaseoli***, and ***Rhizoctonia solani*** on BEANS; and ***S. rolfsii*** and ***F. oxysporum* f. sp. *udum*** on PIGEON PEAS.

b. The above tentative diagnosis of the major root rot pathogens in Venezuela need to be confirmed during a more appropriate time of the legume growing season and to cover the other production areas that were not possible to visit during this trip.

c. It appear that considerable portion of the leguminous crops produced in Venezuela are grown on margional soils or soils with poor structure. This is an area which need to be addressed if yield of these crops is expected to be improved considerably.

d. Like the situation in the other countries of the Andean subregion, There is a need to develop integrated management programs to control all major pests on legume crops as well as improve other production practices inorder to improve and stabilize yield potentials.

C. PRINCIPALES RESULTADOS ALCANZADOS

1. Several root rot diseases were found to be prevalent and causing considerable yield losses to leguminous crops grown in the Andean subregion (See previous section for specific diagnosis).

2. Few diseases such as **Fusarium- wilt** of peas were common and occurred in every country and almost in every production area.

However, the incidence and severity of several other diseases such as **Fusarium- wilt, Sclerotium- blight,** and **root- knot nematodes** on beans varied greatly among the countries and within the production areas in each country. The observed differences in the distribution of these diseases, however, may be due to the prevailing weather conditions and growth stages of the crops when observed during this trip. Thus, a follow-up survey of root diseases prevalent in these areas during another time of the planting season in each country should be conducted.

3. There is a need to demonstrate and promote the use of effective and practical control measures for the major root diseases identified in the different production regions. Management of root diseases is usually best accomplished through the use of integrated control strategies. Some diseases which are caused by the so-called specialized pathogens such as Furarium- wilts may be effectively controlled through the use of resistant cultivars. However, the majority of root rot diseases are caused by the so-called non-specialized pathogens such as *Rhizoctonia* or*Sclerotium*. It is very difficult to find crop germplasm with high level of resistance to such pathogens and immunity essentially does not exist. Management of diseases cuased by these pathogens is best achieved through the use of tolerant cultivars, where available, and other production practices such as the use of proper crop rotations, clean seeds with effective fungicide treatments, adjusting time and depth of planting, use of mulches, improving soil conditions, planting systems, etc. In other words, good production practices that insure vigorus plant growth will generally minimize the severity of root diseases.

4. Many of the crop rotations being practiced are not adequate and are undoubtly cortributing to increased severity of root diseases. The possible improvement or alteration of such rotations should be considered where appropriate. Growing a grain crop in advance of a leguminous crop will be beneficial.

5. In several production areas, insect injuries and specially those of stem borers were severe. Insect injuries directly or indirectly affect the prevalence and damage caused by root disease pathogens and also weak or nonpathogenic soil organisms. For example, stem borers injury to fababean or peas was always found associated with symptoms and mycelial growth of Fsarium spp. which are most likely acting as secondary invaders. Insect injuries

provide entrances for soil organisms and weaken plant responses to root pathogens through altered plant physiology or other predisposition effects.

6. Foliar diseases incited by fungal, bacterial, and viral pathogens were also prevalent and should be managed to reduce damage of root diseases or to be able to attain the full benefit from managing root diseases.

7. In many production areas, leguminous crops are being grown in fields with poor soil conditions such as inadequate drainage, poor structure, low organic matter content, high compaction and others. Such soil conditions directly or indirectly affect plant growth and increase severity of root diseases, and thus need to be improved whenever possible.

8. All of the above suggest the need to formulate an Integrated Crop Production program inorder to effectively and practically manage root diseases and improve yield and quality of food legume crop production in the Andean subregion countries.

D. UTILIDAD DEL VIAJE:

Although root diseases had been identified as a major factor impacting on production of food legume crops in the BID/IICA diagnostic document, this trip provided specific diagnostic information on root rot diseases present and their causal pathogens. This information will be of use to PROCIANDINO for the future development and support of specific research projects to formulate control measures for root diseases, generate the needed and appropriate technologies, and to imropve extension programs for promoting their adaptation. Also, this knowledge will aid PROCIANDINO in its efforts to enhance cooperations and communications among the 5 countries of the region by their ability to identify production regions with similar research needs, suggesting the sharing and transfer of the needed production technologies and identification and introductions of scientists of similar interests or having the needed experiences. The trip also provided some information on other production factors that are impacting on yield of food legume crops. Finally, the trip has helped PROCIANDINO in fullfilling its committment to provide contact and specific information now available to in-country scientists in

regard to soilborne pathogens and control strategies for their diseases.

It is hoped that the trip will contribute to the institutions visited by aiding in establishing research priorities for future projects dealing with root diseases and their managements. Such institutions will be able to identify other institutions and researchers in the Andean countries for possible cooperation and exchange of germplasm and production technologies. Finally, the trip has increased awareness of root diseases and their damage potential to leguminous crops and also to the relative knowledge available in the literature on such diseases.

This trip was of great advantage to the consultant as he obtained a first hand knowledge with specific disease problems of food legume crops grown in the 5 countries visited. As a result of the several institutions and many researchers visited, it will be possible for the consultant to exchange research information and crop germplasm as well as establishing the needed contacts necessary for future cooperative projects on root diseases. The trip was of special benifit for this consultant as it improved his spanish speaking ability.

E. ACCIONES DE TRABAJO QUE REALIZARA EL CONSULTOR:

The consultant has promised to provide publication materials dealing with diagnosis, methodologies for research on root pathogens, and limited pea and bean germplasm to several researchers and institutions visited. He also discussed with colleaques visited possible future cooperative projects dealing with the diagnosis and management of root rot diseases of food legumes through the writting of joint research project proposals that can be submitted for funding by international agencies. In addition, the consultant was asked for possible return to several locations visited in this trip, to advise on thesis research of graduate students, and to participate in the annual meeting of the Colombian Phytopathological Society. However, participation and involvement of such activities will depend on outside funging as Cornell University does not cover expenses for such activities abroad.

F. ACCIONES DE SIGUIMIENTO QUE DEBERA REALIZAR EL PROCIANDINO:

1. Encourage national program scientists to periodically monitor the prevalence and severity of root diseases of leguminous crops such that to cover the different planting seasons and the variable weather conditions.

2. Assists in the establishment of the needed research projects in selected locations to control the major diseases identified and to extend the findings to other productions areas in the region. Initial projects may include germplasm evaluation nurseries for selected pathogens, selected fungicide and insecticide seed treatments, depth of seeding, planting on raised ridges or beds, etc.

3. Assist in the initiations of research and educational extension-type projects that demonstrate and promote the use of appropriate production practices of crop rotations, soil management, insect control, seed selections, and others that directly or indirectly impact on the prevalence and severity of root rot diseases and their damage.

4. Obtain major publications available on production of food legume crops including those dealing with root diseases and to distribute them to institutions and scientists involved. Some of these publications may need to be translated to spanish, when possible.

5. It would be advatageous to promote and facilitate linkages and more cooperation between scientists involved in legume crop research at the national and regional research centers, universities and extension workers.

6. If possible, provide or help to obtain the needed start-up financial support for the high priority projects identified for the whole region.

G. Medidas en que este evento ha contribuido a la cooperacion entre la Sebregion Andina:

The main contribution of this trip was the identification of the major root rot diseases of legume crops in the different production areas in the Andean subregion countries. This information will increase contacts among institutions and researchers in these

countries and thus the increased exchange of research results and the possible coordinations of future research efforts. In addition, production technologies that developed for one area or are now known to reduce diseases and increase yield will undoubtly be of interest and thus may be transfered to other regions of similar needs. The potential increase in cooperation and transfer of technologies among the countries will increase the effeciency of research efforts and at the same time shorten the time needed for their delivery and adaptations.

H. Recomendaciones General y Especificas:

1. PROCIANDINO in cooperation with the national programs should prioritize research efforts needed and the demonstration of management measures required for controlling the major root diseases diagnosed on leguminous crops in the region. PROCIANDINO can then help the establishment of cooperative projects (with short-term and long-term objectives) for controlling these diseases on a crop basis or on a production area basis using a farming system research approach. Such research and demonstration management projects will require the financial support from PROCIANDINO or other international agencies.

2. If possible, PROCIANDINO should attempt to aquire and distribute the major publications available on leguminous crops to each institution involved. It might also be necessary to translate some information into spanish or to consider the writting of new publications to fill a certain need on these crops for the region.

3. National institutions and the scientists involved in many of the projects need to focus their research and limited resources on few high priority problems at a time (disease problems and others). There is always the need and the pressure to work on many problems on several crops, but it is more appropriate and helpfull to bring to a conclussion and solve few problems at a time.

4. There is a great need to make the new research findings and new recommendations available to growers as soon as possible. National programs need to encourage and facilitate communications between research investigators at universities and research centers and extension workers as well as personnel of related industries such as the chemical pesticide venders, etc.

5. The International Research Centers such as CIAT, ICARDA, ICRISAT and others have to continue their contribution and involvement in the improvement of available germplasm and the training of young scientists. However, there is a need for the centers to cooperate with national programs or other institutions in determining and demonstrating appropriate inputs and production practices that are necessary or will impact on the local or improved germplasm from reaching its yield potential.

6. If a diagnostic event such as the one covered in this report is to be hold in the future, it might be advantagous to choose a different time in the growing season for the visit in order to observe crops at about the flowering growth stages. Also, it might not be possible to visit all countries and to observe all food legume crops during the same time. It would be interesting to consider, if possible, holding a short workshop at the end of the visit in each country to discuss the findings, exchange ideas, identify research and management needs and formulate tentative cooperative research proposal among in-country institutions as well as those within and outside the region.

IV. INFORME TECNICO COPLETO:

Todate, no technical articles have been written or in the planning at this time from information gathered or the observations made during this trip. However, it would be possible to write an illustrated bulletin in cooperation with Dr. Guillermo Hernandez-Bravo and PROCIANDINO dealing with Major **Root Diseases of Food Legume Crops in the Andean Subregion of South America.** Actually, it is even possible to consider writting a bulletin dealing with all major diseases (Root and Foliar) of food legume crops in Latin America and their management.

Apendice "A"

Instituciones Visitadas:

Bolivia -

Centro de Investigaciones Fitotecnicas de Pairumain, IBTA, Cochabamba.

Estacion Experimental "La Jota", IBTA, Chapare.

Estacion Experimental "Chipiriri", IBTA.

Mision Tecnica Alemana, Programe de Riego Altiplano/Valles, Proyecto IBTA/G.T.Z., Cochabamba.

Facultad de Martin Cardenas (Agronomia), Universidad de San Simon, Cochabamba.

Universidad Autonomia, "Gabriel Rene Moreno", Santa Cruz.

Officina de la Asociacion de Productores de Algodon, Santa Cruz.

Estacion Experimental del Universidad Autonomia, "Gabriel Rene Moreno."

Peru -

Officina del INIAP, Lima.

Officina del IICA, Lima.

Facultad de Agronomia, Universidad de Cajamarca, Cajamarca.

Estacion Experimental "Cajabamba", Cajabamba.

Estacion Experimental "Banos del Inca", Cajamarca.

Estacion Experimental "Tahuaco", Yunguyo.

Universidad Nacional Agraria La Molina, Lima.

Centro Internacional de La Papa, Lima.

Ecuador -

Estacion Experimental "Sta. Catalina", Quito.

Officina del IICA, Quito.

Officina del Secrataria de desarrollo Rural Integral proyecto, DRI-Quimiag.

Colombia -

Centro Regional del Investigacion - OBONUCO, ICA, Pasto.

Centro Nacional del Investigacion - TIBITATA, ICA, Bogota.

Centro De Investigacion "La Selva", ICA, A.A. 100, Rionegro, Antioquia.

Venezuela -

Centro Nacional Investigaciones Agropecuarias (CENIAP), Fondo Nacional de Investigaciones Agropecuarias (FONAIAP)/Apartado 4653, Maracay.

Oficina Central del FONAIAP, Maracay.

Estacion Experimental "Yoracuy", FONAIAP, Yaritequa.

Campo Experimental Quibor de Estacion Experimental "Lara", Nea Barquisimeto.

Facultad de Agronomia, Universidad Central de Venezuela, Maracay.

Apendice "B"

lugares a los que Viajo (Itinerario de Viaje desde 3 de Octubre hasta 20 de Noviembre, 1987):

October 03: Left Geneva, New York to LaPaz, Bolivia via Syracuse, New York City, Miami, Panama City and Cochabamba.

October 04: Arrived LaPaz at 9:00 a.m. In the afternoon I met with Dr. Alberto Franco, IICA representative in Bolivia and Ing. Edger Zapata, Dir. general del IBTA.

October 05: Travelled to Cochabamba. We were met by Ing. Raul Rios, Coord. Nacional del Leguminosas de Grano, who arranged our schedule in Bolivia and accompanied us in all visits. Visited the "Centro de Investigaciones Fitotecnicas de Pairumani" and discussed research in progress and needs with the station director, Dr. Gonsalo Avila and Ing. Mario Crespo, Coord de secion Haba. We also toured the station facilities, and research plots of Haba and Frijoles.

October 06: Visited the "Estaciones Experimetales La Jota" y "Chipiriri" del IBTA" as well as several fields of growers in the area. We were also accompanied by Dr. Alfredo Alvarado, Coord. of the IBTA/ Experience, Inc. farming system project.

October 07: Visited the headquarters of the 'Mision Tecnica Alemania' and several Haba y frijol fields in the 'zonas productoras del valle Alto' where the IBTA/GTZ project is being implemented.

October 08: Made a presentation at the "Universidad major de San Simon: Facultad Martin Cardenas (Agronomia)" titled "Pudriciones Radiculares en Leguminosas de Grano y Su Manejo". Also, visited the research plots on campus where several graduate students are conducting their thesis research on Haba.

October 09: Travelled to Santa Cruz and participated in a round table discussion with the plant pathology faculty, Universidad Autonomia "Gabriel Rene Moreno," the bean research coordinator and the chancellor of the University in regards to bean research needs and market situations. In the afternoon, presented a seminar to the Agronomy faculty and students, titled "Pudriciones Radiculares de frijoles y Arveja y Su Manejo."

October 10: Visited the Estacion Experimental del Universidad Autonomia 'Gabriel Rene Moreno' and toured the facilities and observed research trials of several students thesis research and a pea seed increase plot.

October 11: Travelled to Lima, Peru.

October 12: Visited the offices of INIAP and IICA in Lima and arranged for my visits in Peru.

October 13: Travelled to Cajamarca and met the Director of the Estacion Experimental "Banos del INCA". Visited the Agronomy faculty of the "Universidad de Cajamarca."

October 14: Travelled to Cajabamba and visited frijol y Arveja fields.

October 15: Travelled back to Cajamarca.

October 16: Presented a seminar to the faculty and students of the University of Cajamarca titled "Pudriciones Radiculares de frijoles, Arveja y Lenteja y Strategias pora Su Manejo."

October 17: Travelled to Lima.

October 18: Travelled to Puno with Dr. Juan Risi, colider Nacional de Leguminosas de Grano.

October 19: Visited the "Estacion Experimental Tahuaco" near Yungunyo on Lake Titicaca.

October 20: Visited the E.E. Potojani near Puno and travelled back to Lima.

October 21: Visited the "Universidad Nacional Agraria La Molina" and presented a seminar titled "Pudriciones Radiculares en Leguminosas de Grano y Su Manejo." Travelled to Quito, Ecuador.

October 22: Visited the Estacion Experimental "Santa Catalina", INIAP and toured the facilities, discussed research in progress and needs with scientists working on Legume crops and presented a seminar entitled "Pudriciones Radiculares en frijoles y Su Manejo." Also, visited the IICA/PROCIANDINO office in Quito.

October 23: Travelled to El Choupi, La Libertad, Romerillos and Jamubile (Pinchincha y Cotopaxi) with 4 scientists of the E.E. "Sta. Catalina" and examined several Haba y Arveja fields.

October 24: Visited several bean fields in the areas of Tumbaco, guayllabamba, Alchipichi and Puellaro (Pinchincha) accompanied by 5 researchers from the E.E. "Sta. Catalina."

October 25: Remained in Quito and worked on the final report.

October 26: Travelled to the areas north of Quito (Bolivar, chulunhuasi, Pimampiro, Chalguayacu and Ibarra in the Province of Imbabura and Carchi) and observed many beans and some pea fields, accompanied by Ing. E. Cevallos.

October 27: Visited bean fields with Ing. E. Cevallos near San Antonio and Natabeula. Also, visited with Ing. Jose Vasquez and observed and discussed INIAP research plots around San Antonio

October 28: Remained in Quito and worked on the final report as there was a nationwide strike.

October 29: Travelled to Quimiag (Chimborazo) and visited several beans and pea fields in the area accompanied by 4 researchers of "E.E. Sta. Catalina."

October 30: Visited Haba, lenteja and several vegetable fields in the areas of Riobamba, Urbena, Salcedo and Ambato (Chimborazo, Tungurahua and Cotopaxi).

October 31: Remained in Quito and worked on report.

November 1: Remained in Quito and worked on report.

November 2: Travelled to Pasto, Colombia by car.

November 3: Visiited the Centro Regional del Investigacion, OBONUCO, ICA, Pasto. Discussed Root Disease problems on beans, peas and breadbeans, Methedology of isolation of Pathogens, increase of inocula and inoculation methodologies. Also, showed slides and informally discussed root diseases of beans and peas.

November 4: Travelled to Bogata, arriving at about 1 p.m. Travelled with Ings. Osario, Ligarreto and Velandia to Cajica, Susa and Villadeleyva observing several pea fields.

November 5: Observed beans, peas, lentils and garbanzos in Cucaite, Tunja, Soraca, Jenesano, Tibana, quaraqua and Huatica with the above mentioned investigators and also Ing. Louis Jorge Sierra.

November 6: Visited the Centro Nacional de Investigacion TIBAITATA, Bogata and talked to Dr. Pedro Leon Gumez, Dir. Cultivos Multiples. Then visited several bean and pea fields in the company of Ings. Osorio and Valendia in the areas of Pasca, South of Bogota.

November 7: Travelled to Medellin.

November 8: Remained in Medellin, prepared the lecture to be presented in TIBAITATA on Tuesday and worked on final report.

November 9: Visited C.R.I. - La Selva, ICA in Rio Negro, observed the many nurseries of peas and beans at the station and a growers farm nearby. Also, presented a talk titled "Pudriciones Radiculares de frijoe y Arveja y Su Manejo."

November 10: Returned to Bogota and went to TIBAITATA. I had a discussion with Inj. Jorge Valandia about research being conducted at TIBAITATA on root diseases of legumes crops. In the afternoon I presented a talk titled "Pudriciones Radiculares de Leguminosas del Grano (Frijoles, Arvejas, Garbanzos y Lentegas y sus Manejo). The talk and the extensive discussion afterword lasted about two hours.

November 11: Travelled to Caracus, Venezuela arriving late at night and thus remained in the Capital city.

November 12: Travelled to Maracay by car leaving at 6:30 a.m. and went directly to FONIAP headquarters at the campus of the Universidad Central in Maracay. In the afternoon I visited with investigators at the center working in the departments of Agronomy and Plant Pathology at FONAIAP.

November 13: Travelled to Quavavao, Yaritaqua and the Estacion Experimental Yaracay where I observed bean fields and trials as well as pigeon peas experiments. I remained in Borquisimeto.

November 14: Visited the "Campo Experimental Quibor/Estacion Experimental "Loa" and several bean fields near Sanare and Quibor. Returned to Maracay.

November 15: Remained in Maracay and worked on final report.

November 16: Visited the bean growing areas of the "Valle de Tucutunemo" and the "Puerta Nigra."

November 17: Went back to CENIAP and visited with the faculty and students of the facultad de Agronomia - Instituto de genetica. In the afternoon I presented a talk titled "Pudriciones Radiculares de Caraotas en Nueva York y America Latina y Sus Manejos" at the "Instituto de Investigaciones Agronomias, CENIAP."

November 18: Travelled to Caracus and worked on final report.

November 19: Remained in Caracus and worked on final report.

November 20: Travelled back to Geneva, New York, USA.

APENDICE "C"

Nombre Y direccion de las Personas Contactadas:

Bolivia:

Dr. Alberto Franco, Representante del IICA in Bolivia, LaPaz.

Ing. Edger Zapata, Dir. General del IBTA, LaPaz.

Dr. Marcial Pastor-Corrales, Fitopathologo, CIAT, Cali, Colombia

Dr. Guillermo Hernandez-Bravo, Coord. Internacional, Leguminosas de Grano, PROCIANDINO/IICA, Quito, Ecuador.

Ing. Raul Rios, Coord. Nacional, Seccion Leguminosa, Centro de Investigaciones Fitotecnicas de Pairumani (CIFP) Cochabamba.

Dr. Gonzalo Avila, Dir. CIFP, Cochabamba.

Ing. Mario Crespo, Coord., Seccion Haba, CIFP, Cochabamba.

Dr. Alfredo Alvarado, Especialista en Suelos, Experience, Inc./IBTA proyecto, chapare, cochabamba.

Ing. Jorge Aldunate, Estacion Experimental "La Jota", IBTA, Chapare.

Ing. Eduardo Ayala, E.E. "La Jota", Chapare.

Ing. cleto prado, E.E.. "Chipiriri," IBTA.

Dr. Henning Von Platen, Economista Agricola, Mision Techica Alemania, proyecto IBTA/G.T.Z., Cochabamba.

Ing. Tito Terrazas, Contra parte Agronomia, mision Techica Alemania, proyecto IBTA/G.T.Z., Cochabamba.

Ing. Carlos Sempertegui, Mision Tecnica Alemania, proyecto IBTA/G.T.Z., Cochabamba.

Ing. Rosario Torrico, Profesora, Facultad de Martin Cardenas (Agronomia), Departmenta de Fitotecnica, Universidad de San Simon, Cochabamba.

Ing. Alfredo Perez, Coord. Frijol, IBTA, Santa Cruz.

Ing. Francisco N. Kempff Lancedo, Vicerrector, Universidad Autonoma "Gabriel Rene Moreno" (U.A.G.R.M.) Santa Cruz.

Ing. Juan Ortube Flores, Dir. de Investigacion, U.A.G.R.M., Santa Cruz.

Ing. Macos Coriyama, produccion de Semillas, U.A.G.R.M., Santa Cruz.

Ing. Lura L. de antelo, Fitopatologia, U.A.G.R.M., Santa Cruz.

Ing. Carlos Rivadeneira, Fitopatologo, U.A.G.R.M., Santa Cruz.

Lic. Ernesto Antelo C., Gerente General, Asociacion de Productores de Algodon, Santa Cruz.

Peru:

Ing. Ricardo Fort, Dir. Cultivo de Investigacion Agropecuaria, INIAP, Lima.

Dr. Tommy Fairlie, Cientifico de Suelos/Administracion de investigacion, INIAP, Lima.

Dr. Juan Risi Carbone, Colider, programa Nacional de Leguminosas de grano, INIAP, Lima.

Dr. Miguel A. Cetrangolo, Expecialista en generacion y transferencia de Tecnologia, officina de IICA, Lima.

Ing. Jorge Ferreyros, INIAP, Lima.

Ing. Alejando Carughi, INIAP, Lima.

Ing. Jesus Hipolito de la cruz, E.E. "Banos del Inca", cajamarca.

Ing. Secundo Torrones Cotrina, Fitopatologo, E.E. "Banos del Inca" y CIPA, Cajabamba Cajamarca.

Ing. Elmer Rojas, Agronomo, E.E. "Banos del Inca", Cajamarca.

Dr. Aurelio Martos Dias, Decano de la facultad y Hefe de Fitopatologia, Universidad de Cajamarca, Cajamarca.

Ing. Manuel Roncal Ordones, Prof. de Fitopathologia, Universidad de Cajamarca, Cajamarca.

Ing. Valfriano Huanco, CIPA/INIAP, Puno.

Ing. Valtasar Quiespe, mejorador, E.E. "Tahuaco," Yuaguyo.

Ing. Jose Luis Lescano, Prof. Universidad de puno, puno.

Dr. Gordon Prain, Antropologista, CIP/INIAP proyecto produccion Semillas del papa, Huanyaco.

Ing. Carlos Rodriguez Koch, Fitopatologia Dpto de Fitopatologo, Universidad Nacional Agraria La Molina, Lima.

Ing. Christian Door Remotti, Fitopathologo-Micologo, Dpto de Fitopathologia, U.N.A. La Moline, Lima.

Dra. Elsa Carbonell, Nematologa/Entomologa, Dpto. de Fitopatologia, U.N.A. La Molina, Lima.

Ing. Luis Chiappe V. Agronoms, Dpto. de Fitotecnica, U.N.A. La Molina, Lima.

Dr. Jose Bruno, Mejorador, Dpto. de Fitotecnica, U.N.A. La Molina, Lima.

Inj. Walter Giutierrez Caceres, Fitopatologo, Depto. de Fitopatologia, U.N.A. LaMolina, Lima.

Ecuador:

Dr. Guillermo Hernandez-Bravo, Coord. Internacional, Leguminosa de Grano, PROCIANDINO/IICA, Quito.

Dr. Victor Palma, Dir., PROCIANDINO/IICA, Quito.

Lcdo. Jose Villa Gomez, Admin., PROCIANDINO/IICA, Quito.

Ing. Cristoball Villasis, Coord. Nacional, Leguminos de Grano, E.E. Santa Catalina, INIAP, Quito.

Dr. Jorge Rivadeneira, Dir., E.E. "Sta. Catalina", INIAP, Quito.

Ing. Edmundo Cevallos, Agronomo, E.E. "Sta. Catalina", INIAP, Quito.

Ing. Jose Acuna, Agronomo, E.E. "Sta Catalina", INIAP, Quito.

Ing. Consuelo Estevez, Fitopatologa, E.E. "Sta. Catalina", INIAP, Quito.

Ing. Ligia Ayala, Fitopatologa, E.E. "Sta. Catalina", INIAP, Quito.

Ing. Sandra Garcas, Fitopatologa, E.E. "Sta. Catalina", INIAP, Quito.

Ing. Julio Cardenas Granja, Jefe, Dpto. de Control de Malezas, E.E. "Sta. Catalina", INIAP, Quito.

Dr. Jose Espinosa, Especialista en Quimica y fertilidad de suelos, E.E. "Sta. Catalina", INIAP, Quito.

Ing. Ivan Reinosa, Agonomo, Dpto. Tecnico, E.E. "Sta. Catalina", INIAP, Quito.

Ing. Alvaro Yepez, programa Papa-Hortalizas, E.E. "Sta Catalina", INIPA, Quito.

Ing. Maria Defaz, Nematologo, E.E. "Sta. Catalina", INIPA, Quito.

Ing. Jose Vasquez, Agronomo, INIAP, San Antonio.

Dr. Hernan Rincon, Coord., Unidad de Communicacion, CIP, Lima, Peru.

Dr. Jaime Roman, Sr./Representante del IICA en Quito.

Ing. Jose Ochoa, Fitopatologo, E.E. "Sta. Catalina", INIAP, Quito.

Ing. Carlos Monar, Agronomo, INIAP/DRI Proyecto, Quimiag.

Columbia:

Inj. Omar Guerrero G., Programa de Fitopatologia, ICA-OBONUCO, A.A. 339, Pasto.

Inj. Nestor Angulo, Programa de Leguminosas, ICA-OBONUCO, A.A. 339, Pasto.

Inj. Dalton Zambrano, Director, Centro Regional del Investigacion-OBONUCO, ICA, A.A. 339, Pasto.

Inj. Oscar Checa, Programa de Hortilezas, ICA-OBONUCO, A.A. 339, Pasto.

Inj. Jaime Osorio, Coord. Nacional, Programa Hortelizas, ICA, A.A. 339, Pasto.

Inj. Jorge Valandia, Fitopatologo - Leguminosas, ICA, A.A. 151123, Bogota.

Inj. Gustavo Ligarreto, Mejorador, Leguminosas, ICA A.A. 151123, Bogota.

Inj. Louis Jorge Sierra, Agronomo, ICA No. 1, Qaraqua.

Dr. Pedro Leon Gumez, Dir. de la Unidad de Cultivos multiples, Centro Nacional de Investigacion - TIBAITATA, ICA, Bogota.

Ing. Emile Girard Obregon, Hortalizas/Arveja, C.R.I. LaSelva, ICA, A.A. 100, Rio Negro.

Dr. Mario Lobo A., Coord. Nacional programa de Genetica, C.R.I. - La Selva, ICA, Rio Negro.

Ing. Roman Alberto, Mejorador, Frijol, C.R.I. - LaSelva, ICA, Rio Negro.

Ing. Rafael Navarro, Fitopatologo, ICA A.A. 51764, Medellien.

Venezuela:

Ing. Simon Ortega, Coord. Nacional, Leguminosas de Grano, CENIAP/FONAIAP, Apartado 4653, Maracay.

Ing. Alfredo Barrios, Agronomo, CENIAP/FONAIAP, Maracay.

Ing. Amado Rondeon, Fitopatologo, CENIAP/FONAIAP, Maracay.

Ing. Francisco Teraswa, aAgronomo, F.T. - Pesquisa E. Sementes, Ponta Grossa, Parana, Brazil.

Ing. Francisco Fernandez, Dir. General, DIPRO/AGRO C.A., Distribucion y produccion agropecuaria, A.P. 76.944, Caraens, Venezuela.

Dr. Santiago Rodriquez Carasquel, Gerente General del FONAIAP.

Inj. Luis Alorado Ramos, Gerente de Investigaciones, FONAIAP.

Dr. Yolanda Guevara, Microbiologia/Bacteriosis, CENIAP, Maracay.

Ing. Manuel Salas, Agronomo, Estacion Experimental 'Yaracuy', Yaritagua.

Ing. Augusto Aponte, Agronomo, Estacion Experimental Yaracuy.

Sr. Domingo Garcia, Asistante/Leguminosa, Estacion Experimental, Yaracuy.

Sta. Gubilaith Duran, Asistante/Programa Leguminosas, Estacion Experimental Yaracuy.

Dr. Orangel Borges, Facultad de Agronomia, Universidad Central de Venezuela, Instituto de genetica, Maracay.

Ing. Alberto Salih, FONAIAP, Maracay.

Ing. Atilio Higuero Moros, Univ. de Zulia, Facultad de Agronomia, Apdo. 526, Maracaibo.

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3. Abawi, G. S. and M. A. Pastor-Corrales. 1987. Charcoal rot screening procedure and virulence of isolates of *Macrophomina phaseolina* on beans. Plant Disease 71: (in press).

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1. Mohamed, H. A. R. 1982. Major disease problems of faba beans in Egypt. PP. 213-225. In: G. Hawtin and C. Webb(eds.), Faba Beans Improvement: Proceedings of the Faba Bean Conference held in Cairo, Egypt, March 7-11, 1981. For ICARDA: Martinus Nijhoff Publishers, The Hague, The Netherlands. PP. 398.

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Apendice "E"

ABREVIACIONES

IICA:	Instituto Interamericano de Cooperacion para La Agricultura.
INIAP:	Instituto National de Investigacion Agropecuaria (Peru/Ecuador).
PROCIANDINO:	Programa Cooperativa de Investigacion Agricola para La Subregion Andina.
CIPA:	Centro de Investigacion Y promocion Agropecuaria (Peru).
CIAT:	Centro Internacional de Agricultura Tropical (Columbia).
IBTA:	Instituto Boliviano de Technologia Agropecuaria (Bolivia).
CIP:	Centro Internacional de La papa, Peru.
ICA:	Instituto Colombiano Agropecuaria (Colombia).
BID:	Banco Interamericano de Desarrollo.
FONAIAP:	Fondo Nacional de Investigaciones Agropecuarias (Venezuela).
CENIAP:	Centro Nacional de Investigaciones Agropecuarias (Maracay), (Venezuela).
ICARDA:	International Center for Agricultural Research in The Dry Areas (Syria).
ICRISAT:	International Crops Research Institute for The Semi-Aird Tropics (India).
CGIAR:	The Consultative Group for International Agriculture Research.

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