THE SEED UNIT AT CIAT

A REPORT ON 1984-86

C O N T E N T S

OVERVIEW i

RATIONALE FOR A SEED UNIT AT CIAT

Limited Availability of Seed at National Level 1

Constraints of Seed Preograms and Industries in Latin America 2

Creation of the Seed Unit at CIAT 3

ACHIEVEMENTS DURING THE FIRST PHASE -- 1979-83 6

ACHIEVEMENTS DURING 1984-86

Training and Conferences

Short Courses 8
In-service 11
Degree Related Training 11
Subregional and In-country Courses 12
Review of Training Activities 15
Workshops and Seminars 15

Technical Collaboration

National Level 19
Subregional Level 21
International Le el 22

Seed Production and Supply 23

Research and Development

Bean Seed Research 29
Rice Seed Research 33
Tropical Pasture Seed Research 34

Information and Communication

Publications 36
Audiotutorials 38
Seed Network Development 39

Personnel

Seed Unit Staff 45
Research Fellows 46
Visiting Scientists Consultants and Other Support 47

Appendix 1 National Institutions and Private Enterprises from which Course Participants came in 1984-86 53

Appendix 2 Non-CIAT Specialists who contributed to Seed Unit Program Activities 1984-86 57

Appendix 3 Seed Unit Staff in 1986 59

F I G U R E S

1	National Seed Program and Training Participant Network (1984-86)	16
2	National Seed Program and Training Participant Network (1979-86)	20
3	Regional Seed Association Network	40
4	Subregional Network	42
5	University Network	43

T A B L E S

1	Number of Seed Unit Training Participants in Five Categories for the Years 1984-86	9
2	Distribution of Training Participants by Sector or Types of Employing Organizations 1984-86	10
3	List of Degree Program Candidates 1984-86	11
4	Participation in Training Activities held at the Subregional and National Level 1984-86	13
5	Summary of Workshops Number of Participants and Sponsorship 1984-86	18
6	Seed Multiplied during the 1984-86 Period	24
7	Seed Supplied during 1984-86 Period	25
8	Service Tests Conducted in the Quality Control Laboratory during 1984-86	28

OVERVIEW THE SEED UNIT REPORT ON 1984-86

The Seed Unit was started in 1979 to assist the development of the seed sector in Latin America and the Caribbean with a special emphasis on the crop commodity mandate of CIAT but not limited to those crops The Swiss Development Cooperation (SDC) provided the primary financial support for the development of the Unit through the first five years The achievements of the Unit through those years 1979-83 is summarized in a special report of that period Because of the recognition of the value of the work of the Seed Unit in the region and to the CIAT Commodity Programs the SDC agreed to continue support to the Seed Unit through the period 1984-86 This report summarized these last three years of the Seed Unit's work

Training and Conferences

The development of the human resource base in the seed sector through training has been a major emphasis of the Seed Unit Increased emphasis has been placed on advanced and/or specialized courses tailored to the needs of the region during the 1984-86 period Three advanced courses were offered with total support from the Seed Unit and two were jointly sponsored with two different CIAT Commodity Programs with a total of 143 course participants Intensive seed production and technology courses of nine-weeks duration have also been offered at CIAT Three intensive courses were offered by the Unit with 85 course participants One of these courses was in English especially for the benefit of the Caribbean region

Training has also included assistance to the Bean and Rice Commodity Program courses and to the international courses offered by CIMMYT Twenty in-service trainees have worked with the Seed Unit and three thesis candidates have completed their research with the Unit The work of the thesis candidates was done in cooperation with the Bean Rice and Tropical Pasture Commodity Programs Twelve in-country courses

were assisted by the Seed Unit staff Two seminars were assisted in countries Seven subregional courses were held in cooperation with interested organizations or associations

Two workshops were organized totally by the Seed Unit and held at CIAT to meet special needs in the region One workshop was held at CIAT with joint sponsorship of the Seed Unit and the International Seed Testing Association A workshop was held at CIMMYT on Sorghum Seed Production in cooperation with ICRISAT INTSORMIL and INIA of Mexico The Pan-American Seed Seminar and the Seminar for Seed Associations were held at CIAT with some assistance from the Seed Unit All of these workshops contributed to the process of network development in the region

All of these training and conference events were assisted considerably by non-CIAT specialists from within and outside the region These kinds of contributions from outside CIAT also contribute much to the seed sector network development process

Technical Collaboration

Technical collaboration concentrated primarily at the national level to help countries achieve their objectives for the development of the seed sector Visits meetings and correspondence with former course and workshop participants leaders in national seed programs seed associations seed enterprises and universities provided many ways to assist the seed sector at the national level

During 1986 a special task force of Commodity Program representatives the administration and the Seed Unit staff have shared experiences and concentrated especially on ways to cooperate more fully in helping countries achieve their objectives at the national level Mechanisms are being developed to help countries accelerate the use of improved varieties through increased Seed Unit - Commodity Program joint activities in targeted locations

Various mechanisms have been developed and are used to collaborate with groups of countries at a subregional level In Central America many activities have been carried out in cooperation with a Regional Technical Committee and a Regional Association of Seed Technologists both of which were formed with Seed Unit assistance A similar working relationship has been developed with the Junta Acuerdo de Cartagena (JUNAC) in the Andean zone especially in the area of training and conferences and to help the process of cooperation within the subregion An agreement with the Centro de Estudos e Treinamento em Tecnologia de Sementes e Mudas (CETREISEM) at Pelotas in Southern Brazil is providing a mechanism to not only assist that center as it works within Brazil but also to offer training opportunities for countries in the Southern Cone

Links have been further strengthened with the maize and wheat programs of CIMMYT and the ICRISAT-INTSORMIL sorghum work in the region Assistance was provided to a study of the need for a Seed Unit type of program in Africa and materials were supplied to ICARDA where a seed technologist is working with the potential of developing a seed sector improvement effort to help countries in the Middle East and North African region The other international activity with potential impact outside the Latin American and Caribbean region was the preparation of a paper for the International Center Directors on The Role of the IARCs in Seed Research and Seed Sector Improvement This paper is currently being studied by the Directors

Seed Production and Supply

The development of effective basic seed production capabilities within national programs is a major objective of the Seed Unit Similarly the development of seed production and supply capabilities at the commercial level to move more improved varieties to farmers is equally important In addition to helping these developments through training conferences and technical collaboration some basic seed of

the most promising varieties was produced and sold primarily to interested national programs During the three years the volume of beans rice and tropical pasture seed sold totalled 150 tons with an approximate value of US$130 000 This work has been done in cooperation with the Commodity Programs and the Farm Operations Unit of CIAT

The seed drying and conditioning facilities and the seed laboratory of the Seed Unit have been used to provide service to those interested within and outside CIAT Approximately 690 M T of seed were conditioned during the three years The seed laboratory did over 10 000 tests Both of these facilities were used extensively as an integral part of the training activities

Research and Development

Most of the research done in the Seed Unit during the three years was closely linked to thesis work and was in association with one of the Commodity Programs In the long-term the Workshop on Research and Training can have a substantial impact on research by achieving increased cooperation and coordination throughout the region As a result of that workshop the Unit has now identified major research priorities for the future and is working on ways to play a more effective catalytic role in developing linkages among seed production and technology researchers in the region This report summarizes the major research work done in beans rice and tropical pastures during the period

Information and Communication

The Seed Unit s objective is to use information and communication activities as a tool for rapidly strengthening the integration of the seed network New initiatives with publications have included the development of a Directory of Seed Specialists and Institutions in Latin America and the Caribbean a Seed Science and Technology Thesaurus in English and Spanish and a Glossary of Terms Used in Seed A book with

Conclusion

The 250 people in training with the Seed Unit during the period when combined with those trained during the first five years adds over 500 better qualified seed technology and production personnel to the region s seed sector Seed technology and production training in subregions and within countries has greatly increased during the past eight years Courses of this kind with which the Seed Unit has been involved have included over 1100 people Courses developed by former course participants and others through the region have reached hundreds of other people The human resource base has improved! All evidence indicates a high percentage of these people are remaining in the seed sector and equally important they are assuming more and more responsibility Interest and motivation within the seed sector has greatly increased New seed enterprises have been formed Increased effort is placed on improving the quantity and quality of seed for small farmers

Even with these improvements great differences exist among countries and in regions within countries The rate of spread of improved varieties is inadequate The maximum benefit-cost ratio is not being achieved from the investments made in research Public-private sector cooperation is often weak Compared to the potential of what could be achieved the region has much to do before it has a highly dynamic seed sector in every country A solid foundation has been started in many countries upon which to build A few countries are still identifying the pieces to start the foundation The Seed Unit and the CGIAR Commodity Programs in the region can contribute much more to the building of a truly first class seed sector throughout the region

Latin American authors on Seed Production and Technology is under preparation Three workshop proceedings were published and six other publications are in various stages of completion The newsletter was enlarged and the mailing lists were improved and categorized Work continued on the preparation and completion of audiotutorials

The development of the seed sector networks continues Among these networks are the seed technology and trade associations those at the subregional level the universities with seed production and technology courses and research work and the former course participants and leaders in national programs

Personnel

The Seed Unit staff consists of two senior scientists six junior scientists two secretaries four technicans and seven laborers The only staff addition during the period was a seed information specialist The staff was organized into four working groups to assist the program planning and follow through with maximum staff participation To complement this small staff the Seed Unit continued to utilize many visiting scientists consultants research fellows and guest lecturers Over four man years of time were utilized from these specialists In additional much assistance was received from the Commodity Programs and Units of CIAT as well as the other International Centers Mississippi State University's seed specialists continued to assist the Unit's program with staff time amounting to two man months Many in the region especially people from the seed sector in Colombia assisted in numerous ways

Minor improvements in the facilities and equipment of the Seed Unit were made during the three years to improve the efficiency and effectiveness of the operation

the needed external professional talent in seed production and in maintaining support to programs long enough for them to become firmly established Research programs at the International Centers and the national institutes have developed promising materials but often find it difficult to move such materials through these inadequate national seed supply systems

Constraints of Seed Programs and Industries in Latin America

An analysis of the situation of seed programs and industries in Latin America was prepared by the Seed Unit staff[1/] and the following main constraints have been identified

a) The greatest deficiency uncovered in most country studies was a lack of clear and consistent policies for seed program development Country situation profiles prepared for this analysis show that 15 out the 22 Latin America and Caribbean countries studied do not have available a clearly defined set of seed policies

b) The next most limiting factor uncovered was an inadequate number of properly trained and experienced seed professionals People with some training have not had the opportunity to further upgrade their training and to relate to other professionals with similar interests and problems

c) Seed quality control programs were found to be very weak in the majority of the countries Although most of the countries have some kind of legislation on paper implementation of quality control activities was found to be poor These conditions have often resulted in seed of questionable quality being supplied to farmers and a loss of confidence in the materials available from both the private and public sectors

---

1/ Country Seed Profile Reports Internal Seminars Seed Unit 1978-80

THE SEED UNIT AT CIAT
A REPORT ON 1984-86

RATIONALE FOR A SEED UNIT AT CIAT

The need for a Seed Unit grew out of two overlapping problem areas that hampered rapid agricultural development based on improved production technology

1) Limited availability of good quality seed of improved varieties

2) Only an incipient seed industry which needs determined and systematic outside assistance to develop rapidly in most countries

Limited Availability of Seed at National Level

During recent years national and international research programs have expended considerable efforts to develop new crop varieties with increased yield potential The investment in agricultural research by many national governments of the Third World and the contributions for international research by developed countries and funding agencies have greatly increased during the last 20 years As a consequence a large number of new improved varieties has been developed and released Yet the actual increases in food production have not been concomitant with the magnitude of these research efforts One important reason for this is that adequate seed supplies of the improved varieties are limited

The question confronting many national programs donors and technical assistance agencies is how this limitation can be overcome National programs have the leading role to play in developing seed programs and industries but many countries especially the least developed ones have difficulties building a cadre of trained people in establishing clear strategies and in developing proper facilities Donors and technical assistance agencies have limitations in supplying

of an international input in the development of national seed programs From its inception the Center had been concerned that a strong seed sector existed in Latin America capable of delivering seed of improved materials to the producer level In addition CIAT had available the necessary factors for hosting a successful seed effort physical facilities for seed production an extensive training infrastructure expertise on seed-related aspects and an international mode of operation

By mid 1977 the management of CIAT had come to the conclusion that it would be desirable not only to increase seed training but also to establish at CIAT a program to catalyze the development of adequate structures for seed activities in Latin America and the Caribbean Assistance from the Rockefeller Foundation was requested to develop a proposal to be presented to interested donors for the creation of a Seed Unit at CIAT The Rockefeller Foundation assigned an experienced seed specialist to CIAT for that purpose by October 1977 and in addition to providing his salary and perquisites until other funding could be found approved a grant for US$23 400 to initiate these activities

At the CIAT Executive Committee meeting of March 1978 the Director of International Cooperation presented the need for a Seed Unit which would provide training and conduct research in seed production and described the actions that were being executed in the preparation of the proposal for a special project The proposal discussed in that meeting contemplated to provide seed training capabilities and technological support for national programs to support CIAT s own commodity programs by producing foundation seed and to do some research in seed physiology and technology It was envisaged that a 5-year program would be required with a staff of two senior members the cooperation of consultants and additional physical facilities Management reported in those meetings that support was being sought from UNDP AID and Title XII (for collaboration with Mississippi State University) The Executive Committee reacted very favorably to this report and suggested that two additional funding agencies should be informed of CIAT s proposal

d) Limited breeder and basic seed supplies for further multiplication by local seed enterprises were found to be an additional major limiting factor In many instances improved cultivars have been released by national programs with no accompanying basic seed available for subsequent multiplication

e) Seed drying conditioning and storage was also found to be inadequate in most of the countries in the region

f) Marketing systems particularly for farmers with small holdings were found to be weak and limited

The task of overcoming these limitations is a difficult one and cannot be accomplished quickly It requires sustained effort by national governments seed enterprises and support agencies A cadre of properly trained seed technologists must also be built Unfortunately in most of the countries of the region these efforts were varied and limited No catalyst existed to stimulate action and help consolidate achievements For this reason a Seed Unit was established at CIAT to serve in a catalytic role to help develop a strong seed sector in the region that will constitute the missing link needed for increased production especially of the CIAT commodities and for agricultural development in general

Creation of the Seed Unit at CIAT

At the time of the 1977 Technical Advisory Committee review of CIAT program activities the following recommendation was made

A major direct effect on crop production is known to be achieved by clean seed but national arrangements for the multiplication and distribution of clean seed of improved varieties is sadly deficient throughout the region Training in this technology should therefore have a high priority in CIAT programmes and should be available to suitably qualified personnel of commercial seed producing enterprises CIAT moved to meet this need and was an obvious choice for the location

ACHIEVEMENTS DURING THE FIRST PHASE -- 1979-83

During the first phase of the Seed Unit's activities the physical facilities were constructed equipment was installed and the staff assembled and trained The Unit conducted six intensive courses and four advanced courses with 283 participants In-service training was offered for 15 people and six scholars completed thesis work In addition the Unit organized or assisted 12 in-country and subregional training courses with 267 participants Five workshops were held on topics of high relevance to the needs of the region with 319 people participating These training and conference activities did much to initate the strengthening of the human resource base of seed production and technology specialists in the region

Work with countries in the region individually and in groups on a subregional level started a technical collaboration program designed to help countries clarify their goals and strategies It also provided a means to follow-up with many former course participants to help assure that they made the best possible application of the training received These activities also included the organization of two workshops in Central America the formation of a technical working group in that region and the formation of a technical seed association Similar initiatives were taken in the Andean zone with the Junta Acuerdo de Cartagena (JUNAC) that resulted in support from them for special training for people from that region A collaborative agreement was signed with the Centro de Estudos e Treinamento em Tecnologia de Sementes e Mudas (CETREISEM) at Pelotas in southern Brazil to assist the Southern Cone and Brazil through training activities A Seed Liaison Committee with representatives from seed programs in the region and from the International Centers with program activities in the area was formed and works to improve cooperation among the agencies

The Seed Unit in cooperation with the Farm Operations Unit and the Bean Rice and Tropical Pastures Programs produced and sold 150 tons of basic seed for use in further multiplications in 16 countries The seed drying and conditioning facility was used to provide services for seed producers in the area and the Colombian research program

In September 1978 the Swiss Development Cooperation indicated interest in the proposal and in November an agreement for a 5-year project was signed in Washington The special project was initiated on January 9 1979 The objectives of the agreement with the Swiss government are the following

'To create a Seed Unit at CIAT to

a) Train personnel in government and private institutions primarily from Latin American and Caribbean countries in various aspects of seed industry and seed program development

b) Extend technical collaboration to countries in the region interested in seed program development with the aim of expanding the production of high quality seed of improved cultivars at all levels from the breeder to the commercial stage with main emphasis on but not restricted to the commodities with which CIAT works

c) Conduct specific research in seed technology highly relevant to CIAT commodity interests and relevant to problems of the impact areas

d) Provide CIAT with a single unit to cooperate with commodity programs in multiplying conditioning storing and distributing advanced experimental material or breeder and basic seed to collaborating countries for their further multiplication

ACHIEVEMENTS DURING 1984-86

During the first five years the Seed Unit was changed from an idea to an active and dynamic tool for seed program and industry development in the region These achievements reinforced the basic concept that a Unit of this kind is a valuable addition to the total agricultural reseach and development effort in the region The strong and highly positive response from collaborating national seed programs in the region and the successes achieved resulted in continued support from the SDC during the period from 1984-86 During the period the Seed Unit became a restricted core project of CIAT The activities and achievements of the Unit are divided into the five main programs of work--training and conferences technical collaboration seed production and supply research and development and communication and information

Training and Conferences

An emphasis on training continued during the period from 1984-86 but special attention was given to the advanced and/or specialized courses A combination of intensive seed production and technology courses of nine weeks advanced courses of four to five weeks in-service training thesis programs and in-country training were used to achieve the training objectives Table 1 shows the number of participants in each category

Short Courses

The Postgraduate Courses in Seed Production and Technology covered the different aspects of seed production conditioning and quality control at the field laboratory and marketing level These subjects combined with discussions on seed program and enterprise development and management provided an over-all view for the basic understanding needed by seed technologists Lectures field and laboratory exercises round tables case studies and visits to seed enterprises and production fields were used as educational methods Beans rice tropical pastures maize and sorghum were the main crops for teaching purposes One of the two courses was offered in English

Although research was not a major emphasis of the Seed Unit during the period four research projects were completed These were collaborative projects with the Bean Rice and Tropical Pasture Programs on seed quality of pasture species and the environmental-variety interaction with respect to characters used in describing bean and rice varieties A fourth M Sc candidate worked on seed conditioning from the standpoint of agricultural economics Six visiting scientists from North America and Europe contributed to development work by adapting existing temperate technology for application to the seed problems of the region

In communication and information twelve issues of a newsletter were published Five audiotutorial units were developed totally and assistance was given to the preparation of others Training course material was prepared a book on managing seed programs was translated and published and a technical manual on varietal description was prepared and published Proceedings for all workshops were published

Support to the first five years of activities came from sources beyond the Swiss Development Cooperation (SDC) grant helped to achieve and exceed the objectives The combined support from other sources amounted to $425 000

Participants in the training courses have come from a number of kinds of organizations and from 26 countries in Latin America and the Caribbean region and 5 countries from outside the region (Appendix 1) Although 67 percent of the participants came from public seed development production and research programs the public and private sector seed enterprises accounted for 21 percent of those trained Universities in the region accounted for another 12 percent (Table 2)

A survey was completed of 297 former Seed Unit course participants through the 1982 period and their supervisors The results of the survey were quite positive All course participants returned to their jobs immediately after training and 94 percent of those responding were on seed sector activities at the time of the survey Alumni found 70 percent of the course content to be highly relevant to their present work The professional development of course participants clearly had been affected positively A copy of the detailed study is available in English and Spanish

Table 2 Distribution of Training Participants by Sector or Types of Employing Organizations 1984-86

Sector of Origin of Participants	Number of Participants	%
Public Research	72	29
Seed Development Quality Control	80	32
Public National Seed Enterprises	15	6
Private Seed Enterprises	38	15
Regional Research - Development Organizations	15	6
Universities	31	12
	251	100

Table 1 Number of Seed Unit Training Participants in Five Categories for the Years 1984-86

Category		Number of Participants
Intensive Courses	(3)	85
Advanced Courses	(5)	143
In-service Training		20
Thesis Programs		3
At CIAT Subtotal		251
In-country and Subregional Training Courses		574
Total		825

The Advanced Postgraduate Courses specialized on aspects of seed production and technology for the benefit of more experienced seed technologists One advanced and/or specialized course was offered on each of the following topics Seed Enterprise Management and Marketing Seed Quality and Disease Control Seed Conditioning Facility Management and Rice Seed Production Two such courses were offered on Tropical Pasture Seed Production in cooperation with the Tropical Pasture Program

Approximately 60 percent of the participants time in both types of courses was spent doing practical exercises in the field laboratory or conditioning facilities Post-course evaluations and later follow-up show substantial gains in knowledge and skills on the part of training participants as well as increased motivation and levels of interest in contributing to the further development of incipient seed programs

Subregional and In-country Courses

To achieve seed improvement objectives the Seed Unit increased its work at the subregional level et al Central America and the Carıbbean the Andean Zone and the Southern Cone Training courses were held in all of these subregions during the three years as planned These courses the year held and the number of participants in each is shown in Table 4 The courses in the Andean Zone were provided with the financial and administratıve support of the JUNAC The course at CETREISEM in Brazil was also assisted by the Instituto Interamericano de Cooperacion para la Agricultura (IICA)

In-country courses had been assisted for many years by FAO and Mississippi State University before the Seed Unit existed FAO continues to support in-country training independent of Seed Unit activities Mississippi State University has occasionally assisted an in-country courses during the past three years Although the Seed Unit's greatest comparative advantage is in regional training at CIAT countries increasingly request varying kınds of help from the Seed Unit in their in-country training Emphasis continues to be placed on the need to develop a national strategy for seed training that would include a strong emphasis on in-country training Assistance to in-country training has taken many forms including help in organizıng the course only particıpation as requested or supplying training materials

Assistance to commodity courses included participation of the Seed Unit staff in the short courses offered by the bean and rice programs In addition 3 staff members cooperated with the CIMMYT maize and wheat programs on six different occasions during the period to provide a one-week seed production and technology section in the regular production and breeding courses in Mexico This cooperative effort in training between CIMMYT and CIAT continues to be quite successful and an important component of CIMMYT's training activities

In-service

Individualized in-service training was provided to 18 people in seed testing production and conditioning Interest continues to develop for in-service training The time available for the staff to devote to this training is limited Many of the programs have been linked to courses as follow-on activities Those who have participated in such training have been well satisfied

Degree Related Training

During the three years two Master of Science theses and one Ph D dissertation have been completed through the assistance of the Seed Unit In all cases these research programs have been conducted in cooperation with one of the CIAT Commodity Programs Table 3 summarizes the information about all of these degree programs

Table 3 List of Degree Program Candidates 1984-86

Name	University and Degree	Country	Discipline
Carmona Ricardo	Universidad Federal de Pelotas (M S)	Brazil	Seed Production-Tropical Pastures
Ramírez Hector	Universidad Federal de Pelotas (M S)	Paraguay	Seed Quality - Rice
Wilson Dale	Ohio State University (Ph D)	USA	Seed Quality - Beans

Table 4 Continued

Guatemala	Development of the Seed Enterprises with Emphasis in Management and Marketing**	29	1985
	Central American Course on Bean Varietal Description**	18	1985
	Bean Seed Production for Small Farmers*	30	1986
Mexico	Rice Genetic Purity Short Course*	25	1984
Nicaragua	Rice Variety Description and Identification*	30	1984
Panamá	Seed Technology Short Course (FAO supported)**	23	1984
	Seed Enterprise Management and Marketing Course**	20	1986
Venezuela	Seed Enterprise Management and Marketing Course**	32	1986

* National Level
** Subregional Level

Table 4 Participation in Training Activities held at the Subregional and National Level 1984-86

Location	Activity	Number of Participants	Year
Argentina	Seed Production Technology*		1986
Bolivia	III National Seed Round Table*	111	1985
	Curso Nacional sobre Certificación y Control de Calidad*	30	1986
Brazil	Breeder and Basic Seed Production**	22	1986
Colombia	Seed Conditioning Short Course*	18	1984
	Varietal Description Seminar*	11	1984
	Seed Certification and Quality Control (Andean Pact supported)*	21	1984
	Handling of Cassava Planting Material*	17	1985
	Analysis of Tropical Pasture Seed Quality*	26	1985
	Small Farmer Bean Seed Production Workshop*	17	1985
	Rice Seed Production for Santa Catarina Brazil*	15	1986
Dominican Republic	Rice Variety Description and Identification*	25	1984
	Seed Production Short Course*	20	1984
Ecuador	Development of Seed Enterprises with Emphasis in Management and Marketing**	29	1985

Figure 1

National Seed Program and Training Participant Network[1]

[1] Total number trained by country 1984 86 illustrated

Review of Training Activities

Figure 1 summarizes the number of people trained by country of origin during the 1984-86 period Course participants came from 99 national institutions and seed enterprises located in 26 countries Appendix 1 lists the organizations and countries Table 2 summarizes the number of professional trained by different sectors and types of employing organizations It shows 61 percent of the participants came from the public research and seed development and quality control programs with 21 percent from seed enterprises

Assistance to training was provided by the CIAT staff members of the commodity programs the Farm Operations Unit the Genetic Resources Unit the Communication/Information Support Unit Training and Conferences plus the Seed Unit From outside CIAT assistance was obtained from several specialists Among the institutions assisting were Mississippi State University Oregon State University Iowa State University the International Executive Service Corps the International Fertilizer Development Center in the USA the Fondo Nacional de Investigaciones Agropecuarias (FONAIAP) and the Universidad Central de Venezuela Venezuela the Universidad Federal de Pelotas Brazil the Universidad Autonoma Chapingo Mexico and the Instituto Colombiano Agropecuario (ICA) Colombia The Association of Official Seed Certifying Agencies (AOSCA) USA the Colombian and Brazilian seed industries other specialists in the region and visiting scientists research fellows and consultants also helped A total listing of these individuals is given in Appendix 2 Without their contributions the training effort could not have been as effective as it was

Workshops and Seminars

Three workshops were held at CIAT under the sponsorship of the Seed Unit One of the workshops was jointly sponsored with the International Seed Testing Association and included several participants from outside the region In addition assistance was provided to the Panamerican Seed Seminar and the Seminar for Seed Associations both of which were

Table 5 Summary of Workshops Number of Participants and Sponsorship 1984-86

Workshop		Number of Participants	Sponsorship
Pasture Species Seed Testing	(1984)	20	ISTA-CIAT
Research and Training in Seed Production and Technology	(1985)	50	CIAT
Sorghum Seed Production and Technology Workshop	(1985)	127	CIAT ICRISAT INTSORMIL INIA
Pan-American Seed Seminar	(1985)	253	ACOSEMILLAS*
Improved Seed for Small Farmers	(1986)	50	CIAT
Seminar for Seed Associations	(1986)	33	ALES*

* Held at CIAT and assisted by the Seed Unit

held at CIAT but largely financed by the Colombian Seed Producers Association the Latin American Association of Seed Experts and the participants themselves A workshop was held at CIMMYT in cooperation with ICRISAT INTSORMIL and INIA of Mexico on Sorghum Seed Production and Technology Table 5 summarizes the workshops held the number of participants and the sponsorship The workshop on Improved Seed for Small Farmers is especially interesting because it was a follow-up workshop to the first one sponsored by the Seed Unit in 1982 Progress made in Colombia and other countries in the region in developing increased means to produce seed by and for small farmers made it possible for this workshop to review activities being carried forward in the region and gain from the combined experiences of the participants The interest and response of participants to this workshop was quite positive Production sites in Colombia were visited

All of these workshops provided a forum for professionals with similar interests to exchange views and work together in developing plans recommendations and fresh approaches to help seed activities advance more rapidly They contributed especially to the development of the seed network in the region

During the period the Seed Unit staff contributed to several national seed seminars and events designed to support developments within countries

The achievements with the workshops could not have been possible without the help and support of many non Seed Unit staff members in CIAT and outside CIAT Appendix 2 lists the non-CIAT individuals and organizations who assisted

Figure 2

National Seed Program and Training Participant Network[1]

[1] Total number trained by country 1979 1986 illustrated

Technical Collaboration

National Level

Technical collaboration takes many forms at the national level and is vital to achieving the seed related objectives of the Commodity programs of CIAT and the Seed Unit During 1986 a special task force of Commodity Program representatives the administration and the Seed Unit staff have shared experiences and concentrated especially on ways to cooperate more fully at the national level Developing closer linkages between the crop research programs and the seed sector is essential at the national level As the Seed Unit works with not only the CIAT Commodity Programs but also those of CIMMYT CIP and other International Center activities in the region a more sharply focused effort at the national level can contribute to an accelerated use of improved varieties in each country

For the Seed Unit the interaction with former training and workshop participants at the national level is a means to help them achieve their goals and apply knowledge learned in CIAT courses and workshops Through visits meetings and correspondence links are maintained with many former course participants leaders in national seed programs seed associations seed enterprises universities subregional groups and co-workers in sister International Centers and development agencies in the region

During the period former course participants and seed technologists with close links to the Seed Unit have assumed more leadership positions As these people assume more responsible for the seed activities in the region the impact of the Unit s work increases Figure 2 shows the number of people trained by country since the Seed Unit started and illustrates the network development process that is going on in the region This human resource base is becoming increasingly valuable

offered at that location for the countries in the Southern Cone contributed not only technical information but also steps toward closer cooperation among seed programs in that region

International Level

In addition to improved collaboration at the national and subregional level links were further strengthened with the maize and wheat programs of CIMMYT and the ICRISAT-INTSORMIL sorghum work in the region

At the request of the International Center Directors concerned with Africa Winrock International organized a team to study the need for a Seed Unit type of program in Africa The CIAT Seed Unit contributed to the development of the study and the team studied the Seed Unit's activities The International Center for Agricultural Research in the Dry Areas (ICARDA) added a seed technologist to its staff Materials were supplied to that program and a visit of their seed specialist to CIAT provided a chance for him to become better acquainted with the nature of the Seed Unit's activities

A paper was developed for the International Center Directors on The Role of the IARCs in Seed Research and Seed Sector Improvement The paper is currently under review by the Directors and can become the basis for future seed activities by the IARC system

The country profiles and status of the seed sector were revised during 1986 to provide a further assessment of the progress being made by individual countries With this information the Seed Unit and the Commodity Programs can better assess needs and the future direction of technical collaboration at the national level

Subregional Level

The initiatives taken during the first five years of the Seed Unit activities were followed up and built upon as the staff worked especially in Central America and the Caribbean and the Andean Zone The Regional Technical Committee and the Regional Association of Seed Technologists in Central America continued to provide leadership to a regional effort The seed section of the Annual Programa Cooperativo Centroamericano para el Mejoramiento de Cultivos Alimenticios (PCCMCA) meetings were organized by these groups with Seed Unit support The groups help to coordinate and sponsored training and other activities in the subregion Work on publications of joint interest continued Long-term training plans were developed An increased flow of technical information and the sharing of statistics on the status of seed supplies occurred

In the Andean Region the agreement between the JUNAC and CIAT contributed to seed sector development in the region primarily through training The Seed Enterprise and Marketing Courses provided many opportunities for the participants to gain not only knowledge but also to develop new relationships that can help the exchange of seed within the region A direct result of one of the courses was the formation of a Seed Association for the Andean Region (ARAS) JUNAC supported 11 training participants from the region in regular courses offered by the Seed Unit

The collaborative agreement with CETREISEM in Brazil has made it possible to continue to exchange staff for training purposes The Seed Unit has received three M Sc candidates from that program The course

Table 6 Seed Multiplied during the 1984-86 Period

Kind of Seeds and Variety			Quantity of Seed Multiplied (Kg)
Beans			
A 36		90	
A 486		824	
BAT 58		466	
BAT 1297		485	
BAT 1676		562	
ICA Pijao		917	
PAI 29		124	
PAI 92		120	
PVA 782		201	
PVA 916		369	
PVA 1261		634	
PVA 1438		52	4 844
Pastures			
Grasses			
Andropogon gayanus	621		161
Brachiaria dictyoneura	6133		94
Legumes			
Centrosema pubescens	438	40	
Centrosema acutifolium	5277	16	
Centrosema acutifolium	5568	14	
Centrosema brasilianum	5234	69	
Pueraria phaseoloides	9900	5 5	
CAPICA	10280	360	
Stylosanthes capitata	1315	42 5	
Stylosanthes capitata	1318	19 2	
Stylosanthes capitata	1342	33 0	
Stylosanthes capitata	1693	13 0	
Stylosanthes capitata	1728	54 8	
Stylosanthes guianensis	136	25 0	
Stylosanthes guianensis	184	45 0	
Stylosanthes macrocephala	1643	2 5	739
Maize			
CIMMYT 634 (White)			2 600
Suwan-1 (Yellow)			1 500
Rice			
CICA 4		8 200	
CICA 7		12 222	
CICA 8		38 584	
IR 22		31 475	
Oryzica 1		66 645	157 126
Grand Total			167 064

Seed Production and Supply

Developing stronger basic seed production capabilities within each country continues to be a primary objective of the Seed Unit Basic seed is the vital link between breeder seed supplied by research programs and the producers of commercial seed Similarly the development of seed production and supply capabilities at the commercial level are also an objective These aspects of the seed sector were assisted primarily through training and conference activities and technical collaboration

The production and sale of basic seed or its equivalent to national programs and the Commodity Programs of CIAT helps accelerate the next stages of seed multiplication and increases seed supplies for on-farm testing The Seed Unit does not produce or sell commercial seed to farmers Seed multiplication is done in cooperation with Station Operations and the Bean Rice and Tropical Pastures Programs The Seed Unit has sold 150 tons of seed of different cultivars to various organizations in the region Basic seed of beans (Phaseolus vulgaris) rice (Oryza sativa) and selected tropical pasture species (Andropogon gayanus Stylosanthes capitata Stylosanthes guianensis and Pueraria phaseoloides) has been sent to several countries in Latin America and the Caribbean during the last three years The total value of this seed was approximately US$130 000 Table 6 provides further details of seed multiplied and Table 7 summarizes seed supplied

Potentially useful in-bred lines of publicly developed material of maize and sorghum are held in storage to respond to requests from seed enterprises and institutions interested in utilizing them in their own hybrid development programs Many of the materials are also used in training activities

The seed may be grown by the Farm Operations Unit at Palmira or Quilichao on land of the CIAT farm utilized by the Seed Unit for training or on land under the control of one of the programs However an innovation during this three year period has been the production of

pasture legume seed under a contract system with carefully selected seed growers Using a contract system makes it possible to select and evaluate production sites with good potential reduce production costs and train potential future seed growers of the selected species

The seed drying and conditioning facility is utilized for training handling the above production and to provide a service to the Commodity Programs ICA and local seed enterprises Income for this service has covered the operational costs including the cost of the extra laborers and technicians needed to handle the production drying conditioning and quality control work A rotating fund on seed conditioning is utilized to handle such income and expenditures Approximately 690 M T of seed were conditioned during the three years The dispatch of the seed is arranged in cooperation with the Supplies Office

Seed of named varieties or promising lines are multiplied and sold at prices above the normal price for Certified Seed when the quantities needed exceed 50 kg or the amount needed to plant one hectare in the case of pasture seed Smaller quantities of seed continue to be supplied by the programs without cost or with only the payment of transportation costs The objective in seed production is to help facilitate the introduction and use of new varieties at an economic level that allows operation on a self-financing basis

A rotating fund for seed marketing is operative and is the fund that reimburses seed growers the seed production and conditioning work of the Seed Unit and receives revenue from sales Ultimately income from the fund is transferred to the CIAT core budget to help meet general operating costs

The seed testing laboratory offers a service to the Commodity Programs for seed quality evaluations The Tropical Pasture Program is utilizing the laboratory extensively with staff working in the laboratory to handle research and routine testing from their seed research and

Table 7 Seed Supplied during 1984-86 Period

Kind of Seed and Variety	Quantity	Seed Consignee
Beans		
A-36 179 486 BAT-58 76 448 1230 1274 1297 1367 1370 1412 Calima DOR 198 Esperanza 4 ICA Llanogrande ICA Pijao L-23 24 Pai 9 29 45 81 92 97 PVA 782 916 1261 Tamazulapa Quetzal	5 291	Bean Program Farm Operations Unit Cuba Dominican Republic Cassava Program Guatemala Phosphorus Project Haiti
Rice		
CICA 4 7 8 IRR 222 Oryzica 1 Line 11643	142 766	ICA J Janne Colombia Secretariat of Natural Resources Honduras ENASEM Panamá
Pasture & Legumes		
Andropogon gayanus 621	1 588	Tropical Pastures Program
Centrosema acutifolium 5277	26	ICA Hacienda Llano Grande
CAPICA 10280	291	Hacienda Las Lomas Semillas El Aceituno Colombia
Stylosanthes guianensis 184	26	
Pueraria phaseoloides 9900	0 25	Cuba Dominican Republic México
Maize		
CIMMYT 346	620	Farm Operations Unit
CIMMYT 346	261	Bean Program
Grand Total	150 869	

Table 8 Service Tests Conducted in the Quality Control Laboratory during 1984-86

	Moisture	Purity	Germi-nation	Viability		Vigor	Varietal Description (Seedlings)	Mechanical Damage
				TZ	pH Exudate			
Rice	1736	416	787	21		716	432	-
Beans	755	81	1144	42	356	638	-	480
Maize	10	9	34	42		48	-	58
Sorghum	30	12	71	33		-	-	-
Soybean	70	70	70	30		-	-	-
Pastures*	41	669	955	932		-	-	-
Total	2642	1257	3061	1100	356	1402	432	538
				Total Tests	10 788			

* Tests made by the Tropical Pastures Program and the Seed Unit

production activities Table 8 summarizes the tests made from 1984-86 A seed herbarium of over 700 weed and crop seed was started in the laboratory The herbarium is used to aid in the identification of seeds in samples to assist analysts in the region and to help trainees A regular system of field inspections and testing of samples is conducted on all seed produced stored and sold as a part of the internal quality assurance program of the Seed Unit

2 Attributes of bean cultivars which predispose them to threshing damage and interaction with field emergence stress factors

3 Mathematical description of the deterioration of bean seed in response to moisture and temperature to permit the quantification and prediction of physiological injury resulting from either storage or drying

4 Efficacy of visual selection of planting materials (plants pods and seeds) for reducing the rate of infection by seed-borne pathogens

5 Understanding the micro-environment of sun-drying and its impact on bean seed quality

During the course of the research it became apparent that basic knowledge of the behavior of Phaseolus vulgaris seed was lacking with regard to some of these topics Thus the topics 1 and 3 were treated in more depth than originally envisioned The threshing study involved eight cultivars threshed with two machine threshers and four hand methods of threshing Two seed moisture ranges were used - 11 to 15 percent (higher) and 8 to 10 percent (lower) Three classes of tests were used to evaluate the seed physical examination laboratory germination and field planting

From this study conclusions were made concerning threshing treatments the cultivars and the seed moisture levels

Threshing treatments

1 The mechanical threshing treatments created more mechanical injury to the seed on the average than manual methods and this damage resulted in a significant reduction in germinating plants in the field

2 Under typical field drydown in the Cauca Valley only large seeded cultivars are damaged by typical mechanical threshing

Research and Development

The Seed Unit gave research a relatively low priority during the three years because of the need to more adequately apply what is already known especially on the cereal crops and in many aspects the Unit has no comparative advantage over other institutions The research that is done largely relates to thesis work and is linked to one of the CIAT Commodity Programs

In the the long-term the Workshop on Research and Training held in 1985 was the most significant achievement From the implementation of the recommendations of the workshop can come increased cooperation and coordination of seed technology and production research efforts throughout the Latin American and Caribbean region Linked with this step can be a more clearly defined role for the Seed Unit with solid research priorities

Bean Seed Research

Variety description The application of the methodology developed through research on bean variety descriptions has been encouraged with course participants and in a bean variety description course in Central America Work continued at CIAT on a bean variety description project by a Seed Unit staff member to evaluate the application of the bean variety description methodology on a wider range of Colombian bean varieties

Seed Quality In cooperation with the Bean Program the Ph D research on factors affecting the quality of bean seed used by small farmers was completed at CIAT The study was originally focused on these components

1 Threshing injury its occurrence in various threshing systems and relevance to the field emergence capability of the resulting need

addition to standard germination tests the samples were evaluated with an ASAC 1000 that measures leachate by electrical conductivity on individual seeds Seed deterioration was measured under ten temperature regimes from 15 to 60 C with eleven sampling times from 2 hours to 12 months

This aspect of the study resulted in large numbers of regular and ASAC 1000 evaluations the accumulation of vast experience in analyzing data from seed deterioration experiments and improved understanding of the parameters involved Some specific information gained included the need to time the sampling of the material to achieve a concentration of the most useful data and the need to equilibrate seed moisture to the relative humidity of the environment before germination tests The partition for the ASAC 1000 for the cultivar Calima is 152 with seed equilibrated at 50% relative humidity With this beginning follow-up studies on more lots and cultivars can be done more efficiently with the ASAC 1000 connected to a microcomputer

Seed Drying A study on the use of a small solar dryer that needs no other source of energy to dry bean seed was completed and summarized during the period through the work of two students from the Universidad del Valle These results were promising because they demonstrated that the dryer was effective in handling small lots of up to 400 kg The seed was dried from 18 2 percent moisture content to 12 6 percent in 20 hours of effective drying time No loss of seed quality was detected in the germination accelerated aging and electrical conductivity tests Further work is needed to refine the management of the dryer test modifications and assess direct sun-drying compared with the dryer

ASAC 1000 A series of comparative tests between the ASAC 1000 conductivity method to assess seed viability and standard germination tests were initiated primarily on beans to establish the instrument s partition levels for different types of beans and assess the utility of the machine with Latin American bean types These studies are continuing

3 The manual threshing methods recovered more seed than the mechanical threshing methods

4 Threshing in sacks is slightly inferior to other manual methods from a seed quality perspective

5 Bean seed quality produced by threshing the plants by beating in the open on a rubberized tarpaulin is virtually indistinguishable from that of hand-shelled seed regardless of the hardness of the underlying surface

Cultivar Treatment

1 White seeded beans are no more susceptible to threshing injury than colored beans

2 Seed size is the principal factor which predispose field beans to threshing injury

3 White seeded lines are more susceptible to emergence stress than colored lines and this may be related to imbibitional injury

4 A490 an Alubia grain type may be subject to more severe seed viability and emergence problems than other white seeded cultivars

Seed Moisture Content

1 Mechanical threshing injury is likely to be agronomically significant under very dry conditions (8-10% seed moisture) for all cultivars

The second aspect of this study was undertaken to evaluate the deterioration of field beans under various combinations of temperature and seed moisture for the purpose of estimating deterioration parameters using the cultivar Calima and to determine the efficacy of the Ellis and Roberts new improved viability equation as published in 1981 [1/] for prediction of field bean seed viability after storage In

---

1/ Ellis R H and Roberts E H (1981) The quantification of ageing and survival in orthodox seeds Seed Science and Technology 9 373-409

and 37 other Latin American rice varieties An evaluation has also been made of seedling vigor of rice varieties grown and harvested in six different locations in Colombia Preliminary results show significant differences in seedling vigor among locations and among varieties Further work is needed on this topic

Disease and Insect Control An investigator from Paraguay completed a M Sc thesis research project under the Federal University of Pelotas - Seed Unit agreement in August 1986 His study done cooperately with the Rice Program was on the improvement of stand establishment of rice based on protection from early attacks of Piricularia" and insects A fungicide has been found to effectively protect seedlings for 40 days which would be of economic advantage to the rice grower The results have motivated the Colombian Federation of Rice Growers to start commercial scale testings

Tropical Pasture Seed Research

Pasture Seed Quality A Brazilian investigator completed a M S thesis in 1985 under the Federal University of Pelotas agreement These pasture seed quality studies supported by the Seed Unit and supervised by the Tropical Pasture Program provide further information on methodologies to obtain high quality pasture seed The study on Stylosanthes macrocephala evaluated the most suitable time for harvest to achieve maximum seed yield and highest quality Harvesting between 65 and 78 days after flowering gave the highest yield and maximum viability was obtained at 78 days after harvest Harvesting methods were evaluated with Stylosanthes capitata Direct combining was found better than other methods for total seed yield

Planting Density A visiting research fellow from the Faculty of Agronomy Palmira Colombia undertook research on population densities and seed yield on Centrosema sp 5277 in cooperation with the Tropical Pasture Program Population densities of 6 666 16 665 and 26 664 plants per hectare were used A density of 16 665 produced the highest average yield but the difference was not statistically significant Germination differences were not statistically significant either

Rice Seed Research

Variety Description As a follow-up to a thesis on rice variety description a project to make the application of that investigation to Colombian varieties was completed The project conducted cooperatively between ICA the Rice Program and the Seed Unit studied the morphological characters of seven existing rice varieties and four experimental lines in six locations The result has been much improved descriptions of these varieties and lines the use of the information in the release of Oryzica 2 and a technical seminar with ten of the Colombian seed certification staff members to consider the application of the methodology at the seed production stage The Colombian certification staff continues to evaluate the procedures and the steps needed to incorporate the system into their program Agreement has also been reached to move ahead on one publication that outlines the method used and a second one on the description of the varieties and the use of these descriptions in seed production Audiotutorial units are also planned This work has been the basis for several in-country training activities

The benefits of improved variety descriptions for bean and rice will be felt by both the breeding programs and the seed production/ certification activities The application of the principles involved can help plant breeders in the development of variety descriptions that facilitate seed production and make seed certification field inspection work more objective and accurate Friction that often results between breeding and seed certification programs when inadequate descriptions are prepared can be greatly reduced A recent publication of CIMMYT Development Maintenance and Seed Multiplication of Open-Pollinated Maize Varieties outlines a similar method in part as a result of discussions with the Seed Unit staff They too propose identifying qualitative and quantitative characters and the need to calculate standard deviation from the mean when preparing descriptions

Seed and Seedling Characters and Vigor Other investigations have resulted in seed and seedling characters being described for 8 Colombian

Information and Communication

With the addition of a staff member to this section it is possible to place greater emphasis on information and communication The Seed Unit's objective is to use information and communication activities as a tool for rapidly strengthening the integration of the seed network Several initiatives were taken to accelerate this process

Publications

The first Directory of Seed Specialists and Institutions in Latin America and the Caribbean was prepared The Directory includes names and addresses of 850 individuals organized by countries The institutional listings include the name address telephone and telex (when known) for 28 seed associations 80 seed testing laboratories 25 national programs 17 universities with seed production and technology courses and 25 special institutions many of which are outside this region The use of the Directory can result in a greatly increased information exchange within the region and among institutions and individuals within and outside it

To facilitate the exchange and management of information a Seed Science and Technology Thesaurus in English and Spanish was prepared No comparable controlled vocabulary on seed exists for handling information Consultants from outside the region were used to assist the development of the thesaurus and it was reviewed by many specialists within the region It was also reviewed during the Workshop on Training and Research and at the time of the Panamerican Seminar and during the International Seed Testing Association's 1986 Congress to further internationalize it and open the way to adding other languages

During the Seed Unit s existence a Spanish Glossary of Terms Used in Seed has been evolving The Glossary has been reviewed by several people including participants in the 1984 PCCMCA meeting A preliminary version was prepared and distributed to the Workshop on Research and Training The Glossary can help increase understanding and standardize the use of terms in the region

Seed Blowing Method A study of a blowing method to simplify the purity analysis of Brachiaria decumbens and Panicum maximum was made Referee samples were sent to eight laboratories with instructions and standard samples to provide for comparative tests among laboratories The results showed good comparisons among laboratories and point to the need for wider adoption of the procedures to simplify seed purity testing of these species

Ohaus Seed Moisture Tester The potential utilization of the Ohaus infra-red seed moisture tester with tropical pasture seed was evaluated This work shows this kind of moisture tester not to be of value for Andropogon gayanus because of the burning of awns during the test The moisture tester shows promise for use with Brachiaria decumbens and Stylosanthes capitata as a more rapid but somewhat less accurate method than the standard oven method of moisture determination

4 Post-harvest Crop Handling
5 A Manual for Operators of Seed Conditioning Facilities
6 Seed Certification Guide

The newsletter was enlarged to increase the technical content and published every four months An abstract section was added and reprints of technical papers that can have special value to the region are included The mailing list for it has been improved and categorized A separate mailing list was developed to communicate with specific audiences such as laboratories seed technology researchers seed enterprises etc

Audiotutorials

The audiotutorial on Seed Development and Morphology was completed in both Spanish and English Two existing audiotutorials are being converted to English Other audiotutorials are in various stages of completion on the following topics

- Purity Analysis
- Germination Test
- Seedling Evaluation
- General Varietal Description
- Varietal Description on Rice
- Packaging Materials for Seed
- Seed Maturation

Audiotutorials on seed production and technology developed by the Seed Unit the Commodity Programs and/or jointly and available include

- Control y Normas de Calidad de las Semillas Certificadas de Arroz
- Desarrollo y Morfología de la Semilla*
- Elementos Esenciales para el Exito de un Programa de Semillas*

---

* Completed totally by the Seed Unit

Copy for all of the chapters but two of the book Seed Production and Technology is in the first or second draft stage Most of the seventeen Latin Americans who are working on the book participated in the Workshop on Research and Training and had an opportunity to exchange ideas The current phase involves work in sub-groups and technical editing When completed the book will be valuable for training purposes in universities and in short courses

The books Programas de Semillas - Guía de Planeación y Manejo and Metodología para Obtener Semillas de Calidad - Arroz Frijol, Maíz Sorgo were both reprinted during the period The latter book is being revised to provide an improved second edition

The Proceedings of the following workshops were printed

- The Development of the Latin American and Caribbean Seed Sector and Projected Needs (Spanish)
- Improved Seed for Small Farmers (English)
- Seed Research and Training (Spanish)

The proceedings for the Workshop on Improved Seed for Small Farmers (1986) is currently being edited in Spanish Translation will start soon on the English version

Proceedings of the following earlier workshops are also available in Spanish

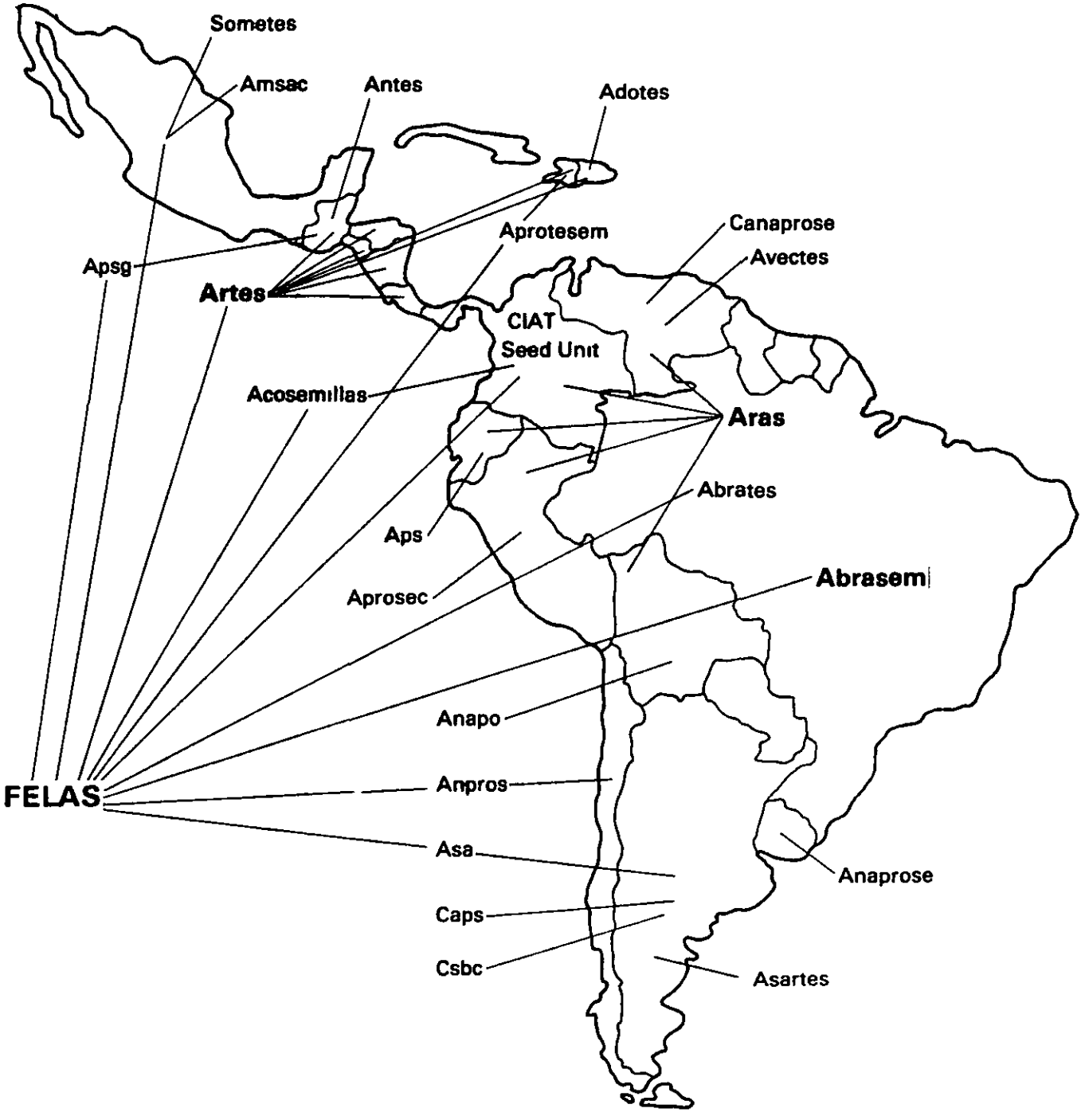
- Strategies Planning and Implementation of a Seed Program
- Seed Enterprise Management and Marketing
- Training Strategies in Seed Technology
- Improved Seed for Small Farmer

Publications in various stages of completion include

1 Guide for Breeder and Basic Seed Production
2 Methodology for Preparing Rice Variety Descriptions
3 Variety Descriptions for Eight Varieties in Colombia

Figure 3

Regional Seed Association Network



- Essential Elements for Successful Seed Programs*
- Evaluación de la Calidad de la Semilla de Maíz*
- Good Quality Bean Seed Production*
- Latencia y Pregerminacion de la Semilla de Arroz
- Maize Seed Quality Evaluation*
- Morfología de la Planta de Arroz
- Morfología de la Planta de Frijol Común
- Morfología de la Planta de Yuca
- Principios del Acondicionamiento de Semillas*
- Producción y Beneficio de Semilla Certificada de Arroz
- Seed Development and Morphology*
- Selección y Preparación de Estacas de Yuca para Siembra
- Semilla de Frijol de Buena Calidad
- Sistema de Propagación Rápida de la Yuca
- Técnicas de Muestreo*

Translations of individual articles and material were made within the Unit and outside to support training and workshop activities Through this process many seed specialists in the region have an opportunity to benefit from recent advances from outside thus the Seed Unit serves as a critical information bridge for the area

Seed Network Development

Within each country seed network development is necessary for success But this network must link effectively with the crop research network being assisted by the Commodity Programs of the International Centers In several countries a critical mass of seed sector personnel exists but the need is to help them form a functional network with linkages to research activities Seed technology and trade associations are one mechanism that can assist network development Associations have been formed in many countries as shown by Figure 3 Ten of these associations have been formed since the Seed Unit was started A pressing need is to help these associations develop leadership and meaningful program activities

Figure 4

Subregional Network

One role of the Federation of Latin American Seed Associations (FELAS) is to foster and encourage these national associations which are becoming members of this federation of associations (The Latin American Association of Seed Experts (ALES) changed its name in 1986 to FELAS) The Seminar with the leadership of associations held in cooperation with ALES now FELAS contributed to the strengthening of this seed association network The Seed Unit is in a unique position to assist this process because of its links with former course participants and the regional nature of its activities

The seed network at the sub-regional level continues to be assisted by ARTES in Central America and the Caribbean as reviewed earlier The formation of ARAS in the Andean Zone offers the potential of similar benefits in that area Complementing these sub-regional associations are the more official links that need further strengthening These include 1) the Regional Technical Committee for Central America and Panamá 2) a proposed Regional Technical Committee for the Andean Zone and 3) the working relationship with CETREISEM in Brazil which is developing links within the Southern Cone (Figure 4)

The regional seed network embodies the people at the national level Figure 2 illustrates this network as it relates specifically to CIAT trained people in National Seed Programs Of course the actual network includes many more people than have been in CIAT courses

The fourth segment of the seed network includes universities that have strong seed technology and production training and research (Figure 5) The Workshop on Seed Research and Training provided a unique opportunity for many people from this network to meet and work together for the first time Twenty four staff members from universities participated in Seed Unit courses at CIAT during the three years Six of the people contributing chapters to the seed technology and production book are from institutions in this network Most seed activities in Ministries of Agriculture do not include seed technology and production research This university network provides the best opportunity for problem solving and for meeting the long-term educational needs

These seed networks are having and can have an even more significant impact on seed sector development and the use of improved varieties and hybrids A major objective of the Seed Unit continues to be the strengthening of these networks

Figure 5

University Network

- Seed Laboratory Operation
- Training Information and Communication

The Seed Unit has used visiting scientists consultants research fellows and guest lecturers to complement the permanent staff The approach is used because the permanent staff is small and the flexibility provides opportunities to utilize recognized leaders with just the right experience and knowledge for a particular task In addition many of the Commodity Program and other Unit staff members have assisted the Seed Unit especially in training conferences and seed production Staff members of CIMMYT CIP ICRISAT and INTSORMIL have also collaborated Integrating assistance from outside the Unit to help meet program objectives requires a high level of cooperation and coordination of activities

Researh Fellows

Mr Luis Vicente Malaver Professor Faculty of Agronomy Palmira was with the Seed Unit from March 1985 to February 1986 as a Senior Research Fellow His primary objective was to strengthen his seed production and technology background so he could lead the development and offering of a Seed Technology Course at the Faculty of Agronomy Palmira During his year with the Seed Unit he contributed to and participated in courses and workshops at CIAT participated in a course on Seed Enterprise Management and Marketing at Quito developed the outline for a course on Seed Production and Technology and undertook independent research on Centrosema sp 5277 His year with the Seed Unit has resulted in the offering of a course in Seed Production and Technology at the Faculty of Agronomy in Palmira

Dr Silmar T Peske Professor Federal University of Pelotas Brazil was with the Seed Unit throughout 1986 and will continue through 1987 A primary objective is to broaden his experiences in training and seed program improvement Specific activities on preparing publications and audiotutorials are planned plus limited research

Personnel

Seed Unit Staff

The Seed Unit staff of two senior scientists six junior scientists two secretaries four technicians and seven laborers is small compared to the growing requests and needs for assistance Appendix 3 lists the staff During the three years the staff has been relatively stable The senior staff position on Seed Production and Seed Industry Development was filled One replacement was done for the junior scientist position on seed conditioning The new seed information specialist position was filled but unfortunately is vacant and is to be filled soon

Each member of the Seed Unit staff has worked diligently at maintaining a team approach in helping to achieve objectives The staff developed professionally while successfully completing an extremely demanding schedule of activities

Four junior staff members had opportunities for professional improvement outside Colombia with financial assistance provided by external sponsors The staff member responsible for Communication was awarded financial assistance by the Fulbright Commission/USAID to participate in a six-week Communications Course at Iowa State University Ames in July 1985 This opportunity further strengthened the staff capability in this area of work A secretary completed a degree in Colombia and was selected for additional English language training in the USA in 1985 A laboratory technician received eight weeks of training in the Seed Testing Laboratory in Brisbane Australia in 1986 The Seed Conditioning Facility technician completed a six month course in Italy in 1986

The staff was organized into four working groups to assist program planning and follow through with maximum staff participation The working groups are

- Administration Budget Secretarial
- Seed Production Conditioning and Seed Quality

Dr Alvaro Castillo EDIAGRO Private Consultant Colombia three weeks Dr Castillo reviewed literature on research completed in Latin America and the Caribbean related to seed economics seed enterprise management seed marketing and the role of seed in the development process From this review he prepared a paper for presentation in the Workshop on Research and Training in Seed Production and Technology and contributed to achieving the workshop objectives

Dr Leroy E Everson Retired Professor of Seed Technology Iowa State University USA five weeks service donated with partial support from ISTA Dr Everson led the purity section of the Workshop on Testing of Tropical Pasture Seed Species including the lectures laboratory and round table periods He also continued work on audiotutorial units on seed purity analysis seed germination and seedling evaluation

Mr Juan Carlos García Chief of Production and Management of Seeds University of Chapingo México fifty five weeks He completed a sabbatical year with the Seed Unit to obtain more information on the content of seed technology curricula and courses in other universities in Latin America and to help initiate work on the preparation of teaching material for use in national programs and universities He contributed enormously to the achievement of Seed Unit program objectives while also pursuing his sabbatical goals He worked with COTERES and ARTES in Central America and assisted the development of the PCCMCA seed program Through visits with universities in Argentina Brazil Costa Rica Peru and Mexico he contributed to university network development while obtaining more detailed information on each university's program for the Seed Unit and himself He assisted training activities at CIAT CIMMYT and Mexico and conducted research on mechanical damage of maize During an additional three weeks he assisted and provided leadership to the seed sector of the PCCMCA meeting In addition he assisted with lectures and provided leadership to the practical sessions on seed production and varietal description He has contributed to several of the Seed Weeks assisted by the Seed Unit at CIMMYT

During Dr Peske s first year with the Seed Unit he contributed to trainıng courses at CIAT and in Bolivia Argentina and at CIMMYT He assumed considerable leadership and responsıbility for the course on Management of Seed Conditioning Facilities and Rice Seed Production and Technology He also contributed to the development of a Manual for Seed Conditioning Facility Managers and did revisions and edıting of a Module on Seed Conditioning for the book on Seed Production and Technology

Within the region he worked especially with the State of Santa Catarina Brazil in cooperation with the Rice Program to help clarify goals and strategies for overcoming rice production problems He also assisted Guatemala in planning seed conditioning facilities to be used mainly with small seed producers His research focused on work with a rapid viability test based upon the pH of seed exudate for beans and corn seeds in cooperation with the Seed Unit staff and students from the Universidad del Valle

Visıting Scientists Consultants and Other Support

Visıting scıentists and consultants were used to help meet specifıc program objectives During the period 196 weeks of time were provided by the following visiting scientists and consultants who were with the Seed Unit for two weeks or more

Mr William H Cable Retıred Seedsman International Executive Servıce Corps (IESC) USA five months of servıces donated Mr Cable contributed to the plannıng and development of the Seed Enterprise Management and Marketing Course In addition he helped identify management and marketing informatıon training materıals equipment sources and seed certification documents He also contributed lectures and to the discussions from his personal experiences ın seed enterprıse management and marketing His work represented the first time IESC has assisted an International Center in this way

Dr Ray L Harty Supervising Seed Technologist Department of Primary Industries Brisbane Australia three weeks service provided by the Government of Australia and ISTA Dr Harty provided leadership on behalf of the International Seed Testing Association to the Workshop on Testing of Tropical Pasture Seed Species He contributed in many ways also to the technical content of the workshop through lectures and leadership in laboratory sessions and discussion periods

Dr Donald Leatherdale Private Consultant England four weeks Dr Leatherdale contributed to the development of the Thesaurus on Seed Science and Technology He also prepared and presented a paper on the use of a thesaurus at the Workshop on Research and Training With the Seed Unit staff he analyzed and evaluated needs for an improved seed information and storage system

Miss Helen Low Senior Seed Analyst Seed Services Section Brisbane Australia seventeen weeks service provided in part by the Government of Australia and ISTA Miss Low spent three weeks in the seed laboratory preparing material for the Workshop on Testing Tropical Pasture Seed Species She then contributed substantially to the workshop through lectures and leadership in laboratory sessions During a second period with the Seed Unit she reviewed the operation of the seed testing laboratory assisted the staff in improving their efficiency and methodology of work and evaluated seed testing methods especially on tropical pasture species She also contributed significantly to the Seed Quality and Seed-borne Disease Control Course

Mr Alejandro Mendoza Head of the Seed Division of ICA Colombia six weeks Mr Mendoza contributed to seed program development in Bolivia through the Seed Unit on two separate occasions He first went to participate in the Third National Seed Round Table which is a planning session for the next year He also consulted with seed program leaders and provided the Seed Unit with a current appraisal of the Bolivian program The second mission was at the request and with the assistance of USAID but with Seed Unit backstopping This provided an

Dr Fernando Gómez M Private Consultant former Director of ICA Colombia 13 weeks Dr Gómez assisted in carrying out the Workshop on Improved Seed for Small Farmers and did the technical editing and organization of the proceedings for that workshop He also reviewed the conclusions and recommendations from all previous workshops organized by the Seed Unit at CIAT and made a consolidated summary of this material He assisted the Seed Associations Seminar organized by ALES In cooperation with the Seed Unit staff he developed copy for a book chapter on Bean Seed Production

Dr Don F Grabe Professor Seed Technology Oregon State University USA 2½ weeks service contributed by OSU Dr Grabe led the biochemical and moisture testing sections of the Workshop on Testing of Tropical Pastures Species including the lecture laboratory and round table periods A previous four month sabbatical leave at CIAT and his chairmanship of the ISTA Seed Moisture Committee made him a valuable addition to the workshop in general

Mr Robert G Griffiths Consultant United Kingdom 7 weeks Mr Griffiths contributed to the Second Intensive Seed Technology Course conducted in English with lectures and by providing continued technical monitoring of the course and assistance to individual students He also contributed to the further improvement of the Seed Study Report on Africa and to the development of a study on the Seed Unit

Dr David Harris Private Consultant USA six months Dr Harris worked closely with William H Cable in the planning and development of the Seed Enteprise Management and Marketing Course He concentrated especially on local management and marketing resource material and the potential contributions from the International Fertilizer Development Center (IFDC) He also followed-up after the course to organize material in a manner for possible reproduction and use in later courses In addition to the course he evaluated potential computer applications and equipment needs of the Unit

Mr Fabio Polania Private Consultant Colombia five weeks Mr Polania did the technical editing and organization of the Workshop on Research and Training in Seed Production and Technology He also contributed to the development and content of the Workshop on Improved Seeds for the Small Farmer in 1986

Mrs Frieda Wertman Seed Analyst Private Laboratory California 14 weeks Mrs Wertman a seed analyst with over 40 years of experience reviewed organized and added to the seed herbarium of the Unit Her work helped to start a process which can result in the seed herbarium becoming a basic reference not only for CIAT but also for the region especially with respect to weed seed The herbarium has over 700 seeds She also contributed quite useful lectures and laboratory material to the Workshop on Testing Tropical Pasture Species the Andean Pact Course and the Advanced Course on Seed Quality and Seed Disease Control She added to the training materials especially in seed identification and provided training for the Seed Unit staff

Many other specialists and organizations within Latin America as well as outside contributed to courses and the achievement of the Unit s objectives Especially among these are ICA Colombia seed enterprises in Colombia Brazil Costa Rica Ecuador and Perú Mississippi State University with assistance from USAID the International Fertilizer Development Center the International Executive Service Corps the International Seed Testing Association and Iowa State University A complete listing of individuals and their organizations outside CIAT who assisted the Seed Unit during the period is given in Appendix 2

The Administration the Commodity Programs the other Units and all of the service and support groups in CIAT have contributed immeasurably to the achievement of program objectives

opportunity to develop preliminary proposals for a renewed seed project in the country On another mission he participated in a Caribbean Rice Network meeting in the Dominican Republic

Dr Joseph T Park Private Consultant formerly with the USDA Agricultural Research Service Oregon USA three weeks Dr Park followed-up on the evaluation of the friction separator that he had helped construct at CIAT in 1982 He provided useful suggestions on work underway and for further evaluations He also contributed to an evaluation of threshing methodology for Stylosanthes capitata and the seed conditioning section of the Second Intensive Seed Technology Course in English

Dr Silmar T Peske Professor Seed Technology Universidad Federal de Pelotas Brazil three weeks Dr Peske through the agreement with CETREISEM - Universidad Federal de Pelotas assisted the Intensive Course on Seed Production and Technology and contributed to the Workshop on Research and Training He also helped plan the Basic Seed Course to be held in 1986 in Pelotas and participated in the Seed Enterprise Management and Marketing Course in Quito

Dr Federico R Poey AGRIDEC Private Consultant USA eight weeks Dr Poey continued to assist the Seed Unit on selected events He contributed to the Central American program through his contributions to the PCCMCA meeting and a Seed Enterprise Management and Marketing Course in Guatemala The training program benefited through his contributions to the Intensive Seed Production and Technology Course the Seed Enterprise Management and Marketing Course and the Andean Pact course on Seed Certification and Quality Control He is also doing the technical editing on the publication Breeder and Basic Seed Production In 1986 Dr Poey contributed to the Workshop on Improved Seed for Small Farmers

Appendix 1 Continued

Brazil	Empresa Brasileira de Pesquisa Agropecuaria (EMBRAPA) Empresa Goiana de Pesquisa Agropecuaria (EMGOPA) Empresa de Pesquisa Agropecuaria de Santa Catarina (EMPASC) IBS-IBEMA Sementes e Cereais Ltd Instituto Agronómico do Paraná (IAPAR) Universidad Federal de Goias Universidad Federal de Pelotas (CETREISEM/UFPel) Secretaría de Estado da Agricultura e Pecuária Supagro Servicio de Producao de Sementes Básicas (SPSB)
Colombia	CENICAFE Centro Internacional de Agricultura Tropical (CIAT) Compañía Colombiana de Semillas (COLSEMILLAS) CRESEMILLAS Distribuidora del Valle Federación Nacional de Arroceros (FEDEARROZ) Fondo Ganadero del Valle del Cauca Instituto Colombiano Agropecuario (ICA) PROACOL PROAGRO & CIA Procampo Villezca S A PROSEMILLAS Secretaría de Agricultura de Antioquia Semillas del Huila Semillas del Llano (SEMILLANO LTDA)
Costa Rica	Centro de Investigación en Granos y Semillas (CIGRAS) Consejo Nacional de Producción Ministerio de Agricultura y Ganadería Oficina Nacional de Semillas
Cuba	Empresa Productora de Semillas Establecimiento Provincial de Semillas Estacion Experimental de Pastos y Forrajes Indio Hatuey Instituto de Pastos y Forrajes Ministerio de la Agricultura
Chile	Instituto de Investigaciones Agropecuarias (INIA) Servicio Agrícola y Ganadero (SAG)
Dominican Republic	Centro de Investigación Arrocera (CEDIA) Instituto Superior de Agricultura (ISA) Secretaría de Estado de Agricultura

Appendix 1 National Institutions and Private Enterprises from which course participants came in 1984-86

Country	Institution
Antigua	Caribbean Agricultural Research & Development Institute (CARDI)
Argentina	Centro de Investigacion en Forrajes La Violeta Compañia Mercantil y Ganadera Dirección General Agropecuaria Instituto Nacional de Tecnología Agropecuaria (INTA) Secretaría de Agricultura Ganaderia y Pesca Semillero La Magdalena Universidad Nacional de Córdoba
Belize	Caribbean Agricultural Research & Development Institute (CARDI)
Bolivia	Asociacion Nacional de Productores de Oleaginosas (ANAPO) CARITAS Centro de Investigacion Agrícola Tropical (CIAT) Cooperativa Agropecuaria Integral Colonia Okinaua (CAICO) Cooperativa Americana de Remesas al Exterior (CARE) Cooperativa Integral Gran Chaco Ltda Corporacion Regional de Desarrollo de Chuquisaca (CORDECH) Empresa Universitaria de Semillas Forrajeras (SEFO-SAM) Instituto Boliviano de Tecnologia Agropecuaria (IBTA) Ministerio de Asuntos Campesinos y Agropecuarios Programa Semillas Las Barrancas Semillas Cordillera Servicio Regional de Certificación de Semillas Universidad Autónoma Regional Gabriel René Moreno Universidad Mayor de San Simón
Brazil	AGROCERES S A Companhia Integrada de Desenvolvimento Agrícola de Santa Catarina (CIDASC) Coordenadoria de Assistencia Tecnica Integral (CATI) Delegacia Federal de Agricultura na Bahia Delegacia Federal de Agricultura em Goias Empresa de Assistencia Tecnica e Extensao Rural da Bahía (EMATER-BA)

Appendix 1 Continued

Nicaragua	MIDINRA AGROINRA Asociación Nicaraguense de Arroceros (ANAR)
Panama	Comité Nacional de Semillas Empresa Nacional de Semillas Instituto de Investigación Agropecuaria de Panamá (IDIAP)
Paraguay	PRONIEGA
Peru	Empresa Comercializadora de Arroz (ECASA) Estación Experimental de Vista Florida HORTUS S A Instituto Nacional de Investigación y Promoción Agrícola (INIPA) Instituto Superior Tecnológico Instituto Veterinario de Investigaciones Tropicales y de Altura (IVITA) Ministerio de Agricultura Selva Industria S A Universidad Nacional Agraria La Molina
Philippines	Dalwangan Experiment Station
Rwanda	OPROVIA
St Lucia	Caribbean Agricultural Research & Development Institute (CARDI)
Surinam	University of Surinam
Trinidad & Tobago	University of the West Indies
Venezuela	ASOBARINAS-PROACA Fondo Nacional de Investigaciones Agropecuarias (FONAIAP)
Zambia	Seed Control and Certification Institute

Appendix 1 Continued

Ecuador	Instituto Nacional de Investigaciones Agropecuarias (INIAP) Semillas Conti Ecuador Molinos Champion S A
El Salvador	Centro Nacional de Tecnología Agrícola (CENTA)
Ethiopia	Institute of Agricultural Research International Livestock Centre for Africa (ILCA) Ministry of Agriculture
Guatemala	Direccion General de Servicios Agrícolas (DIGESA) GERMINAGUATE Instituto de Ciencia y Tecnología Agrícolas (ICTA) Universidad de San Carlos
Guyana	Caribbean Agricultural Research and Development Institute (CARDI) National Agricultural Research Institute (NARI)
Haiti	Ministry of Agriculture
Honduras	FACACH Secretaria de Recursos Naturales
India	International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)
Jamaica	Ministry of Agriculture
Mexico	Banco de México Colegio de Posgraduados de Chapingo Confederación de Asociaciones Agricolas del Estado de Sinaloa (CAADES) Facultad de Ciencias Agrícolas de Cordoba Veracruz Instituto Nacional de Investigaciones Forestales y Agropecuarias (INIFAP) Northrup King & Co Productora Nacional de Semillas (PRONASE) Servicio Nacional de Inspección y Certificacion de Semillas (SNICS) Tecnica Agrícola de Chiapas S A Universidad Autónoma Agraria Antonio Narro (UAAAN) Universidad Autónoma de Baja California (UABC) Universidad de Guadalajara

Appendix 2 Continued

Ramiro Tejada	Semillas Valle Ltda (SEMIVALLE)	Colombia
Napoleón Viveros*	Semillas Valle Ltda (SEMIVALLE)	Colombia
Rafael Angel Mena	Ministerio de Agricultura y Ganadería	Costa Rica
Sergio R Balarezo	Central Ecuatoriana de Servicios Agrícolas (CESA)	Ecuador
Donald Leatherdale*	Private Consultant	England
Julio Alfredo Trejo	Dirección General de Servicios Agrícolas (DIGESA)	Guatemala
Jairo A Cano G *	Fundación Hondureña de Investigación Agrícola	Honduras
B L Renfro	Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT)	México
Elizabeth J Warham	Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT)	México
Juan Carlos García*	University of Chapingo	México
Miguel A Rodríguez	MIDINRA-DGA	Nicaragua
Urs C Scheidegger	Centro Internacional de la Papa (CIP)	Perú
Carlos Herrera M	HORTUS S A	Perú
Robert G Griffiths*	Consultant	U K
Federico R Poey*	Agricultural Development Consultants Inc (AGRIDEC)	U S A
Mark A Brick*	Colorado Seed Growers Association	U S A
William H Cable*	International Executive Service Corps (IESC)	U S A
Leroy E Everson*	Iowa State University	U S A
D C McGee*	Iowa State University	U S A
Charles C Baskin*	Mississippi State University	U S A
Edgar Cabrera*	Mississippi State University	U S A
Joseph Cortés*	Mississippi State University	U S A
Catalino Flores	Mississippi State University/INTSORMIL	U S A
Charles E Vaughan	Mississippi State University	U S A
Don F Grabe*	Oregon State University	U S A
Harold Youngberg*	Oregon State University	U S A
David Harris*	Private Consultant	U S A
Joseph T Park*	Private Consultant	U S A
Frieda L Wertman*	Private Consultant	U S A
Robert Bronkhorst	The World Bank	U S A
Fausto Miranda*	Fondo Nacional de Investigaciones Agropecuarias (FONAIAP)	Venezuela
Miriana de Miranda*	Universidad Central de Venezuela	Venezuela

* Specialists who provided a week or more of service to the Seed Unit training workshop and other program activities 1984-86

Appendix 2 Non-CIAT Specialists who contributed to Seed Unit Program Activities 1984-86

Name	Organization	Country
Ray L Harty*	Department of Primary Industries	Australia
Helen M Low*	Department of Primary Industries	Australia
Daniel Blanc	Cooperación Técnica Suiza (COTESU)	Bolivia
Fernando Cardona	Centro de Investigacion Agrícola Tropical (CIAT)	Bolivia
Kurt Steiger	Semillas SEFO	Bolivia
J Ribeiro da Silva	EMBRATER	Brazil
Francisco B de Souza	EMBRAPA/SPSB	Brazil
Cilas Pacheco Camargo	Ministerio de Agricultura	Brazil
K Matsumoto	Sementes Agromen Ltda	Brazil
Silmar T Peske*	Universidad Federal de Pelotas	Brazil
Fernando Duque	COLSEMILLAS	Colombia
Mario Giraldo	CRESEMILLAS	Colombia
Carlos A González	CRESEMILLAS	Colombia
Amparo de Marroquín*	CRESEMILLAS	Colombia
German Torres	CRESEMILLAS	Colombia
Alvaro Castillo*	Estudios y Diseños Agroindustriales Ltda (EDIAGRO)	Colombia
Gentil Vargas	Federación Nacional de Arroceros (FEDEARROZ)	Colombia
Fernando Arboleda	Instituto Colombiano Agropecuario (ICA)	Colombia
Jesus H Arias	Instituto Colombiano Agropecuario (ICA)	Colombia
Claudio Fuentes	Instituto Colombiano Agropecuario (ICA)	Colombia
Carlos Gómez	Instituto Colombiano Agropecuario (ICA)	Colombia
Carlos A Martínez	Instituto Colombiano Agropecuario (ICA)	Colombia
Edgar Martínez	Instituto Colombiano Agropecuario (ICA)	Colombia
Alejandro Mendoza	Instituto Colombiano Agropecuario (ICA)	Colombia
Jesús A Rivera	Instituto Colombiano Agropecuario (ICA)	Colombia
Carlos A Tarazona	Instituto Colombiano Agropecuario (ICA)	Colombia
Jorge Trochez	Instituto Colombiano Agropecuario (ICA)	Colombia
Freddy Victoria	Instituto Colombiano Agropecuario (ICA)	Colombia
Carlos F Cuevas*	Instituto Colombiano de Estudios Superiores de INCOLDA (ICESI)	Colombia
Rodrigo Varela	Instituto Colombiano de Estudios Superiores de INCOLDA (ICESI)	Colombia
Luis Obregon*	Luis Obregón & Asociados	Colombia
Fernando Gómez M *	Private Consultant	Colombia
Fabio Polania*	Private Consultant	Colombia
Enrique Holguin	PROACOL LTDA	Colombia
Eduardo Villota	SEMILLANO LTDA	Colombia
Jaime Barbosa	Semillas Valle Ltda (SEMIVALLE)	Colombia
Leopoldo Salas	Semillas Valle Ltda (SEMIVALLE)	Colombia

Appendix 3 Seed Unit Staff in 1986

Permanent

JOHNSON E DOUGLAS Head
ADRIEL E GARAY Seed Specialist
CARLOS E DOMINGUEZ Training
EDGAR A BURBANO Seed Laboratory and Production
JOSE FERNANDEZ DE SOTO Seed Communications
CONSTANZA ANZOLA Documentalist
ROBERTO AGUIRRE Seed Conditioning
GUILLERMO GIRALDO Seed Production
LUZ MARINA DUQUE Secretary
GLORIA S DE GARCIA Secretary
RODRIGO NUÑEZ Technician Laboratory
CESAR OCTAVIO VASQUEZ Technician Conditioning Plant
GERMAN OYUELA Technician Laboratory
MARIO ROMERO Technician Production
GILBERTO GONZALEZ Laborer
GONZALO MONZON Laborer
ALBERTO OROZCO Laborer
RUDECINDO PALMA Laborer
BENJAMIN REYNOSO Laborer
JORGE VILLEGAS Laborer
CARLOS ORLANDO VIVAS Laborer

Non permanent

LUIS VICENTE MALAVER Research Fellow*
SILMAR T PESKE Research Fellow
HECTOR RAMIREZ M S Candidate
RUBY ISAZA Secretary

* Left February 1986