TRAINING PROGRAM

Review

1984

ICRISAT

International Crops Research Institute for the Semi-Arid Tropics
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ICRISAT TRAINING PROGRAM REVIEW 1984

I. OVERVIEW

The training program was initiated at ICRISAT Center in 1974. The individualized programs are developed to provide educational opportunities for agricultural personnel who are working or who intend to work in national, regional or international agricultural research and development programs of the rainfed semi-arid tropics. The training programs link the SAT agricultural research and development programs with ICRISAT's scientific expertise, germplasm resources, collection of research findings, and facilities which are not readily available elsewhere. To provide the most complete learning opportunities, a team approach is used to present skill and concept development in crop improvement, crop production, farming systems, socioeconomics, utilization and conservation of natural resources, breeding nursery management, research farm management, extension methods and training methods. The training staff collaborates with the research scientists in providing individualized theoretical and practical skill development through experience in the field, laboratory and classroom.

A. Training objectives and duration of programs

1. International Internship:

To provide recent recipients of PhD degrees from developed countries research leadership and skill development opportunities through postdoctoral training and experience in rainfed semi-arid tropical research techniques and procedures. An interdisciplinary approach is used as they are assigned problem solving and applied research areas in on-going research programs. The program is for a minimum of 1 year to a maximum of 2 years.

2. Research Fellowship:

To provide recent PhD (rarely MSc) degree holders from clientele countries postdoctoral training and experience on specific research problems utilizing a team approach to learn recent research developments, techniques, and skills. The program is for a minimum of 1-12 months and a maximum of 24 months.

3. In-service Fellowship:

To provide experienced clientele country scientists (research, teaching, or development) with MSc or PhD (rarely BSc) degrees, opportunities to study and develop skills related to his country programs and ICRISAT's mandate.The fellowships are for a minimum of 1 month and an optimum of 4 to 6 months.

4. Research Scholarship:

To provide university students the opportunity to conduct their thesis research (MSc or PhD) under the guidance of ICRISAT staff in partial fulfilment of their degree requirements. To enable them to develop competence in technical and managerial skills, scientific techniques in plant breeding, physiology, pathology, entomology, .microbiology, agronomy, economics, land and water management, cropping systems, and other sciences related to semi-arid tropical resource development and food production. Full programs vary from 12 to 36 months in order to complete 3 to 5 cycles of research on their selected thesis problem, as approved by the University and ICRISAT guides.

5. In-service Training:

In-service training programs are based on a 6-month individualized program to cover one cycle of field crop experimentation and demonstration projects.

a. Crop improvement: To develop the practical application of skills in plant breeding techniques for the utilization of sources of resistance and tolerance, to improve and stabilize yields of ICRISAT mandate crops.

b. Crop production: To develop the ability to practically ascertain and utilize improved crop production and management procedures and to adopt them for utilization in local conditions in ever changing environments minimizing the adverse influences which limit crop production in the rainfed semi-arid tropics.

c. Farming systems: To develop the ability to evaluate the potential to use natural resources and develop farming systems that will utilize improved genetic resources, cropping systems, land and water management techniques, improved machinery and power, market systems and human resources for increased and stabilized food production in the rainfed semi-arid tropics.

6. Apprenticeship:

To provide undergraduate and graduate students a

work/study opportunity to obtain practical experience in land development, water management, economics, operation, maintenance, and repair of farm machinery and other mandate research, skills, and procedures. These are self supported and limited to the programs' facilities and ability to accept them to work for up to 12 months with research scientists, engineers or service staff.

7. Short-term training:

To provide opportunities for groups to participate in brief training opportunites related to the learning of skills and transfer of technology. Selected nominees are accommodated, with full or partial financial support, in special programs developed in close association with the research staff. The courses are usually for 2 to 14 days.

B. Organization

The training programs are directed by the principal training officer and the training officers under the auspices of the Director of International Cooperation. A training advisory committee including the Director of International Cooperation and Leaders of the Millet, Sorghum, Groundnut, Pulse, Economic, and Farming Systems programs, Principal Training Officer, and Senior Training Officer II establish policies and will consider all applications. The committee recommends the acceptance of international interns, research fellows, in-service fellows, research scholars, and other trainees. The candidate's education, experience, geographical location, and potential to serve in a SAT program are considered. Final acceptance depends on ICRISAT's approved research facilities and accommodations, and the ability to assure that program scientists can maintain a satisfactory balance between training and research activities.

Training programs are developed for each category of participants within the specialized sciences and services associated with ICRISAT's mandate. Comprehensive individualized programs based on pre-training evaluations, interviews, and sponsor's directions are developed by the concerned research scientists and training program staff. The duration and content of each training program is adjusted to provide a sufficient number of seasons or laboratory cycles to obtain adequate data and the desired level of skill development and specialization of the trainee.

The study schedules for in-service trainees provide practical and theoretical experiences in research techniques, crop improvement, crop production, economics, extension, management, and training methods. The practical

and theoretical learning experiences are guided by research scientists and coordinate by training staff in the field, laboratory, and classroom. More than 100 research scientists annually participate directly in training through lectures and research supervision. The training staff (Table 1) coordinate the instruction, individualized research projects, and evaluate periodically each trainee's performance. Remedial followup programs insure a balanced and comprehensive learning opportunity for each person.

As an integral part of the training, each person develops and conducts laboratory and field experiments or demonstrations which are supervised by research scientists and training staff. These practical field and laboratory activities form the core of the trainee's research and managerial experience and occupy approximately 60% of each person's training program. Final evaluations are used to determine an individual's progress, to assist in establishing personal confidence and provide an indication of the trainee's reaction to the program which was completed. These evaluations are also used to follow up the trainee's work and development activities which were related to the training received while at ICRISAT.

C. Acceptance

Applications from persons desiring training are evaluated by the advisory committee and the appropriate research scientist or staff guide for all categories. Interns fellows, and scholars are interviewed by staff before acceptance In-service trainee and apprentice applications are evaluated by the training staff and appropriate research or service staff with whom they would be associated. To qualify for training each candidate:

1. Must be sponsored by an agency or institution (Tables 2 and 3),working or intending to work in the semi-arid tropics, or the trainee must indicate an aptitude to work in the SAT agricultural programs.
2. Must usually have a rank within the first four applicants nominated by any country.
3. Must present his records of academic training and experience including capabilities in the use of the English language, which indicate the potentiality for profit from training within ICRISAT's mandate and facilities.
4. Must indicate a willingness to do practical field work and to study and conduct laboratory and field research in areas compatible with ICRISAT's mandate and the objectives of the sponsoring agency's programs

The candidate's education, experience, geographical location, and potential to serve in a SAT program considered. Final acceptance depends on ICRISAT's research facilities, accommodations and the program's ability to

maintain a satisfactory balance between training and research activities.

Persons selected for in-service training have had a wide range in educational background and experience (Table 4). The individualized programs have simultaneously accommodated trainees who have completed secondary school and postgraduate degrees. Apprentices, in-service trainees, research scholars, in-service fellows, research fellows, and international interns have been trained by scientists in almost all programs at ICRISAT (Tables 5 through 10).

D. Allowances

Trainee costs include an incidental allowance (Table 11), accommodation, board (including laundry), insurance (health and accidental death benefit), books, (Appendix I) recreation facilities, educational visits, training related transport, excess baggage, rail/air freight for book shipments, transit allowances, training supplies, and operating expenses. A summary of the ICRISAT core fund expenditures (Table 12) shows the increased support given by sponsors.

E. Followup activities

Trainees have come from 66 countries (Tables 13, 14, 15). Contact is maintained with former trainees through correspondence (Table 16), personal contact by ICRISAT scientists working and travelling in SAT countries and providing germplasm, reports, and information developed by ICRISAT. The number of in-service trainees who corresponded with us and who left before 31 December 1981 was high (Table 16). Responses continue to be received from our recent offer to furnish current literature related to their interests.

II. INTERNATIONAL INTERNSHIPS

A limited number of international internships are offered to recent recipients of a PhD degree in the agricultural sciences from developed countries who are interested and show an aptitude to study and work in the rainfed semi-arid tropics.

A. Applications

The programs indicate the areas of research which are appropriate for postdoctoral training of international interns. Potential interns submit applications, letters of recommendation, and are interviewed. The program leader and the supervisor identify and define the areas of study and assure that space and funds are available, and recommend acceptance to the Training Advisory Committee. When

the individual and the study program are approved by the Training Advisory Committee, the recommendation is forwarded to the Director General to offer an internship.

B. Appointment

Appointment is made by the Director General for an initial 12 months extendable up to 24 months following a satisfactory evaluation of the first year and by mutual agreement. A stipend based on academic qualifications and nature of the assignment is established by the Director General.

C. Transportation and insurance

Upon appointment and when leaving, the Institute provides direct route economy class airfare for the intern, spouse, and one accompanying child, plus 10 kg excess baggage per person (maximum of 30 kg). A consolidated air-freight shipment of up to 50 kg per intern or 100 kg for intern and spouse, and 50 kg per accompanying child (maximum of 200 kg per family) is allowed. Alternatively all personal effects may be carried as accompanied excess baggage, provided the total cost to ICRISAT is not in excess of the cost of the authorized air freight. The intern will have the use of a compact sedan for official travel. The vehicle may be used for personal travel by paying all fuel and lubricant costs. Insurance is provided through the Institute for International Education for medical and term life insurance with accidental death or dismemberment benefits.

D. Accommodation

A furnished single bedroom flatlet with a kitchenette which can accommodate a family with one or two preschool children or a single dormitory room with a shared shower can be rented at the Research Center. Housing and furnishings can be rented in the twin cities. Meals may be purchased at the Research Center cafeteria.

E. Followup

Most programs have had international interns (Appendix II). Those who completed their programs here have served as staff of development programs in Upper Volta, Niger, Nigeria, Syria, Botswana, Switzerland, Colombia, Philippines, and New Guinea. Contact after training has been maintained by correspondence and ICRISAT staff visits (Table 16).

I. RESEARCH FELLOWSHIPS

ICRISAT offers a limited number of research fellowships to recent recipients of a PhD (or MSc) degree to enable young scientists from SAT developing countries to gain field and laboratory research skills and experience by participating in the research activities of the Institute.

A. Acceptance

1. Conditions:
   a. The candidate must have completed his postgraduate degree within the past 12 months and not have participated in another long duration post doctoral or post MSc research program.
   b. The applicant must be recommended by representatives of his country program or the sponsor of his postgraduate degree program.
   c. The ICRISAT research program leader and principal research guide must recommend him (after an interview) to study an identified approved research project and assure that facilities and research support are available.
   d. The applicant's qualifications, interview recommendations, and the program's recommendations for research study must meet the approval of the Training Advisory Committee.

B. Fellowship appointment and allowances

1. Research fellows are appointed for 12 months with the potential for an extension (based on satisfactory performance and availability of facilities) to a maximum of 24 months. Research fellows are assigned to a multidisciplinary research program with a research supervisor.

2. The consolidated allowance (Table 11) provides for a fellow living on the campus room, an incidental allowance, and a food allowance. Unaccompanied research fellows living off campus must provide their own accommodation and support from the consolidated allowance. All research fellows are enrolled in a medical and accident group insurance policy.

3. Fellows who are married are encouraged to bring their families. When available, housing will be provided at the Research Center in a furnished flatlet for the fellow, spouse and up to two preschool children. An accompanied fellow may elect to arrange his own housing, board, and daily transport and receive an all inclusive allowance (Table 11).

4. Vacation leave of 12 days is earned during the first year. Twenty two work days of leave are earned during the second year. In addition the fellow may observe the

Institue official holidays.

C. Transportation

Research fellows from India will be reimbursed for transportation costs by rail or road for the fellow and authorized family members. Research fellows from other countries will be provided economy-class air fare for the fellow and authorized family members plus an appropriate transit allowance. Excess baggage (50 kg for the fellow, or 100 kg for fellow and spouse; 50 kg for two preschool childern) will be allowed for reimbursement. The shuttle-bus system will be available for the use of the fellow and family. Other personal transport will be at the expense of the fellow. Return journey allowances are provided as when joining.

D. Followup

Research fellows have been mostly from India (Table 13) and trained in many research programs (Table 9). Their areas of supervised research projects have covered a wide range (Appendix III). The research fellows have been successfully employed in their areas of expertise and have continued to correspond (Table 16) with the Institute's research scientists. They have received germplasm, literature, and further consultation requested.

IV. IN-SERVICE FELLOWSHIPS

In-service fellowships were established in 1982 to provide training opportunities for persons who have been employed for one or more years by a SAT country program which is related to ICRISAT's mandate. Persons (mid-level scientists) who have a MSc or PhD degree (BSc may be accepted) who are expected to return to their programs (research, teaching or development) will receive priority. The fellow would study with the appropriate ICRISAT program and develop skills related to the sponsoring country program.

A. Acceptance

Nominees will be accepted on the basis of application, interview or invitation with the recommendation of the employer indicating that the in-service fellow will be expected to continue in a research or development program. The fellow may be sponsored by hi country, a bilateral aid program, a commercial project ICRISAT. Applicants will be recommended for acceptance to the Training Advisory Committee by the program where they will be associated for their in-service fellowship training, indicating the availability of training oppor-

tunity, staff, and facilities to accommodate the person for the program requested. A satisfactory medical clearance will be required. The in-service fellowship will be for one to six months.

B. Transportation

The in-service fellow from outside of India will be provided up to 10 kg excess baggage with economy airfare to travel to and from ICRISAT and up to 30 kg air freight (germplasm, books, and literature) on the return journey. Family members are not expected to accompany the in-service fellow, but when accompanying, their fares and expenses would be the full responsibility of the in-service fellow. A vehicle will not be assigned to the in-service fellow, but provision will be made for hire of a vehicle from the ICRISAT pool.

C. Allowance

The stipend (Table 11) was established to provide the in-service fellow with the option to reside in dormitory style accommodation on the research center or to live in a hotel in the city. Medical and accident insurance will be provided while the fellow is at ICRISAT. The allowance is all inclusive to cover the costs of books, accommodation, all personal travel, and all other incidental expenses.

D. Followup

In-service fellows have participated in program areas (Table 9) with sponsorship from different agencies (Tables 2 and 3). They have returned to their respective employers and are continuing to utilize the skills and techniques (Appendix IV) they developed while in training at ICRISAT.

V. RESEARCH SCHOLARSHIPS

ICRISAT offers a limited number of thesis research scholarships to students who are enrolled in MSc or PhD degree programs in universities. Degree candidates usually conduct their course work and any preliminary requirements of the university prior to starting a thesis research problem under ICRISAT supervision. These scholarships are:

- To give promising students an opportunity to develop competence in technical and managerial skills in crop breeding, physiology, pathology, entomology, microbiology, economics, agronomy, cropping systems, and other sciences related to increased and stabilized food production in the rainfed semi-arid tropics.
- To provide formal training opportunities for partial fulfilment of an advanced degree for students planning for a

career in a research or development program in the rainfed semi-arid tropics.

A. Acceptance

1. Conditions
   a. The student must be enrolled in an university which recognizes ICRISAT as a place to conduct their student's thesis research and approves the ICRISAT staff selected to guide their student's thesis research.
   b. The course work and preliminary examinations must be successfully completed.
   c. The thesis research problem must be suitable for the degree, acceptable to the university and within ICRISAT's mandate.
   d. The student (by interview) and the proposed research problem must be acceptable to the ICRISAT staff who will guide the thesis research.
   e. Research funds, research facilities and student support must be available or assured by ICRISAT or a sponsor to insure the successful completion of the thesis research.
   f. The application must be approved and recommended by an university authority (advisory committee member).

2. Procedures:
   a. Applicants who satisfy the conditions for acceptance are interviewed to consider their present aptitude for scientific research and their potential for undertaking and satisfactorily completing the proposed thesis research within the normal 18-24 month for a MSc and up to 36 months for PhD scholarships. They must receive a favorable recommendation of the ICRISAT research guide, and Program Leader.
   b. The final acceptance of a scholar is dependent on the decision of the Training Advisory Committee.

B. Transportation

Scholars sponsored by ICRISAT will be provided a round trip air or rail fare (India) for the student. Passage for his approved family (spouse and up to two preschool children) will be provided when the duration of the thesis research is anticipated to exceed one year. Scholars are allowed 10 kg excess baggage (30 kg maximum for a family) of 4 and 50 kg air freight (150 kg maximum for family of 4) or surface freight. A transit allowance of US$50 for scholars from outside of India is granted to each adult person to cover all transit expenses while traveling to Hyderabad.

Scholars sponsored by other agencies will receive travel allowances as per the sponsor's policies. It is

recommended that other sponsors provide similar transport allowances and personal allowances when funds are administered by ICRISAT (Table 11).

All research related transport will be budgeted and provided by the associated ICRISAT research program. Scholars possessing a valid Indian driving licence, who are granted permission, will be allowed to drive ICRISAT vehicles within and outside the campus on business when authorized by the research guide and program leader. All personal transport will be the full responsibility and at the expense of the scholar.

One round trip economy air fare or first class rail transport will be provided for the chairman or major advisor of the student's university advisory committee.

C. Accommodation and stipend

Single or unaccompanied scholars will be provided a single room and laundry facilities in the Research Center dormitory. Scholars who are accompanied by their spouse and up to two preschool children, will when available, be accommodated in a furnished two room flatlet with kitchenette at the Research Center. Scholars accompanied by older children will be required to obtain suitable accommodation outside the Research Center. A scholar may elect to accept a consolidated allowance and obtain accommodation outside the Research Center. The student is then responsible for transport to and from the Research Center on an ICRISAT bus or otherwise.

When living on the Research Center an incidental allowance is provided for the student's personal expenses and needs. In addition, a food allowance (Table 11) is provided and the scholar may purchase his meals in the Research Center cafeteria or canteens or provide his own at his residence if facilities permit.

D. Insurance

While in India, the group insurance policy provides: Medical and accident insurance for the scholar and approved family members, but does not include maternity benefits.

E. Leave

A maximum of 10 work days leave can be availed during the scholarship plus the 10 annually approved Institute holidays.

F. Followup

Students from 46 universities (Table 17) have been associated with the ICRISAT training program. Titles of thesis submitted for partial fulfilment of their degrees cover an extensive range of subjects (Appendix V).

Thirty-five students were at ICRISAT for special degree related training for periods of less than one month. The remaining 68 students completed their thesis research leading to a MSc degree (2 years) or PhD degree (3 years or less). There have been 15 sponsors of students (Tables 2 and 3). The number of students associated with ICRISAT has been increasing (Tables 7 and 15) and is expected to continue to increase as an effective way to provide training for research scientists for future work in the SAT and related regions of the tropics.

VI. IN-SERVICE TRAINING

Applications from SAT country programs are accepted on recommendation of the sponsors or supervisors and satisfactory medical examination reports. Up to 4 nominations from a country are normally accepted so the effort is evenly distributed over most of the SAT area. About 66% of the group are to come from Africa which has a higher priority due to the greater need to strengthen the national research and extension programs. Sixty has been identified as the optimum number of participants in the rainy season programs.

A. Crop Production and Extension Education Programs
Dr. A.S. Murthy

1. General Comments: The crop production training was initiated in 1974 with a group of four Nigerians. There have been 112 crop production trainees from 28 countries (Table 18). The large groups of crop production trainees were from Nigeria, Tanzania, and Kenya. The Nigerian Accelerated Food Production Program sent four groups selected from the federal as well as the state governments who would be mainly trainers in their regional training centers. The Kenya Dryland Farming Research and Development Project, Magarini Land Settlement Scheme, and the Kenya Sorghum and Millet Development Project sent trainees for strengthening their programs. Tanzania, Cameroon, and Ghana sent trainees for participating in food production projects. Mali, Sudan, Niger, Senegal, Guinee, and Ethiopia sent trainees in crop production techniques in one or more crops. Sri Lanka sent trainees for strengthening their on-going training programs at regional levels. Ghana and Sierra Leone participants desired greater exposure to the T & V system of intensive agricultural development or the World Bank extension project.
We had 20 crop production trainees with BSc degrees, 67 diploma holders, 11 with Certificates in Agriculture, and 14 with Secondary School qualifications (Total 112

from 28 countries). The age of the trainees ranged from 26 to 47 with a mean of 32 years. Most of them are experienced people with 5 to 20 years in-service experience in crop production, rural development, and extension services. Table 19 gives the areas of special training desired by the groups. Table 20 indicates the source of support for the crop production groups.

Two senior persons from the first group of Nigerians visited India as members of a special study team on the Green Revolution. Several crop production trainees have gone for higher studies and are in senior positions in the national governments.

Objectives: The crop production program is designed to provide opportunities:

a. To gain practical skills for increasing crop production in the semi-arid tropics through an integrated approach to natural and human resources in ever changing environments.
b. To assess improved cropping and management procedures and learn how to adapt them to local conditions.
c. To learn to identify and reduce adverse influences that limit crop production in the rainfed semi-arid tropics.
d. To develop an appreciation of the role of social, cultural, and economic factors in improving agricultural production.
e. To develop the ability to use extension techniques for communicating new and improved technology for increased and stabilized food production.

3. Case study of a trainee from Ghana, West Africa

This person was working in the Volta Region Agricultural Development Project supported by the World Bank. He was District Agricultural Officer in the Ministry of Agriculture (1975-82) and was transferred Subject Matter Specialist (crop production and protection) in the Training and Visit (Agricultural Extension) Project in 1982-83. He completed a 3 year general agriculture course in an agricultural college (1969-72) later obtained a National Diploma in Agriculture in 1974 and a Diploma in Agricultural Administration in 1980.

a. Objectives:
   The training requested for him by his sponsor was:
   i. Research methods and techniques in agronomy, cropping systems, and soil fertility with reference to groundnut, sorghum, and pigeonpea.
   ii. On-farm trials
   iii. T & V extension programs

b. Initial evaluation
An initial evaluation soon after his arrival at the ICRISAT Center showed that he was weak in general agronomy and agricultural experimentation. His combined score in theory and practical test was 55%. The practical test consisted of:

i. Staking out a rectangle (basic requirement for agricultural experimentation and demonstration)
ii. Land slope estimation (study of micro watesheds and cropping systems)
iii. Visual estimation of area and mensuration (reporting results of experiments in standard kilogram and hectare).
iv. Identification of ICRISAT mandate crops, seeds, soil types, manures, and fertilizers, identification of major pests and diseases, nutrient deficiency symptoms etc.

The written test consisted of 2 parts. Each part is divided into five sections. Part I consisted of general agronomy and nursery management, soils, soil fertility, agricultural mathematics, cropping systems, and land & water management. Part II consisted of agricultural extension communication, agricultural experiments, general botany, genetics, and plant breeding. He scored 50 to 60% in soils, soil fertility, cropping systems, and extension communication.

c. Individualized training strategy: The following training strategy was developed for him to:

i. Strengthening his skills in mensuration, calibration of seed, fertilizers, insecticides, etc.
ii. Cropping systems on flat as well as watershed based farming system.
iii. Laying out of varietal, fertilizer, and other agronomic trials, and one demonstration.
iv. An opportunity to work with scientists in entomology, pathology, and plant protection related to ICRISAT mandate crops.
v. Individualized instruction in the field, laboratory, and classroom through contact with the training officer and scientists.
vi. Reading assignments on agronomy and extension from material available in the program and library.
vii. Development of ability to plan and conduct intensive extension program through discussion and guest lectures
viii. Visit to the T & V system
ix. Ability to develop visual aids for teaching in classroom and extension programs.
x. Field tours to on-farm research and extension programs conducted by Departments of Agri-

culture and Agricultural Universities.

xi. Visits to seed production programs conducted by the A.P. Seed Development Corporation and National Seeds Corporation.

xii. Study of bullock drawn implements at ICRISAT Center as well as the university research farms and farmers' holdings.

d. Field experiments and demonstrations: He conducted one experiment with 3 sorghum varieties and 2 planting dates (6 x 4 randomized block design). He conducted a groundnut varietal trial. A pearl millet demonstration was laid out by him with WCC-75 planted on ridges (improved method) and hills (control). In the sorghum experiment, he studied yield contributing factors; tillers, panicle width, and 1000 grain weight. In the case of groundnut, plant density, pod yield, and shelling percentage were recorded.

He found that the second date of planting in sorghum suffered much due to shootfly and stem borer, and that one of the varieties did not flower till late October. On the first date of planting he recorded up to 2400 kg of grain/ha. In the groundnut experiment he recorded up to 1900 kg pods/ha. The ridge planted pearl millet demonstration gave a yield advantage of 400 kg grain/ha over hill planting.

e. First eight weeks: The training program started with a general orientation to the ICRISAT, its mandate, soil types, facilities etc., followed by a cultural orientation to help the individual to get along with the Indian public, and men and women labor on the Center.

The first 4 weeks were devoted to help the participant to develop experimental designs and plans, skills needed in mensuration, calibration of seed, fertilizer, and insecticides, so his abilities to establish a good crop were strengthened. During this period, lectures were given by the Program Leaders of the sorghum, pearl millet, groundnut, and the farming systems research programs; reviewing the progress of research and potentials for further development.

f. Working with Scientists: After the first 6 to 8 weeks field experience, the trainee worked with scientists in the entomology, pathology, and physiology laboratories and fields in addition he cared for his own experiments and demonstration. During this period, he learned methods of taking observations, recording data directly in a field book, and scoring techniques.

g. Theoretical preparation and practical skills:

i. Major factors controlling crop yields: Outside human control; air, (carbon dioxide and oxygen), light, temperature, precipitation, and

soil. Manageable production factors: Tillage and land management, farm power, mechanization, use of agricultural chemicals, fertilizer management, cropping systems, insect, and disease control, on farm water management.

ii Concept of production potentials, yield gaps.

iii Climate and other environmental factors influencing crop production in rainfed semi-arid tropics, weather and climate, climate of the semi-arid tropics, monsoon type of rainfall, meteorological instruments, recording weather elements for use of weather data in crop production.

iv. The soil-plant-atmosphere system, soil texture, and structure, water and air movement, soil moisture measurement, soil management for efficient water utilization and seedbed preparation, soil types in ICRISAT Center and semi-arid tropics, soil sampling procedure, and demonstration of sampling techniques. Properties of major soil types, conservation, and utilization in relation to environment and crops.

v. Plant nutrition: Soil productivity and soil fertility, plant nutrient elements, nutrient absorption mechanisms, optimum requirements related to crop production, fertilizers, and their composition, use, and deficiency symptoms.

vi Crops: Selection of crops and cropping systems for economic production.

vii Crop protection: Major pests of sorghum, pearl millet, and groundnut; pests of stored products; control of pests. Major diseases of sorghum, pearl millet, and groundnut. Disease, and pest symptoms and their levels of incidence, principles of control methods, and economic evaluation of procedures. Farm pest and disease surveillance; objectives, methods, sampling procedures, methods of pest control, and handling and storage of plant protection chemicals.

viii Harvesting, drying, storage, and marketing.

ix Efficient use of animal powered equipment and other power sources.

Extension Education: Concepts of extension education, meaning, philosophy, principles of extension, teaching-learning principles, characteristics of adult learners, extension teaching methods, layout of demonstrations, the need for these plus why-when-where and how to conduct them. Motivation of extension rkers and farmers, diffusion and adoptio process; rural attitudes and resistance to change, leadership; selection of leaders,

methods of training, audio-visual aids, and their role in effective communication. Use of communication media, management methods, and procedures which will result in increased and stabilized crop production by farmers.

xi. Mensuration, statistical methods, and field experimentation: Land measurement; visual estimation compared to actual measurement. Measurement of land slope, establishing a rectangular plot, layout of experiment/demonstration plots of a given size. Calibration of seed and fertilizer per unit area and weighing fertilizer per row for uniform application. Estimation of crop yield and techniques of sampling plots for yield estimation. Mathematical symbols, use of logarithms, explanation of basic concepts like population, sample, variable, frequency distribution, normal curve, measures of central tendency: mean, median, mode; dispersion, variance, standard deviation, standard error, coefficient of variability, significance tests. 't' test, 'F' test, error, null hypothesis, standard error of difference of two means, and least significant difference. Location and layout of experiments, treatments, replication, experimental error, randomization, and replication, care in field operations from land preparation to harvesting, threshing, and recording yield data. Experimental designs; randomized block design and Latin square, factori . experiments, lattice designs, and missing plot technique.

h. Guest Lectures: During the afternoon session, about 60% of the time was devoted to agronomy and 40% to extension education and rural development including guest lectures. During the invited talks, experts discussed the progress of agricultural development programs in Andhra Pradesh, Integrated Rural Development; democratic decentralization in local self government, T & V system and its evaluation, extension workers', and farmers' training programs, farm radio and TV programs. Extension education; philosophy and methods, communication problems with farmers, motivating change, attitudes as barriers to rural extension, communication materials, audio visual aids, seed production, and distribution.

i. Special Training Programs: The trainee visited the T & V program in the Miriyalaguda area of Nalgonda district under the Command Area Development Project, and attended staff training programs organized by the subject matter specialists. He attended a 3-day communication materials workshop, and prepared posters and charts (visual aids) in the AP Agricultural University Extension Education Department.

j. **Seminar:** His oral communication abilities were improved through a seminar given by him on "Motivational and resistance forces related to the acceptance of new ideas in farming." His seminar score was graded above 5 by 14 and below 5 by only one of his class group (on a ten point continuum with 19 attributes in the rating scale).

k. **Assignments:** He completed assignments given in support of his theory classes and scored 88% (the highest in the group).

l. **Books:** He was supplied Rs. 1000 worth of books on agronomy, extension education, and agricultural experimentation etc.

m. Study tour: During the study tour he visited agricultural universities at Bangalore and Coimbatore, the University of Mysore (Downy mildew research laboratory), rainfed agriculture in four states of Andhra Pradesh, Karnataka, Maharastra, and Tamil Nadu, extension programs, one dry farming program, soil conservation training, and research station, local farm implements and improved implements developed by the agricultural engineering departments, seed testing laboratories, and on-farm trials.

n. Data analysis: When the growth data recording was complete, the experiment, and demonstration crops were harvested and threshed. Grain weights and yield data were recorded and statistically analyzed. A seminar, presenting the information, and using projection equipment was given to his group. In the economics prc am, the trainee learned how to evaluate agronomic data before its recommendation to the farmer. The crop yields obtained by him and most other trainees was around 5000 kg/ha for sorghum and pearl millet; and 3000 kg/ha of groundnut pods.

o. Final evaluation: On the final evaluation he scored 67% in crop botany, agricultural experiments, and seed production; 84% in crop production, general agronomy, and extension communication. So he improved his scores by 25 to 35%. He also obtained the highest score in the crop production group with an overall 73%.

p. Trainee comments: When asked to list three items in the training program which were of maximum value to him as per his country program, he listed the following:

   i. Preparation of visual aids
   ii. Layout of experiments, data analysis, and nursery management
   iii. Soil fertility studies

B. Farming system programs

Dr. A.S. Murthy

1. General Comments: There were 104 trainees in Farming Systems from 27 countries. Thailand topped the list with 24 trainees with Kenya, India, Senegal, Upper Volta, Botswana, Indonesia, Mali and Niger following. In 1979 a group of 12 Thai trainees had short-term training in sorghum and rainfed rice based farming systems. Several from India, Kenya, Botswana, Tanzania, Indonesia etc., were interested in farm equipment, land and water management and cropping systems. Table 21 indicates the number of participants from a country and their educational background. Tables 22 and 23 summarize the areas of specialization and support arrangements. Most of the farming systems group were supported from ICRISAT/Core and World Bank. Their educational background was a diploma in agriculture (African participants) or a B.Sc(Ag) (South & South-east Asian group) as shown in Table 21.

2. Objectives: The farming systems program is designed to provide opportunities:
   a. To develop skills in natural resource utilization research related to catchment area development for improved land and water management.
   b. To become proficient in production factors, research methods and techniques related to agronomic practices, cropping systems, soil fertility, soil physics, plant protection, farm power, machinery, economics and management skills to insure increased and stabilized food production for the rainfed semi-arid tropics.

3. Case study of a participant from Senegal (Francophone group):
   a. He was working as a research assistant in the Agronomy program ISRA/SCS, Senegal since 1978. He had French diploma: BEPC and Diploma'd Ingenieur de Travaux Agric (ITA). His sponsor recommended that he should receive training in soil fertility and physics with reference to pearl millet and groundnut.
   b. He was one of the Francophone group (1983) who attended the intensive English course at the Osmania University for 8 weeks prior to training at the Center. He had problems with fast speakers in the lecture classes.
   c. Initial evaluation:
      i. His performance on field exercises and specimen identification was above 70%. He was one of the few who could layout a rectangle and estimate a given area in hectares. In the

written test, he scored 60% but was weak in soil fertility, cropping systems, and land and water management. In other areas; general agronomy and nursery management, soils, agricultural mathematics, agricultural extension, agricultural experiments, general botany, genetics, and plant breeding he scored 50 to 60%.

d. The following training strategy was developed for him:
   i. Strengthening his skills in mensuration, calibration of seed, fertilizer and herbicides.
   ii. Laying out a herbicide trial and a fertilizer response trial on selected crops.
   iii. Study of cropping systems; intercropping, land and water management in the FSRP, observation of run off studies.
   iv. Opportunity to work in the soil fertility and chemistry laboratory.
   v. Individualized instruction through study assignments from the training staff and the program scientists.
   vi. Field visits to study agronomic research in the national universities and research stations.
   vii. Visits to seed production programs, extension programs etc.
   viii. Opportunity to work on the computer for data analysis.

e. He conducted two experiments: A herbicide trial on pearl millet included 6 treatments (4 replications; RBD design); no weeding, hand weeding, propazine at 0.75 kg/ha, propazine at 1.00 kg/ha, ametryne at 0.75 kg/ha, and ametryne at 1.00 kg/ha. The results showed that ametryne at 0.75 kg/ha increased grain yield by 2430 kg/ha over no weeding (420 kg/ha) with a SED of plus or minus 220. Observations recorded included dry weight of weeds, dry weight of plants, nutrient content (N-P-K) in weeds and plants, plant height, panicle length, number of panicles harvested per ha and grain yield. The experiment on groundnut included 6 levels of gypsum; no gypsum, gypsum 100, 200, 300, 400 and 500 kg/ha. Use of gypsum gave an increase of 260 kg pods/ha while there was no difference among the gypsum levels from 100 to 500 kg/ha.

f. First eight weeks: The training program started with a general orientation to the ICRISAT, its mandate, soil types, facilities etc., followed by a cultural orientation to help the individual to get along with the Indian public, and men and women labor on the center. The first 4 weeks were devoted to help the participant to develop experimental designs and plans, skills needed in mensuration, calibration of seed, fertilizer and insecticides,

so his abilities to establish a good crop were strengthened. During this period lectures were given by the Program Leaders; sorghum, pearl millet, groundnut and the farming systems research programs, and reviewing the progress of research and potentials for future development.

g. Classroom instruction;

i. Agroclimatology: Climate and other environmental factors influencing crop production in rainfed semi-arid tropics, weather and climate, climate of the semi-arid tropics, monsoon type of rainfall, meteorological instruments, recording weather elements, use of weather data in crop production.

ii. Collecting data on soil,, crop, weather, and management factors to develop and test dynamic growth simulation models to quantify the crop response to changes in environmental factors, specifically the genotypic behavior in relation to light interception phenology; leaf development, total dry matter production, and its partitioning.

iii. Soil physics: The soil-plant-atmosphere system, soil texture, and structure, water and air movement, soil sampling for moisture estimation, soil coring for estimation of root development, soil moisture estimation, gravimetric method, using a lysimeter, neutron probe method, soil management for efficient water utilization, and seedbed preparation.

iv. Soil types in ICRISAT Center and semi-arid tropics, soil sampling procedure, demonstration of sampling techniques. Properties of major soil types, conservation, and utilization in relation to environment and crops.

v. Soil Fertility and Chemistry: Soil productivity and soil fertility, plant nutrient elements, essentiality of nutrients, nutrient absorption mechanisms, optimum requirements, and critical levels, luxury consumption, toxic range,and hidden hunger.

vi. Plant nutrition, fertilizers, and their composition, use, and deficiency symptoms. Nitrogen; nitrogen content in soils, nitrogen needs of crops, gains, and losses of nitrogen, nitrogen fixation, azofication, addition by rain, addition through manures, and fertilizers, forms of soil nitrogen transformations in soils, immobilization, mineralization, losses of nitrogen, nitrogen management in soils.

vii. Nitrogen fertilizers; content and usage, slow release nitrogenous fertilizers, nitrification inhibitors, residual effect of nitrogenous fertilizers, crop response to various sources of fertilizer N.

viii. Phosphorus; phosphorus problem in soil fertility, forms of uptake, role in plants, deficiency symptoms, phosphorus fixation in soil, factors affecting P fixation, effect of soil pH on P fixation, organic matter influence on P availability, phosphatic fertilizers, fertilizer technology, water soluble P, citrate soluble P, citrate insoluble P, available P, and total P.

ix. Phosphate fertilizers; content and usage, bacterial phosphate fertilization, crop responses to source of fertilizer P.

x. Potassium economy in soils, potassium fertilizers, and their agronomic value.

xi. Analytical procedures for determining nitrogen, phosphorus, and potassium in soil and plant samples; using equipment for chemical analysis of soil and plant samples.

xii. Land and Water Management: Land preparation, different configurations of the soil (broad ridge, furrow ridge, and furrow waves), construction of structure for"V" notch, automatic level recorder, utilization of the tropicultor and wheeled tool carrier, utilization of traditional implements for land preparation and cultivation in India, simulation of the small watershed: Survey, mapping, contour lines, waterways, broadbed and furrows boundaries, using a dumpy level for the survey, relief meter utilization, erosion study: runoff calculation, soil erosion (soil loss), bulk density determination, soil moisture determination by different methods, rainfall intensity, mean weighted intensity (calculation), calibration of the drums (RM 19E), study of steps in improved technology, operational scale experiments, contour bund problems in India, hydrologic balance, water harvest,and utilization.

xiii. Slope estimation: graded and contour bunds, runoff plots, measurement of runoff, and soil loss.

xiv. Experiments on watersheds in FSRP and steps in technology.

xv. Cropping Systems: Basic concepts, single or sole cropping, multiple cropping, relay cropping, mixed cropping, intercropping, and perennial cropping.

xvi. Crop combinations and row alignments for intercropping; parameters like root development, light interception, dry matter accumulation by plant partitioning, leaf area development, and grain yield, to evaluate intercropping against sole cropping, the equipment used to measure the above parameters. Genotype evaluation for

intercropping, experimental designs, and statistical techniques for analyses of data.

xvii Farm Implements: Comparison of Tropicultor, Ariana, Sine-hoe, and Desi implements for field efficiency, draft requirement, and ease of handling. Fabrication of threshers for sorghum and pearl millet. Designing of single equipment for sowing crops in small experimental plots.

viii Farm Development and Organization: Organizing the day to day farm operations to meet the requirements of research workers, modification of implements to meet the farming systems requirements, designing, and fabrication to meet specific scientific needs, maintenance, and repair of machinery. Drying and threshing of farm produce, survey and making water control bunds, irrigation system layout, and scheduling irrigation.

xix On-farm research and economics: Objectives of on-farm research, selection of farmers, and fields, planning for land and water management, cropping pattern, requirements, and procurement of inputs, scheduling of operations, recording costs and observations, and evaluation of results.

xx On-farm testing of technologies; base line surveys and village-level studies, evaluation of perspective technologies with partial budgeting and whole farm planning, technology adoption studies, economic analysis of cropping systems, and studies on impact assessment for traditional and improved technologies.

xxi Special training program: He attended laboratory practice in soil physics and soil fertility and chemistry for about 8 weeks during the forenoons.

xxii Seminar: He was awarded a score above 5 by 16 persons and below 5 by one person in his group. The grading was on a 10 point continuum with 19 traits like preparation and presentation of subject, use of visual aids, oral communication abilities, ability to understand anothers' point of view, and accept constructive criticism.

xxiii Books: He was supplied Rs. 1000 worth of books on agronomy, farming systems, and agricultural experimentation

xxiv Study tour: During the study tour he visited agricultural universities at Bangalore and Coimbatore, University of Mysore (Downy mildew research laboratory), rainfed agricultur[illegible] four states of Andhra Pradesh, Karna[illegible] Maharastra, and Tamil Nadu, extension programs, one dry farming, and soil conservation training

and research station, and saw local farm implements, and improved implements developed by the agricultural engineering departments, seed testing laboratories, and on farm trials.

xxv. Data analysis: When the growth data recording was completed, the experimental crops were harvested and threshed.Grain weights and yield data were recorded and statistically analyzed. A seminar was given presenting the information to the class, using projection equipment.

xxvi. In the Economics program the trainee learned how to evaluate agronomic data before its recommendation to the farmer.

xxvii. The crop yields obtained by him and most other trainees ranged up to 5000 kg/ha for sorghum and pearl millet, and 3000 kg/ha of groundnut pods.

xxviii. Final evaluation: He scored 78% in general and special agronomy (Part I) and 80 to 90% in (Part II) agricultural experimentation, seed production etc. He improved his scores by 20 to 30% in almost all areas over his initial evaluation. He scored highest in the farming systems group in the final evaluation, obtaining 93%.

C. Cereal improvement programs.

Dr. T. Nagur

The training we provide to the in-service cereal improvement trainees is represented by two case studies, one from South America and one from Africa.

1. The South American trainee had a Certificate in Agriculture and was working as a technician. He was interested in:
   a. Integrated pest management in sorghum
   b. Insect resistance breeding in sorghum
   c. Principles of nursery management

   In order to assess his level of knowledge in different of crop improvement he was given an initial evaluation consisting of a practical test and a written test. The practical test consisted of
   a. Staking out a rectangle with a given dimension
   b. Estimating % of a given slope
   c. Visual estimation of a given area
   d. Identification of seeds and plant materials, categories of soil, pests, specimens with disease, and nutrient deficiency symptoms, reproductive parts of plants etc.

The written part of the test included 200 multiple choice questions covering the areas of general agronomy and nursery management, soils, soil fertility, agricultural mathematics, cropping systems, and land and water management, agricultural extension and communication, agricultural experiments, general botany, genetics, and plant breeding.
He scored 49% on the practical test and 67% in the written test. The written test indicated that he needed training in nursery management, agricultural experiments, and genetics.
Since his major interest was sorghum entomology, it was decided, after discussions with the sorghum entomologists, that he should work with the sorghum entomologists in the laboratory and field. He designed a stem borer trial and a trial on the chemical control of head bugs with the entomology program and an international trial on midge resistance with the training program.
He was given classroom instruction and field experience of:

a. Laying out and marking of the field
b. Calculation of fertilizers, insecticide, and seed requirements
c. Application of fertilizer and insecticide
d. Planting the seed

He conducted the International Midge Resistance Trial with 11 entries and one susceptible check, and the stem borer trial with 20 entries and 3 hecks. The trial for the chemical control of headbugs was planned with four levels of treatment with the chemical (carboryl 50% w.p).
He learned methods of recording data from his trial from the training program and the scientists in the sorghum entomology program. He recorded the data directly in his field book with a pencil for days to 50% bloom, . % of midge incidence, % of chaffy florets, and % of ergot incidence in the International Trial on Midge Resistance and days to 50% bloom, plant height, % of leaf damage, % of dead hearts, and number of heads harvested in the stem borer trial. For the trial on the chemical control of headbugs he recorded the number of head bugs per 10 heads at 24 hr intervals after the 1st, 2nd, and 3rd sprayings.
He attended general lectures including land management, meteorology, farming systems, soils, and soil fertility, statistical methods, experimental techniques, scientific report writing, general botany, crop physiology, crop protection, and extension education and communication.
As a crop improvement trainee, he attended the lectures and completed the written assignments on cytogenetics and plant breeding. He participated in extra assign-

ments in statistical methods, experimental techniques, and reading assignments in genetics.
He attended the guest lectures from the crop improvement scientists such as:

a. The overviews of the improvement work on sorghum, pearl millet, and groundnut
b. The functioning of the genetic resources units of sorghum, pearl millet, and groundnut
c. Hybrid production and population improvement in sorghum and pearl millet.
d. Breeding for drought, insects, and *Striga* resistance in sorghum
e. Breeding for quality improvement and its relation to acceptance.
f. Physiology, entomology, and pathology of sorghum and pearl millet.
g. Microbiology of pearl millet and groundnut
h. Plant quarantine

Apart from sorghum entomology, he had practical training for one week in each of the programs related to insect resistance breeding in sorghum, breeding for drought resistance in sorghum, and sorghum pathology.
In the sorghum entomology program he acquainted himself with the:

a. Mass rearing techniques of sorghum stem borer larvae
   and field infestation techniques
b. Screening methods for stem borer resistance
c. Screening techniques for sorghum midge resistance (use of head cages)
d. Scoring techniques for screening for headbugs on sorghum.

With the help of the ICRISAT sorghum entomology program, he had the *Hymenopteran* parasites associated with sorghum midge in El Salvador identified through the Commonwealth Institute of Entomology, London.
In the program of breeding for insect resistance in sorghum he gained experience and skill in:

a. Identification of source material
b. Breeding for a single pest resistance by the pedigree method.
c. Development of resistant populations by using MS_3, MS_7, genetic male steriles for shoot pests, and head pests.

In the drought resistance breeding program he acquired experience and knowledge with respect to:

a. Studying the drought resistance with at different growth stages
b. Studying the traits associated with drought resistance
c. Screening of germplasm for drought resistance
d. Identification of the source materials

e. Studying the inheritance of drought resistance
f. Transfering the genes for drought resistance by the pedigree method of breeding.

In the sorghum pathology program he learned the techniques for screening for resistance to grain mold, zonate leaf spot, and sooti strip.

To fulfil his requirement of nursery management, different aspects of nursery management were explained to him through field demonstrations. They included:

a. The time and nature of recording different qualitative and quantitative characters in sorghum.
b. Identification of pests of sorghum
c. Scoring for different disease symptoms in sorghum
d. Selection of parent material
e. Selfing
f. Emasculation techniques
g. Crossing techniques
h. Handling of F_2 and other segregating generations
i. Handling of male sterile, maintainer and restorer lines
j. Development and production of hybrids in sorghum.
k. Development of new male steriles
l. Study of border effects
m. Techniques in harvesting experimental plots leaving border rows and ends while harvesting the plants in the net area having self competition on all sides
n. Precautions in handling the harvested experimental produce
o. Pollen viability studies
p. Stigma receptivity studies
q. Visual evaluation of grain yield potential

In order to provide experience in handling male sterile lines, emasculation, and crossing, this trainee was provided with 2291A, 2219B, P721 (high lysine) and SPV 351 (high yielding variety) in the crossing block. Utilizing these lines he made the following crosses:

a. Maintained the A line by crossing the A line with the B line
b. Made hybrids by crossing the A line with two fertile lines, P721, and SPV 351
c. Emasculated P721 and crossed it with SPV 351
d. Made the reciprocal cross by crossing SPV 351 with P721

He also increased the seed of the B line and the two fertile lines by selfing.

In a program to provide experience to the trainee in giving a seminar, this trainee from South America chose an article, "A media for mass rearing of the sorghum stem borer and its use in resistance breeding" from the Indian Journal of Plant Protection VI(i): 48-55.

While he was presenting his seminar, his trainee colleagues have evaluated his presentation by giving grades on 19 different aspects of presentation (grade 10 was very good and 1 was poor) The grades were given by the 23 persons who attended the seminar and 22 persons graded his presentation above 5 on all traits and one person gave a grade below 5.
He visited the following National and State Institutions:

a. Agricultural College and Research Institute, Coimbatore.
b. Downy Mildew Laboratory, Mysore.
c. Dryland Research Station, Bangalore.
d. Agricultural College and Research Institute, Akola.
e. Millet Research Station, Aurangabad.
f. Dryland Research Station, Hayathnagar, Hyderabad.
g. Seed Testing Laboratory, Rajendranagar, Hyderabad.
h. Seed Processing Unit of National Seeds Corporation at Lalaguda, Hyderabad.

He indicated that the study of the insect resistance breeding work at Coimbatore, foundation seed plots of sorghum at Akola, and the seed testing and seed processing techniques were most useful. He presented the summarized results of his three trials in a seminar at the end of the program.
His final evaluation covered areas studied in crop improvement and he scored 83%. He ranked third among the cereal crop improvement trainees. His initial overall evaluation score was 61%.
In his evaluation of the training program, he expressed that the time spent by him in different programs was adequate. While evaluating the teaching methods used he felt all of them were very useful and he ranked 1st the experiments, 2nd lectures, and 3rd written assignments followed by field visits to ICRISAT programs, field trips, and tours.

2. The trainee from Africa had a PhD in the cytogenetics of interspecific hybrids of *Triticum*, *Aegilops*, and *Secale* in the University of Reading, UK. As a research scientist in his country he was to have the responsibility:

a. To select high yielding early duration dwarf varieties of sorghum, which would be suitable for mechanization
b. To develop *Striga* resistant varieties of sorghum.

He was sponsored by the Arab Organization for Agricultural Development, Khartoum as an in-service trainee to obtain experience and skill in sorghum work. His objectives while at ICRISAT

:
To understand the plant breeding methods pertaining

to the sorghum crop.

b. To acquaint himself with the screening techniques and resistance breeding methods for *Striga* in sorghum.
c. To understand statistical methods and experimental techniques
d. To establish contacts with the scientists at ICRISAT for developing a coordinated approach for the improvement of sorghum in his country.

He took the initial evaluation and scored 63% in the practical test and 72% in the written test. After discussions with the sorghum program leader it was decided that he:

a. Should acquaint himself with the activities of the sorghum genetic resources unit.
b. Should work with the scientists in the sorghum improvement program.
c. Should gain experience in the nursery management principles of sorghum in the training department.
d. Should conduct one trial on sorghum or pearl millet in the training program.
e. Would attend lectures on specific topics given to the crop improvement trainees.
f. Should complete written assignments on specific topics pertaining to sorghum crop improvement.
g. Would select seed material from the sorghum breeding program and sorghum genetic resources unit.

He worked with the scientist in the sorghum genetic resources unit and acquainted himself with the collection, maintenance, evaluation, documentation, classification, and preservation of sorghum germplasm.
He made useful single plant selections from the F_3 generations of the conversion program of the sorghum genetic resources unit.
He became acquainted with the work of the different scientists in charge of the sorghum crop improvement in population improvement, breeding for drought resistance, breeding for insect resistance, breeding for *Striga* resistance, breeding for quality improvement, and sorghum physiology.
He made individual plant selections in the segregating progenies of the sorghum breeding program which will be sent to him in the Sudan.
He received training and experience in nursery management principles by:

a. Laying out experiments
b. Calculating fertilizer and seed requirements
c. Applying fertilizer and planting seed by hand and mechanical methods
d. Thinning, weeding and intercultivation
e. Selfing
f. Practising emasculation techniques

g. Practising crossing techniques
h. Studying methods of handling of F_1, F_2, F_3, and F_4 generations
i. Maintaining cytoplasmic genetic male sterile lines
j. Developing hybrids
k. Developing new male steriles
l. Recording qualitative and quantitative characters.
m. Identifying and scoring pest and disease symptoms on sorghum
n. Studying and using various techniques in harvesting experimental plots
o. Identifying precautions in handling harvested experimental produce, threshing, etc.

He was provided with 4 selections of sorghum and 3 selections of pearl millet in the crossing block of the training program. They were:
a. Sorghum: 2077A, 2077B, BR12, and A4
b. Pearl millet: 5054A, 5054B, and IVS 5454

In sorghum he maintained the male sterile line, developed hybrids using the male sterile line, and made a cross and a reciprocal cross between the two fertile lines by using the hand emasculation technique. In pearl millet he maintained the male sterile line and produced the hybrid by using the male sterile line.
He supervised and helped the fellow trainees in the crossing block.
He conducted an International Pearl Millet Adaptation Trial in the training program. He laid out the trial, marked the field, calibrated the fertilizers and seed, applied the fertilizer, and planted the seed. He opened a field book, maintained the log of operations, and recorded the data. He harvested the experiment, analysed the data and presented the results in a seminar.
He participated in the lectures related to meteorology, soils, statistical methods, experimental techniques, crop botany of sorghum, pearl millet, and groundnut, crop physiology, crop protection, improvement of self pollinated crops, improvement of cross pollinated crops, genetic and cytoplasmic-genetic male sterility, and their utility in crop improvement, polyploid breeding and mutation breeding.
He attended all the guest lectures pertaining to the crop improvement of sorghum.
He collected literature in the library and gathered information from the scientists on different aspects of sorghum crop improvement and completed the following special assignments:
a. Pure line selection
b. Hybridization and progeny selection
c. Back crossing
d. Cytoplasmic-genetic male sterility and hybrid development

e. Hybrid seed production and related problems
f. Population improvement for yield potential, and resistance to pests and diseases.
g. *Striga* resistance breeding
h. Drought resistance breeding
i. Insect resistance breeding
j. Grain quality improvement
k. Principles of nursery management

He visited national and state institutions in Tamil Nadu, Maharastra, and Karnataka apart from the related Institutions at Hyderabad. He indicated that his visits to the sorghum improvement work at Coimbatore, the work on the male sterile lines of sorghum, and breeder and foundation seed plots of sorghum at Akola, and the seed testing laboratory and seed processing unit of the National Seeds Corporation at Hyderabad were most useful.
He scored 92% on the final evaluation which was highest among the cereal crop improvement trainees.
He evaluated the training program and rated lectures and experiments to be very useful and ranked 1st to 4th; lectures, experiments, lab practices, and assignments as the teaching methods most helpful.
He offered the following suggestions for improving the training program:
a. Increase the nursery management instructions
b. Work more time with the research scientists
c. Develop video modules for crop improvement
d. Arrange post training meetings and workshops.

D. Legume improvement programs
Dr A.P. Rao

The case studies of two in-service trainees will indicate the training opportunities provided in their fields of interest.

1. The in-service trainee from East Asia had a BSc degree in agriculture and has been working since 1965 in crop improvement, including investigations of wheat viruses, their identification and control through:
   a. Host range, symptomatology and strains
   b. Transmission by vectors
   c. Purification procedures
   d. Properties of particles, serology

   He desired training in groundnut crop improvement in the areas of:
   a. Purification and diagnosis of groundnut viruses
   b. Identification of sources of resistance in the groundnut germplasm, and cultivars
   c. Appropriate breeding methods to transfer identified sources of resistances

d. Laying out and managing of field experimentation

In his pre-training evaluation he scored 59% in the field and laboratory practicals which included identification of different mandate crops of ICRISAT and their economic products, soils of the SAT regions, fertilizers, fungicides, disease specimens, mineral deficiency symptoms in crop plants, estimations of area, calculation of slope, forming rectangular etc. The written evaluation covered basic information on general agronomy and nursery management, soils, soil fertility, agricultural mathematics, cropping systems, and land and water management, agricultural extension and communication, agricultural experiments, general botany, genetics, and plant breeding and he scored 53%. Based on the scores obtained in his evaluation the areas where he showed weakness included nursery management, agricultural experiments, general botany, genetics, and plant breeding. In addition, it was determined to provide opportunities to improve his capabilities by way of learning new techniques and methods in groundnut virology.

The training methodology in his case involved the following three strategies:

a. Individualized instruction/training in the field, lab, and classroom.
b. Opportunity to work in close collaboration with the groundnut virology staff for the entire period of six months.
c. Opportunity to work with other scientists in his desired areas.

In the first strategy it was determined to provide an opportunity for conducting one groundnut experiment to evaluate the natural occurrence of fungal diseases. Training was provided through classroom instruction, discussion, and supplemented with the required handouts and assignments for:

a. Designing a RBD experiment
b. Laying out, staking, and labelling plots
c. Calculating seed requirements for eight row plots at the rate of 333,000 plants per hectare plus 50% over planting, counting, and packeting the seeds for single row hand planting
d. Fertilizer calculations; ium sulphate diammonium phosphate and single superphosphate @10-20-0 per hectare, and packeting the required amount for hand application near the seed row at planting
e. Application of carbofuran at the required rate in each furrow prior to planting (prevention or control of white grub)
f. Planting his own experiment
g. A data record book was developed to record date of 50% emergence, seedling vigor (1-5 rating scale), rust incidence (1-9 scale), days from emergence to

75% flowering, number of primary branches, yield per area harvested (i.e. 4 middle rows, leaving 2 border rows on each side and 1 m on either end) matured pod weight per plant, statistical analysis, and interpretation of the data. He was advised to maintain a log of his daily activiti in the field. Data were recorded directly in the field record book using a pencil. Throughout the period of data collection, several discussions took place in the field about how the data should be accurately taken.

He chose to participate in lectures from the core crop improvement syllabus, covering areas provided by training, and research staff for In-Service trainees through classroom instruction and discussion, supplemented with handouts and written assignments as follows:

a. Cytogenetics: Plant cell, and its contents, mitosis, meiosis, microsporogenesis, pollen tube development, megasporogenesis, fertilization, and embryo development, Mendel's Laws, monogenic and digenic ratios, gene interactions, chi-square test, and DNA
b. Quantitative inheritance, linkage, crossing over xenia, and their significance.
c. Plant breeding; methods of reproduction, sterility, environmental, morphological, and generational effects; genetic and cytoplasmic-genetic male sterility, hybrids, and hybrid vigor, improvement of self-pollinated crops, mass selectic , pureline selection, hybridization, and progeny selection; back crossing and resistance breeding; mutation breeding, hybrid production with cytoplasmic genetic male steriles; synthetics and population improvement, improvement of cross- pollinated crops; mass selection, development of inbreds, single and double cross hybrids, synthetic, composite, and population breeding. Insect resistance breeding, *Striga* resistance breeding, disease resistance breeding, and breeding for quality improvement.
d. Apomixis and its importance in plant breeding, polyploid breeding, genetic male sterility, its origin, and utilization in population improvement, different types of gene actions, general and specific combining ability, and the different methods of estimation of its utilization in plant breeding.

Opportunity to work with the groundnut virologists was a very important part of his training program. Experiments to evaluate groundnut bud necrosis and to learning techniques for purification of PBMV were developed in association with the groundnut

entomologist within the groundnut programs.

a. In the virology program, he conducted one field experiment to study the effect of date of planting, plant and row spacing, and two genotypes on the incidence of bud necrosis. He observed and studied symptomatologies such as chlorotic rings, terminal bud necrosis, smaller new leaves, severe stunting, proliferation of axillary shoots with deformed leaves, and production of plant discoloration. He recorded the incidence BNP 30, 60, 90 days after planting.
b. The second experiment in virology involved the utilization of a virus source by culturing PGMV from groundnut fields, and maintaining it in groundnut seedlings in the green house. Inoculam was made by grinding infected tissue in 0.05 m phosphate buffer, pH 7.0 containing 0.02 m 2-mercaptoethanol. Groundnut leaves showing chlorotic spots and vein clearing symptoms were harvested 10-12 days after inoculation. He studied several steps in the viral purification procedure from infected groundnut leaves and made electron microscopic examination.
c. The trainee's exposure to electron microscopy and opportunity to involve himself in this methodology of virus purification was an added experience.
d. He also had an opportunity to study for one week in each program; groundnut entomology, groundnut pathology ,and groundnut breeding.
e. In entomology, he had an opportunity to study the major insect pests of groundnut in India and in SAT regions. He studied insect vectors of virus diseases in particular thrip identification, their methods of invasion, and their control through cultural methods. He studied methods of screening germplasm for pest resistance in the field, and their evaluation techniques. In groundnut pathology he learned to identify various foliar diseases, scoring techniques using standard charts, and selecting resistant genotypes in the field. In entomology he had an opportunity to study the major insect pests of groundnut in India and in SAT regions. He studied insect vectors of virus diseases, in particular thrip identification, their methods of invasion, and their control through cultural methods. He studied methods of screening germplasm for pest resistance in the field, and their evaluation techniques. In groundnut pathology he learned to identify various foliar diseases, scoring techniques using standard charts, and selecting resistant genotypes in the field. In breeding he had an opportunity to work and learn breeding methods to incorporate resistance to major diseases and pests, earliness, high yield, and how to potentially utilize the wild species related to

groundnut in cultivated selections. He also improved his emasculation and pollination technique and skills.

f. He was given an opportunity to present a seminar on published articles. He used a slide projector and epidioscope for his presentation. In addition, he participated in seminars given by ICRISAT scientists.

g. Educational tours were arranged to enable him to see the diversity in cultivation practices, soils, and crops etc. with special emphasis on the groundnut crop. Finally, a research report was submitted by him.

2. The in-service trainee from Africa obtained his diploma in agriculture and has been working since 1977. He was involved in crop improvement with local field crops and in designing,laying out, and supervising nematological and pathological experiments.

He desired training in pigeonpea crop improvement with emphasis on screening for fusarium wilt.

In his pre-training evaluation he scored 54% in the field and laboratory practicals and 42.5% in the written test.

The training methodology developed was based on the scores obtained in his evaluation and the areas where he showed weakness. These include: agricultural experimentation, genetics, plant breeding, and nursery management. To study breeding techniques and methods in pigeonpea fusarium wilt control, three pigeonpea trials (early planted varietal trial, late planted varietal trial and seed size varieties trial) were designed.

He chose to participate in lectures from the core crop improvement syllabus provided by the training and research staff, as follows:

a. Basic genetics: A plant cell as a fundamental and structural unit of a living body, its development and hereditary material.

b. Mendel's laws, modifications and use of the chi-square test. The linkage mechanism, crossing over, production of variability through recombinations and quantitative inheritance.

c. Plant breeding: Methods of reproduction, improving self-pollinated crops and often cross- pollinated crops through various methods of breeding, hybrid seed production, use of male-sterility in self pollinated plants, backcross methods of breeding, and its application to transferring disease resistant genes.

d. Polyploidy, mutagenesis, and use of tissue culture in improving crop plants.

He studied with the pigeonpea pathologists to learn advanced techniques involved in screening for fusarium wilt of pigeonpea, with some study of sterility mosaic

and phytophthora blight. He studied the various disease symptoms under field and lab conditions. He made microscopic examinations of the pathogen, and learned to prepare the inoculum and growth media and the inoculation techniques.
Additional special training programs were arranged for one to two weeks to enable him to learn and develop special skills in;

a. Physiology
b. Utilizing resources
c. Pigeonpea microbiology
d. Pigeonpea breeding methods

While working in the above programs, he had an opportunity to learn the parameters that affect photosynthesis i.e. day length, and leaf area in pigeonpea. He observed the existing variability in several germplasm collections, the methods of evaluation, and its utilization in crop improvement, preparation of seed for long term and short term storage, methods for screening different rhizobium strains for their effectiveness in nitrogen fixation, and breeding methods for disease resistance, quality improvement, and yield.
Opportunities were provided to him for presenting a seminar, using audio visual equipment and for participation in seminars presented by ICRISAT scientists. Several educational tours were arranged where he had an opportunity to study his areas of interest. Finally, a research report was submitted by him.

VII. APPRENTICES

A limited number of undergraduates or students in work/study programs related to ICRISAT's mandate are accepted for 1 to 12 months.

A. Applications

University or an individual applies for an opportunity to obtain practical experience with scientists, or engineering, maintenance and service staff. Recommendations are required from the University and sponsor.

1. Conditions of acceptance
   a. The area of interest must be related to approved research and service programs and available facilities. Interested staff must be agreeabe to accept the responsibility for supervision.
   b. A program must have an opportunity and be willing for the applicant to be associated with a project for a work/study experience.

c. The applicant must be fully self supported or have full financial support from a sponsor.

B. Accommodation

1. Dormitory accommodations are made available at cost if not fully occupied by other trainees.
2. The apprentice will be fully responsible for obtaining suitable accommodation off campus if on-campus facilities are not available.
3. Apprentices may utilize the regular shuttle facilities without charge.

C. Followup

The number of apprentices accepted has decreased (Tables 5 and 15) as the research center development has been completed. Many of the apprentices are students therefore, correspondence with them, after completion of training, has been low.

III. SPECIAL GROUPS

Short-term training programs, from a couple of days (orientation) up to 4 weeks, were conducted since 1975. (Table 24). The participants were staff in national research and extension programs. They were identified and deputed by their employers. Most were of the middle level of management. During their stay at the Center, they were usually provided room and training facilities in the laboratories and fields.

More recently, development staff and bank field officers from India have been trained in the deep Vertisol technology to facilitate on-farm research and the transfer of improved technology.

It is anticipated that a larger number of special short duration training programs will be developed in subject areas where practical experiences and skill development can be completed in a short time.

Table 1. Number of training program staff and list of staff.

CG Category	1975	1976	1977	1978	1979	1980	1981	1982	1983
I	0.75	1	1	1	1	1	1	1	1
II	1	1	1	1	1	1	1	1	1.25
IIIa	-	-	-	1.5	2	2	2	3	3.25
IIIb	-	-	0.75	1.5	2	2	2	2	1.5
IV	1	2.75	5.75	6	6	8	8	9	9
Total	2.75	4.75	8.50	11	12	14	14	16	16

1983 List of staff

Name	Designation
Dr.D.L. Oswalt	Principal Training Officer
Dr.A.S. Murthy	Sr. Training Officer II
Dr.B. Diwakar	Sr. Training Officer
Dr.T. Nagur	Training Officer II
Dr.A. Prakash Rao	Training Officer II
Mr. T.A. Krishna Murthy	Sr.Admin. Officer
Mr. P.N. Murthy	Sr.Office Asst.
Mr. M. Sudershan Reddy	Sr.Field Asst.
Mrs. Jagatha Seetharaman	Stenographer
Mr. G.T. Krishna	Office Asst.
Mr. P. Chenchaiah	Clerk/Typist
Mrs. Molly Daniel	Clerk/Typist
Mr. K. Anjaiah	Office Helper
Mr. M.A. Razak	Sr.Driver/Gen. Asst.
Mr. K. Raghavan	Driver/Gen. Asst.
Mr. C.F. Boaler	Driver/Gen. Asst.

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Table 2 : Sponsors 1974-1983 and numbers per region

Sponsors	Total	Western African countries	Eastern African countries	Southern African countries	Asian countries	Southern American countries	European countries	North American countries	Australia
AOAD	7	-	5	-	2	-	-	-	-
APAU	6	-	-	-	6	-	-	-	-
Aust.Dev.Bureau	2	-	2	-	-	-	-	-	-
CRSP(GM)	3	-	-	-	3	-	-	-	-
DSE	3	1	2	-	-	-	-	-	-
EMBRAPA	3	-	-	-	-	3	-	-	-
FAO	55	1	38	1	15	-	-	-	-
FORD	18	3	3	8	2	2	-	-	-
GTZ	9	2	2	-	-	-	5	-	-
Governments (9)	18	-	2	1	13	1	1	-	-
Govt/ICRISAT (3)	15	-	1	-	14	-	-	-	-
IADS	5	-	-	1	4	-	-	-	-
IC/CORE	316	48	20	16	205	11	4	9	2
IDRC	35	1	21	5	7	-	-	1	-
INC	3	-	-	-	3	-	-	-	-
Leverhulme	9	9	-	-	-	-	-	-	-
Mag.Lan.Set.	2	-	2	-	-	-	-	-	-
NORDEC	1	-	-	1	-	-	-	-	-
ODA	1	-	-	-	-	-	1	-	-
Others (4)	5	1	-	1	3	-	-	-	-
Rockefeller	1	-	1	-	-	-	-	-	-
SAFGRAD	10	8	1	1	-	-	-	-	-
SAHEL Inst.	8	8	-	-	-	-	-	-	-
Self Paid	51	-	-	-	31	-	15	4	1
Self/ICRISAT	6	-	-	-	5	-	-	1	-
UNDP/CORE	128	68	19	5	21	6	-	7	2
UNDP/W.Af.	21	20	1	-	-	-	-	-	-
UNESCO	3	1	-	-	-	-	2	-	-
Univ.	4	1	-	-	1	1	1	-	-
USAID	49	32	-	12	3	-	-	2	-
WHO	2	1	-	1	-	-	-	-	-
World Bank	27	5	-	1	21	-	-	-	-
	825	210	120	54	359	24	29	24	5

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Table 3 :Sponsors 1974-1983 and number of persons per category of trainees

Sponsors	International Interns	Research Fellows	In-Service Fellows	Research Scholars	In-Service Trainees	Apprentices	Total
AOAD	-	-	-	-	7	-	7
APAU	-	-	-	6	-	-	6
Aust.Dev.Bureau	-	-	-	-	2	-	2
CTSP(GN)	-	-	-	-	3	-	3
DSE	-	-	-	1	2	-	3
EMBRAPA	-	-	1	2	-	-	3
FAO	-	-	1	7	47	-	55
FORD	-	-	2	4	12	-	18
GTZ	-	-	-	5	4	-	9
Governments (9)	-	3	-	4	11	-	18
Govt/ICRISAT (3)	-	1	-	3	8	3	15
IADS	-	-	-	2	3	-	5
IC/CORE	15	30	11	39	299	21	315
IDRC	-	-	3	6	26	-	35
INC	-	-	-	3	-	-	3
Leverhulme	-	-	-	9	-	-	9
Mag.Lan.Set.	-	-	-	2	-	-	2
NORDBC	-	-	-	1	-	-	1
ODA	-	-	-	1	-	-	1
Others (4)	-	-	-	-	5	-	5
Rockefeller	-	-	-	1	-	-	1
SAFGRAD	-	-	-	10	-	-	10
SAHEL Inst.	-	-	-	8	-	-	8
Self Paid	-	1	-	18	6	26	51
Self/ICRISAT	-	2	-	-	4	-	6
UNDP/CORE	5	5	1	9	108	-	128
UNDP/W.Af.	-	-	-	-	21	-	21
UNESCO	-	-	-	3	-	-	3
University (4)	-	-	-	3	1	-	4
USAID	1	-	-	-	48	-	49
WHO	-	-	-	-	2	-	2
World Bank	-	-	-	-	25	-	25
							825

Table 4 : In-Service trainee level of education.

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	Cont.	Total
Secondary School	-	-	7	5	9	23	16	14	16	5	4	99
Agr. Certificate	-	-	2	4	-	2	2	13	7	15	1	46
Agr. Diploma	2	6	7	15	16	18	33	26	36	15	1	175
B.Sc/B.A.	2	3	7	9	7	21	26	13	18	23	2	131
M.Sc.	-	2	5	1	5	18	18	10	9	6	-	74
Ph.D	-	-	1	2	-	13	8	3	5	10	-	42
Total	4	11	29	36	37	95	103	79	91	74	8	567

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Table 5: Number of apprentices trained and the associated programs

Program	Apprentices									
	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Crop improvement	-	-	-	-	-	-	-	-	-	-
Crop production	-	-	-	-	-	-	-	-	-	-
FS-Climatology	-	-	-	-	-	-	-	-	-	-
FS-Cropping systems	-	-	-	-	-	-	-	-	-	-
FS-Equipment	-	1	-	-	-	-	-	-	-	-
FS-L&W management	-	-	-	2	-	3	-	-	-	-
FS-Others	1	-	-	-	-	-	-	-	-	-
Farm development	-	3	3	8	5	-	-	-	-	-
Farm machinery	-	-	5	1	-	6	-	-	-	-
Socioeconomics	-	2	-	2	2	-	-	-	1	-
Genetic Resources	-	-	-	-	-	-	-	-	-	-
Microbiology	-	-	-	-	-	-	-	-	-	-
Pathology	-	1	-	-	-	-	-	-	-	-
Physiology	-	-	-	-	-	-	-	-	-	-
Entomology	-	-	-	-	-	-	1	-	-	2
Virology	-	-	-	-	-	-	-	-	-	-
Biochemistry	-	-	-	-	-	-	-	-	-	-
Information Services	-	-	-	-	-	-	-	-	-	1
Statistics	-	-	-	-	-	-	-	-	-	-
Farm management	-	-	-	-	-	-	-	-	-	-
Fiscal	-	-	-	-	-	-	-	-	-	-
Cytogenetics	-	-	-	-	-	-	-	-	-	-
TOTAL	1	7	8	13	7	9	1	-	1	3

GRAND TOTAL : 50 + 2 (continuing)

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Table 6: Number of In-service trainees and the associated programs.

Program	In-service Trainees									
	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Crop improvement	1	2	12	19	29	36	38	38	38	27
Crop production	3	8	12	10	3	11	17	15	21	11
FS-Climatology	-	-	-	-	-	-	2	1	-	1
FS-Cropping systems	-	1	-	2	1	12	7	5	8	5
FS-Equipment	-	-	-	-	-	-	5	5	1	3
FS-L&W management	-	-	2	1	-	4	5	5	1	1
FS-Others	-	-	1	1	-	-	3	2	5	3
Farm development	-	-	-	-	1	-	-	-	-	-
Farm machinery	-	-	-	-	1	-	-	1	1	-
Socioeconomics	-	-	-	-	-	-	-	-	-	-
Genetic resources	-	-	-	-	-	-	-	1	2	-
Microbiology	-	-	-	-	-	-	6	1	1	14
Pathology	-	-	-	-	-	19	17	3	10	1
Physiology	-	-	1	-	-	-	-	-	-	-
Entomology	-	-	1	-	-	13	2	1	1	6
Virology	-	-	-	-	1	-	-	1	-	-
Biochemistry	-	-	-	-	-	-	1	-	-	-
Information services	-	-	-	1	-	-	-	-	-	-
Statistics	-	-	-	-	1	-	-	-	-	-
Farm management	-	-	-	-	-	-	-	-	-	1
Fiscal	-	-	-	-	-	-	-	-	-	1
Cytogenetics	-	-	-	-	-	-	-	-	-	-
TOTAL	4	11	29	36	37	95	103	79	91	74

GRAND TOTAL : 559 + 8 (continuing)

Table 7: Number of Research Scholars trained and the associated program.

Program	Research Scholars							
	1976	1977	1978	1979	1980	1981	1982	1983
Crop improvement	-	2	1	3	3	5	3	2
Crop production	-	-	-	-	-	-	-	-
FS-Climatology	-	-	-	-	-	1	-	2
FS-Cropping systems	-	1	-	-	-	4	1	1
FS-Equipment	-	-	-	1	1	1	1	-
FS-L&W management	-	1	-	1	-	2	1	3
FS-Others	-	3	1	-	1	6	2	2
Farm development	-	-	-	-	-	-	-	-
Farm machinery	-	-	-	-	-	-	-	-
Socioeconomics	1	1	3	-	2	2	2	1
Genetic resources	-	-	-	-	-	-	-	-
Microbiology	-	-	1	-	2	4	-	2
Pathology	1	-	2	1	-	2	2	3
Physiology	-	-	-	-	1	1	-	2
Entomology	-	1	-	-	-	2	-	3
Virology	-	-	-	-	-	-	-	-
Biochemistry	-	-	1	-	-	-	1	1
Information Services	-	-	-	-	-	-	-	-
Statistics	-	-	-	-	-	-	-	-
Farm management	-	-	-	-	-	-	-	-
Fiscal	-	-	-	-	-	-	-	-
Cytogenetics	-	-	-	-	-	-	2	-
TOTAL	2	9	9	6	10	30	15	22

GRAND TOTAL : 103 + 15 (continuing)

Table 8: Number of In-service Fellows and the associated program

Program	In-service Fellows	
	1982	1983
Crop improvement	3	-
Crop production	-	-
FS-Climatology	-	4
FS-Cropping systems	1	-
FS-Equipment	-	-
FS-L&W management	1	2
FS-Others	-	-
Farm development	-	-
Farm machinery	-	-
Socioeconomics	-	-
Genetic resources	-	-
Microbiology	-	-
Pathology	2	5
Physiology	-	-
Entomology	-	-
Virology	-	1
Biochemistry	-	-
Information services	-	-
Statistics	-	-
Farm management	-	-
Fiscal	-	-
Cytogenetics	-	-
TOTAL	7	12

GRAND TOTAL: 19 + 0 (continuing)

Table 9: Number of Research Fellows and the associated programs.

Program	Research Fellows						
	1977	1978	1979	1980	1981	1982	1983
Crop improvement	-	1	-	1	2	2	-
Crop production	-	-	-	-	-	-	-
FS-Climatology	1	-	-	-	1	-	-
FS-Cropping systems	-	1	2	-	1	-	-
FS-Equipment	-	-	-	-	1	1	-
FS-L&W management	3	1	-	-	-	-	-
FS-Others	-	-	2	1	-	-	-
Farm development	-	-	-	-	-	-	-
Farm machinery	-	-	-	-	-	-	-
Socioeconomics	-	-	1	-	-	-	-
Genetic resources	-	-	-	-	-	-	-
Microbiology	2	-	-	1	-	1	-
Pathology	2	-	-	-	3	1	2
Physiology	-	-	-	-	2	-	1
Entomology	-	1	-	-	-	-	-
Virology	-	1	-	1	-	-	-
Biochemistry	-	-	-	1	1	1	-
Information Services	-	-	-	-	-	-	-
Statistics	-	-	-	-	-	-	-
Farm management	-	-	-	-	-	-	-
Fiscal	-	-	-	-	-	-	-
Cytogenetics	-	-	-	-	-	-	-
TOTAL	8	5	5	5	11	6	3

GRAND TOTAL : 43 + 5 (continuing)

Table 10: Number of International Interns and the associated programs.

Program	International Interns							
	1976	1977	1978	1979	1980	1981	1982	1983
Crop improvement	1	1	1	-	-	-	2	1
Crop production	-	-	-	-	-	-	-	-
FS-Climatology	-	-	-	-	-	-	-	-
FS-Cropping systems	-	-	-	-	-	1	-	-
FS-Equipment	-	-	-	-	-	-	-	-
FS-L&W management	-	-	-	-	-	-	-	1
FS-Others	-	-	-	-	-	-	-	-
Farm development	-	-	-	-	-	-	-	-
Farm machinery	-	-	-	-	-	-	-	-
Socioeconomics	-	-	-	-	-	-	-	-
Genetic resources	-	-	-	-	-	-	-	-
Microbiology	-	-	-	-	1	-	-	1
Pathology	-	-	-	-	1	-	-	-
Physiology	-	-	-	-	1	-	2	-
Entomology	1	-	-	-	-	-	-	-
Virology	-	-	-	-	-	-	1	1
Biochemistry	-	-	-	-	-	-	-	-
Information Services	-	-	-	-	-	-	-	-
Statistics	-	-	-	-	-	-	-	-
Farm management	-	-	-	-	-	-	-	-
Fiscal	-	-	-	-	-	-	-	-
Cytogenetics	-	-	-	-	-	-	-	-
TOTAL	2	1	1	-	3	1	5	4

GRAND TOTAL : 17 + 4 (continuing)

Table 11: Trainee allowances as of 1 March 1983.

Category	ICRISAT (allowance)		Outside (allowance)		Books	Book air freight	Return excess baggage	Return transit allowance (maximum)
	Dorms* Rs.	(Flatlet with family) Rs.	Married (with family Rs.	Single Rs.	Rs.	kg.	kg	US $
In-service trainees	550	-	-	-	1000	30	10	100
M.Sc scholar	550	1600	1700	1300	1500	30	10	100
Ph.D scholar	650	1700	1800	1400	1500	30	10	100
M.Sc fellow	650	1700	1800	1800	1000	30	10	100
Ph.D fellow	750	2100	2500	2500	1000	30	10	100
In-service Fellow	Rs. 3300/- per month (all inclusive allowance)							

* plus food allowance at Rs. 27/- per day.

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Table 12: Summary of annual (US$) expenditures and recoveries

Year	Trainees present	Net Non-salary	Recoveries	Gross Non-salary	Reported total	Gross total
1974	8	3,019	-	3,019	3,019	3,019
1975	23	7,351	7,054	14,405	36,562	43,616
1976	54	19,408	51,613	71,021	98,231	149,844
1977	79	75,535	21,300	96,835	131,146	152,446
1978	81	134,141	27,475	161,616	196,900	224,375
1979	155	302,311	65,690	368,001	377,408	443,098
1980	148	367,002	98,890	465,892	455,513	554,403
1981	172	415,449	121,760	537,209	508,251	620,011
1982	154	251,593	253,475	505,072	366,015	519,490
1983	144	-	196,130	-	-	-

Table 13: Number of trainees from countries and regions since 1974.

Western African Countries

Benin	6
Cameroon	4
Gambia	8
Ghana	13
Guinee	4
Mali	33 + 1
Mauritania	7
Niger	32 + 1
Nigeria	41
Senegal	27
Sierra Leone	1
Tchad	6
Togo	1
Upper Volta	27
	210 + 2

Eastern African Countries

Egypt	2
Ethiopia	20 + 1
Kenya	36 + 2
Rwanda	1
Somalia	3 + 3
Sudan	38 + 4
Uganda	12
	112 +10

Southern African Countries

Botswana	13
Lesotho	2
Malawi	14
Mozambique	3
Tanzania	16
Zambia	1
Zimbabwe	3
	52

Asian Countries

Afghanistan	2
Bangladesh	9
Burma	3
China	17
Fiji	3
India	201 + 8
Indonesia	9
Iraq	2
Japan	2
Jordon	2
Korea (South)	3
Malaysia	1
Nepal	3 + 1
Pakistan	5
Philippines	3
Sri Lanka	21
Thailand	48 + 3
Turkey	3
Yemen (South)	2
Yemen (North)	1
	340 + 11

Southern American Countries

Barbados	1
Brazil	16
Chile	2
Dom Republic	1
El Salvador	2
Honduras	1
Mexico	3
Panama	1
Uruguay	1
	28

Others

Australia	5
Canada	2
Czechoslovakia	3
Italy	1
Holland	6 + 1
Switzerland	1
W.Germany	6 + 3
U.K.	4 + 5
U.S.	21 + 1
	49 +10

Total 791 + 34 (cont.)

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Table 14: Annual duration and number of trainees who participated in the training program 1974-1983

Category	Man weeks at ICRISAT*										
	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	No. continuing
Research Scholars	0	23 (1)	272 (9)	450 (18)	483 (16)	410 (14)	800 (27)	920 (49)	845 (32)	904 (37)	(15)
In-service Fellows	0	0	0	0	0	0	0	0	41 (7)	53 (12)	(0)
Research Fellows	0	0	0	55 (9)	70 (6)	161 (9)	106 (8)	379 (19)	283 (11)	225 (8)	(5)
International Interns	43 (1)	88 (3)	169 (4)	67 (2)	43 (3)	185 (5)	330 (8)	348 (11)	317 (10)	198 (8)	(4)
In-service Trainees	104 (4)	260 (12)	656 (33)	912 (39)	852 (49)	1653 (118)	1737 (104)	2104 (93)	2012 (93)	1494 (74)	(8)
Apprentices	32 (3)	45 (7)	60 (8)	82 (13)	40 (7)	55 (9)	15 (1)	0	17 (1)	69 (5)	(2)
Total	179 (8)	416 (23)	1157 (54)	1357 (79)	1488 (81)	2464 (155)	2988 (148)	3751 (172)	3515 (194)	2993 (144)	(35)

* Figures in parentheses are the number of trainees on board

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Table 15: Number of trainees who completed training each year and total weeks at ICRISAT

	International Interns		Research Fellows		In-Service Fellows		Research Scholars		In-Service Trainees		Apprentices		Total	
	No.	Wk.	No.	Wk.	No.	Wk.	No.	Wk.	No.	Wk.	No.	Wk.	No.	Wk.
1974	-	-	-	-	-	-	-	-	4	104	1	12	5	116
1975	-	-	-	-	-	-	-	-	11	258	7	65	18	323
1976	2	110	-	-	-	-	2	7	29	626	8	60	41	803
1977	1	162	8	44	-	-	9	453	36	928	13	231	67	1818
1978	1	103	5	61	-	-	9	354	37	795	7	40	59	1353
1979	-	-	6	42	-	-	6	295	95	1435	9	55	116	1827
1980	3	278	4	195	-	-	10	463	103	1975	1	15	121	2926
1981	1	122	11	122	-	-	30	1073	79	1906	-	-	121	3223
1982	5	469	6	364	7	41	14	937	91	2200	1	17	124	4028
1983	4	394	3	309	12	53	23	1053	74	1410	3	39	119	3258
Total	17	1638	43	1137	19	94	103	4635	559	11637	50	534	791	19675
Continuing	4		5				15		8		2		34	
													825	

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Table 16: Correspondence with those who left before 1 January 1982

	In-Service %	Research Scholars %	Research Fellows %	International Interns %
West African Countries				
Benin		100		
Cameroon	100			
Gambia	50			
Ghana	90			
Mali	80		100	
Mauritania	71			
Niger	46			
Nigeria	86		100	
Senegal	93		50	
Tchad	83			
Togo	100			
Upper Volta	76		100	
Eastern African Countries				
Egypt	100			
Ethiopia	30	100		
Kenya	69	100		
Rwanda	0			
Somalia	0			
Sudan	54	100	0	
Uganda	50	100		
Southern African Countries				
Botswana	89			
Malawi	100			
Mozambique	61			
Tanzania	100			
Zimbabwe	100			
Asian Countries				
Afghanistan	0	0		
Bangladesh	75			
Burma	100			
China	100			
Fiji	100			
Asian Countries(contd.)				
India	72	52	70	
Indonesia	50	50		
Iraq	0			
Japan				
Jordon	0			
Korea (South)	0		0	
Malaysia	100			
Nepal	100	100		
Philippines	100		100	
Sri Lanka	83	43	0	
Thailand	51	50	100	
Yemen (South)	0			
Southern American Countries				
Brazil	100	100	67	
Chili	100			
Dom Republic	0			
El Salvador	100			
Honduras	0			
Mexico	100			
Panama	0			
Uruguay	100			
Others				
Australia			0	0
Canada		100		
Czechoslovakia	33			
Italy	100			
Holland	100	0		
Switzerland	100			
U.K.		100		100
U.S.A.	0	60		0
Number of responses/ No.of trainees	262/398	41/78	20/32	5/7

Table 17. Universities where Research Scholars have been enrolled.

Africa	Students
University of Niamey	1
University of Khartoum	1
University of Nairobi	2
Addis Ababa University	1
National University of Benin	1
Kenya IRDI	1
Asia (India)	
AP Agricultural University	35 (c)
Sardar Patel Inst of Eco	1 (a)
Osmania University,A.P.	1 (a)
Pantnagar University,U.P.	2 (a)
Haryana Agri Univ, Hissar	4 (d)
IARI, New Delhi	2 (a)
Bangalore University	2 (a)
Marathwada Agri Univ, Maharashtra	2 (b)
H.P.Agric University	1
T.N.Agric University	1 (a)
Punjab Agric University	2
IIT, Kharagpur	1
University of Ag. Sciences, Bangalore	1
Asia (others)	
Univ. of Peradeniya	14 (a)
AIT, Bangkok	5
Dacca University	2 (a)
Bogor Agric University, Indonesia	2 (b)
Khonkaen University	1 (a)
Kasetsart University	1

Australia	Students
University of New England	2
University of Sydney	1
Europe	
Wageningen	4
Max-Planck Inst.	1
Cambridge University	1
University of Reading	3
University of Hohenheim	1
University of Bonn	1
Philipps University	2
North America	
Texas A & M University	1
University of Manitoba	2
Harvard University	1
Cornell University	1
University of Arizona	1
North Carolina State Univ	1
Iowa State University	3
Kansas State University	1
University of Illinois	1
University of Minnesota	1
Univ of California (Davis)	1 (a)
Colorado State University	1

(a) Less than 1 month
(b) One here less than 1 month
(c) Two here less than 1 month
(d) Three here less than 1 month

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Table 18: Distribution of crop production trainees according to their countries and their educational qualifications.

S.No.	Country	Total No.	Education			
			B.Sc/BA	Dip.	Certi.	S.S.
1	Bangladesh	1	1	-	-	-
2	Botswana	2	-	1	1	-
3	Burma	1	1	-	-	-
4	Cameroon	2	-	2	-	-
5	Chad	1	-	1	-	-
6	China	1	1	-	-	-
7	Ethiopia	6	-	3	-	3
8	Fiji	1	-	-	1	-
9	Gambia	1	-	-	1	-
10	Ghana	7	3	2	1	1
11	Guinee	4	-	4	-	-
12	India	1	1	-	-	-
13	Indonesia	1	-	-	1	-
14	Kenya	10	1	5	3	1
15	Malawi	2	1	1	-	-
16	Mali	5	2	2	-	1
17	Mauritania	2	-	-	1	1
18	Niger	6	-	5	1	-
19	Nigeria	25	8	16	-	1
20	Senegal	5	-	5	-	-
21	Sri Lanka	5	-	5	-	-
22	Sudan	8	-	1	-	7
23	Sierra Leone	1	-	1	-	-
24	Thailand	1	1	-	-	-
25	Tanzania	10	-	9	1	-
26	Upper Volta	2	-	2	-	-
27	USA	1	-	1	-	-
28	Uganda	1	-	1	-	-
	Total	112	20	67	11	14

Table 19: Area of special training in crop production

S.No.	Crop Production techniques in	No.
1	Sorghum (S)	97
2	Pearl millet (Pm)	72
3	Groundnut (Gn)	41
4	Pigeonpea (P)	1
5	Sorghum & Pearl millet	63
6	Sorghum & Groundnut	26
7	Millet & Groundnut	6
8	Sorghum, Pearl millet & Groundnut	4

Table 20: Support arrangements for crop production trainees

Agency	No.
USAID	34
UNPD/Core & W.Africa	24
FAO	15
IC/Core	12
SAFGRAD	8
World Bank	5
Others	14
Total	112

Table 21: Distribution of farming systems trainees according to their countries and their educational qualifications.

S.No.	Country	Total No.	Education					
			Ph.D	M.Teh/M.Sc	B.Sc/BA	Dip.	Certifi.	Second.
1	Bangladesh	3	-	2	1	-	-	-
2	Benin	1	-	-	-	-	1	-
3	Botswana	5	-	-	3	-	1	1
4	Brazil	2	2	-	-	-	-	-
5	China	1	-	-	1	-	-	-
6	Czech	1	1	-	-	-	-	-
7	Fiji	1	-	-	-	1	-	-
8	Gambia	4	-	1	-	-	3	-
9	Ghana	1	-	-	-	1	-	-
10	Holland	1	-	-	1	-	-	-
11	India	9	1	2	3	2	-	1
12	Indonesia	5	-	2	1	-	-	2
13	Italy	1	-	-	-	1	-	-
14	Kenya	8	-	-	3	5	-	-
15	Lesotho	2	-	-	-	2	-	-
16	Malawi	3	-	1	-	1	1	-
17	Mali	5	-	-	-	4	1	-
18	Mauritania	2	-	-	-	2	-	-
19	Mozambique	1	-	-	-	-	-	1
20	Niger	5	-	-	1	4	-	-
21	Senegal	7	1	-	-	6	-	-
22	Sri Lanka	1	-	-	-	1	-	-
23	Swisse	1	-	-	1	-	-	-
24	Sudan	1	-	1	-	-	-	-
25	Tanzania	3	-	-	1	1	-	1
26	Thailand	24	1	1	21	1	-	-
27	Upper Volta	6	-	-	-	6	-	-
	Total	104	6	10	37	38	7	6

Table 22: Area of special training in the sub-programs (FSRP)

S.No.	Sub-programs	Number
1	Cropping Systems	41
2	Land & Water Management	21
3	Farm Machinery and Equipment	19
4	Soil Physics	11
5	Agroclimatology	4
6	Production Agronomy	2
7	Weed Science	2
8	Farm Management	2
9	On-farm Research	2
	Total	104

Table 23: Support arrangements

Agency	Number
ICI/CORE	36
World Bank	19
FAO	9
Leverhulme	7
Governments	6
USAID	5
Others	22
Total	104

Table 24: Special short-term training programs

Year	Program	Duration	No.of participants
1975	Economics field investigators	31 Mar-15 Apr	6
1976	Economics field investigators	4 Apr-25 Apr	7
	Resource mgt. training conference	13 Dec-15 Dec	27
1977	Resource mgt. training conference	20 Jan-22 Jan	10
	Sorghum breeding methods	24 Jan-25 Jan	6
	Resource mgt. training conference	10 Apr-17 Apr	15
1979	Chickpea pathology	11 Jan-14 Feb	10
	Pigeonpea pathology	20 Jul- 2 Aug	8
	Pulse entomology	18 Nov-24 Nov	13
1980	Chickpea pathology	10 Jan- 3 Feb	8
	Pigeonpea pathology	18 Jul- 2 Aug	8
	FAO Training workshop	10 Sep-20 Sept	14
1981	Post-graduates; Sri Lanka	4 Jan-14 Jan	14
	BBF Agricultural Officers, Deep Vertisol trng.	31 Aug- 1 Sep	17
	BBF Agricultural Officers, Deep Vertisol trng.	3 Sep- 4 Sep	24
	BBF Agricultural Officers, Deep Vertisol trng.	12 Oct-16 Oct	22
	BBF Agricultural Officers, Deep Vertisol trng.	21 Oct-24 Oct	3
	BBF Agricultural Officers, Deep Vertisol trng.	2 Dec- 4 Dec	15
1982	Chickpea pathology	4 Jan-31 Jan	6
	BBF Agricultural Officers, Deep Vertisol Trng.	14 Jan- 3 Feb	29
	BBF Agricultural Officers, Deep Vertisol Trng.	17 Aug-18 Aug	4
	BBF Agricultural Officers, Deep Vertisol Trng.	24 Aug-25 Aug	4
	BBF Policy makers, Deep Vertisol training	10 Sep-11 Sep	30
	BBF Bank Agri. Officers, Deep Vertisol Trng.	17 Oct-21 Oct	17
1983	BBF Agricultural Officers, Deep Vertisol Trng.	10 Jan-15 Jan	15
	BBF Agricultural Officers, Deep Vertisol Trng.	17 Jan-18 Jan	4
	BBF Agricultural Officers, Deep Vertisol Trng.	14 Feb-18 Feb	26
	BBF Agricultural Officers, Deep Vertisol Trng.	3 Mar- 4 Mar	15
	BBF Agricultural Officers, Deep Vertisol Trng.	4 May- 6 May	18
	Wheeled Tool Carrier, Deep Vertisol Training	9 May-12 May	31
	Pest management for Agril. Officers Deep Vertisol Training	20 Sep-21 Sep	29

Appendix I: Partial list of books available to trainees to obtain with their book allowance.

S.No.	Title	Author	Price Rs.
1.	Agricultural experimentation	Little	267.00
2.	Statistical methods for agricultural workers	Panse	17.00
3.	Soil,water and crop production	D Wynne	240.00
4.	Soil Physics	Kohnke	28.50
5.	Soil conservation	Hudson	202.00
6.	Soil fertility and fertilizers	Tisdale	130.00
7.	Nature and properties of soils	NC brady	60.00
8.	Fertilizer guide for the tropics and subtropics	JG deGeus	75.00
9.	Fertilizer usage hand book	RN Roy	10.00
10.	Botany for degree students	AC Datta	40.00
11.	Botany of field crops	Sunderraj	20.50
12.	Breeding Asian field crops	Poehlman	18.00
13.	Elementary principles of plant breeding	Chaudhary	20.00
14.	Guide for the field crops in the tropics and subtropics	SC Litzenberger	66.00
15.	Production of field crops	Kipps	57.00
16.	Practicals in plant breeding	MN Bhandari	15.00
17.	Principles of plant breeding	Allard	112.00
18.	Pearl millet	Ferraris	81.00
19.	Sorghum in the eighties*	****	******
20.	A guide to sorghum breeding*	LR House	******
21.	Genetics	Altenburg	35.00
22.	Genetics	Strickberger	105.00
23.	Genetics	Stanfield	100.00
24.	Biometrical methods in quantitative genetic analysis	Singh & Chaudhary	35.00
25.	Crop physiology	LT Evans	60.00
26.	Physiological aspects of dryland farming	US Gupta	100.00
27.	Diseases of millets	Ramakrishna	12.50
28.	Diseases of crop plants in India	Rangaswami	32.00
29.	Fungicides in plant diseases control	YL Nene	15.75
30.	Sorghum and pearl millet disease identification hand book	***	*****
31.	Plant diseases	RS Singh	26.00
32.	Pest control in groundnuts	SD Peakin	45.00
33.	Peanut diseases atlas	CS Horne	10.00
34.	Peanut diseases control alternatives	CS Horne	10.00
35.	General and applied entomology	KK Nair	150.00
36.	Successful seed programs	Douglas	60.00
37.	Principles of agril engineering (vol 1 & 2)	Michael	30.00
38.	Principles of agronomy	VTS Mudaliar	40.00
39.	Hand book of agriculture	PL Jaiswal	25.00
40.	Glossary of soil science terms	SSSA	12.00
41.	An introduction to agricultural extension	AT Mosher	40.00
42.	Audio visual communication hand book	DW Pett	37.00
43.	Extension and rural welfare	OP Dahama	30.80
44.	From agronomic data to farmer recommendations	RK Perrin	24.00
45.	Genetique et amilioration des plantes	G Valdeyron	204.00

*** ICRISAT publications

APPENDIX II. INTERNATIONAL INTERN AREAS OF STUDY AND RESEARCH

Intern No	Year Left	Area of study and research
Sorghum		
[illegible]	1977	Sorghum breeding
[illegible]	1978	Sorghum entomology
[illegible]	1982	Sorghum improvement in Upper Volta
[illegible]	1987	Genetic investigations of heat tolerance in sorghum
Millet		
[illegible]	1976	Millet and sorghum breeding
[illegible]	1979	Pearl millet breeding
[illegible]	1980	Plant and environmental features involved in adaptation of pearl millet
[illegible]	1982	Potential utilization of exotic germplasm for increasing grain yield in pearl millet
[illegible]	1987	Pearl millet microbiology
[illegible]	*	Pearl millet physiology
Groundnut		
[illegible]	1981	Screening for foliar pathogen resistance
[illegible]	1983	Electron microscopy of groundnut and pigeonpea virus diseases
[illegible]	1982	Drought, aerial, etc and density relations
[illegible]	1987	Groundnut virology
[illegible]	1984	Relationship between N-compounds in the xylem sap and N-fixing activity of groundnut, pigeonpea, and chickpea
[illegible]	*	Groundnut physiology
Pulses		
[illegible]	1987	Response of pigeonpea cultivars to off-season planting and a computerized pedigree management system
[illegible]	*	Pulse entomology
Farming systems		
[illegible]	1981	Identification of genotypes for improving intercrop performance in the sorghum/pearl millet/groundnut combinations
[illegible]	1987	On farm technology testing and adaptation
[illegible]	*	On-farm research

* continuing in training

APPENDIX III. RESEARCH FELLOW AREAS OF STUDY AND RESEARCH

Fellow No.	Year Left	Area of study and research
Sorghum		
114	1977	Determining nitrogen fixation in biological systems using acetylene reduction assay method.
115	1977	Inoculation techniques and methods for utilizing resistance against sorghum downy mildew.
203	1978	Sorghum entomology
384	1981	Seedling emergence in sorghum and pearl millet
395	1981	Studies on disease resistance screening techniques.
452	1980	Physiology
496	1983	Studies on grain mold causal fungi during sorghum grain development and maturity
513	1981	Sorghum breeding
544	1981	Physiological aspects of drought resistance
689	1982	Insect resistance in sorghum
Millet		
113	1977	Identification and utilization of stable disease resistance in pearl millet
Groundnut		
132	1977	Microbiology
196	1978	Groundnut virology
210	1978	Groundnut improvement
278	1979	Measurements of nitrogenase activity, gas chromatography and isolation and testing nitrogen fixing bacteria
280	1980	Biochemical and genetic aspects of aflatoxins in groundnut
397	1982	Occurrence and production of mycotoxins in groundnut
495	1983	Calcium and water relations in groundnut
510	1983	Mycotoxins contamination of groundnut pods and seeds
703	*	Groundnut entomology
829	*	Investigation of the interactions of plant growth habit and population on the nitrogen fixation of different groundnut genotypes, and the consequences to breeding for improved nitrogen fixation.
Pulses		
279	1980	Studies on host-pathogen interaction in PSMV infected pigeonpea cultivars
525	1981	Control of pod borer, pod flies and mites
526	1981	Disease control procedures
566	1982	Ureides in nitrogen fixation
572	1981	Characterization of yellow mosaic virus of pigeonpea
791	*	Phytophthora blight epidemiology
820	*	Pulse pathology
394	1982	Inheritance of resistance to Fusarium wilt in chickpea (*Cicer arietinum* L.)

(Continued to page 63)

Appendix III. continued from page 48.

Fellow No.	Year Left	Area of study and research
569	1981	Chickpea breeding
575	1982	Study of relationship between environment and productivity in chickpea
699	*	Inheritance of different strains of wilt on chickpea
Farming systems		
83	1977	Soil and water management
84	1977	Soil and water management
117	1977	Farming systems development with emphasis on climatological data analysis
135	1977	Land and water management
144	1978	Effect of moisture supply on the yield advantages of intercropping
204	1978	Soil management and conservation
206	1980	Production agronomy and weed science
214	1979	Soil fertility and plant nutrition
215	1979	Genotype identification for intercropping systems
216	1979	Genotype identification for intercropping systems
281	1979	Land and water management, soil and water relations, and cropping systems
514	1981	Farm machinery
522	1981	Agroclimatology
524	1981	Cropping systems
571	1982	Development and evaluation of improved tillage, planting and interrow cultivation practices, and design and testing of a soil crust breaking equipment for improving crop establishment
Economics		
228	1979	Agricultural economics

*Continuing in training

APPENDIX IV. INSERVICE FELLOWS AREAS OF STUDY

I.S.F. No.	Year Left	Area of study
Sorghum		
695	1982	Sorghum grain mold, downy mildew and leaf diseases
776	1983	Sorghum pathology
Millet		
714	1983	Disease screening techniques
715	1983	Disease screening techniques
716	1983	Disease screening techniques
717	1983	Disease screening techniques
Groundnut		
697	1982	Screening for resistance to rust and leaf spots of groundnut
730	1983	Purification, electron microscopy, production of antiserum, ISEM and ELISA with reference to yellow mosaic virus of legumes
Pulses		
612	1982	Chickpea improvement
613	1982	Chickpea improvement
614	1982	Chickpea improvement
Farming systems		
647	1982	Intercropping cultivations, especially aimed at improvement in methodology
694	1982	Land and water management
728	1983	Agroclimatology modeling and analysis
729	1983	Agroclimatology modeling and analysis
774	1983	Cropping systems and land and water management
780	1983	Agroclimatology
781	1983	Agroclimatology
785	1983	Rainfed agriculture related to management of farming systems

APPENDIX V(a). RESEARCH SCHOLAR THESIS TITLE AND AREA OF STUDY

Scholar No.	Degree	Weeks at ICRISAT	Thesis title(A) and area of study
Sorghum			
42	PhD	176	Inheritance of lysine content, and environmental responses in high and normal lines of *Sorghum bicolor* (L.) Moench. in the semi-arid tropics of India *
271	MSc	102	Effects of recurrent selection in the sorghum populations*
492	MSc	115	Genetic and combining ability analysis of some agronomic and grain quality characters in sorghum (*Sorghum bicolor* (L) Moench)*
Millet			
156	MSc	104	Studies on tester choice in pearl millet (*Pennisetum americanum* (L.) Leeke.)*
429	MSc	95	Genetic advance after 3 cycles of recurrent selection in a composite population of pearl millet (*Pennisetum americanum* (L.) Leeke.)
Groundnut			
213	MSc	79	Studies on the agronomic and breeding potential of some interspecific hybrids in *Arachis.**
430	MSc	74	Studies on the inheritance of resistance to rust (*Puccinia arachidis*) in the cultivate groundnut (*Arachis hypogaea* L.)*
45[illegible]	MSc	50	Comparison of different screening methods for determining resistance to rust in groundnut (*Arachis hypogaea* L.) and in wild relatives (*Arachis* spp.)*
Pulses			
43	MSc	6	The effects of plant population and phosphate fertilizer on the growth, flower and pod abscission, the final yield, and yield components of pigeonpea (*Cajanus cajan*) cv. ppl.
490	MSc	115	Studies on the magnitude and nature of hybrid vigour utilizing male sterile and fertile lines in pigeonpea (*Cajanus cajan* (L.) Millsp.)*
80	MSc	105	Evaluation of parents in three types of crosses in chickpea (*Cicer arietinum* (L))*

(Continued

(Appendix VIa) continued from Page 65)

Scholar No.	Degree	Weeks at ICRISAT	Thesis title and area of study
(Pulses continued)			
175	PhD	157	Studies on some ecological aspects of *Cicer rhizobium* and the effects of *Rhizobium* inoculation method on chickpea (*Cicer arietinum* (L.)
Farming systems			
41	MSc	106	The effect of ridged vs. flat cultivation at two slopes upon runoff, erosion, crop growth and yield
66	MSc	74	Studies on the influence of azobacter, blue-green algae and different nitrogen levels on two rice varieties.*
116	MSc	62	The potential for introducing improved weed control methods to small farmer of the India semi-arid tropics.
	MSc	86	Studies on the effect of intercropping of sorghum with grain legumes under semi-arid conditions*
172	MSc	47	Effect of phosphorus fertilizer placement and soil moisture regime on yield of pigeonpea (*Cajanus cajan* (L.) Mill)*
306	MEng	28	Evaluation of broad bed and narrow ridge irrigation methods*
416	PhD	82	Some investigations on animal traction and other related parameters with reference to a tool carrier design
417	MEng	26	Evaluation of some design parameters of a seed and fertilizer drill*
432	MEng	35	Draft measurements in an Alfisol and a Vertisol under two management systems*
450	PhD	108	Effect of cultivation on mineralization of organic matter in soil*
485	MSc	52	Investigations into nutritional disorders causing chlorosis of groundnut (*Arachis hypogaea* L.) at ICRISAT Center.*
491	MSc	104	Evaluation of different cropping systems for Alfisols at different fertility levels on an operational scale*
568	MEng	31	Evaluation of some low cost tank sealing techniques for seepage control*
Economics			
78	PhD	68	Factor combination and resource use efficiency on small and large farms - a comparative study of hill agriculture and the semi-arid tropics*
119	MSc	64	Economics of on-the-farm processing and storage of food grains in Mahaboobnagar district, Andhra Pradesh

(Continued on Page 67)

(Appendix V(a) continued from 66)

Schoclar No.	Degre	Weeks at ICRISAT	Thesis title and area of study
(Economics continued)			
266	PhD	54	The determinants of kharif fallowing on the Vertisols in semi-arid tropical India

*Thesis copy available

AFFILIATION (b). RESEARCH SCHOLAR AREA OF THESIS RESEARCH

Scholar No.	Degree	Week at ICRISAT	Area of thesis research
Sorghum			
[illegible]	MSc	[illegible]	Sorghum and millet pathology
[illegible]	PhD	128	Inheritance of resistance to shootfly in sorghum
1.4	PhD	[illegible]	Studies on the parasitic species of *Striga*:host parasite relations and control measures
15[illegible]	PhD	[illegible]	Operation of amino acid analyser
1[illegible]	PhD	11	Sorghum breeding and selection
1[illegible]	PhD	1[illegible]	Grain mold of sorghum
[illegible]5	PhD	1	Laboratory and field techniques of screening for sorghum grain molds
41[illegible]	PhD	1	Sorghum grain quality testing
4[illegible]	MSc	6[illegible]	Line into tester analysis of non-restorers in sorghum
14[illegible]	PhD	1[illegible]	Experimental introgression of wild germplasm into cultivated sorghum
[illegible]	MPhil	1	Cereal and pulse entomology
[illegible]34	MSc	**	Entomology
[illegible]	MSc	**	Plant breeding
71[illegible]	PhD	17	Estimation of ethylene produced in the cultures of *M.phaseolina*
[illegible]	MSc	**	Genetics and plant breeding
[illegible]	PhD	[illegible]	Principles and techniques involved in nitrogen fixation
Millet			
[illegible]	MSc	84	Experiments on the biology and epidemiology of pearl millet downy mildew. Experiment on the existence of certation in pigeonpea
40[illegible]	PhD	111	Growth rate, harvest index and grain yield of pearl millet
43[illegible]	PhD	38	Comparison of methods of evaluation of seedling drought tolerance in pearl millet
[illegible]4[illegible]	PhD	51	Climatological modeling of the physiological responses of pearl millet
[illegible]	PhD	**	Isolation and characterization of the rhizosphere nitrogen fixing bacteria
[illegible]24	MSc	1	Techniques in VA mycorrhiza
Groundnut			
15[illegible]	PhD	6	Microbiological techniques related to groundnut improvement
[illegible]71	MSc	67	Studies on the mechanism of natural leaf senescence in groundnut (*Arachis hypogaea* L.)

(Appendix V (b) continued from Page 68)

Scholar No.	Degree	Weeks at ICRISAT	Area of thesis research
Groundnut continued			
403	PhD	27	The influence of the host genotype on *Rhizobium* strain performance on groundnut (*Arachis hypogaea* L.)
645	PhD	**	Microbiology
690	PhD	2	Groundnut cytogenetics, breeding and tissue culture techniques
691	PhD	2	Groundnut cytogenetics, breeding and tissue culture techniques
706	PhD	**	Epidemiology of leaf spot and rust diseases of groundnuts
707	PhD	46	Growth responses of groundnut
709	MSc	13	Studies on trapping of *Spodoptera litura*
711	PhD	**	Factors controlling competition between strains of *Rhizobium* in forming nodules on groundnuts
732	PhD	2	Analytical methodology for mycotoxin identification and detection
788	MSc	**	Nature of resistance in groundnut against jassids
Pulses			
81	MSc	10	The effect of pod borers on the developing pods and seeds development and the final yield in pigeonpea, *Cajanus cajan* (L.) Millsp. in Kenya.
389	PhD	2	Sampling for gas chromatograph and operation of the equipment
390	PhD	2	Sampling for gas chromatograph and operation of the equipment
562	MPhil	1	Microbiology
564	MPhil	1	Microbiology
565	PhD	1	Insect-pest complex of pigeonpea
610	MSc	2	Study of phytophthora blight of pigeonpea
700	PhD	**	Investigation of the chemistry of resistance to insect pests in pigeonpea and chickpea
712	PhD	3	Observational procedures on the pests of pigeonpea
713	PhD	3	Observational procedures on pigeonpea podfly
772	PhD	7	Study of the causal agent of mung bean yellow mosaic in relation to pigeonpea, soybean and other legumes
779	MSc	**	Genetics and plant breeding
822	PhD	**	Methods for isolation and cultivation of free-living nitrogen fixing bacteria

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(Appendix V (b) Continued from Page 69)

Scholar No.	Degree	Weeks at ICRISAT	Area of study and research
(Pulses continued)			
381	PhD	104	Identification and characterization of cucumber mosaic and bean yellow mosaic viruses affecting chickpea (*Cicer arietinum* L.) in India*
385	MSc	117	Inheritance of resistance to wilt (*Fusarium oxysporum* f.sp. *Ciceri*) in chickpea (*Cicer arietinum* L.)
431	PhD	2	Chickpea wilt/root rots screening techniques
Farming systems			
65	MSc	60	Production agronomy
67	MSc	82	Weeds
155	MEng	31	Draft and speed measurements of various bullocks vs. load, time and climate conditions
359	PhD	65	Light and water use efficiency in pure and intercrops of millet and groundnut
448	PhD	98	Study of row arrangement and population effects in pearl millet/groundnut intercropping
489	PhD	97	Effect of land treatment on moisture retention and surface runoff in cultivated plots under rainfed agriculture
494	PhD	2	Training in the agroclimatic systems of analyzing the effect of climatic variables-mainly temperature, solar radiation, and water on plant growth
545	PhD	99	Selection and evaluation of sorghum genotypes for intercropping
551	MPhil	1	Cereal and pulse pathology
552	MPhil	1	Soil fertility
553	MPhil	1	Environmental physics
555	MPhil	1	Environmental physics
556	MPhil	1	Environmental physics
557	MPhil	1	Rainfed cropping systems
558	MPhil	1	Environmental physics
559	MPhil	1	Rainfed cropping systems and plant analytical techniques
560	MPhil	1	Cropping systems
561	MPhil	1	Rainfed cropping systems and plant analytical techniques
563	MPhil	1	Soil fertility
574	PhD	103	Canopy architecture-light interception-water use and dry matter production relationships
615	PhD	95	Response of groundnut to moisture stress in rainy and postrainy seasons

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(Appendix V (b) continued from Page 70)

Scholar No.	Degree	Weeks at ICRISAT	Area of thesis research
(Pulses continued)			
682	MSc	24	The surface structure of an Alfisol and its stability; effects on infiltration, runoff and erosion
685	MSc	43	Instrumental techniques and methods for analysis of soil and plant tissue
734	MSc	**	Weed science
777	MSc	20	Evaluation of water balance in a Vertisol watershed under improved land and water management systems
778	MSc	20	Water use and water balance in some selected cropping systems
782	MSc	**	Cropping systems
Economics			
72	PhD	4	Socioeconomics
82	PhD	197	Agricultural and socioeconomic determinants of human nutrition in the rural semi-arid tropics of India
118	MSc	27	Cost studies on cotton in Nagarjunasagar Project Area of Guntur district
120	MSc	39	Economic impact of DPAP in Mahboobnagar district
301	PhD	**	Millet and other coarse grain marketing in Western Niger
386	PhD	4	Studies in the rural labor market
400	MSc	43	Economic assessment of the impact of tractors in sorghum production in the Gedaref region of the Sudan
527	PhD	62	A microeconomic study of rural soil management practices in Upper Volta
609	PhD	73	Economics of traditional water management
644	PhD	**	Economics of water harvesting and supplementary irrigation of upland crops in the semi-arid tropics of India
696	MEc	14	Micro level evaluation of alternative crop insurance policies in the semi-arid tropics of India
Biochemistry			
702	PhD	1	Electrophoresis technique to separate proteins in nodulating and nonnodulating root extracts
704	PhD	8	Chemical analysis of processed and unprocessed grains

* Thesis copy available
** Continuing