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RP

**SUMMARY RECORD  
TRAINING PROGRAM FOR  
IN-SERVICE TRAINEES  
at ICRISAT**

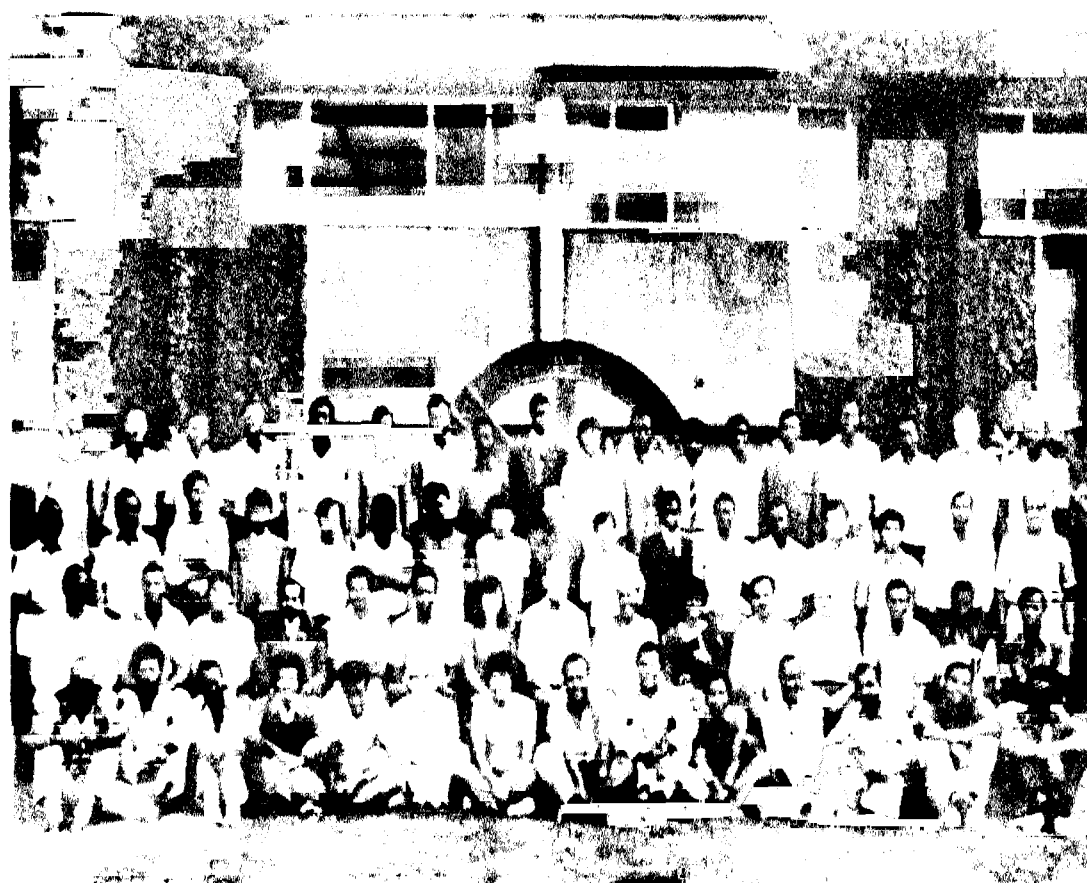
**Training in  
Crop Improvement  
Crop Production, Extension Techniques  
and  
Farming Systems  
With special reference  
to  
Sorghum, Pearl Millet, Groundnut, and Pigeonpea  
from  
21 May to 25 November, 1984**



**ICRISAT**

**International Crops Research Institute for the Semi-Arid Tropics  
ICRISAT Patancheru P.O.  
Andhra Pradesh 502 324, India**

**Inservice Trainees  
May-November 1984  
ICRISAT, India**



**Sitting** Mounkeila Boureima (Niger); Ansumana S L A Gibba (Gambia); Hamadi K H Sowe (Gambia)  
(L to R) Kidanemariam Hagos (Ethiopia); Soungalo Sarra (Mali); Humberto Gonzalez Rodriguez  
(Mexico); Rolando M Ramirez (Philippines); Kgosidintsi N Kgari (Botswana); Abel  
Boyce Chunga (Malawi); John C Musanya (Zambia); Gabriel-Ochola Etolim (Uganda)  
Altafur Rehman (Pakistan); Jamal Adam Abdalrahman (Sudan); Abdoul Abdoulaye Sow  
(Mali);

**Sitting** John Francis Orwanga (Uganda); Anyelwisye Y Lwesya (Malawi); Japannath Reddy (Fiji)  
(L to R) A R M Samarasekara (Sri Lanka); Tilahun Haddis Gebremicael (Ethiopia); Joel Felix  
(2 row) (Tanzania); Jintana Manoppong (Thailand); Dr. D.L. Oswalt; M'bayang Samb (Senegal)  
Padma Rohini Gamage (Sri Lanka); Abdul Qadir Panhwar (Pakistan); Abdul Karim  
Haskir (Syria); Kebba M Drammeh (Gambia); Abdoulie S Bojang (Gambia); Newton N Y  
Dzah (Ghana);

**Standing** Dr. A.S. Murthy; Dr. B. Diwakar; Dar Gaourang Azina (Chad); Tuan Ahamath Booso  
1st row (Sri Lanka); Yongyot Supasak (Thailand); Aron M Sungaunyolo (Malawi); Pipat  
(L to R) Thaikla (Thailand); Rewat Chirasathaworn (Thailand); Sawai Nongwoottisaraj  
(Thailand); Somsak Thongwiwat (Thailand); Serino Haji Nyahoda (Malawi);  
Kenneth Chizoma Abara (Nigeria); Lordson A Della-Braunes (Ghana); Wunlert  
Nunpiyarat (Thailand); Apolonio S Sito (Philippines); M.A. Razzak; Dr. T. Nagur.

**Standing** M.S. Reddy; Worku Konchie Desta (Ethiopia); Kgasane Tsele (Botswana); Joseph  
(2nd row) B M Loga (Malawi); Carlos Manuel Duarte Soares De Carvalho (Cape Verde);  
(L to R) Cheikh A Diouf (Senegal); Tiekoura Traore (Upper Volta); Harouna Moussa (Niger)  
Kabiro Zenon (Burundi); Alberto B Santos (Philippines); Toyoum Nguenaye (Chad)  
Dandeniay Arachchi (Sri Lanka); Harrison R Balaka (Malawi); Zettin Marcellin  
(Chad); Ibra Almany Wane Ndiaye (Senegal); Fode Diallo (Mali); Hakeim Mohamad  
Chafiq (Syria); Amet Sy (Senegal)



# C O N T E N T S

	Page No
Training Program ..	1
Biodata of trainees ..	4
Season and rainfall ..	8
Trainee experiments/trials, demonstrations ..	10
Syllabus ..	22
Special training programs ..	27
Seminars ..	39
Educational tours ..	43
Library, book supply & films ..	44
Staff list ..	45

## TRAINING PROGRAM

During the 1984 rainy season, there were 61 in-service trainees from 25 countries: Benin, Botswana, Ethiopia, Fiji, Gambia, Ghana, Malawi, Mali, Mexico, Niger, Nigeria, Pakistan, Philippines, Senegal, Sri Lanka, Sudan, Tanzania, Tchad, Thailand, Uganda, Burkina Fasso and Zambia, and for the first time from Burundi, Cape Verde, and Syria. Twenty - one trainees arrived mid-March for intensive English instruction at the Osmania University, Hyderabad. All the trainees started the regular in-service training program on 21 May.

A pretraining evaluation was conducted to identify the levels of the individual understanding with reference to the stated objectives in their training proposals. Basic skills were developed in land measurement, calibration of seed, identification of fertilizer and other chemicals, germination tests, and soil sampling by conducting field practicals and laboratory exercises. Overviews of the ICRISAT'S research programs in farming systems, economics, and crop improvement for sorghum, pearl millet, groundnut, and pigeonpea were arranged. Lectures on research techniques, experimental designs, layout of demonstrations and trials were given in the first 4 weeks. Discussions and field visits on crop production in the semi-arid tropics (SAT) with special reference to rainfall by regions were organized. Given this background information, each person selected and developed plans for experiments, trials or demonstrations which they would conduct during the rainy season. Thirty-two experiments in sorghum, 19 in pearl millet, 18 in groundnut, 2 in pigeonpea, 1 in maize, and 19 in intercropping were established (total 91). In addition, 10 sorghum and 9 pearl millet international yield trials, and 12 demonstrations were developed. The trainees conducted 18 experiments with the research programs to which they were assigned.

A total of 140 experiments, trials, and demonstrations were conducted by the trainees to evaluate varietal differences, fertilizer rates, plant densities, weed control methods and combinations of above factors (Table 1).

Abstracts of field experiments and summaries of observations are appended in Section II.

The trainees were divided into 3 subgroups:

1. Crop Improvement	26
2. Crop Production	13
3. Farming Systems	22

Table 1: Details of selected experiments/trials/demonstrations.

Particulars	Crop						Total
	Borghua	Pearl millet	Ground-nut	Maize	Inter-cropping	Pigeon-pea	
Varietal	15	9	7	-	-	2	33
Fertilizer	8	3	-	-	-	-	11
Weed control	1	-	1	-	-	-	2
Plant density	6	1	1	-	-	-	8
Planting methods	-	1	-	-	-	-	1
Combinations of factors	-	4	3	1	-	-	8
Physiology	1	1	1	-	-	-	3
Pathology	-	-	4	-	-	-	4
Intercropping	-	-	-	-	19	-	19
Run-off studies	-	-	1	-	-	-	1
Variability/competition trial	1	-	-	-	-	-	1
	32	19	18	1	19	2	91
International yield trials	10	9	-	-	-	-	19
Demonstrations	2	5	5	-	-	-	12
Other experiments	5	3	1	-	6	-	18*
<b>Total</b>							<b>140</b>

\*includes 3 experiments conducted with agricultural implements

After establishing their experiments/trials/demonstrations on Alfisols and Vertisols the trainees were assigned to their chosen areas of specialization. In general, they attended field and laboratory work in the forenoons and lectures in the afternoons. They participated in the seminars and field days organized by the research programs. During the educational tours in July-September-October they visited selected agricultural research stations, universities, and national extension programs.

The break-up of the training periods:

	Days
Total duration of the program (21 May to 25 November 1984)	189
General orientation and pretraining evaluation	5
Training at ICRISAT Center	104
Study tours, field trips	21
Predeparture evaluation and Delhi tour	7
Holidays, Saturdays, and Sundays	52

The biodata of the trainees were furnished in Table 2.

Table 2. Statement showing biodata of the trainees.

Sl. No.	Name	Country	Age (yrs)	Qualifications	Experi- ence (yrs)	Program of training at ICRISAT	Date of arrival at ICRISAT
1.	Soungalo Sarra	Mali	27	Technicien Supérieur (ITA)	4	CI (Sorghum/Pearl millet)	14.3.04
2.	Sadio Traore	Mali	34	Ingénieur Agriculteur (ISA)	7	CI (Groundnut)	14.3.04
3.	Fode Diallo	Mali	27	Technicien Supérieur (ITA)	3	FS (Soil fertility)	14.3.04
4.	Abdoul Abdoulaye Sou	Mali	29	Ingénieur Agriculteur (ISA)	4	CP (Sorghum), Runoff studies and statistics	26.3.0
5.	Tiekoura Traore	Durbina Faso (IV)	29	Certificat d'Etudes Primaire élémentaire (CEPE)	16	CP (Sorghum) and Farm Development Operations	14.3.04
6.	Carlos NDS de Carvalho	Cape Verde	20	Diploma	3	CI (Peanut)	14.3.04
7.	Rosat Chirassathorn	Thailand	31	BSc	9	FS (Land and Water Management)	15.3.04
8.	Pipat Thasla	Thailand	33	BSc	5	FS (Agronomy)	15.3.04
9.	Bunab Thongstut	Thailand	42	Diploma	10	FS (Land and Water Management)	15.3.04
10.	Nonlert Manpivarat	Thailand	35	BSc	13	FS (Land and Water Management)	15.3.04
11.	Miss Jintana Manoppa	Thailand	37	BSc	19	FS (Agronomy)	15.3.04
12.	Alouy Nane Ibra Ndiaye	Senegal	33	Brevet élémentaire du Premier cycle (BEPC)	14	CI (Sorghum/Pearl millet)	15.3.04
13.	Papa Oumar Diève	Senegal	29	Baccalauréat D ENCR degree	3	CI (Sorghum/Pearl millet)	15.3.04
14.	Mrs Mbayang Samb	Senegal	36	Brevet élémentaire du Premier cycle (BEPC)	10	CI (Sorghum/Pearl millet)	15.3.04
15.	Choith A Biouf	Senegal	26	Brevet élémentaire du Premier cycle (BEPC)	7	CI (Groundnut)	23.3.04
16.	Amet Sy	Senegal	33	Brevet élémentaire du Premier cycle (BEPC)	13	CI (Groundnut)	23.3.04
17.	Marcouma Moussa	Niger	20	Certificat d'Etudes Primaire élémentaire (CEPE)	2	CP (Pearl millet)	18.3.04

Sl. No.	Name	Country	Age (yrs)	Qualifications	Experi- ence (yrs)	Program of training at ICRIBAT	Date of arrival at ICRIBAT
18.	Amakasia Bourouma	Niger	26	Certificate d'Etudes Primaire elementaire(CEPE)	2	CP (Pearl millet)	18.3.04
19.	Zettin Marcelin	Benin	28	Diploma	3	CI (Groundnut)	29.3.04
20.	Toussan Ngouave	Tchad	31	FR-DFEN	0	CI (Sorghum/Pearl millet)	8.4.04
21.	Gar Gaurane Azina	Tchad	36	BAC Agricole ENCR decree	0	CI (Sorghum/Pearl millet)	8.4.04
22.	Koosidints N. Kears	Botswana	29	Diploma	4	FS (Farm Development Operations)	15.5.04
23.	Koasane Tsole	Botswana	34	Certificate in Meteorology	14	FS (Agroclimatology)	15.5.04
24.	Kahiro Zanon	Burundi	28	Certificate in Agriculture	7	CI (Sorghum)	17.5.04
25.	G. Tilahun Maddis	Ethiopia	33	Certificate in Agriculture	0	CI (Sorghum)	14.5.04
26.	Kidano Mariam Haqos	Ethiopia	22	Diploma	2	CI (Groundnut)	14.5.04
27.	Desta Werku Konchie	Ethiopia	30	Secondary Sch.Certificate	10	CI (Sorghum)	14.5.04
28.	Jasannath Reddy	Fiji	29	Diploma in Agriculture	7	FS (Cropping Systems)	15.5.04
29.	Sowe Hamadi K M	Gambia	37	Certificate in Agriculture	14	CI (Sorghum)	13.5.04
30.	Boiang Abdoulie S	Gambia	26	Certificate in Agriculture	14	CI (Sorghum/Pearl millet)	13.5.04
31.	Kebba M Brannah	Gambia	26	Certificate in Agriculture	6	CP (Pearl millet and Intercropping)	13.5.04
32.	Ansumana S.L.A. Gibba	Gambia	31	Certificate in Agriculture	6	FS (Cropping Systems)	13.5.04
33.	Sorino Maji Nvahoda	Malawi	35	Certificate in Agriculture	14	CI (Sorghum/Pearl millet)	13.5.04
34.	Joseph B.N. Lona	Malawi	45	Certificate in Agriculture	24	FS (Agricultural Implements)	12.5.04
35.	Luesya Anvelussye Y.	Malawi	40	Diploma	12	CI (Sorghum/Pearl millet)	18.5.04
36.	Chunga Abel Boyce	Malawi	36	Certificate in Agriculture	10	CI (Sorghum/Pearl millet)	13.5.04
37.	Balaka Harrison R.	Malawi	30	Certificate in Engineering	6	FS (Agricultural Implements)	12.5.04



Sl. No.	Name	Country	Age (yrs)	Qualifications	Experi- ence (yrs)	Program of training at ICRIDAT	Date of arrival at ICRIDAT
38.	Aron Bungauvoia	Hawaii	31	Certificate in Engineering	3	FS (Agricultural Implements)	12.5.04
39.	Gonzalez Humberto R	Mexico	25	BSc	2	CI (Sorghum/Pearl millet)	13.5.04
40.	Kenneth C. Abara	Nigeria	24	Secondary Sch. Certificate	4	CP (Sorghum, Groundnut) and intercropping	13.5.04
41.	Alberto B. Santos	Philippines	41	MSc	15	CP (Sorghum/Groundnut)	15.5.04
42.	Apolonio S. Sita	Philippines	35	MSc	11	FS (Cropping Systems)	15.5.04
43.	Ramirez Rolando N.	Philippines	25	BSc	4	CI (Pigeonpea)	15.5.04
44.	F. Bandideniya Arachichi	Sri Lanka	30	Diploma	5	FS (Cropping Systems)	18.5.04
45.	Mrs. Padma Rohini Ganaga	Sri Lanka	40	Certificate in Agriculture	26	FS (Cropping Systems)	18.5.04
46.	Tuan Athanath Boosa	Sri Lanka	33	BSc	3	FS (Cropping Systems)	15.5.04
47.	A.R.M. Samarasekera	Sri Lanka	45	Diploma	20	FS (Cropping Systems)	18.5.04
48.	Muzron Tesetolego K.M.	Tanzania	27	Certificate in Agriculture	3	CI (Sorghum)	14.5.04
49.	Felix Joel	Tanzania	30	Diploma	6	CI (Sorghum/Pearl millet)	14.5.04
50.	Supasak Yongyot	Thailand	35	BSc	11	FS (Land and Water Management)	15.5.04
51.	Sasai Ungasotticoro	Thailand	37	BSc	21	FS (Land and Water Management)	15.5.04
52.	John Francis Oronogo	Uganda	42	Diploma	15	CP (Sorghum/Pearl millet)	19.5.04
53.	Gabriel Ochola-Etolin	Uganda	30	Diploma	0	FS (Cropping Systems)	19.5.04
54.	John Musanya	Zambia	27	BSc	-	CP (Sorghum/Groundnut)	11.5.04
55.	Abdul Karim Mastir	Syria	42	BSc	5	FS (Herd Science)	23.5.04
56.	Habete Mohamed Shafe	Syria	27	Diploma	4	CP (Sorghum/Groundnut)	29.5.04

Sl. No.	Name	Country	Age (yrs)	Qualifications	Experi- ence (yrs)	Program of training at ICRIAT	Date of arrival at ICRIAT
57.	A.A.R. Janol	Sudan	29	Secondary Sch. Certificate	1	CI (Pearl alliot)	28.8.04
58.	Bello-Brames Lardson	Ghana	47	Diploma	23	CP (Berehu/Pearl alliot)	26.8.04
59.	Brah Newton N	Ghana	44	Certificate in Agriculture	10	CP (Berehu/Broundnet)	26.8.04
60.	Altafur Rahman	Pakistan	46	BSc	13	CP (Berehu/Pearl alliot)	31.8.04
61.	Abdul Qadir Panwar	Pakistan	30	MSc	6	CI (Pearl alliot)	1.6.04

CP Crop Production; CI Crop Improvement; FS Famine System

## SEASON AND RAINFALL

The total rainfall received from June to September was 509mm compared to the normal of 624 mm.

The monsoon set in early this year with 78 mm rainfall received from 12 to 15 June. Sorghum was planted early during the 2nd week of June. Last year planting was done in the 4th week of June.

This year after planting sorghum drought conditions prevailed for 3 weeks in June-July, 4 weeks in August-September (10 August to 10 September) and nearly 3 weeks in September-October (21 September to 9 October). The rainfall deficit was 19% in July, 52% in August, 65% in September, and the overall deficit for the season (15 June to 15 October) was 27%.

Table 3. Rainfall record 1980-84 (mm).

Period	Normal	1980	1981	1982	1983	1984
15-30 June	115	59	197	137	57	11
July	172	127	209	155	211	172
August	156	306	218	69	305	146
September	181	153	289	180	287	99
October	67	0	155	59	58	74*
	691	645	1008	600	918	502
Deviation from normal (%)		-7	+46	-13	+33	-27

\* up to 11 October

Sorghum was planted on 13 and 14th June in BL2A and BL1A (Vertisols). Fertilizer was applied in one or two doses as required by the experiments.

Pearl millet, groundnut, pigeonpea, and intercropping experiments were planted in RCW13 and RCW 14 A and B (Alfisols) from 5 to 8 July after receiving a rainfall of 21 mm in the first week of July. Groundnut was planted on 9 July in RM19E.

Drought conditions in August and September promoted root rot in groundnut and also adversely affected the penetration of pegs into the soil. The crop recovered to some extent after the rains in the 2nd week of October.

Shootfly incidence on sorghum was low.

We continued to apply (N-P-K) 60-17-0 for sorghum and pearl millet and 10-17-0 for groundnut and pigeonpea, as response to higher levels were not significant.

Application of propazine at 1.0 kg a.i./ha in BL2A (sorghum), RCW14B (pearl millet), and alachlor at 4.2 kg/ha in RCW14A (groundnut) helped in controlling weeds to a large extent. Weed growth was controlled by hand weeding twice in intercropping experiments.

Aphids and mythimna were noticed on sorghum in July-August. Rogor and thioclor were used to control the pests. In pearl millet, defoliating caterpillars (mythimna) were controlled by use of carbaryl and thioclor. Leaf miners and aphids on groundnut were controlled using rogor and thioclor. Heliothis on pigeonpea was also controlled by thioclor. Bird damage was moderate to severe in some plots. There was some lodging of pearl millet due to heavy winds and rains during August.

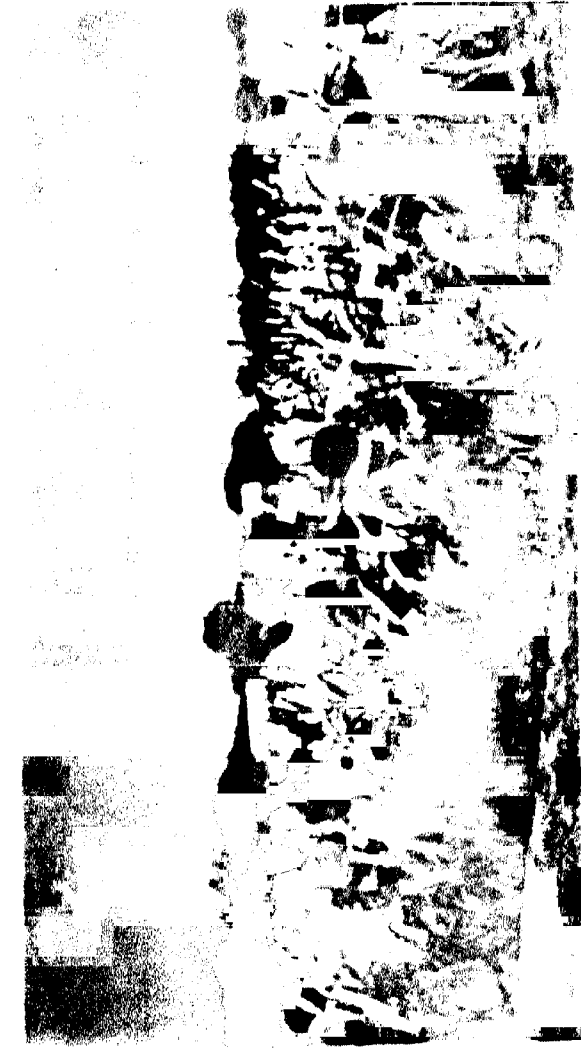
Harvest of pearl millet and sorghum commenced in the last week of September and first week of October. Late sorghum varieties were harvested in 2nd and 3rd week of October. Groundnut was harvested in the 2nd week of November as the 74 mm rainfall in the 2nd week of October helped the later formed pods to mature.

Data were collected for a number of characters in relation to the objectives of the experiments including seedling vigor, plant stand, plant height, identification and scoring pest and disease incidence, leaf area, number of tillers, panicle length and width, and grain or pod yield. Selected data were statistically analyzed and are incorporated in Section II.

Details of experiments/trials/demonstrations conducted by the trainees follow in Tables 4 and 5.

Table 4. Trainsa experiments/trials/demonstrations with sorghum, pearl millet, groundnut, and pigeonpea.

St. Name	Country	Code No.	Details of exp/trials	Particulars of treatments
1. Serra. S.	Mali		varietal trial	IS 22674 (Mali), IS 22680, TRS 05, SPW 297, SPW 298, SPV 475
		04101	Pearl millet fertilizer trial	0C-075, ICH 220, ICH 447 250, 300 kg/ha
2. Kabira. I.			fertilizer trial	475, A 917 400, 600, 800 kg/ha
		04003	lation trial	SPW 221, CBN 6 75,000 pl/ha 125,000 pl/ha 150,000 pl/ha
3. Gonzalez, H.R.	Mexico	04004	Sorghum growth studies	ICSV 130, TRS 05, ICSV 140, ICSV 164, SPV 351, CBN 9
		04102	Pearl millet growth and seed studies	ICH 415, ICHS 7704, MELC-N79,673-K77, ICHS 7930, ICHS 7035
4. Tilahun, B.H.	Ethiopia	04005	Sorghum varietal trial	SPV 306, ICSV 140, IS 9394, 22190z SPL21R, IS 10340 (Hiperia), SPW 290
			lation trial	ES5-1, CBN 6, TRS 05 75,000 pl/ha 150,000 pl/ha
5. Morku, B.K.	Ethiopia	04007	Sorghum varietal trial	SPV 351, SPV 306, ICSV 130, ICSV 140, ICSV 163, CBN 9
			population trial	ET-1966, IS 9394, IS 9395 75,000 plants/ha 150,000 plants/ha
6. Dejang, A.S.	Gambia	04009	varietal trial	SPV 306, SPV 307, SPV 475, SPV 476, SPV 349, CBN 6
		04103	Pearl millet varietal trial	073-K77, ICHS 7703, ICHS 7035, MELC-N79, ICHS 7930, HBN 110



Trainees working in crossing block



Gonzales (Mexico) and Felix (Tanzania) identifying sterile plants



Mrs Samu (Senegal) emasculating sorghum



Abasi (Nigeria) observing bird damage



Drammeh (Gambia) recording carhead length



Lwesya (Malawi) and Qadir (Pakistan) threshing experimental material

Sl. No.	Name	Country	Code No.	Details of exp./trials	Particulars of treatments
7.	Mamadji, S.A.M.	Gambia	04010	Sorghum varietal trial	SPV 351, SPV 476, TRS 05, ICBV 163, SPH 297, CSH 6
			04104	Pearl millet varietal trial	MC-C75, BJ 104, BAH 73, ICMS 7938, MELC-N79, IVS 5454
8.	Joel, F.	Tanzania	04011	Sorghum varietal trial	SPV 351, SPV 386, SPV 475, TRS 05, E35-1, CSH 6
			04012	Sorghum fertilizer trial	SPV 475, A 922 ZSN, 50N, 75N kg/ha
9.	Tusekelee, M.	Tanzania	04013	Sorghum varietal trial	SPV 351, ICBV 163, TRS 05, ICBV 138, SPH 185, 2219AxSPL21R
			04014	Sorghum population trial	SPV 475, CSH 6 .E 35-1 100,000 pl/ha, 150,000 pl/ha
10.	Azina, D.G.	Tchad	04015	Sorghum varietal trial	SPV 351, SPV 386, SPV 549, SPH 221, SPV 185, CSH 9
			04105	Pearl millet varietal trial	MC-C75, BJ 104, ICMS 7703, ICH 447, ICH 220, ICMS 7835
11.	Chunga, A.B.	Malawi	04016	Sorghum varietal trial	SPV 351, SPV 475, SPV 386, SPV 387, TRS 05, CSH 6
			04106	Pearl millet varietal trial	MC-C75, BK 560, ICMS 7703, MELC-N79, ICMS 7704, IVS 5454
12.	Nwaboda, S.N.	Nigeria	04017	Sorghum fertilizer trial	CSH 6, SPV 351 ZSN, 50N, 75N kg/ha
			04018	Sorghum population trial	SPH 298, CSH 9, SPH 185 75,000 pl/ha, 150,000 pl/ha



Sl. No.	Name	Country	Code No.	Details of exp't/trials	Particulars of treatments
13.	Lamaya, A.T.	Nigeria	00019	Burhan fertilizer trial	BN 201, BCR 100 200, 400, 600 kg/ha
			00020	Burhan population trial	BN 9, Z2190 + BR418, 296A + BR108 100,000 g/ha, 150,000 g/ha
14.	Ibra, A.M.R.	Senegal	00107	Four tiller fertilizer trial	IVS 5054, BK 540, BK-C75 200, 300 kg/ha
			00108	Four tiller population trial	ICM 400, ICM 423 90,000 g/ha, 120,000 g/ha 150,000 g/ha
15.	Jandi, A.M.R.	Sudan	00109	Four tiller varietal trial	BC-C75, ICM 7703, ICM 7835, ICM 7730, ICM 7704, MN 110
			00110	Four tiller hybrid yield trial	ICM 220, ICM 415, ICM 423, ICM 440, ICM 400, MN 110
16.	Fror, S.	Nigeria	00201	Burhan varietal trial	MC 12090, PI 301817, ICM 6340, CS 43 ICM 9534, TM-2
			00202	Burhan disease resistance trial	PI 215496, PI 300893, PI 301879, PI 301622, MC 17133 BR, TM-2
17.	Kidane, M.	Ethiopia	00203	Burhan varietal trial	ICM-16, ICM 7785, PI 005132, PI 39333 ICM 7806, TM-2
			00204	Burhan disease resistance trial	ICM 7785, ICM 7806, PI 300600, ICM 6790, ICM 7877, TM-2
18.	Jettin, M.	Burkina Faso	00205	Burhan varietal trial	ICM 6815, ICM 64, ICM 0045, ICM 6430, ICM 5326, TM-2
			00206	Burhan disease resistance trial	MC 12090, PI 310017, PI 301622, ICM 6340, ICM 1008, TM-2

Sl. No.	Name	Country	Code No.	Details of exp't/trials	Particulars of treatments
19.	Diouf, C.A.	Senegal	04207	Growth and development studies on groundnut	ICG 482, Robut 33-1 150,000 pl/ha 333,000 pl/ha 666,000 pl/ha
20	Amet Sv	Senegal	04208	Groundnut varietal trial	PI 341879, PI 381622, NCAC 17133 RF, ICG 4790, ICG 7897
			04209	Groundnut disease resistance trial	NCAC 17090, PI 314817, ICG 6340, ICBS 27, PI 414331, TMV-2
21	Corvalho, C.	Cape Verde	04401	Varietal testing experiment with 3 pigeonpea varieties using 2 plant densities.	Genotypes : ICPL 01, ICPL 6, BBN 1 Densities : 100,000 pl/ha 266,666 pl/ha
			04319	Performance of pigeonpea intercropped with maize removed at different times.	1. Sole pigeonpea 2. Sole maize 3. Pigeonpea+maize removed after 7 weeks 4. Pigeonpea+maize removed after 10 weeks 5. Pigeonpea+maize removed after 13 weeks 6. Pigeonpea+maize removed after 16 weeks Pigeonpea: ICPL 01, Sole 266,000 pl/ha, Intercrop 133,333 pl/ha Maize: Deccan 103, 75,000 pl/ha
22.	Ramirez, R.M.	Philippines	04402	Varietal trial of early duration pigeonpea	ICPL 07, Prabhat, Rajouri, ICPL 105, ICPL 8, UPAS-120
23.	Abara, K.C.	Nigeria	04022	Sorghum varietal trial	CSH 6, SPV 475, SPV 476, SPV 549, SPH 221, SPH 298
			04301	Evaluation of sorghum genotypes intercropped with groundnut	CSH 6 sole, SPV 387 sole, Robut 33-1 sole, CSH 6 + Robut 33-1, SPV 387 + Robut 33-1
			04401	Pearl millet varietal demonstration	IND-3 vs BJ 104

Sl. No.	Country	Code No.	Details of exp't/trials	Particulars of treatments
24. John, R.	Zambia	04023	Sorghum varietal trial	CSH 6, SPV 331, SPV 306, SPV 307, SPV 297, SPV 298
		04209	Groundnut plant densities trial	Robot 33-1 200,000 pl/ha, 230,000 pl/ha, 300,000 pl/ha, 400,000 pl/ha 450,000 pl/ha
		04403	Pearl millet fertilizer demonstration	60-17-0 vs none
25. Santos, A.B.	Philippines	04024	Sorghum variability/competition investigation (Statistics)	SPV 476, CSH 9, CSH 6 SPV 306 Rows : 1, 2, 4
		04210	Groundnut varieties x plant densities trial	Robot 33-1, TWR-2 133,000 pl/ha 266,000 pl/ha 399,000 pl/ha
		04404	Pearl millet varietal demonstration	BK 560 vs local
26. Noussa, H.	Niger	04025	Sorghum fertilizer trial	CSH 6 N-P 30-0, 30-17, 60-17 60-34, 90-17, 90-34
		04114	Pearl millet varietal trial	BNB 110, BJ 104, BK 560, ICIS 7704, IVS454, 673-677
		04405	Groundnut fertilizer demonstration	10-17-0 vs 5-0.5-0
27. Francis, G.	Uganda	04026	Sorghum varietal trial	CSH 6, CSH 9, ISPV 138, SPV 331, SPV 306, SPV 105
		04117	Pearl millet varieties x densities trial	BJ 104, BK 560 125,000 pl/ha 175,000 pl/ha 225,000 pl/ha
		04407	Groundnut fertilizer demonstration	Robot 33-1 with and without gypsum 300 kg/ha

Sl. No.	Country	Code No.	Details of exp./trials	Particulars of treatments
28. Traore, T.	Burkina Faso (U.V)	04027	Sorghum fertilizer trial	N-P 00-0 00-10 00-20 00-10 00-20
		04408	Pearl millet plant densities demonstration	40,000 vs 100,000 pl/ha
29. Makin, H.S.	Swia	04028	Sorghum varietal trial	CBM 6, CBM 9, SPH 185, SPV 475, SPV 476, SPV 549
		04211	Groundnut varietal trial	Rebut 33-1, TRV-2, ICB 7204, ICB 5209, ICB 9327, ICB 5250
		04409	Sorghum population demonstration	CBM 6 60,000 vs 100,000 pl/ha
30. Lordson, B.D.	Ghana	04029	Sorghum varietal trial	SPV 476, SPV 549, SPH 297, SPH 298, CBM 6, CBM 9
		04118	Pearl millet fertilizer trial	MC-C75; 60N, 80N, 100N kg/ha OP, 17P kg/ha
		04410	Groundnut population demonstration	Rebut 33-1 150,000 pl/ha, 300,000 pl/ha
31. Newton, B.	Ghana	04030	Sorghum fertilizer trial	CBM 6; 60N, 80N, 100N kg/ha OP, 17P kg/ha
		03212	Groundnut varietal trial	Rebut 33-1, TRV-2, ICB 7204, ICB 5209, ICB 9327, ICB 5250
		04411	Pearl millet date of planting demonstration	MC-C75 Date of planting: 6.7.84 vs 24.7.84
32. Rahman, A.	Pakistan	04031	Sorghum varietal trial	CBM 6, CBM 9, SPH 185, SPV 351, SPV 386, SPV 476
		04119	Pearl millet varietal trial	Bj 104, BK 546, Ben 73-K77, MC-C75, NBN 110, IVE 5454
		04412	Groundnut fertilizer demonstration	Rebut 33-1 with and without gypsum 300 kg/ha

St. No.	Country	Code No.	Details of exp't/trials	Particulars of treatments
33. Brannah, K.H.	Gambia	04113	Pearl millet varieties + fertilizer trial	BJ 104, BK 360 N-P 0-0, 00-17, 00-17
		04302	Intercropping pearl millet + groundnut	Sole millet 0N Sole millet 60N Sole groundnut 10N Millet + groundnut 0N Millet + groundnut 60N & 10N Pearl millet BK 360 Groundnut Robut 33-1
		04402	Sorghum varietal demonstration	CBN 6 vs local
34. Bourne, H.	Niger	04115	Pearl millet varietal trial	MC-C75, MNM 110, BJ 104, BK 360. ICMS 7835, ICMS 7938
		04116	Pearl millet varieties + density trial	BJ 104, BK 360 30,000 pl/ha, 150,000 pl/ha 3 seeds/l a hill
		04406	Groundnut varietal demonstration	Robut 33-1 vs TWV-2
35. Sou, A.A.	Mali	04303	Intercropping maize + pearl millet	Sole millet 100,000 pl/ha Sole maize 60,000 pl/ha Maize + Pearl millet 30,000 pl/ha " " 60,000 pl/ha " " 90,000 pl/ha " " 100,000 pl/ha
36. Diallo, F.	Mali	04032	Response to N and P in sorghum	N levels - 0,40,80,120 kg/ha P levels - 0,30 kg/ha CBN 6
		04120	N application time and fertilizer efficiency in sorghum and pearl millet	Main plot : Sorghum CBN 9, Pearl millet BJ 104 Sub plot : N splits 60-0, 30-30, 0-60
37. Nankir, A.K.	Sri Lanka	04033	Weed control trial in sorghum	CBN 6 No weeding Weeding @ 2 weeks after planting Weeding @ 4 weeks after planting Weeding @ 6 weeks after planting Weeding @ 2+4 weeks after planting Weeding @ 2+6 weeks after

Sl. No.	Name	Country	Code No.	Details of exp't/trials	Particulars of treatments
37.	Moshir, A.K. (Contd.)	Syria	04216	Weed control trial in groundnut	No weeding Hand weeding @ 2+4 weeks Hand weeding @ 2+6 weeks Hand weeding @ 2+4+6 weeks Laser 4 l/ha Laser 2 l/ha + NH at 6 weeks
38.	Banduniva, A.	Sri Lanka	04301	Population and nitrogen trial on maize	Population levels : 50,000 pl/ha 75,000 pl/ha 100,000 pl/ha N levels : 50,100 kgN/ha Maize Banga 103
			04306	Evaluation of maize and mungbean intercropping	Sole maize (Banga 103) Sole mungbean (PS 16) Maize + mungbean (2:1) Maize + mungbean (2:2) Maize + mungbean (2:3) Maize + mungbean (2:4)
39.	Pipat, T.	Thailand	04213	Effect of date of planting in groundnut	TMV2, Robut 33-1 Date of planting : 6,13,20 July 1984
40.	Ms.Jintana, M.	Thailand	04214	Groundnut varietal trial	IC88 2, IC88 3, IC88 12, IC88 10, IC88 20, TMV-2
41.	Somsak, T.	Thailand	04215	Study on pearl millet and groundnut intercropped with different dates of planting	1.Planting sole pearl millet on time 2.Planting sole pearl millet 15 days later 3.Planting sole groundnut on time 4.Planting sole groundnut later 5.Planting pearl millet and groundnut (intercropping) on time 6.Planting pearl millet 15 days before groundnut planting (intercropping) 7.Planting pearl millet 15 days later to groundnut planting (intercropping)
			04217	Run-off studies on groundnut	Land management : Flat, Broadbed furrow Slope : 0.43, 1.03 Robut 33-1

51. Name No.	Country	Code No. Details of exp./trials	Particulars of treatments
62. Yasuyuki, S.	Thailand	04217 Run-off studies on groundnut	Land management : Flat, Broadbed furrow Slope : 0.4% 1.0% Subst 33-1
63. Reunt, C.	Thailand	04217 Run-off studies on groundnut	Land management : Flat, Broadbed furrow Slope : 0.4% 1.0% Subst 33-1
64. Manjert, B.	Thailand	04217 Run-off studies on groundnut	Land management : Flat, Broadbed furrow Slope : 0.4% 1.0% Subst 33-1
65. Sileo, A.S.	Philippines	04304 Evaluation of sorghum and cowpea intercropping	Sole sorghum Sole cowpeas 4 sorghum + 2 cowpeas 4 sorghum + 4 cowpeas 4 sorghum + 6 cowpeas 4 sorghum + 8 cowpeas
04312		Evaluation of pigeonpea, and cowpeas intercropping	Sole pigeonpea at low population Sole pigeonpea at high population Sole cowpeas Pigeonpea + cowpeas at LP Pigeonpea + cowpeas at HP Pigeonpea at LP + cowpeas at HP
66. Reddy, J.	Fiji	04305 Evaluation of maize and blackgram intercropping	Sole maize - tall-variety (821) Sole maize - dwarf variety (EN 65072) Sole blackgram (79) Maize (79) + blackgram Maize (80) + blackgram
04313		Evaluation of fertilizer response in sorghum and groundnut intercropping	Sole sorghum-40 fertilizer Sole sorghum-40 fertilizer (60-17) Sole groundnut-40 fertilizer Sole groundnut-40 fertilizer (10-17) Sorghum + groundnut-40 fertilizer Sorghum + groundnut-40 fertilizer
67. Sibba, ABA	Senegal	04316 Evaluation of genotypes of pearl millet intercropping with groundnut	Sole millet - dwarf (Sen-73X77) Sole millet - medium tall (M 540) Sole millet - tall (SE-675) Sole groundnut (Subst 33-1) Pearl millet (Sen) + groundnut Pearl millet (tall) + groundnut Pearl millet (t) + groundnut



Oswalt explaining cycles of populations



Santos (Philippines) making observations in plot of investigation



Sawai (Thailand) recording leaf temperature



ICRISAT scientists explaining to local farmers estimates



Sl. No.	Country	Code No.	Details of exp't/trials	Particulars of treatments
47. Bibba, ABLA (Contd.)	Gambia	04315	Evaluation of plant population requirement in pearl millet and groundnut intercropping	Sole millet (MC-C75) 90,000 pl/ha Sole millet 180,000 pl/ha Sole groundnut (TUV-2) Pearl millet (90,000 pl/ha) + groundnut Pearl millet (180,000 pl/ha) + groundnut Groundnut (TUV-2)
48. Boosa, T.A.	Sri Lanka	04307	Evaluation of maize and cowpea intercropping	Sole maize (Duccan 101) 40,000 pl/ha (LP) Sole maize 60,000 pl/ha (NP) Sole cowpea (EC 6216) Maize (LP) + cowpea Maize (NP) + cowpea
		04316	Evaluation of genotypes of groundnut intercropped with pearl millet	Sole pearl millet (MC-C 75) Sole groundnut (TUV-2) Sole groundnut (ICB 6391) Sole groundnut (ICB 3042) Pearl millet + groundnut (TUV-2) Pearl millet + groundnut (ICB 6391) Pearl millet + groundnut (ICB 3042)
49. Ms. Rohini, G.	Sri Lanka	04308	Genotype studies of maize intercropped with cowpea	Sole maize (early dur.) (B 21) Sole maize (medium dur.) (EN 45072) Sole maize (late dur.) (B 103) Sole cowpea (EC 6216) Early maize + cowpea Medium maize + cowpea Late maize + cowpea
		04317	Row arrangement in sorghum and groundnut intercropping	Sole sorghum (CBN 9) Sole groundnut (Rohini 33-1) 2 sorghum + 2 groundnuts 2 sorghum + 3 groundnuts 2 sorghum + 4 groundnuts
50. Samarasekera, AMN	Sri Lanka	04309	Evaluation of maize and soybean intercropping	Sole maize (Duccan 103) Sole soybean (J8-72-44) Maize + soybean (2:1) Maize + soybean (2:2) Maize + soybean (2:3) Maize + soybean (2:4)
		04310	Evaluation of maize and soybean at low and high fertility conditions	Sole maize at low fertility (Duccan 103) Sole maize at high fertility Sole soybean at low fertility (J8-72-44) Sole soybean at high fertility Maize + soybean at low fertili

Sl. No.	Name	Country	Code No.	Details of work/trials	Particulars of treatments
51.	Bchola-Etallo.	Uganda	04311	Evaluation of maize and sorghum intercropped with legumes	Sole sorghum (CSH 9) Sole maize (Ducan 103) Sole sunbeam (PS 16) Sole cowpea (EC 6216) Sorghum + sunbeam Sorghum + cowpea Maize + sunbeam Maize + cowpea
			04310	Evaluation of intercropping systems in alfalfa	Sole sorghum (CSH 9) Sole pearl millet (UC-C75) Sole groundnut (TNY-2) Sorghum + pearl millet Sorghum + groundnut Pearl millet + groundnut
52.	Lopa, J.†	Malawi	04121	Effect of seed size and depth of sowing in pearl millet	Seed size : Large, Mixed, Small Depth of sowing : 3 cm, 5 cm deep NBN 110
53.	Harrison, B.R.†	Malawi	04121	Effect of seed size and depth of sowing in pearl millet	Seed size : Large, Mixed, Small Depth of sowing : 3 cm, 5 cm deep NBN 110
54.	Aron, S.†	Malawi	04121	Effect of seed size and depth of sowing in pearl millet	Seed size : Large, Mixed, Small Depth of sowing : 3 cm, 5 cm deep NBN 110
55.	Kpari, K.N.	Botswana		6 months special training in Farm Development and Operations	
56.	Samai, N.	Thailand		Response of groundnut to fertilizer application	OM, 10N OP, 17P TNY 2, Robert 33-1

plus 5 months training in bullock-equipment

Table 5. Entries for sorghum and pearl millet international yield trials

Name	Country	Code No.	Entries
Kabiro, Z.	Burundi	04021	Sorghum International Yield Trial
Tilahun, M.	Ethiopia	"	Entry Nos. SPV 351, SPV 475, SPH 297, SPH
Desto, M.V.	Ethiopia	"	298, ICSV 163, ICSV 164, A925-PC03R,
Maadi, J.H.	Gambia	"	A 9217-PC03R, 296A x SPL18R, 2219A x
Tovoun, N.	Tchad	"	SPL41R, TR805, CSH 9
Azina, G.G.	Tchad	"	
Chunga, A.B.	Malawi	"	
Lwesya, A.Y.	Malawi	"	
Mrs. Saab, M.	Senegal	"	
Dieve, P.O.	Senegal	04022	Evaluation of 1984 International Shootfly Nursery
			Entry Nos. IS 2123, IS 2205, IS 3962, IS 4663, IS 5470, IS 5484, IS 5566, IS 18551, PS 14454, PS 19618, PS 21318, CSH 1
Sarra, S.	Mali	04111	Pearl Millet International Yield Trial
Boiang, A.S.	Gambia	"	Entry Nos: ICMH 504, ICMH 505, IC 82601,
Joel, F.	Tanzania	"	ICH 433, ICMS B141, ICMS B283, ICMS B120,
Tusekelege, H.	Tanzania	"	ICMS 0019, WC-C75, ICMS 7703, NBH 110, BK 560
Nyahoda, S.H.	Malawi	"	
Ibra, D.	Senegal	04112	Pearl Millet International Yield Trial
Dieve, P.O.	Senegal		Entry Nos: ICMS 0137, ICTP 0202, ICTP 0203
Jamal, A.A.R.	Sudan		ICMV 02111, ICMV 02113, ICMV 02116, ICMV 02117, ICNC 02132, WC-C75, ICMS 7703, NBH 110, BK 560
Dadir, P.	Pakistan		

## SYLLABUS FOR LECTURES AND FIELD PRACTICALS

Each person's needs are different, therefore, we developed a syllabus for each individual in the three groups. However, some areas considered as the core syllabus to all trainees are listed below:

### General

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 application. Estimation of crop yield and techniques of sampling plots for yield estimation.

### Meteorology

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.

### Soils

The soil-plant-atmosphere system. soil texture and structure: water and air movement: soil moisture measurement

Soil types in ICRISAT center and semi-arid tropics: soil sampling procedure: demonstration of sampling techniques.

### General Agronomy

Cropping systems. single or sole cropping: multiple cropping. relay cropping. mixed cropping and intercropping. perennial cropping.

Plant nutrition. fertilizers and their composition. use and deficiency symptoms.

Tillage. land preparation methods in Alfisols and Vertisols: implements for primary tillage. forming seedbeds. local bullock-drawn implements and tractor with different attachments used on watersheds.

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

Experiments on watersheds in the Farming Systems Research Program.

## Statistical Methods

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.

## Experimental Techniques

Location and layout of experiments, treatments, replications, 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, missing plot technique, factorial experiments, and lattice designs.

Advanced training in statistics: Introduction to design of experiments; sources of variation/model/distributions; estimation/significant testing for RBD, testing for assumptions in ANOVA, residuals/plots; testing contrasts/analysis of RBD, multiple range tests; factorial designs, split plot designs, analysis, graphical representation; covariance; lattice designs; contents; associations; graphs; correlation and regression.

## Scientific Report Writing

Techniques for writing reports of experiments/trials, minikit and international yield trials.

## General Botany

Plant parts and their functions, floral morphology anthesis and pollination, fertilization, seed development for sorghum, pearl millet, groundnut, and pigeonpea. Plant growth stages, yield components, developmental biology (stem, root, flower, and seed) and germination of seed. Floral biology and its implications in plant breeding and production.

## Crop Physiology

Basic plant processes; concepts of optimum and limiting factors; source and sink concepts, crop growth, development and yield, ideotype, seedling vigor and emergence.

## Crop Protection

- a) Entomology: Major pests of sorghum, pearl millet, groundnut, and pigeonpea; pests of stored products; control of pests.
- b) Plant pathology: Major diseases of sorghum, pearl millet, groundnut and pigeonpea.

- c) Plant protection: Faru pest and disease surveillance objectives, methods, sampling procedures, methods of pest control, handling and storage of plant protection chemicals.
- d) Plant quarantine procedures.
- e) Microbiology of pearl millet: sorghum, groundnut and pigeonpea.

### Nursery Management

Recording of qualitative characters, identification and scoring of the symptoms on the various parts of the plant due to the incidence of pests and diseases in sorghum, pearl millet and groundnut, selection of parent material in sorghum, pearl millet, groundnut and pigeonpea and hybridization. Selfing, emasculation, and handling of different segregating generations in sorghum. Handling of male-sterile, maintainer and restorer lines and production of hybrid seed in sorghum and pearl millet. Emasculation and hybridization techniques in groundnut. Measurement of leaf area in sorghum, pearl millet, and groundnut. Stigma receptivity and pollen viability studies in sorghum. Visual evaluation of yield in sorghum, pearl millet, and groundnut.

### CROP IMPROVEMENT

#### Cytogenetics

- a) 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 and recombination.

#### Plant Breeding

- a) 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 selection, pure line selection, hybridization and progeny selection: backcrossing and resistance breeding: polyploid breeding: mutation breeding: hybrid production with cytoplasmic-genetic male steriles: population improvement: improvement of cross-pollinated crops: mass selection: development of inbreds: single and double cross hybrids, synthetics composite and population breeding. Insect resistance breeding and breeding for quality improvement.

b) 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.

### CROP PRODUCTION AND FARMING SYSTEMS

In addition to regular field observations in the experiments/demonstrations, the crop production and farming systems trainees were encouraged to study the experiments in the ICRI SAT Farming Systems Program. Depending on their individual interests, the observed experiments in soil fertility management, land and water management, weed management, cropping systems, and use of bullock-drawn implements.

Theory classes were conducted covering the following topics:

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

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 N; nitrogen fertilizers, crop response to various sources of fertilizer N.

Phosphorus - phosphorus problems 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.

Phosphate fertilizers; water soluble P, citrat. soluble P, citrate insoluble P, available P and total P; phosphatic fertilizers - content and usage; bacterial phosphate fertilization; crop responses to source of fertilizer

Potassium economy in soils - potassic fertilizers and their economic value.

Cropping systems - basic concepts - physiological parameters and equipment used to measure them in intercropping studies - genotype evaluation and yield stability studies - experimental designs and evaluation of data in intercropping studies.

Concepts in soil-plant-water relationships - methods of soil moisture estimation - interpretation and use of soil moisture data.

Concepts in soil and water management; land and water management aspects in Vertisols and Alfisols.

### Agricultural Economics

Role of economics in agricultural research, economic analysis of experiments for deriving farmer recommendations, village level studies, marketing in the SAT, role of common property resources in SAT farming systems.

### Extension Education and Communication

Concepts of extension education, meaning, philosophy, principles of extension, teaching-learning principles, extension teaching methods, layout of demonstrations - how to conduct them. To develop abilities to plan, organize, and supervise intensive extension programs.

A series of lectures were given by senior staff of the State Agricultural Department. The topics covered were: Motivation of extension workers and farmers, diffusion and adoption process, farmers' training, rural attitudes and resistance to change, methods of training, audiovisual aids and their role in effective communication, communication problems with farmers, integrated rural development, T&V system including field visits, seed production and distribution.



## SPECIAL TRAINING PROGRAMS

### A. Crop Improvement

The crop improvement trainees received instruction in elementary principles of plant breeding and genetics to strengthen their field experiences. The scientific staff from sorghum, pearl millet, germplasm, pigeonpea and groundnut sections participated in covering the subject matter supplemented by the training staff. Details of additional experience given to selected trainees for one or more weeks are given in Table 6.

#### Sorghum Breeding

Development of populations, mass selection, half-sib family test, full-sib family test; genetic male steriles, hybrid seed production; transferring of male sterility; breeding for shoot fly and stem borer resistance; drought resistance; screening for Striga resistance; improvement of grain quality in sorghum; techniques of selfing; emasculation and crossing; recording data.

#### Sorghum Physiology

Factors affecting crop establishment, response and adaptation to water, heat, and nutrient stress, details of methodology and use of equipment, examples of interpretation of data collected, and design of experiments in the glasshouse and field.

#### Sorghum Entomology

Screening for shoot fly and stem borer, infesting the screening material with the larvae of stem borer; identification of different species of shoot fly and stem borer; rearing the larvae of stem borer on the artificial food media; mating the adults in the chamber and collection of eggs for further studies; mounting the insects on slides and examining them under a microscope. Identification of insect pests and their damages.

#### Sorghum Pathology

Visual symptoms of downy mildew, ergot, smut, and molds; microscopic examination of molds, smut, and downy mildew infected plants; techniques for inoculation; screening for disease resistance; handling of a disease nursery; artificial culturing of fungus in growth media.

### Sorghum Genetic Resources

Collection; registration. maintenance. evaluation. documentation. computerization. distribution of sorghum germplasm. Origin and classification of sorghum, distribution of land races and wild and weedy relatives. Descriptors and descriptor status of sorghum - Basic collection of sorghum germplasm; introgression and conversion programs.

### Millet Breeding

Inbred progenies. inbred trials. hybrid trials. variety crosses. test crosses; populations; half-sib. full-sib and S2 testing; composites. synthetics. varieties; male-sterile lines. production of hybrids; disease nursery. screening for diseases; lifting. crossing. recording of data.

### Millet Physiology

Measurement of leaf water potential with pressure bomb; estimation of conductance with automatic parameter; measurement of light interception by crop canopy with solarimeter tubes.

### Millet Entomology

Identification of shoot bug. thrips and *Heliothis* on pearl millet. nature of damage caused and recording their incidence.

### Millet Pathology

Different types of millet diseases and their symptoms on the plants under field conditions; microscopic examination of pathogen. preparation of inoculum of ergot. inoculation techniques. examination of symptoms and scoring for ergot resistance; screening for downy mildew and smut resistance and inoculation techniques for both the di

### Millet Genetic Resources

Philosophy. collection. and conservation of millet genetic resources; evaluation principles. descriptors. characteristics of land race populations; classification of land race populations. recording of data.

## Groundnut Breeding

Screening the germplasm for foliar diseases resistance such as leaf rust; isolation of resistant lines utilizing the infector row technique; utilization of resistant lines in crossing programs for earliness, dormancy, and resistance to Aspergillus flavus; emasculation and crossing; plant quarantine nursery to study the occurrence of diseases in the germplasm received from outside agencies; interspecific hybridization; progeny selection. Breeding for foliar disease resistance, such as leaf spot, rust and pest resistance by utilizing interspecific crosses and wild species.

## Groundnut Physiology

Methods for testing different varieties of groundnut for relative growth rate - net assimilation rate - utilizing the growth regulator (Ethrel - 0.5 ml/1000 ml of water); response and adaptation to water, heat and nutrient stress; details of methodology and use of equipment; examples of interpretation of data collected; and design of experiments in the glasshouse and field.

## Groundnut Entomology

Identification of jassids, thrips, Heliothis, aphids, and leaf miner and the damage caused to the groundnut crop through the recording of their incidence and mounting the insects on slides for microscopic examination.

## Groundnut Pathology and Virology

Effects of dates of sowing, plant row spacings utilizing TMV-2, and Robut 33-1 on the incidence of bud necrosis; purification procedures for virus (PGMV) from infected groundnut leaves - using supernatant, suspension and pellet; steps involving 0.1 M phosphate buffer, 1% 2-mercaptoethanol and 0.01 M DIECA - 0.2 NaCl 4% (W/V) PEG-8000, 0.2 M urea, and 70% sucrose cushion.

Staining procedures to visualize purified virus with 2% uranyl acetate under Philip model ZM 201C electron microscope.

## Pigeonpea Breeding

Recording observation for days to 50% flowering, emasculation and pollination procedures; identification of male sterile and male-fertile plants; selection procedures for breeding vegetable type pigeonpea; breeding procedures for developing high - protein lines with different plant characteristics.

●

The role of wild relatives of pigeonpea. Plots having species of the genera Alysicarpus, Rhynchosia and Flemingia were shown and discussions held on the various distinguishing features of these genera, their distribution, methods of hybridization, cytological behavior of chromosomes in the hybrids and the potential value of various species in pigeonpea improvement. The F2 populations of some pigeonpea x Alysicarpus species hybrids were examined and character recombination from the parental species was noted.

#### Pulse Agronomy (Physiology)

Growth analysis sampling, other physiological observations on field, total dry matter and harvest index of chickpea and pigeonpea, and intensive cropping of early pigeonpea - ratooning aspects. Effect of solarization on plant growth and effect of weed management on pigeonpea performance.

#### Pulse Entomology

Pests of chickpea, nature and extent of damage, survey methods; pests of pigeonpea, nature and extent of damage, survey methods; cultural, chemical, and biological control of the pests of chickpea and pigeonpea; pest resistance in pigeonpea and chickpea, screening techniques, mechanisms of resistance to pests; demonstration of laboratory rearings (Heliothis and parasites); trapping of insects by using pheromone traps, and light traps.

#### Pulse Pathology

An intensive 30 hr course on pigeonpea pathology was conducted on the procedures for diagnosing pigeonpea diseases, identifying pathogen, and screening germplasm and breeding materials for disease resistance.

#### Pulse Agronomy (Microbiology)

Pigeonpea nodulation; collection and preservation of nodules (using CaCl<sub>2</sub> vials); isolation and authentication of Rhizobium from nodules; evaluation of Rhizobium strains for nitrogen fixing ability with pigeonpea; plot and field trials; acetylene reduction assay, gas chromatography; production and use of legume inoculants; culture maintenance.

## Chickpea Physiology

Explanation of general effects of temperature, light, wind and soil moisture on growth, development and yield; visit to field experiments, related to light duration and row orientation, plant density and inoculation effects on crop growth and development; learning techniques for studying drought resistance in the field; collection of agroclimatological data using instruments in the laboratory and field; learning how to prepare the inoculation media.

## B. Crop Production and Farming Systems

### Land and Water Management

Determination of primary tillage requirements for optimum stand establishment, crop productivity and soil and water conservation practices; investigations on imparting long term stability to the tilled root-zone through improved soil structural characteristics; land configuration, simulation of the small watershed; surveying, mapping, contour lines, establishing waterways and land configuration structures; modeling the management system in conjunction with rainfall and limited irrigation; establishing quantitative values for inherent site characteristics, namely rainfall erosivity, soil erodibility, and topography (slope gradient and length) as causative and predictive erosion and control parameters.

### Agroclimatology

Handling of equipment used and recording of data for agroclimatological studies; non-recording and recording rain gauge, pyranometer, class A pan evaporimeter, albedometer, live quantum sensor with LI-188B integrator, infrared thermometer, steady state porometer, pressure chamber, neutron probe moisture meter etc.; estimating potential evapotranspiration, crop coefficients at various crop growth stages; evolving a system that utilizes rainfall, runoff and irrigation water together for optimizing the water use efficiency by selected SAT crops - determination of the complementary management requirements, specifically plant population and soil fertility gradients that are necessary for effective implementation of the Limited Irrigation concept.

Micro-meteorological studies - relationship between light interception and LAI at different row spacing - energy balance and soil moisture data for the validation of a water balance model.

Integration of the crop, soil and climate information for recommending appropriate farming systems; water balance, moisture availability index, crop available water and moisture stress, runoff water assessment, crop water requirements, selection of cropping system.

### Soil Fertility and Chemistry

Analytical procedures for estimating nitrogen, phosphorus, and potassium in soil and plant samples. use of equipment for chemical analysis of soil and plant samples.

### Farm Power and Equipment

Animal drawn farm implements and techniques for performing field operations - Observe and work with improved as well as traditional implements used in India - method of training draft animals - problems of manufacturing and extension of new designs - effect of fertilizer placement on germination, emergence and growth of plants in Vertisols - evaluation of mechanical interrow cultivation implements - evaluation of furrow openers for simultaneous application of seed and fertilizer. Study of the low cost and simpler implements which have potential for use in Malawi.

### Cropping Systems

Growth and resource use studies in intercropping systems; genotype evaluation for intercropping; evaluation of alternative cropping systems for different soil types; crop combinations and row alignments for intercropping; evaluation of intercropping systems against sole cropping.

### Farm Development and Operations

Farm machinery operation; primary and secondary tillage operations, and equipment; metering the seed, depth control, placement mechanism, planter calibration; irrigation and drainage, water conveyance from source to field, irrigation methods; surface and subsurface drainage; plant protection equipment, calibration of sprayers, integrated pest management principles; harvesting and postharvesting techniques and equipment used; farm maintenance - maintenance of slope, drainage systems, soil and water conservation structures; farm record keeping - field history, daily schedule, farm machinery records and productivity records.

Table 6: Special training program schedule for crop improvement trainees

Trainee	Country	Breeding	Pathology	Physiology	Entomology	Genetic Resources	Others
Sarra S.	Mali	Sorghum Millet	Sorghum Millet	-	-	-	-
Zenan, K.	Burundi	Sorghum	Sorghum	Sorghum	-	-	-
Bonzalez, H.R.	Mexico	-	-	Sorghum Chickpea Groundnut	-	-	Citology
Tilahun G.M.	Ethiopia	Sorghum	Sorghum	Sorghum	-	-	-
Morku, B.K.	Ethiopia	Sorghum	Sorghum	Sorghum	-	-	-
Bojang, A.S.	Gambia	Sorghum Millet	Sorghum				
Maadi, S.K.H	Gambia	Sorghum	Sorghum				Cropping Systems
Joel, F.	Tanzania	Sorghum	Sorghum		-	Sorghum	-
Tusheleqe H.K.H	Tanzania	Sorghum Millet	Sorghum				
Tovon, N.	Tchad	Sorghum	Sorghum Millet				
Azina, G.B.	Tchad	Sorghum Millet				Sorghum	-
Chunqa, A.B.	Malawi	Sorghum Millet	Sorghum Millet				
Nyahoda, S.N.	Malawi	Sorghum Millet					
Luasya, A.Y.	Malawi	Sorghum Millet	Sorghum Millet				
Ibra, A.U.N.	Senegal	Millet	Millet			Millet	
Dieu, P.B.	Senegal	- -	Sorghum Millet	Sorghum			
Mrs. Samb, N.	Senegal	Sorghum	Millet Sorghum				

Trainee	Country	Breeding	Pathology	Physiology	Entomology	Genetic Resources	Others
Jamal, A.A.R.	Sudan	Sorghum Millet	Millet				
Badir, A.P.	Pakistan	Millet	Millet				Millet Microbiology
Traore, S.	Mali	Groundnut	Groundnut	Groundnut	Groundnut		Groundnut Virology
Kidane, H.	Ethiopia	Groundnut	Groundnut	Groundnut	Groundnut		Groundnut Virology Biochemistry
Zottin, H.	Benin	Groundnut	Groundnut	Groundnut	Groundnut		Groundnut Virology
Amt Sv	Senegal	Groundnut	Groundnut	Groundnut	Groundnut		Groundnut Virology
Diouf, C.A.	Senegal	-	-	Groundnut	-		
Carvalho, C.M.D.S.	Cape Verde	Pigeonpea	Pigeonpea	Pigeonpea	Pigeonpea		Pigeonpea Microbiology Biochemistry
Ramirez, R.H.	Philippines	Pigeonpea	Pigeonpea	Pigeonpea	Pigeonpea		Pigeonpea Microbiology Microbiology
				Biochemistry Biochemistry			



Table 7. Special training program for farming systems trainees.

Sl. No.	Name	Country	Special training
1.	Tsele, K.	Botswana	Agroclimatology
2.	Sawai, W.	Thailand	Agroclimatology
3.	Pipt, I.	Thailand	Agroclimatology
4.	Ms. Jintana, M.	Thailand	Agroclimatology
5.	Sito, A.	Philippines	Cropping Systems
6.	Reddy, J.	Fiji	Cropping Systems
7.	Gibba, A.S.L.A.	Gambia	Cropping Systems
8.	Dandeniya, S.A.	Sri Lanka	Cropping Systems
9.	Bosso, T.A.	Sri Lanka	Cropping Systems
10.	Ms. Rohini, G.	Sri Lanka	Cropping Systems
11.	Samarasekera, ARM	Sri Lanka	Cropping Systems
12.	Gabriel, D.E.	Uganda	Cropping Systems
13.	Yongvot, S.	Thailand	Land and Water Management
14.	Rawat, C.	Thailand	Land and Water Management
15.	Somsak, T.	Thailand	Land and Water Management
16.	Wunlert, W.	Thailand	Land and Water Management
17.	Diallo, F.	Mali	Soil Fertility
18.	Hashir, A.H.	Syria	Weed Science
19.	Loga, J.	Malawi	Agricultural Implements
20.	Harrison, B.F.	Malawi	Agricultural Implements
21.	Aron, S.	Malawi	Agricultural Implements
22.	Edani, F.N.	Botswana	Farm Development Operations

**Table B. Special training program for crop production trainees. The following individually selected subject areas (see under crop improvement) provided opportunities to learn the research approaches, adapt methodologies, and use of equipment for data collection.**

Sl. No.	Name	Country	Special training
1.	Abara, K.C.	Nigeria	Sorghum pests; Shootfly, stem borer, midge, headbug. Breeding techniques and quality improvement. Pearl millet breeding methods: crossing, identification of male sterility and its use in hybrid seed production, resistance to downy mildew. Groundnut physiology: drought screening, intercropping nutrition uptake and concepts in increasing crop production.
2.	Drammeh, V.M.	Gambia	Sorghum breeding pest identification, screening for resistance to pests, striga. Sorghum pathology identification of major diseases, inoculation for grain mould. Soil fertility: analytical methods, nitrogen and phosphorus estimation, use of other laboratory equipment.
3.	John, M.	Zambia	Groundnut pathology: Control of foliar diseases, development of resistant lines, use of fungicides and calibration of spraying equipment. Physiology: improving plant efficiency, adaptation, selection, drought resistance, nitrogen fixation. Breeding: screening materials, regional program at Malawi. Entomology: pest identification and control, transmission of virus diseases. Microbiology of groundnut - Rhizobium cultures.
4.	Santos, A.B.	Philippines	Sorghum improvement entomology: laboratory techniques for rearing stem borer, screening techniques for midge resistance. Groundnut improvement - aflatoxin experiments, virus and its transmission, symptoms; emasculation practice, and pollination, inoculation of two species of Rhizobium, vegetative propagation methods, monitoring of micro environment in the crop.

Sl. No.	Name	Country	Special training
5.	Noussa, H.	Niger	Economics program - study of research activities, village level studies, on-farm experiments evaluation, use of computer for recording and data analysis, visited village studies with economics staff at Aurepalle and Shirapur, economic assessment of field experiments.
6.	Boureia, H.		Worked in pearl millet physiology studying effect of temperature on germination and plumule growth; soil sampling and recording soil temperature.
7.	Francis, J. O.	Uganda	Sorghum entomology: common pests and their control, screening for insect resistance. Pathology: diseases of sorghum, grain mould studies, inoculation in field, root rot and seed studies. Groundnut breeding: Pollination practice, germplasm evaluation. Pathology: rusts and leaf spots, screening for resistance.
8.	Traore, I.	Upper Volta	Farm development and operations: machinery and its maintenance, land preparation - tillage, crop planting, row-crop cultivation, fertilizer application. He worked with FDO staff from 27 June to 16 October and participated in field operations.
9.	Hakein, M.C.	Syria	Sorghum breeding: identification and screening for pests, diseases and striga. Pathology: identification of diseases inoculation procedures laboratory work. Groundnut physiology: screening for drought resistance, photoperiod effects on reproduction nitrogen fixation trials.
10.	Della, L.B.	Ghana	Pigeonpea breeding: pigeonpea germplasm collection, variability, breeding methods, practicals in crossing the material, screening material for pests and diseases like sterility mosaic, wilt and phytophthora. Pearl millet pathology:

Sl. No.	Country	Special training
10. Della, L.D. (Contd.)	Ghana	visual symptoms of downy mildew, ergot, smut. techniques of inoculation, screening for disease resistance, sorghum physiology: visual scoring for vigor, screening for shootfly and drought resistance, soil moisture estimation, temperature effects on soil-plant relationships, groundnut entomology: identification of pests, use of systemic insecticides, virus transmission.
11. Newton D.	Ghana.	Pigeonpea breeding: Breeding early, medium and long duration types, disease resistance, quality characters, hybrid development. Sorghum physiology: effects of temperature on soil surface and seed borne diseases, scoring for vigor. Groundnut entomology: virus vector, hairy caterpillars and other major pests, use of insecticides, screening for resistance.
12. Rahman, A.	Pakistan	Sorghum entomology: Shootfly, stemborer, eythiana, midge, and other major pests: cultural, biological and chemical control methods. Pearl millet pathology: downy mildew, infector row test row, and indicator row planting, screening for mildew and ergot, physiology: visual scoring for vigor. Groundnut entomology: major insect problems in groundnut production and their control.
13. Sow, M.A.	Mali	Computer programming on OSBORNE, use of micro computers, special lectures in statistics, soil physics: moisture estimation with Neutron Probe, run-off measurement, soil and water loss by erosion: irrigation: sprinkler, bed and furrow, pipe, bare power, ex-urban equipment.

## SEMINARS

The trainees attended selected seminars given by ICRISAT scientists and visiting scientists.

Seminars were presented by each trainee after studying a selected research article published in a standard journal. The seminar subjects are listed in Table 9.

Table 9. Seminar schedule

Sl. No.	Name of the train	Title of the paper
1.	Serra, S. Kabiro, Z.	Bridging the gap between hybrid and varietal performance in sorghum.
	Gonzalez, H.R.	Noninsecticidal input for insect pest management in sorghum to avoid environmental pollution by toxicants.
4.	Tilahun, G.H.	Growth analysis of a sorghum hybrid and its parents.
5.	Worku, D.K.	Noninsecticidal input for insect pest management in sorghum to avoid environmental pollution by toxicants.
6.	Bojang, A.S.	Effect of plant spacing on the growth and yield of three sorghum ( <u>Sorghum bicolor</u> (L.) Moench.) cultivars.
7.	Hamadi S.K.H.	Basis for further improvement of parental lines of sorghum hybrids.
8.	Joel, F.	Preliminary studies on diseases of maize during winter.
9.	Tusekelede, H.K.M.	Effect of placement of fertilizers on the uptake of major nutrients by lowar.
10.	Tovoum, N.	Effects of row spacing and population density of grain sorghum production in Southern Alberta.
11.	Azina, G.G.	Effect of row spacing and fertilizer levels on the yield and growth of sorghum.
		Line x tester analysis for combining ability in sorghum.

Sl. No.	Name of the trainee	Title of the paper
12.	Chunaa, A.B.	Study on the response of sorghum varieties to time of sowing and nitrogen levels.
13.	Nyahoda, S.H.	Noninsecticidal input for insect pest management in sorghum to avoid environmental pollution by toxicants.
14.	Lweya, A.Y.	Stability of grain yield components across diverse environments.
15.	Ibra, A.W.N.	Breeding millets
16.	Dieve, P.O.	Biology of the sorghum shoot fly, <u>Atherigona varia saccata</u> <u>rond</u> (Anthonvideas: Diptera)
17.	Mrs Samb, M.	Sorghum and millet pathology
18.	Jamal, A.A.R.	Inbreeding effects of full-sib mating in pearl millet populations.
19.	Qadir, A.P.	Characteristics and inheritance of viable mutants in <u>Pennisetum americanum</u> (L.) Leeke.
20.	Sadio, T.	Classification of the cultivated groundnut.
21.	Kidane, M.	Control of early and late leafspot on two peanut cultivars.
22.	Zettin, M.	Heterosis for vegetative characters in grain sorghum.
23.	Diouf, C.A.	Growth analysis
24.	Amet Sv	Correlation studies in spreading groundnut.
25.	Ramirez, R.M.	Genetic variability in pigeonpea.
26.	Carvalho, C.M.	Influence of pigeonpea resistance to <u>Heliothis</u> on the natural parasitism of <u>Heliothis</u> larvae.

Sl. No.	Name of the trainee	Title of the paper
27	Abara, T.C.	Influence of plant height, row width, and plant population on grain yield and yield component associations in grain sorghum.
28	Drammeh, T.M	Fertilizer nitrogen requirement of finger millet.
29	John, M.	Agronomic and economic optimum plant densities for rainfed groundnut.
30	Santos, A.H	Effect of gypsum and moisture stress on growth and pod-fill of groundnut.
31	Moussa, M.	Effect of sowing time and technique on the growth and yield of hybrid pearl millet.
32	Boureima, M.	Response of pearl millet hybrids to dates of sowing under rainfed condition.
33	Francis, J.O.	Nitrogen fertilization and row spacing studies in hybrid pearl millet under irrigated conditions.
34	Haklem, M.C	Maturity effects on genotype x environment interaction in grain sorghum.
35	Lordson, D.B.	Studies on split application of nitrogen on rainfed hybrid sorghum.
36	Dzah, N.N.Y	Performance of sorghum under differential sowing dates.
37	Rahman, A.	Zinc nutrition related to critical deficiency and toxicity levels for sorghum.
38	Sawai, W.	Corn yield and evapotranspiration under simulated drought conditions.
39	Pipat, T.	Effects of soil moisture stress on the reproductive efficiency and yield of the bambara groundnut ( <u>Vandzala subterranea</u> ).

Sl. No.	Name of the trainee	Title of the paper
40	Ms. Jintana, M.	Improving groundnut production under rainfed conditions by inoculating seeds with appropriate strains of <u>Rhizobium</u> .
41	Sito, A.	Effect of intercropping pul oilseeds and tuber crops in maize on yield and net return.
42	Reddy, J.	Intercropping of rainfed maize with different legumes.
43	Gibba, A.S.L.A.	Intercropping of maize with legu under various nitrogen levels.
44	Dandideniva, F.A.	Economy in fertilizer use through organic manures in growing maize.
45.	Bosso, T.A.	Effect of azotobacter inoculation and nitrogen application on the yield of pearl millet.
46.	Samarasekera, A.R.M.	Response of pure and mixed crop of maize to nitrogen under rainfed conditions.
47	Ms. Rohini, G.	Effect of time, technique and pattern of pearl millet planting on its growth and yield in sole and intercropping system.
48	Gabriel, O.E	Intercropping of mung and groundnut in sorghum with different planting patterns under rainfed conditions.
49	Somsak, T	Crop-weed competition studies in mung beans ( <u>Vigna radiata</u> )
50	Rewet, C.	The use of mulching and no-tillage for soil conservation in tropical upland crops.
51	Wunlert, W.	Effect of slope length on runoff and soil loss.
52	Diallo, F.	Fertilizer and water-use efficiency in pearl millet and sorghum in vertisols and alfisols of semi-arid India.
53	Haskir, A.K.	Toxic extracts of the



### ICRISAT Field Tours :

Visits were arranged to research programs and demonstration areas in sorghum, pearl millet, groundnut, farming systems, cereal plant physiology, cereal plant pathology and cereal entomology.

### EDUCATIONAL TOURS

#### 1. Places visited by the trainees in and around Hyderabad:

- 1) Fruit Research Station, Sangareddy.
- 11) Andhra Pradesh Agricultural University, Seed Testing Laboratory, Foundation seed production plots of sorghum, Extension Education Institute.

#### 2. Places visited on other educational tours:

Madras: Extension programs of State Department of Agriculture; demonstrations, varietal trials, adaptive research, cropping patterns; T&V extension program, Fredrick Institute of Plant Protection and Toxicology, Padappai, Chingleput district.

Coimbatore: Tamil Nadu Agricultural University, sorghum, pearl millet, groundnut and pigeonpea programs; agronomy and breeding work - development of high yielding varieties - seed technology laboratory, museum, agricultural engineering research program.

Trichy: Local agriculture

Ooty: Coffee and tea plantations; soil conservation methods and cropping on the hill slopes, botanical gardens.

Mysore: Mysore University; downy mildew laboratory in the Department of Botany, studies on the biology of downy mildew; screening maize, sorghum and millet lines for the downy mildew incidence, Brindavan (KRS).

Bangalore: Research station of the All India Coordinated Research Project for Dryland Agriculture on the campus of the University of Agricultural Sciences (UAS); agricultural implements.

Bravanabelagoal Jain temple

Aurangabad: Local agriculture in the vicinity of Anwi and Khuldabad villages, sugarcane, cotton, banana, vegetables, sorghum, safflower and chickpea. Seed production on farmers' fields and large-scale adoption of sorghum hybrids by the farmers. Visit to the pearl millet research station, and Nath Seeds Seed Processing Unit and seed production plots.

Akola: Punjabrao Krishi Vidyapeeth (Agricultural University), sorghum and groundnut improvement program, breeder and foundation seed production program and the dryland improvement project (dependable rainfall areas in SAT).

Parbhani: Marathwada Krishi Vidyapeeth (Agricultural University); sorghum improvement program, foundation production program, museum and seed technology laboratory.

Jalna: Visit to the demonstration plots and hybrid seed production plots of sorghum, pearl millet and pigeonpea in private hybrid seed production organizations.

Badnapur: Visit to the breeding plots and disease screening nurseries of pigeonpea at the Agricultural Research Station.

Visit to the Research Station of Mahico Hybrid Seed Company, work on the development of new genetic male sterile lines in pigeonpea.

## LIBRARY WORK, BOOK SUPPLY AND FILM SHOWS

The ICRISAT library was extensively consulted by the trainees. The library acquisition includes 35,300 books and bound periodicals, 700 current periodicals, micro-documents, reprints (photo copies) of annual reports, etc., and these available for consultation. The open accession system is adopted.

About Rs.1500/- worth of books for personal use supplied to each trainee.

Video films were shown on Sundays covering documentaries, feature films, and educational films.

## LIST OF PARTICIPATING STAFF

## ADMINISTRATION

L.D. Swindale	Director General
J.S. Kanwar	Director of Research
C.R. Jackson	Director, International Cooperation
R.C.G. Gunasekera	Principal Soil & Water Scientist
M.G. Hedeman	Principal Administrator
S.F. Ambrose	Principal Government Liaison Officer
D. Mitra	Fiscal Manager
R.K. Jhri	Personnel Manager
P. Vaidyanathan	Purchase & Stores Manager
M. Balasubramaniam	Executive Officer
S. Krishnan	Sr. Admn. Officer
P.M. Sharma	Secretary
P.V.S. Rose	Travel Officer
Ms R. Padmini	Asst. Travel Officer
P.K. Sood	Sr. Admn. Officer (Liaison - Delhi office)
V. Lakshmanan	Chief Security Officer
G. Vijaya Kumar	Asst. Manager (Administration)
N. Suryabratkar Rao	Transport Officer
	Resident Medical Officer

## SORGHUM

L.F. House	Leader & Principal Plant Breeder (until September, 1984)
S.Z. Muburu	Principal Plant Breeder
Bhola Nath Verma	Plant Breeder
D.S. Murthi	Plant Breeder
B.L. Agrawal	Plant Breeder
J.M. Peacock	Principal Plant Physiologist
N. Seetharama	Plant Physiologist
P. Leuschner	Principal Entomologist
H.C. Sharma	Entomologist
S.L. Taneri	Entomologist
L.K. Mughogho	Principal Plant Pathologist
Ranjit Bandoopadhay	Plant Pathologist
Suresh Pande	Plant Pathologist

PEARL MILLET

F.R. Bidinoer	Acting Leader & Principal Plant Breeder
J.R. Witcombe	Principal Plant Breeder
B.S. Talukdar	Plant Breeder
K.N. Rai	Plant Breeder
S.B. Chavan	Plant Breeder
Pheru Singh	Plant Breeder
Mrs V. Mahalakshmi	Plant Physiologist
S.B. King	Principal Plant Pathologist

PEARL MILLET (Contd.)

S.D. Singh	Plant Pathologist
R.P. Thakur	Plant Pathologist
K.K. Lee	Principal Cereal Microbiologist
S.P. Wani	Microbiologist
R.K. Maiti	Plant Physiologist
P. Soman	Plant Physiologist
K.R. Krishna	Microbiologist

GENETIC RESOURCES UNIT

M.H. Mengesha	Leader & Principal Germplasm Botanist
K.E. Prasada Rao	Botanist
S. Appa Rao	Botanist
V. Ramanatha Rao	Botanist
R.P.S. Pundir	Botanist
P. Remanandam	Botanist

GROUNDNUT

R.W. Gibbons	Leader & Principal Plant Breeder
D. McDonald	Principal Pathologist
L.J. Reddy	Plant Breeder
S.L. Dwivedi	Plant Breeder
J.P. Moss	Principal Cytogeneticist (until
A.K. Singh	Cytogeneticist
D.C. Sastry	Cytogeneticist
V.K. Mehan	Pathologist
D.V.R. Reddy	Principal Virologist
P.T.C. Nambiar	Microbiologist
P.W. Amin	Entomologist
J.H. Williams	Principal Physiologist
R.C. Nageshwar Rao	Physiologist
A.B. Mohammed	Entomologist
M.J. Vasudeva Rao	Plant Breeder

PULSES

Y.L. Nene	Leader & Principal Pathologist
D.G. Faris	Principal Plant Breeder (Pigeonpea)
K.B. Saxena	Plant Breeder (Pigeonpea)
S.P.S. Beniwal	Sr. Plant Pathologist
Joji Arihara	Assistant Physiologist
Y.S. Chauhan	Plant Physiologist
W. Reed	Principal Entomologist
S.S. Lateef	Entomologist
S. Sithanathan	Entomologist
H.A. van Rheenan	Principal Plant Breeder (Chickpea)
C. Johansen	Pulse Agronomist (from 17 July 84)
J.V.S.D.K. Kumar Rao	Microbiologist
A.M. Ghanekar	Pathologist

FARMING SYSTEMS

S.M. Virmani	Leader & Principal Agroclimatologist
J.R. Burford	Principal Soil Chemist
A.B.S. King	Principal Cropping Systems Entomologist
T. Takenaga	Principal Agricultural Engineer (Small Implements Development)
C.W. Hong	Project Scientist (IFDC)
Robert Bush	Principal Soil Scientist
D. Sharma	Senior Scientist (On-farm research)
M.S. Reddy	Agronomist
M. Natarajan	Agronomist
S.K. Sharma	Sr. Research Associate
A.K.S. Huda	Agroclimatologist
R.K. Bansal	Agricultural Engineer
K.L. Srivastava	Agricultural Engineer
P. Pathak	Agricultural Engineer
R.C. Sachan	Agricultural Engineer
K.L. Sahrawat	Soil Scientist
Sardar Singh	Soil Scientist
T.J. Rego	Soil Scientist
M.R. Rao	Agronomist
C.S. Pawar	Entomologist
K.P.R. Vittal	Soil Scientist
Piara Singh	Soil Scientist

FARM DEVELOPMENT AND OPERATIONS

D.S. Bisht	Manager, Farm Services
S.N. Kapoor	Asst. Manager (Farm Operations)
S.K. Pal	Sr. Plant Protection Officer

ECONOMICS

M. von Oppen	Leader & Principal Economist
R.A.E. Mueller	Principal Economist
N.S. Jodha	Sr. Economist
R.D. Ghodake	Economist
R.P. Singh	Economist
M. Ashokan	Research Associate

FELLOWSHIPS & TRAINING

D.L. Oswalt	Principal Training Officer
A.S. Murthy	Sr. Training Officer
B. Diwakar	Sr. Training Officer
T. Nagur	Sr. Training Officer
T.A. Krishnamurthi	Br. Adm. Officer
P.N. Murthy	Sr. Office Assistant
G.T. Krishna	Office Assistant
Mrs J. Seetharaman	Stenographer
P. Chenchiah	Sr. Typist
Mrs M. Daniel	Sr. Typist
M.S. Reddy	Sr. Field Assistant

**FELLOWSHIPS & TRAINING (Contd.)**

M.A. Razzak	Sr. Driver cum General Assistant
K. Raghavan	Sr. Driver cum General Assistant
C. Soaler	Sr. Driver cum General Assistant
K. Anjiah	Office Helper

**BIOCHEMISTRY & NUTRITION LABORATORY**

R. Jambunathan	Principal Biochemist
Umaid Singh	Biochemist
V. Subramanian	Biochemist

**INFORMATION SERVICES**

H.L. Thompson	Head, Information Services
J.B. Wills	Research Editor
S.M. Sinha	Asst. Manager (Art & Production)
H.S. Duggal	Sr. Photographic Supervisor
A.B. Chitnis	Sr. Photographer

**LIBRARY & DOCUMENTATION SERVICES**

L.J. Haravu	Manager (Library & Documentation)
P.S. Jadhav	Library Officer

**COMPUTER SERVICES**

J.W. Estes	Computer Services Officer
S.M. Luthra	Asst. Manager (Computer Services)
T.B.R.N. Gupta	Sr. Computer Programmer/Analyst

**STATISTICS**

B. Gilliver	Principal Statistician
Murari Singh	Statistician

**PLANT QUARANTINE**

B.K. Varma	Chief Plant Quarantine Officer
Upendra Ravi	Senior Research Associate (Plant Quarantine)

**HOUSING & FOOD SERVICES**

G.W. Conover	Manager
B.R. Revathi Rao	Assistant Manager (Housing)
S. Mazumdar	Assistant Manager (Food)

**VISITORS SERVICES**

S.K. Das Gupta	Sr. Scientific Liaison Officer
A. Lakshminarayana	Scientific Liaison Officer