ICRISAT SAHELIAN CENTER
And WEST AFRICAN PROGRAMS

Quarterly Report

October-December 1993

C. Renard
Executive Director

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Table of Contents

ADMINISTRATION AND SUPPORT PROGRAMS

Staff Matters

- An exhaustive review carried out by program Leaders and Division Heads at ISC of the Support Staff Personnel Policies and Discipline and Appeal Rules was completed. These documents are now being translated into French and will be submitted to ICRISAT Management for consideration and approval in due course

- An Accelerated Promotion Scheme for Support Staff in Niamey, Kano and Bamako was agreed to by PLs/DHs. The Scheme is based on the plan approved for India with suitable modification in the procedures for considering applications

Communication

- The replacement of PABX telephone system for Sadore was installed by Peyrissac This puts internal communication back to normal as extension lines of all essential telephone users were restored The new system has a number of features that should facilitate contact and make telephone conferencing possible

- Negotiations were completed with the Office des Postes et Télécommunications (OPT) for the maintenance of the Multiplex which provides telephone links between Niamey and Sadore We hope this will help improve the quality of our telephone lines and minimise the breaks in telephone communication that often occur between us and our correspondents overseas

- OPT inaugurated a new telephone system for Niger in the middle of October This necessitated changes in the home telephone numbers of most ICRISAT Staff Fortunately, Sadore and TVC numbers were not changed

- The Government of Niger did not grant our request to exempt us from payment of the road tax between Niamey and Sadore A lump sum payment of the tax was negotiated with the Ministry of finance All ICRISAT vehicles identified by the ICRISAT logo can now pass through the tax collection point between Niamey and Sadore without having to pay the tax each time This way ICRISAT avoid wasting time at the point where tax collectors have to write out individual receipts for each vehicle that goes by

Staff

- Mr. Saley Nabi, truck driver, retired at the end of December.

Field activities

Harvest of pearl millet fields (both experiments and cover crop) continued until the end of December. Harvest took longer this year as no temporary labor was hired for this purpose. Only cowpea multiplication fields were harvested on a contract basis. Cowpea planted as cover crop had very low or no yields (because of minimum input due to budget constraints) this year and fields were incorporated.

At the end of December, approximately 10 ha were irrigated and land preparation for those fields was timely performed. An additional 6 ha were ridged for planting in early 1994.

Here is a summary of field activities for 1993:

Activities (cover crop fields included)	Number of requests	Area (ha)
Primary Tillage/Residue Inc.	48	43
Ridging and Reridging	80	100
Mechanized Fertilizer Application	3	5
Fertilizer Incorporation	23	34
Planting with planter	24	43
Mechanical Weeding	38	48
Mowing	50	21
Pesticide treatment (cumulative)	96	106
Irrigation (cumulative)	727	489
Manual Harvesting	50	58

The following table shows monthly irrigation data for 1993.

	JA	FE	MA	AP	MA	JU	JY	AU	SE	OC	NO	DE
Number of irrigations	85	102	106	56	65	23	29	33	52	62	46	46
Cum. linear move (ha)	37	52	53	25	33	1	1	5	17	30	21	23
Cum. total (ha)	57	77	81	47	60	13	15	13	29	43	29	26

In December FDO assisted AF/ICRAF in the construction of a tree nursery of 1,600 m^2 (topo survey, leveling, design and set-up of a laterite flooring).

Windbreak pruning in strip 6 was undertaken in December and should be completed before the beginning of the rainy season.

Livestock

FDO livestock is healthy and training of the young draft animals started in December.

GIS-based Land Use Management

Data collection and encoding for the multidisciplinary crop residue experiment (field 8A) continues. Various on-demand GIS work was performed during the period:

- Land use change analysis for ILCA
- Mapping of crusting experiment for RMP/SWM
- Mapping of infestation variability on the PMIP/PATHO downy mildew nursery.
- Aerial photography analysis of crop residue experiment in collaboration with RDS and A. Buerkardt (scanning, image correction, raster analysis, vectorisation, relationship with yields, variability study). The first results of this work are very promising and could lead to more systematic aerial coverage of experiments.

Staff

- A. Egwu, statistical assistant took his annual leave from December 22 to 31, 1993.

Program Development/Statistics

This has been an exciting three months for statistics and computing. This is partly due to the work undertaken, but particularly the potential for 1994.

- Two internal statistics courses, each of two days duration, were given. The first introduced Genstat and was effectively a conversion course from MSTAT. The second was on statistical methods, for those who were already Genstat users. A seminar was also given, entitled *Modern Methods for the Analysis of Experimental Data*, to explain to senior staff the reasons for encouraging this change in strategy for data analysis by the research assistants.

- Within ISC our routine work of assisting staff on the analysis of their data has become more challenging. Many staff now handle the routine analyses themselves and therefore only come to see us when there are complications. However, we are busier than before, because staff are realising that many sets of data do involve complications and they are becoming more ambitious, particularly in trying multiple site analyses. Because of this the progress on the remaining chapters of our analysis guide has been slow. I anticipate that work on this guide will occupy us through much of 1994.

- Our *Data Entry guide for EPI Info* has now been translated into French. This was started for use on the ICRAF course in November. The translation has been completed by Zed Mawusi, and is now being used internally, as well as for the WARDA/ICRISAT course in January 1994. Zed gave one session and supervised computer use in the ICRAF course. This session was prepared and given by him alone. It is the first time he has been given this type of responsibility.

- A team from computing and statistics travelled to WASIP Kano for a week in December. Here it was Augustine Egwu who, for the first time, was asked to conduct this internal training on statistics. I was delighted with the way he handled this work. With the progress of these two staff, plus our training guides, we have therefore a full team of three to support training initiatives in basic statistics in the future. Up to this date, RDS has had to be involved in all training courses.

- On the Kano course, our driver, Sadou Djibo, gave two sessions teaching their staff about data entry. The training was of real value, but the symbolic value of a driver, who has little more than primary education teaching computing to technical staff, was also important. (He also had to teach using the English version of the package, though he had learned on the French version. The course was in Hausa, though he is Djerma, because this was their one language in common.) Part of this message is that data entry and validation can be done by drivers/field staff, etc. thus freeing research assistants for more demanding tasks. It should be said that this is already the case in many sections at ISC.

- RDS visited WARDA for 3 days in December. This was primarily to help them in their interviewing for a statistician, but also to help in the planning of a 4 week regional statistics/computing course in January/February 1994. This has become very useful because it is to staff from many of the institutes that also collaborate with ICRISAT. It is in French and hence the translation of the course material will be a useful spin-off benefit. In planning the course I was able to include ideas resulting from my visit to Reading last summer. We will also be substantially involved in actual teaching of the course, which is now seen as a joint initiative. It is a useful bit of inter-centre collaboration, because they have the finance for the course and the experience of organising them, while we have the technical knowledge.

- GAO visited Lome in December for an evaluation of an IFDC 'train the trainers' course on December 14 to 18, 1993. He had previously helped in the initial round of training in Summer 1992. His report describes some of the successes and shortcomings of their initiative. The forthcoming WARDA course has a 'train the trainers' component and it has been useful to have the IFDC experience at this stage.

- RDS and GAO had visited INERA staff in Burkina Faso in December 1992. RDS gave a seminar to discuss methods of data analysis and two senior staff later attended our course at WASIP-Mali in January 1993 to evaluate their own strategy for statistics and data processing. We were suddenly contacted by staff from the Purdue team in Bamako in December 1993. They stated that they had bought the software, were very pleased with it and would like a course for their national staff in March 1994. They only require RDS' time, plus any new manuals from ICRISAT, because they can supply the computers etc and their own staff can act as demonstrators. I am very keen to encourage this type of 'within-country' training. It is usually much cheaper than regional courses and more useful.

- A similar initiative has arisen following a visit by Adamou Moustapha to the ISC groundnut program in early December. He is head of the DRA station in Benin. He was here mainly to work on multi-site analyses with JHW, but was also interested to explore a training initiative on statistics/computing in Benin. This would be a 'train-the trainers' course, because there are 70 scientists who, he felt, could benefit from the training.

- Finally, on statistics, we received a test copy of the new Genstat. RDS's family were not impressed with its arrival at Christmas, but scientists will find much of interest in this new version, particularly the sections to help the randomization of experiments. We expect a more complete version at the end of January and will distribute to other sites as soon as a production version arrives. (Un)fortunately there is sufficient that is new in this version, that a high priority in 1994 is to upgrade our guides.

Program Development/Computer Services Unit

- Routine work of support of ISC staff computing and of software installation continues to be the dominant task for the CSU staff. The volume of work is such that ZM from statistics is often involved in computing support.

- Jim Estes visited in October to discuss communications and the forthcoming network.

- A major task for GAO was to assess the different components and options concerning the forthcoming network. A mini-system is operational in CSU and one has been set up in Fiscal. GAO gave one seminar on WP6.0 and one on Foxpro 2.5.

- Programs were written to support the MTP activities and to provide a type of bulletin board for the CCT. SA has been assigned the task of coordinating this CCT's BB.

- We received the new scanner, colour printer and Polaroid CI5000S. These have been installed with the GIS computer. Part of the work of CSU, particularly AS', is to provide support in the use of this equipment to ISC staff.

- Even though ILA's full assignment at Placal continued until mid-November, he spent substantial time on communications. New modems have been received in October and data transfer between Sadoré and TVC resumed. Thus, assistance to Administration's Services continues to be ILA's main activity. He travelled to Kano in December to install Email and assist the accountants at WASIP-NIGERIA. ILA wrote a guide on EMAIL both for WASIP-NIGERIA and ISC.

- Machines were set up for the Winter School climatology course in December.

- A Christmas 'gift' for GAO was a copy of the Clarion software. This is for evaluation, particularly given the limitations of packages like Foxpro in a networking environment.

Future Plans

As we review 1993 and look towards 1994, the picture looks different for computing compared to statistics. On the statistics side, 1993 has prepared us for a support role that can be of genuine value in the region. Our concern is that other institutes may also request support. WARDA has already asked if ISC can give additional support, particularly if they do not have sufficient funds to support their own post of statistician. IFDC are sending more data to ISC, partly because of the statistical support that is possible. While I welcome this 'inter-centre' collaboration I feel there is a danger that it may become merely support by ICRISAT, rather than collaboration. I also would not like it to jeopardize the support for national programmes.

On the computing side the network and communications between institutes are likely to be the major tasks. Both are vital to the new structure of the institute. With routine support to ISC and WASIP staff continuing, I do not see that our computing team will have the resources to give much support to national programmes, though such support would be welcome.

INFORMATION MANAGEMENT EXCHANGE PROGRAM AND HUMAN RESOURCE DEVELOPMENT

Staff

RHG was absent from 21 November - 30 Dec due to family matters.

Support staff were on vacation as follows.

- Aboubakar Madougou, Translator, 29 Nov - 10 Dec
- Hadiza Mamoudou, Secretary, 27 Dec - 21 Jan.
- Djibo Abdoulkarim, Administrative Assistant, 15-26 Nov.
- Fati Diallo, Bilingual Secretary, 15-27 Nov.

Staff changes occured

- Biba Omar was transferred from the Library to Secretary in the Editorial Division.
- Fourera Arzika, was hired as Library Clerk to fill the position vacated by Mme. Omar

Translations, Editing and Publications

Editorial and layout assistance was provided to SVRS Shetty to produce RMP Bulletin no 3- *Cropping Systems Research in the SAT*. It was printed in India and has just arrived

The French and English versions of the *1992 ISC Annual Report* arrived at the end of December and were distributed to staff and institutions in Niger In fact, we received quite a good supply of publications this quarter to distribute to visitors, trainees, and workshop participants

The new ICRISAT video arrived however as the quality is not good, we are unable to use it. The text has been translated to French and is being reviewed. Some examples of items that we translated were:

- course material for the ICRAF/ISC course
- MTP themes
- Instruction manual for email users
- Briefing notes on ISC Administrative Units,
- PSD Manual
- CCT material and organizational changes
- Assorted documents and letters for the ICWPIP

Library and Documentation Services

During this period, Library activities focused on a user analysis of our journals which allowed us to modify our list for the 1994 subscriptions. Nineteen titles were deleted from the 1993 subscriptions and four new titles were added.

Halimatou Djibo Oumarou was accepted as a two-month trainee in the library, until 29 December. She was a student from the Ecole des Bibliothécaires, Archivistes et Documentaliste (EBAD) of Senegal. She was trained in library activities and literature search techniques for our various databases and CDRoms.

The Librarian was asked to supervised the final report of Haoua Soumana, a former trainee of in library. She is finishing her cycle with IFTIC, and the theme of her work is *"The contribution of a documentation center in a research center: the case of the ICRISAT Sahelian Center Library."*

The literature searches services continue to be well utilized by our staff as well as visitors and scientists from outside. We are receiving search requests regularly and this service is now one of the most important functions. During this period, we provided 800 references to scientists, students, trainees, and visitors. We delivered more than 350 copies of journal articles to users from different countries from our collection and from the SRLS database.

The Current Contents Users (30) are receiving their outputs on a regular basis. We provided a total of 1451 records from this retrieval software for this period.

Our Reprography Unit has provided 326 copies of our journals collection to different users.

Workshops and Courses

A good team effort was put forth by the IMEP and HRD Staff to contribute to the success of four workshops and courses held this quarter at ISC. Our group assisted with the organization, administration, infrastructure details, secretarial support and document preparation and translation. A summary is provided below with details in the IMEP/HRD, PMIP and RMP Technology Exchange Sections.

Dates	Titles
4-7 Oct	International Workshop on Panicle Feeding Pests of Sorghum and Millet
1-12 Nov	ICRAF/INRAN/ISC Training courses for Agroforestry Technicians
13-26 Nov	IITA/ISC/SPALNA Equipment Maintenance Training Course
6-17 Dec	MEDIA Workshop on Subtropical Climates and their Evolution

Activities for 1994

In collaboration with our scientists and international institutions, we are currently working on finalizing the following schedule of workshops and courses:

Date	Title	Sponsors
30 Mar - 7 Apr	West and Central African Millet Research Network Coordinators Meeting and Workshop	L. Clase
11-22 Apr	Exploitation of Data for Crop Simulation Models - Part II	WAP/RDS/JHW/ MCK/RHQ
4-15 July	FAO/ISC Soil Tillage, Cultivation and Equipment Selection	MCK/MVKS/RHQ
5-16 Sep	IITA/ISC Striga Technicians Training Course	DEH/RHQ
1-11 Nov	Workshop for Statisticians	RDS/RHQ
12-26 Nov	IITA/ISC/SPALNA Equipment Maintenance Course	RHQ

Research Fellows and Trainees

During this quarter the number of trainees decreased because most of them returned to their institutes. A list for the quarter follows this report. At the end of 1993, the situation was:

PDF	1
RS	8
UN	1
ADM	5

Among the new Research Scholars, we saw the arrival of Mr Boukar Ibrah (Phd) funded by CARFOB (African Centre for Research and Phytosanitary Training) in Cameroon. His period of research is from October 1993 to April 1995 under the joint supervision of Dale Hess and Bill Payne. Siaka Boureima's application for PhD research on plant improvement from the University of Abidjan was approved for Phd research under the supervision of Anand Kumar. This is the second time Mr. Boureima has performed his research here.

Administrative Trainees from institutions in Niger for October-December 1993

Name	Sponsor	Sex	Subject	Program	Start	End
1. Hadiza Idi	CELECMI	F	Secretarial	ADM/PSD	09/08/93	08/02/94
2. Halima B. Mousaa	ATBU Nigeria	F	Mechanical	ADM/PPS	22/11/93	21/02/94
3. Mamoudou Saley	MEGA SYSTEM	M	Secretarial	ADM/PPS	11/08/93	10/11/93
5. Ramatou Boureima	CELECMI	F	Secretarial	ADM/PTO	17/08/93	28/02/94
6. Bintou Labaran	MEGA SYSTEM	F	Secretarial	ADM/GSD	16/08/93	21/01/94
7. Mamoudou Aissa	EBAD	F	Documentation	CSU	29/09/93	28/12/93
8. Djibo Halimatou	EBAD	F	Documentation	Library	12/10/93	28/12/93

Current IBC Fellows for October-December 1993

Training Category	Name	Sex	Institution	Home Country	Program	Supervisor	Dates	Disciplines
PDF	Frits Van Evert	M	Washington State Univ	Netherlands	GIP	JHW	01/01/93 31/12/94	Simulation of growth & development of pearl millet
RS	Holger Brueck	M	Univ of Kiel	Germany	PMIP	WAP	03/05/93 31/12/93	Phosphate use efficiency
RS	Ikpé Felix	M	Univ of Sc & Tec	Nigeria	RMP/ILCA	MP	10/10/90 30/10/93	Soil management in the mixed systems of the Sahel of Niger
RS	Selassie, G Atsbaha	M	Univ of Gottingen	Ethiopia	RMP/PMIP	AB /WAP	18/09/92 18/10/93	Influence of water and nitrogen stress on developing pearl millet roots
RS	Mai Moussa Katella	M	Univ of Côte d'Ivoire	Niger	RMP	JHW	28/11/92 27/11/93	F albida environment study
RS	Rotmans Arjen	M	Univ of Wageningen	Germany	RMP	JB	04/08/93 31/01/94	Physical land qualities
RS	Hermann Ludger	M	Univ of Hohenheim	Germany	RMP	MVKS	10/09/91 30/03/94	Soil science
RS	Andreas Burkert	M	Univ of Hohenheim	Germany	RMP	AB	14/05/91 31/12/93	Investigation of mechanism of crop residue response on millet
RS	Uyovbiere Edward	M	Univ of Hohenheim	Germany	RMP	AB	18/04/93 30/04/96	Crop residue management Soil science
RS	Emhardt Frank	M	Univ of Hohenheim	Germany	RMP	MCK	01/10/91 31/12/96	Animal traction in crop management
RS	Karlheinz Michels	M	Univ of Hohenheim	Germany	RMP	MVKS	22/09/93 08/11/93	Effects of land use on soil physical properties and groundwater recharge in SW Niger
RS	Sadri Fian	M	Univ of Hohenheim	Germany	AB	RMP	02/10/91 30/11/93	Influence of organic amendements on availability of soil-P
RS	Fall Abdou	M	Univ of Edinburgh	Sénégal	ILCA	PL	15/02/93 31/12/95	Feeding of draft oxen
RS	Mark Smith	M	Univ of Endinburgh	Canada	RMP	JCW	20/04/91 30/11/93	Wind erosion
RS	Drame-Yaye Aaetou	F	Univ of Nigeria	Niger	PMIP	OY	01/09/93 01/09/95	Entomology
RS	Imad Bayoum	F	Texas University	Leban	PMIP	OY	14/06/93 31/10/93	Biological control of the millet Head
RS	Siaka Boureima	M	Univ Abidjan	Niger	PMIP	KAK	27/07/93 01/02/93	Amélioration des plantes
RS	Boukar Ibrah	M	CARFOP Cameroun	Niger	PMIP	DEH	06/10/93 31/04/95	Phytopathology

UN	Sangaré Maimouna	F	Abdou Moumouni Univ	Niger	PTO	KAM	07/06/93 08/11/93	Translation
UN	Harou Zouladerni	M	Abdou Moumouni Univ	Niger	ILCA	SF	22/06/93 15/11/93	Animal Husbandry
UN	Abdou Adamou	M	Abdou Moumouni Univ	Niger	ILCA	SF	24/06/93 30/10/93	Variety effects on yield quality of Cowpea crops
UN	Ali Souna Hama	M	Abdou Moumouni Univ	Niger	RMP	MVKS	21/06/93 30/11/93	Evaluation de la performance de 4 variétés de mil sous 5 différents systèmes de cultures
UN	Tiarson Nary	M	IDR Ouagadougou	Madagascar	PMIP	OY	01/07/93 30/04/94	Importance des insectes au niveau d'un système de culture à base de mil
UN	Kindo Djibo Issa	M	UNB Cotonou	Niger	CSU	GAO	27/09/93 24/12/93	Management data processing
UN	Dogo Issoufou	M	ENSA Yamoussokro	Niger	PMIP	OY	25/04/93 12/11/93	*R. hyfusca* biology
UN	Karimou Issa	M	ENSA Yamoussokro	Niger	PMIP	DEH	25/04/93 22/10/93	*Striga hermonthica*
UN	Mahaman C. Chano	M	ENSA Yamoussokro	Niger	RMP	SVRS	25/04/93 05/04/93	Weed control in an alternate millet-based cropping systems
UN	Biga Abdelatif	M	ENGREF Montpellier	Niger	PMIP	JCWO	05/07/93 12/11/93	Tree crop interactions in neem trees windbreaks at INC
IST	Garba Suleiman	M	NEAZDP	Nigeria	RMP	JH	27/08/93 20/10/93	Farmings systems

Abbreviations: PDF Postdoctoral fellow RS Research Scholar UN Undergraduate IST In-Service Training


RESEARCH PROGRAM

GENERAL

All rainy season trials were harvested, processed and analysis is in progress. The necessary trials and seed multiplications for the dry season were designed and sown.

BREEDING

Varietal Improvement

Hybridization. We completed 40 crosses in the glasshouse. The crosses made for IAR Samaru included 20 for resistance to groundnut rosette virus (GRV). The success rate in the latter crossing block averaged 32%, which was an improvement from the previous crossing. A new crossing block was established in the glasshouse to make further crosses and back crosses for various attributes.

Breeding for resistance to GRV. We harvested single plant pod bulks of 19 segregating F3 population grown at Sadore of crosses involving early-maturing and rosette resistant genotypes. We also harvested single plants of 5 F2 populations. In addition 400 F3 progenies from three crosses involving an early-maturing rosette resistant parent and received from SADC/ICRISAT Malawi were also harvested in bulk. These materials will be advanced in the 1994 crop season, and a subset will be screened at Samaru.

Breeding for earliness and dormancy. In an F6 nursery consisting of 530 progenies we selected over 200 lines that showed less sprouting in the field. The nursery was harvested at 110 days after sowing. The progenies are from crosses involving early-maturing and dormant genotypes. The selected material will be evaluated in a preliminary trial in the next crop season and will be assessed for dormancy parameters both in the field and laboratory. Single plant bulks were also made in 51 segregating F2 populations involving diverse early- maturing and dormant genotypes.

Breeding for resistance to foliar diseases. We harvested individual plants of 71 F2 populations from a 9 x 9 diallel cross. This material is for the genetic study of traits related to yield as well as resistance to foliar diseases. In addition, we harvested single plant pod bulks from 296 F4 progenies from crosses involving early-maturing and disease resistant genotypes. This material will be evaluated for resistance to foliar diseases at suitable locations.

A trial consisting of lines with varying levels of resistance to foliar diseases particularly, early and late leaf spot was conducted at Bengou, Bagauda and Benin (2 sites). At Bengou the most prevalent disease was early leafspot and all lines were susceptible. Late leafspot was also present and 17 lines showed high levels of resistance to this disease. In Benin several lines combined high yields and foliar disease resistance. However all the lines were highly susceptible to GRV.

Breeding for high yield and adaptation. In 1992, we initiated an early generation yield trial consisting of 40 F2 populations. The trial was sown at Bengou and Sadore. In 1993 the same material was tested as F3 bulk. The aim of this trial is to determine the efficacy of early generation yield testing in groundnut. Simple phenotypic correlations between F2 and F3 for pod yield were not significant at both the locations. Combining the location data did not improve the correlations. **These results indicate that Sadore and Bengou may not be suitable sites for conducting early generation yield testing.** They also cast doubt about the reliability of early generation testing. We will do further analysis on the components of yield to determine those that can be selected for in segregating populations.

Yield Trials

Preliminary trials

The six preliminary nurseries received from IC were harvested and they will be evaluated in standard variety trials in the coming season.

Advanced trials

Medium and Late (Virginia). This trial consisted of 23 advanced breeding lines selected from the previous preliminary trials along with two local checks and was conducted at Bengou, Tara (Niger) and Bagauda (Nigeria). **None of the new lines significantly yielded higher than the local virginia type (28-206) at all locations.**

Medium and late (Spanish). This trial had 23 breeding lines and two local checks. **None of the new lines significantly yielded higher than** the locally adapted Ts 32-1, but the majority had larger kernel size.

Early maturity. This trial was conducted at Sadore, Bengou, Tara (Niger), Benin (3 sites), Bagauda (Nigeria) and Sierra Leone. The trial was conducted by NARS scientists at sites out of Niger. In Niger, two sowing dates (normal and late sowing) were used at each of the three sites , giving six environments. The objective of the sequential planting was to expose the material to end-of season drought. During the crop season, the rains ended early in September and this gave nearly ideal conditions for drought evaluations. The best cultivars in the second sowing date were the Sahelian lines 55-437, 796, and TS 32-1, which is consistent with previous observations. Among the introduced lines, ICGS 11, ICGV 86015, JL 24 were the best across the environments which confirms their general adaptation in west Africa.

In a separate trial consisting of 16 lines, we harvested the material at four dates separated by an interval of ten days starting from 75 days after sowing (DAS). The trial was planted at Sadore, Bengou and Tara. At Sadore, no yield differences were observed after 85 DAS. At Tara, most cultivars were mature at 95 DAS and all had started sprouting. On the other hand yield of most cultivars was maximum at 105 DAS at Bengou although most had started sprouting. From this preliminary observations, it appears that the best time to harvest this material is between 85 and 90 days. This trial will be repeated in the crop season and further assessment based on thermal time will be made.

Drought resistance. This trial consisted of material developed at IC in India for their tolerance to drought. The trial was sown at the same locations as for the early maturity trial except in Sierra Leone. ICGV 90127 was the highest yielding in all the environments while the Sahelian lines 55-437 and Ts 32-1 were often the best in the late sowing .

Pathology

All trials were completed, and preliminary analysis conducted. Results were sent to P. Waliyar for his information and report preparation. Elisa analysis of the aflatoxin trials was completed.

Physiology

Temperature studies. The last experiment sown in the current heat tolerance experiment series was planned and planted. This planning exploited a climatic analysis to provide the widest range of temperatures during the pod filling phase. The first of two of these selected sowing dates were established successfully.

Calcium studies. The trial series was continued, with the winter season crop being sown and the summer crops being harvested. The measurement of pod volumes from the trials, and from material sampled from farmers field is in progress. The trial results were particularly encouraging at both Tara and Sadoré. Wood ash was as effective as lime, and at Tara more effective than gypsum in improving shelling percentage. The results are consistent with anticipated results and provides a substantial opportunity to improve groundnut productivity, particularly since this is a crop often grown by women. The ash involved is a commodity which the women have as a resource and which can greatly improve their productivity if directed towards their groundnut crops.

Radiation use efficiency experiments. Data from a population by genotype study was used to test concepts for the improved analysis of trials. The trial had substantial variability, in that plants were unevenly distributed in the plots. During the growth of the trial weekly observations of radiation interception were made in the places where plants had established. This data for radiation interception was interpolated between observation dates using Genstat, linked to the daily radiation and summed to provide a radiation intercepted estimate. Biomass and pod yield were used to estimate the determinants of yield (Crop growth rate and partitioning). Analysis then examined the consequences to treatment significance of various approaches to analysis. Examined without taking into account the intercepted radiation data both varieties and spacings had statistically significant effects, however once radiation interception was taken into account population and spacing x variety effects were no longer significant. This provides further evidence to encourage the measurement of radiation in breeding selection plots using techniques like the red:infrared reflectance ratio.

Other Activities

- JHW was involved in the preparation of two project proposals (CFC groundnut germplasm, and an EEC multi-lateral farming system project).
- As part of the local working group JHW was involved in planning for, evaluating and negotiating the Computer Network project for ISC.

Seed multiplication

Seeds of a part of the world germplasm collect were received from Hyderabad and are being multiplied prior to inclusion in the local germplasm collection and testing in our heat tolerance screening.

Organizational Change

Since the 8 November announcements by the DG on Organizational changes in ICRISAT BRN has been largely occupied with the Change Consultation and Communications activities. This mainly involved organizing change forum meetings for both international and support staff, diffusion of information from the CCT and relaying messages and minutes of local forum meetings to Hyderabad. The development of a disc bulletin board by CSU has eased pressure on BRN and effected considerable saving on paper.

JHW was involved in the above activities when BRN was travelling and in the project management work group, the information management work group.

TRAVEL

13-27 Oct	BRN travelled to Washington for ICRISAT Org. and Management.
2-4 Dec	BRN travelled to Mali for Change Consultation with WASIP-M staff
7-10 Dec	BRN travelled to Kano, Nigeria, for Change Consultation with WASIP-N staff and also had an opportunity to interact with the IAR groundnut breeders at Kadawa and Samaru.

Staff

We were greatly saddened by the sudden death of our driver/field assistant Mr. Djibo Seydou.

RESEARCH

Physiology

This quarter had reduced experimental activity due to lack of funds. We continue to slowly process plant samples from last year's experiments with our limited staff. We are trying to plan for the 1994 dry season experiments, but this too has been very difficult due to budget uncertainties. Because of budget problems, we have placed emphasis on data analysis and manuscript preparation for several completed experiments, including archived data sets. We expect this trend to continue well into 1994.

Entomology

Our main research focussed on the millet stem borer with emphasis on the pheromone technology and oviposition non-preference, the millet head miner, with emphasis on host plant resistance and biological control, and the scarab with emphasis on population-ecology and control and behavior.

Millet stem borer (MSB) management. Research on trap interactions, mating disruption, and adult population monitoring was conducted and data collection completed. Experiments on the effect of Gao trees as influencing MSB population, screening for resistance, and adult moth behavior are completed. Release rates of new resin dispensers to be used next year are being studied at NRI after being exposed at ISC for different number of days. The purpose of this study is to develop dispensers which last longer than the resin "boot lace" dispensers to reduce time involved in replacing these during the mating disruption trials. The mating disruption trial conducted in the farmers' field was most encouraging. Results of the analysis showed that pheromone treated plots had fewer number of diapausing residual stem borers than untreated areas. Furthermore, nearly no catches of males occurred in pheromone-baited traps placed in the center of treated plots, indicating that mating disruption was achieved. In untreated areas, substantial catches occurred. We are also pleased to note that the pheromone trap developed for MSB was successfully tested for monitoring *Busseola fusca* attacking sorghum, using its pheromone. Therefore, there is indication for a likely spill-over for this technology on the control and monitoring of other moths attacking sorghum and millet.

Millet head miner (MHM). Several varieties were screened for reaction to MHM under natural conditions. Data summary and analysis is still underway. For artificial infestation, we found 1/3 panicle exsertion was more susceptible to attack than 2/3 or full panicle exsertion. We also found that one-week old larvae caused more damage than newly hatched instars. Collaborative activity with INTSORMIL on the biological control of MHM was carried out successfully. Preliminary results show that *Bracon hebetor*, a hymenopteran larval parasites and *Ortus* sp. an Anthocorid predator were more predominant.

Scarab beetle (SB). Data on the effect of different cropping systems on population densities of SB were conducted. Laboratory biology of SB was studied in more detail. An artificial diet was identified and SB was successfully reared on it. Preliminary results on larval development from natural population showed the existence of three instars. Studies on SB field population ecology and mating behavior indicated a sex ratio favoring females. These results were both confirmed in farmers fields and light traps. The third year-study on the effect of cropping

systems on soil larval population of *Rhinyptia* showed again that the addition of crop residues increased grubs in the soil and therefore this contributes to increasing the residual populations which infest the next season's crop. There are however some apparent interactions residues-treatment which need to be studied. The traditional treatment had fewer grubs for all three years.

Pest surveys in farmers' fields. Results showed that farmers were aware of pest problems and damage they caused. Their ability to identify insects and damage differed, although control techniques used were similar once they knew the insect. Panicle insect pests were mainly controlled by mechanical methods such as hand picking, burning, smoke, squashing, and collecting in water pans then burning. Our studies showed that substantial information can be collected from farmer knowledge, however, a need was identified to educate farmers on basic insect bioecology with emphasis on life cycle, diapause sites, and cultural controls.

Others activities. In collaboration with RMP we monitored insect pests in millet based cropping systems both on station and in farmers' fields. Data handling and analysis is still under way.

Pathology

Downy Mildew (DM). During the rainy season about 140 entries including preliminary and advanced breeders' materials and varieties were evaluated in the DM nursery (DMN) at Bengou. Four entries were free of mildew (PV SSZ 932, ICML IS 82261, ICML IS 82217, and ICML IS 85220) and 24 were highly resistant (≤ 5% DM at maturity). Disease incidence on the controls 7042 and ICMS 8410 were, respectively, 94% and 69%.

The yield response of four pearl millets to DM infection was investigated for a second year under high disease pressure in the Bengou DMN. Metalaxyl treatments (seed and foliar) were employed individually and in combination to obtain varying degrees of DM infection. Grain yield responses to DM attack differed among the four millets: in SOSAT-C88 (resistant) low levels of DM occurred in 3 out of 4 control plots; CIVT (moderately resistant) and ICMS 8410 (moderately susceptible) showed a yield reduction with increasing DM severity; and yield of the tolerant local cultivar (HK Gaya) was unaffected by increasing DM.

An additional 500 entries including preliminary and advanced breeders' materials and A-B pairs were screened in the off-season nursery and glasshouse at Sadoré. Disease incidence in the field at millet maturity averaged 28% among test entries. DM incidence on the controls 7042 and ICMS 8410 were, respectively, 88% and 34%.

Striga hermonthica

Screening. Reduced stimulation of germination of *Striga* seed by pearl millet seedlings grown in Petri dishes in the laboratory correlates with reduced infestation in pots. The technique may permit more rapid selection for *Striga* resistance in pearl millet.

Cultural Control. The handpulling trial was initiated in 1991. Near total inhibition of *Striga* flowering and seed production is achieved through regular (every 2 wk) handpulling or mechanical weeding. A single additional weeding at millet flowering strongly reduces *Striga* flowering, more so in the drier climate at Sadoré (88% reduction) than at Bengou (49% reduction). There is a trend towards improved pearl millet biomass and grain yield production in all weeding treatments, but it is accentuated (34% increase) in the plots with regular total weed removal.

Results from the intercropping/rotation with legumes trial (now in its third year) vary between the two locations. At Bengou *Striga* infestation is enhanced (38% increase) on the millet/cowpea intercrop following groundnut whereas at Sadoré a 55% reduction in infestation is observed. There is a trend towards improved pearl millet grain yield in the continual intercrop (+ 17%) and in the intercrop following groundnut (+24 %) compared to sole millet.

In the date of sowing trial was conducted in Bengou. Here, farmers sow millet beginning at the first rainfall and may continue sowing for up to 8-10 weeks. In two cropping seasons we evaluated the effect of delayed sowing of the early millet landrace (photoperiod sensitive HK Gaya) and the late millet landrace (photoperiod insensitive Somno) on millet yield and infestation by *Striga*. *Striga* infestation is strongly reduced (-80%) on late sown millet. Millet biomass production is also reduced but more so for HK Gaya (-72%) than for Somno (-54%). Increasing sowing density (from 10000 to 25000 plants ha^{-1}) partially compensates for yield loss in late sown millet.

Variability of *S. hermonthica*. The existence of *S. hermonthica* populations specialized for the millet or sorghum host was demonstrated for a second consecutive year on cereal hosts grown in pots. Response of the millet host to infestation by different populations of millet *Striga* primarily reflects yearly environmental variation.

Breeding - SSZ Unit

During this quarter we were occupied with data collation and analysis. In early Oct postrainy season plantings for inbred x variety hybrid multiplication and BC_2F_2 populations (segregating for **bmr** and *tr*) were completed. Isolation plots of varieties SOSAT-C88 and GB 8735 were harvested and SOSAP-S88 was planted.

Regional trial evaluation. We conducted the WCAMRN's regional trial for the Sahelian Zone (REZSAH). Mean yield of the trial was 0.78 t ha^{-1}. Among the ten test entries, grain yield of the INRAN contributed variety, GR P1 (1.40 t ha^{-1}) did not differ from the control, Sadore local, the highest yielding entry of the trial (1.79 t ha^{-1}). The only other test entry that yielded similar to variety GR P1 was ICMV IS 89201 (1.06 t ha^{-1}). The mean empty earheads was 20%, with varieties CIVT (35%), INMV 49 (28%) and IKMV 8201 (27%) showing a high frequency and varieties GR P1 (9%), IBMV 8402 (9%) and Sadore local (12%) a lower frequency

Variety evaluation. In a trial designed to characterize 24 ICRISAT-NARS developed varieties, 15 varieties were retained for future seed increase and distribution to NARS. These varieties were developed at the ISC in collaboration with the NARS over the last 3-10 years. Several of these varieties have given good performance in regional and/or NARS trials. Observations were recorded on several traits and are being summarized to develop a list of 'pearl millet varieties available from ISC'.

From a 11-entry pearl millet advanced variety trial, containing varieties developed between 1988-92, we retained five varieties - PV SSZ 926, ICMV IS 90311, ICMV IS 90313, ICMV IS 89305, and ICMV IS 88305. These varieties yielded 7-16% more than the mean grain yield of the trial (over three locations 1.46 t ha^{-1}) and recorded low DM incidence. These varieties will be multiplied further for regional and/or NARS evaluation in 1994.

From the 9-entry pearl millet preliminary varieties trial containing varieties developed in the last two years, three were retained for evaluation in an advanced variety trial of 1994. These three varieties gave 78% (PV SSZ 931, retained for its earliness and large grain size and DM resistance) to 120% (PV SSZ 922 and PV SSZ 928) more over the mean yield of the trial (1.30 t ha^{-1}, over 2 locations) and were resistant to DM.

Breeding hybrids

Development of male-sterile lines. We have continued succeeding generation of backcrossing using five genetic backgrounds to develop male-sterile lines in the DM nursery planted at ISC. Twenty five A/B pairs, derived from four maintainers identified in the dwarf population 81 BHT (received from IER, Mali), in their second backcross were found to be highly susceptible to DM and were rejected. Thirty three individual A/B pair selections made from ICMS 90111 A/B were free from DM. We are planning to increase seed of selected pairs for evaluation of DM reaction at 3-4 locations in the next rainy season.

IVH observation nurseries. With a view to identify a series of new IVHs, we evaluated, (a) seven replicated observation nurseries with 131 IVHs derived from sister selections of a white grain inbred derived from the cross vr W (a virescent genetic stock ex Nebraska) x Sadore local and seven varieties, and (b) a 255 entry, unreplicated observation nursery with IVHs derived from crosses involving new inbreds and 88- to 92- series varieties. Inbreds in this particular observation nursery were sister selections from the crosses: 81BHT, (81 BHT x Sadore local), (vr W x Sadore local), (inbred 268 x IP 8056), and (ARD 125 x inbreds-UN-L).

From the first group 21 entries were selected, based on DM resistance and grain yield, for further multiplication and evaluation. In the second group varieties ICMV IS 90311, PV SSZ 925, PV SSZ 926, and ICMV IS 88212 and among inbreds selections of crosses (inbred 268 x IP 8056) and (81 BHT x Sadore local) gave better performing IVHs. We retained 39 IVHs for further multiplication and evaluation.

Late maturing IVH trial. IVHs in this trial were derived by crossing inbreds with ICRISAT-ISRA developed variety IBMV 8001. Though the trial was sent to four locations, results are available only from two locations (Tara and Cinzana). Mean yield over the two locations was 1.62 t ha^{-1} and for the variety IBMV 8001 was 1.40 t ha^{-1}. Yield increases of the IVHs over the variety ranged from 2% to 44%. Two entries were selected for multiplication and further evaluation.

Evaluation of inbred x landrace hybrids (ILH). With a view to evaluate the possibility of combining adaptation of landraces with improved yield potential we made nine ILHs using three landraces and three inbreds. The three landraces used were Egalblabane and Ba Aoudarche (both from 17°36' N, Tabelot region of Niger), and Bazagome (14°39' N, Tagalass region of Niger). Results of evalaution at Sadore and Tara indicated that in all the ILHs, the DM incidence was much lower than the corresponding landrace, with dramatic reductions in the case of ILHs derived from Egalblabane and Ba Aoudarche. For grain yield, mean increases of ILHs over respective landrace (100%) ranged from 46% to over 220%. The ILHs flowered at the same time as the landraces with yield increases manifested through increased earhead length and number. The dry fodder yields of ILHs were also superior. The results clearly indicate that the development of ILHs is a practical option to increase grain yield and combine with improved resistance to DM. We hope to develop further ILHs using a range of landraces and evaluate them in their areas of adaptation.

Proportion of IVH seed produced in isolation. We compared the frequency of hybrid and inbred plants in the seed lots derived from multiplication in isolation and deliberate crossing to determine the possibility of large scale seed multiplication of IVHs. During the postrainy season 1992 we multiplied seed of two IVHs in isolation. This was accomplished by planting two rows of the variety followed by two rows of the inbred line and harvesting the inbred rows to obtain hybrid seed. We also produced seed of these two IVHs by deliberate crossing, using the inbred as the female parent. We observed that the frequency of hybrid plants in the IVH 458 (inbred) x GB 8735 (variety) multiplied in isolation was 92% (8% inbred plants) and in the lot derived by deliberate crossing was 78%. For the IVH 410 x GRP1 seed lot from isolation produced 78% hybrid plants and that from deliberate crossing showed 82% hybrid plants. The grain yields of these two seed lots were not significantly different. These results are encouraging as they indicate that it is indeed possible to undertake large-scale multiplication of IVHs in isolation. However, it is important that the male parent (variety) flowers at least 5-7 days earlier than the inbred parent.

Incorporation of bmr **and** *tr* **traits.** To incorporate **bmr** and *tr* genes into adapted backgrounds and create near-isogeneic populations we used CIVT and HKP as recurrent parents and sources **bmr** 4 [(90-1378) (81-1089B)] and **bmr** 5 [(90-0394) (81-1089B)], both from Kansas State University and *tr* source from Tifton, GA. To improve adaptation, two further backcrosses were attempted with the recurrent parent in Summer 1992 and Summer 1993. In the postrainy season of 1993-94 BC_2F_2 populations of these crosses were planted to develop near-isogeneic populations. Stover quality is being estimated by ILCA. We hope by the end of March 1994 we will have a range of isogeneic populations for evaluating potential of these traits in improving stover quality.

Breeding - TZ Unit

Multilocation yield tests. Seven sets of multilocation yield trials were carried out. Institut d'Economie Rurale (IER) Mali and Institut d'Etude et de Recherche Agricole (INERA) Burkina Faso collaborated in conduct of several trials. Except for Longorola (Mali) and Farakoba (Burkina Faso) there was early termination of seasonal rain in other locations of Mali and Burkina Faso, affecting relatively late maturing entries. Analysis of most trial results have been completed. Results from some locations are awaited. In two trials, a total of 33 new varieties developed from selected elite lines from crosses were tested. Ten varieties, ICMV-IS 92101, 92102, 92106, 92107, 92109, 92110, 92113, 92114, 92118 and 92126 were retained for continued evaluation.

Second year trial results indicated stable and superior performance of varieties ICMV-IS 91103, 91106, 91108, 91115 and 91116. Varieties ICMV-IS 88101, 88102, 88103, 89102, 89107 tested over the last 4-5 years maintained stable top performance. The maturity range of these varieties is 115-135 days suited to various agroclimatic regions. Varieties ICMV-IS 88101, 88102, 88103, 89102 were included in Regional Trial 1993 conducted by ROCAFREMI, so several national programs will have an opportunity to evaluate these entries.

Recurrent selection in intervarietal composites Ghana late Local (GHL) X IKMV 8201, CVP 43 X IKMV 8201, Farakoba Local X GT 79 and Kapelga X IRAT 173 continued. Set of S_1s (77-148) selected from each composite half sibs were evaluated at 2-3 locations in Mali and 2 locations in Burkina Faso in collaboration with IER and INERA. Superior lines were selected for each composite, and seeds of 4-5 selfed plants in the selected lines were harvested and bulked for S_2 test.

Genetic diversification. A total of 160 F_5 lines grouped into three maturity sets were evaluated for yield, agronomic characters and reaction to DM. From relatively homogeneous 36 selected lines, plant selections (5-8) were made and seed bulked for each line. These will be multiplied (mass-sibbed) as elite lines. For two other lines from crosses ICMV-IS 87104 X IKM 87/8815 and GT85 X IKM 87/88/15 selected plant (19-21) progenies were individually retained. These will be recombined (twice) to derive a new intervarietal composite. In addition, 92 plant selections were made for observation as F_6 lines.

A total of 51 BC_1F_4 lines from five backcross sets were evaluated in a replicated trial and plant selections made from four sets for recombination in 1993/1994 off season.

Based on multilocation evaluation of 53 elite lines, 10 lines were selected for multiplication as experimental varieties. A set of 113 F_1s was observed and 42 selected for continued evaluation. The crosses were between elite parents from TZ program and new accessions (provided by IER) from Southern Sudanian/Guinean Zone of Mali, as also selections from Tanzanian germplasm.

Multiplication. Multiplication, in isolation, of three varieties ICMV-IS 88101, ICMV-IS 88102 and RP1(C1) was carried out.

Postrainy season. About 3/4 ha off-season material was planted, first lot in early Oct and a second lot towards end Dec. This included materials for recombination, seed multiplication of new elite lines and experimental varieties. Multiplication plots of ICMV-IS 91116 and IKMV 8201 were also planted.

West and Central African Millet Research Network

Activities planned for 1993-94 program and reviewed by the Steering Committee during its annual meeting in April 1993 have been implemented and followed-up appropriately. For the 4 current projects, an effort was made to harmonise methods and approaches. For performance of pearl millet varieties in NARS (project 1), please see next section.

For controlling pearl millet downy mildew improved varieties x treatment with Apron Plus 50 DS were tested on station and on-farm in Burkina Faso, Mali and Senegal.

Work on screening for resistance to millet head insects was focused on the elaboration of a reliable methodology. Surveys on traditional methods used by farmers for controlling millet head insects continued in new areas in Benin, Gambia, Mali and Nigeria.

Activities for the improvement of millet based cropping system were initiated this year in Burkina Faso, Cote d'Ivoire, Mali, Niger and Senegal. Several trials were on-farm and a wide range of mixed or intercropped systems were under tests. Intercropping millet and groundnut seemed to be promising in Mali and Niger.

We observed that activities were more rigorously conducted with a good balance between activities planned and the capabilities of participating countries. Country reports under preparation will give more information on the work completed and results obtained.

TRAVEL

1 Oct	SNL to IER station at Sotuba and Katibougou, Mali
7-8 Oct	SNL to IER station at Cinzana, Mali
4-15 Oct	DEH to Burkina Faso and Mali
18-22 Oct	SNL to IER station at N'Tarla, Mali and INERA Station, Farakoba, Burkina Faso.
25-30 Oct	DEH to Cotonou, Bénin
2-3 Nov	SNL to IER station at Longorola and Cinzana and on-farm trial sites in Ségou region.
10-17 Nov	SNL to ISC
1-16 Dec	KAK to ICRISAT, Hyderabad
11-18 Dec	DEH to Bamako, Mali
13-17 Dec	SNL to INERA station at Farakoba and Kamboinsé.
17 Dec-4 Jan	OY on home-leave

Weather

Weather data for the months of October, November and December 1993 are enclosed. There was no rainfall during this period. Lack of rainfall in October affected the growth of cowpea in the intercrop and late millet.

	Rainfall(mm)		Max Temp		Min Temp		Relative Humidity	
Month	1993	Avg.	1993	Avg.	1993	Avg.	1993	Avg.
Oct	0.0	15.5	38.8	37.4	23.6	23.6	52	58
Nov	0.0	0.5	38.3	36.4	20.0	19.2	28	35
Dec	0.0	0.0	32.7	33.4	17.5	16.4	24	29

Mean maximum air temperatures in October and November were above the long-term average while in December mean maximum temperature was slightly below the average. Minimum temperatures in October was similar to the long term average while in November and December they were above average. Relative humidities during the three months were lower than the long-term averages.

Staff

- Mark Powell left the ILCA programme in Niger. Before departing ILCA, he organized the Nutrient Cycling Conference in Addis Ababa. Salvador Fernandez was subsequently appointed as the Team Leader.
- MVK Sivakumar, MC Klaij, SVR Shetty, JCW Odongo, J.B.Forson, J. Brouwer and A. Bationo took local leave in the second half of December.
- B. Alzouma who managed the OPSCAR experiment at Tara returned to ISC on 30 November.
- KH Michels and F. Sadri who completed their field trials at ISC this year, left Niamey on 5 Nov and 15 Nov respectively.
- F. Ikpe left ISC after completing his research project in ILCA-Niger and submitting his Ph.D Thesis. He is now in his home country, Nigeria, working for the University.
- H. Zouladeini and A. Adamou, from the University of Niamey, completed their training program in ISC. Their research topics were the nutritional evaluation of fodder trees and nutritional value of cowpea hay, respectively.
- J. Adeyemi started his annual leave on 20 Dec.
- H. Mousa and B. Rhali proceeded on leave as from 8 Dec.

RESEARCH

Agroclimatology

Rainfall variability during 1993 at ISC. Individual rainstorms data during 1993 for the 18 raingages at ISC were analyzed and rainfall variability maps for the year and for individual months were prepared. Rainfall totals on the station ranged from 460 mm to 534 mm for the year. The isohyetal patterns did not show any particular directional gradients. Coefficient of variation (cv) of 9 rainfall events in June varied from 5 to 53%. For 10 events in July, the cv decreased and varied between 5 to 39%. In August, for eight events cv ranged from 7-17%, but rainfall on 2 August showed the highest cv of 68%. In September, cv for 5 events ranged from 3-67%.

Evaluation of conditional cropping systems based on the onset of rains. Millet grain yield in the relay crop was 1.33 t ha^{-1} as opposed to 0.98 t ha^{-1} in the improved intercrop. Millet straw yield in the relay crop (4.2 t ha^{-1}) was superior to the improved intercrop (3.1 t ha^{-1}). The relay crop cowpea established very well and gave a total dry matter yield of 0.8 t ha^{-1} by 5 Oct as opposed to 0.2 t ha^{-1} in the improved intercro treatment.

Phenology, and thermal time-growth relationships in contrasting cultivars of millet, cowpea and groundnut. Of the four varieties of millet, the local millet gave the highest grain (2.33 t ha^{-1}) and straw (9.2 t ha^{-1}) yields. Early sowing in June combined with above average rainfall in July and August favoured high biomass production by the local variety. Among the four groundnut cultivars, ICGS-11 and 55-437 gave highest seed yields of 1.9 t ha^{-1}. cv. NCAC 17090 produced the lowest seed yield of 0.9 t ha^{-1} . In cowpea, all the four varieties did not produce any seed because of insect damage to the flowers. cv. Sadore Local gave the highest hay yield of 2.9 t ha^{-1} followed by TN 5-78 (1.78 t ha^{-1}), IT84 E-1-108 (1.53 t ha^{-1}) and Dan Ila (1.51 t ha^{-1}). Analysis of the thermal time-growth relationships is in progress.

Influence of management practices on the water use efficiency of rainfed crop-management and simulation of evaporation from soil. In this project funded by the British ODA through the Natural Resources Institute, we tested the hypothesis that crop management has little effect on evaporation from the soil surface. The five treatments tested included: bare soil; millet at 1 x1 m spacing with no fertilizer; millet at 1 x 1 m spacing with fertilizer (30 kg P_2O_5, 45 kg N); millet at 0.58 x 0.58 m spacing with no fertilizer; millet at 0.58 x 0.58 m spacing with fertilizer; and millet/millet (CIVT/Sadore Local) intercrop at 1 x1 m spacing with fertilizer. Millet cvCIVT was used in treatments 2-4.

Comparison of treatment responses showed that the millet/millet intercropping gave the highest grains yield with 1.24 t ha^{-1} for cv. CIVT and 2.05 t ha^{-1} for cv. Sadore Local. Narrow spacing of 0.58 x 0.58 m gave a higher grain yield either with fertilizer (1.89 t ha^{-1}) or without fertilizer (1.43 t ha^{-1}) in comparison to yields under wider spacing (1x1 m) with fertilizer (1.70 t ha^{-1}) or without fertilizer (1.20 t ha^{-1}). Data from microlysimeters and neutron probe are being processed to examine differences in soil evaporation and water extracon if any, between the different treatments.

Dust Deposition in West Africa (Collaborative Program with the University of Hohenheim). In this collaborative study with the University of Hohenheim, dust deposition measurements on the north-south transect reaching from Ouallam to Cotonou were continued and showed a lower deposition rate in 1993 than in 1992. Climatological data concerning the Harmattan-dust source areas were analyzed and showed two centers of high activity. The first one south-west of the Air mountains and the second one in western direction of Lake Tchad. Laboratory analysis (XRD/XRF) of soil samples from potential Harmattan-dust source regions started in Hohenheim and confirm the results of the analysis of climata data.

Soil and Water Management

Harvest data of the collaborative experiment on wind erosion with University of Wageningen are complete and have been sent to Mr. Geert Sterk.

The relay cowpea and late millet of the Tara OPSCAR experiment have been harvested, and soil sampling completed.Compared to last year's results, grain yields were reduced by 20 to 50% depending on the treatment. Analysis is underway to explain the decline and treatment differences.

Preliminary analysis of the weekly soil profile moisture data from W.A. Payne's drought screening experiment conducted using the linear move irrigation system show consistent significant differences in weekly water balance components due to the amount of irrigation, crop spacing, and fertility. Differences due to millet variety were smaller and mostly insignificant, but there are significant interaction effects.

The Use of Animal Traction in Crop Management (Collaborative Program with the University of Hohenheim). In this collaborative study with the University of Hohenheim, apart from the evaluation of the passes with the donkey-drawn measurement hoe, a new blade holder design for the HATA was introduced and tested. By means of this design, a heavily loaded rivet and the correspondent boring could be abandoned. Pole drawn tests with the disc-ridger have shown improved steerability. To exclude the influences of the draught animals the implement has been drawn by means of a car. The application of the tie-maker has been further improved. However, its use is still not completely satisfactory. Field 20 was treated with the roller mulching sledge whereby special emphasis has been put on the effect of angular blade positions. The experiments revealed a better concentration of the crop residues and acceptable draught force requirements for two donkeys. In addition dynamic cutting force requirements for millet stalks were measured. The experiment to investigate the impact of mechanized mulching on crop emergence and yield has been prepared for the 94 season. The amount of crop residues applied was reduced from 3.2 t ha^{-1} to 1.0 t ha^{-1}.

Cropping and production systems

During this period all the field trials were harvested. Computing and preliminary analyses of the data were completed. The detailed statistical analysis is in progress. Data from off station trials in Cinzana and Samanko are still awaited. Except for severe insect damage in our long term operational scale trial (OPSCAR), grain yields obtained in the trials in Sadore and Tara were satisfactory. Significant responses to P-levels, rotation with legumes and crop residues were noted in VARFERT and OPSCAR trials.

Effect of Crop Residue Application on Productivity of Different Millet Varieties (Collaborative study with the University of Hohenheim)

On-station. All trials were harvested on time. Samples were processed and data analysis is currently under way. Some samples for tissue analysis were sent to Hohenheim University. In addition to the measurements outlined in the experimental protocol, data on the amount of millet leaves produced were collected in the Genotype/CR/P trial at 8C. The leaves will also be sent to Hohenheim to determine in-vitro digestibility and other quality characteristics determining their feeding value to ruminants as a function of fertility treatment. The trial provided a large amount of data not only of below and above ground treatment response on millet growth and final yield but also on the variability structure of millet growth within plots as influenced by treatments. It also showed that the ISC genotype ICMV 89305 gave significantly higher grain yield than the other cultivars (including the LOCAL) under all CR/P fertility levels. Again, as in 1992, treatment effect on weeds growing in millet were significant during the early growth phase. These effects became less pronounced after the second weeding when millet became increasingly the better competitor and was able to shade out weeds.

The wind erosion control/plant nutrition trial at 2C was prepared to continue through the 1994 rainy season to have a total of three years of results. Given the results of the 1993, plots will be split into +/-K application in 1994 to further investigate the mechanisms of millet response to crop residues and to increase the number of sampling units in the trial. In contrast to last year, in 1993 the effects of wind erosion seemed to be more pronounced at this site leading through a higher plant population to a significant increase of grain and straw yield in treatments with the plastic mulch treatments. Yields in plots with plastic mulch were inferior only to crop residue plots where in addition to high plant populations improved plant nutrition lead to an increased yield per plant compared to the bare control and the plastic mulch treatments. The analysis of the data from the trial at 8C on the effects of Mo on two groundnut and cowpea genotypes is still under way. However, preliminary results confirm the importance of this micronutrient for legume mineral nutrition, mainly N_2-fixation, growth, and final yield on the acid sandy soils of the Sahel.

On-farm. The on-farm observational trials were harvested successfully at all four sites (Béllaré, Kirtachi Seybou, Souanga Dossado, and Boulkas). At Boulkas striga and a heavy ear-worm attack severely affected final grain yield. At Kirtachi, despite a particularly vigorous millet growth throughout the growing season, final yield was only 1 t ha^{-1} pointing to the need for solid innovations which allow to increase the grain yield potential of the site. All farmers expressed their interest in putting into place proper replicated experiments in 1994.

Economics

Data collection on groundnut production practices in the Kirtachi and Tanda districts was completed. Follow-up household surveys were discussed with field investigators. The English version of the same survey questionnaire on farmer technological preferences and factors susceptible to promote production of groundnut was also discussed with field staff based at WASIP in Nigeria. Sample farmers to be interviewed in Nigeria were selected using number of years of experience in making decisions on groundnut production and tillage equipment ownership/use as stratification criteria. Revisits to sorghum adoption study sites in the Pouytenga district of Burkina Faso were completed under the supervision of INERA Economist.

A manuscript entitled "Determinants of the availability of adequate millet stover for mulching in the Sahel" was accepted for publication in Journal of Sustainable Agriculture.

Agroforestry

***Ziziphus mauritiana* provenance trial.** Seedling establishment of the six provenances (Ayerou, Tillabery, Sadore, Birni N'gaoure, Dosso and Gaya) transplanted in August was very successful and mortality remained low (< 3 %). Phenological observations made in December indicated that there were also no significant differences in plant heights and basal stem diameters. Plant heights varied from 25.8 cm (Ayerou provenance) to 31.1 cm (Gaya provenance). Similarly, Ayerou provenance had the least basal stem diameter (3.7 mm), while Gaya provenance had the largest stem diameter (4.7 mm).

Evaluation of *Ziziphus rotundifolia*. After only one year in the field, both *Ziziphus mauritiana*, a Sadore local and *Z. rotundifolia* from India, began flowering in September. However, heavy insect infestation was experienced in November and December. The fruits of *Z. rotundifolia* aborted before reaching maturity, either due to the insect attack or other factors which have not been established. It remains to be seen whether this species is adapted to the Sahelian environments. The fruit yield and quality of *Z. mauritiana* are also poor due to the insect attack.

Tree-crop interactions in neem tree windbreaks. A trial started in June 1993 to evaluate the effects of pruning roots and canopies of 10-year old neem windbreak trees on the yields of groundnut and cowpea grown in association with millet was harvested in September and October. The preliminary results indicate that pruning roots and/or canopies of trees was beneficial to the annual crops. In sole groundnut, pod yields increased by 1.5 to 2.2 times the yield of the control treatment (1.0 t ha^{-1}). In the mixture with millet, groundnut pod yields increased by up to 1.6 times the yield of the control which was identical as in sole stands. Similarly in sole cowpea, biomass yields increased by 1.5 to 2 times that of control (0.99 t ha^{-1}). In the mixture with millet, cowpea biomass ranged from 0.88 t ha^{-1} in the control to 1.6 t ha^{-1} where canopy was pruned.

In sole millet, grain yields increased from 478 kg ha^{-1} in the control to 700 kg ha^{-1} where both root and canopy were pruned. Similarly in the mixture with cowpea, millet yield increased from 213 kg ha^{-1} in the control to a maximum of 418 kg ha^{-1} where canopy was pruned. In millet/groundnut mixture, millet yields ranged from 250 kg ha^{-1} in the control to 384 kg ha^{-1}. Millet biomass yields ranged from 1635 to 2758, 773 to 1610 and 844 to 1839 kg ha^{-1} in sole stands, and in cowpea and groundnut mixtures, respectively.

Effect of manure, single superphosphate and rock phosphate on the establishment and growth of directly seeded trees. The six Sahelian tree species (*Faidherbia albida, Prosopis africana, Bauhinia rufescens, Combretum aculeatum, Balanites aegyptiaca* and *Ziziphus mauritiana)* seeded in June and July, 1993 under 4 fertility treatments achieved variable emergence, ranging from less than 5% for *P. africana* to 69% for *C. aculeatum*. Phenological observations made on plant heights and stem diameters indicate that *C. aculeatum* and *Balanites* were fast growing, and attained mean heights of 31.4 and 16.2 cm, respectively. However, *Balanites* terminal buds and *F. albida* leaves were noticed eaten by various insects.

***Andropogon gayanus* as a low windbreak.** The effects of Andropogon windbreaks in different configurations and management regimes on millet grain yields (125 - 291 kg ha^{-1}) and biomass production (1271 - 1973 kg ha^{-1}) did not differ significantly. Configuration and cutting had marked effects on Andropogon biomass production. Combined fodder and biomass yield (2863 kg ha^{-1}) from the double rows was more than doubled that from the single row (1352 kg ha^{-1}). In each configuration, annual cutting for seco yielded 3 times that of fodder. In double rows, seco and fodder yields were 4347 and 1378 kg ha^{-1}, respectively; while in single row seco and fodder yields were 2076 and 628 kg ha^{-1}.

Wind erosion effects on pearl millet. Final harvest of the millet in the windbreak trial took place from 25 September to 13 October. Millet was harvested in 20 m long rows parallel to the hedges, and the sample of each single row has been threshed. Thus, we are trying to get an exact growth pattern of millet up to a distance of 25 m from each hedge. First analyses of the straw dry matter indicate significant increases of average straw yields by the hedges as well as by crop residues. *Faidherbia albida* doubled straw dry matter in the adjacent plot. *Acacia senegal, Acacia holosericea* and *Acacia nilotica* indicated also significant positive impacts on dry matter, whereas the yield increases caused by *Andropogon gayanus, Azadirachta indica* and *Bauhinia rufescens* were not significant. Yield increases were smaller in a 5 m wide hedge-crop interface.

Soil Fertility

Preliminary analysis of the 1993 field data was started. ^{15}N samples of the 1993 were prepared and will be sent to IFDC headquarter for mass spectrometry analysis. Most of the time was spent to write the following papers:

- Agronomic and Economic evaluation of fertilizer application and rotation in farmer-managed trials on sandy Sahelian soils in the Sahel by Bationo A., J. Baidu-Forson, E. Ayuk and F. Beidari.

- **The effect of different management practices on chemical properties of sandy Sahelian soils: their implications on sustainable millet production by Bationo, A., A. Mamu, MC Klaij, and AU Mokwunye.**

- **Recent achievement in the agronomic evaluation of phosphorus fertiliser sources and management in the West African semi-arid tropics by Bationo A., MP Sedogo, A. Buerkert, and E. Ayuk.**

- **A critical review on crop residue use as soil amendment in the West Africa semi-arid tropics by Bationo, A. A. Buerkert, Sedogo MP, Christianson BC and AU Mokwunye.**

- **Recent achievement on soil fertility management in the West African semi-arid tropics.**

The papers were submitted for review by the Editorial Committee.

Influence of organic amendments on the availability of native soil phosphorus (Collaborative Program with the University of Hohenheim). During October an experiment was carried out at Sadoré greenhouse I-A on *"Influence of Organic Amendments on the Availability of Native Soil Phosphorus"*. At 7 days after sowing (DAS) (1st Oct) Pearl millet in the pots of block 1 was thinned to 5 plants per pot. 20 DAS millet was thinned to 3 plants per pot. Harvest was at 42 DAS. Potassium, calcium and sulfur were added at 8 DAS, nitrogen was split applied at 8 DAS and 20 DAS. Weekly plant heights and number of leaves were noted. Shoot dry matter production at thinning and harvest were determined. Plant samples were analyzed for total P-uptake. Analyses of root and soil samples taken at harvest are continued.

ILCA

Livestock nutrition

Improving the feeding value of crop residues. Results from the collaborative study with ICRISAT on the effects of the brown mid-rib (bmr) and trichomeless (tr) traits on the quality of millet stover were analyzed during this quarter. At grain harvest, stover leaves and stems from 120 progenies of either bmr or normal millet and 20 progenies of either tr or normal millets were collected and sequentially analysed for ashless NDF, ADF and lignin, and for organic matter (OM) and *in sacco* OM disappearance.

Leaf from bmr millet had less lignin (31 versus 44 g/kg DM, standard error of the mean, sem=2.0) and was more digestible than normal millet. Digestible OM (g/kg DM, i.e. D value) was 602 for bmr and 572 for normal millet (sem=3.8). Similarly, millet bearing the bmr trait produced stems with less lignin (62 versus 87 g/kg DM, sem=5.5) and a higher D value (479 versus 419 g/kg, sem=4.9) than their normal counterparts. Although leaf yield (g DM/plant) was not different between genotypes (88.8 g for bmr and 85.2 g for normal millet, sem=3.9), bmr millet produced less stem than normal millet (85.6 versus 102.1 g DM/plant, sem=4.4).

Pearl millet plants bearing the tr trait tended (P=0.09) to produce more leaf (123.0 versus 95.3 g DM/plant, sem=12.2) and stem (191.7 versus 152.4 g DM/plant, sem=16.4) than their normal counterparts. No differences were observed in fibre constituents of leaves from both millet types, but tr millet leaves had a higher concentration of OM (918 versus 902, sem=3.8, P<0.01) possibly owing to the chemical nature of the trichomes, and a higher D value (670 versus 645 g/kg, sem=6.1, P<0.01) than normal millet leaves. Stems from tr millet had less (P<0.01) NDF (667 versus 726 g/kg DM, sem=17.6), ADF (463, versus 537 g/kg DM, sem=19.8) and lignin (87 versus 103 g/kg, sem=5.4) and a higher D value (521 versus 441 g/kg, sem=9.1) than stems from normal millet.

These results confirm that the effects of the bmr trait on lignin and digestibility of residues from millet grown for grain production and harvested at advanced stages of maturity are similar to those found in forage millet. An increased residue quality of bmr genotypes could be obtained at expenses of a decreased stem yield. They also suggest that the tr trait might improve the feed quality of millet stover without compromising stover yield. Further evaluations of these genotypes are under way.

Results from the collaborative experiments with ITA and ICRISAT on the differences in feed quality of hay from cowpea varieties grown as sole crop (20 entries) or inter-cropped with millet (16 entries) were also analysed. At grain harvest, the residual forage (four replicates per variety in both experiments) was cut at 2 cm above soil surface and separated into plant parts (stem, leaf). Each plant part was analysed for OM, crude protein (CP) and in sacco OM disappearance. Varieties grown as sole crops differed ($P<0.01$) in leaf yield (range = 134 to 1115, sem = 145 kg DM/ha), stem yield (range = 157 to 1131, sem = 177 kg DM/ha) and litter leaf as proportion of leaf produced (range = 0.221 to 0.772, sem = 0.09). No differences were observed in D value (mean = 720 g /kg, $P>0.48$) nor in crude protein (mean = 197 g/kg DM, $P>0.16$) of leaf. However, high variation among varieties was observed in D value (range = 459 to 611, sem = 20 g/kg) and crude protein concentration of stems (range = 106 to 190, sem = 6.6 g/kg DM). Similar trends were observed in the study with varieties grown intercropped with millet, but in this experiment differences among entries were also observed for crude protein of leaf. These results suggest that there are possibilities for selecting cowpea varieties for feed quality and yield of hay.

Identifying and overcoming nutritional constraints. The study on nutritional constraints to increased output of grazing ruminants continued through this quarter.

Optimizing the utilization of natural feed resources. The 1993 grazing period of the study to determine the effects of stocking rate and goats:sheep ratio (0:6, 2:4, 4:2 and 6:0) on small ruminants live weight gain during the dry and wet-early dry seasons was completed in November. This year's phase included 55 and 154 days of grazing during the dry and wet-early dry seasons, respectively. Individual average daily gain (ADG's), were calculated for goats (ADGG) and sheep (ADGS) by regressing W over time. Individual mean weights (initial W + (0.5 x grazing days x ADG)) were used to calculate the actual stocking rates in TLU (250 kg W)/ha for each pasture. Total (sheep + goats) stocking rates Tropical Livestock Unit per hectare (TLUTHA) during both seasons varied between 0.20 and 0.45 TLU/ha.

Across treatments, mean ADG's (± standard errors) during the late-dry season were -22 ± 3.3 g/d for goats and -39 ± 4.1 g/d for sheep, whereas in the wet season growth rates were 43 ± 3.1 g/d for goats and 54 ± 3.5 g/d for sheep. As TLUTHA increased by 0.1, weight loss of both species in the dry season increased by 11.7 (± 3.5 for goats, ± 4.6 for sheep) g/d. However, in the wet and early-dry seasons the effect of stocking rate on ADG was less pronounced in goats than in sheep. As TLUTHA increased by 0.1, ADGG and ADGS decreased by 5.4 ± 3.1 g/d ($P=0.11$) and 10.3 ± 3.9 g/d ($P<0.01$), respectively.

In both seasons the performance of goats was unaffected by the relative proportion of species in the flock. However, sheep lost more weight during the dry season and grew slower in the wet season as their proportion in the livestock mass increased. As in 1992, the predicted maximum output per unit area during the wet season of 1993 would be obtained when goats constitute 61 % of the livestock mass, whereas the predicted maximum output for the whole 1993 study period would be obtained when goats constitute 68 % of the livestock mass. These results support the hypothesis that the productivity of livestock per unit of land is affected not only by the grazing intensity but also by the relative proportion of species in the herd. This offers opportunities for increasing herd productivity, while improving the use and conservation of natural feed resources.

Feeding and working strategies for draught oxen. An experiment designed to investigate the effect of work in hot conditions on intake of roughage was completed in September. Eighteen oxen (9 pairs) were alloted according to their initial live weight to 3 groups of average body weight of 247, 277 and 391 kg, respectively. The experiment lasted 9 weeks divided into three 3-week periods. One team in each group was subjected to one of the three treatments: 0, 2 and 4h of work/day. Treatments were applied in sequence to teams during the experimental periods. Each team worked 3 days a week. Teams on work schedule for 4h/day worked 2h in the morning and 2h hours in the afternoon. Work consisted of pulling sledges along flat circuits or performing farm tasks (cultivation, weeding) in ISC fields.

Number of hours worked per day did not significantly affect daily intake of millet stover. However, the effect of week in experimental periods was highly significant($P<0.01$) and the interaction between experimental weeks and treatment was significant as well ($P<0.06$). Oxen at rest consumed daily 65.2, 63.7 and 65.2 g DM/kg$W^{.75}$ during the first, second and third week, respectively. Corresponding values were 66.2, 65.2, 67.6 g DM/kg$W^{.75}$ for oxen working 2h/day, and 62.0, 63.8, and 66.4 for oxen working 4h/day. Intake values for animals working 2 and 4h/day include feed consumption of non-working and working days. High intensities of work (4h of work/day) depressed intake during the first days of work. However, oxen under this work intensity were able to increase their intake the following weeks such that they could consume as much as oxen at rest or working lightly.

Number of hours worked per day had a significant effect on body weight change ($P < 0.05$). Daily weight gains were 542(±124), 338(±136) and -14(±136) g/day for oxen working 0, 2, 4 h/day, respectively. Eventhough oxen working 4h/day could gradually improve their food intake, this was not sufficient to allow maintenance of body weight.

Rectal temperatures increased gradually during work. Such increases were more important during the second hour of work and were also greater when animals worked in the afternoon, when ambient temperatures were highest. The maximum 'cumulative change in rectal temperature' (CCRT) during the first hour of work was 1.36 and 1.71 °C for the morning and the afternoon working sessions, respectively with a coefficient of variation of 35.4%. During the afternoon sessions the highest CCRTs were 1.88 and 2.28 °C during the first and second hour of work, respectively with a coefficient of variation of 36%. Power developed by working teams followed a similar pattern. The average power developed was 597 and 490 watts during the first and the second hour of work respectively. Power generated in the morning (640 watts) was also higher than that developed during the afternoon (456 watts). These results suggest that oxen respond to heat gains from work and solar radiation by increasing their core body temperature until an upper limit is reached and heat stress sets in. They adapt to this situation by reducing their rates of work to dissipate excess heat load.

A second experiment was initiated in November to investigate the effect of work on intake, digestion and rate of passage of feed in draught oxen. Twelve oxen are assigned to 3 treatment groups consisting of 3 different levels of work: 0h, 2.5h and 5h of work/day. The experiment is scheduled to last 10 weeks divided into 2-week periods. Oxen are allowed to rest for two weeks after each of the three 2-week experimental periods. Treatments are applied to oxen in sequence during experimental periods so that during each period 4 oxen stay idle, 4 oxen work 2.5h/day and 4 oxen work 5h/day. Work consists of pulling a sledge loaded with weights so that the draught force is equivalent to 10% of the team liveweight.

Measurements include work output, quantity of feed offered and refused, total faecal output, weekly body weight and body condition. Faecal samples are taken, during 7-day collection periods, for the determination of digestibility coefficients and for the determination of the concentrations of solid and liquid phases markers (chromium and Cobalt-EDTA). Blood samples are collected weekly in order to determine plasma urea nitrogen and thyroid hormones concentrations. Oxen feeding behavior is monitored using the scan observation technique.

Nutrient Cycling

Manure management for cropping. Data from the fourth year of a six-year field trial at the ICRISAT Sahelian Centre were analyzed. Treatments include combinations of two types of manure (cattle and sheep), three levels of manuring (corralling for 1, 2, or 3 nights), two levels of urine (with and without), and three manuring intervals (every 1, 2 or 3 years).

Treatments were assigned factorially to subplots of 4m x 4m arranged in a randomized complete block design (RCBD) and replicated 4 times. Controls (no manure) were included in each replication. Animals grazed 10 hours daily. Six cattle and 16 sheep were kept in portable corrals for the designated number of nights and manure was collected daily in bags harnessed to the animals, weighed and analysed for dry matter (DM), N, P, and ash. Manure from similarly herded animals was gathered for application to the "no urine" plots. Grain, stover, and weeds were harvested from the innermost 3.2m x 3.2m of each plot and analysed for DM, N, and P.

Total millet above-ground DM (t/ha) in plots where cattle were corralled (manure plus urine) for 1 night (4.94 sem = 1.18), 2 nights (6.52 sem = 1.02), and 3 nights (8.01 sem = 1.25) during each of the past 4 dry seasons was, on average, 137, 120, and 109% higher than in plots where only manure was hand-spread. The positive effects of urine on millet production was also evident in the residual plots, or where cattle were corralled 2 dry seasons earlier. Millet yield in plots where cattle were corralled two years ago for 1 night (2.48 sem = 1.01) and for 2 nights (4.19 sem = 1.41) was 22 and 37% greater than where only manure was hand-spread. Yield in plots where cattle were corralled for 3 nights the previous year (3.21 sem = 0.887) was 11% lower than where only manure was handspread. The effect of corralling sheep on cropland was not as great as that observed for cattle. Millet yield in plots where sheep were corralled for 1 night (2.42 sem = 0.344), 2 nights (4.94 sem = 0.443), and 3 nights (6.37 sem = 1.30) during each of the past 4 dry seasons was 0, 36 and 10% greater than in plots where only sheep manure was hand-spread. There was residual positive effects of sheep urine on millet yield. Millet yield in plots where sheep were corralled two years ago for 1 night (2.82 sem = 0.435), 2 nights (3.89 sem = 0.693) and 3 nights (5.03 sem = 0.980) were 209, 122 and 75% greater than where only manure was handspread. During this fourth study year, animals were corralled or manure was hand-spread on plots that had been cropped but had not received any amendments during the past 3 years. Millet yield in these plots where cattle were corralled for 1 (4.20 sem = 1.430), 2 (6.09 sem = 0.329) and 3 nights (5.63 sem = 0.973) and where sheep were corralled for 1 (2.29 sem = 0.505), 2 (3.26 sem = 0.511) and 3 nights (4.19 sem = 1.252) were similar to yields obtained in the continuously manured plots. These results indicate that soil productivity may be maintained by manuring every third year. The harvest index (17 SD 5%), and the percentage of leaf in the stover (27 SD 6%) were variable and appeared to be unaffected by animal type, and manure and urine treatments.

Mineralization of nitrogen from soil amended with leaves and manures. An experiment was completed under laboratory conditions using plastic syringes (60 ml) containing sandy soil mixed with sheep manure or leaves at the rate of 120 kg/ha of organic N. A control with no amendment was included. The manure had been collected from sheep fed leaves of *Pennisetum glaucum*, *Acacia trachycarpa*, *Combretum glutinosum*, *Guiera senegalensis*, *Pterocarpus erinaceus*, and *Vigna unguiculata*. The soil was incubated in the laboratory with ambient temperature maintained at 30 °C and soil moisture at 75% of field capacity for 48 weeks. The soil mixture was leached with $CaCl_2$ solution for mineral N analysis at 2, 4, 6 weeks after incubation, and thereafter, every 4 weeks during the study period. The soil microbial C and N contents 36 weeks after incubation were also determined by the chloroform-fumigation method.

The cumulative mineral N recovered from amended soil was relatively low, ranging from 8.6 to 14.6 ppm. There was no difference between leaves and manure treatments in the cumulative N mineralized. After 48 weeks of incubation, the total N concentration in soil varied from 0.45 to 1.27%. The microbial-N content (0.75 to 2.80 ppm) in soil incubated with manure was about twice greater than soil incubated with corresponding leaves. Soil incubated with leaves had a higher total C content than soil incubated with manure. The lowest total C value for soil amended with leaves was 5.0 ppm, whereas the highest value for soil amended with manures was only 4.1 ppm, reflecting faster manure decomposition. Soil incubated with leaves had the lowest (12.7 ppm) and soil incubated with manure the highest (31.4 ppm) microbial-C content. On average, the microbial-C content of manured soil (28.5 ppm) increased 28% relative to those in soil with leaves amendment.

Soil and crop response to millet stover plant parts. A four year field trial to determine crop and soil response to application of millet stover parts was completed. Treatments included 5 millet stover return types (1) total removal (as in cut-and-carry feeding system), (2) total return (no feed removal), (3) stalks only (simulated grazing without manure return), (4) upper one-third (stover parts for feeding), and (5) lower two-thirds (parts for soil conservation) assigned to main plots, and 4 fertilizer N levels (0, 15, 30, and 60 kg/ha) assigned to subplots in a split plot design replicated 8 times.

Results were highly variable and showed no significant ($P>0.01$) interactions between stover part and fertilizer N, no effect of stover part, and significant effects of fertilizer N on total millet above-ground DM yield. Average (across fertilizer N levels) total DM (t/ha) in plots that received either no stover or stalks only (1.85 sem = 0.170) was only slightly lower than plots where all stover (2.23 sem = 1.21), lower stover (2.17 sem = 0.213) or upper stover (2.03 sem = 0.170) had been returned over the past four years. Average (across stover part) total DM (t/ha) was increased from 1.64 (sem=0.154) in the 0 fertilizer N plots to 1.86 (sem = 0.129), 2.05 (sem=0.152), and 2.55 (sem=0.200) in the 15, 30, and 60 kg N/ha plots. These preliminary results indicate that fertilizer N may be able to sustain yields in stover management systems where all stover is removed or only stalks are returned to soil. However, the high yield variability perhaps impeded the detection of various stover management effects on nutrient cycling and crop yield.

Ecology of Sahelian rangelands. The effects of seasonal grazing on the fallow-land vegetation structure and production were studied for four combinations of sheep-goat mixes and two stocking rates, compared to ungrazed control, in a factorial design with two replicates. Grazing treatements were initiated in July 1992 and will be applied over three seasons. Herbaceous and woody plants structure and biomass were described and are monitored since the onset of the experiment. The analysis of September 1993 data gives first indications on the magnitude and direction of the effects.

At the on-set of the experiment, the vegetation of each paddock was characterised: average and standard errors were 554 $\pm$ 344 ha^{-1} for density, 30.9 $\pm$ 16% for crown cover and 934 $\pm$ 567kg DM ha^{-1} for leaf biomass of the woody plants. The biomass of the herbaceous layer in september 1992 ranged from 211 $\pm$ 15 to 78 $\pm$ 5 kg DM ha^{-1}, species composition was also determined. The impact of a year treatment on vegetation structure and production was assessed at the end of the 1993 growing season. The effect of browsing on *Guiera senegalensis* foliage was a function of goat stocking rate but was also inversely related to the density of *Andropogon gayanus*, one of the two perennial grasses present in the rangeland. Some browsing was observed with sheep at the highest stocking rate and low density of *A. gayanus*. *A. gayanus* was heavily grazed by goats and less heavily by sheep, while *Aristida sieberiana* was avoided by both species. Grazing reduced *A. gayanus* biomass by 90% but did not affect its density, while *A. sieberiana* density was promoted by heavy grazing. At the end of the growing season, the annual herb biomass were significantly lowered by grazing depending on stocking rate but not on the herd composition. Some floristic changes occurred in relation to grazing. For instance, *Mitracarpus scaber* and *Sida cordifolia* developed due to heavy grazing. However, the impact of grazing on the dominant species *Cienium elegans* and *Cassia mimosoides* is not yet clearly established. Some of the changes observed following one year of grazing or protection could be reversed at longer term as suggested by the vegetation composition of two neighboring sites which were either protected or heavily grazed for a decade.

In preparation for a study on the influence of land use and stocking density on natural vegetation, potential study sites (villages) were visited and selected on the basis of arable and cultivated fraction of village lands. The vegetation of these villages is presently being mapped.

Economics of livestock production in mixed farming systems

Farm surveys. Reconnaissance surveys were conducted in several villages in western Niger with the aim of identifying villages that appear to mirror the evolving trends in land use patterns and livestock management in the relatively better endowed parts of the Sahel. The selected villages will be the sites for ILCA's on-farm work for the next few years. In 1994, a coordinated set of surveys and on-farm trials will be conducted in the selected villages to study the effects of livestock and natural resource management practices on nutrient transfer efficiency, the influence of changes in socio- economic, cultural and livestock management practices on the use of own, open and common access resources; farmers' perceptions of resource degradation, its causes and measures taken to deal with it if, indeed, it is occurring.

Modelling economic outcomes of mixed farms. A previously constructed whole-farm linear programming (LP) model of crop-livestock activities was modified and used to evaluate the effects of farmers' risk aversion on enterprise combination and farm income. The main modification included a reformulation of the LP model in a MOTAD (Minimization of Total Absolute Deviation) format. This latter formulation allows for the explicit incorpora- tion of income risk and provides an indication of the trade-offs between mean income and risk.

The MOTAD model solutions indicated that compared to a situation where only crops are grown, integration of crop and livestock production, even under high risk-aversion, results in a higher total farm income. Total expected farm income on a representative 10-ha farm increased by 12% from FCFA 171,000 when only crops (millet and cowpea) are cultivated to FCFA 192,000 when crop and livestock (cattle, sheep and goat) production activities are integrated. At this relatively high level of risk aversion, small ruminant breeding and production activities feature much more prominently than cattle production activities. As risk aversion is gradually reduced, a corresponding increase in cattle production activities occurs. The model solutions also indicate that for a given level of risk aversion, increasing farmers' liquidity position will encourage them to undertake production activities which will eventually raise farm income. For example, when the cash constraint was varied but the risk aversion level was maintained constant, total farm income increased by 39% as a result of increased crop and cattle sale activities. These results suggest that measures to improve the liquidity position of resource poor farmers may improve their risk-bearing ability and also encourage them to invest in a more diversified portfolio of crop and livestock production activities.

Human ecology

Socioeconomic and ecological factors causing shifts in livestock species composition in western Niger. Interviews to collect post-1987 histories of livestock ownership, transactions, and demography have been continued (approx. 200 in total). Data entry and analysis will begin in January, 1994.

Herd management strategies and their effect on nutrient transfers in western Niger. Potential village sites were selected on the basis of arable and cultivated fraction of village lands. The village chiefs of eleven potential village sites have been interviewed as to village population, local land use, livestock population, manure management, herd management, crop residue management, pasture resources, and relations with transhumance herders. A summary of each of these interviews has been provided to each member of collaborative research team. In the process, a study area which would provide suitable landuse and population contrasts and sufficient remote sensing data has been identified (containing six of eleven surveyed villages). Final site selection will be completed by 2/1994.

TRAVEL

1-13 Nov	SVR Shetty travelled to USA and participated in the American Society of Agronomy meetings.
13-20 Nov	A. Bationo travelled to Dakar, Senegal to attend a workshop organised by the Scientific Committee on problems of the Environment (SCOPE) on sustainable land management for the semi-arid and sub-humid regions.
18-27 Nov	Jojo-Baidu Forson travelled to Ouagadougou, Burkina Faso
19-26 Nov	MVK Sivakumar travelled to Hyderabad
27 Nov-3 Dec	MVK Sivakumar travelled to FAO, Rome
28 Nov-10 Dec	A. Bationo travelled to Ouagadougou, Burkina Faso for a meeting with IDRC on integrated soil fertility management and to attend on International workshop on sustainable land and environment management in tropical Africa, organized by West and Central Africa Soil Science Associations (WCASS). A. Bationo was also member of the Scientific Committee of this workshop.
6-10 Dec	MVK Sivakumar travelled to Hyderabad
7-10 Dec	Jojo-Baidu Forson travelled to Kano, Nigeria
16-22 Dec	A. Bationo travelled to Lome, Togo to attend an evaluation of a training course on agronomic data for which he was a resource person.


WEST AFRICAN SORGHUM
IMPROVEMENT PROGRAMS

ADMINISTRATION

Staff

Three new employees assumed duties during this quarter:

- Rolands A. Adebayo, Technical Assistant (Breeding), 4 Oct 1993.
- Emmanuel E. Makeri, Research Associate (Agronomy), 7 Oct 1993.
- Titus O. Adewusi, Confidential Secretary (Admin), 1 Nov 1993.

Four employees resigned their appointments:

- Gimba S. Pawa, Driver/General Assistant (Admin), 29 Oct 1993.
- Simeon Y. Igbadi, Typist (Admin), 25 Oct 1993.
- Musibau A. Adebayo, Technical Assistant (Agronomy), 26 Nov 1993.
- Feyi A. Fatodu, Research Assistant (Agronomy), 26 Nov, 1993.
- One employee had his appointment terminated: Umaru Gande, Messenger/Cleaner (Admin), 18 Nov 1993.

Communication

E-Mail facility was installed in December 1993. It is now possible to contact us through the CGNET system.

Internal Audit

The internal auditors from IC visited Kano from 12 to 17 Oct 1993, during which they performed the routine internal audit for 1993.

Computers

The following ISC computer and PPS staff visited from 5-12 Dec 1993:

- Issa Laouali installed the E-Mail system and trained staff in its use as well as assisting Fiscal with their computing needs.

- Augustine Egwu gave courses on EPI-Info and Genstat V to Research staff and scientists. He trained staff to use EPI-Info for data entry and GENSTAT for data analysis.

- Maazou serviced and repaired computers, printers and various other accessories. He also worked with Mr. Laouali in the installation of E-Mail.

Their assistance was very much needed and appreciated. This type of back up from ISC should be maintained and strengthened.

FARM DEVELOPMENT AND OPERATIONS

Materials (transformer, poles, cables etc.) needed for the installation of electricity at Bagauda were purchased with the assistance of Kano State Rural Electricity Board (KREB) who were also awarded the contract of installing electricity.

- All the bulk sorghum and maize plots were harvested and threshed. Cowpea cover crops, sorghum and maize stalks were chopped and harrowed into the soil. Slashing and cutting of grasses along the fence were done.

- We finally collected 100 bags of NPK (15:15:15) (instead of 200 bags originally ordered from KASCO) for which we paid for one year ago, but KASCO had been unable to supply due to various problems.

- We purchased locally all the capital equipment (Troly Jack, air blower, hand drilling machine and workshop crane) approved for 1993. Routine maintenance of all equipment was carried out.

RESEARCH

Agronomy

Field trials. All the trials, including the cultivar/fertility density/interaction, physiology of heterosis in sorghum, adaptation of early-maturity pigeonpea cultivars to different planting dates, characterization of sorghum test locations environments, sorghum/millet/cowpea, sorghum/groundnut and sorghum/soybean intercrops were harvested. Threshing, weighing and other observations were completed. Yield and yield parameters growth analysis, light interception and water use data are being compiled and analyzed.

A total rainfall of 761.0 mm (9% below the long term average) was recorded on the farm during the year and 685.6 mm (6% above the long-term average) during the growing season (Jun to Oct). The improved sorghum varieties and hybrids performed satisfactorily. Some plants lodged in poor soil patches while the late-maturing sorghum and pigeonpea cultivars were adversely affected by terminal drought. None of the 20 medium to late maturing pigeonpea lines sent from EARCAL/ICRISAT for evaluation for adaptation in Nigeria produced any grain due to terminal water stress. They were planted late due to the late arrival and clearance of seeds from the Plant Quarantine Services, Ibadan. The early maturing pigeonpea varieties produced very little and had shrivelled seeds as a result of insect damage and flower abortion. The performance of soybean was satisfactory whereas cowpea was poor probably because of end of season drought and insect damage.

Diagnostic surveys of sorghum based farming systems. The two staff posted at WASIP Nigeria by Dr. Jojo Baidu-Forson, ISC Economics subprogram continued with the administration of questionnaires on influences of household preferences on crop choice decisions in Bichi and Bebeji local government areas in Kano State. New questionnaires for groundnut surveys were also tested in farmers' fields with Baidu-Forson who visited in early December.

Sorghum Breeding

Yield trials. Seventeen yield trials were harvested during the second half of October and third week of November. Highly satisfactory results were obtained in spite of significant terminal drought that affected the trials. In the Nationally Coordinated Sorghum Research Project (NCSRP) Variety Trial, ICSV 400 yielded the highest (5.01 t/ha) while in the NCSRP Hybrid Trial, ICSH 89002 NG ranked first (5.8 t/ha). One regional hybrid trial and one advanced

hybrid trial were conducted under high fertility (91 N:45 P:45 K) as well as low fertility (15 N:15 P:15 K) conditions. Mean yield of these two trials were 5.22 and 4.91 t/ha under high fertility and 3.22 and 2.59 t/ha under low fertility. ICSH 89002 NO and ICSH 89009 NO performed well in both high and low fertility. The variety control ICSV 111 yielded 4.2 t/ha under high fertility and 3.1 t/ha under low fertility. Among the new hybrids, ICSA 902 crosses were the most impressive and need further multilocational evaluation. Mean yield of the advanced variety trial conducted under low fertility was 2.31 t/ha and ICSV 400 gave the highest yield (3.15 t/ha). The newly bred early maturing variety ICSV 902 NO was promising under high fertility as well as low fertility. In the West African Sorghum Variety Adaptation Trial (WASVAT)- Early, ICSV 901 and ICSV 902 obtained high ranks. In the WASVAT- Medium maturity trial, ICSV 904 and ICSV 905 gave satisfactory performance. Two hybrid trials conducted in cooperation with seed companies (PIONEER and PANAR) showed that ICRISAT hybrids are superior and are more adapted and suitable to WA farmer conditions.

. Among the introduced female parents, 16 lines originating from Texas A & M and 2 lines from Nebraska were retained for further intensive evaluation. Thirty germplasm accessions were selected from among 120 lines under visual evaluation for the second successive year. Forty-two midge resistant selections introduced from IC were visually evaluated and 14 were retained for further study. In the head bug nursery comprising sixty F_3 selections including checks, 23 selections were made in cooperation with entomologists. Six F_2 populations involving local FaraFara Variety were screened visually under low fertility conditions and 18 individual plants with bold grain and good agronomic plant type were selected. ICSV 400 and ICSV 247 exhibited the best levels of resistance in the International Sorghum Anthracnose Virulence Nursery.

Striga hermonthica. Resistance to *S. hermonthica* was evaluated in the recently initiated *Striga* sick plot using 25 sorghum cultivars in a triple lattice design experiment. A six row (4m x 0.75) plot was used and the central 4 rows were inoculated with *Striga* seeds at the same time as sorghum was sown. Six thousand *Striga* seeds (from the 92 collection) were mixed with 10 ml of water and ejected with a syringe into each hill followed by planting the sorghum seed. *Striga* plants that emerged 80 days after sowing were counted. On the average, the susceptible check CK60 harbored 167 *Striga* plants per plot. However, the resistant controls such as SRN-39 and Framida showed 10.7 and 5.4 *Striga* plants only per plot. Other cultivars such as ICSV 1156, ICSV 902, ICSV 901, white mutant and ICSV 1007 exhibited 4, 4.4, 7.8, 8.3 and 20.8 *Striga* per plot. Half of the *Striga* sick plot was infested with *Striga* seed + sand mixture by placing it in the planting hole with a spoon followed by the seed of the susceptible cultivar, CK60. The *Striga* seed was from the 1992 collection, but the sand + seed mixture was kept moist for >10 days before sowing. Results of *Striga* emergence in this plot were better than the water + *Striga* inoculated experiment although strict comparisons cannot be made.

Entomology

All the nine trials conducted in 1993 were harvested and data analysis was partially completed. As in previous years, date of sowing sorghum has a significant effect on infestation by *Eurystylus*. Also, a number of insecticides, especially carbofuran, effectively controlled the spittle bug, *Locris rubens*, on sorghum. The first survey of *Eurystylus* on farmers' fields in Nigeria was conducted in October and November. *Eurystylus* occurred on local cultivars in most of the farms visited and is therefore not a problem restricted to research stations or improved cultivars. There were, however, varietal differences in the levels of infestation by the head bug.

A paper on physiology and stem borer infestation of post-rainy season sorghum (Masakwa) was presented in November at the ASA meeting held in Cincinnati, U.S.A.

TRAVEL

3 - 8 Oct	O. Ajayi participated in the International Consultative Workshop on Panicle Insect Pests of Sorghum and Pearl Millet in Niamey where he and joint authors presented four papers on *Eurystylus*.
17-20 Oct	O. Ajayi and R. Tabo visited University of Nigeria, Nsukka (UNN) and Abuja.
18 Oct	DSM visited NCSRP Trials, Samaru
20 - 24 Nov	O. Ajayi participated in the SAFGRAD Regional Symposium on Industrial Utilization of sorghum and other cereals where a joint paper on the industrial use of sorghum in Nigeria was presented.

ADMINISTRATION

Administrative staff provided logistical support for the Field Day held 11-12 October, as well as the *Striga* Workshop on 13-14 December. Action was completed on all approved capital allocations. Of the three capital construction items, the medical clinic has been fully completed while the irrigation installation and Farm Manager's Residence at Samanko are in progress. Both the medical clinic and the Farm Manager's Residence were undertaken departmentally in order to keep the cost down.

Important year-end activities included completion of physical verification exercises of fixed assets and supplies jointly undertaken by PSD and Finance staff as required by our regulations, as well as the performance appraisals for locally recruited staff. Actions pertaining to closing of accounts for 1993 are well under way. To help IC-Finance keep their deadlines, a fully self-contained financial report for the period 26 Nov to 15 Dec, with all related documents, was sent to on 22 Dec. The financial report for the second half of December should be sent to IC on 7 Jan 1994.

FARM OPERATIONS

End of season ploughing of cowpea covered plots was completed and land was prepared for off-season planting. Laying of irrigation pipes and hydrant for irrigation installation project was completed, delivery and installation of electric pump is awaited.

RESEARCH ACTIVITIES

Agro-economics

Working visits were paid to our VLS sites in the ODIMO and CMDT zones in October, November and December. We worked with the technicians and reviewed the questionnaires during each visit. Database files have been created and data entry of the field data has started. Data analysis and report writing would be undertaken in January and February.

In November we analyzed data collected in July on farmers' willingness to pay for 2,4-D herbicide for *Striga hermonthica* control using the Contingent Valuation methodology. The results are contained in a programme progress report that has been circulated for comments.

In October, SKD and DS (Research Asst) met with scientists at the DRSPR (farming systems programme) in Sikasso and reviewed work plan on a collaborative research on farmers' indigenous knowledge of pests and diseases with particular emphasis on *Striga* control.

We had discussions with scientists and development agents in Burkina Faso and the Cinzana research station in Mali and agreed to follow-up on farmer efforts to multiply and distribute seeds of ICRISAT sorghum and millet varieties in the Bobo Dioulasso region.

Sorghum Breeding

Mr. M. Touré, research technician joined the program on 9 Dec 1993.

The harvest of trial materials started on 19 Oct for early genotypes and 25 Nov for late genotypes. Threshing was completed and results are being analysed. Off-season material was sown at Samanko on 12 and 24 Dec. This included material for generation advancement and to produce seeds for trial entries. A set of photoperiodic local genotypes was also sown for characterisation study.

Striga hermonthica

Harvest of all 1993 rainy season trials is over. The trial data are being analysed. A very sensitive CK 60B *Striga hermonthica* variety has been planted in an off-season plot for seeds multiplication.

Sorghum Pathology

Grain mold. Results of grain mold multilocation trial in Samanko, Longorola and Cinzana, indicated that 5,3, and 12 varieties,respectively had rating ≤ 2, and were considered resistant.

Leaf anthracnose (*Colletotrichum graminicola*)

Effect on grain weight. Based on the mean grain weight of 15 tagged plants assessed for disease severity at Samanko, results indicated that loss in grain weight was as much as 61 and 89% for the highly susceptible varieties IS-18696 and ICSV-700, respectively. Loss in grain weight for variety CSM-408 was 12%.

Source of resistance. One hundred breeders lines and varieties were screened at Samanko using the "Composite" spreader row technique; 33 of the 100 entries had mean disease severity scores ≤ 3.0 on a 1-9 scale and were considered resistant.

Sooty stripe (*Ramulispora sorghi*)

Artificial inoculation technique. In 1993 the efficacy of using conidia formed *in vivo* for artificial inoculation was further confirmed at Samanko.

Sources of resistance. The same 100 entries screened for leaf anthracnose at Samanko and Longorola were screened against sooty stripe at Cinzana using the spreader row technique. Six of the 100 entries had mean disease severity score ≤ 3.0, and were thus considered resistant.

Off-season activities. Some varieties are being multiplied for use in 1994 trials.

Entomology

Technical activities

All Entomology trials were harvested at Samanko and Cinzana, and analysis of data is underway. Several times during the period, AR and BC visited Entomology trials at Cinzana and made observations on Agronomy on-farm tests at Nogolasso and Konobougou. AR also visited stem borer trapping experiment conducted at Farako-Bâ, in cooperation with INERA. Off-season seed multiplication plots were planted on 2 Dec.

Agronomy

This quarter was mainly spent on harvesting, weighing, and collecting grain and stem samples for analysis. Data entry, analysis and interpretation began in early December.

Samanko. Harvesting, weighing and collection of plant samples on all three sites where sorghum and legumes were grown in association were undertaken. On the long term trial on "soil evolution" soil samples were collected on each elementary plot within strata 0-20 cm and 20-40 cm depth and were sent to Montpellier for analysis. The experimental plot was ploughed to a depth of 20 cm in preparation for the next season.

Longorola. Harvesting and weighing of the sorghum-legume associated trials was completed.

Nogolasso. (Sikasso Region): Harvesting and weighing of all trials and tests was completed. We continued to collect soil samples to follow-up on pH evaluation. Soil was collected near the trial plots for analysis, and we dug four pits to observe pedological profiles. Data analysis is going on, and the interpretation of the "Dosepn" trial is completed.

Fana. Harvesting and weighing of five trials were undertaken with CMDT local authorities. For 1994, a research project aimed at improving the efficacity of fertilizer utilization through soil erosion control on the farmers' field will be undertaken with CMDT. During the quarter, contacts were made at Fana in preparation for the project.

TRAVEL

28 Sept - 8 Oct	A. Ratnadass to ISC to attend Entomology Workshop
03-06 Oct	G. Hoffman to Sikasso region
04 - 05 Oct	B. Cissé visited trials at Cinzana and Konobougou
15 Oct	G. Hoffman made a working visit to Mafeya, Koulikoro
16-19 Oct	J. Chantereau and Ag Hamada to Burkina Faso to attend a meeting held by ECC team on Sorghum Grain Quality Project.
21 Oct	G. Hoffman made a working visit to Kolokani
24 - 27 Oct	A. Ratnadass visited trials at Konobougou, Cinzana, Nogolasso and Farako-Bâ
25-28 Oct	K. Traore visited on-farm trials at Nogolasso, and Longorola trials. G. Hoffmann visited Sikasso region
27-29 Oct	J. Chantereau visited Longorola trials
27-30 Oct	S. K. Debrah and D. Sanogo studied villages of Foh and Sona.
02-15 Nov	K. Traore visited on-farm trials at Dioila and Konobougou
03 - 06 Nov	B. Cissé visited trials at Cinzana and Nogolasso
14-20 Nov	J. Gigou visited Dakar to attend an International workshop on Gestion Durable des Terres en Zones Tropicales Semi-Arides et Sub Humides de l'Afrique.
16 - 17 Nov	B. Cissé visited trials at Cinzana
20-30 Nov	S. K. Debrah and D. Sanogo to Foh, Sona, Ouagadougou (sorghum utilization workshop) and Farako-Bâ.
23-24 Nov	Kalifa Traore visited Dioila and Konobougou for harvest trials in farmers' fields.
25 Nov	J. Gigou visited Bougouni region with Mr. NEDELEC of CMDT
30 Nov-3 Dec	K. Traore visited trials in farmers' fields in Dioila, Konobougou and Sikasso.
31 Oct-01 Nov	J. Chantereau visited Longorola trials.
15 Dec	S. K. Debrah on leave to Bulawayo, Zimbabwe, and Accra.
26-30 Dec	DS to study villages of Doribougouni, Foh, Sona and Farako-Bâ, Burkina Faso for preliminary survey on some ICRISAT promising sorghum and millet varieties seed multiplication program in the Bobo-Dioulasso region.

TRANSFER OF TECHNOLOGY REPORT

Collaborative Activities

ICRAF / ISC
INRAN / ILCA

Experimental Methods and Data Collection for Agroforestry Technicians
1 - 12 Nov 1993

This course, held in French, had the objective to improve technicians skills in experimental methods and data collection in agroforestry research. This venture was a good collaborative effort of institutes. Between ISC and ILCA, 10 resource persons were provided for the different modules, with course notes being translated to French by ISC. Resource persons were also from the SALWA network. Equipment and material for the course were provided by ICRAF. There were 14 participants from the SALWA regions: ISC (5), INRAN (3); Senegal (2); Mali (2) and Burkina Faso (2). A major accomplishment for this course was the translation of *Data Entry at ISC*, produced in English by the Statistics Unit.

IITA / SPALNA / INRAN
Equipment Maintenance
13-26 Nov 1993

This course was organized with the collaboration of INRAN and most activities were held in its laboratories. ISC provided infrastructure arrangements, such as housing at TVC, logistics, meals, transportation and travel assistance. About 15 participants attended the course . As IITA was extremely pleased with our facilities and support, they have asked to use TVC in November 1994 for the English version of the course.

Seminars

Six seminars were held at ISC with a good attendance from outside institutions. A Seminar Status Report was prepared by SVRS Shetty, Seminar Chairman for 1992-93. It showed that 30 seminars were held for the year, with an average participation of 28 persons per seminar. ISC senior staff averaged 14 per seminar, junior staff 11, and 3 from outside institutes. In 1994, we will began a monthly joint seminar series with INRAN.

Date	Speaker/Prog	Title	Part
21/10/93	R. Stern, CSU J.Williams, GIP	The development of a new system for Agroclimatic Analysis	36
28/10/93	Fian Sadri, UH	Influence of Organic Amendments on the Availability of Natural Soil phosphorus	17
04/11/93	M. Karlheinz, UH	Wind Erosion Control by Windbreaks and Crop Residues	27
11/11/93	R. Stern, CSU	Modern Methods for the Analysis of Experimental Data	33
18/11/93	F. Emhardt, UH	Technical approach to donkey drawn mechanization of field work in Niger	14
25/11/93	Grégoire Ouoba, CSU	Winging through WordPerfect	43

IBC Visitors for October 1993

CAT	PRO	SPON	DATE	LNAME	FNAME	ORGANISATION	NUM
GEN INT	ADM	GAO	11/03/93	TRAORE	OUSSEINI	UNISYS	1
INT SC	ED	CR	11/08/93	SALUMU	SHABAYI	ADB	1
INT SC	ED	CR	11/08/93	NANTHAMBWE	MOSES	ADB	1
INT SC	ED	CR	11/16/93	FEYEN	JAN	IDM	3
MARS	ED	CR	11/08/93	SAOUA	IBRAHIM	DIR. PROTEC. VEGETAUX	1
ADMIN	ED	CR	11/08/93	AMOUD	ISSAKA	MF/P IDDR	1
GEN INT	ED	CR	12/29/93	OSAMU	KISHIMOTO	JALDA	4
NARS	GIP	JHW	10/11/93	MAMADOU	BALDE	ISRA SENEGAL	1
NARS	GIP	JHW	11/29/93	ADAMOU	MOUSTAPHA	DTION RECH. AGRONOM.	1
NARS	GIP	JHW	12/14/93	DAOUDA	HAMANI		1
INT SC	HRD	DYA	12/11/93	FELLOUS	JEAN LOUIS	MEDIAS-FRANCE	30
INT SC	MIP	KAK	10/13/93	LEUSCHNER	K	SADC/ICRISAT	1
INT SC	MIP	KAK	10/13/93	ANDREWS	DAVID	UNIVERSITY OF NEBRASKA	1
INT SC	MIP	KAK	10/18/93	BEEVOR	P	NRI	1
INT SC	MIP	KAK	10/19/93	SCHULTHESS	F	IITA	1
INT SC	MIP	KAK	10/19/93	STEIGMEIER		KANSAS STATE UNIV	1
INT SC	MIP	KAK	10/19/93	ANDREWS	D J	UNIV. OF NEBRASKA	1
INT SC	MIP	KAK	10/22/93	YOHE	JOHN	INTSORMIL	2
INT SC	MIP	KAK	10/22/93	SHEPARD	B	CLEMSON UNIVERSITY	2
INT SC	MIP	KAK	10/25/93	CLARK	LAWRENCE	ROTHAMSTED EXP. STATION	1
INT SC	MIP	KAK	10/25/93	KOYAMA	MIKIKO	NATURAL RESOURCES INST	1
INT SC	MIP	KAK	11/02/93	SHAWE	KEITH	NATURAL RESOURCES INST	1
INT SC	MIP	KAK	10/02/93	ZANGRE	R	INERA B. FASO	1
NARS	MIP	KAK	10/12/93	DIAGOURAGA	M	IER MALI	1
NARS	MIP	KAK	10/12/93	FOFANA	A	ISRA SENEGAL	1
NARS	MIP	KAK	10/12/93	MBENGA	M	DAR GAMBIA	1
NARS	MIP	KAK	10/19/93	TRAORE	K	IER	1
NARS	MIP	OY	10/22/93	MANTHE	CHRISTOPHE	DEP. AGRICULTURAL RES.	4
GEN INT	MIP	WAP	11/24/93	DAVID	LEWIS	PEACE CORPS	43
NARS	RMP	AB	10/11/93	ABDOU	MOUSSA	MIN. DE L'AGRICULTURE	1
INT SC	RMP	MVS	10/12/93	PODAIRE	A	MEDIAS FRANCE	3
INT SC	RMP	SVR	10/12/93	PATTANAYAK	CHANDRA	THE WORLD BANK	1
GEN INT	RMP	JW	12/16/93	OUMAROU	YACOUBA	ONAHA	2
INT SC	RMP	AB	12/21/93	OLUKOSI	JAMES	WAFSRN	2
INT SC	RMP	SVR	10/12/93	MANG	MADICKE	THE WORLD BANK	1
INT SC	RMP	JB	11/16/93	VALENTIN	CHRISTIAN	ORSTOM	1
INT SC	RMP	MVKS	12/02/93	ARTHUR	FELIX	UNIVERSITY OF ALABAMA	1
INT SC	RMP	MCR	12/03/93	ISSIFI	CHRISTIAN	GAP	16
INT SC	RMP	MVKS	12/19/93	HILLARY	MUGA	DRSRS KENYA	1
INT SC	RMP	MVKS	12/28/93	NICOLAS	GANZIN	DRSRS KENYA	1
INT SC	RMP	MVKS	12/30/93	BOUBACAR	SOULEY	MIN. OF AGR.	2
INT SC	RMP	MVKS	12/30/93	MOUTARI	GOGE	UNIV. OF NIAMEY	1
NARS	RMP	AB	10/11/93	SAWADOGO	JULES	FAO	1
NARS	RMP	JCW	10/12/93	NAMODA	BUHARI	APCU-FORESTRY II NIGERIA	7
NARS	RMP	MVKS	11/05/93	JEAN-MARIE	WATTIER	UNIV. OF NIAMEY	1
NARS	RMP	JB	11/08/93	GANDAH	MAHAMADOU	INRAN	1
NARS	RMP	MVKS	11/12/93	ABDOURAH	TAHIROU	FAO	1
NARS	RMP	MVKS	12/02/93	MOCTAR	KARIMOU	INRAN	1
NARS	RMP	MVKS	12/29/93	MARTIN K	SOURABIE	FAO	3
				TOTAL			167

Collaboration with national programs

INRAN

The Tara development project advanced and there is now one major item outstanding for the completion of the project. The first items have been transferred to INRAN and reports to USAID are being prepared. This brings to a conclusion the development of this facility. Over the past five years, the station has been surveyed and fenced, soil characteristics were mapped, and buildings were constructed. Irrigation was developed for seed multiplication purposes and electricity was provided. The laboratories have been equipped with basic equipment and material. In the future, the site will be a valuable addition to the research facilities of the Sudano-Sahelian Zone.

DRA Benin

Mr. Adomou Moustapha, Director of the INA station in Benin, visited ISC from 28 Nov to 4 Dec to discuss collaboration and analyze collaborative trial data. The DRA in Benin has collaborated with ISC over the past five years and the trials conducted include a series of on-farm trials to test varieties and treatments selected by DRA scientists from the regional trials provided by ICRISAT. The combined analysis was completed and Mr Adomou was able to evaluate the Genstat package being used at ISC.

Training

Mai Moussa Katiella travelled to Ougadougou to present a paper on the Gao tree research, and attend the ICRAF/SALWA conference.

Pearl Millet Varieties in National Programs

A regional variety trial comprised of the most promising varieties from the network member countries and from ISC was initiated by the West and Central African Millet Research Network (WCAMRN). The regional trial was conducted in the Sahelian, Sudanian and North Guinean Zones and contained 11, 10, and 4 entries respectively, including controls. . Twelve entries that were co-developed by ICRISAT-NARS were contributed to the 19 test entries of the first two trials.

During the WCAMRN monitoring tours in October and November, varieties SOSAT-C 88 and GB 8735 were performing very well in Mauritania and in Cameroon. ICMV-IS 88102 and ICMV-IS 89102 have shown particularly good performance in Burkina Faso, Mali and Cameroon.

Results of 1992 on-farm trials in Burkina Faso and Mali confirmed superior performance of ICMV-IS 88102 in both countries. This variety was officially released in Burkina Faso earlier this year for cultivation in Southern Sudanian and Northern Guinean Zones. In the 1993 season, IER distributed seed of ICMV-IS 88102 and it was planted by several farmers in Ségou and N'Tarla region.

IER conducted on-farm tests at 30 locations. Treatments were ICMV-IS 88102 and local cultivar with (17-17-17 complex kg ha $^{-1}$) and without fertilizer. ICMV-IS 88102 was named by IER as *'Benkadi Nio'* ('friendship millet' in Bambara). According to the IER millet program chief, this name was chosen to signify a fruitful outcome of IER/ICRISAT collaboration over the years. IER also conducted on-farm trials on IKMP1 in Koulikoro region.

INERA planted demonstration plots of ICMV-IS 89102 (130 d maturity) and ICMV-IS 89107 (135 d) among others in Houet and Banfora regions of Burkina Faso.

Workshop on Panicle Insect Pests of Sorghum and Pearl Millet

4-7 Oct 1993

The First International Consultative Workshop on Panicle Insect Pests of Sorghum and Pearl Millet was held at ISC, 4-7 October 1993. It was attended by approximately 40 scientists from 12 countries.

Research on panicle-infesting insect pests, apart from sorghum midge, has received little attention. This workshop was the result of an international effort in consultation with scientists of the National Agricultural Research Systems in Africa and Asia to define research strategies that focus on sustainable management systems. The primary objectives of the Workshop were:

- Assess the extent of the economic importance of panicle insect pests world-wide and review existing knowledge;
- Provide concise and up-to-date information on current research on management tactics;
- Develop research themes for integrated pest management in various cropping systems;
- Enhance collaboration and partnership between IARCs, Universities and NARS.

Training Activitie

Mounkaila Hamani (Nigerien), IPDR Kolo, Niger, worked on the millet stem borer pheromone and host plant resistance and has completed his training and report.

Dogo Issouffou (Nigerien), ENSA, Yamoussoukro (Côte d'Ivoire) completed his training on *Rhinyptia* biology.

I. Bayoun a doctoral candidate funded by INTSORMIL left in October after completing his studies on biological control of millet head miner.

Karimoun Issa, student at ENSA, Yamoussoukro, Côte d'Ivoire, completed his six-month program on 12 Nov in the area of cultural control of *Striga hermonthica*.

Boukar Ibrah, student at CARFOP, Dschang, Cameroon, began an 18-month research program on 7 Oct, investigating nutrient and water interactions on pearl millet infested by *Striga*.

International Winter School

6-17 Dec 1993

An International Winter School on *Subtropical climates and their evolution: from space-based observations to modelling* was conducted at the TVC from 6-17 Dec 1993. The winter school was organized by Centre National d'Etudes Spatiales (CNES), France in collaboration with MEDIAS, ICRISAT, Meteo-France, ORSTOM, ACMAD, Meteo-Niger, AGRHYMET and the University of Niamey. Twenty-five participants from Algeria, Benin, Burkina Paso, Congo, Cote D'Ivoire, Guinee Conakry, Kenya, Mali, Mauritania, Niger, Rwanda, Senegal, Tchad and France attend the Winter School.

M.V.K. Sivakumar was the Director for the Winter School. He conducted one of the practical work sessions on Drought Frequencies and Drought Probabilities and delivered a lecture on "Implications of global climate change for agriculture". P. Hiernaux of ILCA also delivered a lecture "Earth surface features: The vegetation" at the Winter School.

ISC provided the infrastructure and logistical arrangements for the course and 12 computers for the practical sessions.

Training Activities

Mahamane Moussa of ENSA, Yamoussoktro completed his research project on monitoring weeds under different millet based systems.

Ali Souna Hama, University of Niamey, has started writing the report on his research on millet genotypes and cropping systems interactions.

Mamane Manzo and Ene Nweze participated in a statistics course conducted by the Statistics unit.

International Conference on Nutrient Cycling

22-26 Nov 1993

An International Conference on *Livestock and Sustainable Nutrient Cycling in Mixed Farming Systems of Sub-Saharan Africa* was held at ILCA headquarters from 22-26 Nov 1993. It was sponsored by the donors of ILCA with contributions from ICRISAT, ICRAF, IFDC, SDC, and CIDA. Other agencies that provided funds for participants included the Dutch government: CTA, PPS (Projet Production Soudano-Sahelienne), and KIT (Royal Tropical Institute); FAO; and TSBF (Tropical Soil Biology and Fertility Programme of UNEP).

Sixty national and international experts in livestock nutrition and management, ecology, agronomy, soil science and socioeconomics attended the conference. Thirty-six presentations from 18 countries reported on various livestock feeding and nutrient cycling strategies

in grazing and cut-and-carry production systems. These papers focused on how animals acquire and utilize nutrients for production, the fate of nutrients excreted by livestock, and methods to improve nutrient capture and recycling. In addition to these biological dimensions of nutrient cycling, papers relating to the social and economic processes that influence the availability of nutrient sources and flows in farming systems were also presented. The conference addressed issues related to improved resource management on farms, and at the community and regional levels - an important element in Agenda 21's strategy for alleviating poverty in SSA. The conference proceedings is expected to be published in 1994.

C. Renard, T.O. Williams, J.M. Powell, S. Fernandez-Rivera, P. Hiernaux, J. Brouwer, A. Buerkert, F. Mahler, M. Turner, and Z.S. Somda from ISC attended the Conference.

ICRISAT/QDPI Review Meeting

M.V.K. Sivakumar attended the review meeting of the collaborative project between ICRISAT and the Queensland Department of Primary Industries (QDPI), Australia, held at the ICRISAT Center on 25 and 26 Nov. Project results on runoff, erosion, agronomy, nutrient balance, soil properties, model calibration and outputs were presented and discussed. It was recommended that the present experiment should continue for 4-5 years with a focus on sustainability rather than productivity.

FAO Consultation

M.V.K. Sivakumar participated in the FAO Expert Consultation on the *Coordination and Harmonization of Databases and Software for Agroclimate Applications* in Rome from 29 Nov-3 Dec. Prior to the meeting, he was invited along with Prof. G. Maracchi of IATA-CNR, Italy to prepare a background document which was used as the basis for much of the discussion during the 5-day meeting.

Conference in Namibia

M.C. Klaij attended the *SADC Land & Water Management research Programme, 4th Annual Scientific Conference*, held at Windhoek Namibia from 11-14 Oct. He presented a paper entitled "Low-input technology options for millet-based cropping systems for sandy soils in the Sahel", authored by M.C. Klaij and C. Renard.

SAFGRAD Symposium

J. Baidu-Forson and O. Ajayi presented a paper on *"Industrial utilization of sorghum in Nigeria: implications of evidence and distributive impacts for research"* at a SAFGRAD symposium on industrial utilization of sorghum and related cereals.

Workshop on animal power

F. Emhardt attended the Workshop on *Animal power for weed control* held at Tanga, Tanzania from 1-5 Nov 1993. He presented a paper on the design and development of a donkey drawn weeder in Niger.

Other activities

MCK met with Bertrand, and Tinga Abdouloye from the University of Niamey. Both are researching Saharan dust dynamics and dust mineralogy. They sampled dust over time in a transect from Abidjan to Niger. Mr. Abdoulaye, who is associated with HAPEX-Sahel, showed data obtained in Spain using an aerodynamic particle sizer. This equipment analyses dust samples by number and mass of particles (comparable to texture analysis) but using laser technology. The interesting thing about it is that unlike the classical soil textural analysis, sample size is small (a gram or so, instead of 50 g). As soon as the equipment will be available in Niamey, Abdoulaye and Bertrand would like to start collecting dust data in conjunction with our wind erosion studies at Sadore. It would give us an estimation of losses or gain as the case may be of the mineral rich dust.

A. Bationo, worked with the coordinator and deputy-coordinator of the West African farming systems research network (WAFSRN) to develop a proposal on collaborative research group on the maintenance and restoration of soil fertility in the Sudano Sahelian zone (GREFMASS)

Training Activities

H.M. Maiga and M.L. Sangaré completed their technician internship with the entomology subprogram and successfully presented their report at IPR, Katibougou, on 30 Dec 1993. A. Ratnadass and B. Cissé attended their thesis defences.

J. Gigou is supervising the work of Zana Jean-Luc Sanogo, a DRSPR/Sikasso researcher for trials on nitrogen for his thesis at CIRAD/Montpellier. Mr Sanogo collected, ground, and sifted soil and plant samples in our laboratory.

A Radnadass presented three papers at the ICWPIP held at ISC (4 - 8 Oct), and attended an ICRISAT entomologists meeting on 7 Oct.

The Agronomy subprogram was actively involved in various visits at Samanko, notably by representatives of NARS during the Field Day (11 - 12 Oct), INTSORMIL review team, and farmers and agricultural extension staff from the Baguineda Project. On several occasions, AR interacted with scientists and officials at IER, INERA, CILSS and OPAM.

SK Debrah and DS participated in a regional symposium on sorghum utilization held at Ouagadougou, Burkina Faso. It was organized by SAFGRAD/OAU and contacts were made with prospective collaborators with a view to expanding our on-going research project on smallholder utilization of sorghum for local beer in the region.

SKD also participated in the *Striga* Working group meeting at WASIP-Mali. It was attended by NARS participants from Chad, Burkina Faso, Senegal, Niger, Mali as well as representatives from CIRAD and ICRISAT.

A third consultation meeting on *Striga* was held in Bamako on 13-14 December at Samanko. The representatives of six African countries attended the meeting. Discussions were focused on both past and future research programs and possibilities of future collaboration.

Cooperation with NARS

J Chantereau sent local genotype seeds to IDESSA, Côte-d'Ivoire and Framida seeds to Mr. Dembele Alexis, a Malian businessman who intends to brew sorghum local beer. He also visited IPR and IER sorghum breeding programmes on 8 oct and 29 oct respectively.

The collaboration plan between Striga Sub-program and the Research Program of the Institut d'Economie Rurale (DRSPR), Mali has been developped in the southern region of Kadiolo. We provided technical assistance for chemical control of the *S. hermonthica*. The results are being analysed both at DRSPR and WASIP-Mali.

S. hermonthica seed (800 g) was sent to National Resources Institut. NRI scientists harvested the seeds while in Bamako. Their stay in Bamako being too short, sun-dry operation of harvested grains was being carried out by our sub-program. These seeds constitute the basic material for laboratory studies.

With aim to extend ICRISAT/WASIP artificial infestation plot, the sub-program organized *S. hermonthica* seeds harvest (more than 2 Kg of pure grains) for a collaborative project with GTZ.

WASIP-Nigeria

Meetings

R. Tabo and D. S. Murty visited University of Reading, U.K. on 2 November and discussed a possible future collaborative project on sorghum phenology and adaptation to dry land farming with Dr. Peter Craufurd, Senior Research Fellow at the Plant Environment Laboratory (PEL).

R. Tabo and D. S. Murty attended the American Society of Agronomy annual meeting at Cincinnati, Ohio from 7 to 12 November. R. Tabo presented a paper entitled "*Performance of dry season sorghum varying plant densities in northeastern Nigeria*" by R. Tabo, O. E. Olabanji, O. Ajayi and D. J. Flower.

R. Tabo and D. S. Murty visited Purdue University, West Lafayette, Indiana from 13-16 Nov 1993 and had discussions with scientists on various aspects of sorghum research.

R. Tabo and O. Ajayi met with IITA scientists on 29 Oct and discussed the joint ICRISAT/IITA/ILCA proposal on *Farming Systems Research in the Sudano Sahelian Zone* of West and Central Africa.

Visitors - Mali

1 Oct	Dr. Roger Zangré, INERA, Burkina Faso
10 Oct	Dr. G. L. Teetes, Texas A&M, Dr. J. Cauquil, CIRAD, and Dr. B. Michel, CIRAD-IER
11-12 Oct	Participants to WASIP/Mali Field Day from the Gambia, Burkina Faso, Senegal, Ivory Coast and Mali
15 Oct	Intsormil program review team (about 15 people) including Mr. John Yohe, Director, Dr. Aboubacar Touré, Local Coordinator, Mali and Dr. Fran Bidinger, IC
21 Oct	EEC sorghum grain quality project team including Mr. Jacobs and Mr. Vernaillen, Univ. of Brussels, Mr. Lores, Ms. Rother, Univ. of Hamburg, Mrs. Hamon, Mr. Dufour, and Ms. Filedel of CIRAD; Mr. M. Goita, IER, Mali; Dr. Da Sansan, INERA, Burkina Faso
21-23 Oct	Mr. Bruno Gerard, Farm Manager, ISC; Mr. J.W. Estes, IC; Mr. L. Clark, Mr. M. Koyama, Natural Resources Institute, U.K.
28 Oct	PRB group from Baguineda, Mali, composed of 30 people including 15 farmers
4-12 Nov	Mr. L. Clark, Mr. M. Koyama, Mr. K. Shawe, Natural Resources Institute, U.K.
30 Nov	Mr. B. Diallo, IRAG, Conakry
2-3 Dec	Mr. B. N'Tare, ISC, Member CCT
13-14 Dec	Participants to Striga Workshop from Chad, Burkina Faso, Senegal, Niger and Mali. Also Dr. Dale Hess, Pathology, ISC
20 Dec	M. Moussa Sissoko, National Director of Agriculture; M. Sangata Mabayo, Director, Service National de la Protection des Végétaux
23 Dec	Dr. B. Siccard, ORSTOM, Bamako

VISITORS- Nigeria

3-7 Oct	Dr. G. Alagarswamy, ICRISAT Center
10-13 Oct	Dr and Mrs J. Estes, ICRISAT Center
8-11 Oct	K. M. Harris, former Director of the International Institute of Entomology, London, discussed identification of *Eurystylus* and stem borers of *Masakwa* sorghum with O. Ajayi
14 Oct	M. Mortimore (Cambridge Univ) and F. Harris (Bayero Univer/Kano) discussed sorghum local variety trials.
7-10 Dec	B. R. Ntare briefed IRS and support staff on the Organization and Management Review in ICRISAT.
7-10 Dec	J. B. Forson, ISC
7 Dec	L. Brader, DG of IITA, discussed closer technical and administrative relationship between IITA-Kano and WASIP-N.
5-12 Dec	A. Egwu, Issa Laouali and Maazou, ISC
16 Dec	Alf van Damme, SIAT S.A. Brussels, to obtain information on ICRISAT's work on groundnuts.

Workshop Proceedings, Journal Articles and Conference Papers Approved by ICRISAT Sahelian Center Editorial Committee

Bationo, A., Ntare, B.R., Pierre, D. and Christianson, B.C. Crop rotation effects on crop yield and soil productivity in the West African semi-arid tropics (JA 1526).

Bationo, A., Christianson, C.B. and Klaij, M.C. 1993. The effect of crop residue and fertilizer use one pearl millet yields in Niger Fertilizer Research 34 251-258 (JA 1381)

Debrah, S.K. 1993. Sorghum in western Africa Pages 17-37 *in* Sorghum and millets commodity and research environments (Byth, D E., ed.) Patancheru, A.P 502 324, India International Crops Research Institute for the Semi-Arid Tropics. (CP 860).

Klaij, M.C. and Ntare, B.R. Rotation and tillage effects on yield of millet and cowpea and aspects of crop water balance and soil fertility in a semi-arid environment (JA 1380)

Mai Mousse, K.A., Williams, J.H., Stern, R.D., Brouwer, J., Bationo, A. and Odongo, J.C.W. Effet de *Faidherbia albida* sur les propriétés chimiques des sols sableux de la zone sahélienne d'Afrique de l'Ouest Impact de l'âge et de leur densité de peuplement (CP 776).

Shetty, S.V.R., Ntare, B.R., Bationo, A. and Renard, C. Millet and cowpea in the mixed farming systems of the Sahel A review of strategies for increased productivity and sustainability (CP 775)

Shetty, S.V.R. and Renard, C. 1993. Productivity and sustainability of alternative millet based systems in the Sahel Page 61 *in* Agronomy Abstracts 1993 Annual Meetings ASA Cincinati, Ohio (non-numbered series)

Wallace, J.S., Lloyd, C.R. and Sivakumar, M.V.K. 1993. Measurements of soil, plant and total evaporation from millet in Niger Agricultural and Forestry Meteorology 63 149-169. (JA 1232)

Youm, O. and Beevor, P.S. Field evaluation of pheromone baited traps for the millet stem borer *Coniesta ignefusalis* (Lepidoptera Pyralidae) Journal of Economic Entomology (JA 1527)

Youm, O. and Gilstrap, F.E. Habitat site selection, crop damage and oviposition preference by *Coniesta* (= *Haimbachia*) *ignefusalis* (Lepidoptera Pyralidae) International Journal of Pest Management (JA No 1523)

Informal Papers and Posters Collaborative Programs and ICRISAT Staff

Bethedet-Matibet, M., Goebel, R., et Ratnadass, A. 1993. Lutte intégrée contre les foreurs des céréales tropicales évaluation de la résistance variétale aux ravageurs Présenté à la Troisième conférence internationale sur les ravageurs en agriculture (CIRA), 7-9 Dec 1993, Montpellier, France

Debrah, S.K and Sanogo, D.S. 1993. Ex-ante evaluation of the profitability and adoption potential of 2,4-D for Striga control: A Contingent Valuation Analysis. Economics Program Progress Report No.3 (Draft).

Hafner H., George, e., Bationo, A. and **Marschner, H. 1993.** ..rect of the crop residues on root growth and phosphorus acquisition of pearl millet in an acid sandy soil. Plant and soil 150:117-127.

Maiga, H.M. 1993. Inventaire systématique des insectes associés à une "réserve" d'entomofaune, dynamique des populations de Lépidoptères foreurs de tiges de sorgho et piégeage sexuel de *Busseola fusca*. Rapport de fin de cycle présenté pour l'obtention du diplôme de technicien supérieur de l'Institut polytechnique rural de Katibougou.

Rebafka F.P. Bationo, A. and **Marschner, H. 1993.** Phosphorus seed coating increases phosphorus uptake and early growth of pearl millet grown on an acid sandy soil in Niger. Fertilizer Research 35:151-160.

...auriya, Y., Siame, B.A., Hess, D.E., Ejeta, G., and **Butler, L.G. 1993.** Influence of conditions and genotype on the amount of *Striga* germination stimulants exuded by roots of several host crops. Journal of Agricultural and Food Chemistry 41:1492-1496.

Papers presented at International Consultative Workshop on Panicle Insect Pests of Sorghum and Pearl Millet

Krall, S., Youm, O. and **Kogo, S.** Panicle insect damage and yield loss in pearl millet. **Ratnadass, A.,** and **Ajayi, O. 1993.** Panicle insect pests of sorghum in West Africa.

Ratnadass, A., Doumbia, Y.O., and **Ajayi, O. 1993.** Bioecology of sorghum head bug, Eurystylus immaculatus, and crop losses in West Africa.

Ratnadass, A., Ajayi, O., Fliedel, G., and **Ramaiah, K.V. 1993.** Host plant resistance in sorghum to *Eurystylus immaculatus* in West Africa.

Youm, O. Bioecology of *Rhinyptia infuscata* and *Heliochellus albipunctella*.

Youm, O. and **Kumar, K.A.** Screening and breeding for resistance to earhead caterpillar of pearl millet.

Youm, O. and **Baidu-Forson, J.J.** Farmers' Perceptions of insect pests and control strategies and their relevance in IPM.

Papers presented at International Conference on Nutrient Cycling

Bationo, A., Buerkert, A., Sedogo, M.P., Christianson, B.C., and **Mokwunye, A.U.** A critical review of crop residue use as soil amendment in the West African semi-arid tropics.

Diarra, L., P.N.de Leeuw and **Hiernaux, P.** Selectivity of cattle grazing rangelands in semi-arid central Mali.

Fernandes-Rivera, S., Williams, T.O., Powell, J.M. and **Hiernaux, P.** Livestock, feed, and manure availability for crop production in semi-arid West Africa.

Hiernaux, P., P.N. de Leeuw and **Diarra, L.** The interactive effects of rainfall, nutrient supply and defoliation on the herbage yields of Sahelian rangelands in North-East Mali.

Powell, J.M., Fernandez-Rivera, S. and **Williams, T.O.** Research priorities and strategies for improving cereal-based livestock systems in semi-arid Africa.

Schlecht, E., Mahler, F., Sangaré, M., Sissoko, A., and **Becker, K.** Quantitative and qualitative estimation of nutrient intake and faecal excretion by Zebu cattle grazing natural pasture in semi-arid Mali

Somda, Z. S., Powell, J.M., Fernandez-Rivera S., and **Reed, J.D.** Feed factors affecting nutrient excretion by ruminants and fate of nutrients when applied to soil.

Williams, T.O., Powell, J.M. and **Fernandez-Rivera, S.** Manure utilisation, drought cycles and herd dynamics in the Sahel: Implications for cropland productivity