PN-ABI-786

DRAFT FINAL TECHNICAL REPORT ON WEST & CENTRAL AFRICA SORGHUM RESEARCH NETWORK (WCARSRN) AND EAST AFRICA SORGHUM & MILLET RESEARCH NETWORK (EARSAM)

(PHASE II COVERING THE PERIOD 1986-1991)

(GRANT NO. 698-0452-G-00-6023-00)

SUBMITTED TO :

USAID / SAFGRAD / OAU-STRC

ICRISAT

International Crops Research Institute for the Semi-Arid Tropics

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July 1991

WEST & CENTRAL AFRICA SORGHUM RESEARCH NETWORK (WCARSRN)

CONTENTS

TABLE OF CONTENTS

	Page
INTRODUCTION	1
Program Description and Objectives	1
Scope of the Report	1
SECTION ONE	2
RESEARCH PROJECTS	2
Basis for Assigning Research Projects to NARS	2
Rationale for Working Groups	2
Project Titles, Principal Investigators and Objectives	3
Pathology-Entomology Working Group	4
Grain Utilization Working Group	6
Striga Working Group	7
New Project on Grain Quality - Niger	8
Regional Outlook for Three of the Projects	9
Funding of the Projects	10
Financial Accountability	10
Method of Technical Reporting and Evaluation	10
TRAINING	11
Striga Training Workshop	11
Training Workshop on Agronomic Research and On-Farm Testing	11
REGIONAL TRIALS AND NURSERIES	11
1986 Trials	11
1987 Trials	13
1988 Trials	13
1989 Trials	14
1990 Trials	16
1991 Trials	17
FINANCIAL SUPPORT TO NON-LEAD NARS	17
MONITORING TOURS	17
STEERING COMMITTEE MEETINGS	18
REGIONAL WORKSHOPS	22
VISITS TO NATIONAL PROGRAMS	23
SECTION TWO	24
DIFFICULTIES AND SHORTCOMINGS	24
Regional Trials	24
Translation of Reports and Other Network Documents	24
Visits to NARS	24
Training	24

Research Projects 25
Financial Accountability 25

SUGGESTIONS FOR THE FUTURE 25

SECTION - I

INTRODUCTION

Program Description and Objectives

The West and Central Africa Sorghun Research Network (WCASRN) comprises of 17 member countries : Benin, Burkina Faso, Cameroon, Central African Republic, Côte d'Ivoire, The Gambia, Ghana, Guinea, Guinea Bissau, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Tchad, and Togo. Through the USAID/SAFGRAD/ICRISAT Grant No.698-0452-G-00-6023 the WCASRN addresses itself to the sorghum improvement problems of West Africa on a regional basis, concentrating on production constraints of significance to the 17 member countries. In addition to solving sorghum production problems, phase 2 of the WCASRN, which began in 1986, stresses training as an important and integral part of its activities. Most of the 17 countries in the Network have weak research programs on sorghum. Thus, the overall theme in the set of Network objectives is to strengthen the sorghum research capabilities of the national agricultural research systems (NARS).

The objectives of the WCASRN are :

- to increase the production of sorghum thereby contributing to the stabilization of food supplies in the region and contributing to improved nutrition and income for farmers in the drier areas of the region;

- to assist and strengthen national sorghum improvement programs, and contribute to their research needs in all agroecological semi-arid zones;

- to develop improved varieties and hybrids and agronomic/management practices capable of giving higher and more stable economic yields in the semi-arid environments;

- to facilitate the development of agricultural research manpower among West African nationals at all levels;

- to organize regional workshops and monitor uniform yields through field inspections.

Scope of the Report

This report consists of two sections covering activities of the Network between September 1, 1986 and May 1991. The first section contains progress made on the following Network activities: research projects, training, regional trials and nurseries, monitoring tours, steering committee meetings, regional workshops, and visits to national programs. The second section briefly deals with the major difficulties encountered and suggestions for the future.

With respect to the regional trials, details of yield results are given in tables at the end of the main body of the report. Only the first six genotypes with respect to mean yield in t ha^{-1} across all locations for a given trial are included in the tables. Country of origin of the genotypes and other details can be found in Annex 1.

SECTION ONE

RESEARCH PROJECTS

Basis for Assigning Research Projects to NARS

At the fifth Steering Committee meeting of the West and Central Africa Sorghum Research Network (WCASRN) held in Bamako between 5 and 11 May, 1989, it was decided that the Network should fund research projects in some of the NARS. Prior to that decision, national programs had been classified into lead, associate and technology adopting NARS (Table 1). The classification was based on the extent to which certain biotic and abiotic factors limited sorghum production in a given NARS. The availability of qualified scientists to carry out research on these stresses and on certain aspects of food technology was also taken into account.

Although funds are limited in WCASRN's budget for research activities, the Steering Committee thought that there was a need to encourage capable scientists in NARS to carry out research on problems common to sorghum production in the region. Based on the classification of NARS into lead, associate and technology adopting centers, five lead NARS were requested in 1989 to submit research proposals on various constraints. The five NARS and constraints were, Mali on head bugs, Burkina Faso on leaf anthracnose, Niger on long smut, Cameroon on *Striga*, and Nigeria on utilization (Table 1).

During the seventh Steering Committee of WCASRN, held in May 1990 in Niamey, it was agreed that Niger should submit a second research proposal on grain quality. Thus, with respect to lead centers and constraints (Table 1), there are no projects on stem borer and stand establishment (Nigeria) and on grain molds (Burkina Faso).

This approach to assigning research projects is perhaps subjective. The Network hopes to follow a more objective procedure in the future in which lead NARS, and perhaps also associate NARS, will compete for research funds by submitting research proposals on any of the constraints identified in Table 1. A revision of Table 1 might also be necessary.

Rationale for Working Groups

The idea of working groups on research projects is not new. The approach used in identifying and assigning research projects as mentioned above and the rationale for the working groups closely follow those of the Regional Cooperative Potato Network (PRECODEPA) in Central America. Technologies developed in the lead NARS, through the respective projects, could be tested further in the associate NARS and then made available for use, where applicable, in other NARS. Thus, after having identified and assigned research projects, it is important that they be properly monitored and evaluated to ensure high standards and regional outlook. A working group becomes a forum for NARS scientists to evaluate a project, to discuss common problems, and to make recommendations for the future.

Project Titles, Principal Investigators and Objectives

There is a total of five projects. There are two projects on plant pathology, and one each on entomology, *Striga* and wheat/sorghum composite flour.

The title of one of the pathology project is, Identification of Resistance to Leaf Anthracnose of Sorghum (*Sorghum bicolor*) caused by *Colletotrichum graminicola* (ces) Wilson in Burkina Faso. The principal investigator is Adama Neya, and the research is carried out at the Agronomic Station in Farako-Bâ, Burkina Faso. The project has two objectives. The first objective is to identify sources of resistance to leaf anthracnose of sorghum. The second objective is to find out if local races (pathotypes) of the leaf anthracnose fungus exist.

The seond pathology project is on Long Smut Resistance in Sorghum. The research is carried out in Niger by Issoufou Kollo. The objectives of the project are to develop effective inoculation techniques and to screen sorghum germplasm from the Niger national program and from other national programs in the Network for resistance to long smut.

The entomology project is on Head Bugs of Sorghum carried out by Yacouba Doumbia in Mali. The objectives of this project are as follows:

- to determine the zones in Mali with high head bug infestation in farmers' fields;
- to evaluate the economic importance of head bugs in the different zones in which sorghum is grown in Mali;
- to study the biology of the insect;
- to develop a regional nursery for the study of stable resistance in sorghum to head bugs.

The project on *Striga* is on, Screening of Local Sorghum Germplasm of Cameroon and Other Countries Against *Striga hermonthica* in Heavily Infested Field Conditions. The principal investigator is Richard Kenga and the research, which should start in 1991, will be carried out in Maroua, in Northern Cameroon. The major objective of the *Striga* project is to identify suitable sources of resistance in sorghum to *Striga*. Other objectives include the identification of a suitable screening methodology and multilocational testing in the region of genotypes identified from the project as resistant.

The title of the project on wheat-sorghum composite flour is, Technology for Production of Acceptable Wheat-Sorghum Composite Bread and Confectionery. The project is carried out at the Institute for Agricultural Research (IAR) at the Ahmadu Bello University, Zaria, Nigeria by L.B. Olugbemi and R.E. Aluko. The objectives of this project are:

- to develop a technology for producing acceptable local wheat-sorghum composite bread and confectionery, aimed at increasing the sorghum component as high as possible;

- to test the developed technology for wheat-sorghum composite bread and confectionery in industrial pilot plants;

- to test the new technology in selected commercial bakeries;

- to determine the acceptability in Nigerian markets of bread and confectionery produced from wheat-sorghum composite flour.

Pathology-Entomology Working Group

The members of the Pathology-Entomology Working Group are as follows:

- A. Neya - Pathologist and principal investigator, anthracnose project
- Y. Doumbia - Entomologist and principal investigator, head bug project
- I. Kollo - Pathologist and Principal investigator, long smut project
- M. Diourté - Pathologist, Mali national program
- S. Maïga - Entomologist, Niger national program
- A. Ratnadass - Entomologist, ICRISAT-IRAT/CIRAD, Bamako
- The Chairman of WCASRN Steering Committee
- The Coordinator of WCASRN.

The first meeting of the Pathology-Entomology Working Group was held at ICRISAT's Regional program in Bamako on 19 and 20 April, 1990. In addition to the members listed above, the following were present as observers:

- J. Andrew Frowd - Pathologist and Principal Technical Adviser, UNDP/FAO, Bamako
- Fatoumata Bocoum - Research Assistant, pathology sub-program, ICRISAT Regional program, Bamako
- Ibrahim Sissoko - Research Assistant, pathology sub-program, ICRISAT Regional Program, Bamako.

Results of the first year's work on the projects were presented and future work plans were discussed at the meeting. Some members of the Working Group were appointed evaluators and were required to fill out standard evaluation forms. Presentation of results and discussions were completed on the first day. A representative from ICRISAT accounts section was invited to one of the sessions. She explained, especially for the benefit of the principal investigators, procedures for preparing and presenting financial reports. The meeting ended in the morning of the following day, April 20, after general discussions, presentation of summaries of sessions by rapporteurs, and closing remarks by the chairman of the Steering Committee and the Coordinator.

With respect to progress made after the first year, the project on leaf anthracnose used the composite spreader row technique to screen a total of 80 sorghum lines, of which 56 were local varieties and 24 were introduced genotypes. Seventy-four out of the 80 lines tested were resistant (mean score of 3 or less in a 1-6 scale) to the foliar stage of the disease. Of the six susceptible lines, four were introduced genotypes. Only one introduced genotype was susceptible to

stem infection. Grains of thirty out of the 80 lines were free of the fungus. The level of grain contamination by the anthracnose fungus *C. graminicola* was higher in introduced genotypes. In addition to confirming these first year's results, work on the variability of the pathogen will be undertaken during the second year.

Results from the head bug project in Mali indicated that the population of *Eurystylus marginatus* was more abundant towards the end of September and October. Early planting resulted in no attack by *E. marginatus*, whereas two generations of the insect developed in late planted sorghums. In a screening experiment 25 out of 100 lines were resistant to *E. marginatus*. Further lines were identified in an advance trial and in an international trial. A limited survey in farmers' fields revealed that in certain loclaities, *E. marginatus* attack was higher in introduced lines than in locals. However, the level of attack depended on the locality, and some local varieties were severely attacked in some areas. Work will continue on these aspects of the project during the second year.

The project on long smut in Niger encountered problems with flooding in the field. Attempts were made to develop a suitable inoculation technique to screen for the disease by artificial inoculation. Only one or two sori developed on three plants 20 days after inoculating several plants using three forms of inoculation techniques. The principal investigator hoped to continue field work on screening from natural inoculum, on laboratory aspects of culturing the fungus, and on determination of the viability of stored propoagules of the fungus.

The main points from the reports of the two evaluators of the project on leaf anthracnose based on the results of the first year's work are as follows:

- the objectives were achieved;
- the method of scoring for disease severity is time consuming, especially when up to 80 lines are being screened. The investigator scores the top four leaves of 10 tagged plants per variety in each of two replications;
- the height of plants should be taken into account during scoring;
- the number of entries should be reduced, and more emphasis should be placed on the level of infection of the spreader rows with respect to rate of infection;
- there should be studies on cross inoculations of the different isolates of the fungus.

The overall rating of the project by both evaluators was 2 (= good) on a 1-3 scale.

The evaluator of the project on head bugs thought that the objectives were partially obtained. In his report, he indicated that more studies on economic threshold, and yield losses should have been carried out. He suggested that for

the future more emphasis should be placed on the level of infestation in farmers' fields, on the population of natural enemies of the head bug insect, and on the mechanism of resistance. He gave an overall rating of 2 for the project.

The project on long smut was not evaluated since no formal report was presented by the principal investigator.

Grain Utilization Working Group

The following are members of the Grain Utilization Working Group:

- L.B. Olubegmi - Food technologist and principal investigator
- R.E. Aluko - Biochemist and principal investigator
- C.C. Nwasike - Cereals breeder, Institute for Agricultural Research, Ahamadu Bello University
- Mariam Fofana Haidara - Food technologist, IER, National program of Mali
- The Chairman of WCASRN Steering Committee
- The Coordinator of WCASRN.

The first meeting of the Grain Utilization Working Group was held at the Institute for Agricultural Research, Ahmadu Bello University, Zaria, in Northern Nigeria, on 13 September 1990. Except for the chairman of the Steering Committee, all members of the Working Group were present. In addition, the Team Leader of ICRISAT's Regional Program in Kano, O. Ajayi attended the meeting. The same procedure was followed as in the Pathology-Entomology Working Group.

Major progress made after the first year included the identification of Farafara as the most suitable sorghum variety for wheat-sorghum composite bread and confectionery. In the laboratory, acceptable bread can be produced with up to 50% level of wheat substitution by sorghum. Also, acceptable confectionery can be produced with up to 60% level of substitution. In general, it would appear that composite bread was lower in volume and had a shorter shelf-life than 100% wheat bread. The principal investigators hope to get into pilot production in the future. The technology they developed in the laboratory would be tested in two bakeries, one for bread and the other for confectionery. They also hope to carry out some economic studies on production.

Based on the first year's results, the evaluator of the project thought that two of the four objectives were achieved. It was mentioned that the project had completely achieved the objectives related to the laboratory aspect of the work. In the evaluator's report it was mentioned that sorghum substitution of between 30 and 50% would seem too high for bread outside of laboratory conditions and that the investigations should consider reducing their level of sorghum substitution to about 20% for practical production outside the laboratory. The evaluator agreed that 60% substitution for confectioneries could be retained. Furthermore, with respect to the people involved in filling out questionnaire on acceptability, their sample should be increased and should be more diverse and representative of the social and other groups in the town. The project was rated 2 overall.

Striga Working Group

The members of the *Striga* Working Group are :

- Richard Kenga, Sorghum breeder and principal investigator
- S.T.O. Lagoke, Agronomist, Institute for Agricultural Research, Amadu Bello University
- C.C. Nwasike, Cereals breader, IAR
- N. Titus, Agronomist, IRA, Cameroon national program
- B. Dembele, *Striga* specialist, IER, Mali National program
- G. Hoffmann, *Striga* specialist, ICRISAT-IRAT/CIRAD), Bamako
- The Chairman of WCASRN Steering Committee
- The Coordinator of WCASRN.

The official project document from the national program of Cameroon was received in March 1990, and consisted of three sub-projects namely, screening of local germplasm of Cameroon and other countries, use of herbicide under sole and mixed crops, and the effect of intercropping on *Striga*. The project ducument was presented to the Steering Committee in April 1990. Since funds were extremely limited, the committee decided that the *Striga* project in Cameroon should concentrate on identifying resistant lines for further testing in various NARS in West and Central Africa. Thus, as a first step, the project multiplied eight varieties and two germplasm lines that had shown resistance to *Striga* during four years of testing in Northern Cameroon. Because the scientist who had carried out the crosses and tested these lines left Cameroon in December 1990, and because of damage in the post to the package in which the seeds were sent to the Coordinator, the first *Striga* Working Group was requested to finalize the project document and develop strategies for the continuation of the project.

The meeting was held on 10 March, 1991 during the SAFGRAD Inter-Network Conference in Niamey. Except for B. Dembélé and G. Hoffmann, all the members of the Group mentioned above were present. Y. Doumbia attended as an observer. After examining the circumstances and the current situation, the members of the Working Group agreed on the following:

Currently, the following conditions prevail:

- *Striga* is a major problem on sorghum in Cameroon;

- there is an active national *Striga* program in the country;

- a *Striga* task force has been set up at the Institut de Recherche Agronomique (IRA) of Cameroon;

- the FAO/UNDP *Striga* project may take off very soon;

- although the senior sorghum breeder who had been involved in breeding activity against *Striga* had left, the national counterpart can continue the project as the principal investigator.

12

After examining the circumstances and the current situation, the committee agreed that:

- the sorghum breeder at IRA was still in a position to carry out the objectives of the project, although it should include identifying suitable screening methodology which could be adapted for use and improved upon, if need be;

- emphasis should be given to field screening;

- the capabilities of the principal investigator could be enhanced through visits by other *Striga* scientists and the Coordinator and by visits of the principal investigator to other research stations in the region. He should be given opportunities by the Network to attend international meetings on *Striga* research;

- screening should be extended to include local and improved varieties of Cameroon and other countries of the Network;

- adequate quantities (about 500 g) of the varieties earlier indicated by Dr. Dangi and those considered promising by Kenga should be sent to the Coordinator for multilocational trials in 1991.

New Project on Grain Quality - Niger

This project was approved at the eighth Steering Committee meeting in Bamako, 3 and 4 December, 1990. However, funds were not made available until May 1991. The title of the project is: Morphologic, Chemical and Nutritive Characterization of Seeds of Local and Improved Sorghum in West and Central Africa. The objectives of the project are:

- to develop and conduct laboratory tests that can be used to characterize seeds of local and improved sorghums for human consumption;

- to analyze seeds of the best varieties from the Network trials and from national programs;

- to test germination percentage after 6, 9 and 12 months of storage under traditional conditions.

The tests will include, among other things, color, testa, endosperm texture, protein and tannin content, decortication, and use as flour.

Results of 1990, the second year of the head bug project in Mali, confirmed the following:

- *Eurystylus marginatus* was the most abundant species;

13

- based on mean number of individuals, both larvae and adults, the variety Elmota galmi was the most susceptible , whereas Kendé was the most resistant;

- based on visual assessment, using a scale of 1-5, damage was more severe in experimental stations than in farmers' fields;

- in studies on population dynamics two picks were observed, at the end of September and October. Both picks coincided with the milk stage of the grains.

Results from the second year's work of the leaf anthracnose project in Burkina Faso also confirmed several observations made during the first year.

These include:

- the composite spreader row technique was used to study the development of the disease in a total of 80 improved (introduced) and local genotypes It was observed that the progress of the disease was more rapid in improved genotypes that in local landraces. Severity of the disease reached 5, on a 1-6 scale, before physiological maturity in improved genotypes;

- seventy of the 80 lines were resistant (score of 3 or less in a 1-6 scale) to foliar infection, and 44 were resistant to foliar, stem and grain infection. All 44 were local landraces.

Preliminary work on the variability of the causal organism, the fungus *Colletotrichum graminicola*, during the off-season of 1989/90 indicated two types based on the color of their mycelium in culture.

The first complete report of the long smut project in Niger covered work done in 1990. The project encountered logistic difficulties during 1989. In 1990, 11 out of 75 genotypes were highly resistant (score of 0, on a 1-4 scale) to long smut from natural inoculum. The results further showed a positive correlation between infection and the maturity cycle of the genotypes tested. Late maturing genotypes were more susceptible.

Regional Outlook for Three of the Projects

With respect to the projects in Burkina Faso (anthracnose) and in Mali (head bugs) some of the varieties which showed resistance to both of these biotic constraints in 1990 were multiplied during the off-season at ICRISAT's facilities in Mali. Those for which their resistance were confirmed in 1990 will be put into two separate anthracnose and head bug regional trials for confirmation of their resistance. The Regional Sorghum Leaf Anthracnose Resistance Trial (RSLART) comprises 18 entries, one susceptible control and one resistant control. It will be grown in Burkina Faso, Mali, Nigeria and Niger in 1991. The sorghum Head Bug Resistance Trial will have 11 test entries and one susceptible control. The head bug trial will be grown in Mali, and also in Burkina Faso, Niger and Nigeria.

All the 12 test entries in the 1991 West African Sorghum *Striga* Trial (WASST) are genotypes contributed by the principal investigators of the *Striga* project in Cameroon, as recommended by the Steering Committee.

Funding of the Projects

Since Phase II of SAFGRAD is ending in 1991, each project is funded for three years in the first instance. Four of the six projects, leaf anthracnose, head bug, long smut, and wheat-sorghum composite flour, started in 1989, while the project on *Striga* started in 1990. The project on grain quality should start in 1991. The Steering Committee decided that for 1989 and 1990 each project will receive $5,000 per year. Funding for 1991 was decided in December, 1990 at the eighth Steering Committee meeting as follows:

Head bug	-	$ 8,000
Leaf anthracnose	-	$ 8,000
Striga	-	$ 8,000
Long smut	-	$ 6,000
Grain quality	-	$ 5,000
Wheat/sorghum composite flour	-	$ 9,000.

Funds for these projects come from the line item Network Support of the budget, and payments are made in two equal installments per year.

Financial Accountability

Principal investigators decide on detailed expenses, using the line items they presented in their project proposals as a guide. They are required to submit a financial report, with supporting documents. The financial report is the basis for receiving the second half of the total sum for a project for a given year. Thus, two financial reports are required each year. Unforunately, some projects have not submitted any financial report. In this regard, a standard form was prepared on which Directors of NARS where each project is conducted will sign ascertaining expenditures incurred. The English version of this is given in the Annex of this report. The current status of the projects is summarized in Table 2.

Method of Technical Reporting and Evaluation

Each principal investigator is required to fill out a Project Format (PF) form. This form provides for a brief description of the objectives, methodology, and expected impact of the project. The PF format is required in addition to the original detailed project document. At the end of each year, the principal investigators fill out a single page Annual Report (AR) form. Detailed annual reports are also required. The PF and AR forms are useful to the Coordinator, the Steering Committee, and other interested parties who need a quick overview of progress made. Examples of the English versions of these forms are given in the Annex.

Each project is evaluated at the working group meetings. Evaluators are appointed by the Coordinator and they fill out a standard evaluation form, an example of which is also given in the Annex.

TRAINING

Striga Training Workshop

The first training workshop was on *Striga* control and was held in Ouagadougou, Burkina Faso, from 5 to 10 October, 1987. There were 12 participants from the following 11 countries: Burkina Faso, Cameroon, Gambia, Ghana, Kenya, Mali, Niger, Nigeria, Sudan, Togo, and Uganda. Two participants came from Uganda. In addition to ICRISAT scientists, specialists from IRAT, Sudan, and Old Dominion University assisted in the training.

Training Workshop on Agronomic Research and On-Farm Testing

This workshop was held in Bamako, Mali between 9 and 29 September, 1989. Nine out of ten countries invited were represented. The representative from Central African Republic was absent. The countries invited were Central African Republic, Côte d'Ivoire, Gambia, Ghana, Guinea Bissau, Mauritania, Niger, Nigeria, Senegal, and Sierra Leone. There was a total of 11 lectures and five field visits. Lecture topics ranged from soil fertility, control approaches to *Striga*, and crop and animal interaction to principles of on-farm testing. Field visits included a trip to the Cinzana research station some 270 km from Bamako, the national program at the Sotuba station just outside Bamako, a special *Striga* field trip to Katibougou, about 70 km north of Bamako, and trials of ICRISAT's West African Sorghum Improvement Program (WASIP) at the new site at Samanko, 18 km from Bamako.

REGIONAL TRIALS AND NURSERIES

1986 Trials

The West African Sorghum Adaptation Trials were organized by the SAFGRAD/ICRISAT West African Sorghum Improvement Program, as per the recommendations of the Steering Committee of WCASRN.

During 1986, three regional trials were organized. These were the West African Sorghum Variety Adaptation Trial early and medium duration varieties (WASVAT-Early and Medium) and the West African Sorghum Hybrid Adaptation Trial (WASHAT). The variety trials comprised of 20 entries each while the hybrid trial comprised of 36 entries, including controls. The regional trials comprised of elite breeding lines and hybrids contributed by ICRISAT and the National Sorghum Programs of Burkina Faso and Mali. The entries included in the trials were mostly of recent origin and represented promising lines from various breeding programs. Cooperators in the national programs were expected to select useful entries from these trials for further testing and advancement in their countries.

16

Seeds of WASVAT-Early were dispatched to cooperators in nine countries. Results were received from seven locations in five countries. In general, results from five locations were satisfactory and were included in the statistical analysis (Table 3). Grain yield data from two locations were excluded from statistical analysis because of high coefficient of variation. The overall means of individual entries were affected to some extent by the very high yields at Guiring location. Accross the five locations, ICSV 1078 BF was the highest yielder followed by the entries ICSV 1054 BF, ICSH-1 and ICSV 1055 BF. However, exclusion of the data from Guiring would show that the hybrid control ICSH-1 as the topmost yielder and ICSV 16-5 as another promising entry. The local control varieties yielded low at all the locations except Guiring where the improved control variety S-35 yielded the highest (6.84 t ha^{-1}). Examination of ranks across locations indicated that ICSH-1, ICSV 1078 BF, ICSV 1054 and ICSV 16-5 obtained high ranks consistently. The lowest mean yield for all the locations was 2.45 t ha^{-1}.

Overall means of time to 50% flower among test entries ranged from 63 to 72 days. Average number of days to 50% flower were lowest at Guiring and highest at Kamboinse and Sapu. Mali Sor 84-7 flowered later than all the other entries.

Seeds of WASVAT-Medium were supplied to cooperators at twelve locations. Results were received from eight locations. However, grain yield data from two locations were not subjected to statistical analysis because of high coefficient of variation. Overall, the hybrid control ICSH-1 exhibited the highest yield (2.59 t ha^{-1}) across locations and was the most stable. Among the test entries, ICSV 1063 BF and IS 915 were the highest yielders. IS 915 was the highest yielder at Gampela and Karewa locations. It has brown colored grains. ICSV 126 IN was the highest yielder at Saria followed by PM 11344, a midge resistant variety which gave high yields at Gampela and Nyankpala also. ICSV 1063 BF was the highest yielder at Sapu while ICSV 1074 BF gave the highest yield at Kamboinse. The mean yield for the five locations ranged from 7.66 t ha^{-1} to 2.59 t ha^{-1} (Table 4).

The mean number of days to 50% flowering of the trial across locations ranged from 64 at Sotuba to 78 at Gampela. On the average, IS 915 was the earliest entry while ICSV 1070 BF flowered the latest. The overall mean days to 50% flower of the hybrid control was 68 and compares well with the observation made in WASVAT-Early duration trial where it took 66 days.

Seeds of WASHAT where distributed to cooperators located in eight countries. The trial was planted at 15 locations. However, the experiments failed at three locations : Niangoloko (Burkina Faso), Sotuba (Mali) and Maradi (Niger), due to extremely late planting in poor fields. Grain yield data was received from 12 locations among which Saria, Fada and Atetou exhibited high coefficient of variation (> 30%). Considering the experimental conditions described by the cooperators and the high coefficients of variation, data from these locations were not considered for the calculation of overall mean yields. At the location Di (Burkina Faso, irrigated off season crop), night temperatures were very low during the anthesis period and resulted in partial sterility of some hybrids. Data from such entries were deleted from the statistical analysis.

At the location Guiring, grain yields of individual entries were as high as 6.37 t ha^{-1} and were out of the range. Overall mean grain yields over nine

locations showed that ICSH 230 ranked first (3.36 t ha^{-1}) followed by ICSH 229 (3.34 t ha^{-1}), ICSH 208 (3.24 t ha^{-1}). The mean yields ranged from 2.24 t ha^{-1} to 3.36 t ha^{-1} (Table 5). The hybrids ICSH 230, ICSH 229 and ICSH 231 have the common female parent ICSA 11. In general, hybrids of ICSA 11 exhibited relatively higher ranks at many locations and better overall mean performance. Other top yielding hybrids were ICSH 134 and ICSH 208.

Overall mean number of days to 50% flower of test hybrids ranged from 57 to 68. ICSH 287, was the earliest flowering hybrid while CSH-5 flowered later than the other test hybrids. On the average, number of days to 50% flower was the lowest at Ferke and highest at Kamboinse.

1987 Trials

Three regional sorghum adaptation trials were conducted. WASVAT-Early and Medium had 20 entries each. Seeds for WASVAT Early and Medium were sent to 10 and 14 countries, respectively. The third trial was WASHAT which had 25 entries and was sent to seven countries. These trials were conducted for the second consecutive year and the entries were elite varieties and hybrids furnished by ICRISAT and by the national programs of Burkina Faso, Cameroon, Ghana, Mali, and Niger. Most of the entries in the WASVATs were tested for the first time, whereas the others represent the best entries from 1986. Results for 1987 were obtained from 9, 12, and 15 locations for WASVAT-Early, WASVAT-Medium, and WASHAT, respectively.

Because of high coefficient of variation, only data from 7 locations for both the WASVATs and from 10 locations for WASHAT are presented. For WASVAT-Early, the variety Nagawhite had the highest mean yield (2.80 t ha^{-1}) for all seven locations (Table 6), and for WASVAT-Medium, it was ICSV 1063 BF with a mean yield of 2.58 t ha^{-1} (Table 7). For WASHAT, ICSH 336 had the highest mean yield (2.80 t ha^{-1}) for all ten locations (Table 8).

The West African Sorghum Disease Resistance Nursery (WASDRN) was sent for the first time in 1987 to five countries and was grown in six locations. The nursery had 36 entries of which 20 were promising genotypes observed for resistance to leaf diseases in preliminary observation nurseries of ICRISAT's Burkina Faso Pathology program since 1985. They originated from ICRISAT's breeding program in Burkina faso. Thirteen of these lines were agronomically promising germplasm lines and the remaining three were susceptible controls. Results received from five locations indicate that six genotypes, 84 W 19, 84 W 848, ICSV 85-4, ICSV 1034 BF, IS 9928, and IS 21658 had low severity scores, 3.5 or less, for the prevalent leaf diseases in all locations.

1988 Trials

WASVAT-Early duration consisted of 20 entries and 14 sets were sent to seven countries. The 20 varieties were the same as for 1987 and entries included varieties from Cameroon, Ghana, Mali, Senegal, and WASIP. Results were received from 10 locations. Results for grain yield are given in Table 9. The variety Nagawhite had the highest mean yield (3.53 t ha^{-1}) of all 10 locations. The overall mean days to 50% flowering ranged from 64 to 76 days.

WASVAT-Medium duration also consisted of the same 20 entries as in 1987, and 19 sets were sent to 15 countries. Varieties were contributed by Burkina Faso, Cameroon, Mali, Niger and ICRISAT-WASIP. Results were received from 11 locations. The results for grain yield are given in Tables 10. The coefficients of variation were higher than 40% for five locations. Thus, only yield data for the remaining six locations are given in Table 10. The variety ICSV 1063 BF had the highest mean yield (3.34 t ha^{-1}) of all six locations. The overall mean days to 50% flowering ranged from 69 to 85 days.

West African Sorghum Hybrid Adaptation Trial (WASHAT) consisted of 20 entries and was grown at 12 locations in seven countries. Results for grain yield from seven locations are given in Table 11. The hybrids ICSH 507 ranked first for mean yield (3.31 t ha^{-1}) of all seven locations, and exhibited consistent performance across locations. Overall mean time to 50% flowering ranged from 66 to 76 days.

West African Sorghum Disease Resistance Nursery (WASDRN). This nursery contained the same 36 entries as in 1987 and was grown at seven locations in six countries. The objective of WASDRN is to identify stable resistance to the important leaf diseases of sorghum in West Africa. The leaf diseases, leaf anthracnose (*Colletotrichum graminicola*), sooty stripe (*Ramulispora sorghi*) and gray leaf spot (*Cercospora sorghi*) are important in West Africa. Three genotypes, 84 S 82, 84 S 103-3, and 84 S 130, had low levels of infection to these three leaf diseases at all seven locations. Sooty stripe severity was very low, disease score of 3 or less in a 1-6 scale, at all locations except Bengou in Niger. Disease severity did not exceed 3.0 for any disease for all 36 genotypes in Ghana.

The West African Sorghum *Striga* Trial (WASST) was organized for the first time at the request of several national programs. The trial consisted of 11 entries which had been tested by ICRISAT in fields with high *Striga* infestation and one local control. The trial was sent to Cameroon, Ghana, Mali, Niger, Nigeria, and Togo, and results were received from Cameroon, Ghana, and Mali. The results showed that IS 9830 and ICSV 1007 BF are promising lines for *Striga* resistance.

1989 Trials

WASVAT-Early was sent to 16 locations in 12 countries and results were received from 13 locations in nine countries. However, the coefficient of variation (CV) for yield data was high (>30%) in three of these locations and were not included in the general analyses of the results. The yield data in t ha^{-1} is given in Table 12. Mean yield for the 10 locations ranged from 1.27 to 2.85 t ha^{-1}. Among the test varieties, ICSV 1079 had the highest mean yield of 2.74 t ha^{-1}. The top four varieties after ISCV 1079 BF were CS 61 (2.65 t ha^{-1}), ISCV 111 IN (2.55 t ha^{-1}), and ISCV 1172 BF (Table 12).

The control variety Nagawhite had the highest yield of 2.85 t ha^{-1} of all the entries in the trial.

The mean time to 50% flowering for all entries was between 64 and 74 days. The earliest variety was ICSV 401 IN. Other early varieties were CE 196-7-2-1 and CS 54 (65 days), and ICSV 258 IN and CE 151-38-2 (66 days). Plant height varied from 1.4 to 2.4 m. Among the test varieties, Nabana Beida was the tallest and ICSV 1176 BF was the shortest.

WASVAT-Medium was sent to 19 locations in 10 countries. The CV for yield data from three countries were too high (> 30%) and were not included in the analyses. In addition, the results from one location arrived after the preparation of the report. The yield data in t ha^{-1} is given in Table 13. Mean yield for the nine locations ranged from 0.75 t ha^{-1} to 2.37 t ha^{-1}.

The top five varieties for mean yield across locations were ICSV 1171 BF (2.37 t ha^{-1}), F2-20 (2.34 t ha^{-1}), CS 95 (2.32 t ha^{-1}), ICSV 1089 BF (2.29 t ha^{-1}), and SEPON 82 (2.25 t ha^{-1}) (Table 13).

The mean time to 50% flowering for the test entries was between 72 and 97 days. The earliest variety was CS 95. Other early maturing varieties were BF 80-6/6-2-3 (74 days) and ICSV 1157 (77 days). Plant height ranged from 2.0 to 4 m. The tallest variety was NCV-1.

Seeds of WASHAT were despatched to cooperators located at nine locations in six countries. Results were received from eight test locations from the six countries.

ICSH 507 exhibited the highest mean grain yield of 3.66 t ha^{-1} and ranked first while ICSH 780 and INRAN Sorghum Hybrid Tx 623 A x MR 732 obtained the second and third ranks, respectively. ICSH 89002 NG was another good yielding hybrid. The INRAN sorghum hybrid Tx 6233 A MR 732 was the best yielder at both the test locations of Niger. ICSH 89002 NG was the highest yielder at Guiring while ICSH 507 was the best yielder at Bagauda (Table 14).

Overall mean time to flower of the trial varied from 58 days (Guiring, Cameroon) to 79 days (Burkina Faso). The overall mean time to flower of the test hybrids ranged from 64 to 73 days. Overall mean plant height of the test hybrids ranged from 1.68 m to 2.10 m. Late maturing and tall varieties of local origin were used as controls at Farako-Ba and Samanko.

Although 10 sets of the nursery were sent to nine countries, results were received from only two countries. The scores for the 25 entries were given for gray leaf spot and leaf anthracnose at both sites. Twenty two out of 25 entries and all 25 entries had mean scores of less than 3 on a 1-6 scale, for anthracnose and gray leaf spot, respectively at both sites. The most resistant lines for both diseases included 84 S 82, 84 S 130, 84 S 103-2, and IS 3443.

The *Striga* trial was sent to nine countries and results were received from six countries. The promising lines for *Striga* resistance included ICSV 1001 BF, ICSV 1007 BF, ICSV 1164 BF, and IS 9830.

1990 Trials

The West African Sorghum Variety Adaptation Trial (WASVAT-Early) had 20 entries. There were 17 test entries and three controls. The entries included varieties from the national programs of Camerron, Senegal, Mauritania, Ghana, and from ICRISAT's West African Sorghum Improvement Program (WASIP). Fifteen sets of this trial were sent to 12 countries and results were received from 13 locations in 11 countries. The variety CE 196-7-2-1 had the highest mean yield (2.53 t ha^{-1}) for all 13 locations (Table 15). The top four test varieties after CE 196-7-2-1 were ICSV 1174 BF (2.26 t ha^{-1}), ICSV 401 IN (2.22 t ha^{-1}), ICSV 1172 BF (2.14 t ha^{-1}) and Nabana Beida (2.14 t ha^{-1}) (Table 15). The mean time to 50% flowering for all entries was between 68 and 77 days. The earliest variety was ICSV 1125 BF. Other earlier maturing varieties were ICSV 258 IN, ICSV 1174 BF and ICSV 1176 BF, all three of which flowered in 69 days. Based on the mean for all 13 locations, plant height varied from 1.75 to 2.15 m. Among the test entries, ICSV 1177 BF was the tallest and ICSV 1172 BF was the shortest (1.75 m).

The West African Sorghum Variety Adaptation Trial (WASVAT-Medium) also had 20 entries of whigh three varieties were controls. The entries included varieties from Cameroon, Ghana, Niger, Senegal, Mauritania, Burkina Faso, Benin and WASIP. Nineteen sets of WASVAT-Medium were sent to 15 countries and results were received from 13 locations in 11 countries. The variety CS 85 had the highest mean yield of 2.09 t ha^{-1} for the 13 locations followed by Sepon 82 (1.96 t ha^{-1}), F2-20 (1.94 t ha^{-1}), IS 6928 (1.90 t ha^{-1}), and ICSV 1171 BF (1.83 t ha^{-1}) (Table 16). The mean time to 50% flowering for all entries was between 75 for BF 80-10/6-2-3 and 83 for IS 23526. Based on the mean for all 13 locations, plant height varied from 1.96 to 2.48 m. Among the test varieties, Niobougou was the tallest and ICSV 1171 BF the shortest (1.96 m).

The West African Sorghum Hybrid Adaptation Trial (WASHAT) was coordinated and the results analyzed by WASIP in Nigeria. Thus, the presentation of the data in Tables 10, 11 and 12 for this trial is slightly different from those of WASVAT-Early and -Medium.

WASHAT had 20 entries of which two were controls. Two of the test entries came from the national program of Niger whereas the rest were contributed by WASIP. WASHAT was grown in 10 locations. Grain yield was calculated from 8 locations. Based on the mean for those 8 locations, the highest yielding hybrid was ICSH 89008 NG (3.68 t ha^{-1}) followed by ICSH 89012 NG (3.56 t ha^{-1}), ICSH 89007 NG (3.54 t ha^{-1}) and ICSH 89014 NG (3.52 t ha^{-1}) (Table 17). The mean time to 50% flowering for all 10 locations was between 63 for ICSH 780 and 73 days for ICSH 89005 NG. The mean height fOR all 10 locations for the test entries ranged from 1.62 m for ICSH 89012 NG to 1.93 m for ICSH 89001 NG.

The West and Central Africa Sorghum *Striga* Trial (WCASST) consisted of 12 entries of which one was a local control. Eleven sets of WASST were sent to 11 locations in eight countries. Results were received from three locations in three countries. In one of these locations, no *Striga* was recorded. The results from the two remaining locations indicated that ICSV 1001 BF (Framida) and ICSV 1078 were among the entries with the five lowest *Striga* counts. Other entries with low *Striga* counts in each of the two locations were ICSV 1079 BF, ICSV 1098 BF, ICSV

1115 BF and ICSV 1112 BF. *Striga* counts were based on the total number of *Striga* plants from the two center rows of 4-row plots at 90 days after sowing.

Mean *Striga* counts for the varieties mentioned above did not exceed 43. In contrast, the highest *Striga* counts obtained were 71 at one of the locations and 102 at the other.

The West African Sorghum Leaf Disease Nursery (WASDLN) had 25 entries and was dispatched to 8 locations in 7 countries. Results were received from 4 locations in 4 countries. The prevalent leaf diseases in these 4 countries were sooty stripe, gray leaf spot and leaf antrhacnose. Six varieties, 84 S 82, 84 S 103-2, 84 S 126, ICSV 2 IN, ICSV 85 BF, and ICSV 1023 BF, were moderately resistant (3 or less, scale of 1-6) to all of the diseases at all locations. However, it is worth noting that 84 S 109 and IS 3443 were resistant (score of 2 or less) at the three locations were leaf anthracnose was reported. Leaf anthracnose is the most damagining sorghum leaf disease both in locals and introduced genotypes.

The list of the varieties and the programs which contributed them for all the trials are given in Annex 2. It is suggested that the tables on these trials should be closely studied in order to better appreciate the yield performances of the entries in different locations.

1991 Trials

The numbers of each of the five trials and nurseries dispatched per country for 1991 are given in Table 18.

FINANCIAL SUPPORT TO NON-LEAD NARS

The 12 non-lead NARS to which $ 1,000 were paid, and the status of expenses, with respect to acknowledgement and justification, are given in Table 19. Five of the 12 countries have not acknowledged receipt of the payment. In addition to acknowledging payment, the remaining 7 countries have sent a list of expenses incurred. Only one country had receipts attached to the list of expenses. The Network has not made any new payments for 1991 so far.

MONITORING TOURS

1986. A group of national scientists from Benin, Central African Republic, Gambia, Mauritania, Nigeria and Senegal visited national programs in Cameroon, Gambia, Nigeria and Senegal from 23 September to 6 October, 1986. The visiting national scientists were able to exchange views on the sorghum production problems, and the on-going research programs in the countries visited.

The scientists from the national programs of Ghana, Guinea Bissau, Mali, Niger and Sierra Leone visited the research stations located at Kamboinsé, Saria and Farako-Ba in Burkina Faso during 13-16 October 1986 to observe breeding

material, experimental varieties and hybrids, and male steriles and to select material of interest to them.

1987. Representatives from the national programs of Benin, Burkina Faso, Cameroon, Chad, Cote d'Ivoire, Gambia, Niger, Nigeria, Senegal, Togo and Mali visited Burkina Faso. The participants monitored sorghum research activities in the national program, and the on-going ICRISAT's research work.

1988. A monitoring tour was organized between 9-18 October, 1988 in which representatives of Benin, Burkina Faso, Cameroon, Guinea, Mali, Chad and Togo visited Mali, Burkina Faso and Niger. They visited national, regional and international trials and nurseries at Sotuba, Samanko and Cinzana in Mali, Farako-Ba and Saria in Burkina Faso, and Lossa, Tillabery and Maradi in Niger.

STEERING COMMITTEE MEETINGS

The first meeting of the Steering Committee of WCASRN took place in Ouagadougou between 13 and 14 January 1986. The following terms of reference for the Steering Committee were agreed upon :

1. the Steering Committee will play a key role in guiding the network activities.

2. The Steering Committee will monitor the execution of recommendations adopted by the general assembly in the workshops.

3. The Steering Committee will propose for discussion at the regional workshops new themes/ideas of interest to the network and related plan of action.

4. The Steering Committee, through the network Coordinator, will send a report of its decisions to all the members of the network. This report will be a subject of discussion in the workshop.

Other important matters discussed at that meeting were the recommendations adopted at the first and second regional workshop, identification of priorities, mechanics and plan of action for the Network and group travel of researchers from NARS.

The second Steering Committee meeting was held in Ouagadougou between 10 and 11 March, 1987. The following topics were discussed:

1. Germplasm collection and storage from the 17 member countries of the Network.

2. Organization of a *Striga* training workshop.

3. Regional trials.

4. Inter-regional interaction of scientists from NARS.

5. Short-term visits and training for NARS scientists.

6. Visits to ICRISAT's program in Burkina Faso by representatives from some of the 17 member countries;

7. The next regional workshop in Maroua, Cameroon in January 1988;

8. Collaborative research projects with NARS;

9. Collaboration with IRAT/CIRAD;

10. SAFGRAD's new strategy for the Networks.

The third Steering Committee meeting was held in Ouagadougou between December 15 and 17, 1987. The main objective of the meeting was to discuss practical means to strengthen national programs and to seek supplemental financial assistance. The more salient points of the meeting were as follows:

- number of Committee members from national programs was increased from 4 to 6;

- the name of the Network was changed from West African Sorghum Research Network to West and Central Africa Sorghum Research Network (WCASRN);

- the Coordinator should explore the possibility of conservation of NARS' germplasm collection at ISC;

- that the Network provide supplemental assistance of 100,000 CFA per trial to each national program to which regional trials are sent, to the extent of a total of 27 trials for the year 1988;

- that the scheduled workshop be postponed to August 1988.

The fourth meeting of the Steering Committee was held in Maroua, Cameroon on September 24, 1988, after the third regional workshop. An important decision at the meeting was that in view of inadequate funds to network support, and the need to support weaker national programs, the Coordinator was requested to explore the possibility of transferring funds from under-utilized line items to network support line item.

The fifth Steering Committee meeting was held in Bamako, Mali between May 9 and 11, 1989. The Committee elected Dr. M. Traoré as the new chairman to replace C.E. Ohiagu, who had left the services of IAR, Samaru. The Committee decided to invite Chad to replace Senegal as member and to invite Glaobal 2000 to become an observer. Important issues at the meeting were as follows:

- the Acting Coordinator informed the Committee that he had presented a revised proposal to SPAAR in March 1989 regarding supplemental funding to strengthen NARS;

- in order to provide relevant training to national programs, selected African Universities and national research centers should be utilized in order to optimize available resources;

- in order to help weaker NARS fully participate in the Network, the Coordinator could use lead NARS scientists to visit weak NARS;

- the Coordinator was asked to promote the intensive evaluation of the selected varieties from the regional trials such as ICSV 1063 BF, CE 180-33, ICSV 111 IN (early), and ICSV 1063 BF, ICSV 1089 BF, and Malisor 84-1 (medium).

The sixth Steering Committee meeting was held in Ouagadougou, Burkina Faso, between November 14-17, 1989. The Committee spent most of its time discussing the development of the long-term strategic plan for phase III of the Network. The strategic plan will consider the following:

- improvement of NARS research bases;

- the extent to which lead NARS were developed to be able to discharge regional research responsibilities to generate and evaluate technologies;

- the extent of training support provided by respective NARS governments and donors to implement proposed long-term plans for human resource development;

- more resource committements to agricultural development and research by government of respective NARS;

- the extent to which an environment conducive to a productive research career has evolved to motivate NARS scientists to increase research output for national development;

- administrative simplicity of the Network Coordination unit is provided;

- the extent and re-orientation of IARC's programs to provide technical back-stopping with sensitivity to shift network leadership and management to NARS.

Some of the other salient points raised at the meeting were:

- the Committee agreed that the Coordinator should hire translation services for Network activities as required;

- the Coordinator will use unexpended training fund (approximately $ 1,000) and shift approximately $ 7,000 from other Network budget items to finance the participation of 4 network personnel to the SAFGRAD Combined Networks Agronomy Training Workshop in late 1990;

- Funds budgeted for Monitoring Tours and Workshop in 1990 will be used to finance a Training Workshop on Post Harvest Technology, Seed Quality and Utilization on March 25 - April 5, 1991 in Kano, Nigeria;

- the next Regional workshop was scheduled for January 15-18, 1991 in Niamey. In order to encourage a higher caliber of technical

publications, the Committee decided to call 2 types of papers; scientific papers of journal quality will be invited from selected individuals in the network, as well as from international authorities in sorghum;

the Committee was informed of the availability of funds for research projects from the African Development Bank via the SAFGRAD Coordination Unit. Dr. Bezuneh will provide projects proposal forms to all member countries.

The seventh Steering Committee meeting was held between 2 and 4 May, 1990 in Niamey, Niger. Members and observers of the current Steering Committee are as follows:

Burkina Faso	S.Da	member
Cameroon	O.P. Dangi	member
Chad	D. Yagoua	member
Mali	M.D. Traoré	member (Chairman)
Niger	J.W. Clark	member
Nigeria	C.C. Nwasike	member
ICRISAT	M.D. Thomas	member (Coordinator)
SAFGRAD	T. Bezuneh	Regular observer
USAID	G. Kingma	Regular observer
Global 2000	A representative	observer
INSAH/CILSS	A representative	observer
IRAT/CIRAD	A representative	observer.

The Steering Committee decided to invite INTSORMIL and the Team Leaders of ICRISAT's West African Sorghum Improvement Programs (WASIP) in Kano, Nigeria and in Bamako, Mali, as observers.

Major points dicussed at the seventh Steering Committee meeting included results of the 1989 regional trials, collaborative research projects, the budget, and some future activities of the Network. In keeping with the philosophy of the Network that stronger NARS should help weaker ones, the Committee agreed that during the 1990 crop season, S. Da would visit Togo and Benin, C.C. Nwasike would visit Ghana, and O.P. Dangi Chad and Central African Republic. Another important decision was that WCASRN would hold its fourth regional workshop jointly with the two other commodity Networks (Cowpea and Maize) on 25 to 30 March, 1991 in Niamey, Niger. Other decisions were:

1. that the collaborative project from Cameroon on *Striga* be accepted on the condition that the work involved, identitification of resistant lines with a view to develop a regional *Striga* nursery;

2. a joint agronomy workshop for all three commodity networks;

3. that WCASRN invites representatives from some NARS to attend, at the expense of the Networks, the sorghum utilization conference in Bamako, Mali in November 1990.

The eighth Steering Committee meeting was held in Bamako between 3 and 4 December, 1990. In addition to the usual observers, Global 2000, the Team Leaders

of ICRISAT's programs in Bamako, Mali and Kano, Nigeria, principal staff from ICRISAT's program in Mali and a representative of IBPGR were present. Some of the more important decisions taken at that meeting were:

- the Network would start regional agronomy trials;
- an in-service training course on plant protection would be conducted at ICRISAT-Mali in September/October, 1991;
- financial support to the five projects were increased, so also was that for the 12 non-lead NARS; the latter from $ 1,000 to $ 2,000;
- $ 12,000 for sorghum hybrid production training course for NARS to be held in September, at ICRISAT, Kano.

The ninth Steering Committee meeting was held in Niamey, March 13 and 14, 1991, during SAFGRAD's Inter-Network Conference. At that meeting, the Committee took the following important decisions:

- the working groups on the research project and the tenth Steering Committee meeting would be held concurrently at ICRISAT, Kano in November, 1991;.

- the IRAT/CIRAD principal agronomist with ICRISAT/IRAT program in Mali should coordinate the proposed agronomy trials. He had initiated the idea at the eighth Steering Committee meeting.

REGIONAL WORKSHOPS

The first regional sorghum workshop was held in Ouagadougou, Burkina Faso from 27-30 November, 1984. In this workshop, the NARS requested ICRISAT to coordinate the network activitities. It was attended by a total of 46 participants from 16 countries. There were also representatives from ICRISAT Center, IRAT, INSAH/CILSS, and SADCC/ICRISAT.

The second regional workshop was held in Bamako, Mali from 21-24 October, 1985. This workshop was attended by 47 scientists from 15 countries. Representatives from ICRISAT Center, IRAT, INSAH/CILSS, SAFGRAD, INTSORMIL, and TROPSOIL also attended. During this workshop, a Steering Committee was formed to help the network. Several recommendations were made.

The third regional workshop was held in Maroua, Cameroon from 20-23 September, 1988. It was attended by 52 participants from 14 countries. It was also attended by representatives from IRAT, ICRISAT Center, and SAFGRAD. A total of 33 technical papers were presented.

The fourth regional workshop was held in Niamey between 7 and 14 March, 1991 as part of the Inter-Network Conference for all of SAFGRAD' Networks. Twenty representatives from 15 NARS participated in the sorghum section of the conference. In addition, there were 16 other participants from various regional and intercontinental organizations, including seven principal staff and five research assistants from ICRISAT/IRAT in Bamako, ICRISAT Bilateral Program in Mali and ICRISAT in Kano. During the joint session of all the Networks, three scientific papers were presented from the Sorghum Network. In the separate Sorghum Network session, 10 scientific papers and 15 country reports were

presented. Recommendation groups on agronomy, breeding, plant protection, and sorghum utilization were formed.

VISITS TO NATIONAL PROGRAMS

Details of visits made to NARS are given below. During each of these visits, the Terms of Reference for Visits to National Programs developed by the Network acted as a guide. During these visits, information was obtained for the Network's Manpower Information Form. Separate reports on these visits are available on request.

Country	Visited by	Month-Year
Senegal and Gambia	M.D. Traoré*	September, 1989
Burkina Faso	Coordinator	October, 1989
Guinea (Conakry)	Coordinator	April, 1990
Sierra Leone	Coordinator	April, 1990
Burkina Faso	Coordinator	July, August, 1990
Ghana	C.C. Nwasike*	August, 1990
Nigeria	Coordinator	September, 1990
Niger	Coordinator	September, 1990
Benin	S. Da*	September, 1990
Tchad	Coordinator and O.P. Dangi*	October, 1990
Burkina Faso	Coordinator (pre-season)	May, 1991

(An asterisk indicates Steering Committee member).

SECTION - II

SECTION TWO

DIFFICULTIES AND SHORTCOMINGS

Regional Trials

The quality of the results needs to be improved. The notebooks containing the results are received too late and thus the preparation of the annual progress report is also delayed. More and more NARS are requesting funds for the conduct of these trials. It is not known how the absence of funds for these trials have affected the level of management of the trials. Another difficulty has been that the results from these trials have not been widely distributed to the NARS. Almost always the French versions of these results and of the annual progress report do not exist. The reason for this latter problem is given below. Since the inception of the varietal and hybrid trials, no stability analysis test (genotype x interaction) has been carried out. Systematic monitoring and more intensive evaluation of promising lines from these trials by NARS only started in 1991. A systematic procedure by the Network to get NARS to use these lines in their programs should have been developed. For example, separate multiplication and distribution of the seeds to breeding programs of the NARS. A number of varieties received from NARS for the 1990/91 off-season multiplication as entries in the 1991 trials either did not germinate or did not flower. In other cases, seeds were received too late for multiplication. In the latter case, the affected NARS were asked to furnish enough seeds from their stock. These arrived late, which in turn delayed the dispatch of the trials.

Translation of Reports and Other Network Documents

Thirteen of the 17 NARS in the Network are French speaking, yet more than 90% of the documents from the Network are in English. Although the Steering Committee has approved the recruitment of an individual on an ad hoc basis for this purpose, the availability of persons competent enough is a bottleneck. The present bilingual administrative secretary can type reports and other documents written in English directly into French. Perhaps, all documents should be produced in French in the first instance and then translated into English as and when it is necessary.

Visits to NARS

The size of the Network, with 17 countries, creates a problem with respect to annual visits by the Coordinator. Even if half of these countries are visited per year, it takes a lot of time to travel and to effectively interact with officials and the NARS scientists during the limited period when the crop is going through its maturity cycle -heading to physiological maturity. Thus, visits to NARS by the Coordinator have not been as frequent as it should be.

Training

Enough emphasis has not been given to training. During the period under review, only two short-term training programs were conducted.

SUGGESTIONS FOR THE FUTURE

Research Projects

The project on *Striga* in Cameroon was started one year later than the other projects. There were logistic and technical difficulties with the project on long smut in Niger during the first year.

Financial Accountability

Whereas financial accountability from lead NARS where the research projects are conducted has been fairly good, that from the 12 non-lead NARS need improvement. It was difficult to get some NARS to acknowledge receipt of the $ 1,000 paid to them. After reminders, financial reports were eventually received and for the most part without supporting documents. However, it should be recognized that it is sometimes difficult to get specific receipts for small purchases especially if they are made at a general market place.

SUGGESTIONS FOR THE FUTURE

Since the present phase of the SAFGRAD project will end in December, 1991, no elaborate plans have been drawn up for the 1991/92 program of activities. Both the lead and non lead NARS will be requested to account for all payments made to them by December 15, 1991.

However, in planning for the future in Phase III of SAFGRAD project, it might be worth considering the following:

a) Expand on-going research projects with NARS and initiate new ones. Thus, it is envisaged that the Network will become more of a "research" network than a "trials" network;

b) Organize in-service training in various disciplines, but with emphasis on agronomy and food technology;

c) Supervise seed multiplication and dispersal of regional trials and nurseries both by ICRISAT and by strong NARS with the requisite capability;

d) Degree training up to M.Sc. and Ph.D levels according to the needs of the NARS;

e) Assist the NARS in developing promising varieties and hybrids with high and stable yields;

f) Facilitate the exchange of germplasm between member states;

g) Organize annual research working groups on the collaborative research projects with active participation of NARS;

h) Organize germplasm collection and evaluation within agronomic packages for the NARS;

i) Organize once every two years scientific meetings and regional workshops as the forum for evaluating progress and planning for the future;

j) Organize monitoring tours in years when scientific meetings and regional workshops are not scheduled.

k) It would perhaps be necessary to streamline the regional trials and nurseries with respect to the number of countries that should conduct the trials. Promising lines from the trials sould be multiplied and made available to those countries which did not particpate in the conduct of the trials.

l) The philosophy behind visits to NARS by the Coordinator sould be revised. This activity should be shared by Steering Committee members.

m) More technical assistance to the Network by both scientists from lead NARS and ICRISAT scientists should be encouraged.

n) A revision of both the technical and secretarial staff of the Coordinator would be necessary.

An enormous effort should be made to ensure the flow of technology developed in the Lead Centers, where research projects are carried out, to the Associate Centers. In shifting the overall emphasis of the Network from a "trials Network" to a "research Network", this activity will become a priority. The role of a research associate as a Network staff will be extremely important in this regard by working closely with principal investigators in the Lead Centers, researchers in the Associate Centers, and encouraging the Technology Adopting Centers to implement the "finished" product.

TABLES

LIST OF TABLES

Table 1. Distribution of the more important biotic and abiotic stress factors of sorghum and classification of national program for research purposes according to the prevalence of the stress factor and the manpower capability of the national programs into Lead, Associate, and Technology Adapting Centers.

Table 2. Country, project title, amount paid so far and reports received for the six research projects of WCASRN.

Table 3. Mean grain yield (t ha^{-1}) of highest yielding early duration varieties in the West African Sorghum Variety Adaptation Trial (WASVAT) at five locations in West Africa, rainy season, 1986[1].

Table 4. Mean grain yield (t ha^{-1}) of highest yielding medium duration varieties in the West African Sorghum Variety Adaptation Trial (WASVAT) at six locations in West Africa, rainy season, 1986[1].

Table 5. Mean grain yield (t ha^{-1}) of highest yielding hybrids in the West African Sorghum Hybrid Adaptation Trial (WASHAT) at eight locations in West Africa, rainy season, 1986[1].

Table 6. Mean grain yield (t ha-[1]) of highest yielding early duration varieties in the West African Sorghum Variety Adaptation Trial (WASVAT-Early) at seven locations in West Africa, rainy season 1987.

Table 7. Mean grain yield (t ha-[1]) of highest yielding medium duration varieties in the West African Sorghum Variety Adaptation Trial (WASVAT-Medium) at seven locations in West Africa, rainy season 1987.

Table 8. Mean grain yield (t ha^{-1}) of highest-yielding early duration varieties in the West African Sorghum Hybrid Adaptation Trial (WASHAT) at 10 locations in West Africa, rainy season 1987[1].

Table 9. Mean grain yield (t ha^{-1}) of highest-yielding early duration varieties in the West African Sorghum Variety Adaptation Trial (WASVAT) at 10 locations in West Africa, rainy season 1988[1].

Table 10. Mean grain yield (t ha^{-1}) of highest-yielding medium duration varieties in the West African Sorghum Variety Adaptation Trial (WASVAT) at six locations in West Africa, rainy season, 1988[1].

Table 11. Mean grain yield (t ha-1) of selected hybrids in the West African Sorghum Hybrids Adaptation Trial (WASHAT) at seven locations in West Africa, rainy season 1988[1].

Table 12. Mean grain yield (t ha^{-1}) of the top six early duration varieties in the West African Sorghum Variety Adaptation Trial (WASVAT) from 10 locations grown in a randomized block design, three replications with plot size between 5.8 and 14.4 m^2, rainy season, 1989.

Table 13. Mean grain yield (t ha^{-1}) of the top six medium duration varieties in the West African Sorghum Variety Adaptation Trial (WASVAT-Medium) from 10 locations grown in a randomized block design, three replications with plot size between 6 and 14.4 m^2, rainy season, 1989.

Table 14. Mean grain yield (t ha^{-1}) of tes hybrids in the West African Sorghum Hybrid Adaptation Trial (WASHAT) - 1989 at eight locations, rainy season, 1989.

Table 15. Mean grain yield (t ha^{-1}) of the top six early duration varieties in the West African Sorghum Variety Adaptation Trial (WASVAT) from 13 locations grown in a randomized block design, three replications with plot size between 4.8 and 14.4 m^2, rainy season, 1989.

Table 16. Mean grain yield (t ha^{-1}) of the top six medium duration varieties in the West African Sorghum Variety Adaptation Trial (WASVAT) from 13 locations grown in a randomized block design, three replications with plot size between 4.8 and 14.4 m^2, rainy season, 1989.

Table 17. Grain yield (t ha^{-1}) performance of test hybrids across eight locations in the West African Sorghum Hybrid Adaptation Trial (WASHAT) - 1990[1].

Table 18. West and Central Africa Sorghum Research Network (WCASRN). Regional Trials and Nurseries, 1991.

Table 19. Status as of May 1991 of $ 1,000 paid to 12 non-lead NARS in 1990.

Table 1. Distribution of the more important biotic and abiotic stress factors of sorghum and classification of national program for research purposes according to the prevalence of the stress factor and the manpower capability of the national programs into Lead, Associate, and Technology Adapting Centers.

	Insects		Diseases					*Striga*	Grain			
Country	PAN	BOR	GM	SS	AN	GL	LS		QL	UT	DR	ST
Burkina Faso	A	A	L	A	L	A		A	A			
Cameroon				A	A	A		L			A	A
Mali	L		A	A	A	A	A	A	A		A	A
Niger		A					L		L		A	
Nigeria	A	L	A				A	A		A	A	L
Côte d'Ivoire	A											
Ghana	A		A									
Benin												
CAR												
Tchad												
Gambia											A	
Guinea												
Guinea Bissau												
Mauritania												
Senegal												
Sierra Leone												
Togo												

1. Stress factors: PAN: panicle, BOR:boreers, GM: grain molds, SS: sooty stripe, AN: leaf and stem anthracnose, GL: gray Leaf spot, LS: Long smut, QL: grain quality, UT: grain utilization, DR: draught, ST: stand establishment. Classification: L: Lead Centers, A: Associate Centers. The others are Technology Adopting Centers.

Table 2. Country, project title, amount paid so far and reports received for the six research projects of WCASRN.

Country	Project title	Amount paid and date			Reports Received	
		$	CFA	Date	Technical	Financial[3]
Burkina Faso	Identification of sources of resistance to leaf anthracnose of sorghum (*Sorghum bicolor*) caused by *Colletotrichum graminicola* (ces) Wilson in Burkina Faso	2500 2500 2500 4000	877500 787238 712500 1120000	28/6/89 24/11/89 22/6/90 7/5/91	Preliminary, 1989 First year, 1989 Second year, 1990	Complete Complete Partial
Cameroon	Screening of local germplasms of Cameroon and other countries against *Striga hermonthica* in heavily infested field conditions	2500 2500	705000 700000	29/6/90 7/5/91	First year, 1990	Complete
Mali	Studies on head bugs of sorghum in Mali	2500 2500 2500 2500	827500 790000 712500 630500	26/6/89 25/10/89 19/6/90 26/10/90	Preliminary, 1989 First year, 1989 Second year, 1990	Complete Complete Partial
Niger	1. Identification of resistance to long smut 2. Morphologic, Chemical and Nutritive Characterization of seeds of local and improved sorghum in West and Central Africa	2500[1] 2500[1] 2500	- - 700000	- - 7/5/91	Preliminary, 1989 Second year, 1990 -	None None -
Nigeria	Technology for production of acceptable wheat-sorghum composite bread and confectionery	2500[2] 2500[2] 5589[2]	- - -	- - -	Preliminary, 1989 First year 1989/90	Complete Complete

1. Paid through ICRISAT Sahelian Center, Niamey.
2. Paid through ICRISAT, Kano.
3. Partial = some amount still need to be justified. Complete = Total amount justified.

Table 3. Mean grain yield (t ha^{-1}) of highest yielding early duration varieties in the West African Sorghum Variety Adaptation Trial (WASVAT) at five locations in West Africa, rainy season, 1986[1].

Variety	Burkina Faso		Cameroon	Gambia	Ghana	
	Kamboinse	Saria	Guiring	Sapu	Nyankpala	Mean
ICSV 1078 BF	5.58 5	4.16 4	6.75 2	2.82 1	2.01 12	3.66
ICSV 1054 BF	2.68 3	3.55 14	6.70 3	1.96 8	2.73 2	3.52
ICSV 1055 BF	3.07 1	3.98 7	5.63 7	2.09 5	2.07 11	3.37
ICSV 1065 BF	2.08 11	4.31 2	6.07 4	1.56 14	2.41 5	3.28
ICSV 1031 BF	2.00 13	4.10 5	5.65 6	1.91 9	2.4 6	3.21
ICSV 16-5 BF	1.97 14	4.35 1	4.78 14	2.12 4	2.55 3	3.15
Controls						
ICSH-1 (Hybrid)	2.29 9	4.23 3	4.83 12	2.62 2	3.40 1	3.48
Local	0.92 20	3.52 15	6.84 1	1.21 16	-	-
SE	±0.31	±0.36	±0.29	±0.26	±0.31	
Trial mean (20 entries)	2.14	3.67	5.31	1.81	2.00	
CV (%)	25	17	10	26	27	

1. Randomized block design with three replications, plot size ranged from 7.5 to 8.0 m2. Numbers following each yield value indicate the ranking of the varieties.

Table 4. Mean grain yield (t ha^{-1}) of highest yielding medium duration varieties in the West African Sorghum Variety Adaptation Trial (WASVAT) at six locations in West Africa, rainy season, 1986[1].

	Burkina Faso			Cameroon	Gambia	Ghana	
Variety	Kamboinse	Saria	Gampela	Karewa	Sapu	Nyankpala	Mean
ICSV 1063 BF	3.41 6	3.03 9	1.58 11	2.25 4	2.53 1	2.53 2	2.55
IS 915	2.32 19	3.32 5	2.18 1	2.85 1	1.73 15	1.98 6	2.40
ICSV 1074 BF	3.75 1	3.08 8	1.69 7	2.06 6	1.79 14	1.84 12	2.37
PM 11344	2.69 15	3.52 2	1.91 2	1.50 15	2.02 8	2.44 3	2.35
ICSV 1056 BF	3.62 2	3.37 4	1.23 17	1.96 9	2.02 8	1.58 13	2.30
ICSV 1080 BF	3.21 10	3.16 7	1.56 12	1.72 13	2.13 6	1.93 10	2.28
Controls							
ICSH-1 (Hybrid)	3.58 4	2.46 15	1.76 3	2.55 2	2.51 2	2.70 1	2.59
Local	0.85 20	3.23 6	0.69 18	2.05 7	1.47 19	1.53 14	-
SE	±0.38	±0.32	±0.21	±0.39	±0.21	±0.26	
Trial mean (20 entries)	2.96	2.83	1.56	1.87	1.94	1.79	
CV (%)	22	20	24	35	19	25	

1. Randomized block design with three replications, plot size ranged from 7.5. to 8.0 m^2. Numbers following each yield value indicate the ranking of the varieties.

Table 5. Mean grain yield (t ha^{-1}) of highest yielding hybrids in the West African Sorghum Hybrid Adaptation Trial (WASHAT) at eight locations in West Africa, rainy season, 1986[1].

Hybrid	Locations[2] 1		2		3		4		5		6		7		8		Mean
ICSH 230	3.09	3	3.26	10	3.89	6	5.73	15	3.47	5	2.14	6	2.61	14	4.32	3	3.36
ICSH 229	3.02	5	3.59	3	4.17	3	5.93	3	2.50	11	1.90	12	2.78	9	4.31	4	3.34
ICSH 208	3.02	5	3.61	2	4.75	1	5.10	29	2.36	12	3.46	2	3.07	5	3.99	8	3.26
ICSH 134	2.71	10	3.36	8	4.17	3	5.93	9	3.47	5	1.70	18	3.06	6	3.14	21	3.24
ICSH 231	2.43	18	3.23	11	3.78	7	3.57	16	4.03	2	1.92	11	3.67	2	3.01	21	3.20
ICSH 178	3.24	1	2.95	16	2.64	19	5.53	18	3.89	3	1.73	20	3.27	4	3.54	15	3.09
Control[3]																	
Framida	0.91	32	2.72	16	2.51	20	6.37	1	3.06	8	1.54	23	2.57	14	3.15	20	2.68
SE	±0.34		±0.28		±0.33		±0.62		±0.45		±0.24		±0.31		±0.35		
Trial mean (36 entries)	2.38		2.73		3.15		5.33		3.14		1.82		2.49		3.34		
CV (%)	24		17		18		19		24		22		21		18		

1. 6x6 lattice with three replications, plot size ranged from 6.5 to 16 m^2. Numbers following each yield value indicate the ranking of the hybrids.

2. Locations: 1 = Kamboinse, 2 = Farako-Ba in Burkina Faso, 3 = Sapu in Gambia, 4 = Guiring, 5 = Karewa in Cameroon, 6 = Bouake, 7 = Ferkessedougou in Cote d'Ivoire, 8 = Nyankpala in Ghana.

3. Framida is an early maturing variety. The additional three local controls varied according to locations and have not been included in the table.

Table 6. Mean grain yield (t ha-1) of highest yielding early duration varieties in the West African Sorghum Variety Adaptation Trial (WASVAT) at seven locations in West Africa, rainy season 1987[1].

Variety	Farako-Ba	Saria	Sourou	Fada	Samaru	Sapu	Maroua	Mean
Nagawhite	2.81 3	2.90 13	3.08 1	2.07 1	1.48 1	3.58 2	3.68 12	2.80
ICSV 111 IN	2.08 8	3.14 10	1.42 7	1.84 3	0.72 11	2.98 9	5.79 1	2.57
ICSV 1083 BF	2.58 5	3.65 2	1.80 4	1.29 13	1.33 3	2.25 12	4.60 5	2.50
CE 180-33	1.43 16	2.75 16	2.97 2	2.01 2	1.39 2	4.00 1	2.14 20	2.38
S 35	2.47 6	2.77 15	0.86 14	1.69 5	0.50 15	3.04 8	5.30 3	2.37
ICSV 230 IN	3.23 1	3.11 9	2.03 3	1.56 8	0.89 9	2.67 10	2.86 17	2.33
Controls								
ICSH 109 IN	2.97 2	3.80 1	1.33 9	1.46 9	1.02 6	3.42 3	5.25 4	2.75
Local	1.59 13	3.20 7	0.47 16	1.34 11	0.50 15	0.12 14	5.37 2	
SE	±0.38	±0.19	±0.28	±0.21	±0.17	±0.40	±0.62	
Trial mean (20 entries)	2.00	3.07	1.49	1.42	0.94	2.79	3.86	
CV (%)	33	11	33	26	32	25	28	

1. Randomized block design with three replications, plot size ranged from 7.5 to 8 m-2 Numbers following each yield value indicate the ranking of the cultivars.

Table 7. Mean grain yield (t ha-1) of highest yielding medium duration varieties in the West African Sorghum Variety Adaptation Trial (WASVAT) at seven locations in West Africa, rainy season 1987[1]

Variety	Farako-Ba	Saria	Sotuba	Ferké	Samaru	Sapu	Nyankpala	Mean
ICSV 1063 BF	3.20 5	4.00 2	4.87 2	2.76 1	0.94 6	1.67 12	0.62 6	2.58
ICSV 1089 BF	3.52 1	4.26 1	4.49 3	1.33 8	1.50 1	2.29 6	0.59 12	2.56
M 24581	3.26 4	3.35 8	5.04 1	1.58 5	0.93 7	2.67 3	0.56 9	2.48
Malisor 84-1	2.92 8	3.31 10	4.04 8	2.60 2	0.72 14	2.67 3	0.87 3	2.45
ICSV 1093 BF	2.97 7	3.55 4	4.15 7	1.35 7	0.87 10	2.54 4	0.58 8	2.29
BF 80-10-23-2-1	2.97 7	3.35 8	3.15 18	1.60 4	1.24 2	2.25 7	0.99 2	2.22
Controls								
Local	2.50 13	3.42 6	1.16 20	1.99 3	0.67 15	1.33 15	1.68 1	
SE	±0.45	±0.19	±0.44	±0.25	±0.15	±0.28	±0.30	
Trial mean (20 entries)	2.68	3.35	3.78	1.32	0.88	2.05	0.61	
CV (%)	29	10	20	33	30	24	31	

1. Randomized block design with three replications, plot size ranged from 7.5 to 8 m-
Numbers following each yield value indicate the ranking of the cultivars.

Table 8. Mean grain yield (t ha^{-1}) of highest-yielding early duration varieties in the West African Sorghum Hybrid Adaptation Trial (WASHAT) at 10 locations in West Africa, rainy season 1987[1].

Entry	LOCATIONS 1	2	3	4	5	6	7	8	9	10	Mean
ICSH 336	3.90 3	3.26 14	1.81 3	3.15 2	3.11 1	4.33 13	2.61 2	3.51 3	3.72 20	1.04 9	2.80
ICSH 232	3.28 13	3.51 6	2.07 1	3.42 1	2.56 11	4.72 1	1.64 16	3.61 2	4.29 10	0.98 11	2.75
ICSH 643	3.92 2	3.81 1	1.53 8	1.88 11	2.49 13	3.73 8	2.38 4	3.51 3	5.58 2	0.89 15	2.72
ICSH 642	3.39 9	3.34 9	1.92 2	1.70 14	2.75 6	2.87 22	3.16 1	1.44 1	4.90 5	0.98 11	2.64
ICSH 479	3.08 17	3.17 17	1.54 7	1.80 12	2.51 12	3.72 9	1.90 8	0.98 17	6.31 1	1.11 7	2.62
ICSH 229	3.12 16	3.23 15	1.52 19	3.15 2	2.73 8	3.55 11	2.27 5	1.07 5	3.92 16	1.44 2	2.56
Controls											
ICSH 109	2.26 23	3.65 3	1.50 10	1.24 21	2.23 17	3.24 15	0.92 21	1.16 6	4.03 13	0.94 12	2.12
Hageen Durra	0.93 25	2.21 24	1.23 14	2.01 10	2.45 15	3.09 18	0.71 24	1.12 12	2.91 23	0.70 19	1.74
Framida	2.80 21	2.31 23	0.69 24	1.31 20	0.49 21	3.07 20	2.49 3	1.05 15	2.59 24	0.93 13	1.77
Nagawhite	3.24 14	3.50 7	1.10 15	1.23 22	2.20 18	3.97 5	1.86 12	0.91 19	3.09 22	1.19 5	2.23
Local variety	1.35 24	2.40 22	0.92 21	0.72 24	1.95 19	2.54 23	1.98 9	1.12 12	5.58 2	0.60 22	-
SE	± 0.27	± 0.26	± 0.23	± 0.39	± 0.29	± 0.39	± 0.31	± 0.06	± 0.64	± 0.19	
Trial mean	3.12	3.22	1.33	1.94	2.48	3.57	1.73	1.08	4.28	0.97	
CV (%)	15	14	30	35	20	19	31	10	26	35	

1. Locations: 1 = Farako-Ba, 2 = Saria, 3 = Fada, 4 = Gampela, 5 = Kolo, 6 = Sotuba, 7 = Ferké, 8 = Dapaong, 9 = Maroua, 10 = Bouaké. Lattice design (5 x 5), three replications. Plot size ranged from 7.5 to 8 m^2. Numbers following each yield value indicate the ranking of the cultivars.

Table 9. Mean grain yield (t ha^{-1}) of highest-yielding early duration varieties in the West African Sorghum Variety Adaptation Trial (WASVAT) at 10 locations in West Africa, rainy season 1988[1].

	LOCATION[2]										
Entry	1	2	3	4	5	6	7	8	9	10	Mean
Nagawhite	4.78 1	2.88 19	2.86 1	2.59 7	3.79 5	6.35 2	3.60 2	3.00 4	2.98 5	2.44 4	3.53
ICSV 210 IN	3.90 7	4.57 1	1.98 14	2.72 6	4.32 1	5.93 4	3.05 4	3.18 5	1.95 8	2.54 3	3.41
ICSV 111 IN	4.18 4	3.57 9	2.11 13	2.09 15	3.56 6	5.45 11	3.12 3	2.81 8	3.19 3	2.60 2	3.27
S-35	3.32 13	3.51 10	1.69 17	1.93 17	4.15 3	5.55 9	3.69 1	2.44 16	3.19 3	2.81 1	3.23
ICSV 1087 BF	4.09 5	3.38 8	2.85 2	2.23 11	1.89 18	5.90 5	2.81 6	4.10 1	2.35 9	2.18 5	3.18
CE 180-33	2.95 15	3.77 3	1.83 16	3.36 1	4.25 2	5.50 10	2.39 11	2.61 13	3.31 2	1.68 8	3.17
Controls											
IRAT 204	3.66 12	2.76 20	2.23 9	2.41 10	0.72 20	5.27 15	2.22 12	3.39 4	2.16 11	1.36 14	2.62
Local	2.02 18	3.19 16	2.34 8	1.30 19	2.81 10	5.64 8	1.48 17	1.68 18	1.80 13	1.41 13	2.37
SE	± 0.483	± 0.344	± 0.202	± 0.289	± 0.333	± 0.442	± 0.334	± 0.339	± 0.475	± 0.194	
Trial mean (20 entries)	3.49	2.59	1.67	2.39	2.75	5.47	2.41	2.80	2.35	1.77	
CV (%)	24	23	21	21	21	14	24	21	35	19	

1. Randomized-block design with three replications, plot size ranged from 6.4 to 19.4 m^2.

2. Locations: 1 = Saria, Burkina Faso; 2 = Bema, Mali; 3 = Cinzana, Mali; 4 = Bagauda, Nigeria; 5 = Tarna, Niger; 6 = Maroua, Cameroon; 7 = Farako-Ba, Burkina Faso; 8 = Kolo, Niger; 9 = Bambey, Senegal; and 10 = Nyankpala, Ghana. Numbers following each yield value indicate the ranking of the cultivars.

Table 10. Mean grain yield (t ha^{-1}) of highest-yielding medium duration varieties in the West African Sorghum Variety Adaptation Trial (WASVAT) at six locations in West Africa, rainy season, 1988[1].

	Burkina Faso		Mali		Nigeria		
Entry	Farako-Ba	Saria	Sotuba	Samanko	Bagauda	Karewa	Mean
ICSV 1063 BF	3.45 1	4.66 11	4.33 1	1.20 3	3.00 4	3.42 3	3.34
Mali Sor 84-1	3.16 2	4.38 13	3.10 13	1.27 1	2.67 8	3.91 2	3.08
ICSV 1089 BF	2.81 3	4.90 8	3.45 7	0.91 11	3.31 2	2.67 13	3.01
BF 80-7-7-2-1	2.78 4	5.18 5	3.71 5	1.23 2	1.83 12	3.11 4	2.97
ICSV 1092 BF	2.38 10	4.38 13	3.18 11	1.12 5	3.48 1	2.71 12	2.88
BF 80-9-8-3-1	2.59 7	4.56 12	3.10 13	0.95 10	2.91 6	2.98 7	2.85
Control							
Local	1.61 17	2.23 20	3.11 12	0.65 20	0.83 20	4.44 1	2.15 18
SE	± 0.325	± 0.529	± 0.248	± 0.164	± 0.389	± 0.279	
Trial mean (20 entries)	2.25	4.58	3.31	0.98	2.41	3.02	
CV (%)	25	20	13	29	28	16	

1. Randomized-block design with three replications, plot size ranged from 6.4 to 19.4 m^2. Numbers following each yield value indicate the ranking of the cultivars.

Table 11. Mean grain yield (t ha-1) of selected hybrids in the West African Sorghum Hybrids Adaptation Trial (WASHAT) at seven locations in West Africa, rainy season 1988[1].

Entry	Mali		Niger		Nigeria	Burkina Faso	Côte d'Ivoire	Mean
	Samanko	Cinzana	Kolo	Tarna-2	Bagauda	Farako-Ba	Ferké	
ICSH 507	3.67 4	3.16 2	3.54 1	4.14 6	3.98 1	3.05 1	1.66 1	3.32
ICSH 330	3.87 2	2.99 4	3.28 3	4.49 4	3.25 4	2.45 3	1.32 3	3.09
ICSH 88042	3.93 1	3.06 3	2.88 4	4.61 3	3.14 5	2.39 4	1.19 4	3.03
ICSH 88040	3.84 3	2.75 5	3.31 2	4.75 2	3.28 3	1.74 6	0.77 5	2.92
ICSH 88038	3.40 5	3.38 1	2.67 5	4.92 1	3.11 6	2.26 5	0.70 6	2.92
ICSH 780	2.62 6	2.23 6	2.59 6	4.25 5	3.89 2	2.76 2	1.61 2	2.85
Controls								
ICSV 111	2.47	2.19	1.50	4.32	3.58	3.04	0.56	2.57 14
Local	1.00	2.14	1.65	2.72	1.41	1.77	1.52	1.74 20
SE	± 0.267	± 0.337	± 0.459	± 0.370	± 0.413	± 0.289	± 0.23	
Trial mean (20 entries)	3.08	2.54	2.57	4.01	3.11	2.28	1.08	
CV (%)	15	23	31	16	23	22	38	

1. Randomized-block design with three replications, plot size ranged from 6.4 to 19.4 m^2. Numbers following each yield value indicate the ranking of the cultivars.

Table 12. Mean grain yield (t ha^{-1}) of the top six early duration varieties in the West African Sorghum Variety Adaptation Trial (WASVAT) from 10 locations grown in a randomized block design, three replications with plot size between 5.8 and 14.4 m^2, rainy season, 1989.

Entries	LOCATIONS[1]																				Mean
	1		2		3		4		5		6		7		8		9		10		
ICSV 1079 BF	2.84	2	3.18	2	3.24	7	2.29	4	2.40	6	2.74	13	4.83	2	3.18	1	1.45	1	2.71	3	2.74
CS-61	2.99	4	1.94	18	3.54	2	2.40	1	1.96	11	3.24	8	4.98	1	2.96	3	1.25	4	2.57	8	2.65
ICSV 111 IN	2.38	9	2.70	7	3.16	9	1.99	10	1.60	16	3.33	7	4.73	3	2.72	6	1.37	2	2.89	1	2.55
ICSV 1172 BF	2.55	7	3.16	3	3.25	6	1.83	14	2.00	10	3.46	5	4.59	4	2.48	9	0.46	19	2.28	11	2.47
CS-54	2.73	6	2.68	8	3.28	5	1.91	13	2.02	9	2.69	14	3.96	10	2.84	4	1.12	5	2.79	2	2.45
ICSV 1177 BF	2.10	12	3.46	1	3.10	10	2.40	3	1.90	12	2.75	12	3.90	13	2.03	15	0.94	9	2.71	3	2.44
Controls																					
Nagawhite	2.73	6	2.95	4	3.75	1	2.67	1	2.73	3	5.49	1	4.15	8	2.51	8	0.75	14	2.49	10	2.85
Local	2.01	15	2.28	15	3.38	3	1.72	17	2.17	7	4.53	2	3.93	11	2.75	5	0.83	10	2.67	4	
SE	± 0.32		± 0.20		± 0.18		± 0.18		± 0.26		± 0.43		± 0.36		± 0.14		± 0.29		± 0.21		
Mean (20 entries)	2.30		2.55		2.95		2.06		1.96		2.93		3.92		2.27		0.88		2.40		
CV (%)	24		18		11		15		23		25		16		22		28		26		

1. Locations: 1 = Farako-Ba, 2 = Saria in Burkina Faso; 3 = Guiring in Cameroon; 4 = Cinzana, 5 = Samanko in Mali; 6 = Maradi in Niger; 7 = Bagauda in Nigeria; 8 = Nyankpala, 9 = Manga Bawku in Ghana; 10 = Bambey in Senegal.

Table 13. Mean grain yield (t ha^{-1}) of the top six medium duration varieties in the West African Sorghum Variety Adaptation Trial (WASVAT-Medium) from 10 locations grown in a randomized block design, three replications with plot size between 6 and 14.4 m^2, rainy season, 1989.

Entries	LOCATIONS[1]																		Mean
	1		2		3		4		5		6		7		8		9		
ICSV 1171 BF	3.71	1	2.74	2	1.64	1	1.20	4	2.71	3	4.03	3	2.68	8	4.83	1	0.18	11	2.37
F2-20	2.91	9	2.78	1	1.32	8	1.32	2	2.73	2	3.50	6	2.41	11	4.45	5	0.32	3	2.34
CS-95	2.45	13	2.66	3	1.63	3	1.30	3	2.50	7	4.35	1	2.58	9	4.78	2	0.42	1	2.32
ICSV 1089 BF	2.94	8	1.97	12	1.51	5	1.00	8	2.42	9	3.48	7	2.81	7	4.03	10	0.07	15	2.29
SEPON-82	3.32	2	2.35	6	1.67	2	1.15	5	2.65	5	4.31	2	2.93	4	4.44	6	0.18	11	2.25
ICSV 1163 BF	3.03	6	2.42	5	1.54	4	1.32	2	2.23	12	3.73	4	2.83	6	4.74	3	0.24	6	2.17
Control																			
Local	2.35	14	2.65	4	1.31	9	1.39	1	1.44	16	1.79	14	0.26	19	4.16	8	0.24	6	1.85
SE	± 0.31		±0.26		± 0.19		±0.15		± 0.22		± 0.32		± 0.37		± 0.17		-		
Moyenne (20 entrées)	2.67		2.00		1.11		0.89		2.04		2.76		2.32		3.89		0.20		
CV (%)	20		22		30		30		18		20		28		13		25		

1. Locations: 1 = Farako-Ba, 2 = Saria in Burkina Faso; 3 = Manga Bawku in Ghana; 4 = Sotuba, 5 = Samanko in Mali; 6 = Bengou in Niger; 7 = Bagauda in Nigeria; 8 = Nioro in Senegal; 9 = Tantiegou in Togo.

Table 14. Mean grain yield (t ha^{-1}) of test hybrids in the West African Sorghum Hybrid Adaptation Trial (WASHAT) - 1989 at eight locations, rainy season, 1989.

Cultivar	Bagauda	Guiring	Tarna	Sotuba	Samanko	Bouake	FarakoBa	Lossa /	Mean
ICSH 230	4.84	7.04	3.60	3.56(2)	2.7	1.62(4)	1.38(5)	1.81	3.32
ICSH 232	5.05(5)	7.18(6)	3.34	3.33	2.80	1.15	1.36(6)	1.39	3.20
ICSH 642	4.89	7.16	3.82	2.81	2.91	1.47(6)	1.35	1.88(5)	3.29
ICSH 780	5.43(2)	7.54(3)	3.48	3.32	3.40(5)	1.43	1.47(4)	2.74(2)	3.60(2)
ICSH 89001 NG	4.89	7.06	4.27	2.33	2.98	2.09(1)	1.79(2)	2.29(3)	3.46(5)
ICSH 479	5.23(4)	7.21	3.61	3.54(4)	2.89	1.02	1.56(3)	1.81	3.36
ICSH 88038	3.57	6.58	4.47(5)	3.35	2.56	1.44	0.90	1.86(6)	3.09
ICSH 88039	4.57	6.49	4.40	2.93	2.67	1.18	0.84	2.05(4)	3.14
ICSH 507	5.48(1)	7.64(2)	4.84(2)	3.40	2.93	2.08(2)	1.22	1.70	3.66(1)
ICSH 89002	4.92(6)	7.98(1)	4.41(6)	3.41(6)	3.51(3)	1.51(5)	1.14	1.67	3.57(4)
ICSH 330	4.19	7.36(4)	3.70	3.19	3.60(1)	1.40	0.87	1.70	3.25
ICSH 646	0.97	3.77	1.24	1.82	0.93	0.10	0.18	0.38	1.17
ICSH 88042	4.85	7.20(5)	3.45	2.51	3.53(2)	1.01	1.07	1.81	3.18
ICSH 89003 NG	4.67	6.91	4.11	3.53(5)	3.49(4)	1.21	0.87	1.60	3.30
ICSH 89004 NG	4.40	5.82	4.71(3)	3.60(3)	3.20(6)	1.36	0.96	1.60	3.21
Tx 623A x MR 732 (INRAN Sorghum Hybrid)	4.33	6.95	5.33(1)	3.71(1)	3.07	1.34	1.03	2.92(1)	3.58(3)
Tx 631A x SUCR 36 (INRAN Sorghum Hybrid)	5.34(3)	6.92	4.01	2.74	2.98	1.10	0.64	1.63	3.17
Controls									
ICSH 109	4.21	6.00	4.55(4)	2.69	3.09	1.06	0.49	1.81	2.99
ICSH 111	3.34	6.07	3.55	2.44	3.00	1.95(3)	1.82(1)	1.63	2.98
LOCAL[1]	4.69	6.65	3.62	3.07	1.44	1.08	0.93	1.08	2.82
SE±	±0.815	±0.537	±0.370	±0.550	±0.308	±0.396	±0.410	±0.530	
MEAN	4.49	6.80	3.93	3.06	2.88	1.33	1.09	1.77	3.17
CV %	18.1	7.9	16.3	17.9	10.7	29.7	37.4	30.0	

1. The local control variety was different at various locations. Bagauda in Nigeria, Guiring in Cameroon, Tarna and Lossa in Niger, Sotuba and Samanko in Mali, Farako-Ba in Burkina Faso, and Bouaké in Côte d'Ivoire.

Table 15. Mean grain yield (t ha-1) of the top six early maturing varieties in the West African Sorghum Variety Adaptation Trial (WASVAT) from 13 locations grown in a randomized block design, three replications with plot size between 4.8 and 14.4 m2, rainy season, 1990.

Entry	B. FASO Saria	B. FASO Farako-Ba	CAMEROUN Guiring	GAMBIA Sapu	GHANA Nyankpala	MAURITANIE Kaedi	NIGER Kollo	SENEGAL Bambey	S.LEONE Rokupr	TCHAD Gassi	TOGO Tantiegou	MALI Cinzana	MALI Samanko	Mean
CE 196-7-2-1	0.26 2	0.75 7	0.23 14	1.73 8	7.13 2	2.53 4	12.21 1	1.60 9	0.80 6	1.04 11	0.13 12	3.01 15	1.49 4	2.53
ICSV 1174 BF	0.17 8	1.56 2	0.71 5	2.00 6	5.80 10	0.87 13	7.99 6	2.00 6	1.20 2	2.61 3	0.26 2	3.05 14	1.10 8	2.26
ICSV 401 IN	0.22 5	0.56 9	0.71 5	1.73 8	6.26 7	0.69 15	7.10 12	2.69 2	0.48 12	1.59 7	0.13 12	4.86 1	1.87 2	2.22
ICSV 1172 BF	0.18 7	0.88 6	0.49 9	1.47 10	8.19 1	3.33 2	6.07 14	0.50 16	1.12 3	0.51 18	0.14 11	4.33 2	0.59 17	2.14
NABANA BEIDA	0.25 3	0.75 7	0.04 17	1.73 8	6.81 4	1.20 10	7.14 11	2.10 5	1.23 1	1.53 9	0.21 5	3.97 6	0.23 19	2.09
ICSV 1125 BF	0.17 8	0.75 7	0.47 10	1.87 7	5.78 11	1.33 9	6.98 15	1.10 12	0.41 14	2.83 2	0.14 11	3.65 8	1.35 7	2.06
CONTROL														
NAGAWHITE	0.14 9	0.38 10	0.40 11	2.13 5	6.13 9	4.08 1	7.61 9	1.80 7	0.69 9	2.04 4	0.14 11	4.86 1	0.80 12	2.40
ICSV 111 IN	0.10 10	1.19 4	0.36 13	2.13 5	6.82 3	1.73 6	9.68 2	0.60 15	0.83 5	0.39 19	0.27 1	2.00 19	1.41 5	2.12
LOCAL	0.10 10	0.00 12	0.53 7	1.87 7	5.00 15	2.75 3	5.59 16	1.65 8	0.64 9	1.66 6	0.16 9	4.32 3	0.39 18	1.90
SE	±0.03	±0.68	±0,57	±0.33	±0.18	±0.81	±1.35	±0.13	±0.18	±0.52	±0.14	±0.43	±0.45	
MEAN	0.20	0.75	0.50	1.95	5.78	1.52	7.39	1.51	0.67	1.36	0.18	3.47	1.03	
CV(%)	15	75	12	23	49	71	22	33	38	50	52	16	46	

B.FASO = Burkina Faso. S.LEONE = Sierra Leone. Numbers following each yield value indicate the ranks.

Table 16. Mean grain yield (t ha-1) of the top six medium maturing varieties in the West African Sorghum Variety Adaptation Trial (WASVAT-Medium) from 13 locations grown in a randomized block design, three replications with plot size between 4.8 and 14.4 m2, rainy season, 1990.

Entry	B. FASO Farako-Ba	B. FASO Saria	CAMEROON Sanguere	C.D'IVORE Ferke	GAMBIA Sapu	GHANA Nyankpala	GUINEE Kankan	MALI Samanko	MALI PAR Samanko	NIGER Bengou	SENEGAL Nioro	S.LEONE Rokupr	TCHAD Gassi	Mean
CS 85	2.50 4	2.31 7	1.00 14	1.35 13	1.70 13	0.83 3	0.01 16	4.00 2	3.00 2	3.39 1	5.66 5	0.64 7	0.83 6	2.09
SEPON-82	2.75 3	3.12 1	0.35 18	2.79 7	1.78 9	0.01 18	0.71 5	3.47 7	2.92 12	1.46 11	5.47 6	0.72 3	0.54 12	1.96
F2-20	2.50 4	3.06 3	1.23 12	2.81 3	1.85 6	0.39 11	1.76 2	1.73 14	1.99 11	1.06 13	5.86 4	0.68 5	0.33 16	1.94
IS 6928	2.50 4	2.80 5	1.89 8	0.73 14	2.66 2	0.49 10	0.00 17	3.53 6	3.41 1	1.46 11	2.93 12	0.39 11	1.89 1	1.90
ICSV 1171 BF	2.50 4	2.28 8	0.03 19	2.92 2	1.97 4	0.33 12	1.75 3	3.53 6	1.75 13	1.86 8	2.83 13	0.53 8	1.52 3	1.83
ICSV 1163 BF	2.50 4	1.95 11	2.67 4	2.08 8	1.04 14	0.55 9	0.11 13	3.40 8	1.64 14	1.99 6	3.81 9	0.32 14	0.83 6	1.76
CONTROL														
ICSV 1063 BF	1.50 11	2.24 9	1.84 9	2.39 6	3.17 1	0.17 14	0.11 13	3.07 9	0.40 18	2.79 3	5.86 4	0.35 13	0.67 9	1.89
ICSV 1089 BF	1.75 9	0.91 16	1.51 10	2.08 8	0.99 16	1.07 1	0.02 15	3.87 3	2.33 6	1.86 8	4.20 8	0.37 12	0.38 14	1.64
LOCAL	2.38 5	1.69 13	1.91 7	1.67 11	1.81 8	0.71 6	0.10 14	1.47 15	0.30 19	1.93 7	4.98 7	0.66 6	0.15 17	1.52
SE	±0.28	±0.39	±0.73	±0.42	±0.39	±0.21	±0.36	±0.35	±2.27	±0.57	±0.93	±0.11	±0.34	
MEAN	1.94	1.89	1.46	1.91	1.47	0.46	0.54	2.63	1.77	1.66	3.59	0.48	0.67	
CV(%)	18	26	64	27	31	44	120	16	22	42	27	27	63	

B. FASO = Burkina Faso. C. D'IVOIRE = Cote d'Ivoire. S. LEONE = Sierra Leone. PAR = Point d'Appui de Recherche.

ABLE 17. GRAIN YILED (T/HA-1) PERFORMANCE OF TEST HYBRIDS ACROSS EIGHT LOCATIONS IN THE WEST AFRICAN SORGHUM HYBRID ADAPTATION TRIAL (WASHAT) - 1990.[1]

NTRY	DESIGNATION	BAGAUDA	TILEBERY	MAROUA	SANGUERE	SAMANKO	SOTUBA	CINZANA	FERKE	MEAN
1	ICSH 780	5.50(6)	4.32(10)	5.04(10)	3.62(2)	1.81	2.15(9)	3.53(5)	1.65(10)	3.45(7)
2	ICSH 89001 NG	6.26(1)	-	5.23(5)	3.53(4)	2.20	1.78	3.21(10)	1.65(10)	3.41(9)
3	ICSH 88038	4.54	4.34(9)	4.24	3.26(6)	1.76	1.78	3.65(3)	1.79(6)	3.17
4	ICSH 89005 NG	4.78	5.31(3)	4.29	2.01	1.59	2.09	3.22(9)	1.35	3.08
5	ICSH 89006 NG	5.40	-	5.19(7)	3.58(3)	1.92	2.16(8)	3.40(6)	1.52	3.31
6	ICSH 507	5.41(10)	4.46(3)	5.34(3)	3.02(9)	2.79(3)	2.07	3.34(7)	1.65(10)	3.51(6)
7	ICSH 89002 NG	5.74(4)	5.57(2)	4.92	3.22(7)	2.89(1)	2.48(2)	2.89	1.98(1)	3.71(1)
8	ICSH 89007 NG	5.41(10)	4.67(5)	5.86(1)	2.76	2.22	2.13(10)	3.63(4)	1.60	3.54(4)
9	ICSH 89008 NG	5.80(3)	4.94(4)	5.14(8)	3.33(5)	2.37(7)	2.54(1)	3.40(6)	1.90(4)	3.68(2)
10	ICSH 89009 NG	5.51(5)	4.00	5.01	2.39	2.82(2)	2.02	3.30(8)	1.94(2)	3.37(10)
11	ICSH 89010 NG	5.44(9)	4.53(7)	4.42	3.05(8)	2.37(7)	2.29(4)	2.31	1.71(8)	3.27
12	ICSH 89011 NG	4.94	4.66(6)	4.96	3.86(1)	2.27(9)	2.01	2.86	1.92(3)	3.44(8)
13	ICSH 89012 NG	5.46(7)	5.68(1)	5.10(9)	3.58(3)	2.41(6)	2.42(3)	2.10	1.73(7)	3.56(3)
14	ICSH 39013 NG	5.45(8)	3.97	4.64	2.48	2.42(5)	2.17(7)	3.72(2)	1.83(5)	3.34
15	ICSH 89004 NG	5.30	4.04	5.29(4)	2.92(10)	2.31(8)	1.81	2.71	1.52	3.24
16	ICSH 89014 NG	6.25(2)	3.85	5.20(6)	2.39	2.53(4)	2.24(5)	3.99(1)	1.67(9)	3.52(5)
17	INRAN HYBRID-1	5.04	2.93	4.56	2.63	2.26(10)	2.15(9)	2.28	1.37	2.90
18	INRAN HYBRID-2	3.26	2.17	3.98	1.45	1.28	2.04	2.22	0.73	2.14
19	ICSV 111	4.83	3.62	4.94	2.75	2.20	2.23(6)	2.96	1.15	3.09
20	LOCAL CONTROL	3.68	3.00	5.74(2)	1.06	1.74	1.46	2.62	1.23	2.57
	$\bar{x}$	5.20	4.23	4.96	2.84	2.21	2.10	3.07	1.59	3.27
	SE	±0.354	±0.617	±0.257	±0.567	±0.400	±0.214	±0.323	±0.201	
	%CV	12	25	9	34	31	18	18	22	

. Data received from two locations, Maradi and Bouake, were excluded from further analyses due to >50% CV. Numbers in parenthesis indicate the rank of the entry. The local control at various locations was different.

Table 18. West and Central Africa Sorghum Research Network (WCASRN). Regional Trials and Nurseries, 1991.

Country	Trials and number of sets				
	WASVAT				
	Early	Medium	*Striga*	Diseases	WASHAT
Benin	0	1	0	0	1
Burkina Faso	2	2	0	1	1
Cameroon	1	1	1	1	2
CAR	0	1	0	0	0
Côte d'Ivoire	0	1	0	0	2
Gambia	1	0	1	0	0
Ghana	1	2	0	1	1
Guinea	0	1	0	1	0
Guinea Bissau	0	1	0	1	0
Mali	2	2	1	2	2
Mauritania	1	0	0	0	0
Niger	1	1	1	1	2
Nigeria	2	2	0	0	2
Senegal	1	1	1	0	1
Sierra Leone	1	1	0	1	0
Tchad	1	1	1	0	0
Togo	1	0	1	0	0
TOTAL DISPATCHED	15	18	7	9	14
TOTAL RESULTS RECEIVED					

WASVAT = West African Sorghum Variety Adaptation Trial. Early and medium refer to maturity cycle. WASHAT = West African Sorghum Hybrid Adaptation Trial. Disease nursery started in 1987 and *Striga* trial started in 1988. R = Results received, with number in parenthesis.

Table 19. Status as of May 1991 of $ 1,000 paid to 12 non-lead NARS in 1990.

Country	Acknowledged	Expenses justified[1]
Benin	No	-
CAR	Yes	Yes - with some receipts
Côte d'Ivoire	Yes	Yes - with some receipts
Gambia	No	-
Ghana	Yes	Yes - without receipts
Guinea	Yes	Yes - without receipts
Guinea Bissau	No	-
Mauritania	Yes	Yes - without receipts
Senegal	Yes	Yes - without receipts
Sierra Leone	Yes	Yes - without receipts
Tchad	No	-
Togo	No	-

1. Without receipt = only a list of items with corresponding amounts spent.

ANNEXURES

A N N E X 1

RESEARCH PROJECTS

1. Financial Justification Form
2. Project Format Form
3. Annual Report Form
4. Project Evaluation Form

RÉSEAU OUEST ET CENTRE AFRICAIN DE RECHERCHE SUR LE SORGHO
(ROCARS)

WEST AND CENTRAL AFRICA SORGHUM RESEARCH NETWORK (WCASRN)

USAID/SAFGRAD/OAU-STRC/ICRISAT

PROJETS DE RECHERCHE/RESEARCH PROJECTS

FORMULAIRE DE JUSTIFICATION DES DÉPENSES/ EXPENSE JUSTIFICATION FORM

1. Titre du projet/Project Title: _____

2. Chercheur principal/Principal investigator: _____

3. Pays/Country: _____

4. Période de rapport/Period covered by report: De/From _____ à/to _____

5. Réçus joints/Enclosed receipts (obligatoire/mandatory)

6. Détails des dépenses (remplir là où c'est nécessaire)/
   Details of expenses (fill out where applicable)

Poste budgétaire/Line item	Coût/Cost
1. Equipements/Equipments	_____
2. Fournitures/Office supplies	_____
3. Salaires (Technicien)/Salaries (Technician)	_____
4. Salaires (Main d'oeuvre) Salaries (Labor)	_____
5. Voyage/Travel (Hotel, per diem)	_____
6. Essence/Fuel	_____
7. Réparation du véhicule/Car repair costs	_____
8. Réparation de la mobylette/Motorcycle repair costs	_____
9.	_____
10.	_____
11. Autres/Others (spécifier/specify)	_____
Dépenses totales/Total expenses	_____
Montant réçu/Amount received	_____
Solde/Balance	_____

7. Signature du chercheur principal/Signature of principal investigator

   _____

8. Nom du Directeur ou du Chef de la station de recherche/
   Name of Director or Chief of Research station

   _____

9. Signature du Directeur ou du Chef de la station de recherche/
   Signature of Director or Chief of Research station

   _____

10. Date _____

11. Cachet approprié/Appropriate seal

WCASRN COLLABORATIVE PROJECT FORMAT

Starting date :_____

Title :

Principal Investigator :

Training Component :

Objectives :

Techniques :

Expected impact of the project :

_____	_____	_____
Coordinator WCASRN	Chairman Steering Committee WCASRN	Principal Investigators
Date _____	_____	_____

WCASRN ANNUAL REPORT

Period : From _____ to _____

Title Continuing :_____
End :_____

Investigators :

Brief report :

Training : Number of persons :____ % of project resources :_____

Future workplan for next year :

Recommendations of Steering Committee :

Publication :

_____	_____	_____
Coordinator WCASRN	Chairman Steering Committee WCASRN	Principal Investigators

Date :_____ _____

USAID/OAU-STRC/SAFGRAD/ICRISAT

FORMULAIRE D'EVALUATION/EVALUATION FORM

PROJETS COLLABORATIFS DE RECHERCHE/COLLABORATIVE RESEARCH PROJECTS

RESEAU OUEST ET CENTRE AFRICAIN DE RECHERCHE SUR LE SORGHO/ WEST AND CENTRAL AFRICAN SORGHUM RESEARCH NETWORK

(WCASRN)

1. Jusqu'ou les objectifs ont ete atteints/To what extent the objectives have been achieved:

2. Quelques commentaires sur les methodes et approches/Comment on the method and general approach :

61

3. Avez-vous des modifications, recommendations ou suggestions a faire/Briefly mention any modifications, recommendations or suggestions for the future :

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4. Comment evaluez-vous le projet en general/Give an overall rating of the project

( ) Excellent
( ) Bon/Good
( ) Moyen/Average

Nom du projet/Name of project _____

_____

_____

Nom du Chercheur principal/Name of Principal Investigator

_____

Nom de l'Evaluateur/Name of Evaluator _____

_____

Date _____

62

A N N E X 2

DETAILS ON REGIONAL TRIALS

1. Origin of Entries
2. Varieties under Evaluation and Testing in some NARS
3. Summary of Numbers of Regional Trials dispatched and Results Received; 1986-1991
4. Technical Bulletin for Intensive Evaluation of Promising Lines

ENTRIES IN THE 1986 TRIALS

WASVAT-E	WASVAT-M	WASHAT
ICSV 2 BF	ICSV 23 BF	ICSH-208
ICSV 7-1 BF	ICSV 1038 BF	ICSH-221
ICSV 16-3 BF	ICSV 1044 BF	ICSH-228
ICSV 16-5 BF	ICSV 1047 BF	ICSH-229
ICSV 85-2 BF	ICSV 1056 BF	ICSH-230
ICSV 94-1 BF	ICSV 1057 BF	ICSH-231
ICSV 1031 BF	ICSV 1058 BF	ICSH-232
ICSV 1045 BF	ICSV 1063 BF	ICSH-241
ICSV 1054 BF	ICSV 1067 BF	ICSH-357
ICSV 1055 BF	ICSV 1070 BF	ICSH-358
ICSV 1060 BF	ICSV 1074 BF	ICSH-359
ICSV 1061 BF	ICSV 1077 BF	ICSH-259
ICSV 1062 BF	ICSV 1080 BF	ICSH-260
ICSV 1064 BF	PM 11344	ICSH-263
ICSV 1065 BF	IRAT 277	ICSH-284
ICSV 1078 BF	IS 915	ICSH-285
IRAT 203	ICSV 126 IN	ICSH-287
Mali Sor 84-7	ICSV 2 IN	ICSH-290
ICSH-1 (Hybrid Control)	ICSH-1 (Hybrid Control)	ICSH-299
Local (Control)	Local (Control)	ICSH-305
		ICSH-311
		ICSH-319
		ICSH-331
		ICSH-336
		ICSH-109
		ICSH-110
		ICSH-153
		ICSH-159
		ICSH-134
		ICSH-178
		CSH-5
		CSH-6
		Framida

All ICSVs, ICSH, CSH, PM lines and Framida were contributed by ICRISAT West African Program. Malisor 84-7 is from ICRISAT/Mali Bilateral Program, IRAT lines are from the IRAT Program in Burkina Faso. IS 915 is from ICRISAT's germplasm collection.

Entry number, variety, Pedigree and source of WASVAT-Early duration, 1987.

Entry number	Variety	Pedigree	Source
1	Nagawhite	-	Ghana
2	S-35	-	Cameroon
3	Mali Sor 84-5	-	Mali
4	CE 180-33	-	Sénégal
5	CE 194-19	-	Sénégal
6	82-7-BK2	P 967 083 x SEPON 45	Niger
7	M 24733	((SC 108 x CS 3541)16-3 x -1-3/R 2751)5-2-3	ICRISAT
8	ICSV 111 IN	(SPV 35 x E 35-1) CS 3541) - 8 - 1	ICRISAT
9	ICSV 230 IN	(SPV 475 x QL - 3) - 1 - 1 - 1 - 2	ICRISAT
10	ICSV 247 IN	(E 36-1 x CS 3541) - 3 - 15 - 1 - 2 - 2	ICRISAT
11	ICSV 1082 BF	Tetron x ICSV 1002 BF	ICRISAT
12	ICSV 1083 BF	(ICSV 1004 BF x ISVAT 82/Entry 10) - 1 - 3	ICRISAT
13	ICSV 1084 BF	ICSV 1003 BF x CSV-11	ICRISAT
14	ICSV 1085 BF	(ICSV 1004 BF x CSV-11) - 1 - 2	ICRISAT
15	ICSV 1086 BF	(82-S-82 x CSV-11) - 4 - 2	ICRISAT
16	ICSV 1087 BF	Selection of ICSV 1002 BF	ICRISAT
17	ICSV 1078 BF	E 35-1 x IS 8785	ICRISAT
18	ICSV 1054 BF	E 35-1 x IS 8785	ICRISAT
19	ICSH 109 Hybrid control	296 A x MR 844	ICRISAT
20	Local variety		

Entry number, variety, pedigree and source of WASVAT-Medium duration, 1987.

Entry number	Variety	Pedigree	Source
1	S-34	-	Cameroon
2	Mali Sor-84-1	-	Mali
3	BF 80-6-4-1-1	38 - 3 x IRAT S 10	Burkina Faso
4	BF 80-7-7-2-1	38 - 3 x 73 - 6/12 - 1 - 2	Burkina Faso
5	BF 80-9-8-3-1	38 - 3 x 73 - 9/46 - 2 - 1	Burkina Faso
6	BF 80-10-23-2-1	38 - 3 x 73 - 9/29 - 1 - 1	Burkina Faso
7	82-10-BK-3	P 96 7083 x SEPON 72	Niger
8	M 24581	SPV 475 (IS 12611 x SC 108-3) -3-2-7-8-2-2	ICRISAT
9	M 24791	SPV 475 (IS 12611 x SC 108-3) -3-2-2-2	ICRISAT
10	M24525	SPV 475 (IS 12611 x SC 108-3) -5-2-2	ICRISAT
11	M 24723	((GPR 148 x E 35-1) 16-3 x IS 9327 deriv (2077 B x IS 9327) -7-1-3 - 1-2-5-1	ICRISAT
12	ICSV 1088 BF	(82-S-96 x CSV - 11) - 14-2	ICRISAT
13	ICSV 1089 BF	(ICSV 1004 BF x ISVAT 82/Entry 10) - 1 - 2	ICRISAT
14	ICSV 1090 BF	(82 - S - 86 x ISVAT 82/Entrée 14) -1-2	ICRISAT
15	ICSV 1092 BF	(82 - S - 86 x CSV 4) - 3 - 3	ICRISAT
16	ICSV 1093 BF	(82 -S - 86 x CSV 4) - 2 - 9	ICRISAT
17	ICSV 1063 BF	(E35-1 x Najjadh) x (SC 423 x CS 3541) x E 35-1)	ICRISAT
18	ICSV 1074 BF	(SEPON 82 x E 35-1) x CSV 4	ICRISAT
19	ICSV 126 IN	((SC 108-3 x Swarne) [35-1) - 6 - 1	ICRISAT
20	Local control	-	ICRISAT

Hybrids, their parents and source of WASHAT, 1987.

Hybrids	Female Parent		Male Parent	Source
ICSH 641	ICSA-1	X	MR 904	ICRISAT
ICSH 229	ICSA-11	X	MR 841	ICRISAT
ICSH 230	ICSA-11	X	MR 844	ICRISAT
ICSH 231	ICSA-11	X	MR 860	ICRISAT
ICSH 232	ICSA-11	X	MR 862	ICRISAT
ICSH 401	ICSA-11	X	MR 913	ICRISAT
ICSH 642	ICSA-11	X	MR 927	ICRISAT
ICSH 569	ICSA-11	X	SPL 23 R	ICRISAT
ICSH 233	ICSA-11	X	SPL 59 R	ICRISAT
ICSH 479	ICSA-37	X	MR 922	ICRISAT
ICSH 331	ICSA-38	X	MR 862	ICRISAT
ICSH 643	ICSA-38	X	MR 871	ICRISAT
ICSH 644	ICSA-38	X	MR 877	ICRISAT
ICSH 507	ICSA-38	X	MR 926	ICRISAT
ICSH 526	ICSA-38	X	MR 930	ICRISAT
ICSH 645	ICSA-38	X	MR 941	ICRISAT
ICSH 646	ICSA-39	X	MR 877	ICRISAT
ICSH 336	ICSA-40	X	MR 862	ICRISAT
ICSH 647	ICSA-43	X	MR 875	ICRISAT
ICSH 648	ICSA-44	X	MR 875	ICRISAT
ICSH 109	296 A	X	MR 844	ICRISAT
Hageen Durra	ATX 63	X	Karper 1597	ICRISAT
Framida (local control)				-
Nagawhite (local control)				-
Local variety				-

WEST AFRICAN SORGHUM DISEASE RESISTANCE NURSERY -

1987 and 1988

No.d'entree Entry No.	Genotype Genotype
1	84 S 22
2	84 S 82
3	84 S 92
4	84 S 103-1
5	84 S 103-2
6	84 S 105-2
7	84 S 109
8	84 S 115
9	84 S 126
10	84 S 130
11	84 S 157
12	84 W 19
13	84 W 838
14	84 W 848
15	84 W 852
16	ICSV2 IN
17	ICSV16-5BF
18	ICSV85-4BF
19	ICSV1002BF
20	ICSV1011BF
21	ICSV1034BF
22	IS 956
23	IS 3443
24	IS 3555
25	IS 6991
26	IS 9225
27	ICSV 1023 BF
28	IS 9928
29	IS18495
30	IS21629
31	IS21658
32	IS22380
33	IS23526
34	ICSV20-1BF
35	84 S 85
36	IS 18696

All entries are from ICRISAT' West Africa Program, except the IS lines from ICRISAT germplasm collection.

Entry number, variety, their pedigree, and contributing program for WASVAT early, rainy season, 1988.

Entry no.	Name	Pedigree	Contributing program
1	Nagawhite	-	Ghana
2	S-35	-	Cameroon
3	MaliSor 84-5	-	Mali
4	CE 180-33	-	Senegal
5	CE 194-19	-	Senegal
6	ICSV 401 IN	-	ICRISAT
7	ICSV 210 IN	-	ICRISAT
8	ICSV 111 IN	[(SPV 35 x E 35-1) IS 3541]-81	ICRISAT
9	ICSV 230 IN	(SPV 475 x QL-3)-1-1-1-2	ICRISAT
10	ICSV 247 IN	(E 36-1 x CS 3541)-3-15-1-2-2	ICRISAT
11	ICSV 1082 BF	Tetron x ICSV 1002 BF	ICRISAT
12	ICSV 1083 BF	(ICSV 1004 BF x ISVAT 82/Entry 10)-1-3	ICRISAT
13	ICSV 1084 BF	(ISCV 1003 BF x CSV-11)	ICRISAT
14	ICSV 1095 BF	(ISCV 1004 BF x CSV-11)-1-2	ICRISAT
15	ICSV 1086 BF	(82-S-82 x CSV-11)-4-2	ICRISAT
16	ICSV 1087 BF	Framida x E35-1	ICRISAT
17	ICSV 1078 BF	E35-1 x IS 8785	ICRISAT
18	ICSV 1054 BF	E35-1 x IS 8785	ICRISAT
19	IRAT-204 (Control)	-	ICRISAT
20	Local Control/Temoin local	-	National Program

Entry number, variety, their pedigree, and contributing program for medium, rainy season 1988[1].

Entry	Cultivar	Pedigree	Contributing Program
1	S-34	-	Cameroon
2	Malisor 84-1	-	Mali
3	BF 80-6-4-1-1	38-3 x IRAT S10	Burkina Faso
4	BF 80-7-7-2-1	38-3 x 73-/12-1-2	Burkina Faso
5	BF 80-9-8-3-1	38-3 x 73-9/46-2-1	Burkina Faso
6	BF 80-10-23-2-1	38-3 x 73-9/29-1-1	Burkina Faso
7	SEPON-82	P 967083 x SEPON 82	Niger
8	M 24581	SPV 475 (IS 12611 x SC 108-3)-3-2-7-8-2-2	ICRISAT
9	M 24791	SPV 475 (IS 12611 x SC 108-3)-3-2-2-2	ICRISAT
10	M 24525	SPV 475 (IS 12611 x SC 108-3)-5-2-2	ICRISAT
11	M 24723	[(GPR 148 x E35-1) - 16-3 x IS 9327 deriv (2077B x IS 9327)-7-1-3)]	ICRISAT
12	ICSV 1088 BF	(82596 x CSV-11)-14-2	ICRISAT
13	ICSV 1089 BF	(ISCV 1004 BF x ISVAT 82/Entry 10)-1-2	ICRISAT
14	ICSV 1090 BF	(82-S-86 x ISVAT 82/Entry 14)-1-2	ICRISAT
15	ICSV 1092 BF	(82-S-86 x ISV 4)-3-3	ICRISAT
16	ICSV 1093 BF	(82-S-86 x ISV 4)-2-9	ICRISAT
17	ICSV 1063 BF	[E35-1 x Najjadh) x (ISC 423 x SC 3541) x E35-1]	ICRISAT
18	ICSV 1074 BF	(SEPON #2 x E35-1) x ICSV 4	ICRISAT
19	ICSV126IN	[(SC 108-3 xSwarna) E35-1]-6-1	ICRISAT
20	Local Control		National Program

WASVAT - 1988

Entry ICSH #
230
231
232
780
527
88038
88039
369
643
507
330
88040
88041
88042
88043
336
88044
88045

Controls
ICSV 111
Local

STRIGA TRIAL - 1988, 1989, 1990

LIST OF VARIETIES

LISTE DES VARIETES

Entry Entré	Cultivar	Pedigree/Pédigrée	Source
1	ICSV 1078 BF	(Framida x E 35-1)-4-2-13	ICRISAT
2	ICSV 1079 BF	(Framida x E 35-1)-4-2-15	ICRISAT
3	ICSV 1007 BF (SRN 39)	CSV 5 x Framida	Niger
4	ICSV 1098 BF	(ICSV 1011 BF x CSV 4)-2-2	ICRISAT
5	ICSV 1112 BF	(ICSV 1004 BF x ISVAT 82/2022)-3-2	ICRISAT
6	ICSV 1115 BF	(Framida x E 35-1)-3-7	ICRISAT
7	ICSV 1156 BF	(Framida x E 35-1)-4-2-37	ICRISAT
8	ICSV 1164 BF	(ICSV 1011 BF x CSV 4)-2-8	ICRISAT
9	HV 80-10/23-2-1		IRAT/BF
10	IS 9830	-	ICRISAT
11	ICSV 1001 BF	Framida	ICRISAT
12	Local Check Témoin local	-	National Program Programme National

WASVAT - Cycle Precoce/Early

1989, 1990

No. d'entree Entry no.	Variete Variety	Programme d'origine Originating program
1	CS 54	Cameroun
2	CS 61	Cameroun
3	CE 151-382	Senegal
4	CE 196-7-2-1	Senegal
5	Nabana Beida	Mauritania
6	Lekwere Bedha	Mauritania
7	ICSV 242 IN	ICRISAT Reg/Nigeria
8	ICSV 258 IN	"
9	ICSV 401 IN	"
10	ICSV 1079 BF	ICRISAT/Reg/Mali
11	ICSV 1170 BF	"
12	ICSV 1177 BF	"
13	ICSV 1172 BF	"
14	ICSV 1174 BF	"
15	ICSV 1125 BF	"
16	ICSV 1175 BF	"
17	ICSV 1176 BF	"
18	Nagawhite (Control/temoin)	Ghana
19	ICSV 111 IN (")	ICRISAT
20	Local(e) (")	Programe National

P

WASVAT - Cycle Medium/Moyen

1989, 1990

No. d'entree Entry no.	Variete Variety	Programme d'origine Originating program
1	CS 95	Cameroun
2	CS 85	Cameroun
3	NSV-1	Ghana
4	SEPON-82	Niger
5	F_2-20	Senegal
6	Takmalit	Mauritania
7	Niobougou	Mauritania
8	BF 80-10/6-2-3	Burkina Faso
9	BF 82-3/25-1-1	Burkina Faso
10	BF 82-4/4-1-1	Burkina Faso
11	IS 6928	ICRISAT Reg/Nigeria
12	IS 23526	"
13	IS 22380	"
14	ICSV 1163 BF	ICRISAT Reg/Mali
15	ICSV 1157 BF	"
16	ICSV 1171 BF	"
17	Blanc de Karimama	Benin
18	ICSV 1063 BF(Control/temoin)	ICRISAT
19	ICSV 1089 BF(")	ICRISAT
20	Local(e) (")	Programme National

WASHAT - 1989

Cultivar
ICSH 230
ICSH 232
ICSH 642
ICSH 780
ICSH 89001 NG
ICSH 479
ICSH 88038
ICSH 88039
ICSH 507
ICSH 89002 NG
ICSH 330
ICSH 646
ICSH 88042
ICSH 89003 NG
ICSH 89004 NG
Tx 623A x MR 732 (INRAN Sorghum Hybrid)
Tx 631A x SUCR 36 (INRAN Sorghum Hybrid)
Controls
ICSH 109
ICSV 111
LOCAL[1]

6

PEPINIERE OUEST-AFRICAINE DES MALADIES FOLIAIRES DU SORGHO
WEST AFRICAN SORGHUM LEAF DISEASE NURSERY
(WASLDN - 1990)

1989 and 1990

No d'entree Entry no	Genotype Genotype
1	84 S 82
2	84 S 85
3	84 S 103-1
4	84 S 103-2
5	84 S 109
6	84 S 115
7	84 S 126
8	84 S 130
9	84 S 157
10	ICSV 1002 BF
11	84 W 838
12	84 W 848
13	84 W 852
14	ICSV 2 IN
15	ICSV 85.BF
16	ICSV 1011 BF
17	ICSV 1023 BF
18	IS 956
19	IS 3443
20	IS 3555
21	IS 6991
22	IS 9225
23	ICSV 1034 BF
24	ICSV 16-5 BF
25	IS 18696

1. All genotypes are from ICRISAT breeding programs, except for the IS lines which are from ICRISAT's germplasm collection.

WEST AFRICAN SORGHUM HYBRID ADAPTATION TRIAL
(WASHAT) - 1990

LIST OF ENTRIES

ENTRY	DESIGNATION	ORIGIN/PEDIGREE
1	ICSH 780	ICSA 11 x MR 908
2	ICSH 89001 NG	ICSA 11 x ICSV 247
3	ICSH 88038	ICSA 37 x MR 864
4	ICSH 89005 NG	ICSA 37 x MR 904
5	ICSH 89006 NG	ICSA 37 x ICSV 247
6	ICSH 507	ICSA 38 x MR 926
7	ICSH 89002 NG	ICSA 38 x ICSV 247
8	ICSH 89007 NG	ICSA 38 x MR 917
9	ICSH 89008 NG	ICSA 38 x MR 912
10	ICSH 89009 NG	ICSA 39 x MR 906
11	ICSH 89010 NG	ICSA 39 X MR 908
12	ICSH 89011 NG	ICSA 39 x MR 912
13	ICSH 89012 NG	ICSA 39 x MR 917
14	ICSH 89013 NG	ICSA 39 x MR 941
15	ICSH 89004 NG	ICSA 41 x MR 841
16	ICSH 89014 NG	ICSA 41 x ICSV 247
17	INRAN Sorghum Hybrid	Tx 623A x MR 732
18	INRAN Sorghum Hybrid	Tx 631A x Suc 36
19	ICSV 111	Early Maturing Variety Control
20	Local	Early Maturing/Variety/Hybrid Control

WASVAT - CYCLE PRECOCE/EARLY

1991

No. d'entrée/ Entry No.	Genotype	Programme d'origine/ Originating Program
1	NR 71176	Nigeria
2	NR 71169	Nigeria
3	CE 145-66 TRANS 2	Senegal
4	CE 314-18	Senegal
5	CE 315-14-1-1	Senegal
6	SSV-2	Senegal
7	CSM 219	Mali
8	Mota-Maradi	Niger
9	90 W 194	ICRISAT
10	90 W 186	ICRISAT
11	90 W 197	ICRISAT
12	ICSV 401 IN (Témoin/Control)	ICRISAT
13	Nagawhite (Témoin/Control)	Programme national du Ghana/ Ghana national program
14	Témoin local/Local control	

WASVAT - CYCLE MOYEN/MEDIUM

1991

No. d'entrée/ Entry No.	Genotype	Programme d'origine/ Originating Program
1	S 219	Côte d'Ivoire
2	83-3/3-1-1	Burkina Faso
3	83-3/48-2-1	Burkina Faso
4	Kadaga	Ghana
5	CSM 388	Mali
6	NR 71158	Nigeria
7	NR 71149	Nigeria
8	Blanc de Bagou	Benin
9	90 W 187	ICRISAT
10	90 W 188	ICRISAT
11	90 W 190	ICRISAT
12	90 W 191	ICRISAT
13	90 W 193	ICRISAT
14	90 W 195	ICRISAT
15	90 W 196	ICRISAT
16	CS 85 (Témoin/Control)	Cameroon
17	Témoin local/Local control	

ESSAI *STRIGA/STRIGA* TRIAL - WCASST

1991

List of Varieties[1]

No. d'entrée/ Entry No.	Genotype
1	CS 54
2	IS 15823
3	CS-61 X Framida
4	82 S 51 X CS 61
5	IS 1260
6	S 35 X S-34
7	CS 54 X CS 63
8	CS 95
9	CS 54 X Djigari
10	S 35
11	CS 210
12	CS 141
13	Témoin local/Local control

1. Toutes les entrées viennent du Projet *Striga* du ROCARS au Cameroun comme recommandé par le Comité Directeur.

1. All entries were sumitted by the WCASRN's *Striga* Project in Cameroon as per recommendation of the Steering Committee.

Pepinière Ouest Africaine des Maladies Foliaires du Sorgho

West African Sorghum Leaf Disease Nursery

(WASDLN - 1991)

No. d'entrée Entry No.	Genotype
1	48887
2	BF 82-7/18-2-1
3	ICSV 94-3 BF
4	BF 83-3/3-2-2
5	BF 58581
6	BF 83-3/32-1-1
7	E 35-1
8	BF 83-3/48-2-1
9	BF 83-3/3-1-1
10	BF 83-3/52-1-1
11	SPV 386
12	84 W 849
13	84 W 966
14	F2-20
15	84 S 82
16	IS 18442
17	IS 13922
18	ICSV 745

Témoins/Controls: 84 S 82 = résistance à presque toutes les maladies foliaires/resistant to most leaf diseases. IS 18442, IS 13922, ICSV 745 sont sensibles aux anthracnose foliaire, taches grises et bandes de suie, respectivement/are susceptible to leaf anthracnose, gray leaf spot, and sooty stripe, respectively.

VARIETIES UNDER CONSIDERATION BY SOME NATIONAL PROGRAMS FOR FURTHER EVALUATION AND TESTING

Country	Variety
Burkina Faso	ICSV 1002 BF, ICSV 1049 BF, Framida, ICSV 126 IN, ICSV 16-5 BF, ICSV III IN
Niger	Sepon 82, ICSV 1007 BF, S-35
Ghana	ICSV III IN, ICSV 1087 BF, ICSV 1078 BF, ICSV 16-5 BF, ICSV 210 IN, ICSV 1054 BF, ICSV 1093 BF, ICSV 1063 BF, ICSV 1089 BF, ICSV 1092
Togo	ICSV III IN, M 66118, Sepon-82, ICSV 1007 BF.
Côte d'Ivoire	ICSV 1063 BF, Mali Sor 84-1
Nigeria	ICSV 1002 BF and ICSV 1007 BF
Sierra Leone	Malisor 84-7
Guinea-Bissau	ICSV 126 IN and ICSV 1074 BF
Central African Republic	ICSV 1063 BF and ICSV 1093 BF
Mali	ICSV 1063 BF and ICSV 1079 BF

WEST AND CENTRAL AFRICA SORGHUM RESEARCH NETWORK (WCASRN)

Regional Trials and Nurseries

1986

	Trials and number of sets				
	WASVAT				
Country	Early	Medium	*Striga*	Diseases	WASHAT
Benin	0	0	0	0	0
Burkina Faso	3 R(3)	4 R(4)	0	0	6 R(5)
Cameroon	1 R	1 R	0	0	2 R(2)
CAR	0	0	0	0	0
Côte d'Ivoire	0	0	0	0	2 R(2)
Gambia	1 R	1 R	0	0	0
Ghana	1 R	1 R	0	0	1 R
Guinea	0	0	0	0	0
Guinea Bissau	0	0	0	0	0
Mali	0	0	0	0	1
Mauritania	0	0	0	0	0
Niger	0	0	0	0	0
Nigeria	0	0	0	0	0
Senegal	0	0	0	0	0
Sierra Leone	0	0	0	0	0
Tchad	0	0	0	0	0
Togo	1 R	1 R	0	0	2 R(2)
TOTAL DISPATCHED	7	8	0	0	14
TOTAL RESULTS RECEIVED	7	8			12

WASVAT = West African Sorghum Variety Adaptation Trial. Early and medium refer to maturity cycle. WASHAT = West African Sorghum Hybrid Adaptation Trial. Disease nursery started in 1987 and *Striga* trial started in 1988. R = Results received, with number in parenthesis.

WEST AND CENTRAL AFRICA SORGHUM RESEARCH NETWORK (WCASRN)

Regional Trials and Nurseries

1987

	Trials and number of sets				
	WASVAT				
Country	Early	Medium	*Striga*	Diseases	WASHAT
Benin	0	1 R	0	0	0
Burkina Faso	5 R(5)	5 R(5)	0	2 R(2)	7 R(7)
Cameroon	1 R	0	0	0	2 R(2)
CAR	0	0	0	0	0
Côte d'Ivoire	0	1 R	0	1 R	2 R(2)
Gambia	1 R	1 R	0	0	0
Ghana	0	1 R	0	0	1 R
Guinea	0	0	0	0	0
Guinea Bissau	0	0	0	0	0
Mali	1 R	1 R	0	1 R	1 R
Mauritania	0	0	0	0	0
Niger	1	1	0	1 R	1 R
Nigeria	1 R	1 R	0	0	0
Senegal	0	0	0	0	0
Sierra Leone	0	0	0	0	0
Tchad	0	0	0	0	0
Togo	0	1 R	0	0	1 R
TOTAL DISPATCHED	10	13	0	5	15
TOTAL RESULTS RECEIVED	9	12		5	15

WASVAT = West African Sorghum Variety Adaptation Trial. Early and medium refer to maturity cycle. WASHAT = West African Sorghum Hybrid Adaptation Trial. Disease nursery started in 1987 and *Striga* trial started in 1988. R = Results received, with number in parenthesis.

WEST AND CENTRAL AFRICA SORGHUM RESEARCH NETWORK (WCASRN)

Regional Trials and Nurseries

1988

	Trials and number of sets				
	WASVAT				
Country	Early	Medium	*Striga*	Diseases	WASHAT
Benin	0	1 R	0	0	0
Burkina Faso	2 R(2)	2 R(2)	0	2 R	1 R
Cameroon	1 R	1 R	1 R	0	0
CAR	0	1	0	0	0
Côte d'Ivoire	0	1 R	0	1 R	2 R
Gambia	1	1	0	0	0
Ghana	1 R	1 R	1 R	1 R	1 R
Guinea	0	1	0	0	0
Guinea Bissau	0	1	0	0	0
Mali	2 R(2)	2 R(2)	1 R	1 R	2 R
Mauritania	1 R	0	0	0	0
Niger	2 R(2)	2 R(2)	1	1 R	3 R(3)
Nigeria	2 R(2)	2 R(2)	1	1 R	2 R(2)
Senegal	1 R	0	0	0	0
Sierra Leone	0	1	0	0	0
Tchad	1	1	0	0	0
Togo	0	1 R	1	0	1 R
TOTAL DISPATCHED	14	19	6	7	12
TOTAL RESULTS RECEIVED	12	13		7	12

WASVAT = West African Sorghum Variety Adaptation Trial. Early and medium refer to maturity cycle. WASHAT = West African Sorghum Hybrid Adaptation Trial. Disease nursery started in 1987 and *Striga* trial started in 1988. R = Results received, with number in parenthesis.

WEST AND CENTRAL AFRICA SORGHUM RESEARCH NETWORK (WCASRN)

Regional Trials and Nurseries

1989

	Trials and number of sets									
	WASVAT									
Country	Early		Medium		*Striga*		Diseases		WASHAT	
Benin	0		1	R	1		0		0	
Burkina Faso	2	R(2)	2	R(2)	1	R	2	R(1)	1	R
Cameroon	1	R	1	R	1	R	1		1	R
CAR	0		1		0		1		0	
Côte d'Ivoire	0		1		0		0		1	R
Gambia	1		1		0		0		0	
Ghana	2	R(2)	2	R(2)	1	R	1		0	
Guinea	0		1		0		1		0	
Guinea Bissau	0		1		1		1		0	
Mali	2	R(2)	2	R(2)	1	R	1	R	2	R(2)
Mauritania	1		0		0		0		0	
Niger	2	R(2)	1	R	0		1		2	R(2)
Nigeria	1	R	1	R	1	R	0		2	R(1)
Senegal	1	R	1	R	0		0		0	
Sierra Leone	1	R	1	R	0		1		0	
Tchad	1		1		1		0		0	
Togo	1		1	R	1	R	0		0	
TOTAL DISPATCHED	16		19		9		10		9	
TOTAL RESULTS RECEIVED	12		13		6		2		8	

WASVAT = West African Sorghum Variety Adaptation Trial. Early and medium refer to maturity cycle. WASHAT = West African Sorghum Hybrid Adaptation Trial. Disease nursery started in 1987 and *Striga* trial started in 1988. R = Results received, with number in parenthesis.

WEST AND CENTRAL AFRICA SORGHUM RESEARCH NETWORK (WCASRN)

Regional Trials and Nurseries

1990

	Trials and number of sets				
	WASVAT				
Country	Early	Medium	*Striga*	Diseases	WASHAT
Benin	0	1	1	0	0
Burkina Faso	2 R(2)	2 R(2)	0	1 R	0
Cameroon	1 R	1 R	1 R	1	2 R(2)
CAR	0	1	0	0	0
Côte d'Ivoire	0	1 R	0	0	2 R(2)
Gambia	1 R	1 R	0	0	0
Ghana	1 R	2 (1)	1	1	0
Guinea	0	1 R	0	1 R	0
Guinea Bissau	0	1	1	1	0
Mali	2 R(2)	2 R(2)	1	2 R(1)	3 R(3)
Mauritania	1 R	0	0	0	0
Niger	1 R	1 R	1 R	1 R	2 R(2)
Nigeria	2	2	4	0	1 R
Senegal	1 R	1 R	0	0	0
Sierra Leone	1 R	1 R	C	0	0
Tchad	1 R	1 R	0	0	0
Togo	1 R	0	1 R	0	0
TOTAL DISPATCHED	15	19	11	8	10
TOTAL RESULTS RECEIVED	13	13	3	4	10

WASVAT = West African Sorghum Variety Adaptation Trial. Early and medium refer to maturity cycle. WASHAT = West African Sorghum Hybrid Adaptation Trial. Disease nursery started in 1987 and *Striga* trial started in 1988. R = Results received, with number in parenthesis.

WEST AND CENTRAL AFRICA SORGHUM RESEARCH NETWORK (WCASRN)

Regional Trials and Nurseries

1991

	Trials and number of sets				
	WASVAT				
Country	Early	Medium	*Striga*	Diseases	WASHAT
Benin	0	1	0	0	1
Burkina Faso	2	2	0	1	1
Cameroon	1	1	1	1	2
CAR	0	1	0	0	0
Côte d'Ivoire	0	1	0	0	2
Gambia	1	0	1	0	0
Ghana	1	2	0	1	1
Guinea	0	1	0	1	0
Guinea Bissau	0	1	0	1	0
Mali	2	2	1	2	2
Mauritania	1	0	0	0	0
Niger	1	1	1	1	2
Nigeria	2	2	0	0	2
Senegal	1	1	1	0	1
Sierra Leone	1	1	0	1	0
Tchad	1	1	1	0	0
Togo	1	0	1	0	0
TOTAL DISPATCHED	15	18	7	9	14
TOTAL RESULTS RECEIVED					

WASVAT = West African Sorghum Variety Adaptation Trial. Early and medium refer to maturity cycle. WASHAT = West African Sorghum Hybrid Adaptation Trial. Disease nursery started in 1987 and *Striga* trial started in 1988. R = Results received, with number in parenthesis.

SAFGRAD/OAU-STRC/ICRISAT

WEST AND CENTRAL AFRICA
SORGHUM RESEARCH NETWORK
(WCASRN), B.P. 320, BAMAKO,
MALI

RESEAU OUEST ET CENTRE
AFRICAIN DE RECHERCHE SUR
LE SORGHO (ROCARS)
B.P. 320, BAMAKO, MALI

TECHNICAL INFORMATION BULLETIN
ON PROMISING VARIETIES TESTED
BY THE NETWORK

FICHE TECHNIQUE SUR LES
VARIETES PROMETTEUSES
TESTEES PAR LE RESEAU

NAME OF VARIETY/NOM DE LA VARIETE:

1. ORIGIN/ORIGINE:

2. BOTANIC CLASSIFICATION/
   CLASSIFICATION BOTANIQUE:

3. IMPORTANT CHARACTERISTICS/
   PRINCIPALES CARACTERISTIQUES:

   - Seedling vigor/Vigueur a la levée:
   - Photosensitivity/Photosensibilité:
   - Cycle, 50% flowering (in days)/
     Cycle, 50% floraison (en jours):
   - Cycle, at maturity (in days)/
     Cycle, à la maturité (en jours):
   - Plant height from base of panicle (in cm)/
     Hauteur de la plante à partir de la base de
     la panicule (en cm):
   - Anthocyanin color on leaves/Couleur anthocyanée
     sur feuilles:
   - Resistance to leaf diseases/
     Résistance aux maladies foliaires:
   - *Striga*:
   - Lodging/Verse:
   - Panicle exertion/Exertion paniculaire:
   - Panicle form/Type de panicule
   - Grain color, size, weight/Couleur des grains,
     dimension et poids:
   - Acceptance as food/Acceptation gustative:
   - Yield (mean from 2 years)/
     Rendement (moyenne de 2 ans):
   - Rainfall zone/Zone de culture:
   - Planting date/Date de semis:
   - Resistance to stem insects/
     Résistance aux insectes des tiges:
   - Resistance to panicle insects/
     Résistance aux insectes de la panicule:
   - *Testa*:
   - Germination % of one year old seed stand establishment/
     % de germination d'une semence d'un an à la levée:
   - Decortication of yield/Decorticage du rendement:
   - Panicle diseases - grain mold/
     Maladies de la panicule - moisissure des grains:
   - Food quality/Qualité alimentaire:
   - Endosperm texture/Texture de l'endosperme:

A N N E X 3

VISITS TO NARS

1. Terms of Reference
2. Manpower Evaluation Form

USAID/OAU-STRC/SAFGRAD/ICRISAT

RESEAU OUEST ET CENTRE AFRICAIN DE RECHERCHE SUR LE SORGHO

WEST AND CENTRAL AFRICA SORGHUM RESEARCH NETWORK

TERMS OF REFERENCE FOR VISISTS TO NATIONAL PROGRAMS

GUIDE DE REFERENCE POUR LA VISITE AUX PROGRAMMES NATIONAUX

1. The importance of sorghum (area cropped to sorghum, role of sorghum in the diet, market value, national policy on sorghum, etc.);

   L'importance du sorgho (surface cultivée en sorgho, place du sorgho dans l'alimentation, prix de vente, politique nationale sur le sorgho, etc.);

2. Research carried out on sorghum;

   La recherche conduite sur le sorgho;

3. Research personnel working on sorghum (number, discipline, level of qualification); see attached form to be filled.

   Le personnel de recherche travaillant sur le sorgho (nombre, discipline, niveau de formation), ci-joint une fiche à remplir.

4. Major constraints in research and production;

   Contraintes majeures de la recherche et de la production.

5. Farmer's perception of sorghum in their cropping systems;

   Point de vue des paysans sur le sorgho dans leurs systèmes de production;

6. Immediate and long-term research needs and training according to areas of priority;

   Besoins immédiats et à long terme de la recherche et la formation selon les domaines de priorité;

7. Participation in the activities of the West and Central Africa Sorghum Research Network (general workshops, training workshops, monitoring tours, regional trials and nurseries, collaborative research projects).

   Participation aux activités du Réseau de Recherche sur le Sorgho en Afrique Occidentale et Centrale (atéliers généraux, atéliers de formation, visites d'observations, essais régionaux et pépinières, projets de collaboration).

8. Field visit and evaluation of the Network trials (if possible).

   Visite de champs et evaluation des essais du Réseau (si possible).

USAID/OAU-STRC/SAFGRAD/ICRISAT

RESEAU OUEST ET CENTRE AFRICAIN DE RECHERCHE SUR LE SORGHO

WEST AND CENTRAL AFRICAN SORGHUM RESEARCH NETWORK

A. NOM DU PAYS/NAME OF COUNTRY _____

B. DIRECTEUR GENERAL/DIRECTOR _____

Adresse/Address _____

_____

_____

Telephone _____ Telex _____ Fax _____

C. AUTRES PERSONALITES ADMINISTRATIVES/OTHER SENIOR ADMINISTRATIVE PERSONNEL

1. Nom/Name _____

Adresse/Address _____

_____

_____

Telephone _____ Telex _____ Fax _____

2. Nom/Name _____

Adresse/Address _____

_____

_____

Telephone _____ Telex _____ Fax _____

D. NOM, DIPLOME, DISCIPLINE, SITUATION ACTUELLE (en conge, a la station, etc.) DES CHERCHEURS DU SORGHO/NAME, DEGREE, DISCIPLINE, AND CURRENT SITUATION (on leave, at the station) OF SORGHUM RESEARCHERS

NOM DU PAYS/NAME OF COUNTRY _____

	NOM/NAME	DIPLOME DEGREE	DISCIPLINE	SITUATION ACTUELLE CURRENT SITUATION
1.				
2.				
3.				
4.				
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EAST AFRICA SORGHUM & MILLET RESEARCH NETWORK (EARSAM)

CONTENTS

TABLE OF CONTENTS

		PAGE
1.	INTRODUCTION	1
2.	ACCOMPLISHMENTS	7
3.	LESSONS LEARNED	18
4.	RECOMMENDATIONS FOR PHASE III	20

INTRODUCTION

1. Introduction

The region herein referred to as eastern Africa includes Burundi, Ethiopia, Kenya, Rwanda, Somalia, Sudan, Tanzania, and Uganda. Almost all the major sorghum ecological zones found worldwide are represented in eastern Africa (1). The region is unique in that it contains areas of sorghum production in all the ecological niches in which the crop is normally cultivated; ranging from near sea level to 2500 m. Differences in physiography are reflected in the wide range of climates, soils, and crop requirements and constraints found within the region. Well over 75% of the region has an average annual rainfall between 400 to 1000mm. The bimodal rainfall generally falls for about 3 to 5 months and is highly variable. Temperatures in the different ecological zones are variable and can range from 6^0C (Highland) to 45^0 (Lowland), (2).

Although total sorghum and millet production in eastern Africa has increased in both hectarage, and, to some extent, yield per hectare, food production still is not keeping pace with population growth (>3.0%). There is, therefore, an urgent need to increase sorghum and millet production in order to help alleviate hunger and malnutrition (3).

Recognizing the need to improve productivity in this region, breeders have made efforts to increase yield through improved varieties. Despite their special efforts to develop improved varieties, the spread of these varieties is discouragingly slow compared to other cereal crops. The behavior of farmers as producers and consumers in a changing agriculture scenario is not well understood. However, the benefits of research investment in developing acceptable improved varieties are largely related to the market/utilization trends; which together with relative profitability are the motivating factors for adopting new varieties. The allocation of resources is relatively higher for sorghum improvement than for millets. The number of research projects within national agricultural research systems (NARSs), and the collaborative research projects on sorghum compared to the few on millets reflects the relative importance of these crops and this has been confirmed by members of the Eastern Africa Regional Sorghum and Millet (EARSAM) Steering Committee (4).

Sorghum

Of the total area cultivated to cereals in the region (Table 1), in each individual country, sorghum is either the first or second most important cereal. In the drier and drought-stressed zones of the region sorghum is the predominant crop. Since the region is recognized as the origin and center of diversity of the crop, it contains tremendous sorghum genetic variability especially in Ethiopia and the Sudan. Therefore, efficient collection and exploitation of this genetic variability has the potential to benefit not only the region, but also all other sorghum-growing

countries. Globally, this is the single most important region for high-altitude and cold-tolerant sorghums in terms of both genetic diversity, and total tonnage produced. (Table 1). Most of the sorghums produced in the region are used for food and brewing local beer. Sorghum beverages (unfermented or fermented) are regarded as important food item in the rural areas. Average farmers grain yields range from 600 to 1000 kg ha^{-1} compared to experiment station yields of 2000 to 4000 kg ha^{-1}.

In the eastern African region, it is notable that efforts to initiate improvement on cereal crops, primarily maize, date back to the late 1930's and early 1940's (5). At that time, sorghum collections were being made in Kenya, Uganda, and Tanzania. Sorghum selection began at Ukiriguru, Tanzania, in 1948/49 and breeding at Serere Uganda, in 1954. Research in sorghum over the years included development of white and colored-seeded varieties, weevil resistance in stored grain, resistance to *Striga*, shootfly, and stem borers. A network of locations linked in a multilocational testing system assisted in identifying varieties with broad adaptation and reasonable levels of resistance to most of the diseases and pest problems of eastern Africa. Population breeding methods were developed that are still contributing to sorghum improvement.

Millets

The millets are a group of small-grained cereals that are grown on 15-20 million hectares, mainly in south Asia, China, USSR, and in several African countries. These crops have long been important components in traditional farming systems and in the diets of many millions of people in areas where stable food production is difficult due to uncertain rainfall, harsh soils, or topography. Millets are traditional crops of dryland regions in eastern Africa where agriculture is mainly rainfed. Most of the millets have a higher adaptability to drought and other environmental stresses and their cultivation minimizes the risks for dryland farmers.

Among the millets, finger millet *(Eleucine coracana)* is the predominant species grown in most eastern African countries with the exception of Sudan where pearl millet *(Pennisetum glaucum)* is predominant (Table 1). Finger millet is indigenous to eastern Africa and the region has tremendous genetic variability of the crop. Major finger millet producing countries in eastern Africa are Uganda, Ethiopia, Tanzania, Burundi and Kenya. In Uganda finger millet is largely grown in eastern, northern and western regions of the country where it forms a major staple food. In Ethiopia the major finger millet producing areas are located in northern, north western and western parts of the country. In Tanzania the most important finger millet producing areas are in the southern highlands particularly in Mbeya, Rukwa and Ruvuma regions. It is also grown in large quantities in Dodoma, Siginda, Arusha, Kilimanjaro and Mara regions. In Kenya Finger

10

millet is largely grown in western Nyanza and Rift Valley Provinces.

In Uganda, Kenya and Burundi finger millet grains are ground in mixture with sorghum or cassava and used to make thin (uji) and stiff (Ugali) porridges. In Ethiopia it is used for bread (injera) alone or in mixture with teff (Eregrostis teff). In all the countries finger millet is most popular for making all types of local beers. In some countries as high as 75% of the total finger millet production is used for brewing.

Finger millet grain stores well and is free of major storage insect pests. Because of this it is used as an important famine food in some countries particularly in Uganda and stored for this purpose. Finger millet is largrely grown by peasant farmers and the predominant varieties used are their local landraces. Historically, millet breeding began at Serere, Uganda in 1950. Over the years research on finger and pearl millets has included the development of varieties and synthetics with resistance to abiotic and biotic stresses. Through multilocational testing and exchange of germplasm, varieties with broad adaptation have been identified.

Constraints to Production

Lack of improved cultivars: Low-yielding traditional landraces are predominantly grown; there is thus potential to improve the yield and stability of the existing varieties and landraces. Seed set, crop maturity, and plant height are important traits to be considered.

Drought and soil management: Many of the soils in the region whether heavy or light are of low fertility. Increases in production on such soils are only possible when improved varieties are grown with improvement in soil management. Drought, stand establishment, temperature, and nutrient stresses all significantly affect production. Intercropping and sole cropping are both practiced, and further work is required on the relationships of interplanted crops.

Diseases: Priority diseases for regional research include the pathogens that cause anthracnose, covered smut, grain mold, and ergot of sorghum. For finger millet, head blast and sorghum and pearl millet ergot are the most widespread diseases in the region and sometimes causes heavy damage to the crop. Downy mildew, rust, and smut are also common in the region; these diseases do not appear to do much damage to the local landraces, but the situation could change with the introduction of improved cultivars.

Insect pests: The predominant pests of sorghum are stem borers, shootfly, sorghum midge, and storage insects. Several of the insects found on sorghum also attack millets, but do not appear to significantly damage the crop.

Birds: *Quelea* and other species cause significant damage to both crops. The actual extent of damage has not been critically evaluated.

Striga: Several species of this parasitic weed attack sorghum and finger millet crops resulting in significant production losses.

On-farm trials: To translate research results to farmers, it is important to conduct verification trials on farmers' fields, coupled with economic analysis of on-farm trials to provide farmers feed-back to researchers.

Marketing and price control: Most countries have no official market or pricing policies for both crops; consequently the crop does not enter into official trading system and this is a disincentive to growers. Proper and cost-effective distribution of grain with adequate price control is essential to absorb excess production.

Postharvest handling and utilization: Eastern African countries are increasingly expressing concern about the postharvest handling, storage insects, and utilization aspects of both crops. It is important that for rapid acceptance, improved cultivars should be of acceptable quality for food products, brewing, and as livestock and poultry feed. Most countries have no official markets or pricing policies for these crops; consequently they do not enter into official trading systems, and this is a disincentive to growers.

Seed production: One of the bottlenecks to rapid movement of improved varieties and hybrids in the region is the lack of effective seed industry. Kenya is the only country with a good and well-established seed industry, but it alone cannot meet the need for seed production in the region. Varieties are produced but hybrid seed is only available in Sudan. It is, therefore essential to strengthen the seed industry in each of the regions' countries.

Historical Perspective

Since 1982 the United States Agency for International Development (USAID) and the International Crop Research Institute for the Semi Arid Tropics (ICRISAT) have provided funds to implement sorghum and millet improvement in eastern Africa through the Semi-Arid Food Grain Research And Development (SAFGRAD) Project.

Through the Organization of African Unity (OAU), SAFGRAD mobilizes the efforts and strengths of national agricultural research systems (NARSs) through networking, and by facilitating the mobility of scientists and research materials. ICRISAT has the capability to improve the research base of NARS through research support, training, and other activities.

Phase I (1982-86)

ICRISAT/SAFGRAD made remarkable progress in training scientists from national programs in the region. It brought together various national programs through scientist-to-scientist interaction during regional workshops and field tours. As a result of these interactions, scientists shared their research results, exchanged germplasm, and evaluated their elite sorghum genotypes on a regional basis. Thus, Phase I activities established the groundwork for Phase II.

Phase II (1986-91)

In 1986, further effort was needed to expand and strengthen sorghum and millets research in eastern Africa. This was achieved by developing a strong and efficient networking model. This model was designed to further strengthen the ties among the NARSs of the region, not only to interchange scientific results, experiences and germplasm, but also to share responsibilities for common problems in the region, and thus avoid duplication of efforts.

In 1986, during the 5th Regional Workshop in Bujumbura, Burundi, a Steering Committee (SC) comprising one NARS scientist from each country of the region was formed to provide overall guidance for networking activities. The SC members met again in Ethiopia in November 1986 and developed a regional network model, the Eastern Africa Regional Sorghum And Millet (EARSAM) network. The EARSAM network SC includes a Chairman, a Secretary, 6 scientists from NARS, and the EARSAM Coordinator. Representatives from donor agencies and international organizations attend its meetings as observers.

The SC members serve for 2 consecutive years and during each regional workshop (held every other year), 50% of the SC members are elected. The Chairman of the previous SC overlaps with the newly elected members in order to maintain continuity.

Steering Committe

- Prepares short- and long-term network action plans based on prioritized problems of regional significance.
- Monitors the implementation of workshop recommendations and SC decisions.
- Facilitates the implementation of the research network activities in their respective countries in particular, and in the region in general.
- Determines themes for future workshops and regional short-course training programs.

The Regional Coordinator

- Contributes ideas to SC members.
- Executes the decisions taken by NARSs.
- Links ICRISAT scientists to NARS researchers in EARSAM network activities.

EARSAM Network Objectives

- To assist NARS, in the development of improved varieties and hybrids that together with agronomic and soil management and conservation practices will result in higher and more stable economic yields in the region.
- To assist NARS, to develop or adapt screening techniques to identify broad-based genetic resistances/tolerances to abiotic and biotic stresses, to incorporate them in elite breeding material, and to identify materials adapted to the various ecological zones in eastern Africa.

  To organize and promote systematic regional cooperative testing of available elite cultivars.

  To develop collaborative research projects on productionconstraints of major significance in the region with strong (lead) NARS, and provide critical inputs to enable them to carry out research adequately and satisfactorily.
- Assist NARS, in training and manpower development.
- Organize regional workshops, monitoring tours, and field days in order to report research findings, interchange ideas and breeding materials and to foster closer national program cooperation.

Collaboration with National Agricultural Research Systems (NARS)

In 1986, the major and common constraints to sorghum and millet production were identified by NARS SC members, research priorities were formulated, and lead research centers identified to carry out research projects in the region with the help of ICRISAT experts. As a follow up, ICRISAT developed collaborative research projects with NARS and transferred specific technologies developed at ICRISAT Center to lead-center scientists. In addition, needed research supplies were provided by ICRISAT to NARS for the proper execution of each project. The purpose of this collaboration, that utilizes scientific skills and research facilities available in the NARSs, is to develop research leadership of NARS scientists, to strengthen their ability to carry out effective research, and to generate appropriate and affordable research technology that can be used by farmers.

ACCOMPLISHMENTS

2. Accomplishments

Striga resistance screening with the Institute of Agricultural Research (IAR) Ethiopia

- Several hundred breeding and germplasm lines have been screened for resistance to *Striga* in field "sick" plots, and 27 resistant lines identified.

- In pot experiments at Holeta Research Station, 5 sorghum lines (SAR 24, Gambella 1107, N 13, ICSV 1006, and ICSV 1007) have been identified as resistant to both *S. hermonthica* and *S. asiatica*.

- All the identified *Striga*-resistant lines have been distributed to NARSs in the region for further testing and use in their programs.

Long smut (*Tolyposporium ehrenbigii*), with the Kenya Agricultural Research Institute (KARI), Kenya

- During surveys conducted in eastern Kenya in 1987 and 1988 sorghum long smut infestation was observed in farmers fields in Meru and Embu districts. At Marimanti Experiment Station in Meru, the disease incidence varied from 29% on susceptible genotypes to 0% in the local variety IS 8595. 18 lines that showed resistance to long smut at Marimanti have been selected.

- A long smut screening technique has been developed in the greenhouse at the KARI Research Station, Muguga using artificial inoculation. Sporidia were found to be a more effective source of inoculum when inoculation occurred at the boot stage.

- The resistance of IS 8595 was formerly attributed to its long glumes that completely cover the grain. Recent results indicate that complete glume coverage may not be directly linked with long smut resistance since other long-glumed genotypes have been found highly susceptible.

- It has been confirmed that seed treatment with systemic fungicides available in Kenya (Rocol (R) and Bayleton (R)) is ineffective in the control of long smut.

Covered smut (*Sphacelotheca sorghi*) with KARI, Kenya

- A simple and reliable screening technique to screen sorghum germplasm and breeding lines for resistance to covered smut has been developed and is being used to screen a large number of breeding and germplasm lines from NARSs, ICRISAT Center, and other sources. Maximum infection resulted when 10 g of seed was mixed with 50 mg of dry teliospores.

Ergot (*Sphacella sorghii*) with IAR, Ethiopia and l'Institut des sciences agronomique Rwanda (ISAR), Rwanda

- An artificial inoculation technique developed at ICRISAT Center has been transferred to scientists working at IAR, and ISAR.

- Over 300 sorghum lines have been screened for ergot resistance at Arsi Negele, Ethiopia, 48 lines have been identified that show less than 10% ergot-infected florets. After further screening of the 48 selected lines at Arsi Negele, 6 lines (ETS numbers 1446, 2448, 2465, 3155, 4457, and 4927) were confirmed as having resistance to ergot.

- The same technique was used at Rubona and Karama, Rwanda to identify 8 resistant lines (IS numbers 25531, 25485, 25489, 25527, 255530, 25533, 25537, and 25542).

- The relationship between pollination and ergot infection has been studied, ergot incidence has been found to increase with the time interval between inoculation and anthesis.

- The common grasses *(Panicum maximum* and *Cenchrus diliaris)* have been identified as alternate/collateral hosts of the sorghum ergot pathogen in Rwanda. These grasses may serve as primary sources of ergot inoculum.

Anthracnose *(Colletotrichum graminicola)* with IAR, Ethiopia

- An anthracnose artificial screening technique has been transferred from ICRISAT Center to IAR scientists working at Nazreth, and used to screen 111 sorghum germplasm and breeding lines; 67 anthracnose-resistant lines have been identified.

- The technique is being used to screen more lines from NARSs for resistance to anthracnose.

- An anthracnose resistance nursery is being organized, to be evaluated at anthracnose "hot spot" locations in eastern Africa to confirm stability of resistance.

Finger millet head blast *(Pyricularia setariae)* resistance screening, with KARI Kenya

- Nine hundred and sixty finger millet germplasm lines have been screened for resistance to finger millet head blast disease at Kiboko, and lines with variable levels of resistance selected. The 201 selected lines are being screened again for resistance at "hot spot" locations in eastern Africa to identify lines with stable resistance.

- A large number of finger millet germplasm accessions from ICRISAT Center, SADCC/ICRISAT Zimbabwe, and Uganda have been

introduced and will be screened for head blast resistance at Kiboko in 1991.

Sorghum stem borer *(Chilo partellus)* with the Research Division, Ministry of Agriculture, Somalia

- Facilities for insect rearing on artificial diets have been established and successful rearing of *Chilo partellus* initiated at Bonka Research Station. The growth, development, and reproduction of *C. partellus* on the artificial diet were similar to those on its natural host, sorghum.

- An insect-pest survey has been conducted in the Bay Region. *Chilo partellus* was the only pest recorded in all the four districts surveyed, with infestations ranging between 6 to 60% deadhearts.

- It was found that carry-over of stem borers was mainly through the diapausing population in sorghum stalks and stubbles. About 74% of the stalks from the previous gu season contained diapausing larvae and each stalk had an average of 2 larvae, with a maximum of 15 larvae per stalk.

- It was found that stem borer infestation on sorghum crops at Bonka Research Station was half that on ratoon sorghum at Bonka in farmers' fields. Larvae, were in much advanced stage of development in the traditionally ratooned crop, indicating the increase in number of generations (at least 0.5 to 1) per season.

Evaluation of nutritional and food qualities of sorghum in eastern Africa with IAR Ethiopia; University of Nairobi, Kenya; and Food Research Centre, Sudan)

- In a study of the physicochemical characteristics and dehulling quality of 16 selected sorghum cultivars, representing the varieties that are commonly cultivated in Ethiopia, Kenya, and Sudan wide variation in quality was found among the cultivars.

- The organoleptic qualities of such traditional foods as *injera* and *nifro* (Ethiopia), *ugali* (Kenya) and *kisra* (Sudan) have beenevaluated and variation found in the quality of foods madefrom each cultivar. Grains of SPV 475 (India), Dabar (Sudan),and IS 24129 (Tanzania) had comparatively higher ratings for overall food quality.

- Significant associations have been observed between starch characteristics and *injera* quality, and protein content with *injera* and *kisra* quality.

- The tangential abrasive dehulling device (TADD) has been used to dehull large numbers of sorghum samples, and it can also be used to screen for grain hardness.

- If dehulled sorghum grain is used to prepare *injera*, the quality is significantly improved.

Studies on agroclimatic analysis of EARSAM network sites with ICRISAT Center and NARSs

The 22 EARSAM testing locations have been grouped into three classes:

High risk, short-, or medium-duration locations: (60-70 days growing season) where sorghum production can only be stabilized only with supplementary irrigation: Wad Medani (Sudan), Bonka and Afgoi (Somalia), Abu Naam (Sudan), Melkawerer (Ethiopia), Ilonga (Tanzania), and Karama (Rwanda).

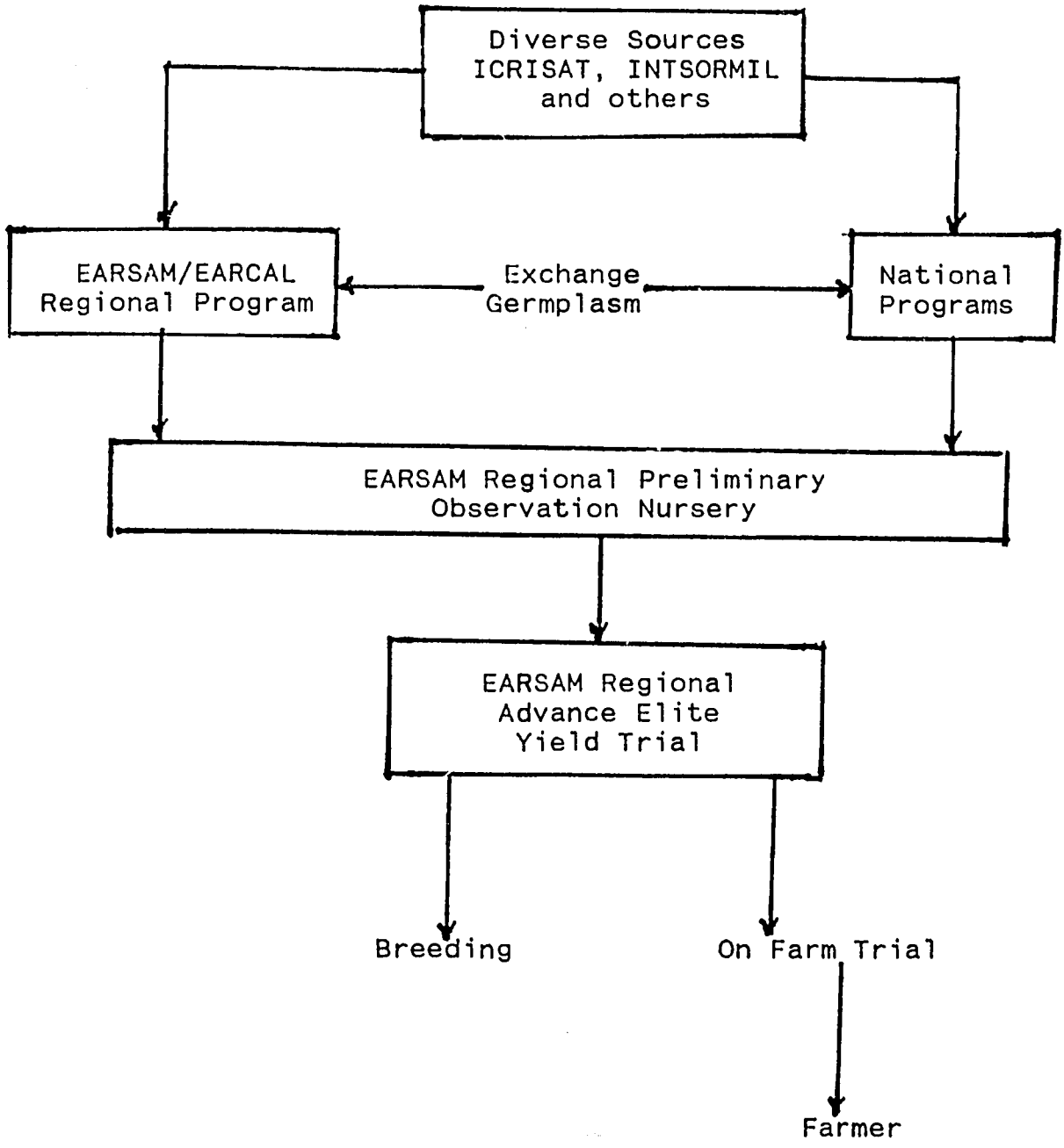
Low risk, medium-duration locations: (80-100 days growing season) where good soil and water management allow stable and increased sorghum yields: Nazret (Ethiopia), Abu Rein (Somalia), Makindu (Kenya), and Malindi (Kenya).

Low risk, long-duration locations (over 120 days growing season) where provision of drainage and fertilizers are necessary to maintain high sorghum yields: Rubona (Rwanda), Bako (Ethiopia), Alupe (Kenya), Mosso (Burundi), Lanet (Kenya), Katumani (Kenya), Kakamega (Kenya), Munanira (Burundi), Alemaya (Ethiopia), Rwerere (Rwanda) and Jimma (Ethiopia).

Regional Sorghum and Millet Germplasm Movement and Evaluation

Germplasm movement and evaluation in the region is an important and integral activity of EARSAM. Germplasm movement in the region from ICRISAT Center to NARS, NARS to NARS, and NARS to ICRISAT Center is extremely important to the sorghum and millet improvement program. This topic was thoroughly discussed and minuted by the SC members in Somalia on 25 July, 1988. A model (Figure 1) for germplasm movement and evaluation was developed and endorsed. In the 1989/90 sowing season, the EARSAM Regional Advanced Elite Yield Trial (EEYT) was organized , evaluated, and analyzed. (EEYT). As a follow-up, under the proposed model, EARSAM regional preliminary observation nurseries have been organized for evaluation in different agro-ecological zones in 1991.

Figure 1. Regional germplasm movement and evaluation.



As a result of germplasm movement, evaluation, and improvement by NARSs, several cultivars of sorghum and millet have been released by NARSs in the region since 1986 (Table 2).

Seed Distribution

Between 1986 and 1990 seed material of sorghum and millet germplasm and breeding lines, resistant or tolerant to *Striga*, stem borer, shootfly, downy mildew, midge, leaf diseases, ergot, and cold has been provided to NARS in the region.

Country	Number of samples
Burundi	731
Ethiopia	1052
Kenya	3451
Rwanda	615
Somalia	583
Sudan	534
Tanzania	525
Uganda	825

Several international nurseries and adaptation trials from ICRISAT Center and USA have been provided. These have been evaluated by regional NARSs who provided useful data, and selected productive and adapted cultivars for further testing or use in their own programs.

Testing Elite Germplasm

Sorghum scientists from NARSs who participated in the EARSAM Network's Sixth Regional Workshop held in 1988 in Somalia recommended that regional sorghum yield trials should be initiated, and requested ICRISAT to organize and coordinate these trials. In 1989 we organized and distributed to NARSs in eastern Africa two sorghum regional trials; the EARSAM Elite Sorghum Yield Trial (EESYT) for intermediate and lowland elevations, and one finger millet regional yield trial; the EARSAM Elite Finger Millet Yield Trial (EEFMYT).

EARSAM Elite Sorghum Yield Trial (EESYT-89)

Lowland:

This trial consisted of 25 entries and was evaluated at 14 locations. The location mean grain yields were highly variable across locations and ranged from 0.76 t ha^{-1} at Gadambalia, Sudan to 5.39 t ha^{-1} at Mombasa, Kenya.

We classified the 12 locations from which data were received into three broad ecological groups:

Group 1: Five locations; Baidoa (Somalia), Gadambalia (Sudan), Ilonga (Tanzania), Kiboko long rains, (Kenya), and Hombolo (Tanzania) in the hot, dry zone with short rainy season. (Table 3).

Group 2: Four locations; Mombasa (Kenya), Kiboko short rains, (Kenya), Wad Medani (Sudan), and Imbo (Burundi) with a comparatively reliable short/medium rainy season. (Table 4)

Group 3: Three locations; Melkassa (Ethiopia), Karama (Rwanda), and Katumani short rains, (Kenya) in cool areas with a medium/long rainy season. (Table 5)

In Group 1 ICSV 335 (2.52 t ha^{-1}, SE $\pm$0.28) was the highest-yielding entry. In Group 2 ICSV 112 (4.60 t ha^{-1}, SE $\pm$ 0.50), was the highest-yielding entry and Kigufi (3.90 t ha^{-1}, SE $\pm$ 0.63) was the highest yielding entry in Group 3. ICSV 335, ICSV 112, CR:35:5 and Kat 83487 were among the highest-yielding entries in both Groups 1 and 2.

The EESYT-89 Lowland trial was severely affected by drought at Gadambalia, Sudan and Baidoa, Somalia in Group 1. However, Gadam Hamam produced acceptable yields at both these locations.

Intermediate:

The location mean grain yields were highly variable across the seven locations where this trial (consisting of 16 entries) was evaluated. Mean grain yields ranged from 1.02 t ha^{-1} at Murongwe, Burundi to 3.86 t ha^{-1} at Katumani (short rains), Kenya. We observed significant differences among entries for mean grain yield, plant height, and time to 50% flowering.

We classified the seven locations at which this trial was evaluated into two broad ecological groups:

Group 1: Four locations; Katumani short rains, (Kenya), Murongwe (Burundi), Arsi Negele (Ethiopia), and Robona (Rwanda) in areas with cool climate and medium to long rainy seaons. (Table 6)

Group 2: Three locations; Ukiriguru (Tanzania), Kiboko long rains (Kenya), and Kiboko short rains, (Kenya) in areas with

slightly warmer climate and short/medium rainy seasons. (Table 7)

IS 9302 (3.60 t ha^{-1}, SE ± 0.53) was the highest-yielding entry in Group 1. While the control, Seredo 2 (3.50 t ha^{-1}, SE ± 0.38), was the highest-yielding entry in Group 2. In general, the entries that yielded well in Group 1 were the cold-tolerant entries contributed by NARSs from Rwanda and Ethiopia, while the entries that yielded well in Group 2 were the lowland adapted entries contributed by NARSs from Tanzania and Uganda. At Arsi Negele, and Murongwe the trial was severely attacked by ergot and some entries not adapted to cool climates failed to produce grain. Cold-tolerant IS 9302, Nyirakabuye, and Amasugi produced high yields at these locations.

EARSAM Elite Finger Millet Yield Trial (EEFMYT-89)

Location mean grain yields (Table 8) ranged from 0.56 t h^{-1} at Serere, Uganda to 3.08 t ha^{-1} at Alupe, Kenya. We observed significant differences among the 16 entries at all locations for grain yield, plant height, and time to 50% flowering, and for head blast resistance at Serere and Alupe. Gulu E (2.08 t ha^{-1}, SE ± 0.13) contributed by the Uganda NARS was the highest-yielding entry across the five locations The other high-yielding entries were P224 (1.98 t ha^{-1}, SE ± 0.13) and Serere 1 (1.97 t ha^{-1}, SE ± 0.13) all contributed by Uganda NARS but their yields were not significantly different from Gulu E. Entries U 10, P 227, and Engeny appeared to be resistant to head blast. KAT/FM 1 contributed by Kenya NARS and Accession numbers 100008 and 100057 both contributed by Ethiopia NARS were the earliest to flower at all locations, but these entries had high levels of head blast infection at Serere and Alupe.

Observation Nurseries

NARS scientists who participated in the EARSAM Network Steering Committee Meeting held at Nairobi in October 1990 recommended that preliminary regional cooperative sorghum and finger millet observation nurseries should be conducted, and requested ICRISAT to organize and coordinate these nurseries. We have organized and distributed to our cooperators in eastern Africa the following unreplicated preliminary observation nurseries for evaluation in the 1991 rainy season.

EARSAM Preliminary Sorghum Observation Nursery (EPSON) for dry and hot environments; 144 entries - 15 locations.

EARSAM Preliminary Sorghum Observation Nursery (EPSON) for humid environments; 184 entries - 11 locations.

EARSAM Preliminary Sorghum Observation Nursery (EPSON) for cool highland environments; 95 entries - 12 locations.

EARSAM Preliminary Finger Millet Head Blast Disease Resistance Nursery (EPFMBRN); 286 entries - 10 locations.

Entries in the above nurseries were selected from a nursery of several hundred introductions of sorghum and millet breeding lines and germplasm from NARS, ICRISAT Center, SADCC/ICRISAT, Zimbabwe, and USA. These introductions were evaluated at appropriate locations in Kenya in 1989 and 1990.

Research Support to NARSs

In general the national sorghum improvement programs in the region are relatively young and lack the expertise and funds needed to introduce and evaluate large numbers of breeding lines and germplasm accession. Most national programs also lack the technical skills to generate and handle large segregating populations. SAFGRAD/ICRISAT therefore provides support to NARSs in various ways.

Introductions: We introduce a large number of breeding and germplasm lines from ICRISAT Center, ICRISAT regional programs, USA Universities, and NARSs, and evaluate the material at; Kiboko for adaptation to hot and dry environments, Alupe for humid environments, and Lanet for cool highland environments.

These three locations in Kenya represent the sorghum-growing environments in eastern Africa. Selected material is then made available to NARS for further testing in appropriate environments. This has reduced the research load of NARS thereby allowing their limited resources to be spent on evaluating and screening specific and smaller amounts of material.

Regional crossing block: We plan to manage and handle a regional crossing block where we will make specific crosses based on NARSs' needs and requests. The NARSs will be provided with segregating material at early or advanced stages depending on their requirements and expertise. We will provide advanced lines to weaker NARSs for testing and early segregating material to stronger NARSs for continued selection and generation advancement.

Long-term research: We undertake long-term strategic research on priority problems identified by NARSs, that are time- consuming and require expertise, manpower, and research facilities that most NARS do not have at this stage; e.g., hybrid parental lines and hybrid development, genetic populations, mechanisms of resistances to major yield reducers, etc.

Facilities: KARI has provided research land at the Kiboko substation of the National Dryland Research Centre, Katumani to EARCAL to assist and support KARI and other NARSs in the region in long-term research that will eventually contribute to increased productivity. EARCAL has developed research facilities at Kiboko and built a crop-work area with research equipment, and

114

a guest house for scientists and technicians from KARI and other NARSs to stay overnight while visiting the station or attending courses.

Training

Training of NARS scientists and technicians in eastern Africa is an important and integral part of EARSAM/EARCAL. During the period 1986-90, the following short courses were offered to NARS, and organized at their request:

Seed Production: Nairobi, Kenya, 1987 attended by 35 NARS scientists and 8 scientists from private companies. Eight ICRISAT scientists served as resource persons.

Entomology: Nairobi, Kenya, 1989 attended by 16 technicians from NARSs. Five ICRISAT scientists served as resource persons.

Pathology: ICRISAT Center, India 1989 attended by 16 technicians from NARSs. Eight ICRISAT scientists, and one NARS scientist from Kenya served as resource persons.

BreedingTechniques: Scheduled for June 1991 Kiboko, Kenya, will be attended by 16 technicians from NARS.

Workshops

One facet of EARSAM network activity that has grown markedly in size and quality has been the bi-annual regional workshops. These workshops are well attended by NARS scientists who present the results obtained from collaborative research projects and other studies. Scientists from ICRISAT, other international organizations, and universities attend these workshops, to share their knowledge, expertise, and experiences with NARS scientists, and to assist in the development of short- and long-term research strategies and work plans for the following years. These workshops are jointly organized with the NARS of the country where the workshop is held. The following workshops have been held since 1986:

Fifth EARSAM Regional Workshop: Bujumbura, Burundi, July 1986 attended by 50 scientists.

Sixth EARSAM Regional Workshop: Mogadishu, Somalia, September 1988, attended by 55 scientists.

Seventh EARSAM Regional Workshop: Nairobi, Kenya, June 1990, attended by 67 scientists.

We have published the proceedings of the Fifth and Sixth Regional Workshops, the proceedings of the Seventh Regional Workshop will be published in early 1991.

Monitoring Research Tours/Field Days

We organize monitoring research tours and field days for NARS scientists in the region. This enables them to visit and evaluate each others' research programs, to evaluate the entries in regional trials and nurseries, and to appreciate the interaction between genotypes and locations. The scientists are also given the opportunity to select or request genetic material for utilization by their national programs.

We have organized monitoring research tours or field days in Burundi 1986, Somalia 1988, Sudan 1989, Ethiopia 1990, and Kenya 1990.

Travel and Consultancy

ICRISAT staff in the regional program travel regularly in eastern Africa countries on request to monitor network activities, to interact with NARS scientists, and to transfer practical technologies and skills in order to strengthen NARS scientists' ability to carry out effective research in the development of technology readily usable by farmers.

LESSONS LEARNED

3.Lessons Learned

Training: Well trained scientists and support staff are assets to a good national program. EARSAM network has trained field technicians as requested by NARS in different disciplines. However, there is a need to train BSc and MSc scientists in addition to field technicians. In addition, degree-level training (PhD and MSc) in all discipline is a high NARS priority. Funds were not available in Phase II to train scientists at post graduate level to adequately carry out collaborative research. The EARSAM Steering Committee members updated the list of manpower requirements for EARSAM countries for the period of 1992 to 1996 as follows: 24 PhDs and 29 MSc are required for eight countries in eastern Africa.

Millets: Allocation of resources by NARS is relatively higher for sorghum than millets. Also EARSAM network did not emphasize millets as much as it should have. However, we have learned that millets play an important role and have a higher adaptability to drought and other environmental stresses and their cultivation minimizes the risks for dryland farmers.

Among the millets, finger millet (*Eleucine coracana*) is the predominant species grown in most eastern Africa countries. However, pearl millet is important in the Sudan, eastern Kenya and central Tanzania only. Finger millet is indigenous to eastern Africa and the region has tremendous genetic variability of the crop. Most of the millets produced in the region is used for food and beverages. In addition, finger millet grain stores well and is free of major storage insect pests. Therefore, EARSAM network should assist NARS (Kenya, Uganda, Ethiopia, Tanzania and Burundi) to develop varieties with resistance to abiotic and biotic stresses and promote their utilization by producing acceptable good quality grain for food products, brewing and feed for poultry. Thus, funds should be made available in Phase III to strengthen the millets network activities.

Networking: No country in the region has all the necessary finance, trained manpower, germplasm and trechnologies to enable it to stand alone and solve all its sorghum and millets improvement problems. Therefore, we learned quickly that networking should continue and strengthened. Limited budgets for research within NARS coupled with inefficient bureaucratic procedures are often cited as limiting factors in sorghum and millets improvement. NARS scientists are often confronted with insufficient and/or untimely support to adequately conduct experiments. Therefore, the network in Phase III should have enough funds to provide research supplies and facilities as and when these are needed to adequately conduct and monitor (by NARS scientists) regional research activities.

Hybrid: Multilocation testing of varieties and gybrids clearly indicated that ICRISAT hybrids out-yielded varieties by 20-30%. Except for Sudan and Ethiopia, hybrid development is not very much emphasized in other countries in the region and at this stage ICRISAT regional program (EARCAL) in Kenya has taken full responsibility to develop good hybrids but eventually in Phase III, funds should be made available to encourage hybrid improvement and production in each country in the region. As a result, this will require strengthening seed industries in each country.

Striga: *Striga* is a serious parasitic weed on sorghum and finger millet crops resulting in significant production losses (40 to 80%) in farmers field. In Phase II, EARSAM network emphasized research on *Striga* with NARS and uniform trials were conducted in *Striga* sick plots for evaluation. The incidence of *Striga* was erratic at several locations and therefore, difficult to confirm resistance. In Phase III, more funds should be allocated to generate technologies with reliable and effective screening techniques in order to make useful progress.

RECOMMENDATIONS FOR PHASE III

170

4. Recommendations

Sorghum and millet improvement in eastern Africa will confront new challenges in the 1990s. The main objective of EARSAM and the NARSs is to facilitate the attainment of food sufficiency in eastern Africa, and we must therefore continue to adapt to environmental, social, and political changes to meet these challenges.

If present trends of underproduction and population growth continue, the net food production shortfall in eastern Africa will be quite substantial by the year 2000 (6). Therefore, SAFGRAD/ICRISAT and NARS combined efforts in the EARSAM network will better equip the NARS to deal with future challenges. We all realize and appreciate the comparative advantages of working together.

For the 1990s to contribute to increasing sustainable food production in eastern African countries, so as to improve the nutritional level and general economic well-being of low-income people the following can be considered as challenges:

Strengthening networking: No country in the region has all the necessary finance, trained manpower, germplasm, and technologies to enable it to stand alone and solve all its sorghum and millet improvement problems. Therefore, networking should be continued and further strengthened in order to exploit the existing strengths in each country and to optimize ICRISAT's input.

Strengthening the sorghum and millet research and training linkages between and among the different national programs, universities, private, public, and international institutions (ICIPE, ICRAF, etc.) is expected to promote and facilitate easy transfer of germplasm and technologies generated within the region, and thus contribute significantly to strengthening each of the national programs.

In addition to germplasm movement and evaluation through cooperative testing it is recommended that service activities are developed. At regional level these include; a crossing block, an off-season nursery, regional screening for resistance to yield limiting factors, and screening for food quality. To facilitate these services the regional program will need to continue.

Limited budgets for research within NARSs coupled with inefficient bureaucratic procedures are often cited as limiting factors in sorghum and millet improvement (7). NARS scientists are often confronted with insufficient and/or untimely support to adequately conduct experiments. The regional network cannot afford to be left at the mercy of such vagaries, and therefore must be in a position to help overcome constraints as they arise. The network should have enough funds during the 1990s to provide research supplies and facilities as and when these are needed to adequately conduct regional research activities.

Manpower development: Well-trained scientists and support staff are assets to a good national program. NARSs appreciate and recognize the training opportunities offered by EARSAM in the region, at ICRISAT Center, and elsewhere. However, the establishment of practical applied training opportunities for technicians in the region in a well-organized training center with adequate facilites is needed to meet expanding manpower requirements.

For specific types of training, appropriate national program centers should also be identified and strengthened so that they can implement training activities. Scientists from NARS and other international institutions will play leading roles in providing knowledge and experience for such activities.

Degree-level training (Ph.D, MSc) in all disciplines is a high NARS priority. Funds should be made available so that this training can continue to be provided.

Research station improvement and management: One of the limitations to good quality research within NARS is the paucity of effective research station management. Every year a substantial percentage of the data collected is inaccurate because it has been collected in poor experimental fields that lack proper management. It will therefore, be necessary in the 1990s for NARSs, in cooperation with other institutes involved in research station improvement and management, to train young scientists in station management in order to improve the research plots.

Major constraints to productivity: Research should be focused on the following priority targets, that have been described earlier in this paper.

grain molds (sorghum) and ergot (pearl millet)

Strategies to combat all these will need to be formulated and put into operation.

Germplasm Collection and conservation: ICRISAT experts from the genetic resource unit collect germplasm materials for all ICRISAT mandate crops from different sources in the world. All the collections are classified and stored properly at ICRISAT Center for evaluation with the purpose of making them available to NARS

when the need arises.

Finger millet is known to have its origin in eastern Africa. Of the 3220 finger millet germplasm accessions conserved at ICRISAT, 2015 (63%) are from Africa (8). Though the number of accessions are small, they show considerable diversity for heads, finger and seed size, shape and colour. In general, African types produce larger and late maturing heads compared with those collected from India. In addition, larger germplasm collections of finger millet are also maintained at SADCC/ICRISAT, Bulawayo, Zimbabwe, Ethiopia, Kenya and All India Co-ordinated Small Millets Improvement Project (AICSMIP), Bangalore, India. All these collections should be adequately exploited, classified and eliminate duplications.

In view of the importance of this crop mainly in eastern, central and southern Africa, more effort should be made to collect and conserve germplasm before it is too late.

On-farm research: On-farm testing of released cultivars coupled with appropriate technolgies is an important activity, and should be strengthened. Such research should include on-farm verification and demonstration trials so that good feedback on the performance of improved cultivars in farmers' fields is obtained. One way to achieve this may be through cooperative links with appropriate Global 2000 programs in the region.

Strengthening seed industries: The shortage of good quality seed that is available to farmers is a major cause for the poor adoption and spread of released cultivars. It is therefore essential to strengthen private and public seed multiplication and distribution agencies, in each of the countries in the region. Once research has identified, evaluated, tested in farmers' fields, and NARS have released good hybrids adapted to regional requirements, agencies should be encouraged to produce quality hybrid seed.

Agroecological Zoning: The eastern Africa region is unique inthat it contains areas of traditional sorghum and millet production in diverse ecological zones; ranging from near sea level to 2500m with a wide range of climates, soils, and crop requirements.

Currently, there is no standardized method that can be used to characterize the different environments encountered in eastern Africa by sorghum and millet producers. The addition of environmental parameters should allow scientists to tailor the improvement and adaptation of germplasm to specific ecological zones. Therefore, there is a need for clear definition of; environments, their variations between and within seasons, and the yield-limiting factors in each agroecological zone of the region. It is also important to identify the relative probabilities of occurence of different types of stress. This is a long-outstanding requirement that was noted at least 10 years ago (8). The time has come to do something about it.

Effective marketing systems: Most farmers in eastern Africa are poorly capitalized, have little or no access to credit, a shortage of labor, and limited scope for marketing. As matters now stand, farmers have few opportunities or incentives to increase productivity. Therefore, effective marketing systems and infrastructures are needed to provide timely, low-cost inputs, such as fertilizers, chemicals, and seed in support of increased farm productivity (9).

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Table 1. Sorghum, millet, and total cereals; area harvested ('000 ha), production '000 t), and yield (kg ha-1) for eight countries in eastern Africa compared to total Africa.

Crop	Burundi	Ethiopia	Kenya	Rwanda	Somalia	Sudan	Tanzania	Uganda	Africa Total
Sorghum									
Area	58	900	146	173	550	3682	514	180	16963
Production	88	964	143	164	291	1924	503	260	13995
Yield	1514	1071	979	948	529	523	979	1444	825
Millet									
Area	13	200	96	2	0	1550	300	270	14263
Production	10	180	60	2	0	167	300	380	9302
Yield	769	900	625	833	0	108	1000	1407	652
Total Cereals									
Area	215	5017	1982	263	848	5448	3168	773	73957
Production	321	5925	3460	268	608	2369	4634	970	90845
Yield	1489	1181	1746	1019	716	435	1463	1255	1228

1. Source: FAO Production Yearbook 1989, Food and Agriculture Organization of the United Nations, Rome. Italy: FAO.

Table 2. Sorghum and millet cultivars released in eight eastern African countries

Country	Crop		
	Sorghum	Pearl Millet	Finger millet
Burundi	5 Dx 160 Gambella 1107		
Ethiopia	Melkamash Gambella 1107 Dinkmash Seredo		
Kenya	Serena Seredo IS 76 2 Kx 17		
Rwanda	Amasugi 5 DX 160		
Somalia	PP 290		
Sudan	White Dwarf Milo Hageen Durra 1 Gadam Hamam	Ugandi	
Tanzania	Serena Lulu Tegemeo	Serere 1 Serere Composite	
Uganda	Serena Seredo	Serere 1 Serere Composite	Engeny P 224

Table 3. Mean grain yields (t ha^{-1}) of the highest-yielding sorghum entries at five eastern African locations in Lowland Group 1 of the EARSAM Elite Sorghum Yield Trial (EESYT-89) rainy season 1989/90.

Entry	Source	Location					Mean
		Baidoa	Gadambalia	Ilonga	Kiboko (long rains)	Hombolo	
ICSV 335	ICRISAT Center	2.84 (1)[1]	0.63(17)	2.66 (2)	3.90 (5)	2.31(20)	2.52 (1)
5 Dx 160	NARS, Burundi	1.23(25)	0.67(14)	2.67 (1)	3.11(16)	4.58 (1)	2.50 (2)
ICSV 112	ICRISAT Center	1.89(11)	0.47(20)	2.16 (7)	3.87 (6)	4.04 (3)	2.46 (4)
CR:35:5	NARS, Sudan	1.99(10)	1.08 (3)	1.49(17)	4.33 (1)	3.11 (9)	2.42 (5)
Kat 83487	NARS, Kenya	1.78(16)	1.08 (3)	2.00 (9)	3.55(10)	3.47 (5)	2.40 (6)
Kat 83369	NARS, Kenya	1.84(14)	0.86(10)	1.61(14)	4.10 (2)	3.33 (7)	2.34 (7)
Gadam Hamam	NARS, Sudan	2.31 (4)	1.69 (1)	1.34(19)	3.69 (9)	2.78(17)	2.32 (8)
1804	NARS, Rwanda	1.88(12)	0.42(22)	2.43 (5)	2.26(24)	4.22 (2)	2.23(11)
PP 290	NARS, Somalia	2.52 (2)	0.78(11)	2.05 (8)	3.95 (4)	1.47(25)	2.11(13)
IS 2284	NARS, Ethiopia	1.02(24)	1.61 (2)	0.63(25)	1.83(25)	1.98(23)	1.47(24)
Controls							
Seredo	NARS Uganda	2.23 (6)	0.61(18)	1.82(11)	4.06 (3)	3.82 (4)	2.48 (3)
Hageen Durra 1		2.25 (5)	0.94 (6)	1.55(16)	3.23(13)	2.89(18)	2.16(12)
Durra 1	NARS Sudan						
SE		±0.15	±0.20	±0.20	±0.34	±0.32	±0.28
Trial mean (24 entries)		1.87	0.76	1.70	3.28	2.97	2.12
CV(%)		14	45	20	18	19	

1. Numbers in parentheses indicate ranking in trial

Table 4. Mean grain yields (t ha^{-1}) of the highest-yielding sorghum entries at one or more eastern African locations in Lowland Group 2 of the EARSAM Elite Sorghum Yield Trial (EESYT-89), rainy season 1989/90.

Entry	Source	Location: Mombasa	Kiboko (short rains)	Wad Medani (irrigated)	Imbo	Mean
ICSV 112	ICRISAT Center	6.31 (3)[1]	5.22 (3)	5.06 (2)	1.82 (2)	4.60 (1)
ICSV 401	ICRISAT Center	6.12 (6)	5.03 (4)	5.03 (4)	1.21(12)	4.32 (2)
KAT 88487	NARS, Kenya	5.50(13)	5.41 (1)	4.44 (7)	1.64 (2)	4.24 (3)
Dinkmash	NARS, Ethiopia	6.43 (1)	3.86(16)	4.85 (4)	1.18(15)	4.08 (4)
M36121	NARS, Ethiopia	5.80(10)	5.23 (2)	3.56(12)	1.18(16)	3.94 (7)
KAT 83369	NARS, Kenya	6.34 (2)	5.02 (5)	1.80(22)	1.88 (1)	3.76(12)
Controls						
Hageen Durra 1	NARS Sudan	4.84(24)	4.05(14)	5.27 (1)	0.97(20)	3.78(11)
Seredo	NARS Uganda	5.50(21)	4.12(13)	2.82(16)	1.24(10)	3.42(14)
SE		±0.37	±0.46	±0.41	±0.10	±0.50
Trial mean (24 entries)		5.39	3.99	3.27	1.20	3.46
CV(%)		12	20	22	27	

1. Numbers in parentheses indicate ranking in trial

Table 5. Mean grain yields (t ha^{-1}) of the highest-yielding sorghum entries at one or more eatern African locations in Lowland Group 3 of the EARSAM Elite Sorghum Yield Trial (EESYT-89), rainy season 1989/90.

Entry	Source	Location			Mean
		Melkassa	Karama	Katumani (short rains)	
Kigufi	NARS, Rwanda	5.19 (2)[1]	3.74 (2)	2.78(23)	3.90 (2)
Framida	NARS, Ethiopia	4.08 (3)	1.61 (8)	5.26 (2)	3.89 (3)
Gadam Hamam	NARS, Sudan	4.39 (5)	1.45(11)	5.35 (1)	3.73 (4)
1804	NARS, Rwanda	2.99(10)	3.09 (3)	4.59 (4)	3.56 (5)
5 Dx 160	NARS, Burundi	3.11 (8)	3.82 (1)	3.19(20)	3.38 (6)
KAT 83369	NARS, Kenya	3.29 (6)	1.06(18)	4.64 (3)	3.00 (8)
Controls					
Seredo	NARS, Uganda	3.42 (1)	2.35 (4)	4.58 (5)	4.12 (1)
Hageen Durra 1	NARS, Sudan	2.15(14)	1.48(10)	4.52 (6)	2.72(12)
SE		±0.59	±0.32	±0.65	±0.63
Trial mean (24 entries)		2.68	1.52	3.86	2.69
CV(%)		38	37	29	

1. Numbers in parentheses indicate ranking in trial

Table 6. Mean grain yields (t ha^{-1}) of the highest-yielding entries at one or more eastern Africa locations in Intermediate Group 1 of the EARSAM Elite Sorghum Yield Trial (EESYT-89), rainy season 1989/90.

		Locations				
	Source	Katumani (short rains)	Murongwe	Arsi Negele	Rubona	MEAN
IS 9302	NARS, Ethiopia	5.99 (1)	2.29 (2)	5.02 (1)	1.10 (5)	3.60 (1)
Nyirakabuye	NARS, Rwanda	4.41 (8)	2.57 (1)	3.33 (3)	1.14 (4)	2.86 (2)
Amasugi	NARS, Rwanda	2.51(14)	2.05 (3)	4.52 (2)	1.96 (1)	2.76 (3)
85MW 5340	NARS, Ethiopia	2.99(12)	1.61 (5)	1.54 (7)	1.78 (2)	1.98 (5)
Control Seredo	NARS, Uganda	4.52 (2)	1.55 (6)	0.66(11)	0.85 (9)	1.93 (6)
SE		±0.44	±0.23	±0.45	±0.28	±0.53
Trial Mean (14 entries)		3.69	1.45	1.99	1.02	2.04
CV(%)		21	28	39	48	

1. Numbers in parentheses indicate ranking in trial

Table 7. Mean grain yields (t ha^{-1}) of the highest-yielding sorghum entries at one or more eastern African locations in Intermediate Group 2 of the EARSAM Elite Sorghum Yield Trial (EESYT-89), rainy season 1989/90.

Entry	Source	Location			Mean
		Ukiriguru	Kiboko (long rains)	Kiboko (short rains)	
Serena	NARS, Uganda	2.04 (2)[1]	3.28 (4)	4.22 (2)	3.18 (2)
4MX 11/9/2	NARS, Uganda	1.90 (3)	3.13 (7)	3.74 (3)	2.92 (3)
TSX 183/2 2/2/1	NARS, Tanzania	1.59 (8)	3.34 (3)	2.13(12)	2.35 (8)
Controls					
Seredo	NARS, Uganda	2.39 (1)	3.78 (1)	4.34 (1)	3.50 (1)
ICSH 153	ICRISAT Center	1.88 (4)	3.52 (2)	2.49(10)	2.63 (5)
SE		±0.19	±0.35	±0.40	±0.38
Trial mean (14 entries)		1.64	2.98	2.86	2.49
CV(%)		20	21	24	

1. Numbers in parentheses indicate ranking in trial

Table 8. Mean grain yields (t ha^{-1}) of the highest-yielding entries at one or more eastern African locations of the EARSAM Elite Finger Millet Yield Trial (EEFMYT-89), rainy season 1989/90.

		Locations					
	Source	Alupe	Katumani (short rains)	Kabanyolo	Serere	Melkasa	MEAN
Gulu E	NARS, Uganda	3.62 (8)	3.10 (2)	0.83 (5)	0.79 (3)	2.05 (4)	2.08 (1)
P 224	NARS, Uganda	4.11 (1)	2.89 (3)	0.61(10)	0.70 (5)	1.56 (6)	1.98 (2)
Serere 1	NARS, Uganda	3.97 (3)	2.57 (7)	0.88 (3)	0.88 (1)	1.54 (7)	1.97 (3)
Engeny	NARS, Uganda	3.99 (2)	2.82 (4)	0.48(12)	0.62 (7)	1.33(10)	1.85 (4)
Ending	NARS, Uganda	3.18(10)	2.78 (5)	0.91 (2)	0.64 (6)	1.47 (8)	1.80 (6)
KAT/FM 1	NARS, Kenya	2.00(13)	3.21 (1)	1.00 (1)	0.37(12)	2.08 (2)	1.73 (7)
Acc# 100008	NARS, Ethiopia	1.24(16)	2.47 (9)	0.85 (4)	0.23(15)	2.27 (1)	1.41(13)
Control Ikhulule	NARS, Kenya	3.00(11)	1.43(16)	0.42(14)	0.42(11)	0.60(14)	1.18(16)
SE		±0.41	±0.41	±0.08	±0.08	±0.28	±0.13
Trial mean (16 entries)		3.08	2.51	0.65	0.56	1.38	1.64
CV(%)		23	28	22	24	35	

1. Numbers in parentheses indicate ranking in trial