WEST AND CENTRAL AFRICA MAIZE NETWORK (WECAMAN)

Proceedings Of The First Meeting Of Heads/Coordinators Of National Maize Research Programs Of West And Central Africa

27-28 January, 1994

Cotonou, Benin Republic

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1 .0 - OPENING SESSION

Following the formal registration of participants, the opening session of the meeting of the heads/coordinators of national maize programs of West and Central Africa was held in the conference room of IITA Station at Calavi, Cotonou, Benin Republic. The opening session was addressed by Dr. J. P. Eckebil, the Deputy Director General for International Cooperation Division of IITA, Dr. F.M. Quin, the Director of IITA Crop Improvement Division, Dr. Taye Bezuneh, the Director of Research of OAU/STRC SAFGRAD and Dr. M. Houssou, the Director of Institute of Agronomic Research of Benin Republic.

1.1 - Opening remarks by the Deputy Director General for International Cooperation of IITA

Dr. J. P. Eckebil who was the chairman of the opening session, warmly welcomed all participants and explained the part played by IITA in the development of the maize network project proposal. He indicated that IITA followed the instructions given by USAID to develop the project proposal. After submitting the proposal to USAID, IITA monitored the approval process by maintaining close contact with USAID office in Washington. He seized the occasion to reiterate that IITA regarded research networks as tools for the National Agricultural Research Systems (NARS). He emphasized that networks belong to the NARS and the participation of IITA in the management of the maize network should be considered essentially as temporary. He added that the management of the maize network would be transferred to the NARS at their request any time they are ready. However, because of the nature of its activities, IITA will remain a partner in the technical functioning of the network in order to make available to network member countries its technological advances.

Concluding, he indicated that the meeting should have been organized jointly with that of the committee of National Directors of Research initiated by USAID and SPAAR to discuss the frame work for action on agricultural research in West and Central Africa of which networks constitute an essential part. For various reasons this meeting

was postponed to March 94, which does not suit our agricultural calendar.

1.2 - Opening remarks by the Director of IITA Maize Improvement Division

In her address, Dr. F.M. Quin, the Director of IITA Crop Improvement Division welcomed the opportunity to meet with the NARS scientists in West and Central Africa. She indicated that there was a need to look for new ways of doing old things and in this both the NARS and the international centers have a role to play in order to contribute to the development of agriculture in the sub-region. She emphasized the need to work out how to make the best use of the available talents in national programs, regional and international centers. She stated that effort should be made to ensure that every dollar counts because the days when dollars were flowing are over. To achieve this, she urged participants to work together. She appealed to participants for feed back which has bearing on where IITA has to place its priorities. She asked the heads/coordinators of the national maize programs to indicate during the presentation of the country reports, the agro-ecological priorities of each country and how the scientists saw the priorities of their respective countries in relation to maize production in the sub-region. She pointed out that tremendous progress had been made in maize research and development in Africa during the past thirteen years and she was impressed and proud of what had been achieved and looked forward to working with NARS in West and Central Africa.

1.3 - Opening remarks by the Director of Research of OAU/SAFGRAD

On his part, Dr. Taye Bezuneh stated that during the past decade, the collaboration between IITA and OAU/STRC through the SAFGRAD project had substantially contributed to national maize research capacity building in West and Central Africa. The future technical challenges of maize network included not only the sustenance of the generation of the new technologies, training, etc., but also the promotion, adoption and utilization of maize technologies in the pipeline. He pointed out that some areas of future collaboration between IITA and OAU/SAFGRAD were promotion of technology, verification, research-extension linkage, policy issues, training and industrial utilization.

1.4 - Welcome address by the Director of Agronomic Research of Benin Republic

Dr. Houssou in his welcome address, stated that a lot of progress had been made by the SAFGRAD project and IITA in the improvement of maize in West and Central Africa. Emphasis should now be placed on the transfer of available technology to farmers in order to increase maize production and productivity in the sub-region. He indicated that the choice of Benin republic as the venue for the launching of the maize network was a testimony of the interest and confidence that the organizers of the meeting have in the country. He pointed out that Benin republic had an impressive maize program and he was optimistic that the maize network would make significant contribution to his country. Finally, he thanked USAID for providing funding for the maize network and wished the participants fruitful deliberations.

1.5 - Attendance

The meeting was attended by eight heads/coordinators of national maize programs of West and Central Africa, representatives of IITA, CIMMYT, and OAU/STRC SAFGRAD. The list of participants is attached as the appendix 5 of this report.

1.6 - Agenda for the meeting

The following items were adopted by participants as the agenda for the meeting held in Cotonou, Benin Republic, from January 27-28, 1994.

i) Welcome address and opening session

ii) Presentation of the project, country reports and overview of the IITA Maize Improvement Program.

iii) Administrative arrangements of the maize network.

iv) Recommendations for 1994 Action Plan

v) Nominations for regional trials

vi) Any Other Business

2.0 - PRESENTATION OF THE PROJECT, COUNTRY REPORTS AND OVERVIEW OF IITA MAIZE IMPROVEMENT PROGRAM

2.1 - The project

Dr. Badu-Apraku, the maize network coordinator in his presentation of the project, traced the history of the SAFGRAD project and the phasing out of the SAFGRAD maize network. This was followed by the presentation of the Maize Network for West and Central Africa and strategies for its implementation as well as the prospects for its evolution. On the Maize Network for West and Central Africa, he indicated that the objective is to increase farmers productivity, production and income through the use of appropriate technologies identified or developed by the network and extended to farmers by extension services, other parastatal extension agencies or NGOs in the respective member countries. Dr. Badu-Apraku stated that the key areas of activities of the network would include varietal development and testing, disease and pest control through integrated pest management, agronomic/natural resource management and technology transfer. The presentation also elaborated on the geographic coverage and focus of the network, the collaborative research projects, and the strategy to be adopted for their implementation, regionally-oriented resident research, regional trials, exchange of scientific information and technologies, structure and management of the maize network, the budget for 1994-1995 and the prospects for the evolution of the maize network. Following the presentation of the project, the following proposals were endorsed by the steering committee:

2.1.1 - Focus of WECAMAN

a) The maize network would focus on the savanna zone where maize has the greatest potential and returns to investments are greatest due to optimum rainfall, adequate sunshine and few disease problems.

b) The maize network should encompass the coastal and sahelian countries of West and Central Africa. However due to fund limitations the eight countries, namely, Nigeria, Cameroon, Ghana, Benin, Togo, Burkina Faso, Côte d'Ivoire and Mali

have been selected as members based on the importance of the crop as a staple food or its export value, common production constraints that influence the production, marketing and the use of the commodity, available research infrastructure and research personnel engaged in the improvement of the crop and eco-regional approach to network research.

c) Non-member NARS of the maize network should be allowed to participate in workshops and regional trials.

2.1.2 - Network program components

The network program components will be collaborative research projects, regionally-oriented resident research, regional trials, exchange of scientific information and technology, impact assessment and human resources development

2.1.3 - Strategy for collaborative projects

a) The strategy of optimizing the network strength and comparative advantage of strong NARS (Lead centers) by assigning them specific research problems identified as principal constraints to maize production in West and Central Africa should continue.

b) To ensure accountability and the maximum returns from the network's research funds, criteria for allocation of funds for collaborative project support should be established by the NARS Directors of research.

c) The idea of competitive research grants should be introduced for specific collaborative project support so as to motivate NARS scientists to increase research output and to be creative. Two-to-three countries should be selected on competitive basis as lead centers for each of the selected collaborative projects. The criteria for the selection of lead centers should be the submission by prospective lead NARS of well conceived research proposals, availability of qualified research personnel, financial and infrastructural resources to effectively carry out

specific research to alleviate food production constraints of mutual interest in the sub-region.

d) An adhoc research committee composed of three non-member country scientists should be established to review all collaborative research proposals, select the lead center for specific collaborative projects and allocate the research funds based on the criteria to be established by NARS directors. Where all collaborating countries of network are assigned responsibilities for a project, each country should submit to the adhoc research committee a project proposal. Countries assigned collaborative research responsibilities should be evaluated during each planting season in order to ensure that the allocated funds are properly utilized for the designed purpose and also to monitor research progress.

2.1.4 - Collaborative projects

The following collaborative projects should be assigned to participating member countries :

- Breeding for disease resistant, intermediate maturing maize varieties (110 days to maturity)
- Breeding for drought tolerant and disease resistant early maturing maize varieties (90-95 days to maturity)
- Breeding for disease resistant extra-early maturing maize varieties (80-85 days to maturity)
- Striga control
- Agronomic research for intermediate, early and extra-early maize varieties
- Promotion of technology transfer.

2.1.5 - Regionally-oriented resident research

The maize network coordinator will spend 40% of his time on research areas of his competence and which are integral part of the network's program. The resident research activities will include:

- Breeding for early and extra-early varieties with resistance/tolerance to drought, striga and streak virus
- Participation in the national variety trials including on-farm testing and demonstrations in the host country
- Seed multiplication of maize varieties nominated for regional trials
- Establishment of nurseries for training purposes
- Germplasm conservation and maintenance.

2.1.6 - Regional trials

a) Three types of regional trials will be dispatched yearly to NARS upon request. These are regional uniform early variety trials (RUVT- early), regional uniform extra-early variety trial (RUVT-Extra-early) and regional adaptive trials.

b) The IITA Maize Improvement Program should continue to coordinate the variety trials for the intermediate and late groups.

2.1.7 - Exchange of scientific information and technologies

a) There should be a regional workshop in 1995 for the exchange of scientific information and new technologies.

b) There should be a monitoring tour in 1994 by scientists from selected network member countries to several other national programs, including IITA. This will afford them the opportunity to observe and discuss in detail with scientists of host countries, issues such as production constraints and technologies developed to overcome constraints and the research methodologies being adopted.

c) There should be consultation visits by the coordinator and senior NARS scientists as well as scientists from IITA to national programs.

2.1.8 - Impact assessment

a) Member countries of the network should be assisted to carry out about ten farmer interviews to collect information which will enable the monitoring of the adaptation and release of network technologies so as to determine the impact of the research efforts of the network.

b) Additional information should be collated during the biennial workshop and monitoring tour.

2.1.9 - Structure and management of the maize network

The management entities of the network should be the committee of NARS directors for all agricultural research networks of West and Central Africa and the steering committee with IITA as the executing agency.

a) <u>The committee of NARS Directors</u>

The committee of NARS directors should be composed of the directors of collaborating NARS, representatives of relevant international centers including IITA and donor representatives. The committee should meet annually as an oversight authority of the network with the following functions:

- determine policy and provide guidance in network management,
- review workplans and budgets in conformity with network objectives,
- encourage technical, administrative and financial support of the network at the national level,
- facilitate the realization of objectives of maize research and related activities,
- review annual technical progress report of the network and propose necessary modifications or termination of activities,

- Identify strategy and goals and assign institutional responsibilities.

b) The Steering Committee

The steering committee should be composed of active scientists of participating member countries and elected in such a manner as to provide for representation of a mix of disciplines. Representatives of cognate or appropriate IITA programs shall attend its meetings as observers. The steering committee shall perform the following functions:

- review all workplans and budgets and allocate resources to different collaborative projects,
- prepare the agenda for biennial workshops and monitoring tours,
- monitor the implementation of network activities.

The steering committee shall meet twice a year and may co-opt persons with expertise to assist in carrying out its functions. The chairman and the secretary of the steering committee would be elected by their peers for a period of two years.

c) The role of IITA as the executing agency

IITA will continue to provide not only technical and managerial support but also a network coordinator during the two year period. As an active partner, IITA will assume the following responsibilities:

- administrative and technical coordination,
- accounting procedures,
- provision of funds from its core program to cover expenses of the resident research of the network coordinator,
- participation in technical reviews and provision of technical backstopping for network activities,
- technical review and editing of research findings for publication,
- assistance in identification and introduction of potentially useful maize germplasm,
- procurement and shipment of office and field supplies,
- development and logistic support of short-term in-service training, attachment courses and participation in IITA annual workplans,

- supplying consultants from its own scientific and administrative staff or from other sources.

2.1.10 - Fund accountability

In order to streamline the reporting system for funds allocated to national programs the format attached as Appendix I was adopted.

2.1.11 - Prospects for the evolution of the maize network

In order to assume leadership and management of the network, it is anticipated that the NARS would eventually assume the following responsibilities:

i) NARS of the network would continue to support and facilitate the involvement of scientists and research administrators in network activities;

ii) Provide leadership at regional level in research areas of comparative advantage as well as by sharing research facilities and results;

iii) To serve as technological base for network coordination as well as contributing resources and facilitating the movement of germplasm and mobility of scientists;

iv) Through network steering committee and the directors of research committee, provide active leadership in the identification and development of network programs;

v) In cooperation with IITA, facilitate the coordination and implementation of network programs;

vi) Support the coordinator's post to the network by covering coordinator's salaries and local expenses;

vii) Provide logistic support for workshops, seminars, training and for related activities.

2.2.0 - Country reports and overview of IITA Maize Improvement Program

Country reports were presented by the heads/coordinator of the national programs of the eight member countries of the network. Also, an overview of the IITA Maize Improvement Program was presented. The country reports gave an overview of the various national maize research programs with a statement of the main needs, research priorities and the national level priority ecologies of each country.

The country reports were presented by the following scientists:

Cameroon:	Dr. Charles Thé
Côte d'Ivoire:	Mr. Attiey Koffi
Ghana:	Dr. P.Y.K. Sallah
Nigeria:	Dr. J.O. S. Kogbe
Togo:	Dr. Yovo Mawule
Burkina Faso:	Mr. Hema Idrissa
Benin Republic:	Mr. C.G. Yallou
Mali:	Mr. N'Tji Coulibaly

The overview of the IITA Maize Improvement Program was presented by Dr. J.G. Kling and Dr. S.K. Kim. The edited text of the presentations are attached as Appendix V of this report. Following the presentations and the discussions that ensued, the following ideas and findings were synthesized:

2.2.1 - Common maize production constraints of member countries of the network

A number of constraints which cut across countries were mentioned in the country reports presented by each of the heads/coordinators of the various national programs. These include:

a) Problem of soil fertility

Soil fertility was mentioned as a major constraint by Ghana, Cameroon and Togo. In these countries attempts are being made to tackle the problem through the use of legumes for intercropping, use of cover crops, rotation and relay cropping.

b) Striga control

This was mentioned as a major constraint by all countries. The problem is being addressed mainly through resistance breeding (Ghana, Cameroon, Togo), through cultural practices (Ghana and Cameroon), and through biological control (Burkina Faso and Togo).

c) Storage

Storage was mentioned as a major problem in Ghana, Togo, Benin and Cameroon. In Togo and Benin Republic both the grain weevil (*Sitophilus sp.*) and the larger grain borer (*Prostephanus truncatus*) are problems whereas in the other countries the main storage problem is with the grain weevil. In Ghana, as in several other countries, in years of high maize production the price of maize falls with the result that farmers do not benefit from their higher production. One way of reducing the problem is to find a solution to the problem of storage losses so that farmers could store for longer periods and thus obtain better prices. The approach to the control of the grain storage pests has been the selection for good husk cover and the use of pesticides. Ghanaian and Nigerian researchers are currently researching on the use of local plant products such as wood ash, groundnut oil and plant extract. IITA believes that appropriate modifications of farmers' practices are crucial to minimizing initial infestation by storage pests while the use of resistant varieties will help to reduce pest build up and losses in storage. Research on biological control of the larger grain borer is currently receiving priority attention in IITA in order to complement other control methods to slow down the pest increase.

d) Drought

Drought was mentioned by all the network member countries as a major constraint to increased maize production in the savanna zone. Breeding for drought tolerance is going on in Cameroon, Burkina Faso and Côte d'Ivoire. Ghana intends to initiate research on drought but does not have the necessary facilities to do this.

2.2.2 - Utilization of maize

There is a need for diversification of the use of maize. There was a feeling that the use of maize for human consumption alone was not enough to absorb excess maize production in good years and that efforts should be made to promote industrial use of maize particularly the use of

maize in the brewing industry as it is currently happening in Nigeria and Burkina Faso. It was indicated that Nigeria has a lot of information on the industrial use of maize particularly in the brewing industry and network countries should take advantage of this. Also the use of maize in the poultry and livestock industries should be promoted.

2.2.3 - Crop management research and technology transfer

Members were of the view that all national programs have crop management components and since a lot of varieties have been developed but have not been adopted by farmers, the emphasis of the maize network should be on crop management research and technology transfer.

2.2.4 - Hybrids

a) Work on hybrids is going on in Ghana, Togo, Côte d'Ivoire and Cameroon. Benin Republic also expressed interest in hybrid development because the feeling was that with intensification of maize production in the savanna zone of Benin, hybrids have good future potential.

b) IITA research on hybrids will focus on the northern guinea savanna ecology. Strong links of collaboration would continue to be established with private companies, NGOs and extension agencies.

c) Results showed that IITA hybrids are superior in the efficient utilization of applied nitrogen than open-pollinated varieties.

2.2.5 - Main needs of national programs

The needs of national programs which cut across countries included:

a) Research funds,
b) Technician training,
c) Exchange of scientific information,
d) Exchange of germplasm among network member countries,
e) Research supplies.

2.2.6 - Research on termites

It was recognized that termite damage is a major constraint to increased maize production in the savanna zone. However, no serious research work has been carried out. The control now is through the use of insecticides which most farmers cannot afford.

2.2.7 - Research on drought and nitrogen use efficiency

There is a need for a physiologist to be involved in nitrogen use efficiency and drought research of the IITA maize program.

2.2.8 - Stemborer control

Stemborers are a major constraint to increased maize production in forest zone of West and Central Africa. Moderate levels of resistance are available. Breeding for stem borer resistance is a controversial area and there is an increasing pressure on the IITA maize program to drop this. There was therefore a need for feed back on this from NARS.

2.2.9 - Genotype x Environment interactions

10-15% of total variance is due to G x E but this varies with the type of germplasm. Varieties developed in the forest zone could do well in the savanna zone but the reverse may not be true for varieties developed in the savanna zone since they may not withstand diseases. Four year data on G x E studies in maize is available in IITA and is being analyzed. G x E interactions are important and could be a subject of a special purpose seminar.

2.2.10 - Breeding for striga control

a) The striga research group at IITA conducts research on striga epidemiology and population dynamics, striga-host interactions, host-plant resistance, agronomic control, biological control, and socio-economic aspects of control measures.

b) A simple, inexpensive in vitro technique has been developed for identifying legumes with high stimulant activity which will be most effective at inducing suicidal germination of striga.

Aechinomenes histrix has been shown in on-farm trials to increase yield of subsequent maize crop by over 70% in moderately infested fields.

c) Infestation methods for Striga screening in breeding programs have been substantially improved. Results have shown that preconditioning in the field is not necessary.

d) Genetic studies have revealed that many genes control Striga resistance. As a result, attempts to transfer resistance into existing varieties by the backcross method have not been very effective. Ratings based on plant symptoms have revealed a predominance of GCA effects whereas Striga emergence has shown SCA effects. The approach currently being used in the IITA maize program is to select for both reduced plant symptoms and reduced emergence of Striga in the field. Moderate levels of resistance have been obtained in several hybrids whereas the level of resistance in open-pollinated varieties is quite low. Recurrent selection and development of synthetics from inbred lines are both being employed to obtain resistant open-pollinated varieties.

e) There is a need to conduct research on not only S. hermonthica but also S. asiatica since it is also very important.

2.2.11 - Husk cover

Breeding for improved husk cover is very important on regional basis because it predisposes the maize ears to insect infestation in the field. The trait can easily be improved since it is highly heritable and a lot of progress has already been made by IITA in this research area.

3.0 - ADMINISTRATIVE ARRANGEMENTS

3.1. Election of steering committee members

Before the elections were conducted, the chairman of the session, Dr. J.M. Fajemisin, referred participants to the guidelines which had been approved for the election of the members of the steering committee (Appendix 3). These were strictly adhered to for the election of the

following scientists as the members of the steering committee for a two year period:

1.	Mr. N'Tji Coulibaly (Chairman)	On-Farm Agronomist Chef du Programme Maïs au Mali Institut d'Economie Rurale (IER) BP 258, Bamako, Mali
2.	Dr. P.Y.K. Sallah	Maize Breeder Nyankpala Agric. Expt. Station Crops Research Institute P.O. Box 52, Tamale, Ghana
3.	Ms. Alice N'Goran	On-Station Agronomist, IDESSA 01 BP 633, Bouaké 01, Côte d'Ivoire
4.	Dr. Saliu Biliwa	Crop Protectionist Institut National des Cultures Vivrières BP 2318 Cacavelli, Lome, Togo
5.	Dr. Charles Thé	Maize Breeder Institute for Agronomic Research BP 2067, Yaounde, Cameroon
6.	Mr. O.A. Adenola	Socio-economist IAR&T, PMB 5029 Moor Plantation Ibadan, Nigeria
7.	Mr. Jean Mouhanou	Crop Utilization Division Station de Recherches sur les cultures vivrières de Niaouli BP 03 Attogon, Benin
8.	Mr. Hema Idrissa	Maize Breeder, INERA 01 BP 476 , Ouagadougou 01 Burkina Faso

Dr. S. Biliwa, Ms. Alice N'Goran, Mr. O.A. Adenola and Mr. J. Mouhanou were elected in absentia. Dr. Y. Mawule and Mr. C.G. Yallou were elected as standby for the maize breeders while Mr. Hamidou was elected as the standby for the on-farm agronomists.

3.2 - First meeting of the steering committee of WECAMAN

The first meeting of the steering committee of WECAMAN was held immediately following the elections. Members who were elected in absentia were represented at the meeting by scientists from their respective countries. The following issues were discussed at the meeting:

3.2.1 - Frequency of steering committee meetings

It was decided that the steering committee should meet twice a year. The next meeting of the committee will take place at Bouaké, Côte d'Ivoire during the first two weeks of November, 1994.

3.2.2 - Adhoc research committee

An adhoc research committee of agricultural research experts was appointed with the following as members:

1.	Dr. Taye Bezuneh	Director of Research, OAU/STRC-SAFGRAD BP 1783, Ouagadougou, Burkina Faso
2.	Dr. F.M. Quin	Director, CID, IITA Ibadan, Nigeria
3.	Dr. A.O. Diallo	CIMMYT Liaison Scientist 01 BP 2559 Bouaké 01, Côte d'Ivoire

The adhoc research committee will be responsible for reviewing and assigning collaborative research projects as well as funds to member countries. Research proposals are therefore to be submitted to the committee through the coordinator.

4.0 - RECOMMENDATIONS FOR 1994 ACTION PLAN

The proposed workplan of the maize network for the period October 1, 1993-September 30, 1995 (Appendix 2) was discussed and approved by the steering committee. The major activities approved for 1994 included:

4.1 - Monitoring tour

A monitoring tour was scheduled for the first two weeks of September 1994. Members of the monitoring tour will visit the national programs of Côte d'Ivoire, IITA-Côte d'Ivoire and Mali to acquaint themselves with research activities in the two countries.

4.2 - Training for technicians

A 5-month training course for technicians with backstopping from IITA would be held from July - November, 1994. It was proposed that one participant from each of the participating network countries should attend this course. The date, time and venue for the course will be communicated to members by the network coordinator.

4.3 - Regional trials

The network will offer three types of maize variety trials to interested countries. These are:

(i) RUVT Extra-Early Maize Variety Trials which will comprise extra-early (80-85 days) drought tolerant varieties,
(ii) RUVT Early Maize Variety Trial comprises early drought tolerant varieties,
(iii) Regional adaptive trials.

The following entries were nominated for RUVT-Early:

1) ABII (Togo)
2) Syn E2 (Cameroon)
3) NAES Pool 16 DT (Ghana)
4) TZE Comp 4 C2 (IITA)
5) TZE Comp 4 DMR BC2 (IITA)

Relevant data indicating the superior performance of the nomination relative to check and 10 kg seed of each variety should be provided to the coordinator by nominating countries.

4.4 - Special purpose seminar

A special purpose seminar for maize scientists of network member countries working in the savanna zone was approved for October, 1994 by the steering committee. The venue, number of participants to be sponsored from each country and the topics for the seminar were to be decided later by a sub-committee of the steering committee.

5.0 ANY OTHER BUSINESS

5.1 - Regulations governing the funding of research projects

The following regulations were adopted by the steering committee with regard to funding of collaborative projects of the network. All research projects funded by the network will be competitive and will be assigned on the basis of (a) research proposals, (b) availability of financial and infrastructural resources as well as qualified personnel to conduct the research. Research proposals should provide background information on previous work; achievements, if any; plan for the next two years; objectives; the methodology to be adopted to achieve stated objectives; expected output as well as the indicators for monitoring impact.

5.2 - Sub-committee

Since there were a number of issues which could not be discussed at this meeting it was decided that the coordinator should appoint a sub-committee of two to three SC members to discuss those outstanding issues.

5.3 - Close of meeting

The first meeting of the steering committee came to a close at 4.52 p.m.

Appendix 1: Maize Network for West and Central Africa

Format for justification of allocated funds for collaborative projects

Summaries of expenditures _____ Tranche 19__

Items	Expenditures	
	Local Currency	US Dollar Equivalent
1. Wages		
2. Out of Station Allowance		
3. Fuel Purchases		
4. Land Preparation		
5. Research materials/supplies		
6. Office supplies		
7. Miscellaneous		
Total		
Balance		

N.B: Please attach original receipts

Appendix 1: **Workplan of Maize Network for West and Central Africa for the period October 1, 1993 - September 30, 1995**

Date	Activity	Location
October, 1993	Cooperation/Grant Agreement signed Announcement of meeting of committee of NARS directors and workshop of NARS scientists	Washington
January, 1994	Establish dry season nursery activities	Ferkéssedougou, Côte d'Ivoire
Jan-March, 1994	a) Workshop of NARS scientists from all member countries to (i) elect a steering committee (ii) assign collaborative projects (iii) review results of collaborative research and regional trials (iv) present progress reports on research in respective countries (v) plan regional on-station and on-farm adaptive trials	Cotonou, Benin Republic
	b) Steering committee meeting to plan future research activities, monitoring tours, training programs, consultation visits and other relevant network activities	Cotonou, Benin Republic
	c) Meeting of committee of NARS directors to approve network structure, composition and coordination, collaborative projects, technology transfer and resident research components of the network and the budget	Banjul, Gambia
May/June, 1994	Field trials, adaptive trials, demonstrations, breeding nurseries and seed production.	In-Country
July-Nov., 1994	Technicians training	Côte d'Ivoire
September, 1994	Monitoring tour to selected network member countries	Côte d'Ivoire, Mali

Appendix 1: **Workplan of Maize Network for West and Central Africa for the period October 1, 1993 - September 30, 1995 (cont'd)**

Date	Activity	Location
October, 1994	Special purpose seminar for NARS scientists	Cotonou, Benin Rep.
November, 1994	Steering committee meeting	Bouaké, Côte d'Ivoire
January, 1995	Establish dry season nursery	
February, 1995	National maize workshops and planning sessions of network member countries	
March/April, 1995	a) Biennial workshop for presentation of scientific papers, progress reports on collaborative projects, in-country reports covering the period 1991-1994	
	b) Steering committee meeting to plan future research activities, monitoring tours, training programs, consultation visits and review of progress on collaborative projects	
May/June, 1995	Conduct of field trials, demonstrations, breeding nurseries and seed production Seed production course Evaluation and impact assessment of network	
July/August, 1995	Preparation and submission of draft final report	
September, 1995	Project activity completion date	

Appendix 3: Guidelines for the Election of a Steering Committee composed of a mix of scientific disciplines

One of the major weaknesses identified with the management of the Maize Network by the SAFGRAD Impact Assessment Team was that the Steering Committee members of the network were made up of entirely crop researchers particularly maize breeder. As a result, the research programs were biased towards crop improvement thus excluding essential disciplines such as socio-economics and utilization of farm produce. It is therefore important that guidelines for the election of the members of the steering committee are established to ensure a representation of a mix of scientific disciplines.

Towards this end, the following guidelines for the election of the members of the steering committee are proposed:

(1) All the eight participating countries of the network should be represented on the steering committee. The Coordinator would also be a member of the steering committee.

(2) The heads of national programs should not necessarily be the representatives of their country on the steering committee. They could nominate other scientists from their national programs to contest for the positions of the various disciplines.

(3) All steering committee members should be active researchers working in the savanna zone which is the focus of the maize network.

(4) The steering committee should be composed of 3 breeders, an on-station agronomist, 2 on-farm agronomists, a crop protectionist and a socio-economist.

(5) Any breeder at the meeting could be a candidate for the 3 positions reserved for breeders. Similarly any agronomist, crop protectionist or socio-economist present at the meeting could contest for the respective positions.

(6) Where there are not enough candidates at the meeting for the positions of any particular discipline, members could elect in absentia a national scientist of the particular discipline to represent his/her country on the steering committee.

Appendix 4: Country Reports

1.0 - Report on Ghana Maize Program by Dr. P.Y.K. Sallah

1.1 - Introduction

Maize is the most important cereal in terms of production and utilization in Ghana. Maize is grown for direct human consumption, although its use as food in the poultry industry is on the increase. Maize accounts for approximately 50% of the total area under cereals each year. Total maize production was 598, 600, 750 and 553 thousand metric tonnes in 1987, 1988, 1989 and 1990, respectively. However, the national average yield remains at 1.2 ton/ha.

1.2 - Major maize growing ecologies

Maize is grown in all the ecologies of Ghana which include the coastal savanna, forest, forest-savanna transition, guinea savanna, and sudan savanna zones. However, in order of importance, the major maize ecologies are (i) guinea savanna, (ii) transition and (iii) forest zones. Maize production in the sudan savanna is increasing due to introduction of early maturing varieties. The introduction of extra-early varieties (in the pipeline) will further hasten adoption of maize production in the sudan savanna zone.

1.3 - Constraints to maize production in Ghana

Several factors limit maize production in Ghana. The most important constraints include:

(a) Low soil fertility,
(b) Drought,
(c) Striga,
(d) Low yield potentials of local varieties ,
(e) Diseases such as the maize streak virus and pests such as armyworm and stemborer,
(f) Storage weevils including Prostephanus sp.,
(g) Problem weeds e.g. Rottboellia and Chromolaus,
(h) High prices of agro-chemicals as a result of the removal of subsidies by the government,
(i) Lack of credit to small-scale farmers.

Low soil fertility, Striga and drought are problems which are peculiar to the savanna regions. The various research programs seek to boost maize production by providing solutions to these production constraints.

1.4 - Maize research in Ghana

Maize research in Ghana is conducted at the Crops Research Institute under the Council for Scientific and Industrial Research. The current research strategy emphasizes inter-disciplinary approach coupled with a strong research-extension linkage to promote technology development and transfer. The major research activities include :

1.4.1- Breeding

Four maturity groups of maize varieties are being developed to satisfy the varietal needs of the major agro-ecologies and cropping seasons. These are early (90 days), intermediate (105 days), late or full- season (120 days) and the extra-early (75-80 days) through the SAFGRAD Maize Network. Emphasis is on the white maize although the yellow types are also developed for the livestock industry. Also, both normal endosperm maize and quality protein maize with high levels of the essential amino acids, lysine and tryptophane, are being developed. Emphasis is on the development of (1) open-pollinated (composite) varieties through population improvement and (2) hybrid development. In the population improvement program, populations corresponding to the major varietal types have been formed and are being improved through recurrent selection. The improved cycles are refined and released as composites. The hybrid program was initiated in 1986 by extracting inbred lines from open pollinated varieties and populations. Homozygous inbred lines are now available and are being tested in hybrid combinations to identify superior hybrids. In addition, two heterotic populations have been formed for improvement via reciprocal recurrent selection to serve as sources of new inbreeds. Variety testing in all the ecological zones is a major component of the breeding program. The objective is to identify superior varieties for on- farm testing and eventually for release. The program also produces breeder seed of recommended varieties for seed producing agencies in Ghana.

(3) Rotation with legumes-soybean, cowpea, groundnut, non-legumes-cotton, yam, cassava
(4) Cover crops-Mucuna
(5) Agroforestry-Gliricidia, Lucaena, etc.
(6) Tillage practices- flat, minimum tillage, tractor, bullock, ridges, mounds
(7) Striga control
(8) Fertilizer studies

In the guinea savanna zone, there are four on-farm teams; three are based in Nyankpala and one in Kumasi. All teams are using farming systems approach.

1.4.5 - On-farm demonstration

When a particular technology is found appropriate in terms of profitability, riskiness, compatibility to the farming systems and institutional requirements among other things, the technology is demonstrated in all the major maize growing areas. Examples are :

1) New maize varieties
2) Line planting + optimum density in sole or intercrop situations
3) Fertilizer application.

1.4.6 - Crop protection

a) Entomology

Studies include:

(i) The maize streak virus (MSV) : this involves (a) collection of Cicadulina leaf hoppers from the major maize ecologies (b) screening of leafhoppers for adaptability and host preference (c) determination of the virus transmission efficiency (d) mass rearing of adaptable and transmission efficient leaf hoppers for screening germplasm for resistance to MSV.

(ii) Persistence of plant products on treated maize seeds.

(iii) Screening maize varieties for resistance to storage insects.

b) Virology

A virologist has just been hired

c) Weed control

Studies include:

(i) Zero tillage in maize production

(ii) Effect of cover crops in suppressing weeds

1.4.7- Socio-economics

Specific studies involve (i) surveys on maize production (ii) marketing of produce (iii) women's roles in crop production and marketing (iv) gender issues in maize production (v) economic analysis of new technologies.

1.4.8 - Training and communication

The objective is to enhance research-extension farmer linkage through (1) planning sessions (2) in-service training for extension staff through field days using demonstration plots, (3) production of extension materials - flip charts, grower recommendations.

1.4.9 - Research needs

The main research needs of the Ghana Maize Program is funds for research equipment and supplies. For a long time the program has relied heavily on international donors such as the Canadian International Development Agency which has been funding maize research through the Ghana-CIDA Grains Development Project since 1979 and the Ghanaian-German (GTZ) Project based at Nyankpala. Another area where there is need is training at the graduate level and in-service training for technical support staff. Irrigation facilities close to Nyankpala will also facilitate breeding for drought tolerance.

1.4.10 - Achievements

The maize program in Ghana has achieved the following:

(1) Improved maize varieties with high and stable yields, which out-yield local varieties by approx. 2.5 times under low technology and up to 5x under medium to high technologies have been made available to farmers. These include:

Year of release	Variety
1983	Safita 2 (early ,white)
	Kawanzie (early, yellow)
	Aburotia (intermediate, white)
	Dobidi (late, white)
1988	Okomasa (late white, SR)
1991	Abeheehi (early white, SR)
1992	Dorke (early white, SR)
1992	Obatanpa (intermediate white, dent, QPM)

(2) Improved crop management practices have been developed for released varieties e.g. optimum plant densities, fertilizer regimes, weed control, timely harvesting and proper storage to minimize grain losses in storage at the farm level.

(3) Production of extension materials, bulletins, grower recommendations, training.

(4) Collaboration with seed producing agencies in various ways to promote production and distribution of improved seed by small-scale farmers.

2.0 - Report on Cameroon Maize Program by Dr. Charles Thé

2.1 - Introduction

The maize research program of Cameroon consists of two main sub-programs:
- the lowland maize sub-program (0-1000m)
- the mid-altitude maize sub-program (above 1000m).

Each sub-program comprises the following units.

1) Breeding unit
2) Agronomy unit
3) Crop protection unit
   - entomology

- plant pathology

4) Pre-extension (T.L.U.) comprising
   - socio-economists
   - extension agronomists
5) Related units such as, AFNETA, ICRAF, genetic resources and soil Scientist.

All the units work as a team.

2.2 - Major ecologies

The main ecologies in Cameroon are :

1) Mid-altitude humid zone
2) Mid-altitude savanna zone
3) Lowland savanna zone
4) Lowland humid forest with 2 rainy seasons
5) Sudan savanna zone
6) Sahel zone

2.3 - Research Activities

Research activities have been categorized into Research operations. The number of research operations are dependent on the production constraints faced by each unit. The lowland maize breeding research operations involve the following:

a) Testing of introductions and program-developed materials.

b) Population improvement activities include:
   - improvement of released varieties
   - improvement of varieties in the pipeline
   - Striga research
   - drought research
   - acid tolerant research
   - borer research
   - streak conversion
   - heterotic pools development.

c) Inbred line development

   17 populations are undergoing inbreeding.

d) Special maize
   - soft endosperm
   - quality protein maize
   - sweet corn
   - pop corn

e) Breeder and foundation seed maintenance and multiplication.

2.3.1 - *Agronomy unit research operations*

1) Soil preparation techniques
   - slash and burn
   - method of soil preparation
     . animal traction
     . minimum tillage
     . conventional tillage
2) Soil fertility and conservation through the use of organic matters
3) Water conservation
   - mulch
   - tied ridges
4) Striga control using:
   . rotation
   . trap crop
   . chemicals
5) Improved fallow
6) Agronomic packages for early and extra early
7) Hedge row using leguminous crops
8) Acid-soil management
9) Erosion control.

2.3.2 - *Crop protection unit research operations*

1) Disease survey
2) Epidemiology of major diseases
3) Maize storage insects
4) Biological and chemical control of pests such as borers
5) Rearing of insects for artificial infestation

2.3.3 - *Pre-extension unit research operations*

1) Socio-economic surveys
2) On-farm variety testing
3) On-farm Agronomy trials
4) Training
5) On-farm seed multiplication.

2.4 - Main Achievements

The main achievements of the national maize program includes :

1) Several varieties and/or hybrids have been developed and released by the program or are in the pipeline
2) Five heterotic pools developed:
   2 for mid-altitude sub-program
   3 for lowland sub-program
3) Moderate striga tolerant varieties and/or hybrids identified
4) Recommendation on seed treatment with Marshall 25 ST developed and made available to the network member countries
5) Plant density, plant population and timing of N fertilizer application for early and extra-early varieties developed and recommended to the network member countries
6) 60 kg/ha of N of fertilizer recommended for adoption by farmers
7) Better understanding of farmers' problems through socio-economic surveys.

2.5 - Future Research Priorities

The future emphasis of the maize program will be on:

1) Maize technology transfer and utilization
2) Refinement of heterotic pools adapted to the mid-altitude, savanna and forest zones
3) Creation of specific pools for borers, striga tolerance, acid tolerance and green maize
4) Development of low input technologies
5) Maize intensification at farmers' level.

2.6 - Main needs of national maize program

1) Training on specific topics
2) Enhancement of communication
   - information exchange
   - germplasm exchange
3) Research Fundings.

3.0 - Report on Nigeria Maize Program by Dr. K.O.S. Kogbe

3.1- Introduction

From available statistics, the estimated annual maize production of Nigeria is about 2.0 million tons, with yield averaging about 1.5t/ha, although higher yields averaging 4-5t/ha have been recorded for hybrid maize. Over the past several years, several improved maize cultivars have been developed and made available to farmers in Nigeria. These are mostly composites or synthetics. More recently, however, single, three-way and double crosses have been introduced to Nigerian farmers, and some of these have been adopted, particularly in Northern Nigeria. Like many African countries, production of maize is constrained by many factors including diseases, like blight, rust, streak, and more lately downy mildew in some parts of Nigeria. Field pests, in particular stem borers, are major constraints during the minor season. Also in storage, grain weevils are major constraint. There is also problem of soil acidity and micro nutrients in some ecological zones of the country. Research is generally conducted at the national and international research institutes and universities, even though there has been private sector participation on a very limited scale, of late. Agricultural research in Nigeria has been re-structured, with the mandate for genetic improvement of maize given to the Institute of Agriculture Research and Training (IAR&T).

3.2 - The maize research at IAR&T

3.2.1 - Maize breeding

The maize research program of the Institute of Agricultural Research and Training is focusing on lowland savanna and the humid forest zones. During the past three years, the Institute has strengthened her collaborative research efforts with IITA for germplasm development for both open-pollinated (OP) and hybrid maize, maintenance of recommended varieties that are resistant to streak virus disease, and the development and maintenance of downy mildew resistant varieties for use in endemic areas of the country. The emphasis of the maize breeding program is on the development of inbred lines for hybrid production and population improvement. Emphasis is also placed on breeding for disease resistance.

Major progress has been made in breeding for resistance to downy mildew and streak virus diseases in collaboration with IITA Maize Program.

3.2.2 - On-farm Research

The IAR&T maize program collaborates with IITA on two projects - EEC - On-Farm Adaptive Research (EEC/OFAR) and the Regional Research Project on Maize and Cassava (RRPMC), and these efforts have been highly productive. The results of the EEC/OFAR trials conducted over two years showed farmer's interest and preference for new technology, resulting in adoption of varieties such as DMR-LSR-W, EV 8443 DMRSR and Suwan-1. Under the RRPMC, the Institute has embarked on local germplasm collection. The results of intercropping trials conducted so far, have confirmed the possibility of intercropping maize with soybean and/or cowpea. The results showed positive yield advantage and the Land Equivalent Ratio (L.E.R.) was positive with higher profit margin.

3.2.3 - IAR&T and the Nationally-coordinated Maize Research Project

The Nationally-coordinated Maize Research Project conducts Nationally-Coordinated Zonal Maize Trials annually in Nigeria. Under the arrangement, the Institute in collaboration with other national research Institutes, Universities, national seed service and IITA have been evaluating newly-developed maize varieties (hybrids and OPs) in different agro-ecologies throughout the country. The most outstanding varieties across locations are recommended to the Technical Sub-Committee of National Variety Release Committee for further testing and eventual release to farmers.

3.2.4 - Research into downy mildew disease

This is one of the projects in which the Institute collaborates with IITA. Following the outbreak of downy mildew, a National Downy Mildew Survey was organized by the Federal Department of Agriculture, Abuja, in 1991. The Maize Improvement Program scientists of the Institute actively participated in it. The report of the survey has been forwarded to F.D.A., Abuja, for consideration and implementation. Furthermore, scientists have intensified further studies into some key aspects of the disease, including detailed survey on the incidence and distribution in Nigeria, host plant/pathogen interactions and survival mechanisms.

3.2.5 - Research on striga

This is one of the areas of close collaboration between IITA and IAR&T. As a result of the IITA collaboration with IAR&T on maize striga research, a technical staff of IAR&T has been trained in Striga research with emphasis on breeding.

3.2.6 - Maize agronomy

The thrust of the maize agronomy program is on the investigation into the optimum macro - (NPK) and micro - nutrients (Zn and S) requirements of hybrid maize.

3.2.7 - Research on maize utilization

From various surveys conducted in different parts of Nigeria it was observed that maize is being used as food in diversified forms, due to various customs, tastes and processing methods. The basic problems on maize utilization are as follows:

(i) There is need to address improved utilization and processing methods of maize for better nutritional and processing methods of maize.

(ii) The existence of diversified maize products necessitates the study of grain properties in order to identify varieties suitable for specific end-use and ensuring dietary preference, acceptability and high nutritive quality.

(iii) Many local maize dishes are deficient in amino-acids and hence there is the need to develop maize dishes which are protein fortified and which provide basic nutrient balance.

(iv) Because of scanty information on improved home-level technologies on utilization, existing methods of processing and utilization of maize only provide monotonous maize diet for the people. Therefore there is a need to explore innovative ways of maize processing and utilization.

As a result of the identified problems, the following studies are in progress:

(i) To determine the nutritional, biochemical, physical and sensory properties of maize varieties for different usage.

(ii) To develop home-level preparations of nutritionally improved maize foods.

(iii) To develop maize-based improved composite flours for local confectioneries, snacks and nutritionally balanced local recipes.

(iv) To determine the effects of processing on the nutritional quality of maize products.

3.2.8 - Technology transfer

Scientists of the Institute's Maize Improvement Program are cooperating with the Maize Association of Nigeria (MAAN) in testing of improved DMR maize varieties and adoption by farmers, and, also jointly with National Seed Services (NSS), in making seed available to farmers in the endemic areas. These efforts have also increased public awareness of the menace of DM disease and subsequently increased farmers' demand for seed of improved DMR varieties or Apron plus-treated seeds for their plantings.

The various technologies developed on maize have been put together into a booklet on recommendations for farmers of South Western Nigeria. The information is updated every two years. The Agricultural Extension Research Liaison Service (AERLS), the extension outfit of the Institute publishes technologies in simple expression in extension bulletins and pamphlets for farmers of the zone. The Institute of Agricultural Research (IAR) of Ahmadu Bello University (ABU) has also produced handbooks for the farmers of North-Western, North Eastern and Middle Belt zones of Nigeria. A National Agricultural Extension and Research Liaison Service (NAERLS) based at ABU has also been set up to complement these efforts. Beside these, the Monthly Technology Meetings (MTRMs), Monthly Training Workshop of the State Government Agricultural Development Projects (ADP) serves as a forum for training high cadre extension officers in these technologies. Maize farmers are subsequently trained by Village Extension Agents (VAEs), the lowest calibre of officers of the ADP.

3.2.9 - Main needs of national maize program

a) The maize program needs the following:

(i) Two breeders

(ii) One entomologist

(iii) One weed scientist

(iv) One agricultural economist

(v) Two agronomists

(vi) Four agricultural superintendents.

b) Material Resources:

(i) Irrigation facilities for dry season nursery
(ii) Soil moisture measuring devices -tensiometers, gypsum blocks
(iii) Moisture meters
(iv) Insect rearing facilities
(v) At least 2 vehicles.

c) Financial assistance

In view of the ever dwindling funding from the Federal Government, there is the need for financial assistance to keep the program going and to purchase basic materials vital to the program.

3.2.10 - Research Priorities

The priorities of the Maize Program will continue to be:

(i) Maintenance of recommended varieties that are resistant/tolerant to streak virus disease,
(ii) Development of open-pollinated and hybrid varieties, resistant to major diseases and pests,
(iii) Development and maintenance of downy mildew resistant varieties for use in endemic areas of the country,
(iv) Development of hybrid maize adapted to rain forest zone of the south-western Nigeria particularly for the production of green maize which is used for filling the hunger gap before the maturity of other crops in northern and southern Nigeria,
(v) Screening of available improved maize breeding materials for tolerance/resistance to stem borers,
(vi) Improvement in the home-level utilization of maize products.

4.0- Report on Côte d'Ivoire Maize Program by Mr. Attiey Koffi

4.1 - Introduction

The present level of maize production and the projected production by 2010 is shown in tables 1 & 2 respectively.

Table 1. National maize requirements (tons)

Years					
1985	1990	1995	2000	2005	2010
274091	325167	382947	442951	515324	602842

It is evident that by 2010 the consumption of maize will be about twice that of the present level. This is why the "Institut Des Savannes (IDESSA)" has been devoting resources and efforts to alleviate the constraints to maize production which farmers face.

Table 2. Gross Production (tons)

Observed gross production		Projected gross production (tons)			
1987	1990	1995	2000	2005	2010
450,000	416,900	491,000	567,900	660,700	772,900

In order to satisfy the future maize consumption needs of the country a steady promotion of maize production has been planned for the rural areas. This calls for a wide diffusion of high yielding varieties and intensification of maize production (good tillage, timely planting using recommended density, water control, weed control, appropriate fertilization and reduction of post-harvest losses). Also, a decision must be taken on the utilization of maize in the industry, the marketing of maize which is currently the major problem of producers.

Maize is cultivated everywhere in Côte d'Ivoire, especially in the northern, central, and central-western regions. The bimodal rainfall allows some of the regions to have a second cropping season. The absence of price guaranties has for quite some time restricted the expansion of maize

production which is presently enjoying a better environment thanks to the development of poultry and livestock industries and other industrial utilization of maize.

The importance of maize for human consumption varies from one region to another. It is eaten mostly on the cob as green maize in the coastal part of the country while it represents more than one third of the calorific intake of the population of the people in the north where it is consumed in the form of bread-like dough and also used in infant feed. In the central and northern areas, maize is used for the production of a local beer known as "Tchapalo" or "N'dolo".

4.2 - Varietal needs of Côte d'Ivoire

The varietal needs are as follows:

- 120 days (late) for production in the northern, north-eastern, western, central-eastern and central-western regions.
- 100-105 days maturing varieties (intermediate) for planting during the major season in the coastal, south-western, south-eastern, V Baoulé, central western, and central-eastern regions.
- 90 days (early) maturing variety for planting in the central western and central eastern regions as first season crop prior to planting of cotton and in all regions with bimodal rainfall as a second season crop.

4.3 - Objectives of the maize breeding program

The short term objective of the maize breeding program is to:

- Create the following composites: Composite S (drought resistance), Cbf, Synthetic-SR IDSA and Synthetic STR-IDSA.
- Classify breeding materials into heterotic groups. Incorporate special traits into varieties and populations e.g. protein quality, prolificacy, tolerance to aluminum toxicity, cytoplasmic male sterility, and resistance to borers.

In the medium term, the emphasis of the breeding program would be on the :

- Development of different varieties: early composites IDSA, late composites IDSA.
- Transfers of MSV resistance to the following varieties: MTS (SR, STR), CD (SR, STR), CJB (SR, STR), Y Composite (SR, STR) and Z composite (SR, STR), CPJ (SR, STR).

- Varietal improvement: according to weaknesses in the different composites and synthetics.

In the long term, the emphasis of the program will be on :
- Varietal improvement
- Hybrid development
- Recycling of inbred lines.

4.4 - Agronomy program

- Improvement of cultural practices for the different pedo-climatic zones particularly for animal driven and motorized culture.
- Survey, study, and improvement of maize-based farming systems.

4.5 - Main needs

The main needs of the national maize program include:
- Installation of maize dryer
- Micro computer
- Research equipments such as sheller, grain counter, moisture meters, etc.
- Vehicle
- Renovation of coldroom
- Research funds.

5.0 - Report on Mali Maize Program by Mr. N. Coulibaly

5.1 - Introduction

Maize is mainly cultivated for human consumption in Mali for different traditional dishes (tô, cous-cous, boiled, green maize, etc.) However, maize utilization in poultry and animal feed is increasing.

Maize has the highest yield potential of all cereal crops grown in Mali, with an average yield of 1.6 t.ha. Maize is cultivated as sole crop or intercropped with crops such as cowpea, or in rotation with cotton. More than 50% of the country's annual maize production comes from the southern cotton belt of Mali. However, maize production is increasing in the west and central regions in response to the good agronomic research and

extension services. High yielding maize varieties have been released and adopted by several farmers.

In 1992, Mali produced over 250,000 tons of maize with 192,000 tons of the production coming from the cotton belt, and 35,000 and 15,000 tons from the western and the central parts of the country respectively.

5.2 - National level priority ecologies

The major constraints to maize production in Mali include erratic rainfall, low soil fertility, low production price, high input costs, poor marketing system, lack of adapted and high yielding varieties for some agro-ecological zones, insufficient financial and technical support.

The overall objective of the maize program in Mali is to increase grain yield by 40% (1,6 t/ha to 2.3 t/ha) by the year 2010. This objective calls for an increase from the present yield of 2 t/ha to 2.7 t/ha in the cotton belt, 1.3 t/ha to 1.8 t/ha in the west, while the focus of the maize program on the central part of the country should be on food security.

5.3 - National needs and research priorities:

To achieve the above objectives, IER (Institut d'Economie Rurale) has placed particular emphasis on a long term agronomic studies with the aim of identifying high yielding, disease resistant and well adapted maize varieties within the major maturity groups, namely, intermediate, early and extra-early. To this end, four projects have been identified. These include:

(a) Improvement of cultural system for intensification of maize production
(b) Identification of high yielding adapted varieties
(c) Identification of low input requiring maize varieties.
(d) Research for integrated pest management control.

Project activities and expected results are summarized as follow:

Project	Activity	Expected results in 1995
Intensification of maize production	Improvement of existing cultural systems	Adequate intercropping system identified

Project	Activity	Expected results in 1995
High yielding and adapted maize varieties	Evaluation of disease resistant and superior varieties	Two varieties identified
	On-farm verification trials	Two adapted varieties proposed to extension agents
Integrated pest management	Biological control	Main pests known
	Cultural control method	Best planting time proposed
	Research on pest resistant varieties	Promising varieties released
	Better use of pesticides	Best rates and products identified
	Research on storage pests	Good traditional control method identified
Research for low input maize varieties	Evaluation of early & extra early maize varieties	Good material identified
	Evaluation of local and introduced maize varieties	Sweet corn & pop corn and other varieties identified
	On-farm verification trials	1-2 early and extra-early varieties identified
	Seed multiplication	Adequate good quality seed produced

IER is seeking financial support, short term training and scientific information exchange to achieve those objectives.

6.0 - Report on Burkina Faso Maize Program by Mr. Hema Idrissa

6.1 - Introduction

The research team of the national maize program consists of two breeders, one entomologist, a virologist and an agronomist. It works in close collaboration with the two core programs of the National Research Institute, INERA. These are (1) the Research Program on Cropping Systems (RSP) in which economists team up with sociologists and (2) the Research Program on water, soil, fertilization and agricultural mechanization (ESFIMA) which is made up of soil scientists.

The section on maize is a multi-disciplinary team with each specialist making available to his colleague the necessary scientific information.

6.2 - Main areas of Research Emphasis

The main components of the maize research program are:

a) - Entomology

This involves the following research areas:

1. Monitoring of insect vector activities.
2. Dynamics of the vector on wild hosts. This involves the monitoring of the vector population in nature, its structure, its growth, the presence or not of natural enemies.
3. Studies of nitrogen effect on the dispersion of insect vectors.
4. Study of the inherent capacity of the insect to transmit in order to help in understanding the epidemiology of the disease.
5. Natural population of virus.
6. Effect of poaceae on biology of the vector.
7. Mass rearing in order to produce enough vectors for the breeding program.
8. Residual population.

b) - Virology

The activities include studies on:

1. The role of abiotic factors in the incidence of MSV.
2. The molecular biology of MSV.
3. The host-vector interaction.

c) - Agronomy

Studies include:

1. Maintenance of soil fertility
2. Soil tillage (ridging, mounding, etc...)
3. NPK and lime application
4. Density-fertilization interaction for production of green maize
5. Maize/(cowpea or dry bean) intercropping
6. Study of moisture stress
7. Use of crop residues
8. Maize/Cotton intercropping

d) - Breeding

Drought tolerance

Burkina Faso was assigned the responsibility for breeding for drought resistance in maize during SAFGRAD II. Results obtained in this research area has been promising and several varieties have been released. These include:

1). Extra-early varieties such as KEJ, KEB
2) Early varieties (90 days) such as KPJ, KPB
3) Intermediate varieties such as SR22
4) Drought tolerant varieties such as MAKA SR, Pool 16 DT.

6.3 - Priority research areas

Hema et al (1990) studied the drought tolerance of 4 varieties (Kamb 85 Pool 16 Ds, Early Pool 16 DT, Across 86 Pool 16 Dt and Maka C_1) with different levels of drought tolerance, Glycol polyethylene 600 (PEG 600) water stress at five levels of asmotic potential under 2 moisture levels (irrigated and non-irrigated). Results of the study showed that :

1) Maka C_1 remains a good source of drought resistance
2) Across 86 Pool 16 DT and Early Pool 16 Dt have good yield stability
3) Kamb 84 Pool 16 DS is very promising only under good moisture conditions.

The Maize Program will continue the research on drought resistance using agronomic and physiological characteristics of local and introduced germplasm. The selection criteria would include anthesis- silking interval (ASI) and physiologic characters (transpiration) which according to earlier studies are highly correlated with yield (Hema et al, 1991).

6.4 - Striga control

Research work on resistance to Striga is becoming more and more important in the Maize Program. In 1993, two trials were conducted at Kamboinse/Pabre and Kouare. So far the major problem has been how to obtain uniform artificial infestation.

6.5 - On-farm testing

On-farm multilocation trials are conducted in collaboration with CRPA; field days are organized and farmers are invited to exchange view points. In 1993, about 140 on-farm trials involving 2 improved varieties and a local variety (check) were evaluated.

6.6 - Community level seed production

Several quantities of seeds of released varieties were produced directly by the maize breeding program or by farmer groups under the supervision of the maize breeder.

6.7 - Future emphasis of the maize program

The major emphasis of the national maize program would be on :

1) Study of drought resistance, breeding for earliness and stable yield
2) Study of resistance to striga
3) Study of resistance to maize streak (epidemiology, biology)
4) Study of resistance to termites
5) Technology transfer with emphasis on on-farm testing
6) Seed multiplication
7) Training.

7.0- Report on Benin Republic Maize Program by Mr. C.G. Yallou

7.1 - Importance of Maize in Benin

Maize is the principal cereal crop grown in Benin for human consumption. More than thirty different dishes may be prepared from maize. Although very important in the southern and central parts of the country, maize tends to increase in the central regions (such as Bougou) where yellow varieties are the only maize grown for filling the hunger period. Maize is almost always intercropped with cassava, sorghum, groundnut or cowpea at various plant densities.

7.2 - Constraints to maize production

The main constraints to maize production in Benin include:

- Lack of appropriate storage technologies.
- Quality requirement for consumers and producers to prepare local dishes.
- Lack of improved, adapted varieties to meet cultural systems, taste and industrial utilization.
- Disease, insects and weed problems especially Striga .
- Lack of good marketing policy, etc.

7.3 - Research achievements

7.3.1 - Variety improvement:

Several maize varieties have been developed from local ecotypes and introductions at Niaouli and INA research stations. The varieties include: NHI (Niaouli hybrid 1), NH2 (Niaouli Hyb. 2) NCP80 (Niaouli composite precose 80), Sekou 81 TZSR (white & Yellow), Sesamia 91, JI (Jaune Ina), CJI (composite jaune d'Ina) IHI (hybrid 1), and Composite de Novora.

Disease and insect resistant varieties have been identified and are being considered for release in the different agroclimatic regions.

7.3.2 - Agronomy:

Agronomic research in Benin has led to the development of recommendations for plant densities, fertilizer and cultural practices for the various agro-ecologies.

7.4 - Research program

The Maize research program has the following objectives:

- Development of hybrids with high yield potential, disease resistance and striga tolerance for intensified maize production.
- Develop economically feasible cultural practices for farmers.
- Improve farmer's storage and conservation techniques.

7.5 - Future program

In order to achieve the stated objectives, the maize program will focus on the following research areas:

- Evaluation of morphological and agronomic characteristics of local varieties of maize

- Study and improvement of traditional methods of maize storage and conservation
- Intensify maize cultivation through the adoption of improved cultural practices
- Conduct studies on utilization and marketing of maize and its by-products

8.0 Report on Togo Maize Program by Dr. Yovo Mawule

8.1 - Introduction

Maize is the most widely cultivated cereal in Togo. It is the main staple diet of the inhabitants. The major constraints to increased maize production and productivity are the parasitic weed, *Striga hermonthica* , stemborers, drought, low and declining soil fertility, erosion and storage pests (*Sitophilus spp and Prostephanus truncatus).*

8.2 - Maize research in Togo

The maize research program aims at the development of improved maize varieties, understanding and improvement of the maize-based cropping systems, and the reduction of losses caused by diseases, insect pests and weeds.

The maize improvement program is placing emphasis on the exploitation of genetic resources to: combat biotic constraints, and eliminate traits that predispose maize to yield losses, and develop varieties acceptable to both farmers and consumers. Streak resistance screening facilities have been established and are being utilized to convert local germplasm for resistance to the maize streak virus. Maize varieties are being improved for tighter husk cover to make them less vulnerable to field-to-store pests, such as *Sitophilus zeamais.* Emphasis is also placed on the development of varieties with the soft floury endosperm characteristics of the local varieties.

Survey studies have revealed that there is heavy infestation by *Striga asiatica* in the soils of Southern Togo and by *S. hermonthica* in the tropical ferrugineous soils of Northern Togo. Experiments have been conducted to search for *Striga* tolerant/resistant varieties. Studies to determine the effect of N fertilizer rate on *Striga* incidence started in 1987. Attempts are also

being made to stimulate *Striga* germination by using root exudates of several maize varieties.

Attempts are being made to tackle the soil fertility problem through the use of legumes for intercropping and relay cropping. Maize-cassava intercrop followed by cowpea or groundnut or a fallow in the second growing season is a common crop rotation sequence.

8.3 - Achievements

The national maize program has released the following varieties:

- Late maturity	-	Poza Rica 8443
- Intermediate maturity	-	8149-SR, ZI_2-BD
- Early maturity	-	EV 8330SR

9.0 - OVERVIEW OF THE IITA MAIZE IMPROVEMENT PROGRAM

9.1 - Strategies for breeding open-pollinated maize varieties at IITA

The population improvement program at IITA has been targeting varietal development to fit both the lowland humid forest and savanna ecologies. Table 1 shows the breeding priorities and maturity groups within each of those ecologies. With the present budget reductions faced by the International Agricultural Research Centers, it will be necessary to reduce efforts in the forest zone in order to place major emphasis on important production ecologies in the savanna.

Descriptions of savanna-adapted populations which have been undergoing improvement at Ibadan headquarters and by the maize network are presented in Table 2. *Striga* resistance is presently the number one priority of the breeding program. Prolific materials are being developed for intercropping with low-growing legumes in the savanna, and for the green maize market in the forest zone. An extra-late population was developed for the long, monomodal, rainy season in the Southern Guinea Savanna, but this work will be discontinued because of budget constraints.

The genetic background of breeding populations are described in Table 3. Two early and two late composites are being improved using reciprocal recurrent selection. The late composites represent the Tuxpeño and Caribbean Flint heterotic groups (TZL Comp. 3 and 4, respectively). This approach is referred to as the "Comprehensive Breeding Scheme". Potential products are improved open-pollinated varieties (OPVs), variety crosses, and inbred lines with high combining ability. An S2 testcross system is utilized for the late reciprocal populations. Three years are required to complete each cycle of selection.

Another strategy being used to reduce the number of populations under improvement and to streamlining the breeding program is to convert white populations to yellow grain color through backcrossing, rather than improving both white and yellow populations for each ecology. Yellow conversions (designated SGY, for single-gene yellow) are available for several elite varieties, including TZB-SR SGY and TZUTSR-W SGY.

Clustering of testing sites based on GXE interactions for yield among 25 elite, late varieties revealed that sites which are closer to each other tend to give more similar results than sites far apart, regardless of the classification of sites into ecological zones (Fig I). Furthermore, relative performance of varieties may be different in the savanna zone of Nigeria than in the savanna zone of Côte d'Ivoire. This indicates that there may be a need to evaluate germplasm across a strategic number of representative sites before final dissemination through International Trials. Collaboration between IITA and several national programs in the region would be required.

Table 1. **Breeding priorities for target ecologies**

Rainy season	Humid forest		Moist forest			
Maturity	1st	2nd	VL	L	I/L	E
Downy mildew	***	***	*	*	*	*
Puccinia polysora	**	**	*			
Bipolaris maydis	**	**	*			
Maize Streak Virus	*	*	*	*	*	*
Other leaf diseases	*	*	*	*		
Ear rots	***	**	**	*		
Sesamia spp.		***				
Eldana saccharina	*	***	*			
Sitophilus spp.	**			**		
Striga hermonthica			**	***	***	***
Low fertility				***		
Drought				**	*	*
Husk cover	***	***	***	***	***	**
Stalk lodging	**	*	*	**	*	*
Root lodging	**	*	**	***	*	*
Grain quality	**			**		
Yield potential	**	**	**	***	**	**

* some efforts, ** considerable effort, *** major effort

Table 2. **Population improvement for the savanna ecologies**

Population	Description	Emphasis
Northern Guinea Savanna		
TZL Comp. 3	L, W/Y, F	Yield Lodging resistance
TZL COMP. 4	L, W, D	Yield Lodging resistance
TZL Comp. 1	L, W, SF	*Striga* resistance Yield Lodging resistance
Pop. 29-STR	L, W, D	*Striga* resistance Yield Lodging resistance
TZUTSR-W	I/L, W, SD	Yield Lodging resistance Ear rot resistance Ear aspect
Prolific composite	I/L, Mixed	Prolificacy Nitrogen use efficiency MSV resistance
Southern Guinea Savanna		
Very Late Germplasm	VL, SD	Maturity Yield , MSV Lodging resistance

Table 2, cont'd. **Population improvement for the savanna ecologies**

Population	Description	Emphasis
Sudan Savanna		
TZE Comp. 3	E, W, F	Yield Drought resistance
TZE Comp. 4	E,W, SD	Yield Drought resistance
TZE Comp. 5	E, Mixed	*Striga* resistance Yield
Pool 16 DT	E, W, D	Yield Drought resistance *Striga* resistance
TZEE-W-SR	EE, W, SD	Extra earliness MSV resistance *Striga* resistance
TZEE-Y-SR	EE, Y, SF	Extra earliness MSV resistance *Striga* resistance

Table 3. **Genetic background of materials in the population improvement program**

Population	Genetic background
TZL Comp. 3	TZB-SR, Suwan 1-SR
TZL Comp. 4	Mar. 7921-SR, Pop. 43-DMRSR, TZPB-SR, DMR-LSRW
TZE Comp. 3	TZESR-W, DMR-ESRW
TZE Comp. 4	EV 8430-SR, IK 8149-SR, (DMR-ESRW)
TZUTSR-W	US germplasm x TZSR
TZL Comp. 1	TZB-SR x 8 STR inbreds
Pop. 29-STR	Pop. 29-SR C2 x TZi3 STR
TZE Comp. 5	TZESR-W C3 x 8 STR inbreds
TZBR Eldana 1	8338-1 x CIMMYT MBR*2
TZBR Eldana 2	TZi2, 10,12,15, & ICAL27
TZBR Eldana 3	DMR-LSRW, TZSR-W-1, La Posta
TZBR Sesamia 1	TZi4 x 6 resistant introductions
TZBR Sesamia 3	TZi1 x CIMMYT MBR
Prolific composite	US germplasm x various IITA populations
Very Late Germplasm	Phebe x TZi3, TZi4, TZPB-SR
Pool 16 DT	Pool 16
TZEE-W-SR	Local and improved germplasm
TZEE-Y-SR	Local and improved germplasm

9.2 - Research on Striga control in maize at IITA

Species of *Striga* are becoming an increasing threat for maize production in the savanna zone of West and Central Africa. *Striga. hermonthica* and *S. asiatica* are widespread and attack a range of cereal crops. Considerable variation also exists within each species in host plant specificity and geographical distribution. This complexity suggests that a diversity of approaches will be required to effectively control these parasites.

The *Striga* research group at IITA conducts research in *Striga* epidemiology and population dynamics, *Striga*- host interactions, host-plant resistance, agronomic control, biological control, and socio-economic aspects of control measures. The group presently consists of a *Striga* biologist, maize and cowpea breeders, a farming systems agronomist and a socio-economist.

Striga is spreading into new areas at an alarming rate. Studies have shown that movement by wind and animals is generally over short distances. The primary agent responsible for the rapid dissemination of *Striga* seed is man. Surveys revealed that frequently 100% of market samples of maize, sorghum, millet, and cowpea are contaminated with *Striga* seeds. Although methods for cleaning seed lots have been developed, they are not feasible for widescale use by farmers. Clearly there is a need to educate farmers about management practices in order to prevent contamination of crops at harvest.

Studies have been conducted to investigate the effect of time of infection on crop yield loss and *Striga* seed production. When *Striga* infestation was delayed for 4-5 weeks after planting, yield losses of maize and sorghum and emergence of *Striga* were greatly reduced. Agronomic practices which protect maize and sorghum during the first 4-5 weeks after planting could provide effective *Striga* control. The feasibility of transplanting sorghum from *Striga*- free seed beds to the field is being investigated. Seed treatments for maize and cowpeas are under study.

An *in vitro* system has been developed which permits *Striga* plants to be studied in the absence of a host. This has been used to assess the effects of various nitrogenous compounds on *Striga* growth and development, and to determine the effect of nitrogen application at particular stages in the *Striga* life cycle.

Sorghum is the most important host for *Striga* reproduction. Among the cereal crops, maize is the most sensitive, but *Striga* seed production is not as great as on sorghum. In fact, maize can serve as an effective catch crop for *Striga* if a late weeding is carried out. The potential of legumes as trap crops for *S. hermonthica* in cereal rotations or mixtures is also being investigated. A simple, inexpensive in vitro technique has been developed for identifying legumes with high stimulant activity which will be most effective at inducing suicidal germination of *Striga*. *Aechinomenes histrix* has been shown in on-farm trials to increase yield of a subsequent maize crop by over 70% in moderately infested fields.

Because *Striga* is endemic to Africa, efforts to find suitable biological control mechanisms have focused on augmentation of indigenous natural enemies. This could include either local release of control agents or modifications in farmers' management practices to enhance their activity. Natural control agents identified to date include fungal pathogens (*Sclerotium, Fusarium*), bacterial pathogens (*Pseudomonas, Xanthomonas*), and *Smicronyx* weevils. It is thought that the pathogens will be easier to manipulate than the insect control agents.

Socio-economic studies have aimed at characterizing both the *Striga* control technologies and the farming systems in the region. Models have been developed which indicate adaptability of particular technologies based on socio-economic indicators. A computer based decision model is being developed to assist NARS in selecting appropriate control packages for on-farm testing.

Infestation methods for *Striga* screening in the breeding programs have been improved substantially over the past ten years. Recent experiments have shown that preconditioning in the field is not necessary, permitting researchers to infest the test site with *Striga* and plant maize breeding material at the same time. A new method is being developed utilizing water injection of *Striga* seed suspensions which should further reduce labor requirements and the costs of infestation.

Genetic studies have been conducted which indicate that many genes control *Striga* resistance. Consequently, attempts to backcross resistance into existing varieties have not been very effective. Plant symptom ratings

have shown a predominance of GCA effects, whereas *Striga* emergence shows more SCA effects. Heritabilities and genetic correlations among resistance traits are presently being estimated in the breeding populations. The approach used in the breeding program is to select for both reduced plant symptoms and reduced emergence of *Striga* in the field. Moderate levels of resistance have been obtained in several hybrids, whereas the level of resistance available in open-pollinated varieties is low. Recurrent selection and formation of synthetics from inbred lines are both being employed to obtain resistant open-pollinated varieties. Efforts are being made to identify better sources of resistance in African landraces. Crosses with perennial maize (*Zea diploperennis*) have been made to try to develop populations which do not support development of *Striga*.

9.3 - IITA Hybrid Maize Program

Focus: Northern Guinea Savanna (NGS)

RESEARCH

Major advantages of hybrids over OPs

Grain yield of hybrids

Yield potential

On-station: 12.1 t/ha in Funtua (1983)
14.7 t/ha in Saminaka (1992)

On-farm: 11.8 t/ha (1984 on-farm demonstration)

Experimental yields: Hybrid over OPs (without much stress):

28% - 64% yield advantage (1983)

69% from Samaru and Bagauda (1992)

Shelling percentage

Hybrids = 84, OPs = 79

Nitrogen

N-use efficiency (kg grain/Kg N)

Hybrid = 48.4, OP = 39.0

Grain yield (t/ha)

At 60kg/ha N : Hybrids = 5.4, OPs = 4.2 (1989-'91)

At 1200kg/ha N: Hybrids = 5.0, OPs = 4.3 (1989-'91)

Striga resistance (STR)

Grain yield (t/ha)	Hybrids = 3.9,	OPs = 1.3 in Nigeria
	Hybrids = 3.6,	OPs = 1.9 in Cameroon and Benin
Striga ratings (1-9):	Hybrids = 3.0,	OPs = 6.7

New STR hybrids

8322-13 STR related (9143-13, -20 etc. 9 hybrids)
8321-18 STR related (9145-11, -5, and 9141-5)

New synthetics (formed from the latest cycle of STR lines):
New STR Syn.-W and New STR Syn.-Y. Families were tested in Nigeria, Cameroon and Côte d'Ivoire on 1993. Selected families across locations are being recombined ; retesting for STR in the screen house and pollinating in the field are going on.

Drought tolerance (Grain yield in t/ha, Bagauda)

Hybrids = 2.4, OPs = 1.2 (98% increase, 1992)
At 60kg/ha N: Hybrids = 2.0, OPs = 1.3 (1989-90)

Maturity

Hybrids: 105 to 110 days. OPs = 120 days'

Agronomic practices

Yield potential of hybrids has not been fully exploited

Timely planting: By mid June.

Timely application of fertilizers: Just before planting or within 1 wk after planting (general practice: 2wk after planting).

Micro-nutrients: Mg, Zn, sulfur.

Planting in water logged areas should be avoided.
Ridging appears to be better in the savanna.

Weed control: First 4 wks after planting
Herbicide is the most expensive input, often adulterated

Combining ability studies

The best combination is tropical x temperature conversion.
Searching for super-combination: W x Y crosses and IITA x Introduced public lines

New outstanding combinations:

White: EV43DMR x 9071BR (9011-3), 9021-18 X Babungoyo S4 (9111-1)
TZi x TZMi 102 (9245-1): Lowland x mid-altitude

Yellow: 8644-27 x Suwan 1SR53 (8981-5), 8425-8 X Suwan 1-SR 53 (88676)

W x Y : TZi 15 x KU1414-SR (9125-9), TZi3 x Fla 2 BT-106 (9120-3)

Advantages of line-development

- Three-way cross cannot be developed by the comprehensive breeding system
- Best hybrid combinations in the NGS are tropical x temperature conversion
- High combination and disease resistant lines can be used to form synthetics with better resistance and uniformity.

Appendix 5: List of participants of the first meeting of heads/coordinators of national maize research programs of West and Central Africa.

Heads/coordinators of national maize research programs of the maize network

The eight heads/coordinators of national maize programs who attended the meeting are listed below:

Name	Title/position	Institution	Address
Attiey Koffi	Principal Maize Breeder	IDESSA	01 BP 633 Bouaké 01 Rep. de Côte d'Ivoire Fax:(225) 63 20 45 Tel:(225) 63 51 21/63 51 22
N'Tji Coulibaly	Chef du Program Maïs	IER	Institut d'Economie Rurale BP 258, Bamako, Mali Tel: (223) 22 60 08 Tlx: 1200 CPUBKO ML
Hema Idrissa	Maize Breeder	INERA	01 BP 476 Ouagadougou 01 Burkina Faso Fax: (226) 31 92 08 Tel: (226) 31 92 02 Tlx: 5381 BF
J.O.S. Kogbe	Senior research fellow and head, maize program	IAR&T	IAR&T, PMB 5029 Moor Plantation, Ibadan Nigeria Tel: (234) 31 25 23/31 17 28
Charles Thé	Maize Breeder	IRA	BP 2067, Yaounde, Cameroon Tel: (237) 22 30 22 Telex: 1144 KN Fax: (237) 22 30 22
P.Y.K. Sallah	Maize Breeder	CRI	Nyankpala Agric. Expt. Station Crops Research Institute P.O. Box 52, Tamale, Ghana Tel: (233) 071 2411 Tlx: 3036 or 3014 BTH 26 GH Fax: (233) 51 41 32/51 53 06
C. G. Yallou	Maize Breeder & Genetician	INRAB	Station de Recherches sur les Cultures Vivrières de Niaouli, BP 03, Attogon, République du Benin Tel: (229) 37 21 50
Yovo Mawule	Chef du Program Mais	INCV	BP 2318, Cacavelli Lome, Togo

Other participants

The following persons also attended the meeting:

Name	Title/position	Institution	Address
J.M. Fajemisin	Research Liaison Scientist	IITA	01 BP 2559 Bouaké 01, Côte d'Ivoire Tel: (225) 63 54 31 Tlx: 69113 IITA CI Fax: (225) 63 52 70
B. Badu-Apraku	Maize Network Coordinator	IITA	01 BP 2559 Bouaké 01 Tel: (225) 63 54 31
J.B. Suh	Research Liaison Scientist	IITA	IITA Research Liaison Office, Crops Research Institute P.O. Box 3785 Kumasi, Ghana Tlx: 3036 or 3014 BTH 26 GH Fax: (233) 51 41 32 / 51 53 06
Vicky Adenle	Visiting Scientist	IITA/PHMD	Oyo Road, PMB 5320 Ibadan, Nigeria Tel: (234-22) 400-300 to 319 Tlx: 31417/31159 TROPIB NG Fax: (INMARSAT) 874-1772276
J.G. Kling	Maize Breeder	IITA	PMB 5320, Oyo Rd, Ibadan
J.L Gulley	Group Training Coordinator	IITA	PMB 5320, Oyo Rd, Ibadan
A.A. Adekunlé	Research Training Specialist	IITA	PMB 5320, Oyo Rd, Ibadan
Alpha O. Diallo	Liaison Scientist	CIMMYT	01 BP 2559 Bouaké 01 Côte d'Ivoire Tel: (225) 63 54 31 Tlx: 69113 IITA CI Fax: (225) 63 52 70
Taye Bezuneh	Director of Research	OAU/STRC-SAFGRAD	BP 1783, Ouagadougou Burkina Faso Tel: (226) 30 60 71 / 31 15 89 Tlx: 5381 BF Fax: (226) 31 15 86
R. Dossou	Breeder	INRAB	SRCV-INA BP. 03 N'Dali, Benin Tel: (229) 30 02 64
J.P. Eckebil	DDG	IITA	PMB 5320, Oyo Rd, Ibadan
F.M. Quin	Director	CID/IITA	PMB 5320, Oyo Rd, Ibadan
M.A.B. Fakorede	Maize Breeder	Obafemi Awolowo University	Department of Plant Science Ile-Ife PMB 5320, Oyo Rd, Ibadan

S.K. Kim	Maize Breeder	IITA	PMB 5320, Oyo Rd, Ibadan
K.F. Cardwell	Plant Pathologist	IITA	PMB 5320, Oyo Rd, Ibadan

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