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SCIENTIFIC, TECHNICAL AND RESEARCH COMMISSION
(OAU / STRC)

WEST AND CENTRAL AFRICA SAFGRAD MAIZE COLLABORATIVE RESEARCH NETWORK

RESEAU MAÏS
SAFGRAD
MAIZE NETWORK

REPORT

OF THE ELEVENTH MEETING OF THE STEERING COMMITTEE

19 - 21 MAY 1992
OUAGADOUGOU, BURKINA FASO

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SEMI-ARID FOOD GRAIN RESEARCH AND DEVELOPMENT
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TABLE OF CONTENTS

Page

1. OPENING SESSIONS

1.1. Joint Maize and Cowpea Session

Following registration, the members of the Maize Network Steering Committee attended a joint opening session of the Steering Committees of the Maize and Cowpea Networks at the SAFGRAD Coordination Office, Ouagadougou, Burkina Faso. The opening session was addressed by the SAFGRAD International Coordinator, the representatives of USAID and IITA Deputy Director General (International Cooperation).

1.1.1. Welcome Address and Introductory Remarks by SAFGRAD International Coordinator

The SAFGRAD International Coordinator, Dr. J.M. Menyonga, welcomed the participants to the 11th Steering Committee Meeting of the Maize and Cowpea Networks. Dr. Menyonga indicated in his address that USAID had made available funds for network activities but at a reduced level from April to December 1992. Dr. Menyonga indicated that the impact assessment study of the SAFGRAD Networks would be conducted during the period. Dr. Menyonga raised the issue of lack of well organized seed production and distribution systems in most countries in the sub-region and suggested that Networks discuss the issue during their deliberations and seek ways to make available seed of improved varieties to the farmer. The Coordinator announced that coordination of RESPAO (Réseau d'Etude des Systèmes de Production en Afrique de l'Ouest) had been transferred to Ahmadu Bello University as funds were not adequate for continued running of the Network by the SAFGRAD Coordination Office. The Coordinator said the officials of RESPAO, including the Coordinator would be on the payroll of the University and thus reduce the running cost of the RESPAO. Dr. Menyonga also announced that the Maize Network Coordinator, Dr. J.M. Fajemisin had been recalled by IITA to head IITA station in the Côte d'Ivoire and would therefore leave the Network at the end of May. Dr. B. Badu-Apraku from the Ghana maize program had been appointed the new Coordinator to replace Dr. Fajemisin. Dr. Menyonga took the opportunity to express his gratitude for the good job which Dr. Fajemisin had done for the Maize Network both in research and technology transfer and wished him the best in his new assignment.

1.1.2. Address by the Representative of USAID

The representative of USAID, Dr. W. Thomas in his address stated that the rapid growth in population in Africa required an equivalent increase in food production. In addition, the drought conditions often experienced on the continent made the search for drought tolerant varieties mandatory if food production and food security were to be ensured. Dr. Thomas stated that he had no doubt that the SAFGRAD Networks would be up to the challenge. He also pointed out that the impact assessment study to be undertaken by the Networks was very appropriate and should be pursued. Dr. Thomas indicated that results from the study could be useful for seeking support for Network activities.

1.1.3. Address by the Representative of IITA Deputy Director-General (International Cooperation)

Mr. E.F. Deganus, Projects Coordinator, International Cooperation, IITA, addressed participants on behalf of the Deputy Director General for International Cooperation. Mr. Deganus emphasized the need to balance population growth and food production in Africa. He indicated that by the year 2115, one out of every four persons in the world would be an African, and that unless food production was tremendously increased, the continent was likely to be in a crisis. Mr. Deganus, therefore called for proper coordination of agricultural research on the continent to ensure that technologies developed were made available to farmers to enable them increase food production and security on the continent.

1.1.4. Impact Assessment Study of SAFGRAD Networks

The Director of Research, Dr. Taye Bezuneh, presented a paper on the Impact Assessment Study of the SAFGRAD Networks during the joint session. The objectives of the impact assessment study, according to Dr. Bezuneh was to examine the justification for supporting regional research networks in Africa as a means of increasing:

1) The efficiency and performance of national agricultural research systems in the development and adaptation of agricultural technology.

2) The contribution of research to economic growth.

The Program Assessment would build on the recent end of project evaluation of SAFGRAD-II to look in more depth at:

- changes taking place as a result of networking activities, and,

- impact on productivity, production and incomes resulting from the use of technology developed and adapted through network efforts.

It will also look more broadly at:

- the justification - comparative advantage for investing in the development of the commodity systems involved;

- the capacity of potential lead National Agricultural Research Systems (NARS) to handle leadership and management of regional research networks.

Dr. Bezuneh, therefore, suggested that the maize and cowpea Networks should plan the protocol for the assessment during the Steering Committee Meetings so as to facilitate the study.

1.2. Attendance

1.2.1. Members of the Steering Committee

The following members of the Steering Committee were present at the meeting:

Name	Title	Address
Dr. Charles Thé (Chairman)	Maize Breeder	IRA/NCRE, B.P. 2067, Yaoundé, Cameroon.
Mr NTji Coulibaly (French Secretary)	Agronomist	IER, B.P. 438, Bamako, Mali.
Dr. P.Y.K. Sallah (English Secretary)	Maize Breeder	Nyankpala Agric. Expt. Station, Crops Research Institute, P.O. Box 52, Tamale, Ghana.
Mr. Abdou Ndiaye	Maize Breeder	ISRA, B.P. 240, CRA/Fleuve, Saint Louis, Senegal
Mr. R.A. Dossou	Maize Breeder	S.R.C.V. d'INA, B.P. 3, N'Dali, Benin.
Dr. E.N.O. Iwuafor	Soil Scientist	IAR/ABU PMB 1044, Zaria, Nigeria
Dr. J.M. Fajemisin	Maize Network Coordinator (out-going)	SAFGRAD-IITA, 01 B.P. 1495 Ouagadougou 01 Burkina Faso
Dr. B. Badu-Apraku	Maize Network Coordinator (in-coming)	SAFGRAD-IITA 01 B.P. 1495 Ouagadougou 01 Burkina Faso

1.2.2. Observers

The following persons attended the meeting as observers:

Mr. E.F. Deganus	Projects Coordinator, International Cooperation, IITA, PMB 5320, Ibadan, Nigeria.
Dr. S.K. Kim	Maize Breeder, IITA, PMB 5320, Ibadan, Nigeria.
Dr. T. Bezuneh	Director of Research, OAU/STRC-SAFGRAD 01 B.P. 1783 Ouagadougou 01 Burkina Faso.
Dr. J.M. Menyonga	SAFGRAD International Coordinator OAU/STRC-SAFGRAD 01 B.P. 1783 Ouagadougou 01 Burkina Faso
Dr. Allan C. Schroeder	Consultant for Impact Assessment Study (USAID).
Prof. A.M. Emechebe	Representative, SAFGRAD Oversight Committee.

1.2.3. Agenda for the Meeting

The following items were adopted as the agenda for the meeting by the Steering Committee:

- Approval of proceedings of the 10th steering committee meeting.
- Network Coordinator's report.
- Discussion on coordinator's report.
- Progress reports on collaborative research.
- Discussion on ways to sustain Network activities.
- Discussion on impact assessment study.
- Other matters
- Recommendations.

1.2.4. Approval of the Proceedings of the 10th Steering Committee Meeting

The proceedings of the 10th steering committee meeting were accepted after a few amendments were effected.

2. REPORT OF MAIZE NETWORK COORDINATOR

2.1. Introduction

Since the originally scheduled Project Activity Completion Date of 31 August 1991, Project 698-0452 (USAID-SAFGRAD) had had three extensions, namely September 1-December 31 1991, January 1-31 March 1992 and April 1-December 31, 1992. This had not made planning of activities easy.

Activities since the last steering committee meeting in November 1991 involved analysis of data from regional trials and documentation of Network performance. Steps were also taken to continue with collaborative research projects in order to sustain the Network.

The principal activity of the Network for the rest of the year would be the impact assessment of SAFGRAD networks. The purpose was "to examine the justification for supporting regional research networks in Africa as a means of increasing (a) the efficiency and performance of national agricultural research systems in the development and adaptation of agricultural technology, and (b) the contribution of research to economic growth".

2.2. Data analysis

Data from the two sets of regional trials RUVT Early and RUVT Extra-Early offered in 1991 to collaborators in West and Central Africa were analyzed. Of 76 sets dispatched to 18 countries, data were received from 63 sets from 16 countries.

RUVT-Early comprised 13 early maturing varieties flowering about 50 days after planting and producing dry grains in 90-95 days. The trial included experimental varieties from Pool 16 DR, populations 30 and 31, soft endosperm version of TZESR-W, TZE Comp 3 x 4, BU-ESRW, a variety from Burkina Faso and streak resistant version (BC3) of one variety each from Benin and Mauritania. RUVT Extra-Early contained 9 varieties flowering 40-45 days after planting and producing dry grains in about 80 days. These varieties are extra-early selections from populations created from crosses among the following: West African savanna landraces, improved early maturing varieties and an extra-early source (Gua 314) from Columbia. Both trials had a slot for an appropriate check variety to be provided by the trial collaborator.

There was good plant establishment in practically all the locations and this was sustained through harvesting. For most of the locations, the season was much wetter than in 1990. For instance, Kamboinse near Ouagadougou in Burkina Faso received 1022 mm of rainfall compared with 576 mm in 1990. Nevertheless, Mauritania and Cape Verde recorded below average rainfall. On the average, extra-early varieties flowered a week earlier than varieties in RUVT-Early. Days to 50% silking ranged from: 51 to 55 days for RUVT-Early and 42-48 days for the extra-early varieties. Extra-early varieties were, on the average, about 24 cm shorter than the early-maturing varieties.

Across-location analysis of RUVT-Early for 20 locations (12 countries), where CV was not above 20%, revealed highly significant main effect for varieties and locations and for the

Location x Variety interaction for grain yield and other important agronomic traits such as flowering, and plant and ear heights. Kamboinse 88 Pool 16 DR (5.48 t/ha) and EV 8731-SR BC6 (5.44 t/ha) produced the highest yields whilst BDP-SR BC3 (4.53 t/ha) was the lowest yielder. The highest yield-producing locations were in Cameroon (7.61, 7.49 and 7.24 t/ha for Soucoundou, Sanguere, and Maroua, respectively) whereas the lowest yields were obtained from Bambari (2.21 t/ha) in Central African Republic.

In the RUVT-Extra-Early, the streak resistant varieties were significantly higher yielding than their non-resistant counterparts by as much as 42% (1.57 t/ha). TZEE-WSR and TZEE-YSR, however, flowered 4 and 3 days, respectively later than their non-SR versions but CSP-SR flowered at the same time as CSP. The SR versions were more vigorous and more resistant to other foliar diseases (rust, blight and *Curvularia* leaf spot) than their non-SR counterparts. TZEE-WSR was the highest yielding entry (5.25 t/ha); it outperformed the lowest yielding entry TZEE-Y by over 2 t/ha even though it was only 5 days later in flowering.

Results from the regional trials over the past 4 years showed that there were Pool 16 DT SR varieties which significantly outyielded SAFITA-2. Pool 16 DT SR varieties were, in addition, streak resistant whereas SAFITA-2 was not. It was therefore recommended that all countries that had hitherto released SAFITA-2 should consider replacing it with either Kamboinse 88 Pool 16 DT SR or Farako-Ba 88 Pool 16 DT SR (HD) in order to assure yield stability. The improvement of the extra-early varieties in plant type, and resistance to fungal foliar diseases and streak virus have enlarged their area of adaptation and possible adoption to include the humid forest zone. At the same time, they remained an attractive option in the semi-arid zone as a result of their extra-earliness.

A compilation of the summary of the data per trial per location has been published and copies of the publication dispatched to trial collaborators.

2.3. Collaborative research

Research was pursued on the improvement of early and extra-early populations and varieties.

2.3.1. Development of Early Maturing Maize

Pool 16 DR C4 F1 was planted under artificially induced streak pressure at Ibadan during the 1991/92 off-season. The streak pressure was unfortunately not as high as desirable. On the other hand, there was a high level of infection of *Helminthosporium* leaf blight and ear smut to permit the selection of desirable plants for recombination.

Experimental varieties from the 1990 IPTT (Pool 16 DT-SR C3) were advanced to F2 in order to generate seed for the 1992 regional variety trial. The varieties are Across 90 Pool 16 DT-SR, Farako-Ba 90 Pool 16, DT-SR Ina 90 Pool 16 DT-SR, Kamboinse 90 Pool 16 DT, Maroua 90 Pool 16 DT-SR and Nyankpala 90 Pool 16 DT-SR. BDP-SR BC4 and Maka-SR BC4 were both advanced to BC5 at IITA-Ibadan during the 1991/92 off-season.

2.3.2 Development of Extra-Early Maize

TZEE-WSR BC4 and TZEE-YSR BC4 were advanced to BC5 at IITA under streak pressure. Plants that were very susceptible to streak virus, *Helminthosporium* leaf blight and rust were not used in crossing.

2.4. Publication of 1991 Workshop Proceedings

Summaries of country reports presented at the 1991 Workshop at Niamey, Niger were compiled and published with the title "Maize Production in West and Central Africa: Trends and Research Orientation". The editing and publishing of the scientific papers presented at the Workshop were in progress.

2.5. Plan for May-December 1992

2.5.1. Program Assessment (Impact Study)

The Program Assessment will "build on the recent end of project evaluation of SAFGRAD II to look in more depth at (i) the changes taking place as a result of networking activities, and (ii) the impact on productivity, production and incomes resulting from the use of technology developed and adapted through network e. forts".

The study will be a collaborative effort among the (i) NARS in countries selected for the study (ii) IARCs (IITA and ICRISAT), (iii) SAFGRAD Coordination Office, (iv) Network Steering Committee, and (vi) a technical team to backstop the program assessment and to synthesize findings. The technical support team will consist of three members: (a) the SAFGRAD Director of Research who would lead the team, (b) an economist to be recruited by USAID/Washington and stationed in Burkina Faso for 9 months, and (c) a research analyst who would be stationed in Burkina Faso to assist for a 3-month period (he would be an AAAS fellow working with AFR/ARTS/FARA of USAID/Washington).

It was anticipated that a majority of the information and data required would be available through existing reports and data sets that IARCs and NARS had. The information would, however, likely need to be organized and examined in a different format and manner than it existed. In some cases, it might be necessary, however, to collect additional information addressing the utilization (level 3) and productivity (level 4) changes. This could involve in-country assessment of the utilization of technology at on-farm level.

2.5.2. Regional Trials

Regional trials would be offered to national programs. The entries would include new varieties generated from Pool 16 DT Cycle 3. Seed of varieties evaluated in the regional trials over the past 4 years were available and could be provided to interested network-member countries on request.

2.5.3. Collaborative Research

The various collaborative research activities assigned to the Network Lead Centers would continue.

2.5.4. Financial Assistance to National Programs

Financial assistance would be provided to National Programs as follows:

Benin	$1500	Guinea Bissau	$1000
Burkina Faso	$2000	Mali	$1500
Cameroon	$2000	Mauritania	$1000
Cape Verde	$1000	Niger	$1000
Central Afr. Rep.	$1000	Nigeria	$2000
Côte d'Ivoire	$1500	Senegal	$1500
Gambia	$1000	Tchad	$1000
Ghana	$2000	Togo	$1500
Guinea	$1000		

2.6. New Network Coordinator

The present Network Coordinator, Dr. J.M. Fajemisin had been relocated by IITA to Bouake, Côte d'Ivoire. He would be replaced by Dr. Badu-Apraku. Dr. Badu-Apraku, a maize breeder of Ghanaian nationality was an active foundation member of the Network.

2.7. Discussion of the Coordinator's Report

The Steering Committee proposed that populations that had been formed for improvement in resistance to drought or experimental varieties derived from such populations be designated "DT" instead of "DR" as has been the practice. This change is necessary since DR designation may be misinterpreted to mean the materials are resistant to drought, which is not the case at this stage.

3. PROGRESS REPORTS ON 1991 COLLABORATIVE RESEARCH

3.1. Report on Activities in Cameroon by Dr. Charles Thé

The Cameroon maize program has responsibility for:

1) Breeding for early maturity.
2) Breeding for drought tolerance.
3) Breeding for *Striga* tolerance.
4) Agronomic Research.

3.1.1. <u>Breeding for early maturity</u>

Collaborative research on breeding for earliness started in 1989. In 1990 116 new genotypes were evaluated for earliness and yield potential. In 1991, two IRA-NCRE developed synthetic varieties showed some potential for *Striga* tolerance under artificial infestation. These were Syn E1 and Syn E2. The two varieties would be retested in 1992 in an effort to release them as *Striga* tolerant varieties. In addition, 6 inbred lines tested for 2 years under artificially infested conditions were crossed in partial diallel fashion. Their F1 would be evaluated in 1992. Furthermore,a *Striga* tolerant pool formed from materials of different genetic backgrounds would be tested as single crosses in 1992. Finally agronomic practices designed to alleviate *Striga* damage showed some promising results.

The remnant seeds of S4 lines selected for drought tolerance which were to be recombined into a drought tolerant pool didn't germinate and progress achieved so far was lost.

3.1.1.1 Germplasm Evaluation

National Variety Trial Early (N.V.T (E/I)

The objective of the trial was to identify high yielding, early stable varieties, acceptable to farmers.

The N.V.T (E/I) were conducted at 8 savanna locations. One of the sites (IRZ, Sanguere) was artificially infested with *Striga* seeds. The trial comprised 15 entries. Seven of these entries were of intermediate maturity while the remaining eight entries were early. The trial was planted at 70,000 plants per hectare. Side-dressing was done not later than 25 days after planting.

Results showed that grain yield ranged from 1.5 t/ha under *Striga* infestation at IRA, Sanguere to 7.0 t/ha on non infested field in Sanguere. The coefficient of variation ranged from 14.7% at Mayo Galke to 33.5% under *Striga* infestation at IRA, Sanguere. CMS 8503 (6.6 t/ha) and BSR Syn I (5.8 t/ha) which are of intermediate maturity outyielded EV 8931 SR (5.8 t/ha) and CMS 9015 (5.5 t/ha). P3 Kollo (4.5 t/ha) had a better performance in the savanna zone, yielding 6.4 t/ha in Sanguere and Maroua. This was an indication of its adaptation to drier conditions. EV 8931 SR which has the same genetic background as CMS 8802 outyielded

CMS 8806 by 0.2 t/ha. Syn E2 (5.0 t/ha) was the best *Striga* tolerant variety, with a 4.0 rating on a 1-9 scale, and 8-9 *Striga* plants per plot. The second best entry under *Striga* was Syn E1 with a rating of 5.5..

R.U.V.T EXTRA-EARLY

This trial comprised 9 extra-early varieties (less than 85 days to maturity). The check used was an early variety CMS 9015. This trial was conducted at the 3 savanna locations, namely Sanguere, Maroua and Soucoundou. Mean grain yield ranged from 5.6 t/ha in Sanguere to 6.1 t/ha in Maroua. C.V. varied from 7.1% in Soucoundou to 16.3% in Maroua. Average yield was 5.9 t/ha. The high yield may be attributed to the higher plant density used (67,000 plants/ha) and to early side dressing (25 days after planting). Variety ranking was highly correlated to plant density at harvest. The best extra-early variety was TZEEW-SR-BC3F3 (6.8 t/ha) with 65,000 plants per hectare at harvest. The lowest yielding variety was TZEE-Y (3.9 t/ha) with 50,000 plants per hectare. TZEF-Y (5.8 t/ha) which was previously identified as promising had 1.0 t/ha less than the best variety.

R.U.V.T EARLY

This trial comprised 14 entries which were supposed to have some tolerance to drought. The trial was planted at Sanguere, Soucoundou and Maroua at 67,000 plants per hectare. The results showed a very high correlation between plant density at harvest and yield. The average grain yield across the 3 sites was 7.0t/ha with an average of 61,400 plants per hectare at harvest. Grain yield ranged from 6.8 t/ha at Maroua to 7.1 t/ha at Soucoundou. The C.V. varied from 10.2% at Soucoundou to 15.4% at Maroua. The best variety was FBC6 (7.8 t/ha) from Burkina-Faso program. This was followed by Maka-SR BC3F3 (7.5 t/ha). TZE comp 3 x 4 (5.8 t/ha) was the lowest yielding entry.

3.1.1.2 Variety development

The objective of this program was to increase the yield potential of released varieties by incorporation of complementary genes through varietal crosses. In addition, evaluation of the varietal hybrids would allow for variety classification into the 3 heterotic pools of Cameroon.

E.V.T. NCRE EARLY

This trial comprised 16 entries. Eight of the entries consisted of crosses involving 4 composites and the testers, 1368, 5012 and 9071. The results revealed that 9071 was the most efficient tester in improving Pool 16 DT-SR (32% heterosis) and DMRESR-W (16%) in the two savanna locations while 5012 was the best tester for TZESR-SE (27% high parent heterosis), Pool 16 DT-SR (37%) and DMRESR-W (37%).

In general, TZUT-W (6.4 t/ha) which is an intermediate variety yielded higher than all the variety crosses. The promising varieties would be advanced to F2 and F3 and evaluated again as experimental varieties.

E.V.T NCRE INTERMEDIATE

This trial comprised 17 entries. Nine of the entries consisted of crosses involving three intermediate maturing varieties and the testers 1368, 9071, and 5012. At the two savanna locations, CMS 8503 x 5012 (8.4 t/ha) showed 20% high parent heterosis, BSR Syn 1 x 1368 (7.8 t/ha) exhibited a 40% heterosis and BSR Syn II x 5012 (7.7 t/ha) had a 24% heterosis. In this zone, it was observed that varieties adapted to forest zone could be improved by the tester, 5012.

In general, CMS 8503 x 5012 (7.1 t/ha) was the best varietal hybrid, followed by CMS 8503 x 1368 (6.8 t/ha).

<u>New Variety Crosses</u>

The best varieties identified from the 1991 main season results of the RUVT early and extra-early were crossed to one of the testers 1368, 9071 or 5012 during the off-season. These varieties were TZEE-W-SR BC3F3, CSP-SR BC3F3 (extra-early) and TBC6, Maka-SR BC3F3, BDP-SRBC3F3 (early). In addition these varieties were crossed to Tuxpeno Sequia and La Posta Sequia. All the F1 would be evaluated during the 1992 main cropping season.

<u>TZE Comp 4C</u>

This trial comprised 5 sets each with 40 entries. The trial was made up of early families and were evaluated in Maroua. The entries were made by crossing S1 lines of the IITA heterotic pool composite 4C1 with bulked pollen from the opposite pool, composite 3C1.

From each set, 2 families were retained based primarily on ear aspect. The results showed that the mean of selected 10 families was 8.0 t/ha for grain yield and 1.6 for ear aspect. The gain from selection was 4% for grain yield and 12% for ear aspect.

3.1.2. <u>Drought Tolerance Research</u>

S4 lines selected in 1990 for their potential for drought tolerance were lost due to poor storage facilities. The activities carried out were: (i) half-sib improvement of Pool 16 DR (ii) advancement from F1 to F2 the following variety crosses which have shown positive high parent heterosis: Maka SR x BDP SR; Tuxpeno DR x CSP SR.

3.1.3. <u>Stem Borer Research</u>

IITA borer resistant (BR) materials which were supposed to be resistant to *Sesamia calamistis* and *Eldana saccharina* were planted at Ekona during the second season. None of the varieties tested showed resistance to any of the insects.

3.1.4. Breeding for *Striga* tolerance

Objectives:

The objectives are:

a) To identify a variety or a hybrid tolerant to *Striga* for release.

b) To identify *Striga* tolerant inbred lines that could be used as donor in the breeding program or that could be recombined to form a *Striga* tolerant pool or variety.

c) To identify agronomic practices that could help alleviate *Striga* damage.

Methods

Two sets each of an open pollinated and hybrid trials were received from IITA. In 1991, these trials were evaluated under artificial infestation of *Striga* . Each hill received an average of 2,000 *Striga* seeds. *Striga* symptoms rating (1-9) were done at 10 weeks and 12 weeks after planting. In addition, the number of *Striga* plants per plot were evaluated at 8 weeks, 10 weeks and 12 weeks.

Furthermore, 486 inbred lines were screened in artificial *Striga* infested fields. These inbred lines were divided into 5 trials based on the population from which they were derived. Each trial was evaluated in single row plots, with 3 replications.

Results

The *Striga* hybrid trial included 14 entries and were tested at two *Striga* infested sites at Sanguere (IRZ Sanguere and Karite Block). Results showed that the best hybrid was 9022-12 STR which yielded 3.4 t/ha and was rated 3.9 on a scale of 1-9. CMS 8710 an open pollinated variety, yielded 2.8 t/ha and had a *Striga* rating of 5.8. The most susceptible line was 8338-1 (0.6 t/ha) and was rated 7.0 with 146 *Striga* plants in the 2 central rows.

The open pollinated variety trial revealed that the best variety was STR DT-SR which yielded 2.5 t/ha with a 5.1 rating. It was also noticed that varieties with TZB background ranked among the best. As in the hybrid trial, CMS 8710 was rated 5.7 and had the fewest *Striga* plants.

Based on the results of the advanced trials, 6 inbred lines were selected and crossed in a partial diallel during the off-season. The F1 would be evaluated in 1992. In addition, lines selected from the 486 inbred lines evaluated in 1991 were crossed to the different Pools for evaluation in 1992.

Finally Ndock 8701 and CMS 8710 were screened in articially *Striga* infested field. The best plants were recombined to form cycle 1 of improvement of these 2 varieties.

3.1.5. Agronomic Research

Performance of maize after different *Striga* trap crops grown in rotation on alfisol infested with *Striga*

This study started in 1989 in a farmer's field called "Karite Block".

In 1990, the following trap crops were planted as preceeding crops: groundnuts, cowpea, soybean, pigeon peas, cotton, crotalaria and maize. Following the farmer's practices, the crop residues were removed after harvesting.

In 1991, two maize varieties (TZPB-SR and CMS 8503) were planted using a split-plot design. The main plot was the preceeding crop while the sub-plot was varieties.

Results showed that, in all main plots, the two maize varieties were affected by *Striga hermonthica*. The magnitude of damage varied from plot to plot and from one variety to another. Grain yield of maize varied from 2.09 t/ha for CMS 8503 with maize as preceeding crop to 3.54 t/ha for the same variety with crotalaria as the preceeding crop. Both varieties responded similarly to different preceeding crops as revealed by the non significant interaction detected between variety and preceeding crop. In general CMS 8501 which is an intermediate maturing variety outyielded TZPB-SR which is a full season variety even though the difference was not significant. It was found that the best preceeding crop was crotalaria (3.28 t/ha) followed by cowpea (2.98 t/ha) and cotton (2.52 t/ha). The worse preceeding crops were maize (2.12 t/ha) and groundnuts (2.24 t/ha).

Effect of different intercropping patterns of maize and legume species on maize yield on an alfisol infested with *Striga*

Two maize varieties (TZPB-SR and CMS 8503) along with 3 legume species (*Crotalaria caricea, Cassia obtusifolia* and cowpea) were used in this study which was started in 1989. The objective of the study was to determine the effects of different intercropping patterns on maize in an alfisol infested with *Striga hermonthica*.

The treatments were:

1) Maize/cowpea (Ratio 2:1 on same row).
2) Maize/cowpea (same hill)

3) Maize/*Crotalaria caricea* (same hill)
4) Maize/*Cassia obtusifolia* (same hill)
5) Maize monocrop.

In treatments 2, 3 and 4 where maize and legume were planted on the same hill, the legumes were removed 20 days after crop emergence. Results showed that, the two maize varieties were affected by *Striga* in all the treatments. Maize grain yield varied from 1.08 t/ha for TZPB-SR monocrop to 2.25 t/ha for CMS 8503 intercropped with *Cassia obtusifolia*. Significant differences were detected among treatments. The best pattern was maize intercropped with *Cassia obtusifolia* with 2.07 t/ha as average yield. This was followed by maize intercropped with *Crotalaria caricea* (1.82 t/ha). The worst treatment was maize monocrop (1.28 t/ha). Variety x treatment interaction was non-significant.

3.2. Maize Research in Mali: Ntji Coulibaly

Maize is the third most important rainfed cereal crop in Mali after millet and sorghum. It is mainly grown for human consumption. However, the utilization of yellow maize in the poultry industry has increased in big cities, such as Bamako, Segou, Sikasso, etc.

Maize is produced as a sole crop or in association with millet or cowpea and in rotation with cotton, etc.

The major constraints of maize production include insufficient and often poorly distributed rainfall, poor soil fertility, low produce price, high input cost, poor marketing system, lack of disease resistant and well adapted varieties, and limited funds for national maize research.

The long term maize research objectives include the increase of production through an increase in productivity and area under maize cultivation. To achieve these objectives, the national maize researchers are conducting adaptive research in collaboration with SAFGRAD, IITA, CIMMYT, etc to identify high yielding, disease resistant and adapted maize varieties (early, extra-early and intermediate). During the 1991/92 cropping season, the national maize research focused on evaluation of varieties across selected stations and sub-stations (Sotuba, Kita, Longorola, Mintola, Katibougou, Bema Same, Samanko) covering a large range of climatic, and soil conditions. Verification trials were conducted on farmers field within three recommendation domains. Also *Striga* resistant trials, hybrid, sweet corn and pop corn trials were conducted. Promising varieties have been identified for further evaluation in the coming years. Several varieties, including EV 8422 SR, DMR-ESRY and TZEF-Y confirmed their yield and stability across the sites in various regions. Hybrid maize showed high yield potential at the Sotuba Station. Sweet corn and pop corn were found to be of much more interest to farmers than legume crops. National and foreign investors are being encouraged to establish industries which use mainly maize as the raw material.

3.3. Maize Research in Senegal: A. Ndiaye

Breeding:

Research activities were conducted in two sectors of the country:

- Central South for rainfed maize research
- Senegal River Valley for maize research under irrigation.

I. Rainfed Research

Variety Trials: In 1991, three SAFGRAD trials were conducted (RUVT early, RUVT extra-early and Pool 16 DT-SR IPTT) at Nioro and Sonkorong stations. Grain yield for early varieties (TZESRW-SE, Kamboinse 88 Pool 16 DT-SR, Across 86 Pool 16 DT-SR, EV 8730 SR BC6 and EV 8731 SR BC6) ranged from 3.8 to 4.2 t/ha at Nioro while grain yield of the extra-early varieties (TZEE-YSR BCF3, CSP and CSP x L. Raytiri) ranged from 2 to 2.5 t/ha at the same station. Results from Sonkonrong were not useable due to high C.V.

Multilocation trials:

The best available varieties including Pool 16 DT-SR, SAFITA-2 and CSP were evaluated on on-farm in four villages around Nioro station.

Seed multiplication

Seeds of Pool 16 DT-SR C1, DMRESR-W and TZESR-YF3 were produced to meet the seed requirements for research.

II. Maize research under irrigation

Maize research under irrigation focused on the creation of a yellow composite for the mid-valley area through crosses among 9 varieties identified the previous years. The F1 progenies would be inter-crossed following the chain-crossing technique.

Heterotic groups:

Thirty-four varieties and populations were crossed during the dry season using the "paired parent" method. The F1 crosses harvested in May 1992 would be tested in Ndiol and Lavaye during the next two years.

Planting date trial

Eight genotypes (populations, hybrids and varieties) of different origin and cycles were tested from August 1990 to July 1991 with the following objectives:

- to identify optimal planting date and suitable varieties for production under irrigation.

- to identify the crosses with high yield potential across planting dates.

- to better understand and identify relationship between climate (especially temperature), growth and maturity cycle of maize.

- to study genotype x environment interactions across planting dates.

All the data are being analyzed.

Agronomy

Trials on NPK and effects of soil physical characteristics on rooting and growth of maize were conducted. Also, studies on soil types and the optimum water requirements for irrigated maize were carried out.

Entomology

The following studies were conducted:

- study of insect population dynamics.
- yield losses due to insect damage.
- screening for stem borer resistant varieties.

3.4. Maize Research in Benin: R.A. Dossou

Introduction

Maize is becoming a high income generating crop in Benin. It is extensively produced in the different agroecological zones. The following are the research objectives:

- Breeding for high yielding, adapted, insect, foliar disease and *Striga* resistant open pollinated varieties with good husk cover.

- Generating cultural practices suitable for the different agro-ecological zones.

- Breeding for high yielding hybrid maize varieties for intensive maize production by well equipped farmers.

In 1991, the activities of the Maize Program included varietal improvement, agronomy and crop protection.

I. Varietal Improvement:

Advanced National Trials: Two types of advanced variety trials involving 6 and 9 late maturing and early maturing varieties respectively, were conducted at different locations using 60 kg/ha of nitrogen and 40 kg/ha of P_2O_5.

Advanced National early variety trials:

The early variety trials were conducted at several locations with altitudes different from those of the Northern Guinea savanna and the Sudan-Sahelian savanna. At Ina, yield differences were significant with DMRESR-W and Across Pool 16 DT-SR yielding 4.0 t/ha and 3.9 t/ha respectively. There were no significant differences among the varieties in yield at the other experimental sites.

Advanced National Late Variety Trials

No significant yield difference was observed among varieties tested across sites in this trial. This confirmed the results of the previous years. Therefore, it is necessary to include new varieties that will be superior to TZB-SR in yield or other characters.

Collaborative Trials

These included SAFGRAD and IITA trials.

IITA late variety trial

This trial was conducted at Ina and Guminou. The varieties 8521-18 and Mokwa 82 TZPB-SR yielded 5.7 t/ha and 5.2 t/ha respectively across sites. None of the other varieties outyielded the check TZB-SR.

IITA intermediate variety trial

No yield difference was observed among the intermediate maturing varieties at Bagou. However, at Angaradebou, SUWAN 2 SR BC4 and IKENNE 86 TZUT SRW yielded 5.0 t/ha each.

RUVT-Early

At Ina, the varieties EV 8731 SR BC6, Kamboinse 88 Pool 16 DT and TZE Comp 3 x 4 yielded 5.8 t/ha, 5.6t/ha and 5.1 t/ha respectively. No yield difference was observed at Bagou and Guene. There was low yield and high C.V at Guene due to termite damage and poor germination. The three varieties outyielded the check BDP-SR BC3F3 by 31.2%, 26.4% and 23.6%, respectively.

RUVT Extra-Early

Although TZEE-WSR BC3F3 yielded 4.2 t/ha and Kito 3.1 t/ha, there was no significant difference between the two varieties.

Hybrid Trials

No hybrid significantly outyielded the checks TZB-SR and TZPB-SR in the hybrid trials.

Evaluation of streak resistant inbreds:

Most of the thirteen inbred lines tested under natural infestation showed some good level of resistance to the maize streak virus.

Maize Breeding:

The second cycle of recombination of the late and early pools initiated in 1989 was carried out.

Improvement and seed multiplication of TZB-SR

One hundred and sixty-eight half sibs selected in 1990 were planted ear to row in an effort to purify and extract the best disease resistant fraction of TZB-SR. The streak resistance level ranged from 2 to 1.5 (on a scale of 1-5, where 1 = highly resistant and 5 = highly susceptible). Also improvement in lodging resistance was achieved through a reduction of ear height.

Seed multiplication:

Twenty-one varieties were planted for seed increase. However, seven of them did not germinate.

II. Agronomic Research

Nitrogen response

At Ina and Angaradebou, grain yield increased with increasing nitrogen levels. However, at Bagou and Guene, there was no yield increase when the nitrogen level was higher than 90 kg/ha.

Plant density

Except at Ina, increasing plant density resulted in increased grain yield. At plant density of 74,000/ha and 111,111 plants/ha, grain yield of 4.2 t/ha and 4.0 t/ha, respectively, were obtained with early varieties at Guene.

Timing of Nitrogen applications:

Applying all the nitrogen at planting or splitting it at two or four weeks after planting gave similar grain yield with early varieties.

III. Crop Protection

Two main areas were studied.

1) Study of parasitic damage on maize during vegetative stage at Bagou:

In 1991, parasitic damage was more important at Ina than observed in the previous years. Almost one third of the plants showed symptoms of damage. The major parasites observed included *Sesamia, Cryptophelebia, Helothis* and *Chilo*.

2) Effect of maize planting date on *Striga* germination

No *Striga* damage was observed during the 1st and 4th planting dates (22/5/91 and 22/8/91). However, during the 2nd and 3rd planting dates (22/6/91 and 22/7/91) *Striga* damage were observed. The greatest damage was observed during the 3rd planting date (22/7/91).

3) Effect of nitrogen on *Striga* germination

No conclusion could be drawn from the trials due to the lack of uniform *Striga* infestation within plots.

3.5. Report on Activities in Ghana by Dr. P.Y.K. Sallah

Ghana, as one of the lead centres of the SAFGRAD Maize Network for West and Central Africa, has responsibility for (i) breeding varieties of different maturity groups for the semi-arid zone (ii) breeding for resistance to the maize streak virus (iii) *Striga* research and (iv) breeding for N use efficiency. The major activities carried out in 1991 in line with these responsibilities were as follows:

3.5.1. Breeding varieties of different maturity groups

3.5.1.1. Population improvement

The populations under improvement are the 120-day (full-season) white dent, 120-day yellow flint/dent, 105-day (medium maturing) white dent, 90-day (early) white dent and 90-day yellow dent/flint populations. These populations correspond to the major types of maize varieties required in Ghana and are being improved through recurrent selection procedures. The improved cycles of each population are refined and released as composite varieties. The possibility of utilizing extra-early varieties is being investigated through SAFGRAD Collaborative Variety Trials.

Improvement of 120-day white dent pool. The 120-day (full season) white dent pool, has undergone improvement for four cycles. Results from replicated field trials have shown that this pool could be a promising source of high yielding varieties. During 1991, 97 full-sib families was extracted from the pool and these would be tested in progeny trials in 1992. The objectives were (1) to extract an experimental variety and (2) to form a new population from the superior fraction of the pool for improvement for drought and *Striga* tolerance/resistance.

Improvement of 120-day yellow dent/flint population. The 120-day yellow population was formed from the superior late fractions of the 110-day yellow pool and the 110-day yellow population based on progeny yield trials conducted in 1989. In addition an experimental variety was formed from the top ten families. In 1991, Suwan 1 was introgressed into the 120-day yellow population in order to broaden the genetic base. The experimental variety was also advanced from the F1 to F2 stage in preparation for evaluation in the on-station variety trials.

Improvement of the 90-day white dent population. One hundred and forty-one full-sib families extracted from the 90-day white dent population plus three checks were evaluated at Nyankpala, Fumesua and Ejura during the 1991 growing season. The objective was to extract an experimental variety and to improve the population for yield and other agronomic characters.

Improvement of the 105-day white dent pool. The 105-day white dent pool has undergone 10 cycles of half-sib selection and further improvement in the material has been curtailed. Evaluation of this pool has shown that it has potential for high grain yield and other desirable agronomic traits. Reciprocal full-sibs extracted at Nyankpala in 1990 were evaluated in replicated field trials at Nyankpala, Fumesua and Ejura in 1991. The objectives were to (1) extract an experimental variety and (2) introgress the superior fraction of the pool into the 105-day white dent population.

Extraction of an experimental variety from the 90-day yellow flint/dent population. The objective of this program was to extract an experimental variety from the 90-day yellow population as a possible replacement for Kawanzie, a streak susceptible variety which was released in 1984. In 1991, a bulk of the 90-day yellow population was grown at high density (83,000 plants/ha) at Nyankpala. The population was planted late to induce high incidence of natural maize streak virus (MSV) infection. Reciprocal full-sib families were generated between MSV disease-free plants and these would be tested in progeny trials during the 1992 season.

Improvement of grain and flour quality of TZB. Local maize varieties have a soft, chalky endosperm which is preferred in traditional dishes. A program was therefore initiated in 1986 to transfer the desirable grain and flour characteristics of local varieties into selected improved varieties. In 1991, BC3 S1 lines from the TZB SR x local backcross program were screened under fluorescent light and the floury kernels were selected. Selected floury grains of the BC3 S1 lines were recombined for further improvement.

Purification of local maize populations. Local maize varieties are increasingly being used in the Ghanaian breeding program because the soft chalky endosperm is preferred for traditional food preparations. However, these varieties have been found to segregate for the soft, chalky endosperm trait. This program was initiated to purify the local varieties for the desired trait. In 1991, S1 lines of Ohawu Local, Volta Region Local and Kwadaso Local varieties were screened under fluorescent light and floury kernels were selected. Selected S1 floury kernels were advanced to the S2 stage.

3.5.1.2. Development of quality protein maize varieties

Maize is a major staple in Ghana and it is widely fed to weaning children without any protein supplement such as meat, milk, or beans. Even though the normal maize contains about 10% protein, this protein is nutritionally poor because it lacks two essential amino acids, lysine and tryptophan, which monogastric animals including humans are unable to synthesize. Quality protein maize (QPM) germplasm are now available that have elevated levels of lysine and tryptophan and thus are nutritionally superior to the normal maize. Research into the development of high quality protein maize in Ghana was intensified in 1989. A large quantity of QPM germplasm was obtained from CIMMYT, Mexico for use in the program. Research carried out on QPM in 1991 are briefly described below:

Improvement in GH 8363 SR. The streak resistance level of EV 8363 SR was upgraded by Dr. Badu-Apraku (while a visiting scientist in IITA) in 1989 using the streak screening facilities of IITA.

On the basis of visual selection in Ghana and protein quality analysis in CIMMYT, 141 S1 lines from EV 8363-SR were selected for field testing in 1991. The 141 S1 lines plus three checks were tested using in a lattice design with two replications at Fumesua, Kpeve, and Nyankpala during the major season of 1991. As a result of erratic rainfall that ocurred at Fumesua and Nyankpala during the growing season, usable data were not obtained at these sites. However, on the basis of analysis of data obtained at Kpeve, visual selection at the two other sites and the results of quality protein analysis, 46 S1 lines (32%) were selected for recombination. Also, the 10 top performing lines out of these selected lines were earmarked for the formation of experimental variety. While the S1 testing was going on, all the 141 lines were planted in the off-season nursery and the 46 lines were recombined to reconstitute the population for further improvement. Also the 10 best selected lines were recombined to form an experimental variety for testing in 1992.

Development of QPM variety, Obatanpa. The source material used to develop Obatanpa was EV 8363-SR, an IITA streak resistant conversion of CIMMYT Population 63. Field tests conducted in Ghana prior to 1989 showed that this variety was the most productive QPM material in Ghana. However, when its streak resistance level was monitored in IITA, it was found to be 60% and thus low. The streak resistance was therefore upgraded to 95.7% by the Ghana Program, using the streak screening facilities of IITA. Obatanpa was derived from the streak resistant version of GH 8363 SR and would be proposed for release in Ghana in 1992.

3.5.1.3. Hybrid Program

Recognizing the potential role of hybrid technology in revolutionalising agriculture in Ghana, the Government of Ghana and an external review team recommended that a modest amount of resources be committed to hybrid development. Since 1986, efforts have been made by the maize program to develop inbred lines and evaluate hybrids developed by the program, at IITA and CIMMYT. Tropically adapted inbred lines have been developed from CIMMYT Population 43, Composite W, Giant Composite and CIMMYT Population 44. Testing of the Ghana inbreds in hybrid combinations was initiated in 1990 and continued in 1991 with the identification of superior hybrids which are expected to be evaluated on-farm in 1992.

Even though the present demand for hybrid maize is very low, it is anticipated that this will increase with the reorganization of the national seed industry and with the continued improvement in crop management and extension.

The major activities carried out in the hybrid program during 1991 included the development of two heterotic populations for hybrid development, evaluation of some Ghana inbreds in hybrid combinations and purification of some Ghana and International inbreds.

Developement of two heterotic populations. Based on yield potential and agronomic characteristics, the 120-day white dent population was identified in 1986 as a female parent for hybrid development. Recognizing the need to introduce more materials of Tuxpeno background into the 120-day white dent female population (which is predominantly of CIMMYT Population 43 background) steps were initiated during the minor season of 1990 to introgress promising materials from Population 21, Population 49 and TZPB into the 120-day white dent female population. In 1991, S2 lines from Pop 21, Pop 49 and TZPB were advanced to the S3 stage in preparation for introgression into the 120-DWD female population. In addition, half-sib families of the 120-DWD female population were selfed in an attempt to improve its inbreeding tolerance.

A male population with high heterosis in crosses with the female population is being developed from EV 8444 SR BC4, CIMMYT Pop 42 and TZB-SR. In 1991, the 120-DWD male population was advanced from the C3 to the C4 stage, using half-sib recombination block with 4 female rows alternating with 1 male row (balanced composite).

Inbred Line Development. The 120 DWD back-up gene pool is presently at the 9th cycle of improvement. Cycle 9 contains a high proportion of La Posta germplasm because it was derived from C8 x EV 8443 SR BC4 in an attempt to upgrade the streak resistance level of the pool. Inbred line development was initiated in both C8 and C9 during the major season of 1990. During 1991, S3 lines of the 120-DWD pool C8 and C9 were advanced to the S4 stage and concurrently top-crossed to the 120-DWD female population and EV 8444 SR BC4.

Line Development in EV 8444 SR BC4. Diallel studies at CIMMYT have shown that Pop 44 combines very well with Pop 43. Inbred line development was therefore initiated in EV 8444 SR BC4 in 1988.

In 1991, lines selected on the basis of the top-cross evaluations conducted in 1990 were crossed to the testers 9071, GH 31, 1368 and 5012 in an attempt to place the inbreds in different heterotic groups.

Line development in Suwan 1 (White). Line extraction was initiated in the Suwan 1 (white) during the minor season of 1990. In 1991, the S2 lines were advanced to the S3 stage.

Line development in Togo Local. Line development was initiated in Togo Local in 1990. In 1991, S2 lines were advanced to the S3 stage.

Evaluation of homozygous Ghana inbred lines in hybrid combinations. Crosses involving some selected IITA inbred lines (testers) and Ghana inbred lines were evaluated at 2-3 locations representative of the major ecologies of Ghana. In all, six hybrid trials were conducted. These were a preliminary hybrid trial, three single-cross hybrid trials and two three-way hybrid trials. The testers were 9071, 1368 and 5012. In the preliminary hybrid trial, grain yield ranged from 6342 kg/ha to 5521 kg/ha for GH 3 x GH 24 and GH 7 x GH 13 respectively. The hybrid GH 3 x GH 24 outyielded the best open pollinated check, Dobidi by 20%. All entries had desirable plant and ear heights and were acceptable as full season varieties. The plants/m^2 was quite low for some entries especially Okomasa thus accounting probably for its low yield.

The results of the single cross hybrid trial 1 showed the single cross hybrid, GH 1 x 5012 as the most outstanding entry, outyielding Okomasa by 37% and the best IITA hybrid, 8321-18 by about 35%. The lower plants/m^2 for Okomasa and 8321-18 might have contributed to the large differences in yield between GH 1 x 5012 and the checks. The entries fitted the late maturity group and possessed desirable plant and ear heights.

In the single cross hybrid trial 2, the mean grain yield ranged from 6787 kg/ha for GH 38 x 9071 to 3107 kg/ha for GH 32 x 2097. Several hybrids outyielded Okomasa by over 55%. The plants/m^2 was very low for Okomasa and they may have accounted for its poor performance. There was not much to choose from the entries in terms of plant height. Both the hybrids and Okomasa had acceptable maturity.

The results of the first three-way hybrid trial conducted at Kpeve revealed the single cross hybrid, GH 36 x 1368 as the most outstanding entry, outyielding Okomasa by 46% and the best IITA check 8321-18 by 11%. Several three-way crosses outyielded Okomasa by 25% or more. The entries were generally very tall with the cross GH 38 x 1188 reaching a height of 303 cm. The entries were also earlier than expected of full season varieties.

Grain yield was very high in the second three-way hybrid trial conducted at Kpeve. It ranged from 10021 kg/ha for (GH 22 x 1368) x 9071 to 4990 kg/ha for Okomasa. The plants/m^2 was very low for the check thus accounting for the large differences in grain yield. All entries were acceptable in the full season maturity group and had desirable plant height.

3.5.1.4. Variety testing

Introduction. Three on-station variety trials termed Station Variety Trials (SVT) were conducted using a randomized complete block design with 4 replications per location in the major agro-ecologies of Ghana. Full-season varieties were evaluated in SVT 1, medium maturing varieties in SVT 2 and early maturing varieties were compared in SVT 3. Recommended agronomic practices were followed in all trials. The objective was to compare varieties developed in the national breeding program and those from the international research centres as a means to recommending varieties for on-farm testing and eventually, for release.

3.5.1.4.1. Station Variety Trial 1 (SVT 1)

Ten full-season varieties comprising 6 composites and 4 hybrids were evaluated at Fumesua, Kpeve, Ejura, Pokuase, Damongo and Nyankpala during the 1991 major season.

Grain yield ranged from 3.8 t/ha at Fumesua to 6.7 t/ha at Kpeve. The highest yielding variety was a three-way hybrid, (GH20 x 1368) x 5012. This hybrid significantly out-yielded both Dobidi and Okomasa, the recommended composite varieties. The yield of Dobidi was significantly higher than that of Okomasa in these trials. This anomaly was attributed to low germination and vigour of seed of Okomasa compared with Dobidi observed at all trial sites. GH 8363 SR, the improved quality protein maize variety being considered for release in 1992 produced grain yield which was similar to that of Dobidi.

Maturity ratings showed that the three-way hybrids and GH 8363 SR were earlier than Dobidi and Okomasa based on days to 50% silk emergence. Plant height and ear placement were acceptable for these full-season varieties although GH 8363 SR and the single cross hybrid P15 x P22 were shorter than Dobidi and Okomasa. Lodging was moderate in all varieties.

3.5.1.4.2. Station Variety Trials 2 (SVT 2)

Six medium maturing open-pollinated varieties were evaluated at Fumesua, Ejura, Kpeve, Pokuase, Damongo, Nyankpala, Manga and Wa. The trial at Wa was lost due to excessive moisture at the experimental site.

The lowest yield was recorded at Fumesua and the highest at Kpeve. The top yielding varieties across the seven sites were GH 105 DWD POP and GH 8363 SR, a high quality protein maize variety. GH 8363 SR produced comparable grain yield to Abeleehi but possesses high nutritive value because of elevated levels of lysine and tryptophan which are limiting in normal maize. Apart from the local variety, all varieties evaluated in this trial fitted the medium maturing group. Again, apart from the local variety, all other varieties had acceptable plant height and ear placement. Plant stand was low in Aburotia probably as a result of cold storage problems. Lodging was particularly high in EV 8444 SR BC4 and the local variety.

3.5.1.4.3. <u>Station Variety Trial 3 (SVT 3)</u>

Eight early maturing varieties were evaluated at Fumesua, Kpeve, Ejura, Pokuase, Damongo, Nyankpala, Manga and Wa. Again, the trial established at Wa was lost due to water logging.

Dorke SR, an early white dent variety being considered for release, significantly out-yielded SAFITA-2, the recommended variety by 11.4%. The local variety produced the least yield and was out-yielded by SAFITA-2 and Dorke SR by 43.8% and 60.2%, respectively. In terms of maturity, Across 87 Pool 16 DR was earlier than all the other varieties. In general, all the varieties evaluated fitted into the early maturity group. Plant height and ear placement were acceptable for all varieties. Plant stand was particularly low in Kawanzie, the recommended early yellow variety and this may be attributed to the problem with cold storage. Lodging was quite high in these varieties probably due to the very wet conditions experienced at most experimental sites in 1991.

3.5.1.4.4. <u>Quality Protein Maize Variety Trial</u>

Based on the results of QPM observation trials involving 150 CIMMYT QPM materials in 1989 at Fumesua and Nyankpala, 16 QPM varieties and two normal checks were selected and tested at seven locations in 1990 and 1991.

The results showed that seven QPM varieties produced grain yields that were comparable to Dobidi and Okomasa. Of these varieties, Poza Rica 8763, significantly outyielded GH 8363 SR. Two other varieties, Nyankpala 8763 and a family hybrid FAHY 60 were found promising in terms of grain yield. Generally, the QPM materials matured earlier than Okomasa and Dobidi. This confirmed the previous observation that QPM germplasm available from CIMMYT are generally intermediate in maturity in Ghana. There is therefore a need to make some of the materials late in order to capitalize on the high yield obtainable from the major growing season. The QPM materials also generally had shorter plant stature than Okomasa and Dobidi. There were no differences among the varieties in terms of lodging and grain moisture at harvest. The results showed that QPM materials with potential for high grain yield are available in the program but some breeding work is necessary to take advantage of this potential.

3.5.2. Breeding for resistance to the maize streak virus

3.5.2.1. Conversion of Nyankpala 8763 for resistance to the maize streak virus disease

Field tests have shown that Nyankpala 8763, an improved version of GH 8363 SR has better grain yield potential than its earlier version. However, Nyankpala 8763 is streak susceptible. A program was therefore initiated in the 1991 minor season to convert this material for streak resistance using GH 8363 SR as the donor for the resistance. The backcross method was used. During the minor season of 1991, a bulk of Nyankpala 8763 SR served as the sole pollen source. Plants within both materials that were the earliest to flower were detasseled. it is intended to make the converted material a bit later to take advantage of the higher yield potential of a full season material.

3.5.2.2. Conversion of Aburotia and Dobidi for Streak Resistance

The program to extract streak resistance sources from Aburotia and Dobidi and to form synthetics from each material was continued. To form the synthetics, the BC2 S3 of each material was planted ear-to-row and random-mated. In addition, selected BC2 S3 plants were advanced to the BC2 S4 stage.

3.5.2.3. Maize Streak Resistance Screening

Maize streak virus disease is transmitted by *Cicadulina* leafhoppers and could cause total crop failure when there is an epidemic. The most effective control measure is the use of resistant varieties. The specific objectives of the study are the following: (i) to collect *Cicadulina* leafhoppers from the major ecozones, (ii) to determine the species composition of the leaf hoppers, (iii) to screen the leafhoppers for adaptability and host preference, (iv) to determine the transmission efficiency of the hoppers, (v) to mass rear adaptable and transmission efficient species of the hoppers and (vi) to screen available maize materials in the maize program for streak resistance. Through the financial assistance of IITA and the SAFGRAD Maize Network, the streak screening facility was commissioned in November, 1991.

About 150 mixed adult *Cicadulina* species were collected from Kwadaso, University of Science and Technology, Kumasi and Fumesua at the start of the study in October and November, 1991 using IITA designed sampling cage and aspirator. The insects were fed on pearl millet seedlings in insect rearing cages in the screenhouse. At the end of December, 1991, the leafhopper population had increased to about 5,000. Separation of the insects into species for biological study and multiplication is in progress.

3.5.3. Resistance of Maize Varieties to Stem Borers

In most parts of the forest zone cultivation of maize in the minor season is uneconomic due to stem borer attack. Two most important species in this zone are *Sesamia botanephaga* and *Eldana saccharina*. Damage caused by *Sesamia* occurs at the seedling stage (between 4-6 weeks after planting) whereas that of *Eldana* occurs during silking.

A collaborative trial with the national maize programme was conducted in the minor season at Fumesua and Kwadaso; Fumesua and Kwadaso being "hot" spots for screening for resistance to stem borers under natural infestation. The objective of the study was to evaluate IITA borer resistant lines for resistance to maize stem borers in Ghana. Maize varieties resistant to *Sesamia* sp. (TZBR-Sesamia 2 and TZBR-Sesamia 3) and to *Eldana saccharina* (TZBR-Eldana 1, TZBR-Eldana 2 and TZBR-Eldana 3) were obtained from IITA. The two groups of materials were planted in separate trials at Fumesua in August, and at Kwadaso in September. In both trials Dobidi and Okomasa were used as checks. The experimental design was a randomized complete block with three replications and four- 5m rows per plot. Four and six weeks after planting, plants in the *Eldana* trial were treated with furadan 5G against infestation by *Sesamia* sp. since the *Eldana*-resistant materials were not resistant to *Sesamia*. Results revealed that Dobidi had the highest percent seedlings with dead heart; seedlings of Okomasa and the *Sesamia*-resistant varieties were equally damaged by *Sesamia*. At Kwadaso, none of the varieties had dead heart at six weeks after planting. Also at harvest, none of the *Sesamia* resistant varieties as well as the checks could be considered resistant to damage by both *Sesamia* and *Eldana* at Fumesua and Kwadaso. None of the *Eldana* resistant varieties (protected against *Sesamia* infestation initially) was resistant to *Eldana* damage at both Fumesua and Kwadaso.

3.5.4. *Striga* Research

3.5.4.1. Breeding for *Striga* tolerance/resistance.

Striga hermonthica, a weed parasite of maize and other cereals, is widespread in the Guinea and Sudan savanna zones of Ghana. *Striga* causes considerable yield losses in maize in heavily infested fields. The objective of this program was to establish a uniform *Striga* infested field for *Striga* tolerance/resistance breeding. *Striga hermonthica* seeds collected from farmers' fields around the Nyankpala Agricultural Experiment Station (NAES) in 1990 was used to establish an artificial *Striga*-sick plot at Chanayilli near NAES in 1991. Ten early and eleven late maturing maize varieties from the national maize breeding program, IITA and CIMMYT were screened in the *Striga*-infested field for *Striga* tolerance/resistance.

Mean grain yield of the early varieties under *Striga* pressure was 2.1. t/ha compared to 5.5. t/ha for the control. In the full-season trials, the mean yield of the varieties from *Striga*-infested plots was 1.6 t/ha as against 4.4 t/ha for uninfested plots. Mean number of *Striga* plants which emerged per maize plant was 8 for the early varieties and 6 for the full-season varieties. Growth was retarded and silk emergence was delayed in plants which were infested with *Striga*. In general, the early maturing varieties were rated (1 = highly resistant, 9 = highly susceptible) more tolerant to the parasite than the full-season varieties, but this did not reflect in grain yield production of the early varieties under *Striga* infestation. Based on the grain yields of the varieties under *Striga* pressure, it might be concluded that all the varieties screened were susceptible to the parasite.

3.5.4.2. <u>Agronomy Research on *Striga*</u>

<u>Effect of source and rate of nitrogen fertilizer on the incidence of *Striga* in maize.</u> The objectives of this trial were to (1) compare the effect of two sources of N fertilizer in reducing *Striga* damage on maize and (2) determine the rate of N that would minimize maize grain yield reduction caused by *Striga*.

A randomized complete block design, 2 x 5 factorial with 3 replicates was used. Two sources of nitrogen-urea and sulphate of ammonia were used at 5 rates: 0, 90, 120, 150 and 180 kg N/ha.

The source of nitrogen fertilizer applied did not affect either maize grain yield or *Striga* populations. Similarly, the rate of nitrogen applied did not significantly affect maize grain yield. This result is in conflict with previous years' results. That there was no response to N rates may be attributed to the high rainfall experienced during the growing season. This might have resulted in leaching of applied fertilizer. The rate of N applied also did not affect *Striga* population.

<u>Effect of Crop Rotation and Intercropping System in reducing *Striga* population in Maize.</u> The objective of this experiment was to compare the effectiveness of different non-host crops in rotation or intercropping with maize in reducing *Striga* populations. A randomized complete block design with seven treatments and three replications was used.

The locations where this trial had been conducted since 1989 were all flooded and the trials were therefore lost. The results available are from sites identified in 1991. There were no significant treatment effects on *Striga* population, this being the first year results from these sites.

3.5.5. <u>Nitrogen use efficiency</u>

One hundred and forty-four full-sib families extracted from GH 120 DWD Pool were evaluated under 40 (low) and 200 (high) kg N/ha levels in 1991. However, the trials which were established at two locations were discarded due to problem with water-logging.

3.6. Report of Activities in Nigeria by Dr. E.N.O. Iwuafor

Nigeria has the responsibility as a Lead Centre for Agronomic Research. In 1991 cropping season, a number of trials were conducted.

3.6.1. <u>Maize Regional Trials</u>

Two sets of SAFGRAD maize regional trials were established at Samaru and Malunfashi in the northern Guinea Savanna zone and at Minjibir in the Sudan Savanna zone. These were the Drought tolerant early maturing varieties and the extra-early maturing varieties. Among the early maturing varieties, Across 86 Pool 16 DT-SR significantly out-yielded the other entries. Other outstanding entries included Across 88 Pool 16 DT-SR, BDP-SR BC3

F3, FBC6, SAFITA-2 (RE) and Kamboinse 88 Pool 16 DT-SR. Among the extra-early varieties, TZESR-W x Gua 314 BC1 F6 and TZEF-Y were outstanding. Other outstanding entries were CSP and TZEE-W.

3.6.2. Hybrid Maize Variety Trial

The main objective of this trial was to identify the most adaptable hybrid maize variety for the northern Guinea and Sudan savanna ecologies. The project was started in 1990 cropping season at Samaru. Eight hybrid maize varieties were used with an open pollinated variety -TZB-SR as a check. A randomized complete block design with four replications was used. Recommended plant density of 50,000 plants per ha and fertilizer rates of 120 kg N ha^{-1}, 60 kg P_2O_5 ha^{-1} and 60 kg K_2O ha^{-1} were used. The 1990 results showed that there was no difference in the grain yield and hundred grain weight of the hybrids and the open-pollinated varieties. In 1991, eight new hybrids, 5-37-1 x 11, 9071-12 x 10-1-13, 1368-226 x 9071-10, 1393-53 x 9091-377, 1393-609 x 9091-377, 1368-137 x 9071 x 10, 10-7-61 x 1368-266 and 9071-12 x 1368-137 from one of the local seed companies (AGSEED) were included in the tests. Results indicated significant difference between the grain yield of the varieties tested. The hybrid 5-37-1 x 11 significantly outyielded all the older hybrids (except 8434-11) and the open pollinated variety TZESR-W. Grain yield of the older hybrids were not significantly different from that of the open-pollinated varieties, thus confirming the 1990 results. The new hybrids 9071-12 x 10-1-13, 1368-226 x 9071-10, 1393-53 x 9091-377 and 1393-609 x 9091-377 also significantly outyielded TZESR-W.

3.6.3. Response of Early and Extra-Early maturing varieties of maize to rate and time of Nitrogen application.

The main objective of this trial was to determine the effect of rate and time of N application on the productivity of early and extra-early maize varieties.

The trial was started in 1990 at Minjibir. An extra-early variety (TZEF-Y) and early variety TZESR-W were used. Five rates of N fertilizer (0, 40, 80, 120 and 160 kg N ha^{-1}) were applied at three different times (viz: all at planting; half at planting followed by another half 14 days after planting (DAP) and half at planting followed by another half 28 DAP). A split-split plot design was used with N fertilizer as the main plot, variety as sub-plot and time of application as the sub-sub plot. There were four replications. Results showed that there was significant N x variety interaction although the main effect of N was not significant. TZEF-Y out yielded the early variety TZESR-W. Applying half of the N fertilizer at planting and the rest at 14 DAP gave the best yield. The trial was repeated in 1991 at Minjibir with an additional location (Samaru) included. The results are being analysed.

3.6.4. Response of early and extra-early maturing varieties of maize to plant density

The main objective was to determine an appropriate planting density for growing early and extra-early maturing maize varieties.

The trial was started in 1991 at Samaru and Minjibir. At both locations, the extra-early variety TZEF-Y and early variety TZESR-W were planted at five plant densities (27,778; 55,555; 66,666; 74,074 and 111,111 plants ha^{-1}) using a randomized complete block design with four replications. The results obtained are being analysed.

3.6.5. Evaluation of herbicides for weed control in sole and crop mixtures

Some herbicides were evaluated for weed control in sole maize, maize/cotton and maize/groundnut mixtures. Results showed that for sole maize, mixtures of acetochlor with atrazine at 0.75 + 0.75; 1.0 + 1.0 and 0.60 + 1.25 kg a.i. ha^{-1} effectively controlled weeds and resulted in grain yield which was comparable to the maximum obtained with the hoe-weeded check. Only P_2O_5 + atrazine at 375 + 900 g a.i. ha^{-1} reduced weed infestation significantly until 6 weeks after sowing (WAS).

For maize/cotton mixture it was observed that though no phytotoxicity was reported, 2 kg a.i. ha^{-1} of Pendimethalin was slightly toxic to cotton while 2 kg a.i. ha^{-1} of diuron slightly depressed maize performance. A combination of diuron + Pendimethalin, Lineron + Pendimethalin, and diuron + alachlor gave excellent weed control as well as cotton and maize yields but not significantly different from the weed free checks. Alachlor + Pendimethalin also gave acceptable results but this treatment was more effective on grass than on broadleaf weeds.

For maize/groundnut mixtures, the results showed that a mixture of metalachlor + terbutryn at 0.75 + 0.75 kg a.i. ha^{-1} gave the highest maize grain yield while the highest groundnut pod yield was obtained with Pendimethalin + linuron at 0.64 + 0.36 kg a.i; ha^{-1}. Both of these yields were similar to their respective hoe-weeded checks. There was 94% and 96% reduction in grain yield of groundnut and maize, respectively, in the weedy check plots.

3.6.6. Appropriate sowing dates for cotton/maize mixture

A trial was conducted at Samaru to determine the optimum sowing dates for maize and cotton when both crops are grown together in the mixture. Two varieties of maize (TZB, TZESR-W) and one cotton variety (SAMCOT-6) were tested using three sowing dates, 11 June 1991 (SD1), 28 June (SD2), and 11 July (SD3). Results indicated that yield and yield components of both crops were depressed by delayed sowing. For maize, this was regardless of the variety used. Maize planted on the third sowing date performed very poorly compared to the performance of the maize planted on the first or second sowing dates. The detrimental effect of delayed sowing on maize yield were more apparent in the variety TZB than in the variety TZESR-W. The mean grain yield of the two varieties were, however, similar. Plant height was also depressed by the delay in the sowing of the maize. Based on the results, it may be concluded that it is not advisable to delay planting of maize until mid-July as this may result in low grain and stover yield.

3.6.7. Productivity of maize and groundnut in mixture as influenced by component cultivar and row arrangement.

A field experiment was initiated at Samaru during the 1990 wet season to study the productivity of two maize varieties (120-day TZB-SR and 90 day TZE-SR) and two groundnut cultivars (late maturing RMP-12 and early maturing RRB) at three different arrangements of components (alternate single rows, alternate double rows and mixing within rows). The crops were planted at the plant density recommended for the sole crop. The experiment was laid out in a randomized complete block design with four replications.

Results obtained in 1990 showed that neither maize nor groundnut variety influenced the yield of components. Groundnut kernel yield was reduced by mixing components within row but row arrangement did not affect maize yield.

In 1991 results showed that maize variety did not influence maize yield but RMP12 produced significantly higher grain yield than RRB. Groundnut kernel yield was higher when TZESR-W was the component than TZB-SR. Again, mixing within row resulted in lower kernel yield. All the interactions were significant. Results also showed that cultivation of groundnut in the mixtures reduced kernel yield. However, maize grain yield in mixture was comparable to that of sole crop.

3.6.8. Comparative evaluation of different compound fertilizer formulations

The comparative effectiveness of four compound fertilizers NPK 27-13-13, NPK 20-10-10 + 25 + Z2, NPK 25-10-10 and NPK 15-15-15 on maize grain yield was evaluated. The rates were 90, 20 kg N ha^{-1}, 60 kg P_2O_5 ha^{-1} and 60 K_2O ha^{-1}. Results of mean values from all locations showed that the fertilizer types did not seem to be significantly different from each other. However, in terms of cost benefit analysis, the profitability of the fertilizers was highest with 27-13-13 and least with 15-15-15.

3.6.9. Alley cropping maize with Leucena leucocephala

A maize-leucaena alley cropping system was studied at Samaru during the 1991 cropping season. The objective was to examine the effect of residue and N contribution from Leucaena on maize yield and soil fertility. Four levels of N (0, 40, 80 & 120 kg N ha^{-1}) as urea and two levels of leucaena prunnings (0 and 10 t ha^{-1}) were examined under a blanket application of 64 P_2O_5 ha^{-1} as ssp and 30 kg K_2O ha^{-1} as Muriate of Potash. Results showed that maize grain yield and yield components increased with increasing levels of N and Leucaena prunnings. It was observed that gains in grain yield made by addition of Leucaena prunnings to N fertilizer tended to decrease with increasing level of N. For example the gains were 0.45, 0.55, 0.23 and 0.04 t ha^{-1} for 0, 40, 80 and 120 kg N ha^{-1} respectively.

3.6.10. Agrolyser micronutrient fertilizer trials on maize

Agrolyser is a fertilizer which according to the manufacturers is a biochemical compound containing mainly inert and naturally occuring essential micronutrients. The suitability of this product for crop production under Nigerian conditions has been a subject of intensive research for the past few years.

Field trials were started in 1990 to evaluate the effect of various combinations of agrolyser and inorganic fertilizers on the yield of maize. The treatments consisted of agrolyser alone, varying rates of NPK alone, combinations of agrolyser NPK and a control. In all cases, agrolyser treatments were dissolved in water and sprayed on the plants at 2 to 3 leaf stage in the early hours of the day or late in the evening.

Results of the two seasons study showed that agrolyser per se was not a substitute for inorganic fertilizer but a suitable supplement. A combination of 200 g agrolyser + NPK -120-60-60 gave the highest grain yield at both Samaru and Saminaka. The yield advantage was 0.88 t ha^{-1} (22.4%) and 1.6 t ha^{-1} (50.4%) over NPK fertilizer alone at Samaru and Saminaka, respectively. This advantage could be due to improvement in crop nutrition by agrolyser. Similar results were obtained with foliar and soil applications except that higher rate (1000 g agrolyser) was required with the latter.

3.6.11. Effect of S and Zn on maize yield

The objective was to determine the effect of adding S and Zn to recommendeded NPK fertilizers on maize yield. Three levels each of S and Zn were applied in a factorial experiment to the open pollinated maize variety TZESR-W and the hybrid maize variety, 8505-5. There was a basal application of 150 kg N ha^{-1}, 100 kg P_2O_5 ha^{-1} and 50 kg K_2O ha^{-1}. Results showed that yields were not significantly affected by the S additions while the addition of Zn resulted in significant grain yield increases with only the hybrid. Optimum yield was obtained at 5 kg Zn ha^{-1}.

3.7. Report on Activities at IITA, by Dr. S.K. Kim

Dr. Esseh-Yovo Mawule, the former Chairman of the SAFGRAD steering committee and head of maize program in Togo joined IITA in April as a visiting scientist for a year. His major research activities would be to:

1) study different types of resistance to the maize streak virus and infestation methods;

2) breed for *Striga* resistance and convert local germplasm for resistance/tolerance to *Striga*.

3) familiarize himself with the IITA maize research program and the inter disciplinary research approach.

Significant progress has been made with respect to the agreement with Côte d'Ivoire on the establishment of the satellite station. Dr. Fajemisin would soon join the Côte d'Ivoire program and take up the research responsibility for the savanna location.

One of the major research focus of IITA is breeding for *Striga* resistance. IITA is strengthening her collaboration with NARS in *Striga* research. Countries involved are Nigeria, Cameroon, Benin, Togo, Ghana, Côte d'Ivoire and Mali.

A new method for *Striga* infestation is 75 x 50 cm for row and hill spacings with two plants per hill and under double the recommended rate for *Striga* seed infestation. Dr. Kling has been assigned the responsibility for breeding for *Striga* resistance in open-pollinated varieties.

As recommended by the SAFGRAD Steering Committee, IITA has offered drought tolerance (DT) maize trials this year.

Another important research area is breeding for stem borer resistance, especially for *Sesamia and Eldana*. Inbred lines with good levels of resistance to *Sesamia* have been identified. Efforts are being made to improve the level of resistance so that borer resistant hybrids and synthetics could be developed.

Maize utilization is another area of research emphasis. IITA has a post-harvest working group. Research focus is on the study of consumer preference for different maize types. Research into the use of floury maize for food and flint maize for brewing is being conducted jointly by IITA and NARS scientists of Mali and Nigeria.

IITA Maize Program has plans to host a workshop on heterotic groups in maize next year and IITA would like to get suggestions from the Steering Committee on the date for the workshhop and number of scientists that should be invited. It was suggested that CIMMYT scientists should be invited to participate in the workshop.

In the discussions that followed the presentation, the Steering Committee decided that the terminology "DR" (Drought Resistance) should be changed to "DT" since the available varieties are only tolerant and not resistant to drought.

4. DISCUSSION ON WAYS TO SUSTAIN NETWORK ACTIVITIES

Members expressed their conviction that the Network had had impact on maize research and development in West and Central Africa. Therefore it was necessary that steps were taken by the members to ensure that the Network activities were sustained in the event that funding from USAID should ceaze. Some of the measures suggested by members to promote and sustain the present level of collaboration among the Network member countries were:

i) the present system of exchange of visits by NARS scientists should be continued.

ii) National programs should invite scientists from other national programs to participate in their workshops, planning sessions and training programs.

5. DISCUSSIONS ON IMPACT ASSESSMENT STUDY

The document No. 2: Synthesis of Primary Information (Impact Indicators) prepared and presented by the Network Coordinator formed the basis of the discussion on the impact study. The Network was of the opinion that there was a lot of information on maize in the SAFGRAD member-countries. However, some data would be more difficult to collect than others and that the study needed careful planning and execution so as to obtain the relevant information. To this end, the steering committee expressed its appreciation for the efforts of the Coordinator in preparing the document on the Impact Assessment Study.

The Steering Committee recommended that the directors of research in the countries which would participate in the impact study should be informed well in advance in preparation for the study. The countries involved are Burkina Faso, Benin, Cameroon, Ghana and Togo.

The USAID Consultant, Dr. Allan Schroeder presented to the Steering Committee the types of data and indicators that might be used to monitor impact and performance of research endeavors of network member countries. The following suggestions were made by the Steering Committee to improve data collection and the information to be derived from such data :

- Yield *per se* is an important indicator but traits such as disease and pest resistance, stability, and consumer acceptability are also important.

- Flow of germplasm through trial stages should include population development and progeny testing since these activities require major efforts.

- Emphasis should not be placed on only the transfer of germplasm from IARCs to NARS but also between NARS.

- Number of research trials should be considered under the headings "National" and "Regional". Information on the type of trial e.g. entomology, *Striga*, etc. would be desirable.

- Under changes in productivity, production and income, information should be obtained on government policy and availability of credit and inputs.

6. OTHER MATTERS

Members of the steering committee felt that the secretaries and the chairman of the steering committee put a lot of effort in preparing the reports for the steering committee meetings. The present practice which requires that the report be completed at the end of the meetings demands too much from the secretaries and the chairman. It was therefore suggested that the three members (secretaries and chairman) should have one day following each meeting to prepare the report. The suggestion was adopted and would be communicated to the Cowpea Network by the Maize Network Coordinator.

The issue of duplication of efforts by the Network and COMBS was brought up again. The Network Coordinator indicated that he had had discussions on the issue with Dr. Weber. He had also pointed out to Dr. Weber that Burkina Faso and the southern part of Mali were undergoing intensification of maize production and might be interested in collaborative research with COMBS.

7. RECOMMENDATIONS

The Steering Committee after its deliberations came up with the following recommendations.

1. In view of the various pertinent recommendations which have been made by the steering committee and which have not been followed through, it is recommended that the SAFGRAD Coordination Office should make an extra effort to ensure that the recommendations are implemented.

2. Considering the problem of loss of valuable breeding materials in many national programs in the sub-region, it is recommended that the Network should assist national programs to upgrade their storage facilities.

3. To promote and sustain the present level of collaboration among NARS in West and Central Africa, it is recommended that the present system of exchange of visits by NARS scientists should be continued.