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Collaborative Striga Research and Control Project in Africa:

Report on field visit to on-farm striga demonstration sites in West and Central Africa

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Summary

The Africa Striga Collaborative Research and Control Program is funded by the Government of the Republic of Korea and the Organization of African Unity. To enhance complementarity and synergy for an effective striga control, the project is implemented through the partnership of participating NARS, farmers, IITA, CIMMYT, ICRISAT, the West and Central Africa Maize Network (WECAMAN) and the National Agricultural Extension Systems.

Following the task force meeting held on 4-5 March 1999 in Abidjan, Cote d'Ivoire, the program was expanded to include Benin, Burkina Faso, Cameroon, Cote d'Ivoire, Ghana, Mali, and Nigeria in West and Central Africa, Ethiopia, Kenya and Tanzania in Eastern Africa and Malawi and Zimbabwe in Southern Africa. As designed, the objectives of the on-farm striga demonstration trials set at the task force meeting were as follows:

- To identify integrated striga management technology packages that are feasible and economically acceptable for farmers.
- To increase awareness on striga problems at community levels inorder to facilitate striga control in participating countries
- To strengthen the capabilities of national programs for striga control activities through training and provision of needed financial and technical back-stopping
- To facilitate management, dissemination, and exchange of technical information among scientists, national programs and relevant institutions.
- To ensure effective transfer of integrated striga management technology to the farmers.

In 1999, 2 types of on-farm adaptive trials were conducted in the participating countries in West and Central Africa:

- On-farm striga tolerant maize variety trials : Cameroon, Côte d'Ivoire, Nigeria.
- Maize/legume intercropped: Benin, Cameroon, Côte d'Ivoire, Ghana.

A scientific monitoring tour comprised of researchers from IRAD, Cameroon, WECAMAN, OAU/STRC-SAFGRAD, IARI of the Republic of Korea and IITA visited Benin, Cote d'Ivoire,

Ghana, and Nigeria from 13 September to 10 October, 1999. This report summarizes the progress made in the implementation of trials activities in countries visited, as well as the recommendations made to address shortcomings.

The on-farm adaptive research in Benin consisted of 21 and 10 trials in the north and central regions respectively. The cultivars used include ACR92TZE Comp.W and Oba super 1 (planted only in the central region). These cultivars were intercropped with cowpea.

In Cote d'Ivoire, on-farm trials were conducted with eight farm sites. It was noted that early instead of intermediate to late maturity cycle was used in the trial at relatively high rainfall (1100mm). **Striga survival has been more apparent with farmers than improved varieties.**

About 60 on-farm trials were conducted in Nigeria in four agroecological zones. In the Northern Guinea Savannah zone, treatments consisted of farmer variety, compared with improved hybrid (Oba Super 1 or 9022-13) and an open-pollinated variety (TZE compl C4 or IWD STR Co, Acr 92, TZE Comp 5-W) grown in association with soybean variety Samsoy 2 or groundnut RMP 91. Intercroping in Nigeria is different from what has been observed in the other countries. The legume is sown in the same row between the maize stands. Furthermore, the maize stand in the intercrop is the same as in sole cropping, and the farmers view the legume crop as an added free benefit to their overall activity. As practised, the soybean covers the soil very well causing a smothering effect on the Striga, but at the same time it caused a lot of competition with the maize.

In Cameroon, six on-farm variety trials and nine cowpea/maize association trials were implemented. In the variety trials, three of the following varieties: Oba super 1, STR yellow, Advanced NCRE, 87036 x 88094, 8321-18 Exp37, comp 5, Syn E1 STR, were tested with farmer variety. In general, at the time of the visit, striga emergence was low. Symptoms were apparent to some degree on maize, although visual differences were not always detected among the treatments. However, in one location, STR varieties had less striga emergence and better plant appearance compared to farmer variety. The intercropping demonstration fields were done using the same varieties and local cowpea variety not tested for suicidal germination of striga. The on-

farm demonstration trials, had the following treatments: STR maize variety in pure stand; STR variety intercropped with cowpea variety (1/1); cowpea variety in pure stand; and the farmer variety. Plant density was about 65 500 plants/ha. Although striga emergence was low at the time of monitoring, there is confidence that enough striga damage symptom will appear later in the season to allow a clear differentiation among the treatments.

Report on field visit to on-farm striga demonstration sites in West and Central Africa

1 Introduction

From September 13, to October 10, 1999, field activities were monitored by a team composed of: Dr. Charles THE, and Dr. Adetirimin, (Benin and Ghana) Dr. Charles THE, Dr. Adetirimin, Dr. Mahama Ouedraogo and Dr. Badu-Apraku (Côte d'Ivoire, Cameroon) Dr. Mahama Ouedraogo (Nigeria). Dr. Kling joined the monitoring tour team in Cameroon. The itinerary of the scientific monitoring team is in Annex 1. The purpose of the field visit was to monitor implementation of the trials activities in West and Central Africa and to suggest recommendations for addressing eventual shortcomings.

2 Benin Republic

2.1 Introduction

Research and development started in the Atakora Province in 1993. This followed a diagnostic survey carried out to identify problems limiting crop productivity. The two problems identified are: (1) low soil fertility, associated with soil erosion and (2) parasitic weed striga. Farmers desire urgent solutions to these problems. Initial attempts to solve the striga problem focussed on three possible control options which are (1) transplanting (in case of sorghum), (2) use of 2,4-D, which is not suited to mixed cropping systems involving dicots and (3) use of mucuna as a cover crop. Results of the above-listed control options were not as encouraging as expected. The Korea-OAU/SAFGRAD striga project on on-farm testing of resistant maize varieties was well received and considered as further opportunity for addressing the striga problem.

In northern Benin where only one crop of maize can be grown, 21 trials were conducted in villages around Ouake. In general, the trials were established late (16 July to 27 August) due to late arrival of seeds of striga-resistant varieties. Maize planting should have been completed by 15 June. Plants established at that time were already drying up at the time of this field visit.

Late planting is associated with reduced striga infestation. Three treatments were investigated as follow:

T1 = Striga resistant variety (ACR 92 TZE COMP-W) grown sole

T2 = ACR 92 TZE COMP-W intercropped with local cowpea (Youpi-youpi or Yangalo)

T3 = Farmers' variety (DMRESR-White) and practice (intercropping with cowpea)

Plot size measured 20 x 10 m. Plots were separated by one or two rows of either groundnut or soybean. NPK (14-23-14) was applied two weeks after planting at the rate of 200 kg/ha (28 kg N/ha). Urea was side-dressed at 45 days after planting at the rate of 100 kg/ha. Total N applied, therefore, was 74 Kg/ha. Eight out of the 21 trials were visited. The activities and observations on the eight trials visited are summarized and presented in annex 1.

2.2 General Observations

The treatments in the trials were simple enough. The trials have the potential for generating proper packages of technologies. A gradient in plant height observed in some fields suggested that fertilizers may not have been uniformly applied. The farmers probably applied more fertilizer to the first plot and gradually reduced the application rate as the quantity of remaining fertilizer was reducing. Plot management in Benin Republic was, in general, very satisfactory.

The field visits ended with a meeting to discuss the shortcomings observed in the implementation of the trials and ways of improving the trials next year. The on-farm striga trials are also being organized in the central part of Benin, where it is possible to grow two crops of maize in one year. Ten trials are planned for execution. As at the time of this visit, four of the trials were already established in Zakpota (trial sites not visited). The trials, in addition to ACR92 TZE COMP-W, include Oba Super 1.

2.3 Comments

Funds for the 1999 trials arrived early enough. However, seeds of the trials arrived late, leading to late establishment of the trials. It seems adequate arrangements were not made for seed procurement. Arrangements for obtaining seeds of varieties to be used for next year's trials need to commence now. Given the difficulty of obtaining seeds of Oba Super 1 from the seed company in Zaria, Dr. Thé has agreed to using his irrigation facilities for off-season seed production of this variety in Cameroon. Decision to go ahead with this arrangement needs to be taken immediately, so that necessary resources can be made available for the activity. Another important issue is the

choice of appropriate STR variety for each ecological zone. The trials in the northern part of Benin Republic were carried out in an ecology with 1300 mm rainfall per annum, which very easily could support an STR variety of intermediate maturity. This calls to question, therefore, the choice of ACR 92 TZE COMP-W, an early maturing variety.

Fertilization is an important agronomic practice, especially for maize cultivation. Application of fertilizers needs to be closely monitored and not left entirely to the farmer. To ensure uniform application of fertilizers to all plots, it was suggested that fertilizer to be applied for each plot must be packed in separate bags rather than having one bag for all the three plots. Fine-tuning of the time of fertilizer application is required. The early maturing materials planted in Benin Republic appear to have been treated as intermediate maturing materials. The early maturing materials ought to have been fertilized earlier.

Since the treatments investigated in Benin involved cultivars and legumes, with sole maize cropping as control treatment, it was agreed that plots used for the different treatments need to be retained for the same treatment next year. This will prevent confounding of effects and make for easy demonstration of treatment effects to the farmers.

Given the level of commitment of the scientist-in-charge, technicians and farmers themselves to this year's trials, we should expect a higher level of success next year. However, adequate arrangement of seed procurement and delivery must complement timely arrival of funds.

3 Cameroon

3.1. Introduction

The purpose of the monitoring tour was to document lessons learned in the area for minimizing infestation of Striga and to disseminate best practices to control this parasitic weed.

Sites visited in Cameroon included, the IRAD station at Nkolbisson, Odza and Nyom II around Yaounde; Ngong, Lagdo, the IRAD station at Djalingo, and IRZV around Garoua; Guidiguis, Guider, and the IRAD station in Maroua and its surroundings.

Before embarking on the tour, the team paid a courtesy visit to the Director General of IRAD, Dr. Ayuk Takem, and the Deputy Director General, Dr. Jean Daniel Ngou Ngoupayou.

The team also interacted a great deal during the visit with the Yaounde-based IRAD maize

research program team composed essentially of: Dr. Aroga, Dr. Enyong, Mr. Celicard Zonkeng, and Mr. Tagne Appolinaire.

3.2 General Observations on the On-Farm Striga Control Trials

Striga in Cameroon is predominant mostly in the northern and extreme north provinces. This first year of the program, the trials are mainly located in three ecological zones (annexe 2).

The objectives of the on-farm Striga demonstration in Cameroon are as follows: i) to promote the adoption of tolerant/resistant maize varieties by farmers; ii) and to reduce the level of Striga and to increase maize grain production by adoption of appropriate cultural practices.

The demonstration trials are managed by farmers, under the supervision of Mr. Youri, (IRAD technician) and extension agents of the zone where the trial is located. One very positive aspect of this project is the close collaboration between research and extension in the implementation of these demonstration fields. The frequency of farmer field visits is once every two weeks. A total of six on-farm variety trials and nine cowpea/maize association trials were planted. We were able to visit five of these trials altogether.

The maize varieties used were selected based on seed availability, farmer preference, and resistance to Striga. Local cowpea varieties are used. Planting at most sites was done during the third week of July. Plant density was usually 15 x 95 cm. Fertilization consisted of 100 kg NPK per hectare and 50 kg urea at planting plus 100 kg urea 45 days after planting.

Data collected in these trials include Striga count, visual damage rating, and yield, as well as farmer perception. The perception of the technologies of the farmer is very important in deciding whether to hold a field day on the site.

3.2.1 Variety trials

At Ngong, the variety trial was good and well maintained. Striga emergence was low, but symptoms were apparent to some degree on maize.

At Guider, where we met the farmer who was very enthusiastic about the trial, the variety trial is located near the road side, thus allowing other farmers to have a look at the varieties. This was a very good window for displaying varieties tolerant to Striga. The farmer was well aware of the objectives of the trials. This particular field was usually highly infested with Striga. A

field day should be organized at these two locations to allow more interaction among farmers.

3.2.2 Maize/cowpea association

At Guider, on one farm where maize is associated with cowpea, not many differences were visually observed among the treatments. While the soil was heterogenous, there was a need for improving legume plant density for more Striga control.

At Guidiguis, the maize/cowpea association was poorly maintained due to flooding. Farmers abandoned the plots without even weeding them.

Flooding also diminished the success of the trials at Ngong. In the future, the choice of trial site should be made with care in order to avoid failure. It is recommended that potential fields for testing be selected a year in advance and the farmer contacted early.

Local cowpea varieties were used and these have not been proven to be good trap crops. In addition, cowpea density was not high enough for good ground cover required to cause effective succidal germination of Striga.

3.3 Comments

- The implementation of the trial in Cameroon was done based on the recommendations of the task force. The Cameroon project adopted two types of on-farm trials. First, the on-farm variety trial for resistance to Striga: Six such trials were implemented under the joint management of farmers, the existing national extension system, and IRAD scientists. The size of the plots were appropriate for on-farm trials (10m x 20 m). Maize varieties tested were selected based on seed availability, farmer preference, and resistance to Striga. Second, the on-farm demonstration of maize/cowpea association to improve soil fertility, reduce seed bank of Striga, and evaluate the effect of resistant maize varieties, the cowpea varieties selected have not been tested as trap crops. Cowpea varieties proven to be good trap crops have been tested extensively in Nigeria, Benin, and by IITA, and can be taken into account by the program. Density of the cowpea should also be increased for improved trap cropping efficiency.

- In Cameroon, fund for the trial was delivered on time. This contributed significantly to the implementation of the Striga research activities. Furthermore, it is recommended that the same

procedure be used for delivery of funds to the system.

- The trial in Cameroon was designed to reach as many farmers as the allocated funds would permit. Trials were, therefore, well dispersed in the selected villages and in most cases in places that are readily accessible to other farmers. For the second year, rotation is necessary while its application on farmer field may be difficult. It is recommended that this aspect of the trial be reviewed for appropriate action.

- Farmers who visited this trial were very enthusiastic and do understand the design used in the demonstration trial. It is expected that farmers involved will voice their opinions and preferences for the different packages proposed. However, this won't be possible in places where sites were flooded, thereby, reducing the information that can be gleaned from these trials. It is recommended that such trials be relocated next year.

- The on-farm demonstration trials in Cameroon were an excellent showcase for on-farm Striga control technology since they brought together research, extension, and farmers. This trial set-up favors a dual purpose. Scientists can collect useful information on technology suitability for Striga control. This complete information involving farmers' opinions allows scientists to screen maize and cowpea varieties as well as cultural practices for combating Striga. At the same time, farmers, based on their preferences, can directly select the technology they feel is suitable for their needs and farming systems.

- Striga is a major problem, and the problem is being addressed by involving many partners including the maize network, IARCs, NARS etc. This monitoring tour was very enriching as it involved several stakeholders (IITA, WECAMAN, SAFGRAD, IAR, South Korea).

- In view of the capability of IRAD in the production of foundation seed, it is recommended that appropriate action be taken for the IRAD program to produce improved STR seed for coming season.

- To strengthen the capability of IRAD to serve as a source of procurement of seed of striga resistant/tolerant varieties for other NARS, it is recommended that the Striga program contributes with WECAMAN and the AMS project to the financing of a compressor for IRAD maize program cold room.

3.4 IRAD Maize Improvement Program

The maize breeding program under the leadership of Dr. Charles THE undertook several research activities at Nkolbisson, Garoua, and Maroua. For the most part, these activities were implemented as part of an on-going collaboration with WECAMAN. The following is a brief and none exhaustive description.

3.4.1 On-Station Striga Research

Breeding for improved Striga resistance is undertaken mostly at the screening site, IRZV in Garoua, where artificial infestation is practiced as well as at Djalingo and Yaounde. Djalingo which is a striga free site, allowed the evaluation of maize cultivars and hybrid for their yield potential. Yaounde is used as breeding nursery for all striga crosses. In addition, Yaounde was used to develop crosses and evaluate crosses on a striga free environment. The Striga program involves population improvement and feature single crosses, three-way crosses and four-way crosses evaluation inbred improvements. While screening for Striga tolerance/resistance under artificial infestation is done at the screening site, it was evident that a lot of promising germplasm are in the pipeline and can help sustain the efforts of the Striga program. It is worth noting that levels of Striga germination during the visit were low, but expectations are that by 10 WAP, discrimination among entries will be easier because a higher level of Striga emergence is expected at that time.

In a diallel for Striga resistance, 141 entries were tested at IRZV, using artificial infestation. Plots consisted of a single row 6 m long with 3 m artificially infested. At planting, 2,500 seed of striga were applied per hill. Striga was emerging and the 87036 x NCRE $gp_1$107 seems to be standing well under Striga infestation.

A set of promising S7 inbred lines were test crossed in order to classify them into heterotic groups. However, Striga emergence was very poor.

Under the on-farm Striga control program, an on-station Striga experiment consisting of 11 varieties tested on plots with 8 rows, 24 m long was implemented at IRZV. The planting density was 65,000 plants/ha. This test included Oba Super 1 x Exp 7, the best 3-way cross resistant to Striga.

Maize/cowpea intercropping consisted of 15 rows, each 15 m long. Treatments included sole cropping of STR yellow and CMS 8501, sole cropping of cowpea, and maize/cowpea intercropping (1/1). Local cowpea varieties were used and these have not been tested for trap cropping. Ground cover of the cowpea was also not adequate. Furthermore, higher crop density is required for good trap cropping of Striga.

Striga research in the IRAD program is very strong despite limited resources. These activities, most of which are undertaken in collaboration with WECAMAN, IITA, and OAU/STRC-SAFGRAD, strengthen the leading role of IRAD in the area of Striga research and control in the subregion.

3.4.2 Breeder and Foundation Seed Production

Using planting dates, maturity duration, and space isolation, the team is able to produce most of the breeder seed at the Djalingo station. Breeder and foundation seed are produced for TZEE-W-SR, CMS 8806, CMS 9015, CMS 8501, CMS 8704, CMS 9213 x Exp1 24, popcorn and sweetcorn, mostly at Djalingo, Mayo Dadi, and at the screening site station. This production covers more than 18 ha.

The system uses three (3) female rows per one (1) male row. It calls for family selection, row selection, and IPS within row. Foundation seed is obtained by bulking the remaining cobs.

The strength and expertise of this seed production and maintenance scheme guarantees the ability of the IRAD maize program to produce seed for the benefit of other national programs involved in the Striga collaborative program.

It should be noted that the compressor for the cold room of the program was stolen. Furthermore, there is no possibility of seed storage for the program, causing rapid loss in viability of the breeding material. The effect of the loss of the compressor the resulting non-functional cold room was seen in the field as a lot of material for the drought tolerance program did not germinate. Therefore, all breeding materials must be grown every year, thus burdening the

program with a lot of extra work.

3.4.3 Other Research Activities

Acid soil trials are underway mostly at Nkolbisson and Ebolowa. Note that soil pH at Nkolbisson is around 3.9, thus making it the prime constraint to maize production in these two localities. The program includes the use of acid tolerant varieties from CIMMYT and IRAD. Populations are tested and classified into heterotic groups. A collaborative project involving IRAD, the University of Hannover, Brazil, and CIRAD is ongoing for breeding for acid tolerance. One of the findings of this collaborative effort is that tolerance to acid soil is linked with higher callus production.

Dr. Aroga is responsible for the work done on tolerance to borer. This activity is funded by the AMS project. It involves variety trials for resistance to stem borer. On-station trials were at Nkolbisson and on-farm trials around Yaounde. The on-station trials included 8 varieties from IITA and 2 from IRAD. The on-farm variety trial was planted in four localities and included 4 varieties: AK 9522 DMR, AK 9528 DMR, CMS 8704, and CMS 8501. Due to time constraints, local extension services have not been associated with this trial. Data to be collected include grain yield and damage caused by borers to stem and cob. The second activity is the assessment of maize/cowpea association for reducing the borer population. Such a trial was conducted at Nyom II. The maize variety used was CMS 9015. The 4 replicated trials included 3 treatments: pure maize, pure maize with furadan, and maize/cowpea intercropping. Early planting was usually associated with borers attacks. Furthermore, this trial included three dates of planting, of which data will be available for only two planting dates.

Activities are also on-going at the Djalingo Station under the responsibility of Mr. Tagne to determine the effect of seed-borne fungi and the efficacy of 5 chemical seed treatment, 2 plants product in the improvement of maize seed germination, plant stand and plant establishment. Intermediate maize varieties (CMS 8704, CMS 8501) and early maize varieties (CMS 9015, CMS 8806) are used in these trials to determine the efficiency of 5 chemical and 2 natural compounds in reducing the effects of fungi and insect attacks on maize seed in order to improve plant stand.

In order to package minikits for technology transfer, a study was undertaken by Dr. Enyong at the on-farm level to determine the level of technology actually used by the farmer.

Research activities for drought tolerance are undertaken at Nkolbisson, Garoua, and Maroua. However, problems of seed germination due to ineffective storage facilities affected these trials.

Various populations (at least 13) are being improved for various traits including yield and Striga tolerance.

Special thanks are expressed to the Cameroon NARS team which took all measures possible to make this tour a real success.

4 Nigeria

4.1. Introduction

Only one person was able to effect the visit in Nigeria, due to communication problems. He was in Nigeria from October 4-10, 1999, however, visits to sites actually only took place on two days during this time.

Expectations were high for this visit since Nigeria has been housing the Pan-African Striga Network and a lot of research has been conducted in this area. Also, in collaboration with WECAMAN, many research activities have been undertaken and need, therefore, to be transferred to farmers.

Nigeria is different in the sense that in addition to Striga, Alectra is also present, thus compounding the problem of weed control. During the visit, the one-man team met with Professor Lagoke, weed scientist Dr. Ibrahim Kureh, agronomist Dr. N. C. Kuchinda, and soil scientist Dr. B. D. Tarfa.

The objectives were to visit sites of technology transfer activities for Striga control (funded by both WECAMAN and SAFGRAD). Visits were done only around Zaria due to time constraints.

4.2 General Observation on the on-Farm Striga Demonstration

In Nigeria, the program's aim is to develop the capability of farmers in the selection and subsequent application of sustainable Striga management strategies. The following objectives

were, therefore, established by the program:

--to demonstrate suitable integrated Striga management practices in farmers' fields;

--to assist and train farmers in the selection and implementation of suitable maize production technologies.

In Nigeria, about 60 on-farm demonstration farms were implemented in four agroecological zones:

-Derived Savannah, Abeokuta and its surroundings

-Southern Guinea Savannah, Bida, Mina, and Abuja FCT

-Northern Guinea Savannah, Zaria

-Sudan Savannah, Yamdota.

Out of the 60 farms, we were able to visit about fifteen.

The methods used in these demonstrations fields consisted of three treatments per farm of 20 x 10 m. Farmer variety was compared with improved hybrid (Oba Super 1 or 9022-13) and an open-pollinated variety (TZE compl C4 or IWD STR Co, Acr 92, TZE Comp 5-W) grown in association with soybean variety Samsoy 2 or groundnut RMP 91. These varieties were screened and shown to stimulate succidal germination of Striga. Fertilizer was applied at the rate of 100 - 120 kg NPK 20-10-10 per ha. This N rate is rather low. Only 20-24 kg N/ha.

Trials were managed by farmers under the supervision of research and extension teams.

The system seems to have the blessing of the farmers. As practiced, the legume is sown in between the maize stand on the same row. Furthermore, the maize stand in the intercrop is the same as in sole cropping. The farmers view the legume crop as an added free benefit to their overall activity. Only legumes that are planted at the same time as the maize have been selected for the program. As a consequence, cowpea has been discarded in spite of the existence of good trap crop varieties.

Soybean is a crop that is being commercialized in Nigeria, and more and more farmers are producing this legume as a cash crop. Groundnut is already in the farming system in Nigeria, thereby resulting in no difficulty with its adoption in this scheme.

At the time of the visit, most plots were mature and were ready for harvest, reducing the amount of Striga plants that were visible.

The performance of the open-pollinated and hybrids seemed to vary according to the site. In some fields, the Striga attack was very severe, causing complete crop loss. In fact, in Layin Taki, the commercial hybrid Oba Super 1 was completely wiped out, suggesting that more work is needed in terms of host plant resistance to Striga. In places where lower levels of infestation is recorded, the STR varieties performed relatively well. Despite the fertilizer application, the tolerant materials are affected, but a bit less than the local varieties. When soybean was intercropped with maize, it covers the soil very well causing a smothering effect on the Striga. However, a higher density of soybean caused a lot of competition with the maize.

In the village of Detu and other places visited, the geographic spacing of the trials is questionable, as some of them are right next to each other. This was more evident in Sakaru, where three farms with the same treatments were contiguous. While there is no doubt as to the impact of such trials, in view of limited resources, ideally, the choice of farms more widely dispersed would allow more comprehensive access to the demonstration farms by the maximum number of farmers. Some of the trials have been replicated, in order to use the space allocated by the farmer for the trial. It should be noted that in such cases, we have a replication, not a new trial as done by the team.

In Detu, there has been attack of army worm on some of the farms. This attack was more prominent in open-pollinated varieties. On one farm, the farmer's practice consisted of intercropping maize and sorghum. This plot seems to have more Striga than the other treatments.

Mr. Saydou's farm in Detu is a farm that does not grow maize. It is suspected that there are nematodes or some other soil-borne disease problem. In the trial only Oba Super 1 produced yield. Legumes will, however, grow well in this field.

When we discussed with some farmers, they seem to be aware of the global objectives of the trials and to show interest in the program. Visually, they seem to have a good preference for Oba Super 1 because of a better stand and high expectation at harvest. They also feel that it has better vigor throughout the whole cycle of the plant. More farmers are willing to participate in next year's trial.

A field day was organized on August 28 where more than 50 farmers visited the plots at Detu and Sakaru.

4.3 Comments

- The model used by the Nigerian program in the implantation of the on-farm Striga demonstration field follows model 2 of the recommendation of the STF. In addition, the legume varieties used have been tested extensively for Striga trap cropping in the laboratory, greenhouse, and farmers' fields. It is suggested that such legumes be made available to other programs. Alternatively, the Nigerian program can assist in testing other cultivars used in other countries for trap cropping.
- The system in Nigeria as currently set up allowed timely delivery of funds. However, Prof. Lagoke, who is coordinating the activities, will be moving to the south (University of Abeokuta). While we have received assurance that this will not affect the Striga activities since the work done is by a team, nevertheless, it is important that appropriate actions be taken to ensure smooth running of the program.
- The existing approach in Nigeria could reach more farmers if the trials were more spread out. It is recommended that this aspect be taken into consideration for next year. Perhaps more emphasis should be given to the farmer field school. Due to fund limitations, it may be good to judiciously select 1 or 2 farmer field schools per village where interested farmers will gather to discuss and practice new techniques before trying them in their own fields.
- While Striga is a problem in northern Nigeria, it is not clear that is also a problem in the south (around Abeokuta). It is recommended that unless deemed necessary, funds not be disbursed for this region.
- Density for soybean planting should be reviewed and appropriate spacing used to avoid competition with the main crop, which is maize.
- Harvesting should also be done properly to avoid losses as were observed in some of the fields.
- The farmers could easily understand the design. Output for the first year might be limited partly because of Striga itself. In the future, more care should be taken in terms of site selection.

4.4 Farmer Field School Approach

The on-going farmer field school allows training of the farmers to implement integrated Striga management packages as well as other technologies. On these plots, hands-on demonstrations were performed and farmer's problems and solutions are discussed. These plots are maintained by farmers under the supervision of research and extension. In return, farmers apply the discussed techniques in their own fields. Two such schools were visited during the monitoring tour.

4.5 WECAMAN On-Farm Striga Demonstration

The WECAMAN Striga demonstration farms were implemented mostly at Kayawa and Layin Taki.

The objectives were to evaluate performance of varieties on farmers' fields and to evaluate on-farm the effect of intercropping on Striga control.

On-farm tests consisted each of five plots:

9022-13 STR with groundnut

9022-13 STR with soybean

Farmer variety

IWD STR Co with groundnut

IWD STR Co with soybean

Other maize varieties used are Oba Super 1 and TZE comp 1 C4.

Striga was very limited in the field which according to the farmer is usually infested with Striga. Discussion with the farmer showed that he is aware of the Striga problem and the efforts of the team in controlling it. This field is at the edge of the village and is, therefore, being visited by many other farmers.

Striga control methods have also been put on posters in Hausa and are available to farmers.

The second field was not as well managed and had many weeds. Very little Striga was visible and competition between maize and soybean was obvious. This farm used Oba Super 1 and IWD STR, RMP 91, and Samsoy 2. At Layin Taki, a total of 16 farms were used. On one farm, the farmer had been growing legumes in his field for over 8 years. But, Oba Super 1 was

wiped out with some 799 Striga per plot. Alectra was also present.
A field day was organized on August 26, 1999 at Kayawa and Layin Taki.

5 Côte d'Ivoire

5.1 Introduction

Visit to Côte d'Ivoire was scheduled from Sept 19 to 24, 1999. It effectively took place between 20 to 24 Sept, 1999 and started with a courtesy visit to Dr. SEKOU Doumbia, the Chief of the Regional Center of CNRA at Korhogo.
Dr. Doumbia, assisted with the scientific coordinator, Dr. Dea Bernard welcomed the monitoring tour members and quickly presented the activities of CNRA in general and Korhogo Center particularly. We learned that CNRA has 22 research programmes. Korhogo Regional Center was in charge of Cereal, Fruit, Farming systems, Anacard and small ruminant programmes. This center has 2 research stations, Ferke, where maize and sugar cane sub-programmes were domiciliated, and Korhogo station. This centers were fully collaborating with IITA sub-station and ANADER, which is the extension agency.

Dr. Louise Akanvou, in-charge of the on farm striga control trials presented the objective of the trial which were :

1. to identify at farmer level, striga tolerant/resistant maize for release.
2. to develop and promote integrated striga control technologies.
3. to reduce striga seed bank in infested areas.

In 1999, Dr. Akanvou covered 2 villages (Ferke and Nielle) and worked with 8 farmers with which she conducted 2 different types of trials namely:

1) On farm variety trial made up of 4 striga tolerant varieties.
2) Rotation intercropping trial of striga tolerant maize with a leguminous crop (cowpea).

The team benefited from the presence of Dr. Badu-Apraku with to visit to WECAMAN

resident research activities at Ferke. The team discovered that lots of good striga tolerant materials were being developed for NARS of the Region.

Finally the team had a working session with Dr. Louise Akanvou, during which observations and suggestions were made on how to improve next year's trials.

The monitoring tour ended with a last visit to Dr. Doumbia who was assisted by the Korhogo Chief of Station. He thanked the team for visiting his Center and promised that the Center will be fully operational next year with a reinforced maize team.

5.2 General Observations

5.2.1 Trials Visited

Côte d'Ivoire conducted 15 trials. 8 of which were on-farm variety trials and 7 were a 3 year rotation trials consisting

y of 3 treatments. Those 15 trials were conducted by 8 farmers. The monitoring tour team visited 7 farmers (13 trials) and one set of trial at the research station in Ferke.

5.2.2 Plants Materials

The variety trial consisted of 4 striga tolerant genotypes. Acr 94 TZE Comp 5-Y; Acr 94 TZE comp 5-W; EVDT 97 STR C, and IWD STR Co. In addition to this, 2 other varieties entered the trials. These were, TZEE-W-SR BC_5 and TZE-SR-W x Gua 314 BC_1 which were 2 extra-early varieties. The experimental unit consisted of 3 row per plot each of 10 m long. Spacing between row was 0.75 m, and 0.50 m between with 2 maize plants per hill. The planting density was 53,300 plant ha^{-1}. 100 kg of NPK (15-15-15) was applied 10 to 15 days after planting and 50 kg of urea (46% N) was applied around 55 days after planting. Trials were flowering at the time of the visit.

The rotation trial was made up of 4 treatments: striga tolerant maize grown sole, leguminous crop (cowpea) grown sole, maize intercrop with cowpea and the farmers practice. The experimental unit was 15 x 15 m. For the intercropped treatment, cowpea hill alternated with maize hill. Observations made for each farmer visited are presented in annex 5.

The following observations could be made.

1. Rainfall of the area is above 1100 mm, enough to crop intermediate maturity cycle maize.
2. All trial had good plant stand. But the planting density is lower for early maize which should be 65,500 plant ha^{-1}.
3. Fertilizer application (especially urea) was very late, more that 55 days after planting instead of less than 30 days after planting.
4. Planting dates were late, this was probably due to late acquisition of maize seed.
5. Most of the fields were weeded late. However, most of the farmers visited were eager to work with CNRA and were interested to see what would happen next year and after.

5.3. Comments

Trials in Côte d'Ivoire were implemented based on the general framework of protocol recommended by the striga task force. However, based on total annual rainfall of the area, (more than 1100 mm). The team would recommend the use of intermediate maturing striga varieties in the area.

Trials were planted late due to late acquisition of seed and to the institutional restructuring that took place just around the planting period. In addition, fertilizer (urea) application was very late. This was partly due to the fact that the center has only one vehicle for all researchers.

The following suggestions are made:

- Extension agents should be involved in these trials. They should help in selecting participating villages and farmer and make sure that the farmers executed on time the protocol designed by the researcher. The farming systems group should also be actively involve in the trials.
- Funds were delivered on time in Côte d'Ivoire and the allocated budget was being used to conduct the trials. It is suggested that similar step be taken in year 2000, to provide funds to NARS on time.
- In Côte d'Ivoire, the two types of trials conducted (variety and rotation trials), were

adequate to produce impact. However, the number of trials/farmers and the plot size of the variety trials were inadequate for immediate impact.

- Next year's trials should reached a greater number of farmers. Selected farmers should not be close to each other (at least 500 m between 2 farmers). Source materials for variety trial should be diversified. Local check should not be later than varieties included in trial. The third year of the trial should include more on-farm demonstration plots.
- Design used for striga trials could generate the proper packages of technologies. However, the expected output of the on going trials will be less than expected.
- Trials in Côte d'Ivoire need more close supervision by the research team. The objectives and practices to be carried out on the trial should be clearly explained to farmers. He should be told that failure to execute all the components of the protocol will result in trial failure.
- One of the farmers wanted to apply herbicide after planting as he did not have labour to carry out manual weeding, but was advised against it. As a result his plot was weedy. Herbicides can be applied immediately after planting, but subsequent weedings should be manual so that growing striga plants are not destroyed.
- In Côte d'Ivoire, the maize network (WECAMAN) has a good working relationship with the NARS. The maize network should use this striga control trial to expose the best genetic materials adapted and available. NARS scientists think that the striga control trials provided a good opportunity to expose their work and to help the farmers. Farmers in general were curious to see if these new varieties and packages will help to alleviate the serious striga problem which is a hindrance to cereal cultivation and they were interested to know if rotating leguminous crop and maize would help to recuperate some of their abandoned land.
- It was difficult convincing some farmers to recultivate land they had abandoned due to the striga problem. Farmers working on abandoned land need more close supervision than others. Scientists and technical staff should be present during fertilizer application to be sure that fertilizers meant for the striga trials are not diverted to other fields and other crops. Scientists and technicians should be willing to take over management when farmers give indication that they are likely to abandon the trials. Good results obtained from such plots where farmers have given up will demonstrate the effectiveness of the striga control technology in a very convincing way. Côte d'Ivoire in particular should make better use of WECAMAN facilities and advice.

- Monitoring, as carried out this year, is clearly an important aspect of the on-farm demonstration trials. It brings out shortcomings and provides for ways of improving the trials in the following year.

5.4 Visit to WECAMAN Research Field at Ferkessedougou

The WECAMAN coordinator (Dr. Badu Apraku) Resident research plot was visited at FERKE. Trials visited included :

- IITA collaborative trials
- Extra-early and early populations improvement
- Diallel inbred lines evaluation
- Striga Diallel evaluation from IRAD Cameroon.

In general, all trials were well executed. Artificial striga infestation was well done and good selection and data are expected from this site. The monitoring group was invited to go through some progenies lines for joint selection. The participating breeders noticed through this exercise that more that 90% of the lines jointly were already identified by Dr. Badu Apraku. In addition, the monitoring team appraised at first hand all good genetic materials in the process of being released.

6 Recommendations

6.1 The funds for the 1999 trials were received timely in all participating countries, it is then recommended that the same system be used to channel funds for the year 2000 trials.

6.2 Having noticed that seeds for the trials arrived late, in most countries leading to late establishment of the trials except in Nigeria, there is need for early start of seed procurement for year 2000 trials. The Coordinator who is a breeder and have adequate irrigation facilities in his country program, could be given the responsibility of producing and distributing seed.

6.3. In some countries, trials were carried out in an ecology with more than 1300 mm rainfall per annum. Yet varieties planted were early and extra-early. It is recommended that appropriate STR variety of intermediate maturity cycle be used in such area.

6.4. Fully aware that the amount and the timing of fertilizer application were very much a problem in some countries, extension agents and the research team should work together to ensure that all agronomic practices needed, are properly done.

6.5. Legume used in some countries has not been tested as striga trap crop. Given the fact that Benin and IITA have tested and classified many legumes varieties as good striga trap crops. It is recommended that STR maize varieties be used along with proven leguminous trap crop for all maize/legume intercropping trials. More over, participating NARS should as much as possible take advantage of IITA and WECAMAN facilities and STR materials. The density of the legume crop should also be optimized for improved trap cropping efficiency, and yet avoid competition with the main crop, which is maize.

6.6 Villages and trials sites should be carefully chosen as to represent the striga situation in the country. It is then recommended to avoid planting trials too close to each other and in addition selected villages should be well distributed in striga areas.

6.7 To enhance technology transfer and participation of farmers, it is recommended that farmer's field day be organized for all successful trials.

Annex 1: Itinerary of the Scientific Monitoring team

Date	Activities	Team members
13 September	Arrival in Cotonou	C. The, V. Adetimirin
14-17 September	Travel to Northern Benin Visit trials in Benin	C. The, V. Adetimirin
17 September	Arrival in Accra	C. The, V. Adetimirin
17 September	Arrival in Abidjan	C. The, V. Adetimirin
19 September	Arrival in Abidjan	M. Ouedraogo
20-23 September	Travel to Bouake, Korhogo and Ferkessedougou Visit trials Cote d'Ivoire	C. The, V. Adetimirin, M. Ouedraogo, B.B. Apraku
24 September	Departure for Douala	C. The, V. Adetimirin, M. Ouedraogo, B.B. Apraku
25 Sept.	Travel to yaounde Visit at IRAD station at Nkolbisson Trials in Cameroon	C. The, V. Adetimirin, M. Ouedraogo, B.B. Apraku
27 - 29 Sept	Travel to Garoua Visit of trials in North Cameroon	C. The, V. Adetimirin, M. Ouedraogo, B.B. Apraku,
29 September	Arrival Garoua	Jennifer Kling
30 Sept.	Visit of trials in Garoua	Mahama Ouedraogo, Badu-Baffour Aprakou, Jennifer Kling, C. The.
30 Sept	Departure for Nigeria	V. Adetimirin
30 Sept-1 Oct	Travel to Maroua Visit of trials in North Cameroon	C. The, M. Ouedraogo B.B. Apraku, J. Kling
1- 3 October	Return to Yaounde and Douala	C. The, J. Kling, M. Ouedraogo
3 Oct.	Departure to Lagos	J. Kling, M. Ouedraogo
4 October	Visit IITA Ibadan	J. Kling, M. Ouedraogo

Annex 1 cont'd.

Date	Activities	Team members
5 October	Travel to Zaria	M. Ouedraogo
6 -7 October	Visit trials in Northern Nigeria	M. Ouedraogo
8 October	Departure for Lagos and Abidjan	M. Ouedraogo
10 October	Arrival in Ouagadougou and end of mission	M. Ouedraogo

Annex 2. Summary of observations on on-farm trials in Benin-Republic

S/N	Name of Village	Name of farmer	Planting date	Planting arrangement	Plant spacing	Remarks
1.	Awanla	Yonna Salifou	16/07	Two hills of maize alternated by one hill of cowpea. Each hill of maize and cowpea had two plants	Maize : 80 x 40 Cowpea: 80 x 80	
2.	Awanla	Yoma Boukari	16/07	Two hills of maize alternated by one hill of cowpea. Each hill of maize and cowpea had two plants.	Maize : 80 x 40 Cowpea: 80 x 80	Striga emergence was observed. More striga plants were observed on DMRESR-W (the check variety) than on STR variety. Plot was well maintained Farmer applied urea late due to dry spell.
3.	Makunusa	Besse Majidou	16/07	Two hills of maize alternated by one hill of cowpea. Each hill of maize and cowpea had two plants.	Maize : 80 x 40 Cowpea: 80 x 80	A lot more striga was observed on DMRESR-W compared STR variety. Urea was applied late due to dry spell. Farmer observed less lodging with STR variety compared to the variety.
4.	Kpaloude	Makunusa	20/07	One row of maize alternates one row of cowpea. Each hill of maize and cowpea had two plants.	Maize : 80 x 40 Cowpea: 80 x 80	No striga was observed on plot. Mg deficiency was observed.
5.	Kpeloude	Abounai Alidu	18/07	One row of maize alternates one row of cowpea. Each hill of maize and cowpea had two plants.	Maize : 80 x 40 Cowpea: 80 x 80	At first, farmer planted on the flat, then came to ridge after germination. Thus, striga may have been further buried. In such a plot late emergence of striga is expected.
6.	Kpeloude	Alhassan Umoru	22/07	One hill of maize alternates one hill of cowpea. Each hill of maize and cowpea had two plants.	Maize : 80 x 40 Cowpea: 80 x 80	No striga was observed. The DMR variety cultivated by farmers and used as check showed high susceptibility to streak.

Annex 2 cont'd . Summary of observations on on-farm trials in Benin-Republic

S/N	Name of Village	Name of Farmer	Planting Date	Planting arrangement	Plant spacing	Remarks
7.	Kpeloude	Mama Suraju	22/07	One hill of maize alternates one hill of cowpea. Each hill of maize and cowpea had two plants.	Maize : 80 x 40 Cowpea: 80 x 40	No striga was observed on plot.
8.	Kpeloupe	Mama Fousseni	22/07	One hill of maize alternates one hill of cowpea. Each hill of maize and cowpea had two plants.	Maize : 80 x 40 Cowpea: 80 x 40	No striga was observed on plot.

Annex 3. Summary of observations on on-farm trials in Cameroon

Zone	Locality	Type of on-farm demonstration trial	No. of on-farm plots	Date of planting	Density	Varieties	General Observation
Subhumid 1000-1500 mm	Tchollire	Maize/cowpea intercropping	2	16 July 99	80 x 50 cm (2 plt/hill) 65 500 plt/ha	Advanced NCRE/local cowpea	
		Maize variety	1	16 July 99	"	Oba Super 1, STR yellow, Advanced NCRE, farmer variety	
	Ngong	Maize/cowpea intercropping	1	17 July 99	"	Advanced NCRE/local cowpea	Field flooded. Site not appropriate
		Maize variety	1	17 July 99	"	87036 x 88094, Oba Super 1, STR yellow, farmer variety.	Well managed trial, should consider farmer day, striga damage visible on farmer variety.
	Garoua	Maize/cowpea intercropping	1		"		
		Maize variety	1		"		
Transition 900-1000 mm	Guider	Maize/cowpea intercropping	2	24 July 99	"	Advance NCRE/ or Cam inb STR/local cowpea	Poor site selection, bad shows no difference among treatments
		Maize variety	1	24 July 99	"	8321-18 Exp37, Comp 5, Syn E_1 STR, farmer variety	Good sit for demonstration. Plot well managed. Farmer enthusiastic.
Semi-arid 700-900 mm	Guidiguis	Maize/cowpea intercropping	2	21 July 99	"	Advanced NCRE/local	Field abandoned due to flooding. Lot of weeds.
		Maize variety	1	21 July 99	"	8321-18 Exp 37, Comp 5, farmer variety	Field abandoned due to flooding. Lot of weeds
	Mora	Maize/cowpea intercropping	1	22 July 99	"	Cam inb STR/local cowpea	
		Maize variety	1	22 July 99	"	Oba Super 1, 8321-18, Exp, Comp 5 farmer variety	

Annex 4. **Summary of observations on on-farm trials in Nigeria**

Zone	Locality	Type of on-farm demonstration trial	No. of on-farm plots	Date of planting	Density	Varieties	General Observations
Northern Guinea savannah 1000-1500 mm	Detu	Maize/ legume intercropping	13	11-14 June 99		Maize 9022-13 IWD STR Co farmer variety Groundnut RMP91 Samsoy 2	Farmer plot has more striga than other plots with low level infection Army Worm attack
	Sakaru	Maize/ legume intercropping	3	11 June 99	"	9022-13 IWD STR Farmer variety RMP 91 Samsoy 2	Farms next to each other having the same treatments
	Kayawa	Maize/ legume intercropping	2	-	"	9022-13 IWD STR Farmer variety RMP 91 Samsoy 2	Good location. Farm easily accessible
	Layin Taki	Maize/ legume intercropping	2	-	"	Oba Super 1 TZE Comp 1 C4 Farmer variety RMP 91 Samsoy 2	High attack Oba Super 1 wiped out

Annex 5. Summary of observations on on-farm trials in Cote d'Ivoire

Village	Name of Farmer	Trial types	Planting date	Observations
NIELLE	PURIGUEGNON ZANA	Variety Trial	July 27, 1999	- rainfall above 1100 mm - good plant stand - clean field - lower plant density - late urea application - striga on local variety
		Rotation Trial	July 27, 1999	- vita 7 cowpea variety used - good cowpea stand - yellowish of maize leave due to late urea application - striga emergence on local variety.
WARAGA	OUATTARA SALOFOU	Variety trial	July 26, 1999	- rainfall more than 1100 m - presence of more striga aspera - very late urea application - poor plant density
		Rotation trial	July 26, 1999	- Same as above - good cowpea stand
KORONANI	OUTTARA YIRBA	Variety trial	July 13, 1999	- local variety is late and expect to do better since urea application was late - farmer field is acceptable - better fertilization
NABONKAHA	SORO CLOGNONGO	Variety trial	July 28, 1999	* farmer not willing to crop infested field * field very poor * no fertilizer applied * weed only 1 day before visit
		Rotation trial	July 28, 1999	* same as above * local will do better because of late maturity cycle.

Annex 5 (cont'd): Summary of observations on on-farm trials in Cote d'Ivoire

Village	Name of Farmer	Trial types	Planting date	Observations
NABONKAHA	SORO PEWOURISSONGUI ABOU	Variety Trial	July 28, 1999	* same as above * trials on the same field as above * nothing to gain from this trial * farmer not willing to work on infested land
		Rotation Trial	July 28, 1999	same as above
NABONKAHA	OUATTARA Siminila Daouda	Variety trial and Rotation trial	July 28, 1999	* rainfall 1350 mm * late maturity cycle for local treatment * very late urea application * good maize on farmer plot * late weeding * received urea after 55 days * good farmer, willing to continue on infested land
NABONKAHA	KONE YAYA DRISSA	Variety trial and Rotation trial	July 28, 1999	* best field visited * good plant stand * greener plant but late urea application * rainfall 1350 mm * late local variety * farmer glad due to no striga at flowering. * farmer willing to work on striga infested land
FERKE	ON STATION	Variety trial and Rotation trial		* natural striga infestation * water logging problem * expect some treatment differences

2000-01

Collaborative Striga Research and Control Project in Africa: Report on field visit to on-farm striga demonstration sites in West and Central Africa

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